UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/097,003	01/13/2023	Paulos Tesfe	088835-1359421 (102300US)	1034

20350 7590 11/28/2023

Kilpatrick Townsend & Stockton LLP - West Coast
Mailstop: IP Docketing - 22
1100 Peachtree Street
Suite 2800
Atlanta, GA 30309

EXAMINER	
O'HERN, BRENT T	

ART UNIT	PAPER NUMBER
1793	

NOTIFICATION DATE	DELIVERY MODE
11/28/2023	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

KTSDocketing2@kilpatrick.foundationip.com
ipefiling@kilpatricktownsend.com

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.
18/097,003	28-Nov-2023	11825860

Kilpatrick Townsend & Stockton LLP - West Coast
Mailstop: IP Docketing - 22
1100 Peachtree Street
Atlanta, GA 30309

EGRANT NOTIFICATION

Your electronic patent grant (eGrant) is now available, which can be accessed via Patent Center at https://patentcenter.uspto.gov

The electronic patent grant is the official patent grant under 35 U.S.C. 153. For more information, please visit https://www.uspto.gov/electronicgrants

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/097,003	11/28/2023	11825860	088835-1359421 (102300US)	1034

20350 7590 11/08/2023

Kilpatrick Townsend & Stockton LLP - West Coast
Mailstop: IP Docketing - 22
1100 Peachtree Street
Suite 2800
Atlanta, GA 30309

ISSUE NOTIFICATION

The projected patent number and issue date are specified above. The patent will issue electronically. The electronically issued patent is the official patent grant pursuant to 35 U.S.C. § 153. The patent may be accessed on or after the issue date through Patent Center at https://patentcenter.uspto.gov/. The patent will be available in both the public and the private sides of Patent Center. Further assistance in electronically accessing the patent, or about Patent Center, is available by calling the Patent Electronic Business Center at 1-888-217-9197.

The USPTO is implementing electronic patent issuance with a transition period, during which period the USPTO will mail a ceremonial paper copy of the electronic patent grant to the correspondence address of record. Additional copies of the patent (i.e., certified and presentation copies) may be ordered for a fee from the USPTO's Certified Copy Center at https://certifiedcopycenter.uspto.gov/index.html. The Certified Copy Center may be reached at (800)972-6382.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Center (https://patentcenter.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Patents Stakeholder Experience (OPSE), Stakeholder Support Division (SSD) at (571)-272-4200.

INVENTOR(s) (Please see PATENT CENTER site https://patentcenter.uspto.gov for additional inventors):

Paulos Tesfe, Commerce City, CO;
Jiancai Li, Englewood, CO;
Bradley Maier, Broomfield, CO;
Richard K. Merrill, Highlands Ranch, CO;

APPLICANT(s) (Please see PATENT CENTER site https://patentcenter.uspto.gov for additional applicants):

Leprino Foods Company, Denver, CO;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/097,003	**10/19/2023 03:31:18 PM ET**	**088835-1359421 (102300US)**

Title of Invention

DENATURED MILK PROTEINS AND METHODS OF MAKING THEM

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	1034	FILED BY	Ashlea Bellatty
PATENT CENTER #	63033549	FILING DATE	01/13/2023
CUSTOMER #	20350	FIRST NAMED INVENTOR	Paulos Tesfe
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Darin Gibby

Documents

TOTAL DOCUMENTS: 1

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
2023-10-19 Issue Fee Transmittal 088835-1359421-102300US.pdf	1	Issue Fee Payment (PTO-85B)	194 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
2023-10-19 Issue Fee Transmittal 088835-1359421-102300US.pdf	53056DE45AB2762BF92B8C88B85A30A52F8B7B54312736C9C433819896D8FC9AC508741194BE901257413F670F66EB85B7FBFE52EC6DF85F2FA9FFFCF5AE525A

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PART B – FEE(S) TRANSMITTAL

Complete and send this form, together with the applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

By fax, send to: (571) 273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

Kilpatrick Townsend & Stockton LLP
1100 Peachtree Street
Suite 2800
Atlanta, GA, 30309
US

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

Ashlea Bellatty	(Typed or printed name)
/Ashlea Bellatty/	(Signature)
October 19, 2023	(Date)

APPLICATION NO	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO	CONFIRMATION NO
18/097,003	2023-01-13	Paulos Tesfe	088835-1359421	1034

TITLE OF INVENTION: DENATURED MILK PROTEINS AND METHODS OF MAKING THEM

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
UTILITY	LARGE	1200	0	0	1200	2023-10-21

EXAMINER	ART UNIT	CLASS-SUBCLASS
Brent O'Hern	1793	-

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363)

☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1. Kilpatrick Townsend &
2. Stockton LLP
3.

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: Leprino Foods Company

(B) RESIDENCE: (CITY and STATE or COUNTRY): Denver, Colorado

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☑ Corporation or other private group entity ☐ Government

4a. Fees Submitted: ☑ Issue Fee ☐ Publication Fee (if required) ☐ Advance Order - # of Copies _____

4b. Method of Payment (*Please first reapply any previously paid fee shown above*):

☑ Electronic Payment via EFS-Web ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)

☑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 20-1430

5. Change of Entity Status (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29. NOTE: Absent a valid Certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

☐ Applicant asserting small entity status. See 37 CFR 1.27. NOTE: If the application was previously under micro entity status, checking this box will be taken as a notification of loss of entitlement to micro entity status.

☐ Applicant changing to regular undiscounted fee status. NOTE: Checking this box will be taken as a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Darin J. Gibby/ Date 2023-10-19

Typed or printed name Darin J. Gibby Registration No. 38,464

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/097,003	**10/19/2023 03:31:18 PM ET**	**088835-1359421 (102300US)**

Title of Invention

DENATURED MILK PROTEINS AND METHODS OF MAKING THEM

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	1034	FILED BY	Ashlea Bellatty
PATENT CENTER #	63033549	AUTHORIZED BY	Darin Gibby
CUSTOMER #	20350	FILING DATE	01/13/2023
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Paulos Tesfe

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
CARD / 8386	**E20230IF31536004**	**Ashlea Bellatty**

PRE-AUTHORIZED ACCOUNT	PRE-AUTHORIZED CATEGORY
201430	**37 CFR 1.20 (Post Issuance fees); 37 CFR 1.21 (Miscellaneous fees and charges)**

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
1501	UTILITY ISSUE FEE	1200.00	1	1200.00
			TOTAL AMOUNT:	**$1,200.00**

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

20350 7590 07/21/2023

Kilpatrick Townsend & Stockton LLP - West Coast
Mailstop: IP Docketing - 22
1100 Peachtree Street
Suite 2800
Atlanta, GA 30309

EXAMINER
O'HERN, BRENT T

ART UNIT	PAPER NUMBER
1793	

DATE MAILED: 07/21/2023

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/097,003	01/13/2023	Paulos Tesfe	088835-1359421 (102300US)	1034

TITLE OF INVENTION: DENATURED MILK PROTEINS AND METHODS OF MAKING THEM

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	10/23/2023

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 40% the amount of undiscounted fees, and micro entity fees are 20% the amount of undiscounted fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

20350 7590 07/21/2023

Kilpatrick Townsend & Stockton LLP - West Coast
Mailstop: IP Docketing - 22
1100 Peachtree Street
Suite 2800
Atlanta, GA 30309

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/097,003	01/13/2023	Paulos Tesfe	088835-1359421 (102300US)	1034

TITLE OF INVENTION: DENATURED MILK PROTEINS AND METHODS OF MAKING THEM

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	10/23/2023

EXAMINER	ART UNIT	CLASS-SUBCLASS
O'HERN, BRENT T	1793	426-657000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑ Issue Fee ❑ Publication Fee (if required)

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via Patent Center or EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

❑ Applicant asserting small entity status. See 37 CFR 1.27

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

❑ Applicant changing to regular undiscounted fee status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/097,003	01/13/2023	Paulos Tesfe	088835-1359421 (102300US)	1034

20350 7590 07/21/2023

Kilpatrick Townsend & Stockton LLP - West Coast
Mailstop: IP Docketing - 22
1100 Peachtree Street
Suite 2800
Atlanta, GA 30309

EXAMINER	
O'HERN, BRENT T	
ART UNIT	PAPER NUMBER
1793	

DATE MAILED: 07/21/2023

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 18/097,003	Applicant(s) Tesfe et al.	
	Examiner BRENT T O'HERN	Art Unit 1793	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to 6/29/2023.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 1-20 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some* c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☑ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/BRENT T O'HERN/
Primary Examiner, Art Unit 1793

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

REASONS FOR ALLOWANCE

2. The following is an examiner's statement of reasons for allowance:

3. A review of Applicant's arguments in the Papers filed 6/29/2023 and a review of the instant claims has convinced the examiner that the claims are allowable over the applied prior art of record.

4. Claims 1-20 are allowed. All withdrawn claims are rejoined.

5. Regarding independent claim 1 and the dependent claims, the prior art fails to teach or suggest a denatured whey protein composition comprising: at least 60 wt.% whey protein on a dry weight basis; less than 8 wt.% native glycomacropeptide (GMP) and greater than 2 wt.% enzymatically hydrolyzed GMP relative to a total weight of protein in the denatured whey protein composition; a proteolysis index of at least 8.0 wt.%; and greater than 50 wt.% denatured whey proteins relative to the total weight of the protein in the denatured whey protein composition.

6. The closest prior art of Tikanmaki et al. (US 2018/0242608) teaches a composition, however, fails to expressly teach the claimed composition including at least 60 wt.% whey protein on a dry weight basis; less than 8 wt.% native glycomacropeptide (GMP) and greater than 2 wt.% enzymatically hydrolyzed GMP relative to a total weight of protein in the denatured whey protein composition; a proteolysis index of at least 8.0 wt.%.

7. The other references of record do not teach or suggest the combined limitations not taught by Tikanmaki et al. (US 2018/0242608).

8. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to BRENT T O'HERN whose telephone number is (571)272-6385. The examiner can normally be reached on M-Th 5:00-3:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Emily Le can be reached on 571-272-0903. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/BRENT T O'HERN/
Primary Examiner, Art Unit 1793
July 9, 2023

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/097,003	Tesfe et al.
	Examiner	Art Unit
	BRENT T O'HERN	1793

CPC - Searched*		
Symbol	**Date**	**Examiner**
A23J3/08	03/24/2023	/BTO/
search updated	06/15/2023	/BTO/
search updated	07/09/2023	/BTO/

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**
426	657	03/24/2023	/BTO/

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	**Date**	**Examiner**
palm/search assignor (inventor)/assignee search	03/24/2023	/BTO/
see search notes	03/24/2023	/BTO/
see search notes	06/15/2023	/BTO/
see search notes	07/09/2023	/BTO/

/BRENT T O'HERN/ Primary Examiner, Art Unit 1793	

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/097,003	Tesfe et al.
	Examiner	Art Unit
	BRENT T O'HERN	1793

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
A23J	3/08	07/09/2023	/BTO/
426	657	07/09/2023	/BTO/

/BRENT T O'HERN/ Primary Examiner, Art Unit 1793	

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/097,003	Tesfe et al.
	Examiner	Art Unit
	BRENT T O'HERN	1793

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	03/05/2023	03/24/2023	06/15/2023	07/09/2023					
1	1	÷	✓	✓	=					
2	2	÷	✓	✓	=					
3	3	÷	✓	✓	=					
4	4	÷	✓	✓	=					
5	5	÷	✓	✓	=					
6	6	÷	✓	✓	=					
7	7	÷	✓	✓	=					
8	8	÷	N	N	=					
9	9	÷	N	N	=					
10	10	÷	N	N	=					
11	11	÷	N	N	=					
12	12	÷	N	N	=					
13	13	÷	N	N	=					
15	14	÷	✓	=	=					
14	15	÷	✓	✓	=					
16	16	÷	✓	✓	=					
17	17	÷	✓	✓	=					
18	18	÷	✓	=	=					
19	19	÷	✓	=	=					
20	20	÷	✓	=	=					

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/097,003	Tesfe et al.
	Examiner	**Art Unit**
	BRENT T O'HERN	1793

CPC							
Symbol						**Type**	**Version**
A23J	/	3	/	08		F	2013-01-01

CPC Combination Sets								
Symbol						**Type**	**Set**	**Ranking**	**Version**
	/		/						

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/BRENT T O'HERN/ Primary Examiner, Art Unit 1793	09 July 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20230709

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/097,003	Tesfe et al.
	Examiner	**Art Unit**
	BRENT T O'HERN	1793

INTERNATIONAL CLASSIFICATION				
CLAIMED				
A23C	/	19	/	084

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**
426	657

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	20	
/BRENT T O'HERN/ Primary Examiner, Art Unit 1793	09 July 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20230709

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/097,003	Tesfe et al.
	Examiner	Art Unit
	BRENT T O'HERN	1793

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1	10	10	19	19										
2	2	11	11	20	20										
3	3	12	12												
4	4	13	13												
5	5	15	14												
6	6	14	15												
7	7	16	16												
8	8	17	17												
9	9	18	18												

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/BRENT T O'HERN/ Primary Examiner, Art Unit 1793	09 July 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office

Part of Paper No.: 20230709

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	9178	A23J3/08	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/05 12:02 PM
L2	2537	426/657	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/05 12:02 PM
L3	11484	L1 L2	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/05 12:02 PM
L4	225	Merrill-Richard-K.IN.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU,	OR	ON	ON	2023/03/05 12:03 PM

			CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L5	6	Maier-Bradley.IN.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/05 12:04 PM
L6	292	Li-Jiancai.IN.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/05 12:04 PM
L7	3	Tesfe-Paulos.IN.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA,	OR	ON	ON	2023/03/05 12:04 PM

			VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L8	103	"Leprino Foods Company"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/05 12:04 PM
L9	501	L4 L5 L6 L7	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/05 12:05 PM
L10	56	denatured.CLM. AND protein.CLM. AND whey.CLM. AND filtering.CLM.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/05 12:07 PM
L11	13	denatured.CLM. AND protein.CLM. AND whey.CLM. AND filtering.CLM. AND cheese.CLM.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB,	OR	ON	ON	2023/03/05 12:07 PM

			HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L12	5	denatured.CLM. AND protein.CLM. AND whey.CLM. AND filtering.CLM. AND cheese.CLM.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/03/05 12:07 PM
L13	5	("0000002" OR "10709146" OR "10834934" OR "5968586" OR "9578890").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2023/03/05 12:23 PM
L14	4	"11206846".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/11 02:25 PM
L15	4	"2002045522".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/11 02:26 PM
L16	0	WO-2002045522-$.did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU,	OR	ON	ON	2023/03/11 02:27 PM

			CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L17	0	WO-20020045522-$.did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/11 02:27 PM
L18	0	WO-200245522-$.did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/11 02:27 PM
L19	0	WO-200200045522-$.did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA,	OR	ON	ON	2023/03/11 02:27 PM

			VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L20	0	WO-200245522-$.did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/11 02:28 PM
L21	3	WO-0245522-$.did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/11 02:28 PM
L22	4	WO-2006089921-$.did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/11 02:29 PM
L23	3	WO-2015059245-$.did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB,	OR	ON	ON	2023/03/11 02:30 PM

			HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L24	5216	denatured WITH whey WITH protein	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:11 PM
L25	63	denatured WITH whey WITH protein SAME glycomacropeptide	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:12 PM
L26	39	(Artificial Intelligence) Similar to: 18/097,003 with 0 CPC Selections and 0 Text Selections Text: (JP-6612745-B2 OR JP-2016533726-A OR JP-2016533725-A OR JP-6525213-B2 OR EP-3720296-B1 OR US-20210007376-A1 OR CN-113784622-A OR EP-0485663-B1 OR WO-2019110668-A1	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN))	OR	ON	ON	2023/03/12 02:12 PM

		OR EP-3720296-A1 OR EP-0485663-A1 OR BR-112016008894-B1 OR IE-50403-B1 OR CN-112137000-A OR US-20220142191-A1 OR EP-3937648-A1 OR WO-2020187842-A1 OR AU-2020243017-A1 OR JP-4637449-B2 OR US-20180317513-A1 OR WO-2018204261-A1 OR CA-2927685-A1 OR CA-2927685-C OR US-20200397020-A1 OR CA-2137913-A1 OR US-20180343890-A1 OR US-20120029165-A1 OR EP-2595494-A1 OR WO-2012012237-A1 OR CA-2804752-A1 OR DK-2595494-T3 OR EP-2595494-B1 OR US-10638775-B2 OR CA-2927686-C OR DK-3071047-T3 OR NZ-508746-A OR US-10834934-B2 OR WO-0048473-A1 OR US-11206846-B2 OR EP-1154700-A1 OR EA-037214-B1 OR EA-035744-B1 OR US-20140287095-A1 OR WO-2014153381-A1 OR WO-2015059248-A1 OR EP-3060065-A1 OR CA-2927686-A1 OR DE-19950240-A1 OR US-20160262424-A1 OR EP-0644720-A1).did.					
L27	4	L26 AND denatured WITH whey WITH protein SAME glycomacropeptide	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:12 PM

L28	6	L26 AND denatured WITH whey WITH protein AND glycomacropeptide	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:13 PM
L29	6	L26 AND denatured AND whey AND glycomacropeptide	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:14 PM
L30	3	L9 AND denatured AND whey AND glycomacropeptide	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:14 PM
L31	0	L8 AND denatured AND whey AND glycomacropeptide	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL,	OR	ON	ON	2023/03/12 02:15 PM

			NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L32	3	Leprino AND denatured AND whey AND glycomacropeptide	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:15 PM
L33	3	Leprino AND denatured AND whey AND (glycomacropeptide OR GMP)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:16 PM
L34	25	((US-20120219665-A1 OR US-20010024677-A1 OR US-20040037905-A1 OR US-20210007376-A1 OR US-20210329949-A1 OR US-20230002173-A1).did. AND PGPB.dbnm.) OR ((US-4105803-A OR US-9462817-B2 OR US-10834934-B2 OR US-10709146-B2 OR US-9578890-B2 OR US-5968586-A OR US-0000002-A OR US-11206846-B2).did. AND USPT.dbnm.) OR	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:16 PM

		((WO-0245522-A1 OR WO-2006089921-A1 OR WO-2015059245-A1 OR WO-2019110668-A1 OR EP-3720296-B1 OR NZ-508746-A OR CN-113784622-A OR WO-2021222013-A1 OR KR-20230008135-A OR CN-114794489-A).did. AND FTDB.dbnm.) OR ((CN-115235530-A).did. AND FPRS.dbnm.)					
L35	11	L34 AND denatured AND whey AND (glycomacropeptide OR GMP)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:16 PM
L36	9	denatured.CLM. AND whey.CLM. AND (glycomacropeptide OR GMP).CLM. AND protein.CLM.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:28 PM
L37	43	denatured WITH whey AND (glycomacropeptide OR GMP).CLM. AND protein.CLM.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE,	OR	ON	ON	2023/03/12 02:29 PM

			SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L38	41	denatured WITH whey AND (glycomacropeptide OR GMP).CLM. AND protein.CLM. AND (cheese OR cheesemaking OR "cheese making")	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:32 PM
L39	41	denatured WITH whey AND (glycomacropeptide OR GMP).CLM. AND protein.CLM. AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:32 PM
L40	5	denatured WITH whey AND (glycomacropeptide OR GMP).CLM. AND protein.CLM. AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) WITH (glycomacropeptide OR GMP)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:33 PM
L41	8	(denatured OR denat$) WITH whey AND (glycomacropeptide OR GMP).CLM. AND	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU,	OR	ON	ON	2023/03/12 02:43 PM

		protein.CLM. AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) WITH (glycomacropeptide OR GMP)	CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L42	29	((US-20120219665-A1 OR US-20010024677-A1 OR US-20040037905-A1 OR US-20210007376-A1 OR US-20210329949-A1 OR US-20140287095-A1 OR US-20230002173-A1).did. AND PGPB.dbnm.) OR ((US-4105803-A OR US-9462817-B2 OR US-10834934-B2 OR US-10709146-B2 OR US-9578890-B2 OR US-5968586-A OR US-0000002-A OR US-11206846-B2).did. AND USPT.dbnm.) OR ((WO-0245522-A1 OR WO-2006089921-A1 OR WO-2015059245-A1 OR WO-2019110668-A1 OR EP-3720296-B1 OR NZ-508746-A OR CN-113784622-A OR WO-2021222013-A1 OR KR-20230008135-A OR JP-6513629-B2 OR CA-2656174-A1 OR WO-2014153381-A1 OR CN-114794489-A).did. AND FTDB.dbnm.) OR ((CN-115235530-A).did. AND FPRS.dbnm.)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:07 AM
L43	3	"JP 6513629 B2"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV,	OR	ON	ON	2023/03/13 10:08 AM

			MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L44	30	((US-20120219665-A1 OR US-20010024677-A1 OR US-20040037905-A1 OR US-20210007376-A1 OR US-20210329949-A1 OR US-20140287095-A1 OR US-20230002173-A1).did. AND PGPB.dbnm.) OR ((US-4105803-A OR US-9462817-B2 OR US-10834934-B2 OR US-10709146-B2 OR US-9578890-B2 OR US-5968586-A OR US-0000002-A OR US-11206846-B2).did. AND USPT.dbnm.) OR ((WO-0245522-A1 OR WO-2006089921-A1 OR WO-2015059245-A1 OR WO-2019110668-A1 OR EP-3720296-B1 OR NZ-508746-A OR CN-113784622-A OR WO-2021222013-A1 OR KR-20230008135-A OR JP-6513629-B2 OR CA-2656174-A1 OR WO-2014153381-A1 OR CN-114794489-A).did. AND FTDB.dbnm.) OR ((WO-2012110705-A1).did. AND DWPI.dbnm.) OR ((CN-115235530-A).did. AND FPRS.dbnm.)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:09 AM
L45	16	L44 AND (denatured OR denat$) AND whey AND (glycomacropeptide OR GMP) AND protein AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL,	OR	ON	ON	2023/03/13 10:10 AM

		enzymatically) AND (reduce OR reduced OR reduc$) AND (glycomacropeptide OR GMP)	NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L46	19	L44 AND (glycomacropeptide OR GMP)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:11 AM
L47	20	"WO 2012110705"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:12 AM
L48	31	((US-20120219665-A1 OR US-20010024677-A1 OR US-20040037905-A1 OR US-20210007376-A1 OR US-20210329949-A1 OR US-20140287095-A1 OR US-20230002173-A1).did. AND PGPB.dbnm.) OR ((US-4105803-A OR US-9462817-B2 OR US-10834934-B2 OR US-10709146-B2 OR US-9578890-B2 OR US-5968586-A OR US-0000002-A OR US-	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:13 AM

		11206846-B2).did. AND USPT.dbnm.) OR ((WO-0245522-A1 OR WO-2006089921-A1 OR WO-2015059245-A1 OR WO-2019110668-A1 OR EP-3720296-B1 OR NZ-508746-A OR CN-113784622-A OR WO-2021222013-A1 OR KR-20230008135-A OR JP-6513629-B2 OR CA-2656174-A1 OR WO-2014153381-A1 OR WO-2012110705-A1 OR CN-114794489-A).did. AND FTDB.dbnm.) OR ((WO-2012110705-A1).did. AND DWPI.dbnm.) OR ((CN-115235530-A).did. AND FPRS.dbnm.)					
L49	17	L48 AND (denatured OR denat$) AND whey AND (glycomacropeptide OR GMP) AND protein AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) AND (glycomacropeptide OR GMP)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:13 AM
L50	17	L48 AND (denatured OR denat$) AND whey AND (glycomacropeptide OR GMP OR glycomacro$) AND protein AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) AND (glycomacropeptide OR GMP)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:17 AM
L51	7	L48 AND (denatured	(US-PGPUB; USPAT;	OR	ON	ON	2023/03/13

		OR denat$) AND whey AND (glycomacropeptide OR GMP OR glycomacro$) AND protein AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) AND (glycomacropeptide OR GMP) AND "off-tastes"	USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				10:20 AM
L52	3	"US 20180242608"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:23 AM
L53	33	((US-20120219665-A1 OR US-20010024677-A1 OR US-20040037905-A1 OR US-20210007376-A1 OR US-20210329949-A1 OR US-20140287095-A1 OR US-20180242608-A1 OR US-20230002173-A1).did. AND PGPB.dbnm.) OR ((US-4105803-A OR US-9462817-B2 OR US-10834934-B2 OR US-10709146-B2 OR US-9578890-B2 OR US-5968586-A OR US-0000002-A OR US-11206846-B2 OR US-10993454-B2).did. AND USPT.dbnm.) OR ((WO-0245522-A1 OR WO-2006089921-A1 OR WO-2015059245-A1 OR WO-	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:24 AM

		2019110668-A1 OR EP-3720296-B1 OR NZ-508746-A OR CN-113784622-A OR WO-2021222013-A1 OR KR-20230008135-A OR JP-6513629-B2 OR CA-2656174-A1 OR WO-2014153381-A1 OR WO-2012110705-A1 OR CN-114794489-A).did. AND FTDB.dbnm.) OR ((WO-2012110705-A1).did. AND DWPI.dbnm.) OR ((CN-115235530-A).did. AND FPRS.dbnm.)					
L54	9	L53 AND (denatured OR denat$) AND whey AND (glycomacropeptide OR GMP OR glycomacro$) AND protein AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) AND (glycomacropeptide OR GMP) AND "off-tastes"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:24 AM
L55	10	L53 AND (denatured OR denat$ OR "heat treatment") AND whey AND (glycomacropeptide OR GMP OR glycomacro$) AND protein AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) AND (glycomacropeptide OR GMP) AND "off-tastes"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 12:58 PM
L56	33	((US-20120219665-A1 OR US-20010024677-A1 OR US-20040037905-A1 OR US-20210007376-A1 OR US-20210329949-A1 OR US-	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS,	OR	ON	ON	2023/03/14 09:50 AM

		20140287095-A1 OR US-20180242608-A1 OR US-20230002173-A1).did. AND PGPB.dbnm.) OR ((US-4105803-A OR US-9462817-B2 OR US-10834934-B2 OR US-10709146-B2 OR US-9578890-B2 OR US-5968586-A OR US-0000002-A OR US-11206846-B2 OR US-10993454-B2).did. AND USPT.dbnm.) OR ((WO-0245522-A1 OR WO-2006089921-A1 OR WO-2015059245-A1 OR WO-2019110668-A1 OR EP-3720296-B1 OR NZ-508746-A OR CN-113784622-A OR WO-2021222013-A1 OR KR-20230008135-A OR JP-6513629-B2 OR CA-2656174-A1 OR WO-2014153381-A1 OR WO-2012110705-A1 OR CN-114794489-A).did. AND FTDB.dbnm.) OR ((WO-2012110705-A1).did. AND DWPI.dbnm.) OR ((CN-115235530-A).did. AND FPRS.dbnm.)	IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L57	22	L3 AND (denatured OR denat$ OR "heat treatment") AND whey AND (glycomacropeptide OR GMP OR glycomacro$) AND protein AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) AND (glycomacropeptide OR GMP) AND "off-tastes"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/24 05:21 PM
L58	0	L9 AND (denatured OR denat$ OR "heat treatment") AND whey AND	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU,	OR	ON	ON	2023/03/24 05:22 PM

		(glycomacropeptide OR GMP OR glycomacro$) AND protein AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) AND (glycomacropeptide OR GMP) AND "off-tastes"	CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L59	41	(Artificial Intelligence) Similar to: 18/097,003 with 0 CPC Selections and 0 Text Selections Text: (JP-6612745-B2 OR JP-2016533726-A OR EP-3720296-B1 OR US-20210007376-A1 OR JP-2016533725-A OR JP-6525213-B2 OR CN-113784622-A OR WO-2019110668-A1 OR EP-3720296-A1 OR EP-0485663-B1 OR EP-0485663-A1 OR IE-50403-B1 OR BR-112016008894-B1 OR CN-112137000-A OR US-20220142191-A1 OR WO-2020187842-A1 OR AU-2020243017-A1 OR EP-3937648-A1 OR CA-2927685-A1 OR CA-2927685-C OR CA-2137913-A1 OR JP-4637449-B2 OR US-20180317513-A1 OR WO-2018204261-A1 OR CA-2927686-C OR US-20200397020-A1 OR EA-037214-B1 OR EA-035744-B1 OR NZ-508746-A OR DK-3071047-T3 OR US-20180343890-A1 OR US-20120029165-A1 OR EP-2595494-A1 OR WO-2012012237-A1 OR CA-2804752-A1 OR DK-2595494-T3 OR EP-2595494-B1 OR US-10638775-B2 OR	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN))	OR	ON	ON	2023/06/15 12:45 PM

		US-10834934-B2 OR WO-0048473-A1 OR EP-1154700-A1 OR US-11206846-B2 OR US-7824728-B2 OR EP-3060065-A1 OR WO-2015059248-A1 OR CA-2927686-A1 OR US-20070128341-A1 OR US-20160262424-A1 OR JP-7266598-B2 OR EP-0644720-A1).did.					
L60	5	L59 AND (denatured OR denat$ OR "heat treatment") AND whey AND (glycomacropeptide OR GMP OR glycomacro$) AND protein AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) AND (glycomacropeptide OR GMP) AND "off-tastes"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/06/15 12:45 PM
L61	20	L59 AND (glycomacropeptide OR GMP)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/06/15 12:46 PM
L62	20	L59 AND (glycomacropeptide OR GMP) AND whey	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH,	OR	ON	ON	2023/06/15 12:46 PM

			TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L63	1	L59 AND (glycomacropeptide OR GMP) AND whey AND proteolysis	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/06/15 12:46 PM
L64	0	L8 AND (glycomacropeptide OR GMP) AND whey AND proteolysis	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/06/15 12:47 PM
L65	53	L3 AND (glycomacropeptide OR GMP) AND whey AND proteolysis	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/06/15 12:47 PM
L66	0	L9 AND (glycomacropeptide OR GMP) AND whey AND proteolysis	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA,	OR	ON	ON	2023/06/15 12:47 PM

			EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L67	53	L3 AND (glycomacropeptide OR GMP) AND whey AND proteolysis	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/07/09 01:46 PM
L68	0	L8 AND (glycomacropeptide OR GMP) AND whey AND proteolysis	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/07/09 01:46 PM
L69	0	L9 AND (glycomacropeptide OR GMP) AND whey AND proteolysis	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO;	OR	ON	ON	2023/07/09 01:46 PM

			JPO; DERWENT; IBM_TDB)				
L70	22	L3 AND (glycomacropeptide OR GMP).CLM. AND whey AND proteolysis	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/07/09 01:46 PM
L71	22	L3 AND (glycomacropeptide OR GMP).CLM. AND whey.CLM. AND proteolysis	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/07/09 01:46 PM
L72	0	L3 AND (glycomacropeptide OR GMP).CLM. AND whey.CLM. AND proteolysis.CLM.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/07/09 01:47 PM
L73	1	(glycomacropeptide OR GMP).CLM. AND whey.CLM. AND proteolysis.CLM.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB,	OR	ON	ON	2023/07/09 01:47 PM

			HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				

PE2E SEARCH - Search History (Interference)

There are no Interference searches to show.

Bibliographic Data

Application No: 18/097,003

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☐ No ☐ Met After Allowance

Verified and Acknowledged: /BRENT T O'HERN/ Examiner's Signature | Initials

Title: DENATURED MILK PROTEINS AND METHODS OF MAKING THEM

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
01/13/2023	426	1793	088835-1359421 (102300US)
RULE			

APPLICANTS

Leprino Foods Company,

INVENTORS

Paulos Tesfe, Commerce City, CO, UNITED STATES

Jiancai Li, Englewood, CO, UNITED STATES

Bradley Maier, Broomfield, CO, UNITED STATES

Richard K. Merrill, Highlands Ranch, CO, UNITED STATES

CONTINUING DATA

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

02/08/2023

STATE OR COUNTRY

UNITED STATES

ADDRESS

Kilpatrick Townsend & Stockton LLP - West Coast
Mailstop: IP Docketing - 22
1100 Peachtree Street
Suite 2800
Atlanta, GA 30309
UNITED STATES

FILING FEE RECEIVED

$6,160

OK TO ENTER: /B.T.O/

I hereby certify that this correspondence is being filed with the United States Patent and Trademark Office via the Office electronic filing system on June 29, 2023.

PATENT
Attorney Docket No.: 088835-1359421-102300US

KILPATRICK TOWNSEND & STOCKTON LLP

By: /Ashlea Bellatty/
Ashlea Bellatty

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	Confirmation No.: 1034
Paulos Tesfe et al.	Examiner: Brent T O'Hern
Application No.: 18/097,003	Technology Center/Art Unit: 1793
Filed: January 13, 2023	
For: DENATURED MILK PROTEINS AND METHODS OF MAKING THEM	**AMENDMENT AND REQUEST FOR RECONSIDERATION AFTER-FINAL**
Customer No.: 20350	

Mail Stop AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Commissioner:

In response to the Final Office Action mailed June 26, 2023, please enter the following amendments and consider the following remarks:

Amendments to the Claims are reflected in the listing of claims which, begins on page 2 of this paper.

Remarks/Arguments begin on page 6 of this paper.

I hereby certify that this correspondence is being filed with the United States Patent and Trademark Office via the Office electronic filing system on June 29, 2023.

PATENT
Attorney Docket No.: 088835-1359421-102300US

KILPATRICK TOWNSEND & STOCKTON LLP

By: /Ashlea Bellatty/
Ashlea Bellatty

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	Confirmation No.: 1034
Paulos Tesfe et al.	Examiner: Brent T O'Hern
Application No.: 18/097,003	Technology Center/Art Unit: 1793
Filed: January 13, 2023	
For: DENATURED MILK PROTEINS AND METHODS OF MAKING THEM	**AMENDMENT AND REQUEST FOR RECONSIDERATION AFTER-FINAL**
Customer No.: 20350	

Mail Stop AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Commissioner:

In response to the Final Office Action mailed June 26, 2023, please enter the following amendments and consider the following remarks:

Amendments to the Claims are reflected in the listing of claims which, begins on page 2 of this paper.

Remarks/Arguments begin on page 6 of this paper.

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings of claims in the application.

Listing of Claims:

1. (Currently Amended) A denatured whey protein composition comprising:

at least 60 wt.% whey protein on a dry weight basis;

less than 8 wt.% native glycomacropeptide (GMP) and greater than 2 wt.% enzymatically hydrolyzed GMP relative to a total weight of [[the]] protein **in the denatured whey protein composition**;

a proteolysis index of at least 8.0 wt.%; and

greater than 50 wt.% denatured whey proteins relative to the total weight of the protein **in the denatured whey protein composition**.

2. (Original) The denatured whey protein composition of claim 1, wherein the denatured whey proteins comprise denatured enzymatically-hydrolyzed cheese whey proteins.

3. (Currently Amended) The denatured whey protein composition of claim 2, wherein the native GMP is less than or about 7 wt.% relative to the total weight of the protein **in the denatured whey protein composition**.

4. (Original) The denatured whey protein composition of claim 1, wherein the denatured whey proteins are characterized by a D50 particle size distribution value of less than or about 4.5 μm.

5. (Original) The denatured whey protein composition of claim 4, wherein the denatured whey proteins are further characterized by a D10 particle size distribution value of less than or about 2.5 μm.

6. (Original) The denatured whey protein composition of claim 4, wherein the denatured whey proteins are further characterized by a D90 particle size distribution value of less than or about 8.0 μm.

7. (Previously presented) The denatured whey protein composition of claim 1, further comprising at most 7.0 wt.% fat on a dry weight basis.

8. (Withdrawn, Currently Amended) A method of making a denatured whey protein composition, the method comprising:

filtering cheese whey from enzymatically coagulated milk into a cheese whey retentate and a permeate; and

reducing native glycomacropeptides (GMP) in the cheese whey retentate to form a reduced-GMP cheese whey retentate composition; and

heating the reduced-GMP cheese whey retentate composition to form the denatured whey protein composition,

wherein the denatured whey protein composition is characterized by

at least 60 wt.% **whey** protein on a dry weight basis;

less than 11 wt.% native GMP relative to a total weight of [[the]] protein **in the denatured whey protein composition**;

a proteolysis index of at least 8.0 wt.% or a beta-lactoglobulin to alpha lactalbumin ratio of greater than 5.00; and

greater than 50 wt.% denatured whey proteins relative to the total weight of the protein **in the denatured whey protein composition**.

9. (Withdrawn, Currently Amended) The method of claim 8, wherein the reduction of **native** GMP **in the cheese whey retentate** includes combining the cheese whey retentate with one or more enzymes that selectively hydrolyze GMP in the cheese whey retentate to form the reduced-GMP cheese whey retentate composition, the one or more enzymes that selectively hydrolyze GMP in the cheese whey retentate comprises at least one alkaline serine protease enzyme and at least one neutral protease enzyme**,** or wherein the reduction of GMP occurs through the microfiltration of the cheese whey retentate.

10. (Withdrawn) The method of claim 8, wherein the heating of the reduced-GMP cheese whey retentate composition also inactivates the one or more enzymes that selectively hydrolyze the GMP in the cheese whey retentate.

11. (Withdrawn) The method of claim 8, wherein the reduced-GMP cheese whey retentate composition is heated to a temperature of greater than or about 160°F.

12. (Withdrawn) The method of claim 8, wherein the heating of the reduced-GMP cheese whey retentate composition further comprises exposing the reduced-GMP cheese whey retentate composition to high shear conditions.

13. (Withdrawn, Currently Amended) The method of claim 8, wherein the denatured whey protein composition is characterized by a weight ratio of native GMP to total whey protein of less than or about 0.15, and/or wherein the denatured whey protein composition is characterized by less than or about 11 wt.% GMP relative to the total weight of the protein **in the denatured whey protein composition**.

14. (Previously presented) A denatured whey protein composition comprising:
at least 60 wt.% protein on a dry weight basis;
less than 11 wt.% native glycomacropeptide (GMP) relative to total weight of the protein;
greater than 7 wt.% fat on a dry basis;
a beta-lactoglobulin to alpha lactalbumin ratio of greater than 5.00; and
greater than 50 wt.% denatured whey proteins relative to the total weight of the protein.

15. (Withdrawn, Currently Amended) The **method** ~~**denatured whey protein composition**~~ of claim [[14]] **8**, wherein the **reduced-GMP cheese whey retentate** ~~**denatured whey protein,**~~ prior to **the heating,** ~~**denaturation**~~ already include[[s]] at least 30 wt.% denatured protein.

16. (Currently Amended) The denatured whey protein composition of claim 14, wherein the denatured whey protein **composition** contains at least 60 wt.% beta lactoglobulin relative to a total weight of protein and/or wherein the denatured whey protein **composition** contains at most 12 wt.% alpha lactalbumin relative to the total weight of protein.

17. (Currently Amended) The denatured whey protein composition of claim 14, wherein the denatured whey protein **composition** comprises a weight ratio of beta lactoglobulin to alpha lactalbumin of greater than or about 5.

18. (Original) The denatured whey protein composition of claim 14, wherein the denatured whey proteins are characterized by a D50 particle size distribution value of less than or about 0.3 μm.

19. (Original) The denatured whey protein composition of claim 14, wherein the denatured whey proteins are further characterized by a D10 particle size distribution value of less than or about 0.1 μm.

20. (Original) The denatured whey protein composition of claim 14, wherein the denatured whey proteins are further characterized by a D90 particle size distribution value of less than or about 1.0 μm.

REMARKS/ARGUMENTS

Upon entry of the present amendment, claims 1-20 will be pending in this application. Claims 1, 3, 8, 9, 13, 15, and 17 have been amended. No new matter is added. Based on the following remarks, Applicant respectfully requests reconsideration, rejoinder, and allowance of the pending claims.

Claim Rejections – 35 U.S.C. § 112

Claims 1-7 and 15-17 are rejected as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor, regards as the invention.

Without commenting on the propriety of the rejection, Applicant has amended claim 1 to clarify that "the protein" is a total weight of protein in the denatured whey protein composition. Thus, Applicant respectfully submits that the rejections in regards to claims 1 and 3 have been overcome, and requests withdrawal of the rejection.

In addition, without commenting on the propriety of the rejection, claim 15 has been amended to be dependent upon method claim 8, and has been clarified to refer to the reduced-GMP cheese whey retentate. Thus, Applicant respectfully submits that the rejection has been overcome, and requests withdrawal of the rejection.

Furthermore, Applicant has clarified that the referenced portions of claims 16 and 17 refer to the denatured whey protein composition. Thus, Applicant respectfully submits that the rejections in regards to claims 16 and 17 have been overcome, and requests withdrawal of the rejection.

Allowable Subject Matter and Request for Rejoinder

Applicant thanks Examiner O'Hern for the identification of allowable subject matter. As the Office Action has indicated that the pending claims would be allowable if re-written to overcome the present rejections under 35 § 112, Applicant respectfully submits that the claims are in condition for allowance, and requests issuance of a formal notice of allowance. Furthermore, as withdrawn claims 8-13 and 15 have been amended along with independent claims 1 and 14, Applicant respectfully request rejoinder of the withdrawn method claims.

CONCLUSION

In view of the foregoing, Applicant believes all claims now pending in this application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

Except for the issue fees payable under 37 C.F.R. § 1.18, the Director is authorized to charge any additional fees during pendency of this application, including any required extension of time fees, or credit any overpayment to Deposit Account Number 20-1430. This paragraph is intended to be a constructive petition for extension of time in accordance with 37 C.F.R. § 1.136(a)(3).

If the Examiner believes a telephone conference would expedite prosecution of this application, please contact the undersigned at (303) 607-3218 or ajhunter@kilpatricktownsend.com.

Respectfully submitted,

/alexa.j.hunter/
Alexa J Hunter
Registration No. 74,538

KILPATRICK TOWNSEND & STOCKTON LLP

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/097,003	**06/29/2023 12:10:15 PM ET**	**088835-1359421 (102300US)**

Title of Invention

DENATURED MILK PROTEINS AND METHODS OF MAKING THEM

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	1034	FILED BY	Ashlea Bellatty
PATENT CENTER #	62361159	FILING DATE	01/13/2023
CUSTOMER #	20350	FIRST NAMED INVENTOR	Paulos Tesfe
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Alexa Hunter

Documents

TOTAL DOCUMENTS: 3

DOCUMENT		PAGES	DESCRIPTION	SIZE (KB)
2023-06-29 Response to Final Office Action d. 2023-06-26; 088835-1359421.pdf		7	-	99 KB
2023-06-29 Response to Final Office Action d. 2023-06-26; 088835-1359421-A.NE.pdf	(1-1)	1	Response After Final Action	84 KB
2023-06-29 Response to Final Office Action d. 2023-06-26; 088835-1359421-CLM.pdf	(2-5)	4	Claims	90 KB
2023-06-29 Response to	(6-7)	2	Applicant Arguments/Remarks	86 KB

Final Office Action d. 2023-06-26; 088835-1359421-REM.pdf	Made in an Amendment

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
2023-06-29 Response to Final Office Action d. 2023-06-26; 088835-1359421.pdf	416733277A1EB02EE1D28822CB7E5B16BFFD77B67673442694CDFDF9C62AC440BB4DF95D091BA1B2474091071165AD2D5657B826682FF55949A53E167F82879F
2023-06-29 Response to Final Office Action d. 2023-06-26; 088835-1359421-A.NE.pdf	34D72346F3BB0F3F3C90B724F22E7459F5242704A9215EF31EA5664F2570213C2860BD8C9F2311CF1391E697FC770BFEDEA74C3F396BF0A4A7339EA44223D35F
2023-06-29 Response to Final Office Action d. 2023-06-26; 088835-1359421-CLM.pdf	B3630CC29BEF2D0937DD0B26FAFDEB4CB6E355514649130F3178DB9CE663223B5F0B0121A8C76FE07038940F736212C937DA6309358CE3CDADFF7CDC8A511B48
2023-06-29 Response to Final Office Action d. 2023-06-26; 088835-1359421-REM.pdf	9F5E5BA499C768F1C2383F2F4DF23F20196D7B47E191759FCB2329577973A918AE0271F19A4F08241C326E121FC0E53841ED760EE30BF9C347ED33004C389651

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 18/097,003	Filing Date 01/13/2023	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $480 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	06/29/2023	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 3	= 0		x $480 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	SLIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/DEIDRE C KING-WOODWARD/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/097,003	01/13/2023	Paulos Tesfe	088835-1359421 (102300US)	1034

20350 7590 06/26/2023

Kilpatrick Townsend & Stockton LLP - West Coast
Mailstop: IP Docketing - 22
1100 Peachtree Street
Suite 2800
Atlanta, GA 30309

EXAMINER	
O'HERN, BRENT T	

ART UNIT	PAPER NUMBER
1793	

NOTIFICATION DATE	DELIVERY MODE
06/26/2023	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

KTSDocketing2@kilpatrick.foundationip.com
ipefiling@kilpatricktownsend.com

Office Action Summary	Application No. 18/097,003	Applicant(s) Tesfe et al.	
	Examiner BRENT T O'HERN	Art Unit 1793	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 08 June 2023.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☑ This action is **FINAL.** 2b) ☐ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-20 is/are pending in the application.

5a) Of the above claim(s) 8-13 is/are withdrawn from consideration.

6) ☑ Claim(s) 14 and 18-20 is/are allowed.

7) ☑ Claim(s) 1-7 and 15-17 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Claims

2. Claims 1-20 are pending with claims 8-13 withdrawn.

Allowable Subject Matter

3. Claims 14 and 18-20 are allowed.

Examiner's Note

4. When making amendments to the claims Applicant is advised to be careful and not add new matter. Applicant is advised to precisely point out where in the disclosure as filed, not the PGPUB, support is present for any amendments.

WITHDRAWN OBJECTIONS

5. All objections of record in the Office Action mailed 4/4/2023 have been withdrawn due to Applicant's amendments in the Paper filed 6/8/2023.

WITHDRAWN REJECTIONS

6. All rejections of record in the Office Action mailed 4/4/2023 have been withdrawn due to Applicant's amendments in the Paper filed 6/8/2023.

NEW REJECTIONS

7. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Official Correspondence.

Claim Rejections - 35 USC § 112

8. Claims 1-7 and 15-17 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter

which the inventor or a joint inventor (or for applications subject to pre-AIA 35 U.S.C. 112, the applicant), regards as the invention.

9. Claim 1 recites the limitation "the protein" in lines 4-5. There is insufficient antecedent basis for this limitation in the claim. Applicant is advised to consider stating "the whey protein" if all protein in the composition is “whey protein” or earlier stating “protein” if the composition includes protein other than “whey protein”. It is unclear what protein Applicant is trying to refer back to by the language "the protein" in line 7.

10. Claim 1 recites the limitation "the protein" in line 7. There is insufficient antecedent basis for this limitation in the claim. Applicant is advised to consider stating "the whey protein" if all protein in the composition is “whey protein” or earlier stating “protein” if the composition includes protein other than “whey protein”. It is unclear what protein Applicant is trying to refer back to by the language "the protein" in line 7.

11. Claim 15 recites the limitation "the denatured whey protein" in line 2. There is insufficient antecedent basis for this limitation in the claim. Applicant is advised to consider stating "the denatured whey proteins".

12. Claim 15 recites the limitation "the denatured whey protein prior to denaturation" in line 2. There is insufficient antecedent basis for this limitation in the claim. Applicant is advised to consider earlier stating "denatured whey protein prior to denaturation". It is further unclear where a denaturation process step fits within the composition claim.

13. Claim 16 recites the limitation "the denatured whey protein" in line 2. There is insufficient antecedent basis for this limitation in the claim. Applicant is advised to consider stating "the denatured whey proteins".

14. Claim 16 recites the limitation "the denatured whey protein" in line 3. There is insufficient antecedent basis for this limitation in the claim. Applicant is advised to consider stating "the denatured whey proteins".

15. Claim 17 recites the limitation "the denatured whey protein" in line 2. There is insufficient antecedent basis for this limitation in the claim. Applicant is advised to consider stating "the denatured whey proteins".

16. Clarification and/or correction required.

ANSWERS TO APPLICANT'S ARGUMENTS

17. The limitations of the amended/new claims are discussed above.

18. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

19. A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

20. Any inquiry concerning this communication or earlier communications from the examiner should be directed to BRENT T O'HERN whose telephone number is (571)272-6385. The examiner can normally be reached M-Th 5:00 am - 3:30 pm.

21. Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

22. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Emily Le can be reached on 571-272-0903. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

23. Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/BRENT T O'HERN/
Primary Examiner, Art Unit 1793
June 15, 2023

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/097,003	Tesfe et al.
	Examiner	Art Unit
	BRENT T O'HERN	1793

CPC - Searched*		
Symbol	Date	Examiner
A23J3/08	03/24/2023	/BTO/
search updated	06/15/2023	/BTO/

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner
426	657	03/24/2023	/BTO/

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
palm/search assignor (inventor)/assignee search	03/24/2023	/BTO/
see search notes	03/24/2023	/BTO/
see search notes	06/15/2023	/BTO/

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

/BRENT T O'HERN/ Primary Examiner, Art Unit 1793	

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/097,003	Tesfe et al.
	Examiner	Art Unit
	BRENT T O'HERN	1793

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	03/05/2023	03/24/2023	06/15/2023						
	1	÷	✓	✓						
	2	÷	✓	✓						
	3	÷	✓	✓						
	4	÷	✓	✓						
	5	÷	✓	✓						
	6	÷	✓	✓						
	7	÷	✓	✓						
	8	÷	N	N						
	9	÷	N	N						
	10	÷	N	N						
	11	÷	N	N						
	12	÷	N	N						
	13	÷	N	N						
	14	÷	✓	=						
	15	÷	✓	✓						
	16	÷	✓	✓						
	17	÷	✓	✓						
	18	÷	✓	=						
	19	÷	✓	=						
	20	÷	✓	=						

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	9178	A23J3/08	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/05 12:02 PM
L2	2537	426/657	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/05 12:02 PM
L3	11484	L1 L2	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/05 12:02 PM
L4	225	Merrill-Richard-K.IN.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU,	OR	ON	ON	2023/03/05 12:03 PM

			CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L5	6	Maier-Bradley.IN.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/05 12:04 PM
L6	292	Li-Jiancai.IN.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/05 12:04 PM
L7	3	Tesfe-Paulos.IN.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA,	OR	ON	ON	2023/03/05 12:04 PM

			VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L8	103	"Leprino Foods Company"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/05 12:04 PM
L9	501	L4 L5 L6 L7	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/05 12:05 PM
L10	56	denatured.CLM. AND protein.CLM. AND whey.CLM. AND filtering.CLM.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/05 12:07 PM
L11	13	denatured.CLM. AND protein.CLM. AND whey.CLM. AND filtering.CLM. AND cheese.CLM.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB,	OR	ON	ON	2023/03/05 12:07 PM

			HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L12	5	denatured.CLM. AND protein.CLM. AND whey.CLM. AND filtering.CLM. AND cheese.CLM.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/03/05 12:07 PM
L13	5	("0000002" OR "10709146" OR "10834934" OR "5968586" OR "9578890").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2023/03/05 12:23 PM
L14	4	"11206846".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/11 02:25 PM
L15	4	"2002045522".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/11 02:26 PM
L16	0	WO-2002045522-$.did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU,	OR	ON	ON	2023/03/11 02:27 PM

			CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L17	0	WO-20020045522-$.did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/11 02:27 PM
L18	0	WO-200245522-$.did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/11 02:27 PM
L19	0	WO-200200045522-$.did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA,	OR	ON	ON	2023/03/11 02:27 PM

			VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L20	0	WO-200245522-$.did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/11 02:28 PM
L21	3	WO-0245522-$.did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/11 02:28 PM
L22	4	WO-2006089921-$.did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/11 02:29 PM
L23	3	WO-2015059245-$.did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB,	OR	ON	ON	2023/03/11 02:30 PM

			HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L24	5216	denatured WITH whey WITH protein	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:11 PM
L25	63	denatured WITH whey WITH protein SAME glycomacropeptide	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:12 PM
L26	39	(Artificial Intelligence) Similar to: 18/097,003 with 0 CPC Selections and 0 Text Selections Text: (JP-6612745-B2 OR JP-2016533726-A OR JP-2016533725-A OR JP-6525213-B2 OR EP-3720296-B1 OR US-20210007376-A1 OR CN-113784622-A OR EP-0485663-B1 OR WO-2019110668-A1	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN))	OR	ON	ON	2023/03/12 02:12 PM

		OR EP-3720296-A1 OR EP-0485663-A1 OR BR-112016008894-B1 OR IE-50403-B1 OR CN-112137000-A OR US-20220142191-A1 OR EP-3937648-A1 OR WO-2020187842-A1 OR AU-2020243017-A1 OR JP-4637449-B2 OR US-20180317513-A1 OR WO-2018204261-A1 OR CA-2927685-A1 OR CA-2927685-C OR US-20200397020-A1 OR CA-2137913-A1 OR US-20180343890-A1 OR US-20120029165-A1 OR EP-2595494-A1 OR WO-2012012237-A1 OR CA-2804752-A1 OR DK-2595494-T3 OR EP-2595494-B1 OR US-10638775-B2 OR CA-2927686-C OR DK-3071047-T3 OR NZ-508746-A OR US-10834934-B2 OR WO-0048473-A1 OR US-11206846-B2 OR EP-1154700-A1 OR EA-037214-B1 OR EA-035744-B1 OR US-20140287095-A1 OR WO-2014153381-A1 OR WO-2015059248-A1 OR EP-3060065-A1 OR CA-2927686-A1 OR DE-19950240-A1 OR US-20160262424-A1 OR EP-0644720-A1).did.					
L27	4	L26 AND denatured WITH whey WITH protein SAME glycomacropeptide	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:12 PM

L28	6	L26 AND denatured WITH whey WITH protein AND glycomacropeptide	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:13 PM
L29	6	L26 AND denatured AND whey AND glycomacropeptide	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:14 PM
L30	3	L9 AND denatured AND whey AND glycomacropeptide	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:14 PM
L31	0	L8 AND denatured AND whey AND glycomacropeptide	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL,	OR	ON	ON	2023/03/12 02:15 PM

			NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L32	3	Leprino AND denatured AND whey AND glycomacropeptide	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:15 PM
L33	3	Leprino AND denatured AND whey AND (glycomacropeptide OR GMP)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:16 PM
L34	25	((US-20120219665-A1 OR US-20010024677-A1 OR US-20040037905-A1 OR US-20210007376-A1 OR US-20210329949-A1 OR US-20230002173-A1).did. AND PGPB.dbnm.) OR ((US-4105803-A OR US-9462817-B2 OR US-10834934-B2 OR US-10709146-B2 OR US-9578890-B2 OR US-5968586-A OR US-0000002-A OR US-11206846-B2).did. AND USPT.dbnm.) OR	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:16 PM

		((WO-0245522-A1 OR WO-2006089921-A1 OR WO-2015059245-A1 OR WO-2019110668-A1 OR EP-3720296-B1 OR NZ-508746-A OR CN-113784622-A OR WO-2021222013-A1 OR KR-20230008135-A OR CN-114794489-A).did. AND FTDB.dbnm.) OR ((CN-115235530-A).did. AND FPRS.dbnm.)					
L35	11	L34 AND denatured AND whey AND (glycomacropeptide OR GMP)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:16 PM
L36	9	denatured.CLM. AND whey.CLM. AND (glycomacropeptide OR GMP).CLM. AND protein.CLM.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:28 PM
L37	43	denatured WITH whey AND (glycomacropeptide OR GMP).CLM. AND protein.CLM.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE,	OR	ON	ON	2023/03/12 02:29 PM

			SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L38	41	denatured WITH whey AND (glycomacropeptide OR GMP).CLM. AND protein.CLM. AND (cheese OR cheesemaking OR "cheese making")	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:32 PM
L39	41	denatured WITH whey AND (glycomacropeptide OR GMP).CLM. AND protein.CLM. AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:32 PM
L40	5	denatured WITH whey AND (glycomacropeptide OR GMP).CLM. AND protein.CLM. AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) WITH (glycomacropeptide OR GMP)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:33 PM
L41	8	(denatured OR denat$) WITH whey AND (glycomacropeptide OR GMP).CLM. AND	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU,	OR	ON	ON	2023/03/12 02:43 PM

		protein.CLM. AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) WITH (glycomacropeptide OR GMP)	CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L42	29	((US-20120219665-A1 OR US-20010024677-A1 OR US-20040037905-A1 OR US-20210007376-A1 OR US-20210329949-A1 OR US-20140287095-A1 OR US-20230002173-A1).did. AND PGPB.dbnm.) OR ((US-4105803-A OR US-9462817-B2 OR US-10834934-B2 OR US-10709146-B2 OR US-9578890-B2 OR US-5968586-A OR US-0000002-A OR US-11206846-B2).did. AND USPT.dbnm.) OR ((WO-0245522-A1 OR WO-2006089921-A1 OR WO-2015059245-A1 OR WO-2019110668-A1 OR EP-3720296-B1 OR NZ-508746-A OR CN-113784622-A OR WO-2021222013-A1 OR KR-20230008135-A OR JP-6513629-B2 OR CA-2656174-A1 OR WO-2014153381-A1 OR CN-114794489-A).did. AND FTDB.dbnm.) OR ((CN-115235530-A).did. AND FPRS.dbnm.)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:07 AM
L43	3	"JP 6513629 B2"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV,	OR	ON	ON	2023/03/13 10:08 AM

			MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L44	30	((US-20120219665-A1 OR US-20010024677-A1 OR US-20040037905-A1 OR US-20210007376-A1 OR US-20210329949-A1 OR US-20140287095-A1 OR US-20230002173-A1).did. AND PGPB.dbnm.) OR ((US-4105803-A OR US-9462817-B2 OR US-10834934-B2 OR US-10709146-B2 OR US-9578890-B2 OR US-5968586-A OR US-0000002-A OR US-11206846-B2).did. AND USPT.dbnm.) OR ((WO-0245522-A1 OR WO-2006089921-A1 OR WO-2015059245-A1 OR WO-2019110668-A1 OR EP-3720296-B1 OR NZ-508746-A OR CN-113784622-A OR WO-2021222013-A1 OR KR-20230008135-A OR JP-6513629-B2 OR CA-2656174-A1 OR WO-2014153381-A1 OR CN-114794489-A).did. AND FTDB.dbnm.) OR ((WO-2012110705-A1).did. AND DWPI.dbnm.) OR ((CN-115235530-A).did. AND FPRS.dbnm.)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:09 AM
L45	16	L44 AND (denatured OR denat$) AND whey AND (glycomacropeptide OR GMP) AND protein AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL,	OR	ON	ON	2023/03/13 10:10 AM

		enzymatically) AND (reduce OR reduced OR reduc$) AND (glycomacropeptide OR GMP)	NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L46	19	L44 AND (glycomacropeptide OR GMP)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:11 AM
L47	20	"WO 2012110705"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:12 AM
L48	31	((US-20120219665-A1 OR US-20010024677-A1 OR US-20040037905-A1 OR US-20210007376-A1 OR US-20210329949-A1 OR US-20140287095-A1 OR US-20230002173-A1).did. AND PGPB.dbnm.) OR ((US-4105803-A OR US-9462817-B2 OR US-10834934-B2 OR US-10709146-B2 OR US-9578890-B2 OR US-5968586-A OR US-0000002-A OR US-	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:13 AM

		11206846-B2).did. AND USPT.dbnm.) OR ((WO-0245522-A1 OR WO-2006089921-A1 OR WO-2015059245-A1 OR WO-2019110668-A1 OR EP-3720296-B1 OR NZ-508746-A OR CN-113784622-A OR WO-2021222013-A1 OR KR-20230008135-A OR JP-6513629-B2 OR CA-2656174-A1 OR WO-2014153381-A1 OR WO-2012110705-A1 OR CN-114794489-A).did. AND FTDB.dbnm.) OR ((WO-2012110705-A1).did. AND DWPI.dbnm.) OR ((CN-115235530-A).did. AND FPRS.dbnm.)					
L49	17	L48 AND (denatured OR denat$) AND whey AND (glycomacropeptide OR GMP) AND protein AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) AND (glycomacropeptide OR GMP)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:13 AM
L50	17	L48 AND (denatured OR denat$) AND whey AND (glycomacropeptide OR GMP OR glycomacro$) AND protein AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) AND (glycomacropeptide OR GMP)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:17 AM
L51	7	L48 AND (denatured	(US-PGPUB; USPAT;	OR	ON	ON	2023/03/13

		OR denat$) AND whey AND (glycomacropeptide OR GMP OR glycomacro$) AND protein AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) AND (glycomacropeptide OR GMP) AND "off-tastes"	USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				10:20 AM
L52	3	"US 20180242608"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:23 AM
L53	33	((US-20120219665-A1 OR US-20010024677-A1 OR US-20040037905-A1 OR US-20210007376-A1 OR US-20210329949-A1 OR US-20140287095-A1 OR US-20180242608-A1 OR US-20230002173-A1).did. AND PGPB.dbnm.) OR ((US-4105803-A OR US-9462817-B2 OR US-10834934-B2 OR US-10709146-B2 OR US-9578890-B2 OR US-5968586-A OR US-0000002-A OR US-11206846-B2 OR US-10993454-B2).did. AND USPT.dbnm.) OR ((WO-0245522-A1 OR WO-2006089921-A1 OR WO-2015059245-A1 OR WO-	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:24 AM

		2019110668-A1 OR EP-3720296-B1 OR NZ-508746-A OR CN-113784622-A OR WO-2021222013-A1 OR KR-20230008135-A OR JP-6513629-B2 OR CA-2656174-A1 OR WO-2014153381-A1 OR WO-2012110705-A1 OR CN-114794489-A).did. AND FTDB.dbnm.) OR ((WO-2012110705-A1).did. AND DWPI.dbnm.) OR ((CN-115235530-A).did. AND FPRS.dbnm.)					
L54	9	L53 AND (denatured OR denat$) AND whey AND (glycomacropeptide OR GMP OR glycomacro$) AND protein AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) AND (glycomacropeptide OR GMP) AND "off-tastes"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:24 AM
L55	10	L53 AND (denatured OR denat$ OR "heat treatment") AND whey AND (glycomacropeptide OR GMP OR glycomacro$) AND protein AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) AND (glycomacropeptide OR GMP) AND "off-tastes"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 12:58 PM
L56	33	((US-20120219665-A1 OR US-20010024677-A1 OR US-20040037905-A1 OR US-20210007376-A1 OR US-20210329949-A1 OR US-	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS,	OR	ON	ON	2023/03/14 09:50 AM

		20140287095-A1 OR US-20180242608-A1 OR US-20230002173-A1).did. AND PGPB.dbnm.) OR ((US-4105803-A OR US-9462817-B2 OR US-10834934-B2 OR US-10709146-B2 OR US-9578890-B2 OR US-5968586-A OR US-0000002-A OR US-11206846-B2 OR US-10993454-B2).did. AND USPT.dbnm.) OR ((WO-0245522-A1 OR WO-2006089921-A1 OR WO-2015059245-A1 OR WO-2019110668-A1 OR EP-3720296-B1 OR NZ-508746-A OR CN-113784622-A OR WO-2021222013-A1 OR KR-20230008135-A OR JP-6513629-B2 OR CA-2656174-A1 OR WO-2014153381-A1 OR WO-2012110705-A1 OR CN-114794489-A).did. AND FTDB.dbnm.) OR ((WO-2012110705-A1).did. AND DWPI.dbnm.) OR ((CN-115235530-A).did. AND FPRS.dbnm.)	IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L57	22	L3 AND (denatured OR denat$ OR "heat treatment") AND whey AND (glycomacropeptide OR GMP OR glycomacro$) AND protein AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) AND (glycomacropeptide OR GMP) AND "off-tastes"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/24 05:21 PM
L58	0	L9 AND (denatured OR denat$ OR "heat treatment") AND whey AND	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU,	OR	ON	ON	2023/03/24 05:22 PM

		(glycomacropeptide OR GMP OR glycomacro$) AND protein AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) AND (glycomacropeptide OR GMP) AND "off-tastes"	CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L59	41	(Artificial Intelligence) Similar to: 18/097,003 with 0 CPC Selections and 0 Text Selections Text: (JP-6612745-B2 OR JP-2016533726-A OR EP-3720296-B1 OR US-20210007376-A1 OR JP-2016533725-A OR JP-6525213-B2 OR CN-113784622-A OR WO-2019110668-A1 OR EP-3720296-A1 OR EP-0485663-B1 OR EP-0485663-A1 OR IE-50403-B1 OR BR-112016008894-B1 OR CN-112137000-A OR US-20220142191-A1 OR WO-2020187842-A1 OR AU-2020243017-A1 OR EP-3937648-A1 OR CA-2927685-A1 OR CA-2927685-C OR CA-2137913-A1 OR JP-4637449-B2 OR US-20180317513-A1 OR WO-2018204261-A1 OR CA-2927686-C OR US-20200397020-A1 OR EA-037214-B1 OR EA-035744-B1 OR NZ-508746-A OR DK-3071047-T3 OR US-20180343890-A1 OR US-20120029165-A1 OR EP-2595494-A1 OR WO-2012012237-A1 OR CA-2804752-A1 OR DK-2595494-T3 OR EP-2595494-B1 OR US-10638775-B2 OR	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN))	OR	ON	ON	2023/06/15 12:45 PM

		US-10834934-B2 OR WO-0048473-A1 OR EP-1154700-A1 OR US-11206846-B2 OR US-7824728-B2 OR EP-3060065-A1 OR WO-2015059248-A1 OR CA-2927686-A1 OR US-20070128341-A1 OR US-20160262424-A1 OR JP-7266598-B2 OR EP-0644720-A1).did.					
L60	5	L59 AND (denatured OR denat$ OR "heat treatment") AND whey AND (glycomacropeptide OR GMP OR glycomacro$) AND protein AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) AND (glycomacropeptide OR GMP) AND "off-tastes"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/06/15 12:45 PM
L61	20	L59 AND (glycomacropeptide OR GMP)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/06/15 12:46 PM
L62	20	L59 AND (glycomacropeptide OR GMP) AND whey	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH,	OR	ON	ON	2023/06/15 12:46 PM

			TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L63	1	L59 AND (glycomacropeptide OR GMP) AND whey AND proteolysis	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/06/15 12:46 PM
L64	0	L8 AND (glycomacropeptide OR GMP) AND whey AND proteolysis	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/06/15 12:47 PM
L65	53	L3 AND (glycomacropeptide OR GMP) AND whey AND proteolysis	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/06/15 12:47 PM
L66	0	L9 AND (glycomacropeptide OR GMP) AND whey AND proteolysis	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU,	OR	ON	ON	2023/06/15 12:47 PM

			CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				

PE2E SEARCH - Search History (Interference)

There are no Interference searches to show.

I hereby certify that this correspondence is being filed with the United States Patent and Trademark Office via the Office electronic filing system on June 8, 2023.

KILPATRICK TOWNSEND & STOCKTON LLP

By: /Ashlea Bellatty/
Ashlea Bellatty

PATENT
Attorney Docket No.: 088835-1359421-102300US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	Confirmation No.: 1034
Paulos Tesfe et al.	Examiner: Brent T O'Hern
Application No.: 18/097,003	Technology Center/Art Unit: 1793
Filed: January 13, 2023	
For: DENATURED MILK PROTEINS AND METHODS OF MAKING THEM	**RESPONSE**
Customer No.: 20350	

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Examiner:

In response to the Non-Final Office Action mailed April 4, 2023, in the above-referenced application, please consider the following remarks:

In the Claims are reflected in the listing of claims, which begins on page 2 of this paper.

Remarks begin on page 6 of this paper.

IN THE CLAIMS

This listing of claims will replace all prior versions, and listings of claims in the application.

1. (Currently Amended) A denatured whey protein composition comprising:

at least 60 wt.% **whey** protein on a dry weight basis;

less than 8 wt.% native **glycomacropeptide (**GMP**)** and greater than 2 wt.% enzymatically hydrolyzed ~~**glycomacropeptide (**~~GMP[[)]] relative to [[the]] **a** total weight of the protein;

a proteolysis index of at least 8.0 wt.%; and

greater than 50 wt.% denatured whey proteins relative to the total weight of the protein.

2. (Original) The denatured whey protein composition of claim 1, wherein the denatured whey proteins comprise denatured enzymatically-hydrolyzed cheese whey proteins.

3. (Original) The denatured whey protein composition of claim 2, wherein the native GMP is less than or about 7 wt.% relative to the total weight of the protein.

4. (Original) The denatured whey protein composition of claim 1, wherein the denatured whey proteins are characterized by a D50 particle size distribution value of less than or about 4.5 μm.

5. (Original) The denatured whey protein composition of claim 4, wherein the denatured whey proteins are further characterized by a D10 particle size distribution value of less than or about 2.5 μm.

6. (Original) The denatured whey protein composition of claim 4, wherein the denatured whey proteins are further characterized by a D90 particle size distribution value of less than or about 8.0 μm.

7. (Currently Amended) The denatured whey protein composition of claim 1, further comprising at most 7.0[[%]] wt.% fat on a dry weight basis.

8. (Withdrawn, Currently Amended) A method of making a denatured whey protein composition, the method comprising:

filtering cheese whey from enzymatically coagulated milk into a cheese whey retentate and a permeate; and

reducing native glycomacropeptides **(GMP)** in the cheese whey retentate to form a reduced-GMP cheese whey retentate composition; and

heating the reduced-GMP cheese whey retentate composition to form the denatured whey protein composition,

wherein the denatured whey protein composition is characterized by

at least 60 wt.% protein on a dry weight basis;

less than 11 wt.% native GMP relative to [[the]] **a** total weight of the protein;

a proteolysis index of at least 8.0 wt.% or a beta-lactoglobulin to alpha lactalbumin ratio of greater than 5.00; and

greater than 50 wt.% denatured whey proteins relative to the total weight of the protein.

9. (Withdrawn) The method of claim 8, wherein the reduction of GMP includes combining the cheese whey retentate with one or more enzymes that selectively hydrolyze GMP in the cheese whey retentate to form the reduced-GMP cheese whey retentate composition, the one or more enzymes that selectively hydrolyze GMP in the cheese whey retentate comprises at least one alkaline serine protease enzyme and at least one neutral protease enzyme or wherein the reduction of GMP occurs through the microfiltration of the cheese whey retentate.

10. (Withdrawn) The method of claim 8, wherein the heating of the reduced-GMP cheese whey retentate composition also inactivates the one or more enzymes that selectively hydrolyze the GMP in the cheese whey retentate.

11. (Withdrawn) The method of claim 8, wherein the reduced-GMP cheese whey retentate composition is heated to a temperature of greater than or about 160°F.

12. (Withdrawn) The method of claim 8, wherein the heating of the reduced-GMP cheese whey retentate composition further comprises exposing the reduced-GMP cheese whey retentate composition to high shear conditions.

13. (Withdrawn) The method of claim 8, wherein the denatured whey protein composition is characterized by a weight ratio of native GMP to total whey protein of less than or about 0.15, and/or wherein the denatured whey protein composition is characterized by less than or about 11 wt.% GMP relative to the total weight of the protein.

14. (Currently Amended) A denatured whey protein composition comprising:

at least 60 wt.% protein on a dry weight basis;

less than 11 wt.% native **glycomacropeptide (**GMP**)** relative to total weight of the protein;

greater than 7 wt.% fat on a dry basis;

a beta-lactoglobulin to alpha lactalbumin ratio of greater than 5.00; and

greater than 50 wt.% denatured whey proteins relative to the total weight of the protein.

15. (Currently Amended) The denatured whey protein composition of claim 14, wherein the **denatured** whey protein prior to denaturation already includes at least 30 wt.% denatured protein.

16. (Currently Amended) The denatured whey protein composition of claim 14, wherein the **denatured** whey protein contains at least 60 wt.% beta lactoglobulin relative to [[the]] **a** total weight of protein and/or wherein the **denatured** whey protein contains at most 12 wt.% alpha lactalbumin relative to the total weight of protein.

17. (Currently Amended) The denatured whey protein composition of claim 14, wherein the **denatured** whey protein comprises a weight ratio of beta lactoglobulin to alpha lactalbumin of greater than or about 5.

18. (Original) The denatured whey protein composition of claim 14, wherein the denatured whey proteins are characterized by a D50 particle size distribution value of less than or about 0.3 μm.

19. (Original) The denatured whey protein composition of claim 14, wherein the denatured whey proteins are further characterized by a D10 particle size distribution value of less than or about 0.1 μm.

20. (Original) The denatured whey protein composition of claim 14, wherein the denatured whey proteins are further characterized by a D90 particle size distribution value of less than or about 1.0 μm.

REMARKS/ARGUMENTS

As an initial matter, Applicant and Attorney Hunter thank Examiner O'Hern for their time during the telephonic interview. Applicant has submitted the arguments discussed during the interview in regards to the rejection under 35 U.S.C. § 103 and amendments discussed during the interview in regards to the rejection under 35 U.S.C. § 112 herewith, as Examiner O'Hern indicated that the arguments and amendments overcome the rejection of record.

Claims 1-20 are pending in this application and stand substantively rejected, with claims 8-13 currently withdrawn from consideration due to a restriction requirement. In this Amendment, claims 1, 7, and 14-17 have been amended. No new matter is believed added by this Amendment. Reconsideration and issuance of a formal notice of allowance is respectfully requested in view of the amendments, as well as the remarks below.

Drawings

Corrected drawing sheets have been submitted herewith. As the corrected drawings merely correctly the blurry lines and text as requested, Applicant respectfully submits that the replacement drawing sheets add no new matter.

Specification

As discussed during the interview, Applicant respectfully submits that there is a space between an adjacent number and a percentage sign (e.g. 70 %), but that there is no space between text and an adjacent percentage sign (e.g. wt.%). As this is common usage in the art, Applicant respectfully submits that no correction is necessary.

In regards to the table in Paragraph [0092] of the present specification, the footnote of Table 7 states that a different letter in a respective column refers to values that are statistically different. Therefore, Applicant respectfully submits that the superscripts are properly defined and as would be understood by common statistical references.

Rejection Under 35 U.S.C. § 112

Next, in the Office Action, claims 1-7 and 14-20 were rejected under 35 U.S.C. § 112 as assertedly being indefinite. Without commenting on the propriety of the rejection, Applicant has amended the claims as suggested, and therefore requests withdrawal of the rejections. For

instance, claims 15-17 have been amended to recite the "denatured" whey protein, referring back to the preamble of claim 14. Therefore, withdrawal of the rejections is respectfully requested.

Rejection Under 35 U.S.C. § 103

In the Office Action, claims 1-7 were rejected under 35 U.S.C. § 103 as assertedly being unpatentable over U.S. Patent App. No. 2018/0242608 to Tikanmaki. However, as discussed and agreed during the interview, Applicant respectfully submits that Tikanmaki fails to disclose or render obvious all of the features of the pending claims.

Namely, presently pending independent claim 1 recites in relevant part: "greater than 2 wt.% enzymatically hydrolyzed GMP relative to the total weight of the protein." As discussed in at least paragraph [0026] of the specification as filed, GMPs are present in whey proteins derived from cheesemaking, but are not present in natural milk, as GMPs are cleaved from kappa-casein proteins during curd formation by chymosin (rennet). The formation of GMPs via cleavage during curd formation is also discussed in paragraph [0004] and [0044] of Tikanmaki. For instance, Tikanmaki discusses that the direction of the application is to **prevent** the cleavage of the glycomacropeptides from the incorporated casein. Thus, as discussed and agreed, and contrary to the assertions of the Office Action, Tikanmaki fails to disclose or render obvious greater than 2 wt.% enzymatically hydrolyzed GMP relative to the total weight of the protein, as Tikanmaki fails to disclose a whey protein source that contains GMP.

This is further illustrated as the only enzymatic hydrolysis present in Tikanmaki is of Lactose (Tikanmaki at [0025]), which would fail to provide the composition with GMPs. Moreover Tikanmaki begins with milk, not whey proteins derived from cheesemaking, as the raw material. (Tikanmaki at [0019]-[0020]). Thus, as discussed and agreed during the Interview, Applicant respectfully submits that Tikanmaki fails to disclose or render obvious all of the features of claim 1, and therefore respectfully requests withdrawal of the rejection.

In addition, presently pending independent claim 1 recites in relevant part, "a proteolysis index of at least 8 w.%." As discussed in at least paragraph [0051] of the present specification, "the proteolysis index (PI) increases in a sample as protein is broken down by enzymatic activity to its primary amino acids or small peptides that become soluble in trichloroacetic acid, known as non-protein nitrogen, and can therefore be an indicator for protein hydrolysates." However,

only Lactose is subjected to hydrolysis in Tikanmaki, which is a carbohydrate (*see,* [0027] of Tikanmakai). As known in the art, breakdown of a carbohydrate would fail to increase a proteolysis index of the composition. Therefore, Applicant respectfully submits that Tikanmaki fails to disclose the proteolysis index of the pending claims. Thus, as discussed and agreed during the Interview, Applicant respectfully submits that Tikanmaki fails to disclose or render obvious all of the features of claim 1, and therefore respectfully requests withdrawal of the rejection.

Furthermore, presently pending claim 1 recites in relevant part, "greater than 50 wt.% denatured whey proteins relative to the total weight of the protein". However, the only discussion of denaturization in Tikanmaki is of β-lactoglobulin, which is removed via microfiltration as Tikanmaki states that it has lower nutritive value. (Tikanmaki at [0045]-[0046]). Therefore, contrary to the assertion of the Office Action, Applicant respectfully submits that Tikanmaki fails to disclose or render obvious the denatured whey protein content according to the pending claims. Thus, as discussed and agreed during the Interview, Applicant respectfully submits that Tikanmaki fails to disclose or render obvious all of the features of claim 1, and therefore respectfully requests withdrawal of the rejection.

As dependent claims 2-6 depend upon claim 1, Applicant respectfully submits that the dependent claims are patentable and nonobvious over the cited art for the same reasons as set forth above. Nonetheless as discussed, Applicant respectfully submits that claims 4-6 are further patentable and nonobvious over the cited art. Namely, the claimed particles sizes in claims 4-6 are of particle sizes of whey protein particles. However, the cited portion of Tikanmaki is in regards to microfiltration membrane pore sizes. In addition to the fact that a membrane fails to disclose particle size ranges, and particularly median particle size, Applicant also notes that the retentate is used in the whey protein product of Tikanmaki. Thus, only the particles that cannot pass through the membrane of Tikanmaki are utilized in the composition of Tikanmaki. For at least these reasons, Applicant respectfully submits that claims 4-6 are further patentable and nonobvious over the cited art.

Allowable Subject Matter

Applicant respectfully notes that no prior art rejection has been set forth over claims 14-20. Therefore, as claims 14-20 have been rewritten to overcome the rejections under 35 U.S.C. § 112, Applicant respectfully submits that all rejections in regards to claims 14-20 have been overcome. For at least these reasons, Applicant respectfully requests issuance of a formal acknowledgement of allowance.

CONCLUSION

In view of the foregoing, Applicant believes all claims now pending in this application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

Except for the issue fees payable under 37 C.F.R. § 1.18, the Director is authorized to charge any additional fees during pendency of this application, including any required extension of time fees, or credit any overpayment to Deposit Account Number 20-1430. This paragraph is intended to be a constructive petition for extension of time in accordance with 37 C.F.R. § 1.136(a)(3).

If the Examiner believes a telephone conference would expedite prosecution of this application, please contact the undersigned at 303-607-3218 or ajhunter@kilpatricktownsend.com.

Respectfully submitted,

/alexa.j.hunter/
Alexa J. Hunter
Registration No. 74,538

KILPATRICK TOWNSEND & STOCKTON LLP

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/097,003	**06/08/2023 05:50:37 PM ET**	**088835-1359421 (102300US)**

Title of Invention

DENATURED MILK PROTEINS AND METHODS OF MAKING THEM

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	1034	FILED BY	Ashlea Bellatty
PATENT CENTER #	62231969	FILING DATE	01/13/2023
CUSTOMER #	20350	FIRST NAMED INVENTOR	Paulos Tesfe
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Alexa Hunter

Documents

TOTAL DOCUMENTS: 4

DOCUMENT		PAGES	DESCRIPTION	SIZE (KB)
2023-06-08 Response to Non-Final Office Action d. 2023-04-04; 088835-1359421-102300US.pdf		9	-	164 KB
2023-06-08 Response to Non-Final Office Action d. 2023-04-04; 088835-1359421-102300US-A....pdf	(1-1)	1	Amendment/Request for Reconsideration-After Non-Final Rejection	98 KB
2023-06-08 Response to Non-Final Office Action d. 2023-04-04; 088835-1359421-102300US-CLM.pdf	(2-5)	4	Claims	104 KB

2023-06-08 Response to Non-Final Office Action d. 2023-04-04; 088835-1359421-102300US-REM.pdf	(6-9)	4	Applicant Arguments/Remarks Made in an Amendment	143 KB
2023-06-08 Replacement Drawings; 088835-1359421-102300US.pdf		10	Drawings-only black and white line drawings	1031 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
2023-06-08 Response to Non-Final Office Action d. 2023-04-04; 088835-1359421-102300US.pdf	582DE668D8422001B3BA9A2660FE195BAB8CE1673F571B18D7AF19B7993817C4EDD9AA1AEF3D74C090333629B0D5036188DB56EE5E67491C1F82685080FAE640
2023-06-08 Response to Non-Final Office Action d. 2023-04-04; 088835-1359421-102300US-A....pdf	8378F737DC9F4099256F1FA0F7D655BA89FC672FA62204BB8D5D5E526AA3EEE6B18D7542B2965C10F77687FE6A9BA1872C88DD784D87C0D8C9D32CAE6B107DFC
2023-06-08 Response to Non-Final Office Action d. 2023-04-04; 088835-1359421-102300US-CLM.pdf	491A8B70FA22519CC9CDAEED47E921BDBA50B6DF6CA65C9599C8CFCC41167203B1C9D7B6E3BC97676E3D3707436E3EAF6021C159B85D37BB3DD4CFFF4FE685E6
2023-06-08 Response to Non-Final Office Action d. 2023-04-04; 088835-1359421-102300US-REM.pdf	45720280B9F358152BEFF827000BE73BFE7D510D13F269A9E295C21D7C2308B2026EED5B3FBF1BE529D2F02780461EF4263AD2970675458A3D57FCD4316ED984
2023-06-08 Replacement Drawings; 088835-1359421-102300US.pdf	EDB0D0E992089A00213A030C1FF13CCD843E4D4B2F8883C753DA03D6B984F687FF8333C763066EE6E46E005A0478BD975B30548A92AFE8890FFBD5708872520C

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

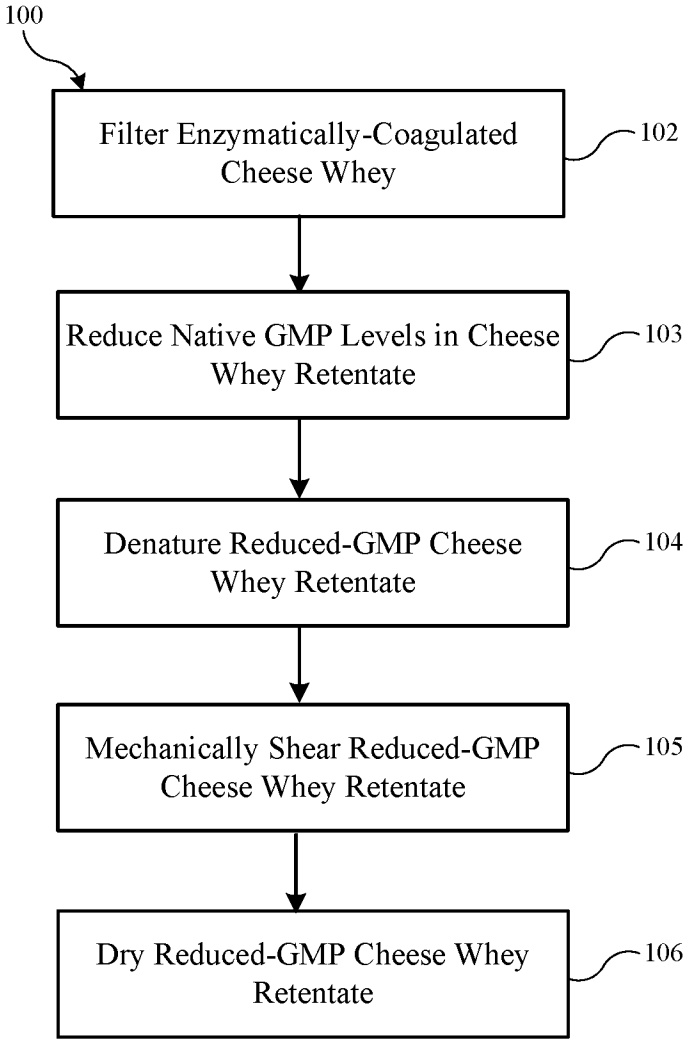

100
Filter Enzymatically-Coagulated Cheese Whey
102
Reduce Native GMP Levels in Cheese Whey Retentate
103
Denature Reduced-GMP Cheese Whey Retentate
104
Mechanically Shear Reduced-GMP Cheese Whey Retentate
105
Dry Reduced-GMP Cheese Whey Retentate
106

FIG. 1

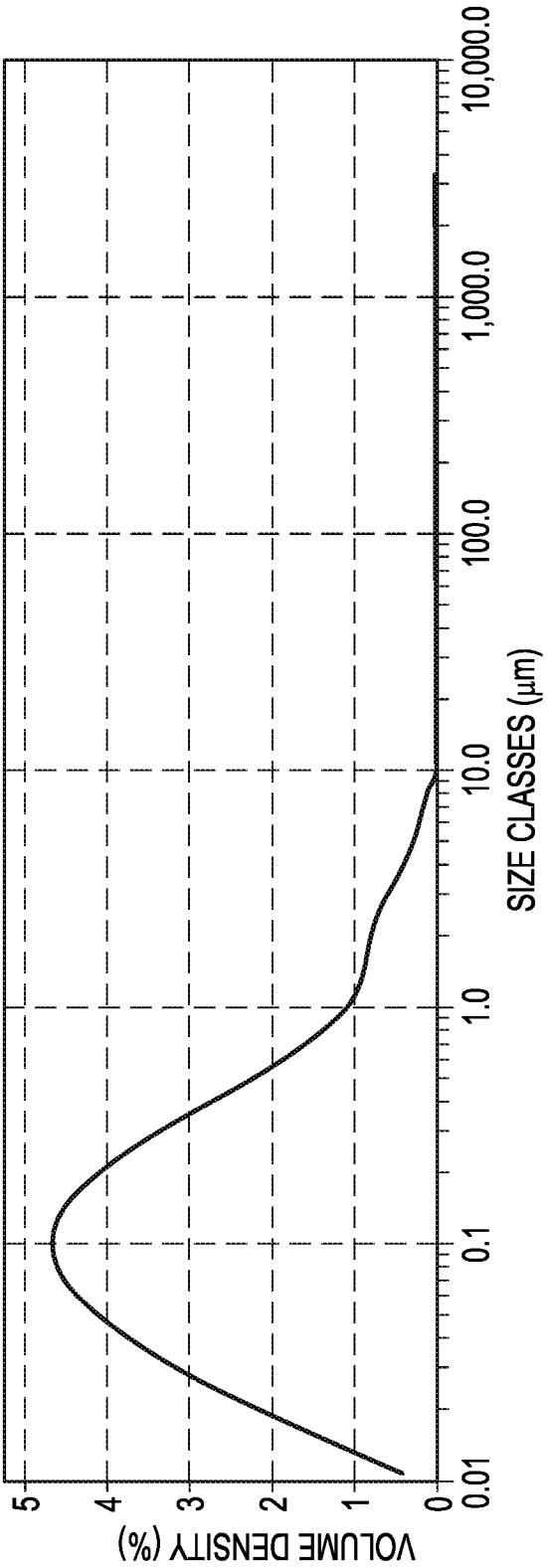

VOLUME DENSITY (%)
0
1
2
3
4
5
0.01
0.1
1.0
10.0
100.0
1,000.0
10,000.0
SIZE CLASSES (µm)
[38] UNDENATURED (FEED) WPC 80

FIG. 2A

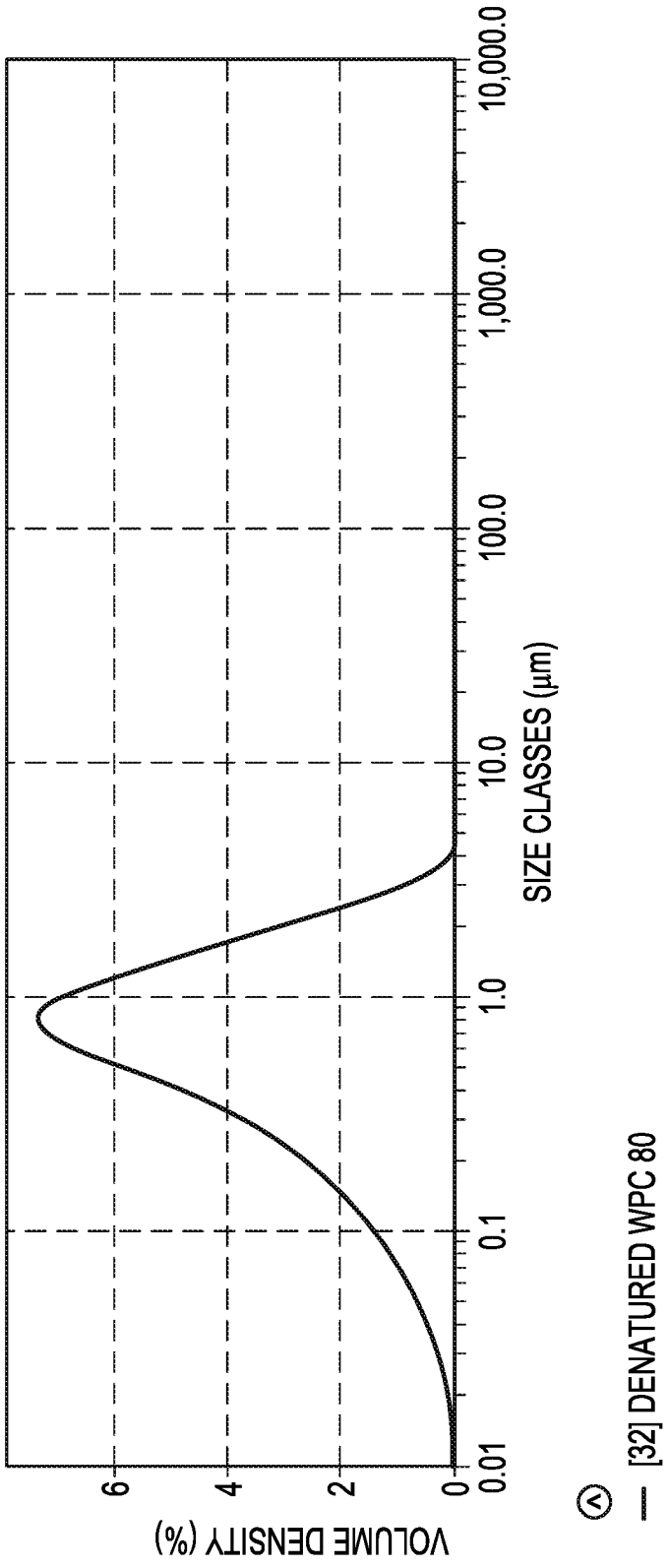

VOLUME DENSITY (%)
0
2
4
6
0.01
0.1
1.0
10.0
100.0
1,000.0
10,000.0
SIZE CLASSES (µm)
[32] DENATURED WPC 80

FIG. 2B

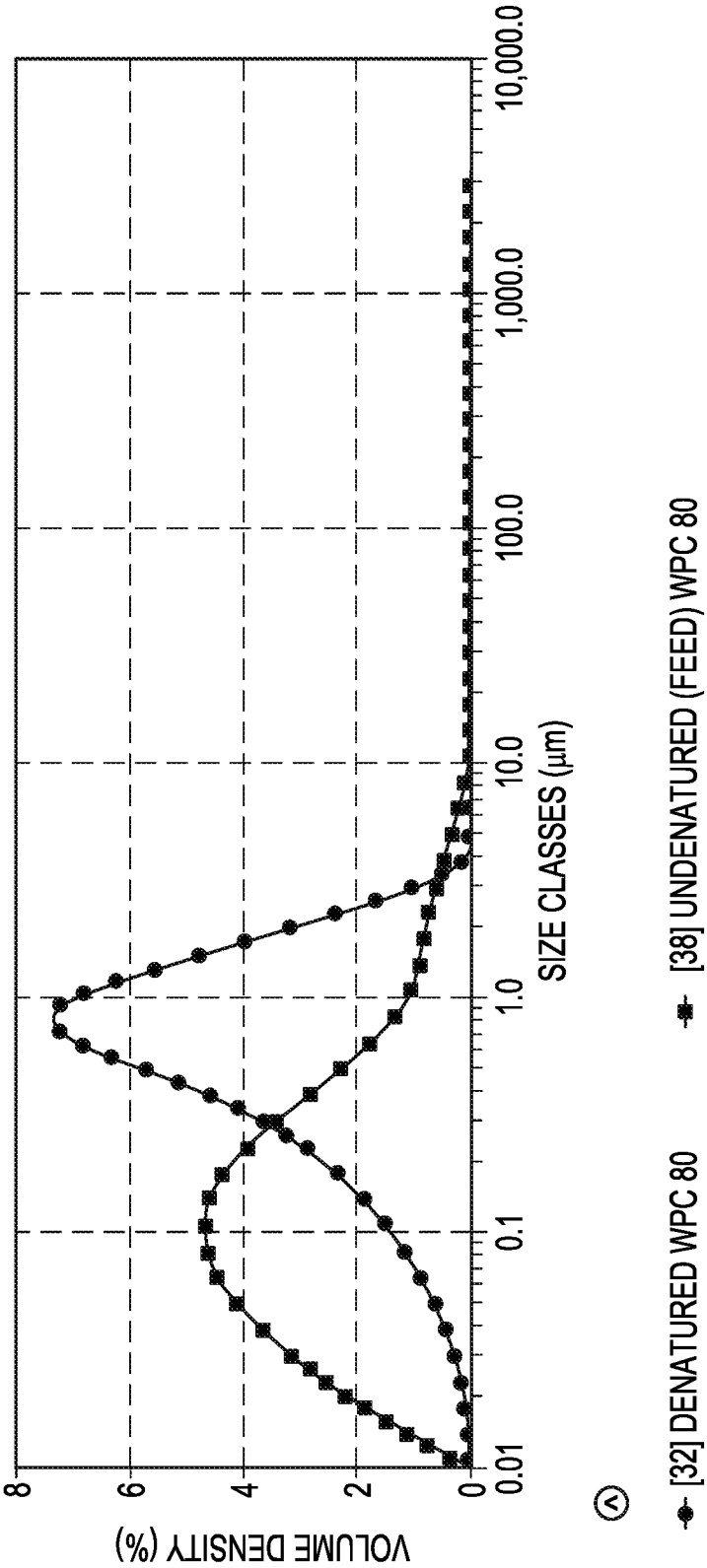

VOLUME DENSITY (%)
0
2
4
6
8
0.01
0.1
1.0
10.0
100.0
1,000.0
10,000.0
SIZE CLASSES (µm)
[32] DENATURED WPC 80
[38] UNDENATURED (FEED) WPC 80

FIG. 2C

REPLACEMENT SHEET

5/10

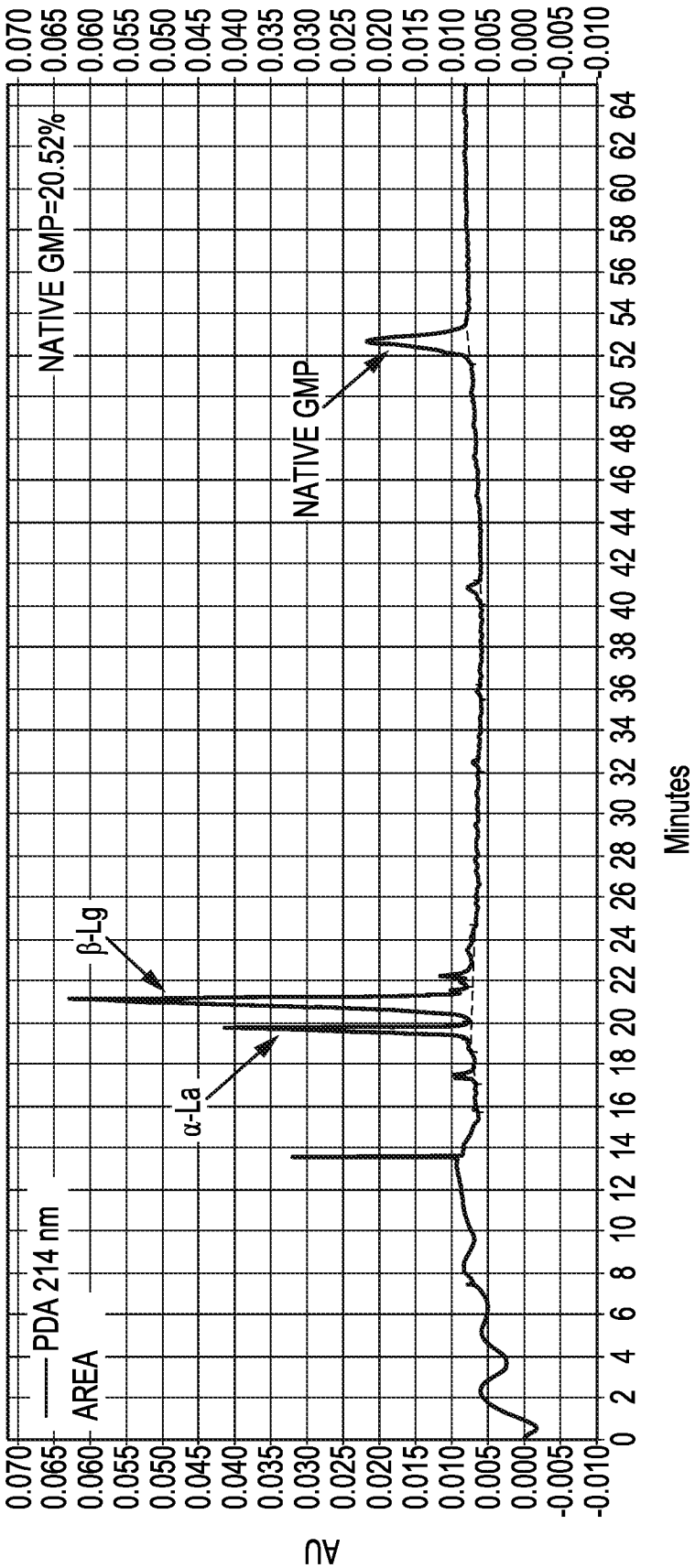


FIG. 3A

REPLACEMENT SHEET

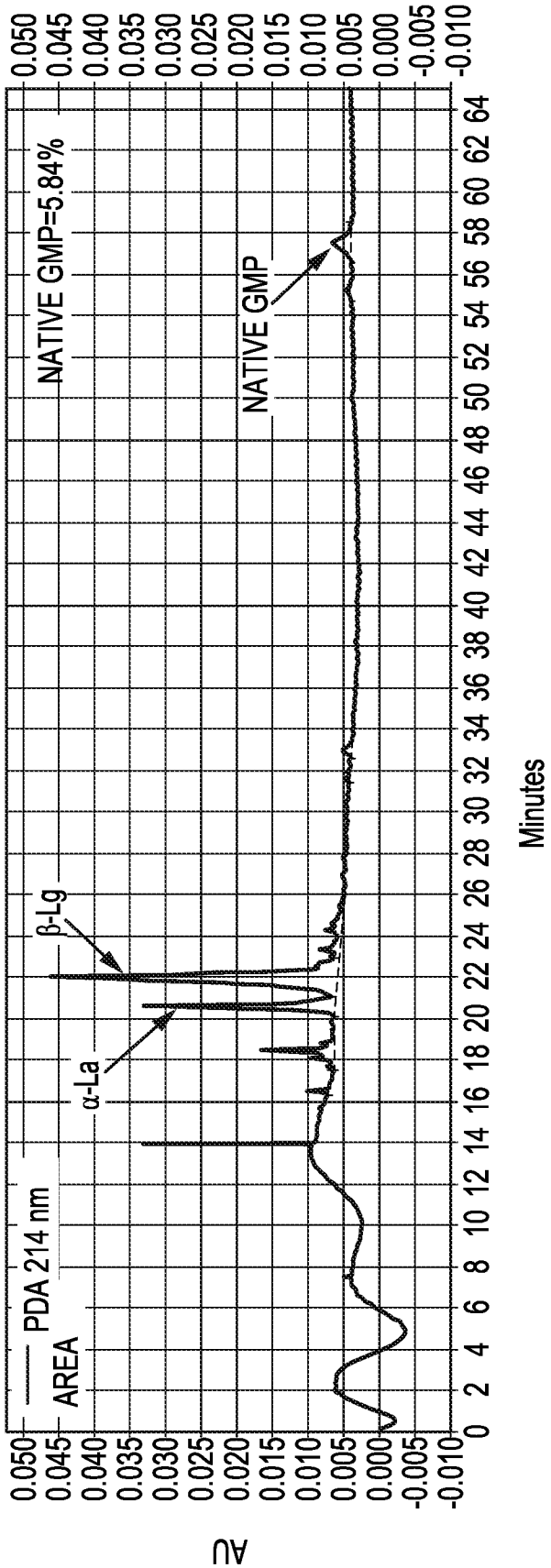


FIG. 3B

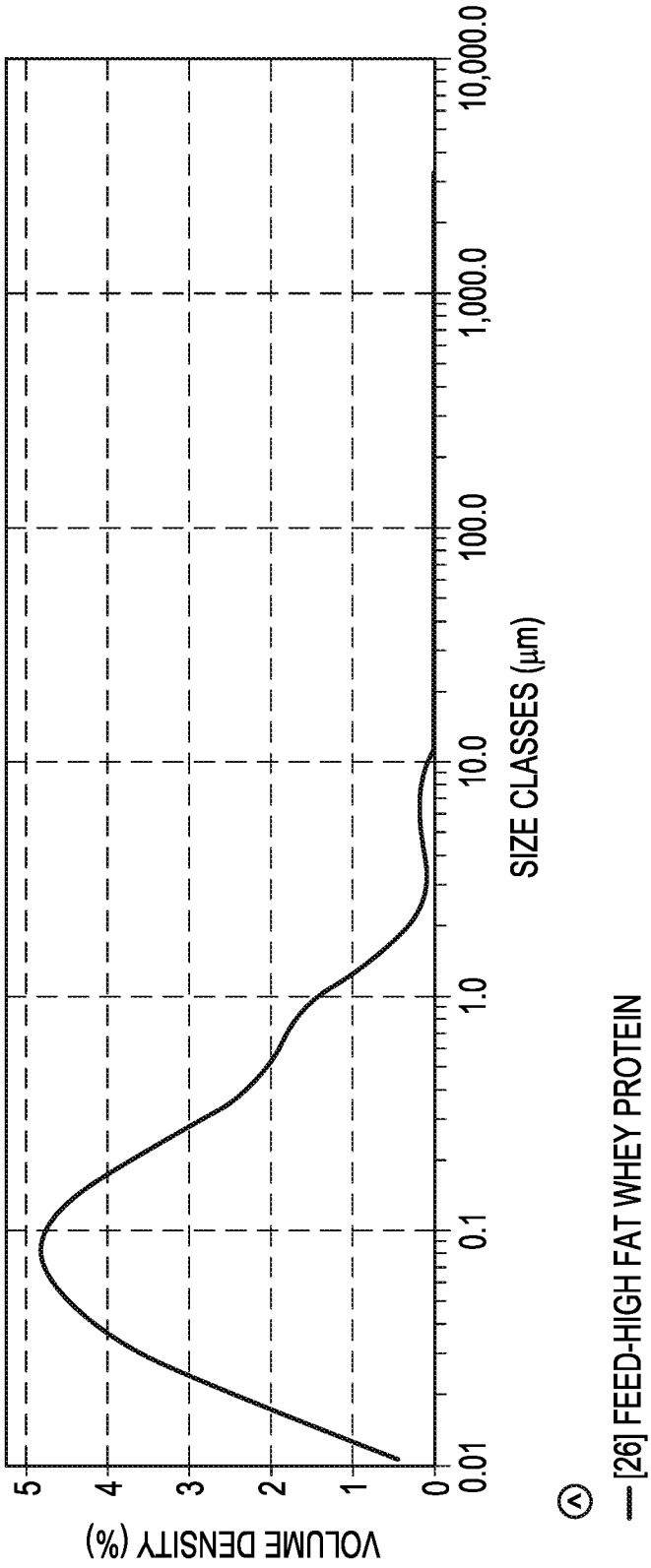

VOLUME DENSITY (%)
0
1
2
3
4
5
0.01
0.1
1.0
10.0
100.0
1,000.0
10,000.0
SIZE CLASSES (µm)
[26] FEED-HIGH FAT WHEY PROTEIN

FIG. 4A

REPLACEMENT SHEET

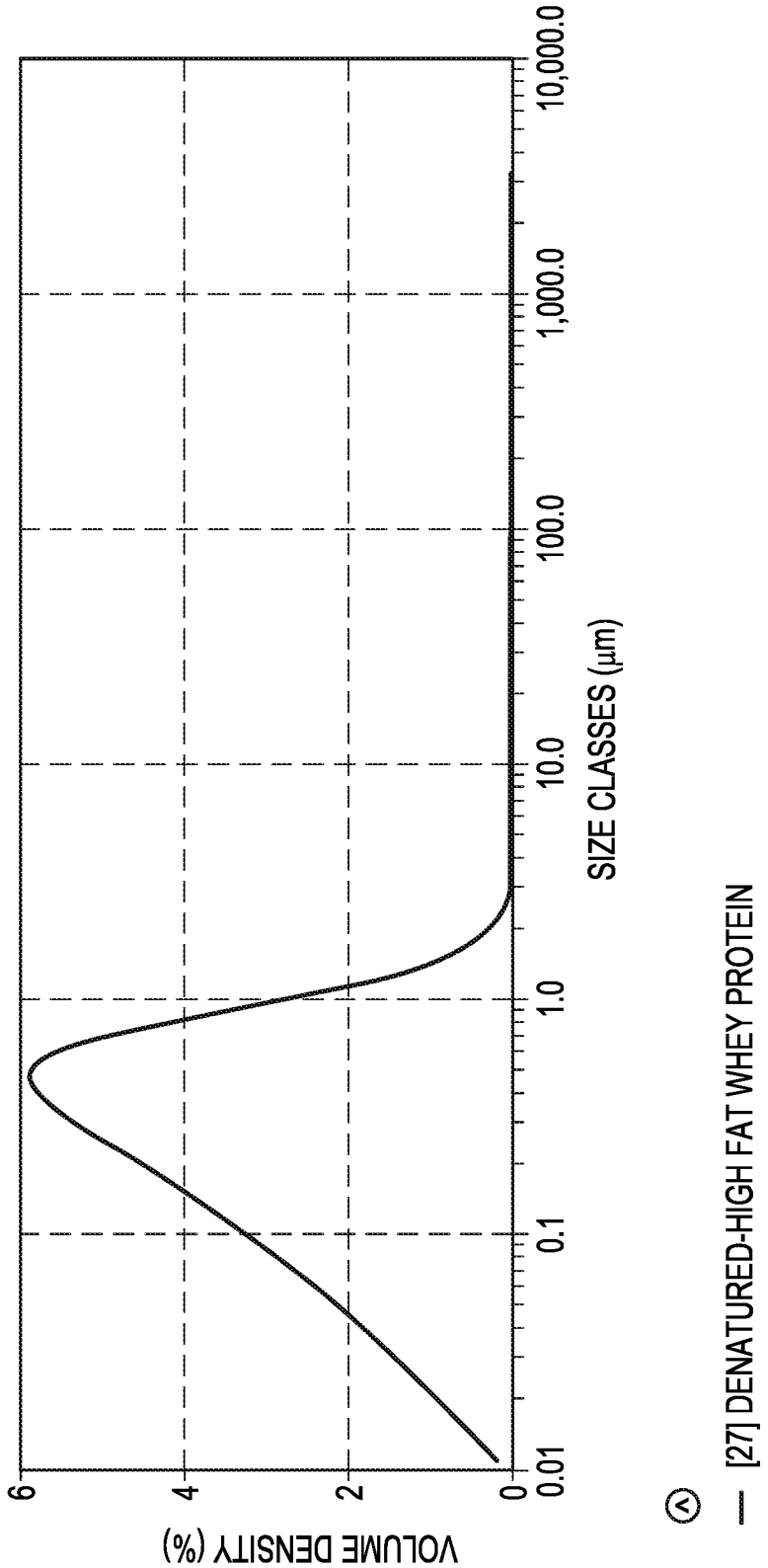


FIG. 4B

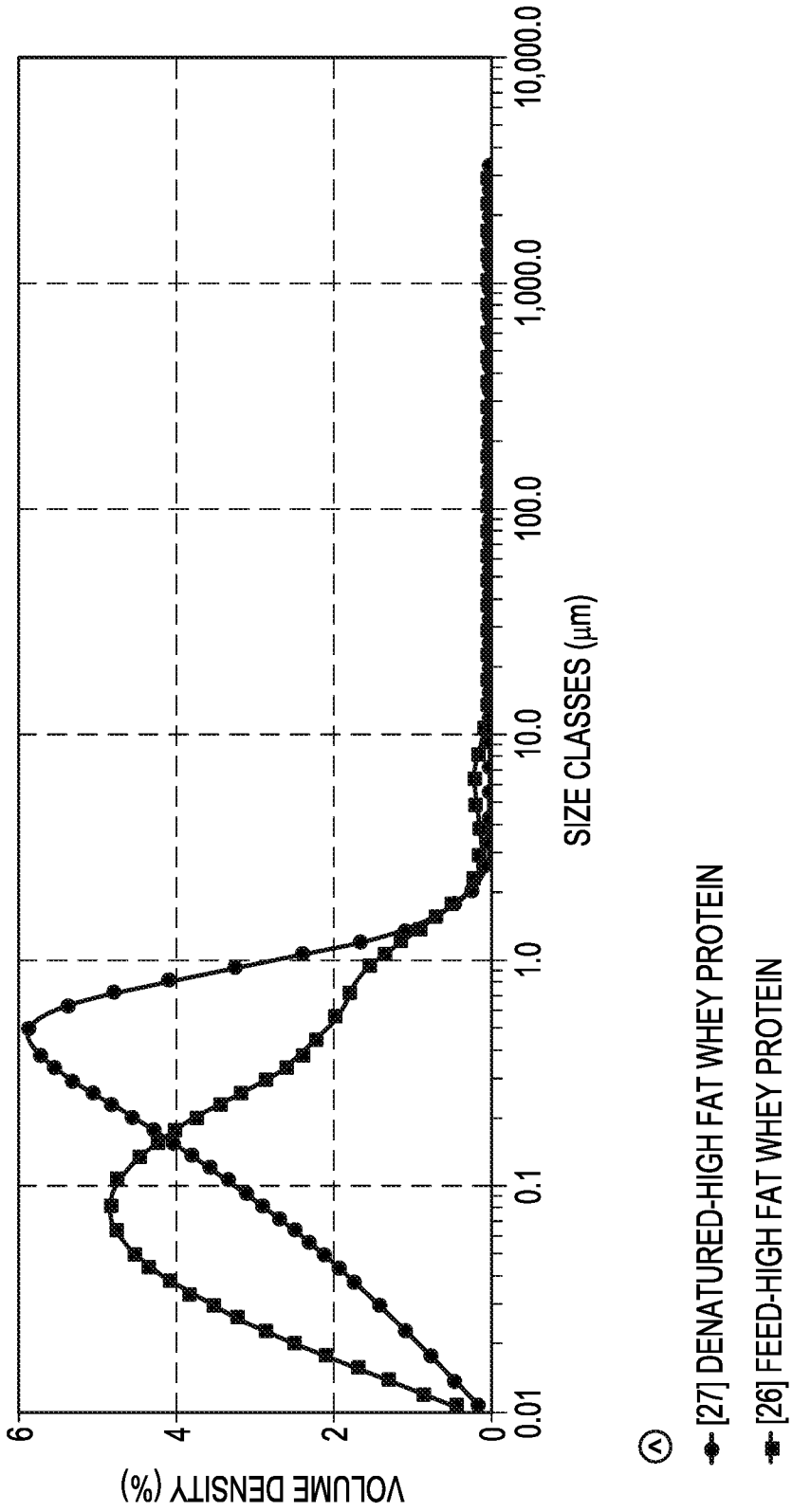

VOLUME DENSITY (%)
0
2
4
6
0.01
0.1
1.0
10.0
100.0
1,000.0
10,000.0
SIZE CLASSES (µm)
[27] DENATURED-HIGH FAT WHEY PROTEIN
[26] FEED-HIGH FAT WHEY PROTEIN

FIG. 4C

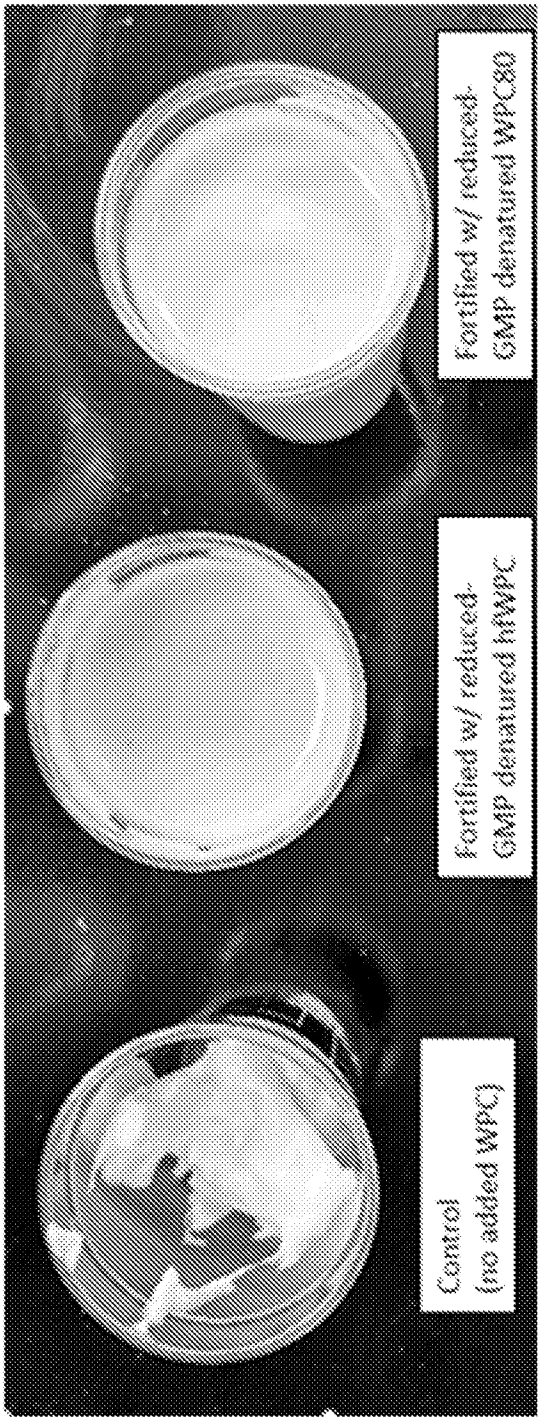

Control
(no added WPC)
Fortified w/ reduced-
GMP denatured hfWPC
Fortified w/ reduced-
GMP denatured WPC80

FIG. 5

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 18/097,003	Filing Date 01/13/2023	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $480 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	06/08/2023	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 3	= 0		x $480 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	SLIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/SHANDA E ROSS/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

SCORE Placeholder Sheet for IFW Content

Application Number: 18097003 Document Date: 06/08/2023

The presence of this form in the IFW record indicates that the following document type was received in electronic format on the date identified above. This content is stored in the SCORE database.

Since this was an electronic submission, there is no physical artifact folder, no artifact folder is recorded in PALM, and no paper documents or physical media exist. The TIFF images in the IFW record were created from the original documents that are stored in SCORE.

- Drawing

At the time of document entry (noted above):

- USPTO employees may access SCORE content via DAV or via the SCORE web page.
- External customers may access SCORE content via PAIR using the Supplemental Content tab.

Form Revision Date: March 1, 2019

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/097,003	01/13/2023	Paulos Tesfe	088835-1359421 (102300US)	1034

20350 7590 04/21/2023

Kilpatrick Townsend & Stockton LLP - West Coast
Mailstop: IP Docketing - 22
1100 Peachtree Street
Suite 2800
Atlanta, GA 30309

EXAMINER	
O HERN, BRENT T	

ART UNIT	PAPER NUMBER
1793	

NOTIFICATION DATE	DELIVERY MODE
04/21/2023	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

KTSDocketing2@kilpatrick.foundationip.com
ipefiling@kilpatricktownsend.com

Applicant-Initiated Interview Summary	**Application No.** 18/097,003	**Applicant(s)** Tesfe et al.		
	Examiner BRENT T O'HERN	**Art Unit** 1793	**AIA (First Inventor to File) Status** Yes	**Page** 1 of 1

All Participants (applicant, applicants representative, PTO personnel)	**Title**	**Type**
BRENT T O'HERN	Primary Examiner	Telephonic
Alexa Hunter	Attorney	

Date of Interview: 18 April 2023

Issues Discussed:

35 U.S.C. 112

Discussed possible amendments to overcome the rejections of record.

35 U.S.C. 103

Discussed possible distinction from prior art.

Objections

Corrections will me made.

Drawings

Corrections will me made.

/BRENT T O'HERN/ Primary Examiner, Art Unit 1793	

Applicant is reminded that a complete written statement as to the substance of the interview must be made of record in the application file. It is the applicants responsibility to provide the written statement, unless the interview was initiated by the Examiner and the Examiner has indicated that a written summary will be provided. See MPEP 713.04
Please further see:
MPEP 713.04
Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews, paragraph (b)
37 CFR § 1.2 Business to be transacted in writing

Applicant recordation instructions: The formal written reply to the last Office action must include the substance of the interview. (See MPEP section 713.04). If a reply to the last Office action has already been filed, applicant is given a non-extendable period of the longer of one month or thirty days from this interview date, or the mailing date of this interview summary form, whichever is later, to file a statement of the substance of the interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/097,003	01/13/2023	Paulos Tesfe	088835-1359421 (102300US)	1034

20350 7590 04/04/2023

Kilpatrick Townsend & Stockton LLP - West Coast
Mailstop: IP Docketing - 22
1100 Peachtree Street
Suite 2800
Atlanta, GA 30309

EXAMINER	
O'HERN, BRENT T	

ART UNIT	PAPER NUMBER
1793	

NOTIFICATION DATE	DELIVERY MODE
04/04/2023	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

KTSDocketing2@kilpatrick.foundationip.com
ipefiling@kilpatricktownsend.com

Office Action Summary	Application No. 18/097,003	Applicant(s) Tesfe et al.	
	Examiner BRENT T O'HERN	Art Unit 1793	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 24 March 2022.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-20 is/are pending in the application.

5a) Of the above claim(s) 8-13 is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-7 and 14-20 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☑ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 13 January 2023 is/are: a)☐ accepted or b)☑ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Election/Restrictions

2. Applicant's election without traverse of Group I in the reply filed on 3/24/2023 is acknowledged.

Drawings

3. The drawings are objected to because the text in FIGs 2A-4C is blurry. Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

4. Spaces are missing between numbers and units throughout the Specification.

5. The disclosure is objected to because of the following informalities: there are superscripts in the Table at para. 92, however, no definition of the superscripts.

6. Appropriate correction is required.

Claim Rejections - 35 USC § 112

7. The following is a quotation of 35 U.S.C. 112(b):

> (b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

> The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:
> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

8. Claims 1-7 and 14-20 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor (or for applications subject to pre-AIA 35 U.S.C. 112, the applicant), regards as the invention.

9. The abbreviation “GMP” in Claim 1, line 3 is vague and indefinite as it is unclear what it is an abbreviation for. Applicant is advised to set forth the unabbreviated text in the first instance.

10. The phrase “7.0% wt.% fat” in Claim 7, line 2 is vague and indefinite at it is unclear why there are two “%”.

11. The abbreviation “GMP” in Claim 14, line 3 is vague and indefinite as it is unclear what it is an abbreviation for. Applicant is advised to set forth the unabbreviated text in the first instance.

12. Claim 15 recites the limitation "the whey protein" in lines 1-2. There is insufficient antecedent basis for this limitation in the claim. Applicant is advised to consider earlier stating “whey protein”.

13. Claim 16 recites the limitation "the whey protein" in lines 1-2. There is insufficient antecedent basis for this limitation in the claim.

14. Claim 16 recites the limitation "of protein" in line 2. There is insufficient antecedent basis for this limitation in the claim.

15. Claim 17 recites the limitation "the whey protein" in lines 1-2. There is insufficient antecedent basis for this limitation in the claim. Applicant is advised to consider earlier stating “whey protein”.

16. Clarification and/or correction required.

Claim Rejections - 35 USC § 103

17. The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

18. Claim(s) 1-7 is/are rejected under 35 U.S.C. 103 as being unpatentable over Tikanmaki et al. (US 2018/0242608).

19. Regarding Claim 1, Tikanmaki (‘608) teaches a denatured whey protein composition *(See paras. 16-18, 40.)* comprising: at least 60 wt.% protein on a dry weight basis *(See para. 17, 60 wt.%.)*; less than 8 wt.% native GMP and greater than 2 wt.% enzymatically hydrolyzed glycomacropeptide (GMP) relative to the total weight of the protein *(See para. 44, claim 16.)*; a proteolysis index of at least 8.0 wt.%; and greater than 50 wt.% denatured whey proteins relative to the total weight of the protein *(See paras. 16, 21 and claim 5.)*, however, fails to expressly disclose a proteolysis index of at least 8.0 wt.%.

20. It would have been foreseeable and obvious to a person having ordinary skill in the art at the time of filing since the type and amount of protein as taught by Tikanmaki (‘608) in the same as claimed it would also have the same proteolysis index.

21. Regarding Claim 2, Tikanmaki (‘608) teaches wherein the denatured whey proteins comprise denatured enzymatically-hydrolyzed cheese whey proteins *(See para. 18.)*.

22. Regarding Claim 3, Tikanmaki (‘608) teaches wherein the native GMP is less than or about 7 wt.% relative to the total weight of the protein *(See para. 44 and Claim 6.)*.

23. Regarding Claim 4, Tikanmaki ('608) teaches wherein the 2 denatured whey proteins are characterized by a D50 particle size distribution value of less than or about 4.5 μm *(See paras. 30-36 and claims 1-3.).*

24. Regarding Claim 5, Tikanmaki ('608) teaches wherein the denatured whey proteins are further characterized by a D10 particle size distribution value of less than or about 2.5 μm *(See paras. 30-36 and claims 1-3.).*

25. Regarding Claim 6, Tikanmaki ('608) teaches wherein the denatured whey proteins are further characterized by a D90 particle size distribution value of less than or about 8.0 μm *(See paras. 30-36 and claims 1-3.).*

26. Regarding Claim 7, Tikanmaki ('608) teaches further comprising at most 7.0% wt. fat on a dry weight basis *(See para. 24, 0-3.5%.).*

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to BRENT T O'HERN whose telephone number is (571)272-6385. The examiner can normally be reached M-Th 5:00 am - 3:30 pm.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Emily Le can be reached on 571-272-0903. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit

https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/BRENT T O'HERN/
Primary Examiner, Art Unit 1793
March 24, 2023

Notice of References Cited	Application/Control No. 18/097,003	Applicant(s)/Patent Under Reexamination Tesfe et al.	
	Examiner BRENT T O'HERN	Art Unit 1793	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20180242608-A1	08-2018	TIKANMÄKI; Reetta	A61K35/20	1/1
	B					
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/097,003	Tesfe et al.
	Examiner	Art Unit
	BRENT T O'HERN	1793

CPC - Searched*		
Symbol	Date	Examiner
A23J3/08	03/24/2023	/BTO/

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner
426	657	03/24/2023	/BTO/

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
palm/search assignor (inventor)/assignee search	03/24/2023	/BTO/
see search notes	03/24/2023	/BTO/

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

/BRENT T O'HERN/ Primary Examiner, Art Unit 1793	

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/097,003	Tesfe et al.
	Examiner	Art Unit
	BRENT T O'HERN	1793

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	03/05/2023	03/24/2023							
	1	÷	✓							
	2	÷	✓							
	3	÷	✓							
	4	÷	✓							
	5	÷	✓							
	6	÷	✓							
	7	÷	✓							
	8	÷	N							
	9	÷	N							
	10	÷	N							
	11	÷	N							
	12	÷	N							
	13	÷	N							
	14	÷	✓							
	15	÷	✓							
	16	÷	✓							
	17	÷	✓							
	18	÷	✓							
	19	÷	✓							
	20	÷	✓							

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	9178	A23J3/08	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/05 12:02 PM
L2	2537	426/657	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/05 12:02 PM
L3	11484	L1 L2	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/05 12:02 PM
L4	225	Merrill-Richard-K.IN.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU,	OR	ON	ON	2023/03/05 12:03 PM

			CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L5	6	Maier-Bradley.IN.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/05 12:04 PM
L6	292	Li-Jiancai.IN.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/05 12:04 PM
L7	3	Tesfe-Paulos.IN.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA,	OR	ON	ON	2023/03/05 12:04 PM

			VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L8	103	"Leprino Foods Company"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/05 12:04 PM
L9	501	L4 L5 L6 L7	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/05 12:05 PM
L10	56	denatured.CLM. AND protein.CLM. AND whey.CLM. AND filtering.CLM.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/05 12:07 PM
L11	13	denatured.CLM. AND protein.CLM. AND whey.CLM. AND filtering.CLM. AND cheese.CLM.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB,	OR	ON	ON	2023/03/05 12:07 PM

			HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L12	5	denatured.CLM. AND protein.CLM. AND whey.CLM. AND filtering.CLM. AND cheese.CLM.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/03/05 12:07 PM
L13	5	("0000002" OR "10709146" OR "10834934" OR "5968586" OR "9578890").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2023/03/05 12:23 PM
L14	4	"11206846".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/11 02:25 PM
L15	4	"2002045522".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/11 02:26 PM
L16	0	WO-2002045522-$.did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU,	OR	ON	ON	2023/03/11 02:27 PM

			CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L17	0	WO-20020045522-$.did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/11 02:27 PM
L18	0	WO-200245522-$.did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/11 02:27 PM
L19	0	WO-200200045522-$.did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA,	OR	ON	ON	2023/03/11 02:27 PM

			VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L20	0	WO-200245522-$.did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/11 02:28 PM
L21	3	WO-0245522-$.did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/11 02:28 PM
L22	4	WO-2006089921-$.did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/11 02:29 PM
L23	3	WO-2015059245-$.did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB,	OR	ON	ON	2023/03/11 02:30 PM

			HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L24	5216	denatured WITH whey WITH protein	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:11 PM
L25	63	denatured WITH whey WITH protein SAME glycomacropeptide	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:12 PM
L26	39	(Artificial Intelligence) Similar to: 18/097,003 with 0 CPC Selections and 0 Text Selections Text: (JP-6612745-B2 OR JP-2016533726-A OR JP-2016533725-A OR JP-6525213-B2 OR EP-3720296-B1 OR US-20210007376-A1 OR CN-113784622-A OR EP-0485663-B1 OR WO-2019110668-A1	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN))	OR	ON	ON	2023/03/12 02:12 PM

		OR EP-3720296-A1 OR EP-0485663-A1 OR BR-112016008894-B1 OR IE-50403-B1 OR CN-112137000-A OR US-20220142191-A1 OR EP-3937648-A1 OR WO-2020187842-A1 OR AU-2020243017-A1 OR JP-4637449-B2 OR US-20180317513-A1 OR WO-2018204261-A1 OR CA-2927685-A1 OR CA-2927685-C OR US-20200397020-A1 OR CA-2137913-A1 OR US-20180343890-A1 OR US-20120029165-A1 OR EP-2595494-A1 OR WO-2012012237-A1 OR CA-2804752-A1 OR DK-2595494-T3 OR EP-2595494-B1 OR US-10638775-B2 OR CA-2927686-C OR DK-3071047-T3 OR NZ-508746-A OR US-10834934-B2 OR WO-0048473-A1 OR US-11206846-B2 OR EP-1154700-A1 OR EA-037214-B1 OR EA-035744-B1 OR US-20140287095-A1 OR WO-2014153381-A1 OR WO-2015059248-A1 OR EP-3060065-A1 OR CA-2927686-A1 OR DE-19950240-A1 OR US-20160262424-A1 OR EP-0644720-A1).did.					
L27	4	L26 AND denatured WITH whey WITH protein SAME glycomacropeptide	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:12 PM

L28	6	L26 AND denatured WITH whey WITH protein AND glycomacropeptide	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:13 PM
L29	6	L26 AND denatured AND whey AND glycomacropeptide	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:14 PM
L30	3	L9 AND denatured AND whey AND glycomacropeptide	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:14 PM
L31	0	L8 AND denatured AND whey AND glycomacropeptide	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL,	OR	ON	ON	2023/03/12 02:15 PM

			NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L32	3	Leprino AND denatured AND whey AND glycomacropeptide	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:15 PM
L33	3	Leprino AND denatured AND whey AND (glycomacropeptide OR GMP)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:16 PM
L34	25	((US-20120219665-A1 OR US-20010024677-A1 OR US-20040037905-A1 OR US-20210007376-A1 OR US-20210329949-A1 OR US-20230002173-A1).did. AND PGPB.dbnm.) OR ((US-4105803-A OR US-9462817-B2 OR US-10834934-B2 OR US-10709146-B2 OR US-9578890-B2 OR US-5968586-A OR US-0000002-A OR US-11206846-B2).did. AND USPT.dbnm.) OR	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:16 PM

		((WO-0245522-A1 OR WO-2006089921-A1 OR WO-2015059245-A1 OR WO-2019110668-A1 OR EP-3720296-B1 OR NZ-508746-A OR CN-113784622-A OR WO-2021222013-A1 OR KR-20230008135-A OR CN-114794489-A).did. AND FTDB.dbnm.) OR ((CN-115235530-A).did. AND FPRS.dbnm.)					
L35	11	L34 AND denatured AND whey AND (glycomacropeptide OR GMP)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:16 PM
L36	9	denatured.CLM. AND whey.CLM. AND (glycomacropeptide OR GMP).CLM. AND protein.CLM.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:28 PM
L37	43	denatured WITH whey AND (glycomacropeptide OR GMP).CLM. AND protein.CLM.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE,	OR	ON	ON	2023/03/12 02:29 PM

			SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L38	41	denatured WITH whey AND (glycomacropeptide OR GMP).CLM. AND protein.CLM. AND (cheese OR cheesemaking OR "cheese making")	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:32 PM
L39	41	denatured WITH whey AND (glycomacropeptide OR GMP).CLM. AND protein.CLM. AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:32 PM
L40	5	denatured WITH whey AND (glycomacropeptide OR GMP).CLM. AND protein.CLM. AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) WITH (glycomacropeptide OR GMP)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/12 02:33 PM
L41	8	(denatured OR denat$) WITH whey AND (glycomacropeptide OR GMP).CLM. AND	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU,	OR	ON	ON	2023/03/12 02:43 PM

		protein.CLM. AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) WITH (glycomacropeptide OR GMP)	CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L42	29	((US-20120219665-A1 OR US-20010024677-A1 OR US-20040037905-A1 OR US-20210007376-A1 OR US-20210329949-A1 OR US-20140287095-A1 OR US-20230002173-A1).did. AND PGPB.dbnm.) OR ((US-4105803-A OR US-9462817-B2 OR US-10834934-B2 OR US-10709146-B2 OR US-9578890-B2 OR US-5968586-A OR US-0000002-A OR US-11206846-B2).did. AND USPT.dbnm.) OR ((WO-0245522-A1 OR WO-2006089921-A1 OR WO-2015059245-A1 OR WO-2019110668-A1 OR EP-3720296-B1 OR NZ-508746-A OR CN-113784622-A OR WO-2021222013-A1 OR KR-20230008135-A OR JP-6513629-B2 OR CA-2656174-A1 OR WO-2014153381-A1 OR CN-114794489-A).did. AND FTDB.dbnm.) OR ((CN-115235530-A).did. AND FPRS.dbnm.)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:07 AM
L43	3	"JP 6513629 B2"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV,	OR	ON	ON	2023/03/13 10:08 AM

			MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L44	30	((US-20120219665-A1 OR US-20010024677-A1 OR US-20040037905-A1 OR US-20210007376-A1 OR US-20210329949-A1 OR US-20140287095-A1 OR US-20230002173-A1).did. AND PGPB.dbnm.) OR ((US-4105803-A OR US-9462817-B2 OR US-10834934-B2 OR US-10709146-B2 OR US-9578890-B2 OR US-5968586-A OR US-0000002-A OR US-11206846-B2).did. AND USPT.dbnm.) OR ((WO-0245522-A1 OR WO-2006089921-A1 OR WO-2015059245-A1 OR WO-2019110668-A1 OR EP-3720296-B1 OR NZ-508746-A OR CN-113784622-A OR WO-2021222013-A1 OR KR-20230008135-A OR JP-6513629-B2 OR CA-2656174-A1 OR WO-2014153381-A1 OR CN-114794489-A).did. AND FTDB.dbnm.) OR ((WO-2012110705-A1).did. AND DWPI.dbnm.) OR ((CN-115235530-A).did. AND FPRS.dbnm.)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:09 AM
L45	16	L44 AND (denatured OR denat$) AND whey AND (glycomacropeptide OR GMP) AND protein AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL,	OR	ON	ON	2023/03/13 10:10 AM

		enzymatically) AND (reduce OR reduced OR reduc$) AND (glycomacropeptide OR GMP)	NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L46	19	L44 AND (glycomacropeptide OR GMP)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:11 AM
L47	20	"WO 2012110705"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:12 AM
L48	31	((US-20120219665-A1 OR US-20010024677-A1 OR US-20040037905-A1 OR US-20210007376-A1 OR US-20210329949-A1 OR US-20140287095-A1 OR US-20230002173-A1).did. AND PGPB.dbnm.) OR ((US-4105803-A OR US-9462817-B2 OR US-10834934-B2 OR US-10709146-B2 OR US-9578890-B2 OR US-5968586-A OR US-0000002-A OR US-	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:13 AM

		11206846-B2).did. AND USPT.dbnm.) OR ((WO-0245522-A1 OR WO-2006089921-A1 OR WO-2015059245-A1 OR WO-2019110668-A1 OR EP-3720296-B1 OR NZ-508746-A OR CN-113784622-A OR WO-2021222013-A1 OR KR-20230008135-A OR JP-6513629-B2 OR CA-2656174-A1 OR WO-2014153381-A1 OR WO-2012110705-A1 OR CN-114794489-A).did. AND FTDB.dbnm.) OR ((WO-2012110705-A1).did. AND DWPI.dbnm.) OR ((CN-115235530-A).did. AND FPRS.dbnm.)					
L49	17	L48 AND (denatured OR denat$) AND whey AND (glycomacropeptide OR GMP) AND protein AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) AND (glycomacropeptide OR GMP)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:13 AM
L50	17	L48 AND (denatured OR denat$) AND whey AND (glycomacropeptide OR GMP OR glycomacro$) AND protein AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) AND (glycomacropeptide OR GMP)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:17 AM
L51	7	L48 AND (denatured	(US-PGPUB; USPAT;	OR	ON	ON	2023/03/13

		OR denat$) AND whey AND (glycomacropeptide OR GMP OR glycomacro$) AND protein AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) AND (glycomacropeptide OR GMP) AND "off-tastes"	USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				10:20 AM
L52	3	"US 20180242608"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:23 AM
L53	33	((US-20120219665-A1 OR US-20010024677-A1 OR US-20040037905-A1 OR US-20210007376-A1 OR US-20210329949-A1 OR US-20140287095-A1 OR US-20180242608-A1 OR US-20230002173-A1).did. AND PGPB.dbnm.) OR ((US-4105803-A OR US-9462817-B2 OR US-10834934-B2 OR US-10709146-B2 OR US-9578890-B2 OR US-5968586-A OR US-0000002-A OR US-11206846-B2 OR US-10993454-B2).did. AND USPT.dbnm.) OR ((WO-0245522-A1 OR WO-2006089921-A1 OR WO-2015059245-A1 OR WO-	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:24 AM

		2019110668-A1 OR EP-3720296-B1 OR NZ-508746-A OR CN-113784622-A OR WO-2021222013-A1 OR KR-20230008135-A OR JP-6513629-B2 OR CA-2656174-A1 OR WO-2014153381-A1 OR WO-2012110705-A1 OR CN-114794489-A).did. AND FTDB.dbnm.) OR ((WO-2012110705-A1).did. AND DWPI.dbnm.) OR ((CN-115235530-A).did. AND FPRS.dbnm.)					
L54	9	L53 AND (denatured OR denat$) AND whey AND (glycomacropeptide OR GMP OR glycomacro$) AND protein AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) AND (glycomacropeptide OR GMP) AND "off-tastes"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 10:24 AM
L55	10	L53 AND (denatured OR denat$ OR "heat treatment") AND whey AND (glycomacropeptide OR GMP OR glycomacro$) AND protein AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) AND (glycomacropeptide OR GMP) AND "off-tastes"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/13 12:58 PM
L56	33	((US-20120219665-A1 OR US-20010024677-A1 OR US-20040037905-A1 OR US-20210007376-A1 OR US-20210329949-A1 OR US-	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS,	OR	ON	ON	2023/03/14 09:50 AM

		20140287095-A1 OR US-20180242608-A1 OR US-20230002173-A1).did. AND PGPB.dbnm.) OR ((US-4105803-A OR US-9462817-B2 OR US-10834934-B2 OR US-10709146-B2 OR US-9578890-B2 OR US-5968586-A OR US-0000002-A OR US-11206846-B2 OR US-10993454-B2).did. AND USPT.dbnm.) OR ((WO-0245522-A1 OR WO-2006089921-A1 OR WO-2015059245-A1 OR WO-2019110668-A1 OR EP-3720296-B1 OR NZ-508746-A OR CN-113784622-A OR WO-2021222013-A1 OR KR-20230008135-A OR JP-6513629-B2 OR CA-2656174-A1 OR WO-2014153381-A1 OR WO-2012110705-A1 OR CN-114794489-A).did. AND FTDB.dbnm.) OR ((WO-2012110705-A1).did. AND DWPI.dbnm.) OR ((CN-115235530-A).did. AND FPRS.dbnm.)	IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L57	22	L3 AND (denatured OR denat$ OR "heat treatment") AND whey AND (glycomacropeptide OR GMP OR glycomacro$) AND protein AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) AND (glycomacropeptide OR GMP) AND "off-tastes"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/03/24 05:21 PM
L58	0	L9 AND (denatured OR denat$ OR "heat treatment") AND whey AND	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU,	OR	ON	ON	2023/03/24 05:22 PM

		(glycomacropeptide OR GMP OR glycomacro$) AND protein AND (cheese OR cheesemaking OR "cheese making") AND (enzyme OR enzymatically) AND (reduce OR reduced OR reduc$) AND (glycomacropeptide OR GMP) AND "off-tastes"	CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				

PE2E SEARCH - Search History (Interference)

There are no Interference searches to show.

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Field

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	
	First Named Inventor	Paulos Tesfe
	Art Unit	
	Examiner Name	
	Attorney Docket Number	088835-1359421-102300US

U.S. PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	1.	5968586		10-19-1999	Etzel	
	2.	9578890	B2	02-28-2017	Li et al.	
	3.	10709146	B2	07-14-2020	Mikkelsen et al.	
	4.	10834934	B2	11-17-2020	Mikkelsen et al.	
	5.	11206846	B2	12-28-2021	Li et al.	

U.S. PATENT APPLICATION PUBLICATIONS

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear

FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear	T[5]
	6.	2002/045522	WO	A1	06-13-2002	Tatua Co-Operative Dairy Company Limited		
	7.	2006/089921	WO	A1	08-31-2006	DSM IP Assets B.V.		
	8.	2015/059245	WO	A1	04-30-2015	Arla Foods Amba		

NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.T.O/

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Field

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	
	First Named Inventor	Paulos Tesfe
	Art Unit	
	Examiner Name	
	Attorney Docket Number	088835-1359421-102300US

EXAMINER SIGNATURE			
Examiner Signature	/BRENT T O'HERN/	Date Considered	03/11/2023

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document.
[4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.T.O/

I hereby certify that this correspondence is being filed with the United States Patent and Trademark Office via the Office electronic filing system on March 24, 2023.

KILPATRICK TOWNSEND & STOCKTON LLP

By: /Michele Connelly/
Michele Connelly

PATENT
Attorney Docket No.: 088835-1359421-102300US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Paulos Tesfe et al. Application No.: 18/097,003 Filed: January 13, 2023 For: DENATURED MILK PROTEINS AND METHODS OF MAKING THEM Customer No.: 20350	Confirmation No.: 1034 Examiner: Brent T O'Hern Technology Center/Art Unit: 1793 **RESPONSE TO RESTRICTION REQUIREMENT**

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Examiner:

In response to the Restriction Requirement mailed March 16, 2023, in the above-referenced application, please consider the following remarks:

In the Claims are reflected in the listing of claims, which begins on page 2 of this paper.

Remarks begin on page 6 of this paper.

IN THE CLAIMS

This listing of claims will replace all prior versions, and listings of claims in the application.

1. (Original) A denatured whey protein composition comprising:

at least 60 wt.% protein on a dry weight basis;

less than 8 wt.% native GMP and greater than 2 wt.% enzymatically hydrolyzed glycomacropeptide (GMP) relative to the total weight of the protein;

a proteolysis index of at least 8.0 wt.%; and

greater than 50 wt.% denatured whey proteins relative to the total weight of the protein.

2. (Original) The denatured whey protein composition of claim 1, wherein the denatured whey proteins comprise denatured enzymatically-hydrolyzed cheese whey proteins.

3. (Original) The denatured whey protein composition of claim 2, wherein the native GMP is less than or about 7 wt.% relative to the total weight of the protein.

4. (Original) The denatured whey protein composition of claim 1, wherein the denatured whey proteins are characterized by a D50 particle size distribution value of less than or about 4.5 μm.

5. (Original) The denatured whey protein composition of claim 4, wherein the denatured whey proteins are further characterized by a D10 particle size distribution value of less than or about 2.5 μm.

6. (Original) The denatured whey protein composition of claim 4, wherein the denatured whey proteins are further characterized by a D90 particle size distribution value of less than or about 8.0 μm.

7. (Original) The denatured whey protein composition of claim 1, further comprising at most 7.0% wt.% fat on a dry weight basis.

8. (Withdrawn) A method of making a denatured whey protein composition, the methodcomprising:

filtering cheese whey from enzymatically coagulated milk into a cheese whey retentate and a permeate; and

reducing native glycomacropeptides in the cheese whey retentate to form a reduced-GMP cheese whey retentate composition; and

heating the reduced-GMP cheese whey retentate composition to form the denatured whey protein composition,

wherein the denatured whey protein composition is characterized by

at least 60 wt.% protein on a dry weight basis;

less than 11 wt.% native GMP relative to the total weight of the protein;

a proteolysis index of at least 8.0 wt.% or a beta-lactoglobulin to alpha lactalbumin ratio of greater than 5.00; and

greater than 50 wt.% denatured whey proteins relative to the total weight of the protein.

9. (Withdrawn) The method of claim 8, wherein the reduction of GMP includes combining the cheese whey retentate with one or more enzymes that selectively hydrolyze GMP in the cheese whey retentate to form the reduced-GMP cheese whey retentate composition, the one or more enzymes that selectively hydrolyze GMP in the cheese whey retentate comprises at least one alkaline serine protease enzyme and at least one neutral protease enzyme or wherein the reduction of GMP occurs through the microfiltration of the cheese whey retentate.

10. (Withdrawn) The method of claim 8, wherein the heating of the reduced-GMP cheese whey retentate composition also inactivates the one or more enzymes that selectively hydrolyze the GMP in the cheese whey retentate.

11. (Withdrawn) The method of claim 8, wherein the reduced-GMP cheese whey retentate composition is heated to a temperature of greater than or about 160°F.

12. (Withdrawn) The method of claim 8, wherein the heating of the reduced-GMP cheese whey retentate composition further comprises exposing the reduced-GMP cheese whey retentate composition to high shear conditions.

13. (Withdrawn) The method of claim 8, wherein the denatured whey protein composition is characterized by a weight ratio of native GMP to total whey protein of less than or about 0.15, and/or wherein the denatured whey protein composition is characterized by less than or about 11 wt.% GMP relative to the total weight of the protein.

14. (Original) A denatured whey protein composition comprising:
at least 60 wt.% protein on a dry weight basis;
less than 11 wt.% native GMP relative to total weight of the protein;
greater than 7 wt.% fat on a dry basis;
a beta-lactoglobulin to alpha lactalbumin ratio of greater than 5.00; and
greater than 50 wt.% denatured whey proteins relative to the total weight of the protein.

15. (Original) The denatured whey protein composition of claim 14, wherein the whey protein prior to denaturation already includes at least 30 wt.% denatured protein.

16. (Original) The denatured whey protein composition of claim 14, wherein the whey protein contains at least 60 wt.% beta lactoglobulin relative to the total weight of protein and/or wherein the whey protein contains at most 12 wt.% alpha lactalbumin relative to the total weight of protein.

17. (Original) The denatured whey protein composition of claim 14, wherein the whey protein comprises a weight ratio of beta lactoglobulin to alpha lactalbumin of greater than or about 5.

18. (Original) The denatured whey protein composition of claim 14, wherein the denatured whey proteins are characterized by a D50 particle size distribution value of less than or about 0.3 μm.

19. (Original) The denatured whey protein composition of claim 14, wherein the denatured whey proteins are further characterized by a D10 particle size distribution value of less than or about 0.1 μm.

20. (Original) The denatured whey protein composition of claim 14, wherein the denatured whey proteins are further characterized by a D90 particle size distribution value of less than or about 1.0 μm.

REMARKS/ARGUMENTS

Claims 1-20 will be pending in this application, with claims 8-13 withdrawn. No claims have been amended or canceled. No new matter is added.

The Examiner has restricted the claims into the following Groups:

Group I: Claims 1-7 and 14-20, drawn to a denatured whey protein composition; and

Group II: Claims 8-13, drawn to a method of making a denatured whey protein composition.

In response to the restriction requirement, but without conceding the propriety thereof, Applicant initially elects to prosecute Group I, claims 1-7 and 14-20, without traverse, and without prejudice to the presentation of the claims of Group II in later applications. In addition, Applicant respectfully requests rejoinder of the withdrawn method claims at such a time as the elected claims are found in condition for allowance.

CONCLUSION

In view of the foregoing, Applicant believes all claims now pending in this application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

Except for the issue fees payable under 37 C.F.R. § 1.18, the Director is authorized to charge any additional fees during pendency of this application, including any required extension of time fees, or credit any overpayment to Deposit Account Number 20-1430. This paragraph is intended to be a constructive petition for extension of time in accordance with 37 C.F.R. § 1.136(a)(3).

If the Examiner believes a telephone conference would expedite prosecution of this application, please contact the undersigned at 303-607-3218 or ajhunter@kilpatricktownsend.com.

Respectfully submitted,

/alexa.j.hunter/
Alexa J. Hunter
Registration No. 74,538

KILPATRICK TOWNSEND & STOCKTON LLP

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/097,003	**03/24/2023 01:12:57 PM ET**	**088835-1359421 (102300US)**

Title of Invention

DENATURED MILK PROTEINS AND METHODS OF MAKING THEM

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	1034	FILED BY	Michele Connelly
PATENT CENTER #	61801807	FILING DATE	01/13/2023
CUSTOMER #	20350	FIRST NAMED INVENTOR	Paulos Tesfe
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Alexa Hunter

Documents

TOTAL DOCUMENTS: 3

DOCUMENT		PAGES	DESCRIPTION	SIZE (KB)
ToFile_Response_to_RR_of_03-16-2023_088835-1359421-102300US.pdf		7	-	89 KB
ToFile_Response_to_RR_of_03-16-2023_088835-1359421-102300US-ELC..pdf	(1-1)	1	Response to Election / Restriction Filed	76 KB
ToFile_Response_to_RR_of_03-16-2023_088835-1359421-102300US-CLM.pdf	(2-5)	4	Claims	81 KB
ToFile_Response_to_RR_of	(6-7)	2	Applicant Arguments/Remarks	77 KB

_03-16-2023_088835-1359421-102300US-REM.pdf	Made in an Amendment

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
ToFile_Response_to_RR_of_03-16-2023_088835-1359421-102300US.pdf	8CC7CBA8EAF95DE9F64291FC57479BEDA919D719468FB8D7925EE8B126E253B933BC8BEE8B23AE35B311034CBB6E0EECAFADAE8DCB8B47EBCC04086CAE6148AD
ToFile_Response_to_RR_of_03-16-2023_088835-1359421-102300US-ELC..pdf	637816852FB379DF89DFA78D428DBCE3CAF8DC7E0E19005B791EDFD3A05760B27DD8157720C96134B6AB9F810055CE1973011E83BBEF3FCEE12CCA2B55976108
ToFile_Response_to_RR_of_03-16-2023_088835-1359421-102300US-CLM.pdf	22B642979CB71932FE4315ECF785D6D03CE800B921F9C0BC3E1266F91ECA5B1229001A62108F4D09E5006E7CEBA48997300AA5CBE1A43745FE2AB6CFC0DDC191
ToFile_Response_to_RR_of_03-16-2023_088835-1359421-102300US-REM.pdf	B62503FD08D6B464DA40A496CE82986C3DDBB19CFDDB0AB1A3C13141124C68B831AD11B2F92E4613580B4157F2A2311F35742DC11C73BFFBBA8F800C0A2EF82B

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 18/097,003	Filing Date 01/13/2023	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $480 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	03/24/2023	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 3	= 0		x $480 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/NICOLE LOVE HENSLEY/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/097,003	01/13/2023	Paulos Tesfe	088835-1359421 (102300US)	1034

20350 7590 03/16/2023

Kilpatrick Townsend & Stockton LLP - West Coast
Mailstop: IP Docketing - 22
1100 Peachtree Street
Suite 2800
Atlanta, GA 30309

EXAMINER	
O'HERN, BRENT T	

ART UNIT	PAPER NUMBER
1793	

NOTIFICATION DATE	DELIVERY MODE
03/16/2023	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

KTSDocketing2@kilpatrick.foundationip.com
ipefiling@kilpatricktownsend.com

Office Action Summary	Application No. 18/097,003	Applicant(s) Tesfe et al.	
	Examiner BRENT T O'HERN	Art Unit 1793	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 2 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 13 January 2013.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-20 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☐ Claim(s) _____ is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☑ Claim(s) 1-20 are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

DETAILED ACTION

Election/Restriction

2. Restriction to one of the following inventions is required under 35 U.S.C. 121:

I. Claims 1-7 and 14-20, drawn to a denatured whey protein composition, classified in A23J 3/08.

II. Claims 8-13, drawn to a method of making denatured whey protein composition, classified in A23C 19/032.

The inventions are independent or distinct, each from the other because:

3. Inventions of Group II and Group I are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make another and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case the process of Group II can be used to make a materially different product such as a product having less than 60 wt. % protein.

4. Restriction for examination purposes as indicated is proper because all the inventions listed in this action are independent or distinct for the reasons given above and there would be a serious search and/or examination burden if restriction were not required.

Applicant is advised that the reply to this requirement to be complete must include (i) an election of an invention to be examined even though the requirement may be traversed (37 CFR 1.143) **and (ii) identification of the claims encompassing the elected invention**.

The election of an invention may be made with or without traverse. To reserve a right to petition, the election must be made with traverse. If the reply does not distinctly and specifically point

out supposed errors in the restriction requirement, the election shall be treated as an election without traverse. Traversal must be presented at the time of election in order to be considered timely. Failure to timely traverse the requirement will result in the loss of right to petition under 37 CFR 1.144. If claims are added after the election, applicant must indicate which of these claims are readable upon the elected invention.

Should applicant traverse on the ground that the inventions are not patentably distinct, applicant should submit evidence or identify such evidence now of record showing the inventions to be obvious variants or clearly admit on the record that this is the case. In either instance, if the examiner finds one of the inventions unpatentable over the prior art, the evidence or admission may be used in a rejection under 35 U.S.C. 103 or pre-AIA 35 U.S.C. 103(a) of the other invention.

5. Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be corrected in compliance with 37 CFR 1.48(a) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. A request to correct inventorship under 37 CFR 1.48(a) must be accompanied by an application data sheet in accordance with 37 CFR 1.76 that identifies each inventor by his or her legal name and by the processing fee required under 37 CFR 1.17(i).

6. The examiner has required restriction between product or apparatus claims and process claims. Where applicant elects claims directed to the product/apparatus, and all product/apparatus claims are subsequently found allowable, withdrawn process claims that include all the limitations of the allowable product/apparatus claims should be considered for rejoinder. All claims directed to a nonelected process invention must include all the limitations of an allowable product/apparatus claim for that process invention to be rejoined.

In the event of rejoinder, the requirement for restriction between the product/apparatus claims and the rejoined process claims will be withdrawn, and the rejoined process claims will be fully

examined for patentability in accordance with 37 CFR 1.104. Thus, to be allowable, the rejoined claims must meet all criteria for patentability including the requirements of 35 U.S.C. 101, 102, 103 and 112. Until all claims to the elected product/apparatus are found allowable, an otherwise proper restriction requirement between product/apparatus claims and process claims may be maintained. Withdrawn process claims that are not commensurate in scope with an allowable product/apparatus claim will not be rejoined. See MPEP § 821.04. Additionally, in order for rejoinder to occur, applicant is advised that the process claims should be amended during prosecution to require the limitations of the product/apparatus claims. **Failure to do so may result in no rejoinder.** Further, note that the prohibition against double patenting rejections of 35 U.S.C. 121 does not apply where the restriction requirement is withdrawn by the examiner before the patent issues. See MPEP § 804.01.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to BRENT T O'HERN whose telephone number is (571)272-6385. The examiner can normally be reached M-Th 5:00 am - 3:30 pm.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Emily Le can be reached on 571-272-0903. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional

questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/BRENT T O'HERN/
Primary Examiner, Art Unit 1793
March 5, 2023

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/097,003	Tesfe et al.
	Examiner	Art Unit
	BRENT T O'HERN	1793

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	03/05/2023								
	1	÷								
	2	÷								
	3	÷								
	4	÷								
	5	÷								
	6	÷								
	7	÷								
	8	÷								
	9	÷								
	10	÷								
	11	÷								
	12	÷								
	13	÷								
	14	÷								
	15	÷								
	16	÷								
	17	÷								
	18	÷								
	19	÷								
	20	÷								

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/097,003	01/13/2023	Paulos Tesfe	088835-1359421 (102300US)	1034

20350 7590 03/06/2023

Kilpatrick Townsend & Stockton LLP - West Coast
Mailstop: IP Docketing - 22
1100 Peachtree Street
Suite 2800
Atlanta, GA 30309

EXAMINER	
O'HERN, BRENT T	

ART UNIT	PAPER NUMBER
1793	

NOTIFICATION DATE	DELIVERY MODE
03/06/2023	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

KTSDocketing2@kilpatrick.foundationip.com
ipefiling@kilpatricktownsend.com

Decision Granting Request for Prioritized Examination (Track I)	**Application No.** 18/097,003	**Applicant(s)** Tesfe et al.	
	Examiner FIKIRTE A GEREMEW	**Art Unit** OMBL	**AIA (FITF) Status** Yes

1. THE REQUEST FILED 13 January 2023 IS **GRANTED** .

   The above-identified application has met the requirements for prioritized examination
   - A. ☑ for an original nonprovisional application (Track I).
   - B. ☐ for an application undergoing continued examination (RCE).

2. **The above-identified application will undergo prioritized examination**. The application will be accorded special status throughout its entire course of prosecution until one of the following occurs:
   - A. filing a **petition for extension of time** to extend the time period for filing a reply;
   - B. filing an **amendment to amend the application to contain more than four independent claims, more than thirty total claims** , or a multiple dependent claim;
   - C. filing a **request for continued examination** ;
   - D. filing a notice of appeal;
   - E. filing a request for suspension of action;
   - F. mailing of a notice of allowance;
   - G. mailing of a final Office action;
   - H. completion of examination as defined in 37 CFR 41.102; or
   - I. abandonment of the application.

Telephone inquiries with regard to this decision should be directed to FIKIRTE GEREMEW at (703) 756-1930. In his/her absence, calls may be directed to Petition Help Desk at (571) 272-3282.

/FIKIRTE A GEREMEW/ PROGRAM SUPPORT ASSISTANT, OMBL	

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
18/097,003	01/13/2023		1820	088835-1359421 (102300US)	20	3

CONFIRMATION NO. 1034

FILING RECEIPT

20350
Kilpatrick Townsend & Stockton LLP - West Coast
Mailstop: IP Docketing - 22
1100 Peachtree Street
Suite 2800
Atlanta, GA 30309

Date Mailed: 02/09/2023

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

Paulos Tesfe, Commerce City, CO;
Jiancai Li, Englewood, CO;
Bradley Maier, Broomfield, CO;
Richard K. Merrill, Highlands Ranch, CO;

Applicant(s)

Leprino Foods Company, Denver, CO;

Assignment For Published Patent Application

Leprino Foods Company, Denver, CO

Power of Attorney: The patent practitioners associated with Customer Number 20350

Domestic Applications for which benefit is claimed - None.
A proper domestic benefit claim must be provided in an Application Data Sheet in order to constitute a claim for domestic benefit. See 37 CFR 1.76 and 1.78.

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 02/08/2023

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 18/097,003**

Projected Publication Date: 07/18/2024

Non-Publication Request: No

Early Publication Request: No

Title

DENATURED MILK PROTEINS AND METHODS OF MAKING THEM

Preliminary Class

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific

countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

SelectUSA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop

technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 18/097,003

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	320
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	700
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	800
TOTAL CLAIMS (37 CFR 1.16(i))	20 minus 20 =	* 0			OR	x =	0
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 minus 3 =	*				x =	0
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	1820

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)	OR	RATE($)	ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

PTO/SB/80 (04-05)

POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(b).

I hereby appoint:

☒ Practitioners associated with the Customer Number: 20350

OR

☐ Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

as attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(b).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(b) to:

☒ The address associated with Customer Number: 20350

OR

☐ Firm or Individual Name			
Address			
City		State	Zip
Country			
Telephone		Email	

Assignee Name and Address:

Lapfino Foods Company
1630 West 38th Avenue
Denver, CO 80211-2200

A copy of this form, together with a statement under 37 CFR 3.73(b) (Form PTO/SB/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(b) may be completed by one of the practitioners appointed in this form if the appointed practitioner is authorized to act on behalf of the assignee, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature		Date	10/19/07
Name	Richard G. Rusnak	Telephone	(303) 480-2805
Title	Vice President and General Counsel		

80607485 v1

Electronic Acknowledgement Receipt

EFS ID:	47394854
Application Number:	18097003
International Application Number:	
Confirmation Number:	1034
Title of Invention:	DENATURED MILK PROTEINS AND METHODS OF MAKING THEM
First Named Inventor/Applicant Name:	Paulos Tesfe
Customer Number:	20350
Filer:	Alexa J. Hunter/Phoebe Young
Filer Authorized By:	Alexa J. Hunter
Attorney Docket Number:	088835-1359421 (102300US)
Receipt Date:	19-JAN-2023
Filing Date:	
Time Stamp:	12:04:32
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Assignee showing of ownership per 37 CFR 3.73	373.pdf	112709 802fba6fc651aae2584f8613d3cd4a150fe3c336	no	3

Warnings:

Information:					
2	Power of Attorney	POA.pdf	154165 f986e4a84d2df4479dfab8a8aef3f64aab00af3e	no	1
Warnings:					
Information:					
			Total Files Size (in bytes):	266874	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/AIA/96 (08-12)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: Leprino Foods Company

Application No./Patent No.: 18/097,003 Filed/Issue Date: January 13, 2023

Titled: DENATURED MILK PROTEINS AND METHODS OF MAKING THEM

Leprino Foods Company, a company

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☑ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☑ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel 062376, Frame 0814, or for which a copy thereof is attached.

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

   1. From: _____ To: _____

      The document was recorded in the United States Patent and Trademark Office at

      Reel _____, Frame _____, or for which a copy thereof is attached.

   2. From: _____ To: _____

      The document was recorded in the United States Patent and Trademark Office at

      Reel _____, Frame _____, or for which a copy thereof is attached.

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450**.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/AIA/96 (08-12)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☑ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/alexa.j.hunter/	01/19/2023
Signature	Date
Alexa J. Hunter	74538
Printed or Typed Name	Title or Registration Number

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	
	First Named Inventor	Paulos Tesfe
	Art Unit	
	Examiner Name	
	Attorney Docket Number	088835-1359421-102300US

U.S. PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	1.	5968586		10-19-1999	Etzel	
	2.	9578890	B2	02-28-2017	Li et al.	
	3.	10709146	B2	07-14-2020	Mikkelsen et al.	
	4.	10834934	B2	11-17-2020	Mikkelsen et al.	
	5.	11206846	B2	12-28-2021	Li et al.	

U.S. PATENT APPLICATION PUBLICATIONS

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear

FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear	T[5]
	6.	2002/045522	WO	A1	06-13-2002	Tatua Co-Operative Dairy Company Limited		
	7.	2006/089921	WO	A1	08-31-2006	DSM IP Assets B.V.		
	8.	2015/059245	WO	A1	04-30-2015	Arla Foods Amba		

NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	
	First Named Inventor	Paulos Tesfe
	Art Unit	
	Examiner Name	
	Attorney Docket Number	088835-1359421-102300US

EXAMINER SIGNATURE			
Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document.
[4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

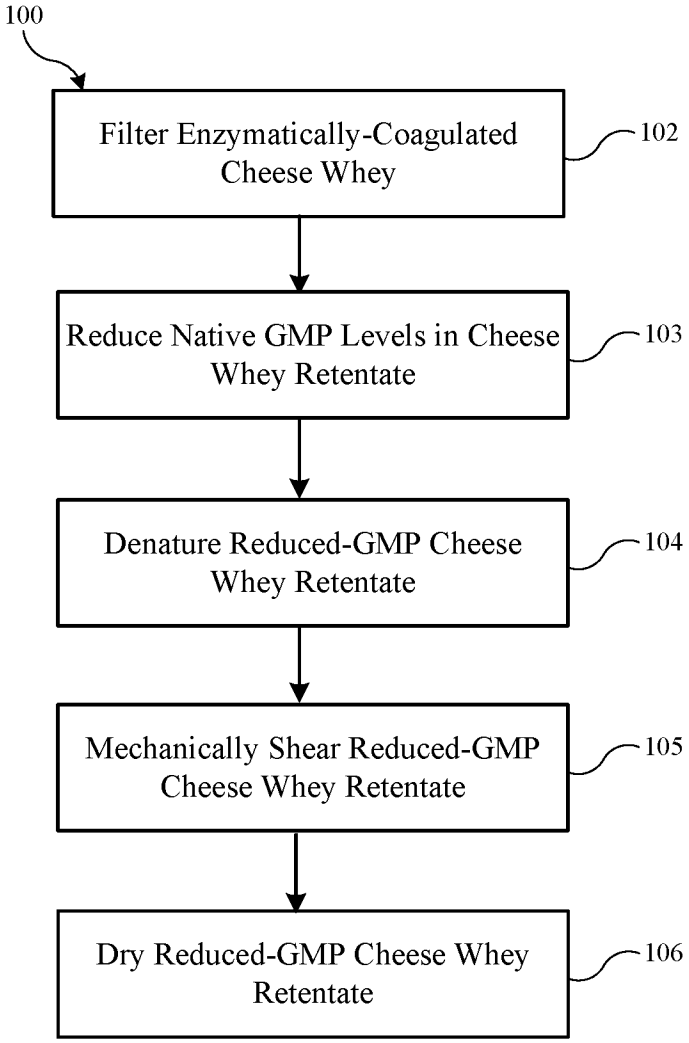

100
Filter Enzymatically-Coagulated Cheese Whey
102
Reduce Native GMP Levels in Cheese Whey Retentate
103
Denature Reduced-GMP Cheese Whey Retentate
104
Mechanically Shear Reduced-GMP Cheese Whey Retentate
105
Dry Reduced-GMP Cheese Whey Retentate
106

FIG. 1

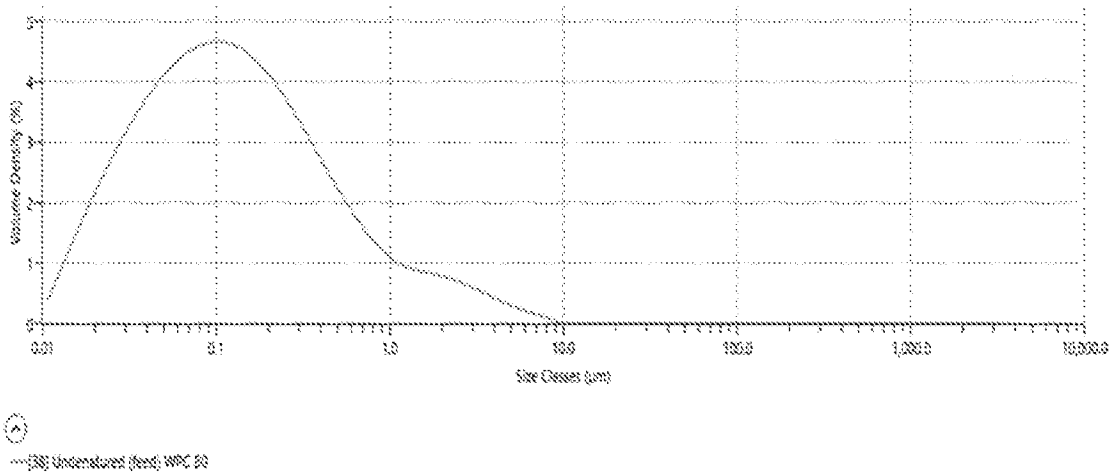


FIG. 2A

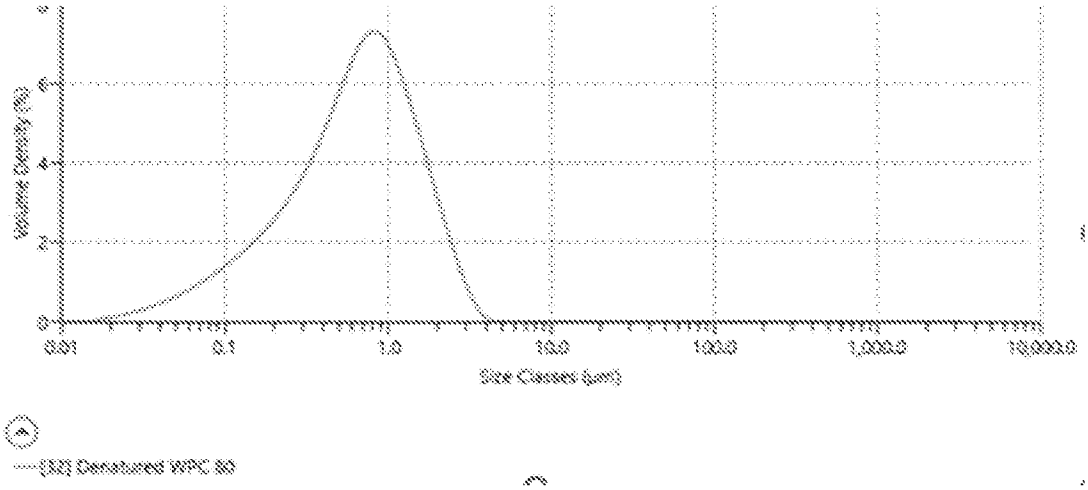


FIG. 2B

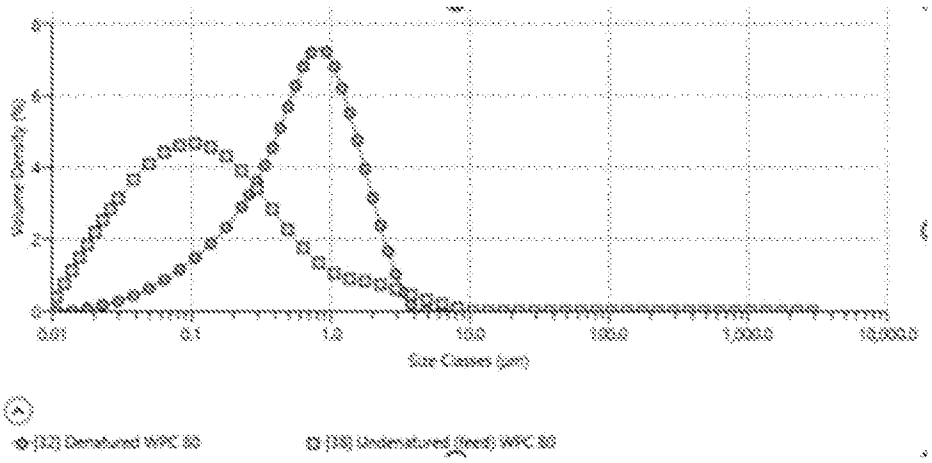


FIG. 2C

3/5

FIG. 3A

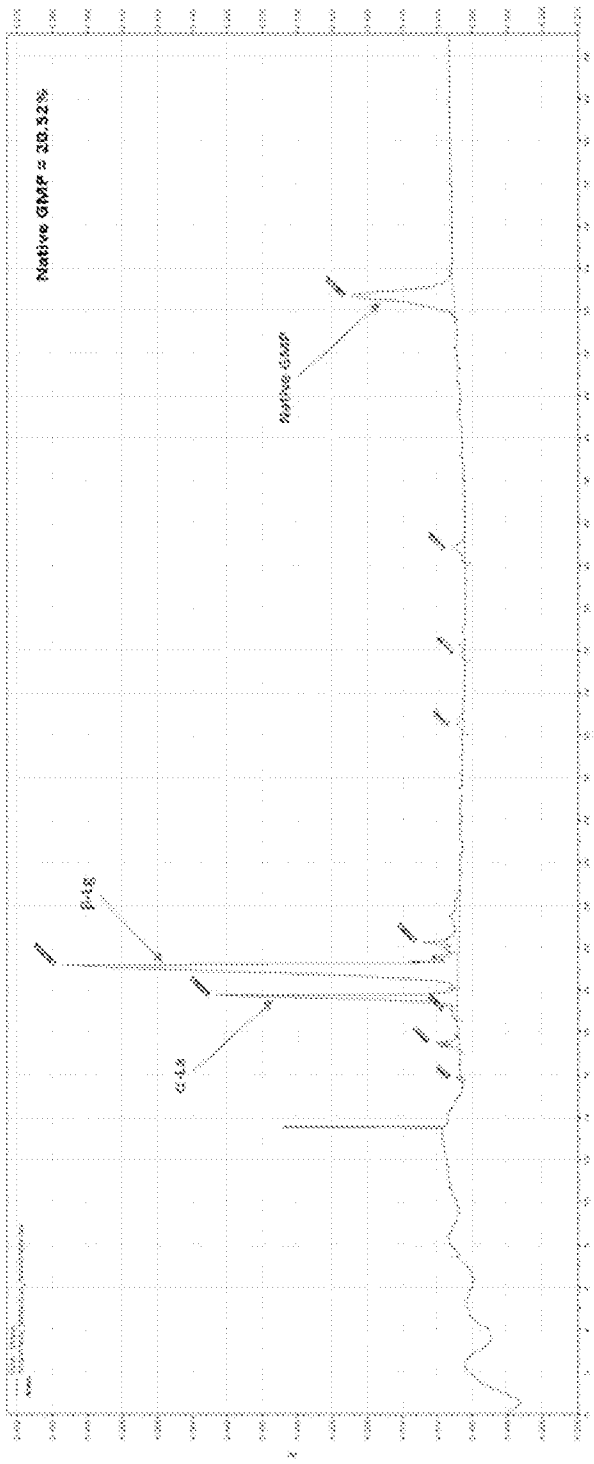
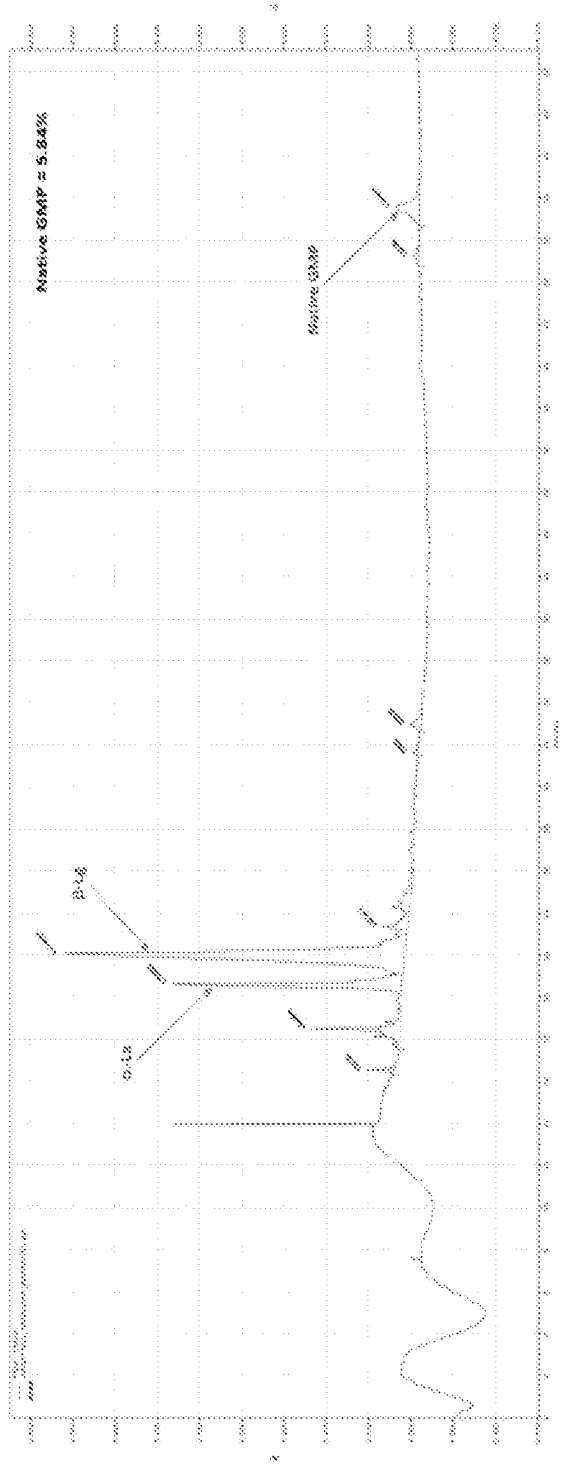


FIG. 3B



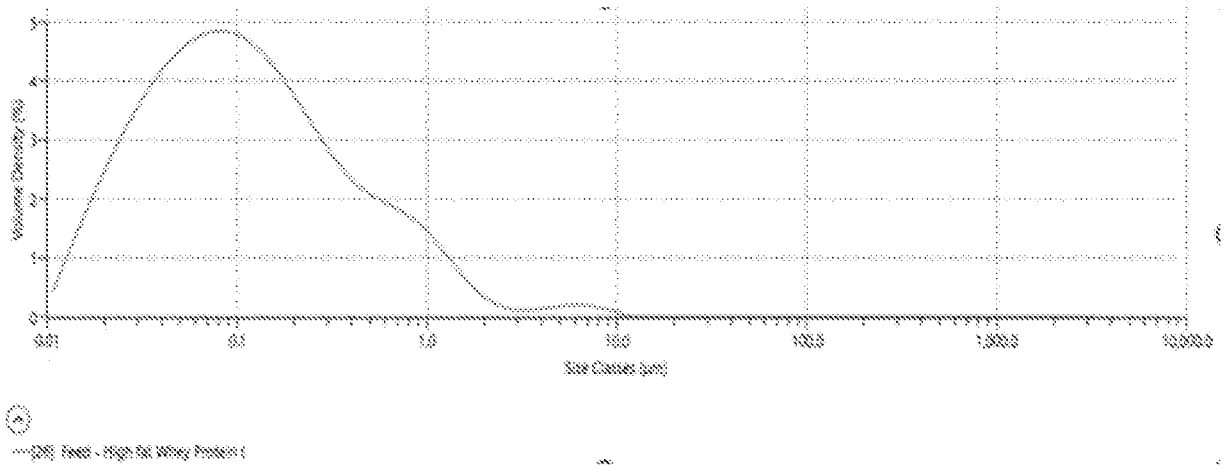


FIG. 4A

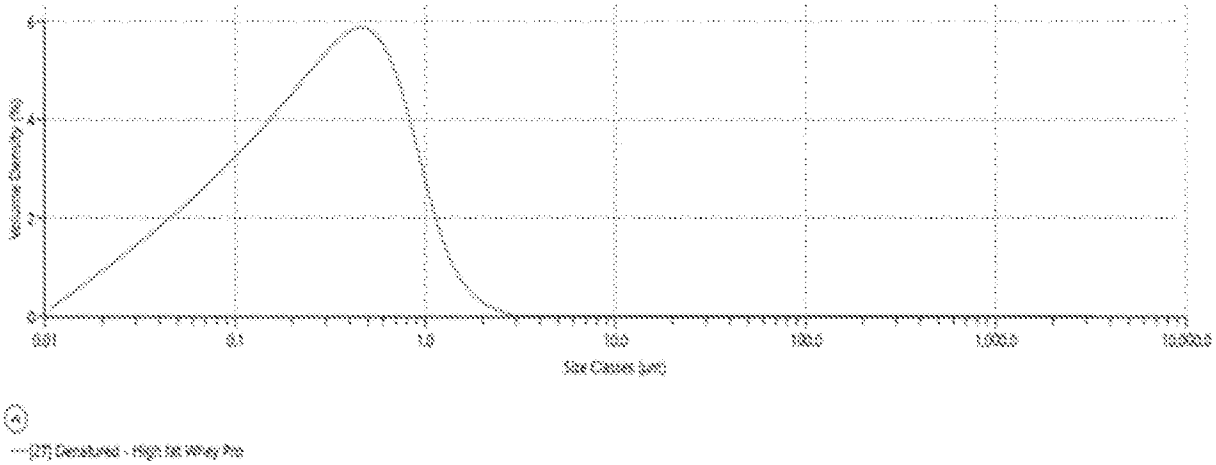


FIG. 4B

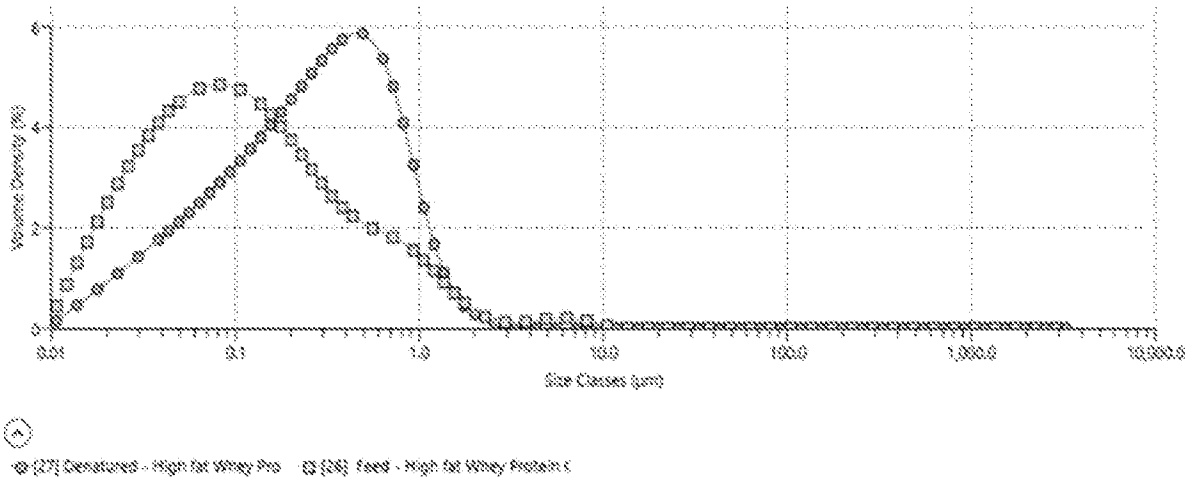


FIG. 4C

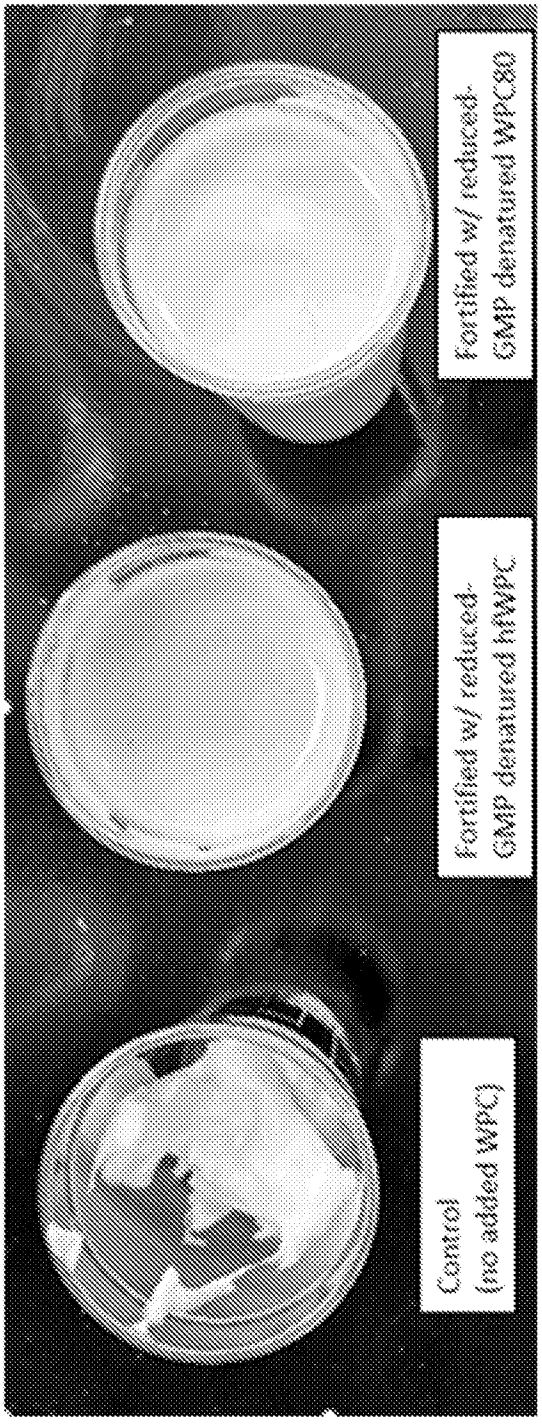

Control
(no added WPC)
fortified w/ reduced-
GMP denatured hWPC
fortified w/ reduced-
GMP denatured WPC80

FIG. 5

CERTIFICATION AND REQUEST FOR PRIORITIZED EXAMINATION UNDER 37 CFR 1.102(e) (Page 1 of 1)

First Named Inventor:	Paulos Tesfe	Nonprovisional Application Number (if known):	
Title of Invention:	DENATURED MILK PROTEINS AND METHODS OF MAKING THEM		

APPLICANT HEREBY CERTIFIES THE FOLLOWING AND REQUESTS PRIORITIZED EXAMINATION FOR THE ABOVE-IDENTIFIED APPLICATION.

1. The processing fee set forth in 37 CFR 1.17(i)(1) and the prioritized examination fee set forth in 37 CFR 1.17(c) have been filed with the request. The publication fee requirement is met because that fee, set forth in 37 CFR 1.18(d), is currently $0. The basic filing fee, search fee, and examination fee are filed with the request or have been already been paid. I understand that any required excess claims fees or application size fee must be paid for the application.

2. I understand that the application may not contain, or be amended to contain, more than four independent claims, more than thirty total claims, or any multiple dependent claims, and that any request for an extension of time will cause an outstanding Track I request to be dismissed.

3. The applicable box is checked below:

I. ☑ Original Application (Track One) - Prioritized Examination under § 1.102(e)(1)

i. (a) The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a). This certification and request is being filed with the utility application via EFS-Web.

---OR---

(b) The application is an original nonprovisional plant application filed under 35 U.S.C. 111(a). This certification and request is being filed with the plant application in paper.

ii. An executed inventor's oath or declaration under 37 CFR 1.63 or 37 CFR 1.64 for each inventor, **or** the application data sheet meeting the conditions specified in 37 CFR 1.53(f)(3)(i) is filed with the application.

II. ☐ Request for Continued Examination - Prioritized Examination under § 1.102(e)(2)

i. A request for continued examination has been filed with, or prior to, this form.
ii. If the application is a utility application, this certification and request is being filed via EFS-Web.
iii. The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a), or is a national stage entry under 35 U.S.C. 371.
iv. This certification and request is being filed prior to the mailing of a first Office action responsive to the request for continued examination.
v. No prior request for continued examination has been granted prioritized examination status under 37 CFR 1.102(e)(2).

Signature /alexa.j.hunter/	Date 2023-01-13
Name (Print/Typed) Alexa J. Hunter	Practitioner Registration Number 74538

Note: *This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. Submit multiple forms if more than one signature is required.**

☑ *Total of 1 forms are submitted.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PTO/AIA/14 (11-15)
Approved for use through 04/30/2017. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	088835-1359421 (102300US)
	Application Number	
Title of Invention	DENATURED MILK PROTEINS AND METHODS OF MAKING THEM	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Paulos		Tesfe	

Residence Information (Select One) ● US Residency Non US Residency Active US Military Service

City	State/Province	Country of Residence
Commerce City	CO	US

Mailing Address of Inventor:

Address 1	1830 West 38th Avenue
Address 2	
City	Denver
State/Province	CO
Postal Code	80211-2200
Country	US

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Jiancai		Li	

Residence Information (Select One) ◉ US Residency Non US Residency Active US Military Service

City	State/Province	Country of Residence
Englewood	CO	US

Mailing Address of Inventor:

Address 1	1830 West 38th Avenue
Address 2	
City	Denver
State/Province	CO
Postal Code	80211-2200
Country	US

Inventor 3 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Bradley		Maier	

Residence Information (Select One) ◉ US Residency Non US Residency Active US Military Service

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	088835-1359421 (102300US)
	Application Number	
Title of Invention	DENATURED MILK PROTEINS AND METHODS OF MAKING THEM	

City	Broomfield	State/Province	CO	Country of Residence	US

Mailing Address of Inventor:

Address 1	1830 West 38th Avenue
Address 2	

City	Denver	State/Province	CO
Postal Code	80211-2200	Country	US

Inventor 4 — Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Richard	K.	Merrill	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Highlands Ranch	State/Province	CO	Country of Residence	US

Mailing Address of Inventor:

Address 1	1830 West 38th Avenue
Address 2	

City	Denver	State/Province	CO
Postal Code	80211-2200	Country	US

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	20350		
Email Address		Add Email	Remove Email

Application Information:

Title of the Invention	DENATURED MILK PROTEINS AND METHODS OF MAKING THEM		
Attorney Docket Number	088835-1359421 (102300US)	Small Entity Status Claimed	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	5	Suggested Figure for Publication (if any)	

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	088835-1359421 (102300US)
	Application Number	
Title of Invention	DENATURED MILK PROTEINS AND METHODS OF MAKING THEM	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	● Customer Number	US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	20350		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status			Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

PTO/AIA/14 (11-15)
Approved for use through 04/30/2017. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	088835-1359421 (102300US)
	Application Number	
Title of Invention	DENATURED MILK PROTEINS AND METHODS OF MAKING THEM	

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. Add

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	088835-1359421 (102300US)
	Application Number	
Title of Invention	DENATURED MILK PROTEINS AND METHODS OF MAKING THEM	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

PTO/AIA/14 (11-15)
Approved for use through 04/30/2017. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	088835-1359421 (102300US)
	Application Number	
Title of Invention	DENATURED MILK PROTEINS AND METHODS OF MAKING THEM	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1 — Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

● Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor
Person to whom the inventor is obligated to assign.	Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	Leprino Foods Company

Mailing Address Information For Applicant:

Address 1	1830 West 38th Avenue		
Address 2			
City	Denver	**State/Province**	CO
Country	US	Postal Code	80211-2200
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

PTO/AIA/14 (11-15)
Approved for use through 04/30/2017. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	088835-1359421 (102300US)
	Application Number	
Title of Invention	DENATURED MILK PROTEINS AND METHODS OF MAKING THEM	

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

Remove

If the Assignee or Non-Applicant Assignee is an Organization check here. ☒

Organization Name	Leprino Foods Company

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1	1830 West 38th Avenue		
Address 2			
City	Denver	**State/Province**	CO
Country i	US	Postal Code	80211-2200
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. Add

Signature:

Remove

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/alexa.j.hunter/			Date (YYYY-MM-DD)	2023-01-13
First Name	Alexa J.	Last Name	Hunter	Registration Number	74538

Additional Signature may be generated within this form by selecting the Add button. Add

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	088835-1359421 (102300US)
	Application Number	
Title of Invention	DENATURED MILK PROTEINS AND METHODS OF MAKING THEM	

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1 The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3 A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent CooperationTreaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PTO/AIA/01 (06-12)
Approved for use through 11/30/2020. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	DENATURED MILK PROTEINS AND METHODS OF MAKING THEM

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [X] The attached application, or
- [ ] United States application or PCT international application number _____

  filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Paulos Tesfe Date (Optional): 1/10/2023

Signature: _____

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PTO/AIA/01 (06-12)
Approved for use through 11/30/2020. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	DENATURED MILK PROTEINS AND METHODS OF MAKING THEM

As the below named inventor, I hereby declare that:

This declaration is directed to:

[X] The attached application, or

[ ] United States application or PCT international application number _____

filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Jiancai Li Date (Optional): 1/10/2023

Signature: _____

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PTO/AIA/01 (06-12)
Approved for use through 11/30/2020. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	DENATURED MILK PROTEINS AND METHODS OF MAKING THEM

As the below named inventor, I hereby declare that:

This declaration is directed to:

[X] The attached application, or

[ ] United States application or PCT international application number _____

filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Bradley Maier Date (Optional): 10 Jan 2023

Signature: Bradley Maier

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PTO/AIA/01 (06-12)
Approved for use through 11/30/2020. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	DENATURED MILK PROTEINS AND METHODS OF MAKING THEM

As the below named inventor, I hereby declare that:

This declaration is directed to:

[X] The attached application, or

[ ] United States application or PCT international application number _____

filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Richard K. Merrill Date (Optional): 1/10/2023

Signature: _____

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
13 June 2002 (13.06.2002)

PCT

(10) International Publication Number
WO 02/45522 A1

(51) International Patent Classification[7]: A23J 3/10, 1/20, A23C 21/00, C07K 14/47

(21) International Application Number: PCT/NZ01/00265

(22) International Filing Date:
30 November 2001 (30.11.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
508747 8 December 2000 (08.12.2000) NZ

(71) Applicant *(for all designated States except US)*: **TATUA CO-OPERATIVE DAIRY COMPANY LIMITED** [NZ/NZ]; Main Road, SH26, Tatuanui, 2251 Morrinsville (NZ).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **HUMPHREY, Rex, Stuart** [NZ/NZ]; 457 Scotsman Valley Road, RD 1, 2251 Morrinsville (NZ). **BROEKHUIZEN, Janine, Lee** [NZ/NZ]; Chitty Road, RD 4, 2001 Hamilton (NZ). **SIEVERS, Faydra, Ann** [NZ/NZ]; 29 King Street, 2351 Cambridge (NZ).

(74) Agents: **WILSON, Kathryn, Shelley** et al.; Private Bag 3140, Level 12, KPMG Centre, 85 Alexandra Street, 2001 Hamilton (NZ).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

WO 02/45522 A1

(54) Title: ISOLATION METHOD

(57) Abstract: This invention relates to a step in a method for the separation of casein glycomacropeptides from a whey protein source, said step being heating the whey protein source in a liquid form, under conditions chosen to ensure minimal denaturation of casein glycomacropeptides but denaturing the majority of other proteins and/or aggregates present in the source, wherein the conditions include heating the whey protein source at a temperature in the range of 85°-125 °C for a time in the range of 2 minutes through 30 minutes inclusive.

Isolation of casein glycomacropeptides from whey by heating and ensuring minimal denaturation of the casein glycomacropeptides

TECHNICAL FIELD

The present invention is directed to the isolation of protein rich products from a whey protein source.

BACKGROUND ART

Whey protein concentrates and isolates are commercially available products produced in the dairy industry. They are by-products of a number of dairy manufacturing processes including the manufacture of cheese and rennet casein.

The compositions of these whey protein products vary depending upon a number of factors including the manufacturing processes of which they are by-products, as well as other geographical and seasonal variations.

These whey protein products have some value due to their high protein content. Some are also more valuable because of their specific protein composition. Their value can be substantially increased by fractionation of specific proteins from the product mixture.

The proteins which are commercially more valuable as fractions include casein glycomacropeptides (GMP), α-lactalbumin, β-lactoglobulin, and proteins which can be transformed into whey protein hydrolysates.

These are typically high value items, and whose value is at least a consequence of involved and tedious manufacturing processes.

One such process is disclosed by AU 74081/91 which details the isolation of kappa-caseino-glycomacropeptide from a concentrated whey product wherein the proteins partly freed from lactose are flocculated, resulting in a precipitate and a first

supernatant. The first supernatant is then concentrated by ultrafiltration, leading to a retentate which is then treated with ethanol to produce a precipitate and a second supernatant. The second supernatant can be collected by a second ultrafiltration step and dried.

The method of AU 74081/91 is described by WO 99/29183 as being "*very inconvenient and troublesome*" (page 2 lines 15-16).

WO 99/29183 itself discloses an alternative process of isolating casein glycomarcopeptide (GMP), wherein the whey protein source is acidified to below pH 4.0 and the solution treated by cold ultrafiltration at around 12 °C before readjusting the pH of the solution to pH 6.7 and subjecting to another cold ultrafiltration step.

As such, the process detailed by WO 99/29183 is quite different to that of the subject invention which uses heat denaturation of the whey protein followed by separation at 50 °C, conditions that are taught away from by WO 99/29183 and stated to cause denaturation and low yields of GMP.

Another method of GMP isolation is disclosed by EP 0,488,589 which involves contacting raw milk materials containing GMP with an ion-exchanger, collecting the fraction which does not absorb to the resin and treating this solution to obtain GMP. This process also does not involve heat denaturation steps as per the subject invention.

However, the use of ion-exchange resins to isolate GMP have been rejected by WO 94/15952 and WO 99/29183 as being tedious and time consuming, requiring frequent cleaning and regeneration of the resin to remove protein deposits. This also makes these isolation processes very expensive in comparison to other methods.

Heat denaturation of the whey protein source is also known in the art, being a much simpler and more cost-effective way of industrially isolating GMP. It is essential

however to identify conditions which produce high yields of GMP at a high purity without causing substantial levels of GMP denaturation.

WO 94/15952 discloses a process for the isolation of GMP involving of a heat treatment step to denature the whey protein followed by acidifying the solution to pH 4-5 to precipitate the whey proteins whilst keeping the GMP in solution, which can then be collected by ultrafiltration.

The isolation process disclosed by WO 94/15952 also suffers from a number of disadvantages, namely ash and mineral contamination which subsequently requires additional purification steps.

By lowering the pH of the denatured protein solution to pH 4-5, mineral ions are introduced into the solution from the acid anions used during acidification. As many applications for GMP products (for example as a component in infant milk formula) require a pH in the neutral range it is essential that the pH of the GMP solution be brought back to pH 6-7. This introduces further contaminants in the way of cations, for example sodium and potassium ions into the solution.

To remove this contaminant loading it is necessary to further process the GMP solution by nanofiltration and/or ultrafiltration.

Another limitation of the process of WO 94/15952 is that it is focussed solely on the recovery of kappa-casein glycomacropeptide. As indicated above there are a number of other valuable components which can be isolated from whey.

It would therefore be desirable to have a simplified process, which would allow GMP to be isolated at a high yield and purity without denaturation. It would also be desirable to use conditions, which reduced the level of ash and contaminant loading, thereby reducing the number of purification steps required. Preferably the process would allow a number of potentially valuable components to be isolated from the one

protein product source.

All references, including any patents or patent applications cited in this specification are hereby incorporated by reference. No admission is made that any reference constitutes prior art. The discussion of the references states what their authors assert, and the applicants reserve the right to challenge the accuracy and pertinency of the cited documents. It will be clearly understood that, although a number of prior art publications are referred to herein, this reference does not constitute an admission that any of these documents form part of the common general knowledge in the art, in New Zealand or in any other country.

It is an object of the present invention to address the foregoing problems or at least to provide the public with a useful choice.

Further aspects and advantages of the present invention will become apparent from the ensuing description which is given by way of example only.

DISCLOSURE OF INVENTION

According to one aspect of the present invention there is provided a step in a method for the separation of casein glycomacropeptides from a whey protein source, said step being

heating the whey protein source in a liquid form, under conditions chosen to ensure minimal denaturation of casein glycomacropeptide(s) but denaturing the majority of other proteins and/or aggregates present in the source,

wherein the conditions include

heating the whey protein source at a temperature in the order of 85-125°C for a time period within the range of 2 minutes through 30 minutes inclusive.

The term "separation" should be taken to mean the removal of casein glycomacropeptides from the whey protein source.

The term "casein glycomacropeptide" should be taken to mean the macropeptide from κ-casein X(f106-169). For ease of reference throughout the specification, casein glycomacropeptide will herein be referred to as GMP.

The term "other protein" should be taken to mean any other proteins present in the whey protein source other than GMP, including but not limited to α-lactalbumin, β-lactoglobulin, immunoglobulins and serum albumin.

The starting material for preferred process of the present invention is a whey protein source. Typically any whey protein can be used though the preference is for use of higher protein whey protein product.

The present invention is particularly suitable for whey protein isolate derived from rennet casein whey and cheese whey sources. Whey protein isolates made by anion exchange and membrane processes (typically microfiltration), and whey protein concentrates by ultrafiltration, are typically suitable.

In preferred embodiments of the present invention there is provided an initial step of dissolving, dispersing, or a combination of both, whey protein source material in a liquid.

Preferably the liquid is water or primarily water though this should not be seen as a limitation on the present invention in any way for the liquid could conceivably be any solvent which met the requirements of the isolation process.

Typically an aqueous solution of whey protein is prepared though it is also permissible that some non-dissolved material may be present. It is envisaged that in most cases the undissolved material will merely be separated at a later stage in the procedure.

Preferably the amount of protein source present in the liquid (by weight) is in the inclusive range of 9 ± 5 %, optimally between 9 ± 2 %.

Protein contents outside of this range are also permissible though in most cases it is considered unlikely that contents above 20%, or below 2% will be considered commercially viable. The inventors have found that outside of these ranges the ability to separate GMP from the whey protein is impaired, or the yields of GMP are too low.

In preferred embodiments of the present invention there is provided a method, substantially as described above, in which the pH of the whey protein is adjusted prior to any significant heating step in the process.

Preferably, the pH of the whey protein should be adjusted to be mildly acidic, to within the pH range of 5.5 through 7.0 inclusive.

It is acknowledged that heat denaturation of whey protein has previously been carried out within this pH range.

Saito T *et al*, 1991 ("A New Isolation Method of Caseinoglypeptide from Sweet Cheese Whey", *Journal of Dairy Science*. **74:** 2831-2837) discloses one experiment where whey protein was heated at 98 °C for one hour at seven different pH conditions (pH 1.0 to 7.0).

In the Saito experiment, pH 6.0 was found to give the highest purity of GMP, though this was still very low at 39.6% and as such not commercially viable. There was also no further testing conducted at other pHs surrounding pH 6.0.

Further, maintaining the heat denaturation step for one hour has been found by the inventors of the present invention to cause high levels of GMP denaturation, a problem previously identified with heat denaturation methods in the prior art.

The inventors have conducted a series of experiments to devise a simplified process with the optimum conditions that overcome the problems with the prior art and allow GMP to be isolated at a high yield and purity without significant denaturation.

Surprisingly, the inventors have identified the preferred pH of the whey protein to be within a narrower range of 5.8 ± 0.3 pH units, inclusive. Their experiments also showed that GMP yields and purity changed markedly over small pH changes, an observation not shown by Saito *et al*, 1991 which used large pH steps by comparison, being 1.0 pH units.

This surprising result was also a contradiction to the prior art which typically uses lower pHs of between 3-5, closer to the isoelectric point of many whey proteins and thus their minimum solubility.

The inventors have however found that while it may be possible to achieve better denaturation of non-GMP proteins at pHs lower than 5.8, there is also a corresponding increase in the level of GMP denaturation. Experiments by the inventors showed that even at pH 5.2, GMP denaturation had increased to levels which substantially reduced GMP yields and purity, below those which were commercially viable.

Using lower pHs than those described herein also significantly increases the ash and mineral load in the system as a consequence of acidification, followed by subsequent neutralisation at a later stage.

This also increases the cost of the process due to the need to include larger amounts of acidifying agents, neutralising agents, and often also attempting to remove the neutralisation products. The presence of any significant quantity of neutralisation products (often salts) can either be unacceptable in products of the type isolated according to the present invention, or can lower their value.

In preferred embodiments of the preset invention the whey protein is then heated to denature the majority of protein and/or aggregates in the source with minimal denaturation of the GMP, which remains soluble.

Heat denaturation of the whey protein source has previously been used in the art to isolate GMP from whey. While a range of conditions could conceivably be used to isolate GMP, it is essential to identify conditions which will produce high yields of GMP at a high purity without resulting in excessive levels of GMP denaturation.

The heat treatment conditions necessary for commercially viable industrial use were selected by the inventors on the basis of three criteria: firstly, the purity of the GMP obtained; secondly, the yield of GMP in the supernatant after separation; and thirdly the ease at which the precipitate could be separated from the soluble GMP phase after heat denaturation. Typically this will involve heating to a temperature exceeding 85°C but typically less than 125°C.

In preferred embodiments of the present invention the whey protein is heated to within the range of 90°C to 110°C inclusive.

Ideally the whey protein is heated at 95°C.

It is possible that temperatures outside of these ranges may also be used, though this will have an effect on other factors such as duration of heating etc.

As will be appreciated by a skilled addressee, time and temperature are linked if the desired results are to be attained. For temperatures in the range of 90°-100°C, a duration of approximately 2–30 minutes has been found by the inventors to produce industrially acceptable levels of GMP purity and yield.

In other preferred embodiments of the present invention the liquid may be heated to a temperature above 110°C but not exceeding 125°C for a period of time within the range of 30 seconds through 5 minutes inclusive.

As can be appreciated, individual processes may be optimised according to user requirements and the nature of the source material being used.

Some additional experimentation may be used to optimise these conditions though it is considered that this would be well within the skill of a competent addressee of the art armed with the information of the invention expressed within this specification.

For such short time durations, it is desirable that heating of the bulk liquid should be relatively rapid. For the purposes of calculating durations, typically time should be commenced when the temperature exceeds 85°C, or for the higher temperature examples above (e.g. 110-120°C), from when the temperature range is entered.

According to another aspect of the present invention there is provided a method, substantially as described above in which, after heating, the liquid and its contents are cooled to below 70°C.

Preferably the liquid and its contents are cooled to within the range of 50±20°C inclusive. Different cooling methods may be employed, such as by the addition of another cooler liquid, or by heat exchange processes.

This cooling step was found to be required to enable the precipitate to be industrially separated from the soluble GMP phase after heat denaturation and to avoid denaturation of GMP that occurs because of extended periods at higher temperatures.

Separation may occur by a number of methods known to a skilled addressee. In preferred embodiments, the separation of the soluble portion from the precipitate is by way of filtration or centrifugation.

In order to be industrially applied and commercially viable, the inventors required a set of conditions that would produce a strong precipitate that was separable from the supernatant using existing dairy clarifiers. The heat denaturation step of the present invention produced such a precipitate.

In order to further ease the separation process of the present invention, the density difference between the precipitate and the soluble phase is preferably improved by dilution of the liquid and its contents to around 7% total solids. Higher dilutions are possible and result in GMP of similar purities and yields but processing costs increase from the need to remove the additional water. The inventors have also found that dilution of the liquid is required to reduce the sedimentable solids loading to the clarifier. If the dilution step was no undertaken then the high solid levels were found to reduce the efficiency of the clarifier, resulting in precipitate being carried over into the soluble phase and causing a reduction in GMP purity.

According to another aspect of the present invention there is provided a method, substantially as described above, including a step in which dissolved components are recovered from the soluble portion to yield a GMP-rich product.

In preferred embodiments the recovery of a solid GMP product includes evaporation, and/or spray drying.

In other preferred embodiments of the present invention the GMP-rich dissolved components may be desalted and/or lactose reduced by ultrafiltration before subsequently being dried to yield the GMP-rich product..

Preferably, ultrafiltration is carried out using a membrane of 10kDa or smaller, to prevent loss of GMP through the membranes. Nanofiltration is also suitable when only water and salts are to be removed.

Further purification steps may also be performed to increase the purity of this product. However, without such purification, a typical casein glycomacropeptide product containing approximately 70% GMP content should be attainable.

According to another aspect of the present invention there is provided a method, substantially as described above, which includes a step in which the separated non-

soluble components remaining after separation of the soluble GMP- rich fraction are further processed to produce other high value whey protein products.

These further steps may include the hydrolysis of the protein, preferably by enzyme hydrolysis.

In preferred embodiments of the present invention the non-soluble components are mixed to a slurry of 15% solids or less by weight prior to proteolytic enzyme treatment.

Preferably the slurry contains 7.5±2.5% inclusive of solids, by weight which has been found by the inventors to be the best conditions for which to undertake this reaction.

The slurry may then be subjected to proteolytic enzyme treatment, the conditions of which are sufficient to digest all the protein aggregates to yield soluble peptides. Any of a number of commercially available food grade proteolytic enzyme preparations may be used, including for example (but not restricted to): alcalase™, trypsin, and protex™ 6L.

In preferred embodiments, proteolysis is performed for a period of time within the range of 0.5 through 24 hours, or for as long a period as is desirable. Typically the time range is within one through 18 hours inclusive. The temperature and pH range can be altered in accordance with the appropriate conditions known for the selected enzyme preparation(s).

At the end of the hydrolysis step, the enzyme is preferably inactivated. This may be simply achieved by heating the reaction mixture to a suitable inactivation temperature for the enzyme being used.

In preferred embodiments, the soluble fraction after proteolytic enzyme treatment is dried through such techniques as evaporation and/or spray drying to yield a solid

whey protein hydrolysate. Typically this protein hydrolysate has a high commercial value.

According to a further aspect of the present invention there is provided a casein glycomacropeptide rich material prepared according to a method substantially as described above.

According to a further aspect of the present invention there is provided a whey protein hydrolysate material prepared according to a method substantially as described above.

BRIEF DESCRIPTION OF DRAWINGS

Further aspects of the present invention will become apparent from the following description which is given by way of example only and with reference to the accompanying drawings in which:

Figure 1 is a schematic flow chart for one preferred embodiment of the present invention, and

Figure 2 is schematic flow chart of a variation of the process according to the present invention.

BEST MODES FOR CARRYING OUT THE INVENTION

Example 1

The inventors conducted a series of experiments to determine the optimum conditions that allow GMP to be isolated at a high yield and purity without significant GMP denaturation.

The conditions necessary for commercially viable industrial use were selected on the basis of three criteria: firstly, the purity of the GMP obtained; secondly, the yield of

GMP in the supernatant after separation; and thirdly the ease at which the precipitate could be separated from the soluble GMP phase after heat denaturation.

The heat denaturation step was found to involve heating to a temperature exceeding 85°C but typically less than 125°C.

A range of experiments were carried out first at a laboratory level, followed by further testing in pilot industrial-sized levels to determine the optimal pH, temperature and length of the heat denaturation step. The results of these experiments with regards to GMP purity and yields are shown in Tables 1, 2 and 3.

Table 1 Heating at 95°C for different times at pH 6.0

Time (min)	*GMP Purity %*	*GMP yield %*	*Purity x Yield*
5	74	67	0.50
10	71	73	0.52
15	74	78	0.58
20	78	76	0.60
30	75	64	0.48
60	74	68	0.50

Table 2 Heating at 90°C for 15 min at different pHs

pH	*GMP Purity %*	*GMP yield %*	*Purity x Yield*
5.5	72	54	0.39
5.6	70	57	0.40
5.7	68	58	0.39
5.8	58	74	0.43
5.9	67	67	0.45
6.0	76	74	0.56
6.1	75	68	0.51
6.2	74	46	0.34
6.4	73	4	0.03

Table 3 Heating at 85, 90 and 95°C for 20 mins at pH 6.0

Temperature °C	GMP Purity %	GMP yield %	Purity x Yield
85	69	64	0.44
90	69	67	0.46
95	71	71	0.50

It was concluded that the optimal conditions for the heat denaturation step utilised a pH of 5.8±0.3 pH units, at a temperature between 90 and 110 °C for 20±10 minutes.

While conditions outside these ranges also could result in GMP isolation, these were found by the inventors to give the best yields and purity.

Example 2

Figures 1 and 2 illustrate in detail processes according to the present invention enabling a casein glycomacropeptide rich product, and low-lactose whey protein hydrolysate product to be obtained. The following description should be read in conjunction with these figures, and in particular with reference to Figure 1.

Source of base material:

1 Any dairy whey protein source containing casein glycomacropeptide such as whey protein isolate made by anion exchange or micro filtration or whey protein concentrate, both from rennet casein whey or cheese whey sources.

Process:

2. Mix the base material to a concentration of 10% (±3%) into 45°C (±15°C) water until dissolved.

3. Adjust the pH to 5.8 (±0.3) with any food grade acid of choice.

4. Heat the slurry to 95°C (±5°C).

5. Hold at temperature for 20 (±10) minutes.

6. Cool the preparation to 50°C.

7. Separate the heat denatured and precipitated whey protein aggregates from the supernatant containing soluble glycomacropeptide, by centrifugation.

8. Take the soluble fraction at about 65-75% glycomacropeptide purity on protein and evaporate then spray dry.

9. The insoluble precipitate (from step 7) is mixed to a slurry at 10% solids or less. Depending on the centrifugation separation method used in step 7, the addition of water may be required to dilute to 10%.

   This slurry is subjected to proteolytic enzyme treatment to digest the protein aggregates yielding soluble peptides. This can be achieved with the use of commercial enzyme preparations - including for example (but not restricted to): alcalase™, trypsin, and protex™ 6L - over an 18 hour period at a temperature and within a pH range appropriate for the enzyme used.

   The enzyme is inactivated by heating the solution at the inactivation temperature for the enzyme used before evaporating and spray-drying to yield the whey protein hydrolysate.

10. The casein glycomacropeptide product can be desalted and lactose reduced, after centrifugation in step 7, by an ultrafiltration step using membranes of 10kDa or smaller, before spray drying.

Aspects of the present invention have been described by way of example only and it should be appreciated that modifications and additions may be made thereto without departing from the scope thereof as defined in the appended claims.

THE CLAIMS DEFINING THE INVENTION ARE:

1. A step in a method for the separation of casein glycomacropeptides from a whey protein source, said step being

   heating the whey protein source in a liquid form, under conditions chosen to ensure minimal denaturation of casein glycomacropeptides but denaturing the majority of other proteins and/or aggregates present in the source,

   wherein the conditions include

   heating the whey protein source at a temperature in the range of 85°-125°C for a time in the range of 2 minutes through 30 minutes inclusive.

2. A method as claimed in claim 1 wherein the preferred temperature of the heat denaturation step is in the order of 90°-110°C inclusive.

3. A method as claimed in claim 1 or claim 2 wherein the temperature of the denaturation step is in the order of 98°C.

4. A method as claimed in any one of claims 1 to 3 wherein the denaturation step is held at an elevated temperature for a time period in the order of 20 minutes.

5. A method of separation as claimed in any one of claims 1 to 4 including steps of

   i) heating the whey protein source in a liquid form under conditions chosen to denature the majority of protein and/or aggregates present in the source but while ensuring minimal denaturation of the casein glycomacropeptides, and

   ii) separating the soluble fraction containing casein glycomacropeptides from the denatured protein.

6. A method as claimed in any one of claims 1 to 5 wherein the heat denaturation step is carried out at a pH in the range of 5.5 through 7.0 inclusive.

7. A method as claimed in any one of claims 1 to 6 wherein the pH of the liquid is 5.5 through 6.3 inclusive.

8. A method as claimed in any one of claims 1 to 7 wherein the total quantity of whey protein present in the liquid source is within the range of 4-14% by weight inclusive.

9. A method as claimed in any one of claims 1 to 8 wherein the total quantity of whey protein present in the liquid source is within the range of 7-11% by weight inclusive.

10. A method as claimed in any one of claims 1 to 9 for ensuring that the total solid level of the solution produced by the heat treatment step is in the range of 5 through 10% by weight inclusive.

11. A method as claimed in any one of claims 1 to 10 wherein the solution following heat treatment has in the order of 7% solids by weight.

12. A method as claimed in any one of claims 1 to 11 wherein the solution is cooled to 30°C through 70°C inclusive.

13. A method as claimed in any one of claims 1 to 12 wherein the solution is cooled to a temperature in the order of 50°C.

14. A method as claimed in any one of claims 1 to 13 wherein the solution is separated into two fractions.

15. A method as claimed in any one of claims 1 to 14 wherein the method of separation is filtration.

16. A method as claimed in any one of claims 1 to 15 wherein the method of separation is centrifugation.

17. A method as claimed in any one of claims 1 to 16 wherein the method of separation is decanting.

18. A method for treating a casein glycomacropeptide-rich product separated by a method as claimed in any one of claims 1 to 17 wherein the casein glycomacropeptide is further treated by evaporation followed by spray drying.

19. A method of treating a casein glycomacropeptide-rich product separated by the method as claimed in any one of claims 1 to 17 wherein the previously separated non-casein glycomacropeptide whey protein fraction is further processed to yield a higher value product, by hydrolysis of the protein.

20. A method as claimed in claim 19 wherein the hydrolysis step involves enzyme hydrolysis.

21. A composition containing casein glycomacropeptide produced by a method as claimed in any one of claims 1 to 18.

22. A composition containing non-casein glycomacropeptide whey protein produced by a method as claimed by any one of claims 1 to 17, 19 and 20.

23. A method of separation substantially as herein described with reference to and as illustrated by the accompanying examples.

24. A method of manufacturing whey protein products substantially as herein described with reference to and as illustrated by the accompanying examples.

FIG. 1

Process Flow for the Production of Casein Glycomacropeptide

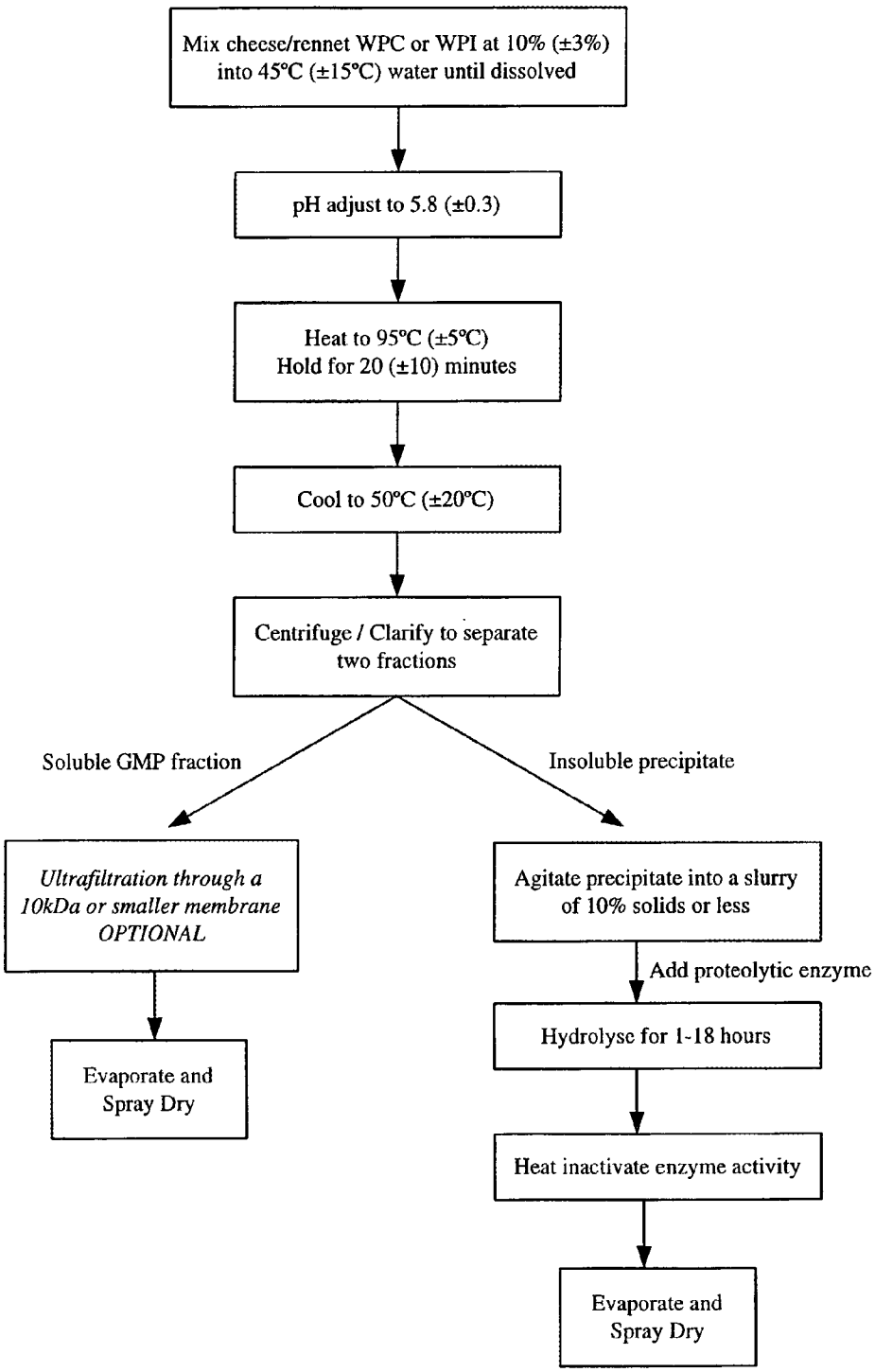
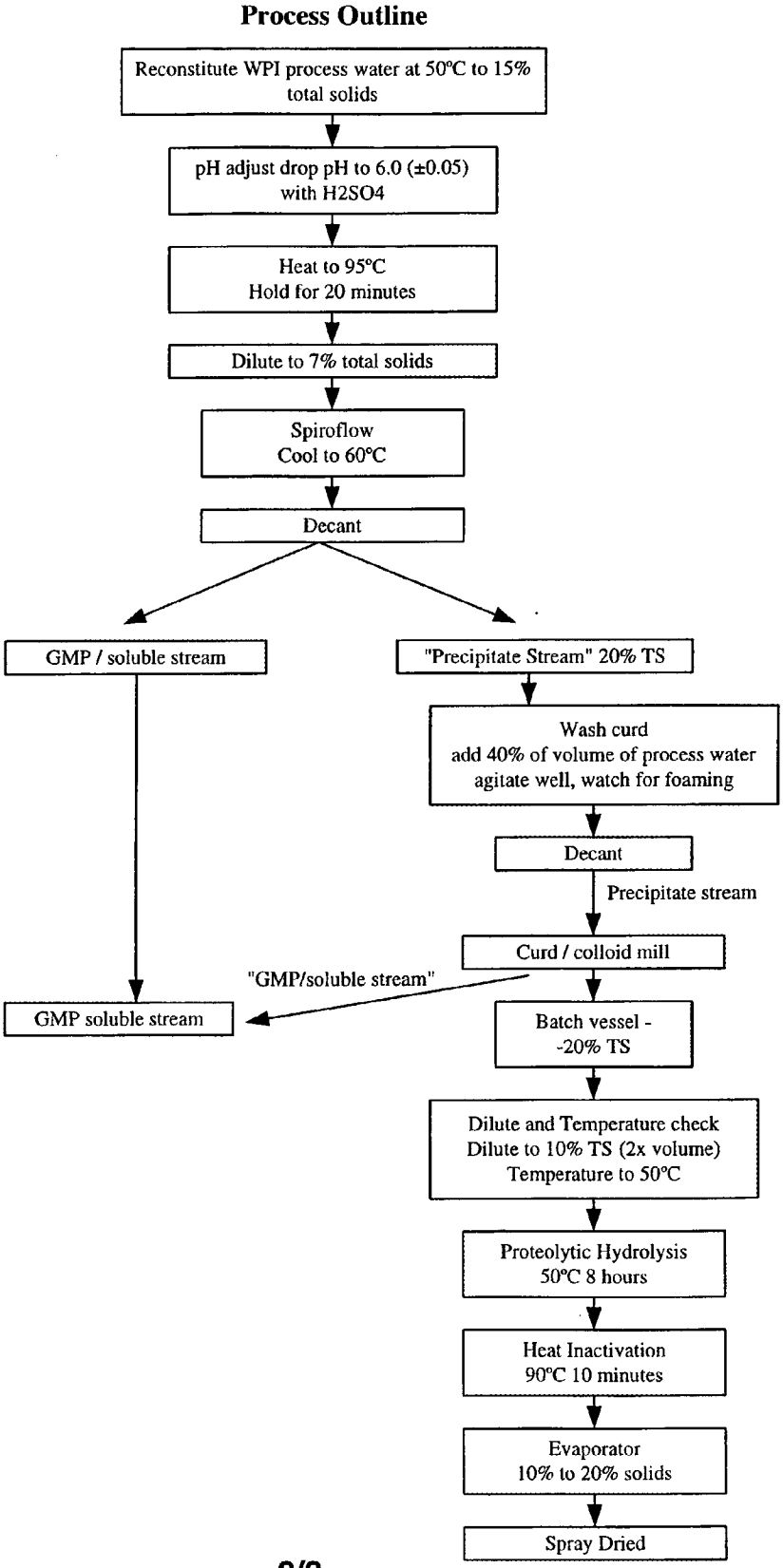


FIG. 2


Process Outline
Reconstitute WPI process water at 50°C to 15% total solids
pH adjust drop pH to 6.0 (±0.05) with H2SO4
Heat to 95°C Hold for 20 minutes
Dilute to 7% total solids
Spiroflow Cool to 60°C
Decant
GMP / soluble stream
"Precipitate Stream" 20% TS
Wash curd add 40% of volume of process water agitate well, watch for foaming
Decant
Precipitate stream
Curd / colloid mill
"GMP/soluble stream"
GMP soluble stream
Batch vessel - -20% TS
Dilute and Temperature check Dilute to 10% TS (2x volume) Temperature to 50°C
Proteolytic Hydrolysis 50°C 8 hours
Heat Inactivation 90°C 10 minutes
Evaporator 10% to 20% solids
Spray Dried

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NZ01/00265

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. [7]: A23J 3/10 A23J 1/20 A23C 21/00 CO7K 14/47

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
WPIDS, CA

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
SEE ELECTRONIC DATABASES

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPIDS, CA, FSTA (casein, whey, glycomacropeptide, GMP, heat?, denatur?, temperature)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 94/15952 A (NOVO NORDISK A/S) 21 July 1994. See whole document.	1-22
X	US 5216129 A (Berrocal, R. *et al.*) 1 June 1993. See whole document.	1-22
X	JP 05-271295 A (SNOW BRAND MILK PROD CO LTD) 19 October 1993 See abstract.	1, 4,5

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 March 2002	14 MAR 2002
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer **Terry Moore** Telephone No : (02) 6283 2632

INTERNATIONAL SEARCH REPORT	International application No. PCT/NZ01/00265

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 03-294299 A (SNOW BRAND MILK PROD CO LTD) 25 December 1991. See abstract.	1, 5, 6, 8, 9, 14, 15, 18
A	Saito, T. *et al.* 1991. A new isolation method of caseinoglycopeptide from sweet cheese whey. Journal of Dairy Science. 74:2831-2837. See p.2833 "Results and Discussion", experiment 2 and Table 2.	1-22
A	WO 9929183 A (MD FOODS A.M.B.A.) 17 June 1999. See whole document.	1-22
P/A	WO 0111990 A (SOCIETE DES PRODUCTS NESTLE S.A.) 22 February 2001 See examples 2 and 3.	1-22

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/NZ01/00265

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
WO	9415952	AU	58329/94				
US	5216129	AU	74081/91	CH	681543	EP	453782
		JP	4225999	NZ	237939		
JP	271295/93	JP	7105513				
JP	294299/91	JP	5136745				
WO	9929183	AU	14845/99	BR	9813541	EP	1037537
WO	200111990	AU	200047535	BR	200010125	EP	1048226
		NO	20015178	AU	200076543	WO	200122837

END OF ANNEX

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
30 April 2015 (30.04.2015)

WIPO | PCT

(10) International Publication Number
WO 2015/059245 A1

(51) **International Patent Classification**:
A23J 1/20 (2006.01) *A23L 2/66* (2006.01)
A23C 9/13 (2006.01) *A23C 19/05* (2006.01)
A23L 1/305 (2006.01) *A23C 21/06* (2006.01)

(21) **International Application Number**:
PCT/EP2014/072790

(22) **International Filing Date**:
23 October 2014 (23.10.2014)

(25) **Filing Language**: English

(26) **Publication Language**: English

(30) **Priority Data**:
PA 2013 70615 23 October 2013 (23.10.2013) DK

(71) **Applicant**: **ARLA FOODS AMBA** [DK/DK]; Sønderhøj 14, DK-8260 Viby J (DK).

(72) **Inventors**: **MIKKELSEN, Bente Østergaard**; c/o Arla Foods Amba, Sønderhøj 14, DK-8260 Viby J (DK). **BERTELSEN, Hans**; Chr. Aagaardsvej 8, DK-6920 Videbæk (DK). **FIHL, Thea**; c/o Arla Foods Amba, Sønderhøj 14, DK-8260 Viby J (DK). **JENSEN, Torben**; c/o Arla Foods Amba, Sønderhøj 14, DK-8260 Viby J (DK). **PEDERSEN, Henrik**; c/o Arla Foods Amba, Sønderhøj 14, DK-8260 Viby J (DK).

(74) **Agent**: **ØSTERGAARD, Steen**; Guardian IP Consulting I/S, Diplomvej, Building 381, DK-2800 Kgs. Lyngby (DK).

(81) **Designated States** *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

WO 2015/059245 A1

(54) **Title**: LOW ALPHA-LACTALBUMIN, HIGH PROTEIN, DENATURED WHEY PROTEIN COMPOSITIONS, PRODUCTS CONTAINING THEM, AND USES THEREOF

(57) **Abstract**: The present invention pertains to a new type of high protein denatured whey protein compositions having a low content of soluble alpha-lactalbumin and to a method of pro- ducing them. The invention furthermore pertains to products containing the high protein denatured whey protein compositions, particularly high protein, acidified dairy products, and additional uses thereof the denatured whey protein compositions.

LOW ALPHA-LACTALBUMIN, HIGH PROTEIN, DENATURED WHEY PROTEIN COMPOSITIONS, PRODUCTS CONTAINING THEM, AND USES THEREOF

FIELD OF THE INVENTION

The present invention pertains to a new type of high protein denatured whey protein compositions having a low content of soluble alpha-lactalbumin and to a method of producing them. The invention furthermore pertains to products containing the high protein denatured whey protein compositions, particularly high protein, acidified dairy products, and additional uses thereof.

BACKGROUND

Denatured, microparticulated whey protein concentrates have for long been used as a food ingredient for the production of e.g. cheese or yoghurt. Traditionally, the products have been produced by heating a whey protein solution having a neutral to acidic pH to a protein denaturing temperature whereby whey protein gel is formed, and subsequently subjecting the gel to high shear conditions so as to convert the gel to microparticles, which can be converted to a powder by spray-drying.

Prior art:

US 5,096,731 B2 discloses a yogurt where all or part of the fat and/or oil of the yogurt is replaced with microparticulated protein comprising substantially non-aggregated particles of denatured protein having a mean diameter of 0.5 – 2 microns when in a dry state.

US 6,605,311 B2 discloses insoluble, denatured, heat-stable protein particles having a mean diameter of 0.1 – 3 microns when in a hydrated state, which are dispersible in aqueous solutions in the form of substantially non-aggregated macro-colloids and are used in food and beverage products.

SUMMARY OF THE INVENTION

An aspect of the invention pertains to a denatured whey protein composition containing:
- a total amount of protein of at least 60% (w/w) on a dry weight basis,
- a total amount of soluble alpha-lactalbumin of at most 6% (w/w) relative to the total amount of protein, and
- insoluble whey protein particles having a particle size in the range of 1-10 micron, where the amount of said insoluble whey protein particles is in the range of 50-100% (w/w) relative to the total amount of protein.

The present inventors have found that denatured whey protein compositions containing a low amount of alpha-lactalbumin, when used for producing high protein drinking yoghurts, provide a lower viscosity than denatured whey protein compositions containing a higher content of alpha-lactalbumin (see Example 3).

The inventors have furthermore found that the present denatured whey protein compositions, which has a relatively high protein content, provides high protein dairy products with a higher degree of milky flavour and less dryness than prior art denatured whey protein compositions (see Examples 4 and 5).

Another aspect of the invention pertains to a method of producing a denatured whey protein composition, the method comprising the steps of

a) providing a solution comprising whey protein, said solution having a pH in the range of 5-8, said solution comprising:
- water,
- a total amount of protein of at least 60% (w/w) on a dry weight basis,
- a total amount of soluble alpha-lactalbumin of at most 16% (w/w) relative to the total amount of protein,

b) heating said solution to a temperature in the range of 70-160 degrees C and keeping the temperature of the solution within this range for sufficient time to form insoluble whey protein microparticles having a particle size in the range of 1-10 micron,

c) optionally, cooling the heat-treated solution,

d) optionally, converting the heat-treated solution to a powder,

wherein at least step b) involves subjecting the solution to mechanical shear.

A further aspect of the invention pertains to a method of producing a high protein, acidified dairy product, the method comprising the steps of:

a) providing a dairy base comprising at least one dairy component and at least one carbohydrate,

b) pasteurising the dairy base at a temperature in the range of 70-150 degrees C and subsequently cooling the dairy base,

c) contacting the heat-treated dairy base with an acidifying agent,

d) allowing the acidifying agent to reduce the pH of the dairy base to a pH of at most 5,

e) optionally, subjecting the acidified dairy base to one or more additional processing steps,

f) optionally, packaging the acidified dairy product in a suitable container.

wherein:

I) the dairy base provided in step a) comprises a total amount of protein of at least 7% (w/w), the solids of a denatured whey protein composition in an amount of at least 2% (w/w), and a total amount of at most 6% soluble alpha-lactalbumin (w/w) relative to the total amount of protein,

or

II) an ingredient comprising, or even consisting of, the solids of denatured whey protein composition is added to the dairy base between steps a) and f) in an amount sufficient to form the acidified dairy product containing:

- a total amount of protein of at least 7% (w/w),
- the solids of the denatured whey protein composition in an amount of at least 2% (w/w), and
- a total amount of at most 6% soluble alpha-lactalbumin (w/w) relative to the total amount of protein.

Yet an aspect of the invention relates to a high protein, acidified dairy product obtainable by the method, said dairy product containing a total amount of protein of at least 7% (w/w).

A further aspect of the invention relates to a food ingredient powder comprising, or even consisting of:

i. the solids of the denatured whey protein composition in an amount of at least 5% (w/w),

ii. optionally, a small amount of water,

iii. one or more additional components selected from the group consisting of:

- a caseinate composition,
- a concentrate of micellar casein,
- a milk protein concentrate, and
- a milk powder, such as e.g. skimmed milk powder.

DETAILED DESCRIPTION OF THE INVENTION

The denatured whey protein composition according to the present invention contains:

- a total amount of protein of at least 60% (w/w) on a dry weight basis, and
- insoluble whey protein particles having a particle size in the range of 1-10 micron,

where the amount of said insoluble whey protein particles is in the range of 50-100% (w/w) relative to the total amount of protein.

An alternative aspect of the invention pertains to a denatured whey protein composition containing:

- a total amount of protein of at least 40% (w/w dry-matter basis),
- a weight ratio between total protein and ash content of at least 15, and
- insoluble whey protein particles having a particle size in the range of 1-10 micron,

where the amount of said insoluble whey protein particles is in the range of 50-100% (w/w) relative to the total amount of protein.

In the context of the present invention the term "total protein" pertains to the total amount of true protein of a composition or product and disregards non-protein nitrogen (NPN).

In the context of the present invention, the term "denatured whey protein composition" relates to a composition which contains at least some denatured whey protein and preferably a significant amount of denatured whey protein. The composition may also contain some non-denatured whey proteins, however, the protein of the denatured whey protein composition preferably has a degree of denaturation of at least 50%.

In the context of the present invention the term "whey protein" relates to the proteins which are present in the serum phase of either milk or coagulated milk. The proteins of

the serum phase of milk are sometimes also referred to as milk serum proteins or ideal whey.

In the context of the present invention, the term "whey" relates to the liquid composition which is left when casein has been removed from milk. Casein may e.g. be removed by microfiltration providing a liquid permeate which is free of or essentially free of micellar casein but contains the native whey proteins. This liquid permeate is sometimes referred to as ideal whey, serum or milk serum.

Alternatively, the casein may be removed from milk by contacting a milk composition with rennet enzyme, which cleavages kappa-casein into para-kappa-casein and the peptide caseinomacropeptide (CMP), thereby destabilising the casein micelles and causing casein to precipitate. The liquid surrounding the rennet precipitated casein is often referred to as sweet whey and contains CMP in addition to the whey proteins which are normally found in milk.

Casein may also be removed from milk by acid precipitation, i.e. reducing the pH of the milk below pH 4.6 which is the isoelectric point of casein and which causes the casein micelles to disintegrate and precipitate. The liquid surrounding the acid precipitated casein is often referred to as acid whey or casein whey and does not contain CMP.

In the context of the present invention, the terms "native alpha-lactalbumin", "native beta-lactoglobulin", "native CMP", "soluble alpha-lactalbumin", "soluble beta-lactoglobulin" or "soluble CMP" pertain to soluble, non-denatured alpha-lactalbumin, beta-lactoglobulin or CMP which preferably has approximately the same retention time as the standard of alpha-lactalbumin, beta-lactoglobulin or CMP when assayed according to Example 1.2.

The whey proteins used in the present invention are preferably whey proteins from mammalian milk, such as e.g. milk from human, cow, sheep, goat, buffalo, camel, llama, horse and/or deer. In some preferred embodiments of the invention the whey proteins are bovine whey proteins.

In some preferred embodiments of the invention, the total amount of soluble alpha-lactalbumin of the denatured whey protein composition is at most 5% (w/w) relative to the total amount of protein. Preferably, the total amount of soluble alpha-lactalbumin of the denatured whey protein composition is at most 4% (w/w) relative to the total amount of protein, preferably at most 3% (w/w). Even more preferably, the total amount of soluble alpha-lactalbumin of the denatured whey protein composition is at most 2% (w/w). For example, the total amount of soluble alpha-lactalbumin of the de-

natured whey protein composition may be at most 1% (w/w) relative to the total amount of protein, such as at most 0.5% (w/w).

As said, the total protein content of the denatured whey protein composition is preferably at least 60% (w/w). The denatured whey protein composition may e.g. comprise a total amount of protein of at least 70% (w/w) on a dry weight basis. Preferably, the denatured whey protein composition may comprise a total amount of protein of at least 75% (w/w) on a dry weight basis. Even more preferably, the denatured whey protein composition may comprise a total amount of protein of at least 80% (w/w) on a dry weight basis. Alternatively, the denatured whey protein composition may comprise a total amount of protein of at least 85% (w/w) on a dry weight basis.

As said, the protein of the denatured whey protein composition preferably has a degree of denaturation of at least 50%. For example, the protein of denatured whey protein composition may have a degree of denaturation of at least 60%. The protein of denatured whey protein composition may e.g. have a degree of denaturation of at least 70% such at least 75%. Alternatively, the protein of denatured whey protein composition may have a degree of denaturation of at least 80%.

Even higher degrees of denaturation may be desirable, thus, the protein of denatured whey protein composition may have a degree of denaturation of at least 85%. For example, the protein of denatured whey protein composition may have a degree of denaturation of at least 90%. The protein of denatured whey protein composition may e.g. have a degree of denaturation of at least 95%, such at least 97%. Alternatively, the protein of denatured whey protein composition may have a degree of denaturation of at least 99%.

The degree of denaturation is determined according to the procedure outlined in Example 1.9.

In addition to the denatured whey protein, which typically is present in the form of insoluble whey protein particles, the denatured whey protein composition may also contain minor amounts of soluble whey proteins which have not been denaturated during the heat-treatment. The denatured whey protein composition may for example comprise soluble beta-lactoglobulin and/or soluble alpha-lactalbumin. The denatured whey protein composition may furthermore contain CMP, e.g. if the whey protein has been derived from sweet whey.

In the context of the present invention, the phrase "Y and/or X" means "Y" or "X" or "Y and X". Along the same line of logic, the phrase "n_1, n_2, ..., n_{i-1}, and/or n_i" means " n_1"

or " n_2" or ... or "n_{i-1}" or "n_i" or any combination of the components : n_1, n_2,...n_{i-1}, and n_i.

The denatured whey protein composition of the present invention contains insoluble whey protein particles and preferably a substantial part of the insoluble particles have a particle size in the range of 1-10 micron. The insoluble whey protein particles are typically produced by heating a solution of whey protein at an appropriate pH while subjecting the solution to a high degree of internal shear. The shear may be provided by mechanical shearing, using e.g. scraped-surface heat-exchangers or homogenizers or by subjecting the solution to high linear flow rates which promote turbulence.

It is also possible to prepare the denatured whey protein compositions using low shear or non-shear microparticulation methods. Such methods typically involve the use of relatively low concentrations of whey protein during heat treatment and precise control of the pH and the concentration of calcium.

In the context of the present invention the term "insoluble whey protein particles" pertains to particulate aggregates comprising denatured whey proteins, which aggregate can be separated from soluble whey protein by centrifugation.

Insoluble whey protein particles having a particle size in the range of 1-10 micron are interesting for the present invention, and in some preferred embodiments the denatured whey protein composition comprises insoluble whey protein particles in this size range in an amount of at least 50% (w/w) relative to the total amount of protein of the composition.

The amount (% w/w relative to the total amount of protein) of insoluble whey protein particles having a particle size in the range of 1-10 micron in a denatured whey protein composition is determined according to Example 1.1 (P_{1-10}).

For example, the denatured whey protein composition may comprise insoluble whey protein particles having a particle size in the range of 1-10 micron in an amount of at least 60% (w/w) relative to the total amount of protein of the composition. The particle size range 1-10 micron effectively covers particles having a particle size (hydrodynamic diameter) as low as 0.5000 micron and as high as 10.4999 micron.

The denatured whey protein composition may e.g. comprise insoluble whey protein particles having a particle size in the range of 1-10 micron in an amount of at least 65% (w/w) relative to the total amount of protein of the composition. Alternatively, the denatured whey protein composition may comprise insoluble whey protein particles having

a particle size in the range of 1-10 micron in an amount of at least 70% (w/w) relative to the total amount of protein of the composition. The denatured whey protein composition may for example comprise insoluble whey protein particles having a particle size in the range of 1-10 micron, in an amount of at least 75% (w/w) relative to the total amount of protein of the composition, such as in an amount of at least 80% (w/w).

A higher content of insoluble whey protein particles having a particle size in the range of 1-10 micron may be preferred for some applications. Thus, the denatured whey protein composition may comprise insoluble whey protein particles having a particle size in the range of 1-10 micron in an amount of at least 85% (w/w) relative to the total amount of protein of the composition. The denatured whey protein composition may e.g. comprise insoluble whey protein particles having a particle size in the range of 1-10 micron in an amount of at least 88% (w/w) relative to the total amount of protein of the composition. Alternatively, the denatured whey protein composition may comprise insoluble whey protein particles having a particle size in the range of 1-10 micron in an amount of at least 90% (w/w) relative to the total amount of protein of the composition, such as in an amount of at least 95% (w/w) or approx. 100% (w/w).

In some embodiments of the invention, the denatured whey protein composition may comprise insoluble whey protein particles having a particle size in the range of 1-10 micron in an amount in the range of 50-100% (w/w) relative to the total amount of protein of the composition. The denatured whey protein composition may e.g. comprise insoluble whey protein particles having a particle size in the range of 1-10 micron in an amount in the range of 60-95% (w/w) relative to the total amount of protein of the composition. Alternatively, the denatured whey protein composition may comprise insoluble whey protein particles having a particle size in the range of 1-10 micron in an amount in the range of 65-90% (w/w) relative to the total amount of protein of the composition. The denatured whey protein composition may for example comprise insoluble whey protein particles having a particle size in the range of 1-10 micron in an amount in the range of 70-85% (w/w) relative to the total amount of protein of the composition.

Insoluble whey protein particles having a particle size of approx. 1 micron are of particular interest for the present invention, and in some preferred embodiments the denatured whey protein composition comprises insoluble whey protein particles within this size range in an amount of at least 50% (w/w) relative to the total amount of protein of the composition. The particle size of approx. 1 micron effectively covers particles having a particle size (hydrodynamic diameter) as low as 0.5000 micron and as high as 1.4999 micron. The amount (% w/w relative to the total amount of protein) of insoluble whey

protein particles having a particle size of approx. 1 micron in a denatured whey protein composition is determined according to Example 1.1 (P_1).

For example, the denatured whey protein composition may comprise insoluble whey protein particles having a particle size of approx. 1 micron in an amount of at least 55% (w/w) relative to the total amount of protein of the composition. The denatured whey protein composition may e.g. comprise insoluble whey protein particles having a particle size of approx. 1 micron in an amount of at least 60% (w/w) relative to the total amount of protein of the composition. Alternatively, the denatured whey protein composition may comprise insoluble whey protein particles having a particle size of approx. 1 micron in an amount of at least 70% (w/w) relative to the total amount of protein of the composition. The denatured whey protein composition may for example comprise insoluble whey protein particles having a particle size of approx. 1 micron in an amount of at least 75% (w/w) relative to the total amount of protein of the composition, such as in an amount of at least 80% (w/w).

A higher content of insoluble whey protein particles having a particle size of approx. 1 micron may be preferred for some applications. Thus, the denatured whey protein composition may comprise insoluble whey protein particles having a particle size of approx. 1 micron in an amount of at least 85% (w/w) relative to the total amount of protein of the composition. The denatured whey protein composition may e.g. comprise insoluble whey protein particles having a particle size of approx. 1 micron in an amount of at least 90% (w/w) relative to the total amount of protein of the composition. Alternatively, the denatured whey protein composition may comprise insoluble whey protein particles having a particle size of approx. 1 micron in an amount of at least 95% (w/w) relative to the total amount of protein of the composition, such as in an amount of at least 97% (w/w) or approx. 100% (w/w).

In some embodiments of the invention, the denatured whey protein composition may comprise insoluble whey protein particles having a particle size of approx. 1 micron in an amount in the range of 50-100% (w/w) relative to the total amount of protein of the composition. The denatured whey protein composition may e.g. comprise insoluble whey protein particles having a particle size of approx. 1 micron in an amount in the range of 60-95% (w/w) relative to the total amount of protein of the composition. Alternatively, the denatured whey protein composition may comprise insoluble whey protein particles having a particle size of approx. 1 micron in an amount in the range of 65-90% (w/w) relative to the total amount of protein of the composition. The denatured whey protein composition may for example comprise insoluble whey protein particles having a particle size of approx. 1 micron in an amount in the range of 70-85% (w/w) relative to the total amount of protein of the composition.

Larger particles of insoluble whey protein are often less desirable as they may give rise to a sandy texture of the food products incorporating the denatured whey protein compositions.

Thus, in some preferred embodiments of the invention, the denatured whey protein composition comprises insoluble whey protein particles having a particle size of more than 10 micron in an amount of at most 10% (w/w) relative to the total amount of protein of the composition, preferably at most 5% (w/w), and even more preferably at most 1% (w/w).

For example, the denatured whey protein composition comprises insoluble whey protein particles having a particle size of more than 10 micron in an amount of at most 10% (w/w) relative to the total amount of protein of the composition, preferably at most 5% (w/w), and even more preferably at most 1% (w/w).

Additionally, it is sometimes preferred that the amount of insoluble whey protein particles having a size below 0.5 micron is kept to a minimum as these may provide an undesirably high viscosity to the products comprising them.

Thus, in some embodiments of the invention, the denatured whey protein composition comprises insoluble whey protein particles having a particle size of less than 0.5 micron in an amount of at most 10% (w/w) relative to the total amount of protein of the composition, preferably at most 5% (w/w), and even more preferably at most 1% (w/w).

In some preferred embodiments of the invention, the denatured whey protein composition comprises:

- insoluble whey protein particles having a particle size in the range of 1-10 micron in an amount of at least 50% (w/w) relative to the total amount of protein of the composition,
- insoluble whey protein particles having a particle size of more than 10 micron in an amount of at most 10% (w/w) relative to the total amount of protein of the composition, and
- insoluble whey protein particles having a particle size of less than 0.5 micron in an amount of at most 10% (w/w) relative to the total amount of protein of the composition.

For example, the denatured whey protein composition comprises:

- insoluble whey protein particles having a particle size in the range of 1-10 micron in an amount of at least 50% (w/w) relative to the total amount of protein of the composition,
- insoluble whey protein particles having a particle size of more than 10 micron in an amount of at most 5% (w/w) relative to the total amount of protein of the composition, and
- insoluble whey protein particles having a particle size of less than 0.5 micron in an amount of at most 10% (w/w) relative to the total amount of protein of the composition.

Alternatively, the denatured whey protein composition may comprise:
- insoluble whey protein particles having a particle size in the range of 1-10 micron in an amount of at least 50% (w/w) relative to the total amount of protein of the composition,
- insoluble whey protein particles having a particle size of more than 10 micron in an amount of at most 1% (w/w) relative to the total amount of protein of the composition, and
- insoluble whey protein particles having a particle size of less than 0.5 micron in an amount of at most 10% (w/w) relative to the total amount of protein of the composition.

The particle size distribution of the insoluble whey protein particles is using the procedure outlined in Example 1.1.

The denatured whey protein composition may furthermore contain salts and minerals, which typically are present in whey or milk derived products. The mineral content of food products are typically represented as the ash content of the food product.

The ash content is a measure of the total amount of minerals present within a food. Ash is the inorganic residue remaining after the water and organic matter have been removed by heating in the presence of oxidizing agents, and it should be noted that the product to which the ash content relates does not contain the ash particles as such. The ash content is preferably determined by the technique of dry ashing.

The present inventors have found that it is advantageous to reduce the ash content of the denatured whey protein composition. The reduced ash-content seems to provide high protein dairy products containing the denatured whey protein composition with a more milky flavour relative to high protein dairy products containing denatured whey protein ingredients having a higher ash content.

In some preferred embodiments of the invention, the denatured whey protein composition has a total protein : ash content weight ratio of at least 15. Preferably, the total protein : ash content weight ratio of the denatured whey protein composition is at least 20. Even more preferably, the total protein : ash content weight ratio of the denatured whey protein composition is at least 30. For example, the total protein : ash content weight ratio of the denatured whey protein composition may be at least 40, such as at least 50.

For example, the denatured whey protein composition may have a total protein : ash content weight ratio in the range of 15 - 60. The denatured whey protein composition may e.g. have a total protein : ash content weight ratio in the range of 20 - 55. Alternatively, the denatured whey protein composition may have a total protein : ash content weight ratio in the range of 25 – 50, such as in the range of 30-45.

The ash content is determined according to example 1.6 and the total protein is determined according to Example 1.4.

In addition to salts and minerals, the denatured whey protein composition furthermore typically contains fat, e.g. milk fat or whey fat. For example, the denatured whey protein composition may furthermore comprise fat in an amount of at most 8% (w/w) on a dry weight basis.

The present inventors have found that such compositions are particularly advantageous for preparing high protein, non-fat food products.

The denatured whey protein composition may furthermore comprise carbohydrate, typically in the form of lactose or lactose-based oligosaccharides. For example, the denatured whey protein composition may comprise lactose in an amount of at most 30% (w/w) on a dry weight basis. The denatured whey protein composition may e.g. comprise lactose in an amount of at most 15% (w/w) on a dry weight basis. Alternatively, the denatured whey protein composition may comprise lactose in an amount of at most 10% (w/w) on a dry weight basis.

In some preferred embodiments of the invention, the lactose content of the denatured whey protein composition is even lower, such as at most 4% (w/w) on a dry weight basis. Preferably, the lactose content of the denatured whey protein composition is at most 3% (w/w) on a dry weight basis. Even more preferably, the lactose content of the denatured whey protein composition is at most 2% (w/w) on a dry weight basis, such as at most 1% (w/w).

The present inventors have found that such compositions are particularly advantageous for preparing high protein, low lactose food products or high protein, low carbohydrate food products.

The denatured whey protein composition may be present in different forms. For example the denatured whey protein composition may be a powder, preferably a dry powder. In the context of the present invention, a dry powder contains at most 6% (w/w) water.

Alternatively, the denatured whey protein composition may be a suspension and preferably an aqueous suspension, meaning that the insoluble particles of the denatured whey protein composition are suspended in water. In the context of the present invention, an aqueous suspension contains at least 50% (w/w) water, preferably at least 60% (w/w) water, such as at least 70% (w/w). Even higher contents of water may be preferred for some applications, thus an aqueous suspension may contain at least 80% (w/w) water, such as e.g. at least 90% (w/w) water.

The pH of a suspension of denatured whey protein composition typically ranges from 6.4-7.0 when measured by dispersing 10 g of denatured whey protein composition in 90 g water at 25 degrees C.

The contents of water in a food product may be determined according to ISO 5537:2004 (Dried milk - Determination of moisture content (Reference method)) or by NMKL 110 2nd Edition, 2005 (Total solids (Water) - Gravimetric determination in milk and milk products). NMKL is an abbreviation for "Nordisk Metodikkomité for Nærings-midler".

In the context of the present invention, the term "dry weight" of a composition or product relates to the weight of the composition or product when it has been dried to a water content of 3% (w/w) water.

The insoluble whey protein particles are typically produced by heating a solution of whey protein having an appropriate pH while subjecting the solution a high degree of internal shear or by adjusting the conditions of the solution so that particles build up without the generation of a continuous gel in the solution. The shear may be provided by mechanical shearing, using e.g. scraped-surface heat-exchangers or homogenizers or by subjecting the solution to flow conditions which promote turbulence.

An aspect of the invention pertains to a method of producing a denatured whey protein composition, the method comprising the steps of

a) providing a solution comprising whey protein, said solution having a pH in the range of 5-8, said solution comprising:

- water,
- a total amount of whey protein of at least 1% (w/w),
- a total amount of protein of at least 60% (w/w) on a dry weight basis,
- a total amount of soluble alpha-lactalbumin of at most 16% (w/w) relative to the total amount of protein,

b) heating said solution to a temperature in the range of 70-160 degrees C and keeping the temperature of the solution within this range for sufficient time to form insoluble whey protein microparticles having a particle size in the range of 1-10 micron,

c) optionally, cooling the heat-treated solution,

d) optionally, converting the heat-treated solution to a powder,

wherein at least step b) involves subjecting the solution to mechanical shear.

The method may comprise the steps a) and b), and c), and d) in which case the denatured whey protein composition is a powder, and preferably a dry powder.

The method may comprise the steps a) and b), and d) but not step c) in which case the heat-treated solution is subjected to powder conversion without prior cooling.

The method may comprise the steps a) and b), and c) but not step d) in which case the denatured whey protein composition could be a suspension containing insoluble whey protein particles.

The solution typically contains a total amount of whey protein of at least 1% (w/w) relative to the weight of the solution, such as e.g. at least 5% (w/w). For example, the solution may contain a total amount of whey protein of at least 10% (w/w). The solution may e.g. contain a total amount of whey protein of at least 15% (w/w). Alternatively, the solution may contain a total amount of whey protein of at least 20% (w/w).

The solution may for example contain a total amount of whey protein in the range of 1-50% (w/w). For example, the solution may contain a total amount of whey protein in the range of 5-40% (w/w). The solution may e.g. contain a total amount of whey protein in the range of 10-30% (w/w). Alternatively, the solution may contain a total amount of whey protein in the range of 15-25% (w/w).

It is furthermore preferred that the solution contains a total amount of whey protein of at least 60% (w/w) on a dry weight basis, such as e.g. at least 70% (w/w) on a dry weight basis. For example, the solution may contain a total amount of whey protein of at least 75% (w/w) on a dry weight basis. The solution may e.g. contain a total amount of whey protein of at least 80% (w/w) on a dry weight basis. Alternatively, the solution may contain a total amount of whey protein of at least 85% (w/w) on a dry weight basis.

The solution may for example contain a total amount of whey protein in the range of 60-100% (w/w) on a dry weight basis. For example, the solution may contain a total amount of whey protein in the range of 65-95% (w/w) on a dry weight basis. The solution may e.g. contain a total amount of whey protein in the range of 70-90% (w/w) on a dry weight basis. Alternatively, the solution may contain a total amount of whey protein in the range of 75-85% (w/w) on a dry weight basis.

The whey protein used in the solution may be whey protein from acid whey, whey protein from sweet whey and/or milk protein from milk serum.

The solution preferably contains beta-lactoglobulin, which is an important component for the formation of insoluble whey protein particles. The solution may furthermore contain one or more of the additional proteins found in whey, for example alpha-lactalbumin and/or CMP.

In some preferred embodiments of the invention the solution contains a total amount of soluble alpha-lactalbumin of at most 16% (w/w) relative to the total amount of protein. For example, the solution may contain a total amount of soluble alpha-lactalbumin of at most 12% (w/w) relative to the total amount of protein. The solution may e.g. contain a total amount of soluble alpha-lactalbumin of at most 10% (w/w) relative to the total amount of protein. Alternatively, the solution may contain a total amount of soluble alpha-lactalbumin of at most 8% (w/w) relative to the total amount of protein.

A lower concentration of soluble alpha-lactalbumin may be preferred, thus, the solution may contain a total amount of soluble alpha-lactalbumin of at most 6% (w/w) relative to the total amount of protein. For example, the solution may contain a total amount of soluble alpha-lactalbumin of at most 4% (w/w) relative to the total amount of protein. The solution may e.g. contain a total amount of soluble alpha-lactalbumin of at most 2% (w/w) relative to the total amount of protein. Alternatively, the solution may contain a total amount of soluble alpha-lactalbumin of at most 1% (w/w) relative to the total amount of protein, such as e.g. substantially no soluble alpha-lactalbumin.

In some preferred embodiments of the invention the solution contains a total amount of soluble alpha-lactalbumin in the range of 1-16% (w/w) relative to the total amount of protein. For example, the solution may contain a total amount of soluble alpha-lactalbumin in the range of 2-12% (w/w) relative to the total amount of protein. The solution may e.g. contain a total amount of soluble alpha-lactalbumin in the range of 3-10% (w/w) relative to the total amount of protein. Alternatively, the solution may contain a total amount of soluble alpha-lactalbumin in the range of 4-8% (w/w) relative to the total amount of protein.

The solution of step a) may e.g. contain a total amount of soluble beta-lactoglobulin in the range of 20-100% (w/w) relative to the total amount of protein. For example, the solution may contain a total amount of soluble beta-lactoglobulin in the range of 30-80% (w/w) relative to the total amount of protein. The solution may e.g. contain a total amount of soluble beta-lactoglobulin in the range of 35-70% (w/w) relative to the total amount of protein. Alternatively, the solution may contain a total amount of soluble beta-lactoglobulin in the range of 40-60% (w/w) relative to the total amount of protein.

The pH of the solution is typically in the range of 5-8. For example, the pH of the solution may be in the range of 5.0-8.0. The pH of the solution may e.g. be in the range of 5.5-7.5. Alternatively, the pH of the solution may e.g. be in the range of 6.0-7.0, such as in the range of 6.0-6.5.

All pH-values presented herein have been measured in liquids/solutions having a temperature of 25 degrees C unless specified otherwise.

While the content of divalent cations in the solution of step a) may vary, it is often preferred that the solution e.g. contains a total amount of elemental Ca in the range of 0.05-3% (w/w) on a dry weight basis. For example, the solution may contain a total amount of elemental Ca in the range of 0.1-1.5% (w/w) on a dry weight basis. The solution may e.g. contain a total amount of elemental Ca in the range of 0.2-1.0% (w/w) on a dry weight basis. Alternatively, the solution may contain a total amount of elemental Ca in the range of 0.3-0.8% (w/w) on a dry weight basis.

Whey contains lactose and the solution of step a) will typically contain some lactose as well. In some embodiments of the invention the solution contains at most 30% (w/w) lactose on a dry weight basis. For example, the solution may contain at most 20% (w/w) lactose on a dry weight basis. The solution may e.g. contain at most 10% (w/w) lactose on a dry weight basis. Alternatively, the solution may contain at most 5% (w/w) lactose on a dry weight basis.

The present inventors have found that solutions having a low lactose content are advantageous for producing denatured whey protein compositions for low carbohydrate or lactose-free applications. Thus, in some preferred embodiments of the invention the solution contains at most 4% (w/w) lactose. For example, the solution may contain at most 3% (w/w) lactose on a dry weight basis. The solution may e.g. contain at most 2% (w/w) lactose on a dry weight basis. Alternatively, the solution may contain at most 1% (w/w) lactose on a dry weight basis.

For example, the solution may contain at most 0.5% (w/w) lactose on a dry weight basis, such as e.g. substantially no lactose.

The dry-matter content (solid content) of the solution of step a) is typically in the range of 2-50% (w/w). For example, the solution may have a dry-matter content in the range of 5-40% (w/w). The solution may e.g. have a dry-matter content in the range of 10-30% (w/w). Alternatively, the solution may contain a total amount of elemental Ca in the range of 0.3-0.8% (w/w) on a dry weight basis.

The solution typically contains at most 15% fat (w/w) on a dry weight basis. For example, the solution may contain at most 12% fat (w/w) on a dry weight basis. The solution may e.g. contain at most 10% fat (w/w) on a dry weight basis. Alternatively, the solution may contain at most 8% (w/w) fat on a dry weight basis, such as e.g. at most 6% fat (w/w) on a dry weight basis.

During the heat-treatment of step b), the solution should reach a temperature where denaturation of whey protein and formation of insoluble whey protein particles take place. The solution should preferably be heated to a temperature of at least 70 degrees C, and e.g. to a temperature in the range of 70-160 degrees C. The temperature of the solution should be kept within this range for sufficient time to form insoluble whey protein microparticles having a particle size in the range of 1-10 micron. The solution is typically held within the above temperature range for 1 second – 30 minutes, depending on which temperature(s) is (are) used. Higher temperatures tend to require a short heat-treatment whereas relatively low temperatures require a longer treatment.

In some preferred embodiments of the invention, the heat-treatment temperature range is 70-160 degrees C. For example, the heat-treatment temperature range may be in the range of 72-140 degrees C. The heat-treatment temperature range may e.g. be in the range of 74-120 degrees C. Alternatively, the heat-treatment temperature range may be in the range of 75-120 degrees C.

In some embodiments of the invention, the heat-treatment temperature range is 70-120 degrees C. For example, the heat-treatment temperature range may be in the range of 72-100 degrees C. The heat-treatment temperature range may e.g. be in the range of 74-95 degrees C. Alternatively, the heat-treatment temperature range may be in the range of 76-90 degrees C.

As said, the duration of the heat-treatment, i.e. the duration in which the solution has a temperature within the heat-treatment temperature range is typically 1 second – 30 minutes. For example, the duration of the heat treatment may be in the range of 5 seconds to 10 minutes. The duration of the heat treatment may e.g. be in the range of 10 seconds to 5 minutes. Alternatively, the duration of the heat-treatment may be in the range of 30 seconds to 2 minutes.

The heat-treatment of step b) and optionally also the cooling of step c) involves subjecting the solution to mechanical shear, e.g. using shearing units such as scraped surface heat exchangers, homogenisers and/or high shear mixers.

The mechanical shear may e.g. be present while the temperature of the solution is raised to the heat-treatment temperature range, particularly during the last phase where the temperature of the solution reaches the denaturation temperature of beta-lactoglobulin (approx. 68 degrees C). Additionally, it may be preferred to maintain the high shear conditions while the solution is kept at a temperature within the heat-treatment temperature range.

It is furthermore preferred to subject the heat-treated solution to high shear during the cooling of step c), provided that the method involves a cooling step.

In the context of the present invention, the term "mechanical shear" relates to shear provided by mechanical agitation of the solution including the action of scraped surface heat exchangers, homogenisers, high shear mixers and/or high pressure pumps.

Non-limiting examples of suitable forms of mechanical shear include high shear mixing, homogenization (e.g. operating at a pressure in excess of about 5000 psi (351.55 kg/cm^2), colloid milling (e.g. operating with a gap size of about 1 micron to about 20 microns), operation of a scraped surface heat exchanger (e.g. at a rate of at least 200 RPM) and combinations thereof.

The method of producing the denatured whey protein composition may furthermore include other steps which e.g. may form part of steps b), c) or d), or which may take

place between steps a) and b), between steps b) and c) and between steps c) and d), or which may even take place after step d).

In some preferred embodiments of the invention, the method involves a step d) of converting the heat-treated solution to a powder, e.g. by drying, freeze-drying or spray-drying.

Finally, the denatured whey protein composition is packaged in a suitable container.

The present denatured whey protein composition may be used as a food ingredient and preferably as an ingredient for high protein food products.

In the context of the present invention the term "food" relates to ingestible products in general and therefore encompasses both liquid foods such as beverages, semi-liquid foods (e.g. gels or highly viscous foods products such as spreadable cheese) and non-liquid foods such as bread or hard cheese.

Thus, an aspect of the invention pertains to a high protein food product comprising
- a total amount of protein of at least 4% (w/w),
- the solids of the denatured whey protein composition in an amount of at least 2% (w/w).

In the context of the present invention the term "solids" of a composition pertains to the material that would be left if all water of the composition was completely removed. For example, fats, carbohydrates, proteins and minerals all form part of the solids of a composition. The solid content of a food product is preferably determined according to Example 1.7.

In some preferred embodiments of the invention the high protein, food product has a total amount of protein of at least 7% (w/w), such as e.g. at least 8% (w/w). For example, the high protein food product may have a total amount of protein of at least 10% (w/w). The high protein food product may e.g. have a total amount of protein of at least 12% (w/w). Alternatively, the high protein food product may e.g. have a total amount of protein of at least 14% (w/w).

An even higher protein content may be desired, thus, the high protein food product may have a total amount of protein of at least 16% (w/w). The high protein food product may e.g. have a total amount of protein of at least 18% (w/w). Alternatively, the high protein food product may e.g. have a total amount of protein of at least 21% (w/w).

Typically, the high protein, acidified dairy product has a total amount of protein in the range of 7-25% (w/w). For example, the high protein, food product may contain a total amount of protein in the range of 8-20% (w/w). The high protein, food product may e.g. contain a total amount of protein of at least 10-18% (w/w). Alternatively, the high protein food product may contain a total amount of protein of at least 12-16% (w/w).

In some embodiments of the invention, the high protein food product contains a total amount of protein in the range of 21-25% (w/w).

While the high protein food product contains the solids of the denatured whey protein composition in an amount of at least 2% (w/w), it is often preferred that the denatured whey protein composition is used at even higher concentrations. For example, the high protein food product may contain the solids of the denatured whey protein composition in an amount of at least 4% (w/w). The high protein food product may e.g. contain the solids of the denatured whey protein composition in an amount of at least 6% (w/w). Alternatively, the high protein food product may contain the solids of the denatured whey protein composition in an amount of at least 8% (w/w). The high protein food product may e.g. contain the solids of the denatured whey protein composition in an amount of at least 10% (w/w), such as at least 15%.

The high protein food product typically contains the solids of the denatured whey protein composition in an amount in the range of 2-30% (w/w). For examples, the high protein food product may contain the solids of the denatured whey protein composition in an amount in the range of 4-25% (w/w). The high protein food product may e.g. contain the solids of the denatured whey protein composition in an amount in the range of 6-20% (w/w). Alternatively, the high protein food product may contain the solids of the denatured whey protein composition in an amount in the range of 8-18% (w/w). The high protein food product may e.g. contain the solids of the denatured whey protein composition in an amount in the range of 10-16% (w/w).

The food product containing the denatured whey protein composition may further comprise one of more fats. In the present context, the term "fat" relates to the triglycerides in general and includes both fats which have a solid fat content of at least 50% (w/w) at 25 degrees C and fats which have a solid fat content of less than 50% (w/w) at 25 degrees C (sometimes referred to as "oils"). The one or more fats may be derived from a vegetable fat source and/or an animal fat source.

According to one embodiment, the food product comprises one or more vegetable oil(s) selected from the group consisting of maize oil, sesame oil, soya oil, soya bean oil, linseed oil, grape seed oil, rapeseed oil, olive oil, groundnut oil, sunflower oil, safflower oil

and a combination thereof. Alternatively, where the food product comprises one or more vegetable fat(s), the fat(s) may be selected from the group consisting of palm fat, palm kernel fat and cocoanut fat and a combination thereof.

According to a second embodiment, the food product comprises one or more animal fats, such as a milk fat. The milk fat may be derived from cream, butter or sweet butter milk solids.

The food product containing the denatured whey protein composition may have a fat content in the range of 1-50% (w/w) relative to the dry weight of the food product, where the fat may be of vegetable and/or animal origin as described above. Where the food product is fat-enriched, it may have a fat content in the range of 5-40% (w/w) relative to the dry weight of the food product; or have a fat content in the range of 10-30% (w/w) relative to the dry weight of the food product. Where the food product has a low fat content, it may have a fat content in the range of 0.1-10% (w/w) relative to the dry weight of the food product; preferably in the range of 0-1.0% (w/w) relative to the dry weight of the food product.

The food product containing the denatured whey protein composition may comprise one of more carbohydrates, which may provide sweetness and nutritional energy to the product. The one or more carbohydrates may be a native component of the denatured whey protein composition, such as e.g. lactose. The food product may contain one or more additional carbohydrates in the form of di- and mono-saccharides such as sucrose, maltose, lactose, dextrose, glucose, fructose, galactose and a combination thereof that provide both nutritional energy and a sweet taste when the food product is ingested.

Other types of carbohydrate which may be present in the food product are oligosaccharides or polysaccharides. Oligosaccharides and polysaccharides normally do not contribute to the sweetness of the food product but may be beneficial for microbial environment of the gastrointestinal system of mammals, e.g. as a source of energy for the probiotic microorganisms of the gastrointestinal system and/or a general source of food fibres.

The food product may contain one of more additional carbohydrates derived from mammalian milk or a derivative thereof.

In some embodiments, the food product containing the denatured whey protein composition comprises a total amount of carbohydrate in the range of 1-80% (w/w) relative to the dry weight of the food product. In a further embodiment, the food product comprises a first carbohydrate component in addition to the native carbohydrate which may be

present in the denatured whey protein composition, where the amount of the first carbohydrate component in the range of 1-80% (w/w) relative to the dry weight of the food product.

A food product containing the denatured whey protein composition may further comprise casein. Casein is a phosphoprotein found in milk, which is mainly found in the form of micelles in milk. Alternatively, the casein may be used in the form of the caseinate, which is typically prepared by acidification of skimmed milk.

Thus, the food product may comprise micellar casein and/or caseinate.

In one embodiment, the food product containing the denatured whey protein composition comprises a total amount of casein in the range of 0-20% (w/w) relative to the dry weight of the food product, preferably in the range of 6-18% (w/w); more preferably in the range of 10-16% (w/w), and even more preferably in the range of 12-13% (w/w) relative to the dry weight of the food product.

Additionally, the food product may contain non-dairy protein such as animal, non-dairy protein, e.g. gelatine, or vegetable protein such as gluten, soy protein and/or pea protein.

In some embodiments of the invention, the food product may furthermore contain one or more native whey protein(s), however, in other embodiments the presence of native whey protein is less desirable.

A suitable source of milk proteins comprised in the food product of the invention may be derived from either liquid or dried whole milk, non-fat milk, skimmed-milk, semi-skimmed milk and butter milk.

A food product containing the denatured whey protein composition may further comprise one of more non-carbohydrate natural or artificial sweeteners.

In one embodiment, the food product contains one or more natural sweetening agent(s) selected from the group consisting of Momordica Grosvenorii (Mogrosides IV or V) extracts, Rooibos extracts, Honeybush extracts, Stevia, Rebaudioside A, thaumatin, Brazzein, Glycyrrhyzic acid and its salts, Curculin, Monellin, Phylloducin, Rubusosides, Mabinlin, dulcoside A, dulcoside B, siamenoside, monatin and its salts (monatin SS, RR, RS, SR), thaumatin, hernandulcin, phyllodulcin, glycyphyllin, phloridzin, trilobatin, baiyunoside, osladin, polypodoside A, pterocaryoside A, pterocaryoside B, mukuroziside, phlomisoside I, periandrin I, abrusoside A, cyclocarioside I, erythritol, isomaltulose,

and/or natural polyol sweeteners such as maltitol, mannitol, lactitol, sorbitol, inositol, xylitol, threitol, galactitol and combinations thereof.

In one embodiment, the food product contains one or more artificial sweetening agent(s) selected from the group consisting of Aspartame, Cyclamate, Sucralose, Acesulfame K, neotame, Saccharin, Neohesperidin dihydrochalcone and combinations thereof.

A food product containing the denatured whey protein composition may comprise one or more mineral(s) such as phosphorus, magnesium, iron, zinc, manganese, copper, chromium, iodine, sodium, potassium, chloride and combinations thereof.

The one or more mineral(s) may be a native component of the denatured whey protein composition, and/or the food product may be provided as an additional source of mineral(s). A suitable source of minerals includes milk or milk derivatives that contain the inorganic salts elemental calcium, elemental phosphorous, elemental magnesium and elemental potassium.

A food product containing the denatured whey protein composition may e.g. have a total ash content (i.e. salt and mineral content) in the range of 0.1-10% (w/w) relative to the dry weight of the food product; preferably in the range of 0.5-8% (w/w), more preferably in the range of 1-5% (w/w) relative to the dry weight of the food product.

A food product containing the denatured whey protein composition may for example have an elemental calcium content in the range of 0.3-2% (w/w) relative to the dry weight of the food product; preferably in the range of 0.5-1.5% (w/w), more preferably in the range of 0.7-1% (w/w) relative to the dry weight of the food product.

A food product containing the denatured whey protein composition may for example have an elemental phosphorous content in the range of 0.1-1.5% (w/w) relative to the dry weight of the food product; preferably in the range of 0.3-1% (w/w), more preferably in the range of 0.5-0.8% (w/w) relative to the dry weight of the food product.

A food product containing the denatured whey protein composition may have a sodium chloride content in the range of 0.5-0.8% (w/w) relative to the dry weight of the food product.

A food product containing the denatured whey protein composition may further comprise one of more vitamin(s) and similar other ingredients such as vitamin A, vitamin D, vitamin E, vitamin K, thiamine, riboflavin, pyridoxine, vitamin B12, niacin, folic acid,

pantothenic acid, biotin, vitamin C, choline, inositol, their salts, their derivatives and combinations thereof.

A food product containing the denatured whey protein composition may further comprise one of more stabilizer(s). Suitable stabilizers which can be used in the present invention include locust bean gum, guar gum, alginates, cellulose, xanthan gum, carboxymethyl cellulose, microcrystalline cellulose, carrageenans, pectins, inulin and mixtures thereof.

The content of the one of more stabiliser may e.g. be in the range of 0.01-5% (w/w) relative to the dry weight of the food product, preferably in the range of 0.1 to 0.5% (w/w).

A food product containing the denatured whey protein composition may further comprise one of more emulsifier(s). Suitable emulsifiers to be used are mono- and di-glycerides, citric acid esters of mono- and di-glycerides, diacetyltartaric acid esters of mono- and di-glycerides polysorbate, lecithin, or polyol esters of fatty acids such as propylene glycol monoester of fatty acids, as well as natural emulsifiers such as egg yolk, butter milk, raw acacia gum, rice bran extract or mixtures thereof.

The content of the one of more emulsifier(s) may be in the range of 0.01-3% (w/w) relative to the dry weight of the food product, for example in the range of 0.1 to 0.5% (w/w).

The denatured whey protein composition is advantageously used as a dairy-based ingredient in the production of dairy products. The present denatured whey protein composition is even more advantageous for high protein dairy products, i.e. dairy products which contain a total amount of protein of at least 7%.

Thus, an aspect of the invention relates to a high protein dairy product containing:
- a total amount of protein of at least 7% (w/w), and
- the solids of the denatured whey protein composition in an amount of at least 2% (w/w).

In some preferred embodiments, the high protein dairy product is a high protein, acidified dairy product containing:
- a total amount of protein of at least 7% (w/w), and
- the solids of the denatured whey protein composition in an amount of at least 2% (w/w).

In the context of the present invention, the term "acidified dairy product" relates to a dairy product having a pH of at most 5.5, and e.g. less, such as at most 5.0 or even at most 4.7. An acidified dairy product may even have a pH at most 4.4. The pH range of an acidified dairy product is typically pH 3.5-5.5. Preferably, the acidified dairy product has a pH in the range of pH 4.0-5.0. Even more preferably, the acidified dairy product has a pH in the range of pH 4.2-4.8, such as e.g. approx. pH 4.6.

In some preferred embodiments of the invention the high protein, acidified dairy product has a total amount of protein of at least 8% (w/w). For example, the high protein, acidified dairy product may have a total amount of protein of at least 10% (w/w). The high protein, acidified dairy product may e.g. have a total amount of protein of at least 12% (w/w). Alternatively, the high protein, acidified dairy product may e.g. have a total amount of protein of at least 14% (w/w).

An even higher protein content may be desired, thus, the high protein, acidified dairy product may have a total amount of protein of at least 16% (w/w). The high protein, acidified dairy product may e.g. have a total amount of protein of at least 18% (w/w). Alternatively, the high protein, acidified dairy product may e.g. have a total amount of protein of at least 21% (w/w).

Typically, the high protein, acidified dairy product has a total amount of protein in the range of 7-25% (w/w). For example, the high protein, acidified dairy product may have a total amount of protein in the range of 8-20% (w/w). The high protein, acidified dairy product may e.g. have a total amount of protein of at least 10-18% (w/w). Alternatively, the high protein, acidified dairy product may e.g. have a total amount of protein of at least 12-16% (w/w).

In some embodiments of the invention, the high protein, acidified dairy product has a total amount of protein in the range of 21-25% (w/w).

In some preferred embodiments of the invention, the high protein, acidified dairy product is a yoghurt.

In the context of the present invention, the term "yoghurt" refers to an acidic or fermented food or beverage product prepared from a one or more dairy components, and which has been acidified by means of microorganisms and/or chemical acidulants. It should be noted that the term "yoghurt" also refers to yoghurt-like products that may include non-dairy derived lipids, flavourings and food-approved stabilisers, acids and

texturizers. Heat-treated yoghurt and yoghurt-like products are also included by the term yoghurt. The term "yoghurt" includes set yoghurts, stirred yoghurts, drinking yoghurt and Petit Suisse.

The yoghurts according to the present invention may, but need not, contain casein.

For example, the high protein yoghurt may have a weight ratio between casein and whey protein of at most 50:50. For example, the weight ratio between casein and whey protein of the high protein yoghurt may be at most 30:70. The weight ratio between casein and whey protein of the high protein yoghurt may e.g. be at most 20:80. Alternatively, the weight ratio between casein and whey protein of the high protein yoghurt may e.g. be at most 15:85, such as e.g. at most 10:90.

In some preferred embodiments of the invention, high protein yoghurt is a set yoghurt. Set yoghurts (or set-type yoghurts) are typically characterised by a jelly-like texture and are often allowed to incubate and cool in the final package. Set yoghurts are normally non-pourable and are often eaten out of the packaging with a spoon.

In other preferred embodiments of the invention, the high protein yoghurt is a stirred yoghurt. Relative to a set yoghurt, a stirred yoghurt is pourable but often still rather viscous. The term "stirred" is most likely based on the fact that the acidified yoghurt milks originally were stirred to break the formed coagulum/gel and make the product more liquid and pumpable. However, in the context of the present invention, the term "stirred yoghurt" also encompasses yoghurts which have not been subjected to stirring, but which have obtained a liquid-like, viscous texture by other ways.

A stirred yoghurt may for example have a viscosity of at most 2500 cP, and typically in the range of 350-2500 cP. For example, the viscosity of the stirred yoghurt may be in the range of 400-2000 cP. The viscosity of the stirred yoghurt may e.g. be in the range of 500-1500 cP. Alternatively, the viscosity of the stirred yoghurt may be in the range of 600-1250 cP.

In further preferred embodiments of the invention, the high protein yoghurt is a drinking yoghurt, which may be perceived as a low viscosity, drinkable yoghurt. A drinking yoghurt may for example have a viscosity of at most 400 cP, and typically in the range of 4-400 cP. For example, the viscosity of the drinking yoghurt may be in the range of 10-300 cP. The viscosity of the drinking yoghurt may e.g. be in the range of 15-200 cP. Alternatively, the viscosity of the drinking yoghurt may be in the range of 20-150 cP.

In some preferred embodiments of the invention, the high protein, acidified dairy product, e.g. a high protein yoghurt, comprises one or more sweeteners, such as carbohydrate sweeteners, polyols and/or high intensity sweeteners.

The high protein, acidified dairy product, e.g. a high protein yoghurt, may e.g. comprise a total amount of carbohydrate sweetener in the range of 1-20% (w/w) relative to the total weight of the acidified dairy product. Alternatively, the acidified dairy product, e.g. a high protein yoghurt, may comprise a total amount of carbohydrate sweetener in the range of 4-15% (w/w) relative to the total weight of the acidified dairy product. Since other ingredients of the acidified dairy product inherently may comprise some carbohydrate sweetener, such as lactose, it will often be sufficient to add carbohydrate sweetener in an amount of about 2 – 10% relative to the total weight of the acidified dairy product to reach the desired sweetness of taste. Alternatively, the acidified dairy product may comprise a total amount of added carbohydrate sweetener in the range of 4-8% (w/w) relative to the total weight of the acidified dairy product.

A high protein, acidified dairy product, e.g. a high protein yoghurt, containing the denatured whey protein composition, may further comprise one of more non-carbohydrate natural or artificial sweetener.

In one embodiment, the high protein, acidified dairy product, e.g. a high protein yoghurt, contains one or more natural sweetening agent(s) that are not sugars. These natural sweetening agent(s) may be provided as a component of a second sweetening agent, either alone or in combination with a carbohydrate sweetener, as described. The natural non-sugar sweetening agent(s) may for example be selected from the group consisting of Momordica Grosvenorii (Mogrosides IV or V) extracts, Rooibos extracts, Honeybush extracts, Stevia extract, Rebaudioside A, thaumatin, Brazzein, Glycyrrhyzic acid and its salts, Curculin, Monellin, Phylloducin, Rubusosides, Mabinlin, dulcoside A, dulcoside B, siamenoside, monatin and its salts (monatin SS, RR, RS, SR), hernandulcin, phyllodulcin, glycyphyllin, phloridzin, trilobatin, baiyunoside, osladin, polypodoside A, pterocaryoside A, pterocaryoside B, mukuroziside, phlomisoside I, periandrin I, abrusoside A, cyclocarioside I, erythritol, isomaltulose, and/or natural polyols such as maltitol, mannitol, lactitol, sorbitol, inositol, xylitol, threitol, galactitol and combinations thereof.

In one embodiment, the high protein, acidified dairy product, e.g. a high protein yoghurt, contains one or more artificial sweetening agent(s). These artificial sweetening agent(s) may be provided as a component of the first sweetener, either alone or in combination with other of the sweeteners as defined above. The artificial non-sugar sweetening agent(s) may for example be selected from the group consisting of Aspar-

tame, Cyclamate, Sucralose, Acesulfame K, neotame, Saccharin, Neohesperidin dihydrochalcone, Stevia extract, Rebaudioside A, thaumatin, Brazzein, Glycyrrhyzic acid and its salts, Curculin, Monellin, Phylloducin, Rubususides, Mabinlin, dulcoside A, dulcoside B, siamenoside, monatin and its salts (monatin SS, RR, RS, SR) and combinations thereof.

In some embodiments of the invention, it is particularly preferred that the sweetener, comprises or even consists of, one or more high intensity sweeteners (HIS). HIS are both found among the natural and the artificial sweeteners and typically have a sweetening intensity of at least 10 times that of sucrose. Non-limiting examples of useful HIS are Aspartame, Cyclamate, Sucralose, Acesulfame K, neotame, Saccharin, Neohesperidin dihydrochalcone and combinations thereof.

If used, the total amount of HIS is typically in the range of 0.01-2% (w/w). For example, the total amount of HIS may be in the range of 0.05-1.5% (w/w). Alternatively, the total amount of HIS may be in the range of 0.1-1.0% (w/w).

It may furthermore be preferred that the sweetener comprises or even consists of, one or more polyol sweetener(s). Non-limiting examples of useful polyol sweeteners are maltitol, mannitol, lactitol, sorbitol, inositol, xylitol, threitol, galactitol or combinations thereof.

If used, the total amount of polyol sweetener is typically in the range of 1-20% (w/w). For example, the total amount of polyol sweetener may be in the range of 2-15% (w/w). Alternatively, the total amount of polyol sweetener may be in the range of 4-10% (w/w).

In one embodiment, the high protein, acidified dairy product, e.g. a high protein yoghurt, contains the casein, e.g. in the form of caseinate or micellar casein. The use of micellar casein is sometimes preferred as it contributes less to the viscosity of the final product than caseinate.

Examples of suitable sources of micellar casein are whole milk, non-fat milk, skimmed-milk, semi-skimmed milk, and butter milk. These sources may be used both as liquid milk or in dried, powdered form.

The caseinate may e.g. be Na-caseinate or Ca-caseinate or other caseinate salts.

High protein yoghurt may e.g. contain casein in an amount in the range of 0-90% (w/w) relative to the total amount of protein, such as e.g. in the range of 0-70% (w/w) rela-

tive to the total amount of protein. When using a high casein level, the yoghurts tend to become highly viscous and may even form a non-pourable gel. Stirred high protein yoghurts often contain casein in an amount in the range of 25-60% (w/w) relative to the total amount of protein, such as e.g. in the range of 30-55% (w/w) relative to the total amount of protein, or even in the range of 35-50% (w/w) relative to the total amount of protein.

High protein drinking yoghurt may e.g. contain casein in an amount in the range of 0-35% (w/w) relative to the total amount of protein, such as e.g. in the range of 0-30% (w/w) relative to the total amount of protein. High protein drinking yoghurts may e.g. contain casein in an amount in the range of 5-30% (w/w) relative to the total amount of protein. For example, high protein drinking yoghurts may contain casein in an amount in the range of 10-30% (w/w) relative to the total amount of protein. Alternatively, high protein drinking yoghurts may contain casein in an amount in the range of 15-30% (w/w) relative to the total amount of protein, or even in the range of 20-30% (w/w) relative to the total amount of protein.

In some embodiments of the invention, the acidified dairy product, e.g. a high protein yoghurt, furthermore contains native whey protein e.g. in the form of whey protein concentrates or whey protein isolates. Native whey protein is also provided by several milk protein sources such as liquid or dried milk and by milk protein concentrates.

High protein yoghurt may e.g. contain native whey protein in an amount in the range of 0-40% (w/w) relative to the total amount of protein, such as e.g. in the range of 2-30% (w/w) relative to the total amount of protein. High protein yoghurts may e.g. contain native whey protein in an amount in the range of 3-30% (w/w) relative to the total amount of protein. For example, high protein yoghurts may contain native whey protein in an amount in the range of 4-25% (w/w) relative to the total amount of protein. Alternatively, high protein yoghurts may contain native whey protein in an amount in the range of 5-20% (w/w) relative to the total amount of protein, or even in the range of 6-15% (w/w) relative to the total amount of protein.

It should be noted that while both casein and native whey protein may be present in the ingredients of the acidified dairy product, such as a high protein yoghurt, they often aggregate and form part of gel networks and/or particles during the processing of the acidified dairy product – especially if prolonged pasteurisation is involved. The amounts of protein components of the acidified dairy product which are mentioned herein therefore primarily relate to the ingredients which are used for producing the product.

The acidified dairy product, e.g. a high protein yoghurt, may furthermore comprise one or more vitamin(s) and similar other ingredients such as vitamin A, vitamin D, vitamin E, vitamin K, thiamine, riboflavin, pyridoxine, vitamin B12, niacin, folic acid, pantothenic acid, biotin, vitamin C, choline, inositol, their salts, their derivatives and combinations thereof.

The acidified dairy product, e.g. a high protein yoghurt, may furthermore comprise one of more stabilizer(s). Suitable stabilizers which can be used in the present invention include locust bean gum, guar gum, alginates, cellulose, xanthan gum, carboxymethyl cellulose, microcrystalline cellulose, carrageenans, pectins, inulin and mixtures thereof.

The content of the one of more stabiliser(s) may e.g. be in the range of 0.01-5% (w/w) relative to the dry weight of the product, preferably in the range of 0.1 to 0.5% (w/w).

The acidified dairy product, e.g. a high protein yoghurt, may furthermore comprise one of more emulsifier(s). Suitable emulsifiers to be used are mono- and di-glycerides, citric acid esters of mono- and di-glycerides, diacetyltartaric acid esters of mono- and di-glycerides polysorbate, lecithin, or polyol esters of fatty acids such as propylene glycol monoester of fatty acids, as well as natural emulsifiers such as egg yolk, butter milk, raw acacia gum, rice bran extract or mixtures thereof.

The content of the one of more emulsifier(s) may be in the range of 0.01-3% (w/w) relative to the dry weight of the product, for example in the range of 0.1 to 0.5% (w/w).

In some preferred embodiments, the yoghurt is a stirred yoghurt containing:
- a total amount of protein in the range of 9-18% (w/w),
- the solids of the denatured whey protein composition in an amount of at least 3.5% (w/w), which denatured whey protein composition comprises at least 70% (w/w) protein on a dry weight basis relative to the weight of the denatured whey protein composition,
- casein in an amount in the range of 30-65% (w/w) relative to the total amount of protein,
- a total amount of fat of at most 2% (w/w), and
- a total amount of carbohydrate in the range of 2-20% (w/w).

In some preferred embodiments, the yoghurt is a stirred yoghurt containing:
- a total amount of protein in the range of 9-18% (w/w),
- the solids of the denatured whey protein composition in an amount of at least 3.5% (w/w), which denatured whey protein composition comprises at least 70% (w/w) pro-

tein on a dry weight basis relative to the weight of the denatured whey protein composition,
- casein in an amount in the range of 30-65% (w/w) relative to the total amount of protein,
- a total amount of fat of at most 0.3% (w/w), and
- a total amount of carbohydrate in the range of 2-20% (w/w).

In some preferred embodiments, the high protein yoghurt is a stirred yoghurt containing:
- a total amount of protein in the range of 9-18% (w/w),
- the solids of the denatured whey protein composition in an amount of at least 3.5% (w/w), which denatured whey protein composition comprises at least 70% (w/w) protein on a dry weight basis relative to the weight of the denatured whey protein composition, which denatured whey protein composition contains at most 2% lactose (w/w) on a dry weight basis,
- casein in an amount in the range of 30-65% (w/w) relative to the total amount of protein,
- a total amount of fat of at most 2% (w/w), and
- a total amount of lactose of at most 1% (w/w), preferably at most 0.4% (w/w).

In some preferred embodiments, the high protein yoghurt is a stirred yoghurt containing:
- a total amount of protein in the range of 9-18% (w/w),
- the solids of the denatured whey protein composition in an amount of at least 3.5% (w/w), which denatured whey protein composition comprises at least 70% (w/w) protein on a dry weight basis relative to the weight of the denatured whey protein composition, which denatured whey protein composition contains at most 2% lactose (w/w) on a dry weight basis and at most 0.3% (w/w) fat on a dry weight basis,
- casein in an amount in the range of 30-65% (w/w) relative to the total amount of protein,
- a total amount of fat of at most 0.3% (w/w), and
- a total amount of lactose of at most 1% (w/w), preferably at most 0.4% (w/w).

In other preferred embodiments of the invention the high protein yoghurt is a drinking yoghurt containing:
- a total amount of protein in the range of 8-16% (w/w),
- the solids of the denatured whey protein composition in the range of at least 6% (w/w), which denatured whey protein composition comprises at least 70% (w/w) protein on a dry weight basis relative to the weight of the denatured whey protein composition,

- casein in an amount in the range of 0-30% (w/w) relative to the total amount of protein,
- a total amount of fat of at most 2% (w/w), and
- a total amount of carbohydrate in the range of 2-20% (w/w).

In other preferred embodiments of the invention the high protein yoghurt is a drinking yoghurt containing:
- a total amount of protein in the range of 8-16% (w/w),
- the solids of the denatured whey protein composition in the range of at least 6% (w/w), which denatured whey protein composition comprises at least 70% (w/w) protein on a dry weight basis relative to the weight of the denatured whey protein composition, which denatured whey protein composition contains at most 0.3% fat(w/w) on a dry weight basis,
- casein in an amount in the range of 0-30% (w/w) relative to the total amount of protein,
- a total amount of fat of at most 0.4% (w/w), and
- a total amount of carbohydrate in the range of 2-20% (w/w).

In other preferred embodiments of the invention the high protein yoghurt is a drinking yoghurt containing:
- a total amount of protein in the range of 8-16% (w/w),
- the solids of the denatured whey protein composition in the range of at least 6% (w/w), which denatured whey protein composition comprises at least 70% (w/w) protein on a dry weight basis relative to the weight of the denatured whey protein composition, which denatured whey protein composition contains at most 0.3% fat(w/w) on a dry weight basis and at most 1% (w/w) lactose, preferably at most 0.4% (w/w) on a dry weight basis,
- casein in an amount in the range of 0-30% (w/w) relative to the total amount of protein,
- a total amount of fat of at most 0.4% (w/w), and
- a total amount of lactose of at most 1% (w/w), preferably at most 0.4% (w/w).

In other preferred embodiments of the invention the high protein yoghurt is a drinking yoghurt containing:
- a total amount of protein in the range of 8-16% (w/w),
- the solids of the denatured whey protein composition in the range of at least 6% (w/w), which denatured whey protein composition comprises at least 70% (w/w) protein on a dry weight basis relative to the weight of the denatured whey protein composition, which denatured whey protein composition contains at most 0.3% fat (w/w) on a

dry weight basis and at most 1% (w/w) lactose, preferably at most 0.4% (w/w) on a dry weight basis,

- casein in an amount in the range of 0-30% (w/w) relative to the total amount of protein,
- a total amount of fat of at most 2% (w/w),
- a total amount of lactose of at most 1% (w/w), preferably at most 0.4% (w/w).

Such high protein drinking yoghurts preferably have a viscosity in the range of 10-150 cP, and even more preferably in the range of 10-100 cP.

Yet an aspect of the invention is a dairy product obtainable by the present method of producing a dairy product.

In some preferred embodiments of the invention, the dairy product is a low fat dairy product meaning that the total amount of fat of the product is at most 10% (w/w). For example, the low fat dairy product may contain a total amount of fat of at most 5% (w/w).

Preferably, the low fat dairy product, e.g. a high protein yoghurt, may contain a total amount of fat of at most 2% (w/w). Even more preferably, the low fat dairy product, e.g. a high protein yoghurt, may contain a total amount of fat of at most 1% (w/w), such as e.g. a total amount of fat of at most 0.5% (w/w).

For example, the low fat dairy product, e.g. a high protein yoghurt, may contain a total amount of fat of at most 0.4% (w/w). The low fat dairy product, e.g. a high protein yoghurt, may e.g. contain a total amount of fat of at most 0.3% (w/w). Alternatively, the low fat dairy product, e.g. a high protein yoghurt, may contain a total amount of fat of at most 0.2% (w/w), such as e.g. at most 0.1% (w/w).

In some preferred embodiments of the invention, the dairy product, e.g. a high protein yoghurt, is a low lactose dairy product meaning that the total amount of lactose of the product is at most 2% (w/w). Thus, the low lactose dairy product, e.g. a high protein yoghurt, may contain a total amount of lactose of at most 1.5% (w/w). Preferably, the low lactose dairy product, e.g. a high protein yoghurt, may contain a total amount of lactose of at most 1% (w/w). Even more preferably, the low lactose dairy product, e.g. a high protein yoghurt, may contain a total amount of lactose of at most 0.5% (w/w). For example, the low lactose dairy product, e.g. a high protein yoghurt, may contain a total amount of lactose of at most 0.3% (w/w). The low lactose dairy product, e.g. a high protein yoghurt, may e.g. contain a total amount of lactose of at most 0.2% (w/w).

Alternatively, the low lactose dairy product, e.g. a high protein yoghurt, may contain a total amount of lactose of at most 0.1% (w/w), such as e.g. substantially no lactose.

The low lactose variants of the dairy product, such as yoghurts, are particularly advantageous for persons suffering from lactose-intolerance.

Lactose may be removed enzymatically in which case it is converted to the monosaccharides glucose and galactose. Both monosaccharides contribute to the total carbohydrate content of the dairy product.

In some preferred embodiments of the invention, the dairy product, e.g. a high protein yoghurt, is a low carbohydrate dairy product meaning that the total amount of carbohydrate of the product is at most 2% (w/w). For example, the low carbohydrate dairy product, e.g. a high protein yoghurt, may contain a total amount of carbohydrate of at most 1.5% (w/w). Preferably, the low carbohydrate dairy product, e.g. a high protein yoghurt, may contain a total amount of carbohydrate of at most 1% (w/w). Even more preferably, the low carbohydrate dairy product, e.g. a high protein yoghurt, may contain a total amount of carbohydrate of at most 0.5% (w/w). For example, the low carbohydrate dairy product, e.g. a high protein yoghurt, may contain a total amount of carbohydrate of at most 0.3% (w/w). The low carbohydrate dairy product, e.g. a high protein yoghurt, may e.g. contain a total amount of carbohydrate of at most 0.2% (w/w). Alternatively, the low carbohydrate dairy product, e.g. a high protein yoghurt, may contain a total amount of carbohydrate of at most 0.1% (w/w), such as e.g. substantially no carbohydrate.

In some preferred embodiments of the invention the high protein food product is a high protein, acidified beverage.

In the context of the present invention the term "acidified beverage" relates to a dairy product having a pH of at most 5.5, and e.g. less, such as at most 5.0 or even at most 4.7, such as e.g. approx. pH 4.6. Even lower pH'es may be employed.

Typically, high protein, acidified beverages have been acidified with chemical acidulants and without the use of microorganisms.

In the context of the present invention, the term "chemical acidulants" relates to non-microbial agents that as such are acidic or that are converted to acids, e.g. by hydrolysis. Food acids are useful examples of non-microbial agents that are acidic as such.

The beverage may for example comprise a food acid selected from the group consisting of citric acid, malic acid, tartaric acid, acetic acid, benzoic acid, butyric acid, lactic acid, fumaric acid, succinic acid, ascorbic acid, adipic acid, phosphoric acid and mixtures thereof.

The total amount of food acid in the beverage may be at least 0.1% (w/w) of the total weight of the beverage, preferably 0.5% (w/w), for example in the range of 1.0 – 5%; more preferably at least 1.0% (w/w) of the total weight of the beverage. These total amounts of food acids in the beverage correspond to the sum of food acid, including both acids, partly deprotonated and fully deprotonated forms of the food acid.

Lactones such as e.g. Glucono Delta Lactone (GDL) are converted to acids by hydrolysis.

In some preferred embodiments of the invention, the high protein, acidified beverage contains substantially no casein, i.e. at most 0.5% (w/w) casein relative to the total weight of the beverage and preferably at most 0.1% (w/w).

Another aspect of the invention pertains to a high protein beverage obtainable according to the method of producing a high protein beverage of the present invention.

The types and amounts of protein ingredients, fat, sweeteners, stabilisers and emulsifiers that are mentioned in the context of the high protein, acidified dairy products can also be used for high protein beverages in general.

The denatured whey protein composition and ingredients containing the denatured whey protein composition are also useful for preparing high protein, nutritional products, including nutritional beverages, and specialist nutritional products including meal replacement products.

Specialist nutritional products (sometimes known as medical foods and enteral foods) can be prepared for patients and the elderly and administered in liquid form. One of the challenges to be overcome in the preparation of such foods is attaining sufficient calorie density.

In some preferred embodiments of the invention, the food product is a high protein, nutritional beverage having a calorie density of at least 0.1 kcal/mL, such as e.g. at least 1 kcal/mL or at least to at approx. 3 kcal/mL. Such beverages typically contain a significant amount of fat, e.g. at least 5% (w/w) fat relative to the total weight of the

beverage, preferably at least 8% (w/w) fat, and even more preferably at least 10% (w/w) fat relative to the total weight of the beverage.

The high protein nutritional beverage may for example have a pH in the range of 6-8, such as approx. 7. Alternatively, the high protein nutritional beverage may be an acidified high protein beverage as described herein.

The protein nutritional beverages may have a total protein content in the same ranges as mentioned in the context of acidified high protein beverages.

The fat may e.g. comprise, or even consist of, one or more of the fat or oil types mentioned herein.

The denatured whey protein composition may e.g. be used as an ingredient in a mixture to form a nutritional product comprising the denatured whey protein composition, water and soluble carbohydrate, and preferably also comprising a significant amount of fat. Preferably, the mixture further comprises sodium and potassium salts and a source of fats and vitamins. Preferably, the mixture is heated to a temperature above 70°C, preferably above 100°C, more preferably under at least commercial sterilising conditions. Preferably, the mixture also includes a magnesium salt. Commercial sterilising conditions are conditions achieved using the application of heat or high pressure to render a product free of microorganisms capable of growing in the product at non refrigerated conditions (over 10°C at which the product will be held during distribution and storage).

In some preferred embodiments of the invention, the high protein nutritional beverage has a calorie density of at least 1 kcal/mL and comprises

- a total amount of protein of at least 4% (w/w),
- a total amount of fat of at least 8% (w/w),
- the solids of the denatured whey protein composition in an amount of at least 4% (w/w).

For example, the high protein, nutritional beverage may have a calorie density of at least 1 kcal/mL and may comprise

- a total amount of protein of at least 8% (w/w),
- a total amount of fat of at least 8% (w/w),
- the solids of the denatured whey protein composition in an amount of at least 6% (w/w).

The food product containing the denatured whey protein composition can be produced in a number of different ways. The denatured whey protein composition may for exam-

ple be added as a dry ingredient during the production of the food product or it may be added in the form of a suspension during the production.

When the denatured whey protein composition is used in the form of powder, it is often preferred to resuspend the denatured whey protein composition powder in an aqueous liquid, e.g. water or milk, and give it time to rehydrate, e.g. 10 minutes – 1 hour, before continuing the processing. However, the general process may already inherently give the denatured whey protein composition powder sufficient time for rehydration in which case extra rehydration time is not necessary.

An aspect of the invention pertains to a method of producing a high protein acidified dairy product, such as e.g. a high protein yoghurt, the method comprising the steps of:

a) providing a dairy base comprising at least one dairy component and at least one carbohydrate

b) pasteurising the dairy base at a temperature in the range of 70-150 degrees C and subsequently cooling the dairy base,

c) contacting the heat-treated dairy base with an acidifying agent,

d) allowing the acidifying agent to reduce the pH of the dairy base to a pH of at most 5,

e) optionally, subjecting the acidified dairy base to one or more additional processing steps,

f) optionally, packaging the final acidified dairy product in a suitable container.

wherein:

I) the dairy base provided in step a) comprises a total amount of protein of at least 7% (w/w), the solids of a denatured whey protein composition as defined herein in an amount of at least 2% (w/w), and a total amount of soluble alpha-lactalbumin of at most 16% (w/w) relative to the total amount of protein, or

II) an ingredient comprising, or even consisting of, the solids of denatured whey protein composition is added to the dairy base between steps a) and f) in an amount sufficient to form the acidified dairy product containing:
- a total amount of protein of at least 7% (w/w),

- the solids of the denatured whey protein composition in an amount of at least 2% (w/w), and
- a total amount of soluble alpha-lactalbumin of at most 16% (w/w) relative to the total amount of protein.

The above method includes two variants; variant I) where all or substantially all of the ingredients are present in the dairy based from the start, or variant II) where at least some of the denatured whey protein composition is added to the dairy bases after step a).

For example, the solids of a denatured whey protein composition may be added between steps a) and b), during step b), between steps b) and c), during step c), between steps c) and d), during step d), between steps d) and e), during step e) and/or between steps e) and f).

It should be noted that the term "dairy base" describes the product stream during the method and that the dairy base may have different compositions during the method – especially following variant II), but also according to variant I) if sweetener(s) and/or flavour is added in step e).

Step a) involves the provision of the dairy base comprising at least one dairy component and at least one carbohydrate.

In some embodiments of the invention according to variant I), the dairy base of step a) contains all or substantially all protein ingredients that go into the final product, except for the protein contribution of the acidifying agent.

The dairy base of step a) may e.g. comprise a total amount of protein of at least 7% (w/w), solids of the denatured whey protein composition amount of at least 2% (w/w) and a total amount of alpha-lactalbumin of at most 16% (w/w) relative to the total amount of protein.

In some preferred embodiments of the invention, the dairy base of step a) contains a total amount of soluble alpha-lactalbumin of at most 16% (w/w) relative to the total amount of protein. For example, the dairy base of step a) may contain a total amount of soluble alpha-lactalbumin of at most 12% (w/w) relative to the total amount of protein. The dairy base of step a) may e.g. contain a total amount of soluble alpha-lactalbumin of at most 10% (w/w) relative to the total amount of protein. Alternatively, the dairy base of step a) may contain a total amount of soluble alpha-lactalbumin of at most 8% (w/w) relative to the total amount of protein.

A lower concentration of soluble alpha-lactalbumin may be preferred, thus, the dairy base of step a) may contain a total amount of soluble alpha-lactalbumin of at most 6% (w/w) relative to the total amount of protein. For example, the dairy base of step a) may contain a total amount of soluble alpha-lactalbumin of at most 4% (w/w) relative to the total amount of protein. The dairy base of step a) may e.g. contain a total amount of soluble alpha-lactalbumin of at most 2% (w/w) relative to the total amount of protein. Alternatively, the dairy base of step a) may contain a total amount of soluble alpha-lactalbumin of at most 1% (w/w) relative to the total amount of protein, such as e.g. substantially no soluble alpha-lactalbumin.

In some preferred embodiments of the invention, the dairy base of step a) contains a total amount of soluble alpha-lactalbumin in the range of 1-16% (w/w) relative to the total amount of protein. For example, the dairy base of step a) may contain a total amount of soluble alpha-lactalbumin in the range of 2-12% (w/w) relative to the total amount of protein. The dairy base of step a) may e.g. contain a total amount of soluble alpha-lactalbumin in the range of 3-10% (w/w) relative to the total amount of protein. Alternatively, the dairy base of step a) may contain a total amount of soluble alpha-lactalbumin in the range of 4-8% (w/w) relative to the total amount of protein.

In some embodiments of the invention according to variant I), the dairy base of step a) contains all the solids that will be present in the final acidified dairy product, except for the solids contribution of the acidifying agent.

Thus, the dairy base of step a) may have the composition of the high protein, acidified dairy products, e.g. yoghurts, described herein.

In other embodiments of the invention, the dairy base of step a) a carbohydrate, e.g. lactose, and some of the protein ingredients, but at least some of the solids of the denatured whey protein composition, such as e.g. all the solids of the denatured whey protein composition, are provided after step a), e.g. after the acidification of step d) or as one of the additional processing steps of step e).

In some embodiments of the invention, the dairy base of steps a) and b) only contains lactose and a sufficient amount of mineral nutrients to allow the bacterial acidification of the dairy base to take place. The remaining protein ingredients are added after the acidification of step d).

The dairy base of step a) may e.g. contain the types and amounts of protein ingredients, sweeteners, stabilisers, fats, and minerals mentioned in the context of the high protein, acidified dairy product or the high protein yoghurt.

Step b) involves pasteurising the dairy base of step a) by heating it to a temperature of at least 70 degrees C, e.g. in the range of 70-150 degrees C, and maintaining the temperature of the dairy base in that range for a duration sufficient to kill a substantial number of the viable microorganisms of the dairy base. Typically, at least 99% of the microorganisms are killed during the pasteurisation. Another purpose of the pasteurisation may be to denature at least some of the native whey protein which may be present in the dairy base of step a).

The duration of the pasteurisation depends on the temperature(s) to which the dairy based is heated and is typically somewhere between 1 second and 30 minutes.

For example, the dairy base may be heated to one or more temperatures in the range of 70-85 degrees C for 1-30 minutes. The dairy base may e.g. be heated to one or more temperatures in the range of 80-95 degrees C for 0.5-15 minutes. Alternatively, the dairy base may be heated to one or more temperatures in the range of 90-110 degrees C for 0.2-10 minutes. For example, the dairy base may be heated to one or more temperatures in the range of 100-150 degrees C for 1 second-2 minutes.

After the heat-treatment the dairy base is cooled, e.g. to a temperature of at most 50 degrees C, preferably even lower such as at most 45 degrees C or at most 40 degrees C.

In addition to the pasteurisation, step b) typically contains a homogenisation step which may be place before or after the heat treatment.

The cooled dairy base of step b) is contacted with the acidifying agent.

The acidifying agent may for example be a bacterial culture, typically referred to as a starter culture, in which case the addition of the acidifying agent may be perceived as an inoculation of the dairy base, in which case one obtains an inoculated dairy base.

Thus, in some embodiments of the invention the acidifying agent comprises a chemical acidifying agent.

In the context of the present invention the term "chemical acidifying agent" pertains to a chemical compound capable of gradual or instantaneous reduction of the pH of the mixture.

The chemical acidifying agent may for example be a food acceptable acid (also referred as a food acid) and/or a lactone. Examples of useful acids are carboxylic acids such as citric acid, tartaric acid and/or acetic acid. An example of a useful lactone is glucono delta-lactone (GDL).

In some embodiments of the invention, the chemical acidifying agent comprises one or more components selected from the group consisting of acetic acid, lactic acid, malic acid, citric acid, phosphoric acid or glucono delta-lactone.

The actual concentration of the chemical acidifying agent depends on the specific formulation of dairy base. It is generally preferred that the chemical acidifying agent is used in a sufficient amount to reduce the pH of the mixture to at most pH 5.5, and preferably at most pH 5.0, such as e.g. at most pH 4.6.

In some preferred embodiments of the invention, the acidifying agent comprises, or even is, a starter culture.

In principle, any type of starter culture traditionally used in making yoghurt-type high protein acidified dairy product may be used. Starter cultures used in the dairy industry are normally mixtures of lactic acid bacterial strains, but a single strain starter culture may also be useful in the present invention. Thus, in preferred embodiments, the one or more starter culture organism of the present process is a lactic acid bacterial species selected from the group consisting of Lactobacillus, Leuconostoc, Lactococcus and Streptococcus. Commercial starter culture comprising one or more of these lactic acid bacterial species may be useful in the present invention.

In some preferred embodiments of the invention, the starter culture comprises one or more halotolerant bacterial culture(s).

The amount of the added acidifying agent is typically relatively low compared to the amount of the dairy base.

In some embodiments of the invention, the acidifying agent dilutes the dairy base by a factor of at most 1.05, preferably at most by a factor of 1.01, and even more preferably by a factor of at most 1.005.

Flavouring and/or aromatic agents may be added to the dairy base to obtain a flavoured acidified dairy product. Flavours may be added as solids, but are preferably added in the form of liquids.

During step d) the acidifying agent is allowed to reduce the pH of the dairy base of step c).

If the dairy base of step c) contains a starter culture the dairy base, which is an inoculated dairy base, is incubated under conditions permitting the starter culture to become metabolically active to produce said acidified dairy product. In some preferred embodiments, the inoculated dairy base is incubated at a temperature between 32°C and 43°C until the desired pH is reached. The fermentation may be stopped by decreasing the temperature to around 10°C.

If the mixture contains a chemical acidifying agent, the chemical acidifying agent will normally start reducing the pH of the mixture as soon as the chemical acidifying agent forms part of the mixture. Some chemical acidifying agents, such as lactones and slowly dissolving acids, will provide a gradual pH reduction as they react with water or are dissolved.

The temperature of the dairy base during step d) is typically in the range of 20-50 degrees C, and preferably in the range of 32-45 degrees C.

The method of producing the acidified, high protein dairy product may contain one or more process steps in addition to steps a), b), c), and d). For example, one or more of such additional process steps may take place in step e) after the acidification of the dairy base.

Often, the acidified dairy base obtained in step d) is subsequently subjected to mechanical stirring and/or homogenisation, particularly if the acidification leads to the formation of strong gels. Thus, step e) may involve mechanical stirring and/or homogenisation of the acidified dairy base.

Moreover, if additional ingredients are required in the acidified, high protein dairy product, these may be added during step e) and mixed into the acidified dairy base.

Useful examples of such additional ingredients are sweeteners, flavouring agents, additional denatured whey protein composition, stabilisers, emulsifiers and vitamins. Examples of such additional ingredients are mentioned in the context of the composition of the high protein, acidified dairy product or the high protein yoghurt.

The packaging of step f) may involve any suitable packaging techniques, and any suitable container may be used for packaging the high protein, acidified dairy product.

The packaging of step f) may for example involve aseptic packaging, i.e. the product is packaged under aseptic conditions. For example, the aseptic packaging may be performed by using an aseptic filling system, and it preferably involves filling the product into one or more aseptic container(s).

Examples of useful containers are e.g. bottles, cartons, bricks and/or bags.

The packaging is preferably performed at or below room temperature. Thus, the temperature of the product is preferably at most 30 degrees C during the packaging, preferably at most 25 degrees C and even more preferably at most 20 degrees C, such as at most 10 degrees C.

The temperature of the product during packaging may for example be in the range of 2-30 degrees C, and preferably in the range of 5-25 degrees C.

The denatured whey protein composition of the invention is advantageously used as a component of a food ingredient powder.

Accordingly, one embodiment of the invention is a food ingredient powder comprising, or even consisting of:

i. the solids of the denatured whey protein composition in an amount of at least 5% (w/w), wherein the denatured whey protein composition contains
   - a total amount of protein of at least 60% (w/w) on a dry weight basis,
   - a total amount of soluble alpha-lactalbumin of at most 6% (w/w) relative to the total amount of protein,
   - insoluble whey protein particles having a particle size in the range of 1-10 micron, where the amount of said insoluble whey protein particles is in the range of 50-100% (w/w) relative to the total amount of protein
ii. optionally, a small amount of water
iii. one or more additional components selected from the group consisting of:
   - a caseinate composition,
   - a concentrate of micellar casein,
   - a milk protein concentrate, and
   - a milk powder, such as e.g. skimmed milk powder.

The solids of the denatured whey protein composition, meaning the material that would be left if all water of the composition was removed, may in some cases be present in higher amounts in the food ingredient powder. The solids present in the food ingredient powder may be present in an amount of at least 25% (w/w). For example the solids present in the food ingredient powder may be present in amount of at least 40% (w/w); preferably the solids are present in amount of at least 60% (w/w).

The denatured whey protein composition in the food ingredient powder typically has a total amount of protein of at least 70% (w/w) on a dry-matter basis, preferably at least 75% (w/w) and even more preferably at least 80% (w/w) on a dry weight basis.

In a preferred embodiment, the denatured whey protein composition contains soluble alpha-lactalbumin in an amount of at most 5% (w/w) relative to the total amount of protein. For example, the denatured whey protein composition may contain soluble alpha-lactalbumin in an amount of at most 4% (w/w). In some cases, the denatured whey protein composition may contain soluble alpha-lactalbumin in an amount of at most 3% (w/w) relative to the total amount of protein.

In a preferred embodiment, the food ingredient powder has a total protein : ash content weight ratio of at least 15. In some cases, the total protein : ash content weight ratio of the food ingredient powder is at least 20. Even more preferably, the total protein : ash content weight ratio of the food ingredient powder is at least 30. For example, the total protein : ash content weight ratio of the food ingredient powder may be at least 40, such as at least 50, preferably at least 20, and even more preferably at least 30, such at least 40 or at least 50.

For example, the food ingredient powder may have a total protein : ash content weight ratio in the range of 15 - 60. The food ingredient powder may e.g. have a total protein : ash content weight ratio in the range of 20 - 55. Alternatively, the food ingredient powder may have a total protein : ash content weight ratio in the range of 25 – 50, such as in the range of 30-45.

In a preferred embodiment, the food ingredient powder has a water content of at most 6% (w/w), preferably at most 3% (w/w).

In a preferred embodiment, the food ingredient powder has a lactose content of at most 35% (w/w). Preferably, the food ingredient powder has a lactose content of at most 15% (w/w). For example, the food ingredient powder has a lactose content of at most 10% (w/w).

In one embodiment, the food ingredient powder has a low fat content of at most 8% (w/w). For example, the food ingredient powder may contain at most 4% fat (w/w). In some cases, the food ingredient powder contains at most 3% fat (w/w). Alternatively, the food ingredient powder may contain at most 2% fat (w/w).

In one embodiment, the food ingredient powder additionally comprises casein, either in the form of a caseinate composition or a concentrate of micellar casein. In one embodiment, the food ingredient powder contains a total amount of casein in the range of 0-20% (w/w). In some cases, the food ingredient powder contains a total amount of casein in the range of 6-18% (w/w); such as in the range of 10-16% (w/w). For example, the food ingredient powder may contain a total amount of casein in the range of 12-13% (w/w).

In one embodiment, the food ingredient powder additionally comprises one or more of a milk protein concentrate; and a milk powder, such as e.g. skimmed milk powder.

In some embodiments of the invention, it is particularly preferred that the food ingredient powder contains at total amount of soluble alpha-lactalbumin and beta-lactoglobulin of at most 15% (w/w) relative to the total amount of protein. For example, the food ingredient powder may contain a total amount of soluble alpha-lactalbumin and beta-lactoglobulin of at most 10% (w/w) relative to the total amount of protein. The food ingredient powder may e.g. contain a total amount of soluble alpha-lactalbumin and beta-lactoglobulin of at most 8% (w/w) relative to the total amount of protein. Alternatively, the food ingredient powder may contain a total amount of soluble alpha-lactalbumin and beta-lactoglobulin of at most 6% (w/w) relative to the total amount of protein, such as at most 4% (w/w) or even at most 2%. For example, the food ingredient powder may contain substantially no soluble alpha-lactalbumin and beta-lactoglobulin i.e. of at most 1% (w/w) relative to the total amount of protein and preferably 0% (w/w).

It should be noted that embodiments and features described in the context of one of the aspects of the present invention also apply to the other aspects of the invention.

All patent and non-patent references cited in the present application are hereby incorporated by reference in their entirety.

The invention will now be described in further details in the following non-limiting examples.

EXAMPLES

Example 1: Methods of analysis

Example 1.1: Quantification of the amount of insoluble particles

The amount of insoluble whey protein particles having a particles size in the range of 1-10 micron (effectively encompassing the size range 0.5-10.49 micron) of a denatured whey protein composition is determined using the following procedure:

1. Make a 5% (w/w in water) suspension of the sample to be tested.

2. Let the resulting suspension rehydrate for one hour with gentle agitation (stirring).

3. Homogenize the suspension at 100 bar.

4. Centrifuge a first portion of the suspension at 15000 g for 5 minutes.

5. Collect the resulting supernatant and analyse for total protein (true protein). The amount of total protein of the supernatant is referred to as "A".

6. Analyse a second portion of the suspension (not subjected to centrifugation) for total protein (true protein). The amount of total protein of the suspension is referred to as "B".

7. Subject a third portion of the suspension to particle size distribution analysis by static light scattering and determine the percentage by volume of the particles that have a particle size >10 micron, this percentage is referred to "C".

8. Determine the amount (% w/w relative to total protein) of insoluble whey protein particles having a particle size the range of 1-10 micron as:
P_{1-10}= (((B – A)/B)*100%)-C

9. Repeate steps 4-5, but centrifuging at 3000 g for 5 minutes instead of 15000 g (only the largest part of the particles will be removed). The total protein of the supernatant of step 9 is referred to as "D".

10. Determine the amount (% w/w relative to total protein) of insoluble whey protein particles having a particle size the range of 0.5-1.5 micron as:

P_1= ((D-A)/B)*100%

The procedure is performed at approx. 15 degrees C using a refrigerated centrifuge 3-30K from SIGMA Laborzentrifugen GmbH and 85 mL tubes (Order no. 15076), in which the 5% suspension is filled so that the total weight of tube and sample amounts to 96 g.

Particle size distribution analysis is performed using a Malvern Mastersizer (Micro Particle Sizer, Malvern Instruments Ltd., Worcestershire, UK).
Parameters: Particle refractive index 1.52 (real part), 0.1 (imaginary part) and dispersant refractive index 1.33 were used.
Data analysis: The data was fitted using the Mie scattering model (residuals < 2%).

Example 1.2: Determination of soluble CMP, alpha-lactalbumin and beta-lactobulin

The content of soluble CMP, alpha-lactalbumin and beta-lactobulin was analyzed by size exclusion high performance liquid chromatography (SE-HPLC). A Waters 600 E Multisolvent Delivery System, a Waters 700 Satellite Wisp Injector and a Waters H90 Programmable Multiwavelength Detector (Waters, Milford, MA, USA) were used. The elution buffer was composed of 0.15 M Na2S04, 0.09 M KH2P04 and 0.01 M K2HP04. The flow rate was 0.8 mL min-1 and the temperature 20°C.

Twenty-four hours prior to analysis, suspensions of the denatured whey protein compositions were prepared by using a sodium phosphate buffer (0.02 M) to obtain a final protein content of 0.1% (w/v). In addition, standard solutions of alpha-lactalbumin (Sigma-Aldrich Chemie GmbH, Steinheim, Germany) and beta-lactoglobulin (Sigma-Aldrich Chemie GmbH) and caseinomacropeptide at a concentration of 1 mg mL-1 were prepared. Prior to injection, the solutions were stirred and filtered (0.22 micron). A 25 microL sample was injected. The absorbance was recorded at 210 and 280 nm. For all the samples denatured whey protein compositions and the standards, the total protein content was determined according to Example 1.4.

Quantitative determination of the contents of native alpha-lactalbumin, beta-lactoglobulin and caseinomacropeptide was performed by comparing the peak areas obtained for the corresponding standard proteins with those of the samples.

Example 1.3: Determination of viscosity

The viscosity of liquid products was measured on a rheometer (Haake rheostress) with a bob/cup system.

The measurement was performed at 5 degrees C (both the temperature of the liquid sample and the relevant parts of the rheometer had a temperature of 5 degrees C).

Procedure:

1. Sample preparation
Each sample is filled into bottles during processing and placed in the laboratory cooler (5°C) to temperate for 1 day.

2. Setup
Set up the program for measurement of the product on the Haake rheostress, see method setup.

Install the bob/cup system. Check that the temperature of the water bath for HAAKE rheostress is set at 1°C, if not adjust the temperature.

3. Measuring
Only the sample that is to be analysed is removed from cool storage, the sample bottle is gently turned upside down 3 times to homogenise the sample if it is phase separated during storage. Add 40 ml sample to the cup and start the data-sampling programme. A double repetition is made.

4. Cleaning
When the analysis is finished, dismantle the bob/cup system and clean it with water and soap and afterwards with cold water to temperate the system before the next measurement. Wipe the bob/cup system and install it again for the next sample.

Results:
The viscosity is presented in the unit centipoise (cP). Based on the cP-value read after 90 sec. (t(seq)), an average of the double repetition is calculated. The higher the measured cP values are, the higher the viscosity.

Materials:
For this procedure the following is required:

- Haake rheostress 1 rheometer
- Bob: Z34 DIN 53019 series
- Cup: Z34 DIN53018 series probes
- Water bath Haake K20/Haake DC50

Method setup:

The parameters for the programme were as follows:
Step 1: Measurement position
Step 2: Controlled Stress of 1.00 Pa for 30 sec. at 5.00°C. Frequency of 1.000 Hz. 2 data points are collected
Step 3: Controlled Rate of 50.00 I/s for 120 sec. at 5.00°C. 30 data points are collected
Step 4: Lift apart

Example 1.4: Determination of total protein

The total protein content (true protein) of a sample is determined by:

1) Determining the total nitrogen of the sample following ISO 8968-1/2|IDF 020-1/2-Milk - Determination of nitrogen content - Part 1/2: Determination of nitrogen content using the Kjeldahl method.

2) Determining the non-protein nitrogen of the sample following ISO 8968-4|IDF 020-4-Milk - Determination of nitrogen content - Part 4: Determination of non-protein-nitrogen content.

3) Calculating the total amount protein as $(m_{\text{total nitrogen}} - m_{\text{non-protein-nitrogen}})*6.38$.

Example 1.5: Determination of the water content of a powder

The water content of a food product is determined according to ISO 5537:2004 (Dried milk - Determination of moisture content (Reference method)). NMKL is an abbreviation for "Nordisk Metodikkomité for Næringsmidler".

Example 1.6: Determination of ash content

The ash content of a food product is determined according to NMKL 173:2005 "Ash, gravimetric determination in foods".

Example 1.7: Determination of the dry weight of a solution

The dry-weight of a solution may be determined according NMKL 110 2nd Edition, 2005 (Total solids (Water) - Gravimetric determination in milk and milk products). NMKL is an abbreviation for "Nordisk Metodikkomité for Næringsmidler".

The water content of the solution can be calculated as 100% minus the relative amount of dry-matter (% w/w).

Example 1.8: Determination of the total amount of lactose

The total amount of lactose is determined according to ISO 5765-2:2002 (IDF 79-2: 2002) "Dried milk, dried ice-mixes and processed cheese – Determination of lactose content – Part 2: Enzymatic method utilizing the galactose moiety of the lactose".

Example 1.9: Determination of the degree of denaturation

The denaturation degree of the proteins of the denatured whey protein compositions was analyzed by size exclusion high performance liquid chromatography (SE-HPLC). A Waters 600 E Multisolvent Delivery System, a Waters 700 Satellite Wisp Injector, and a Waters H90 Programmable Multiwavelength Detector (Waters, Milford, MA, USA) were used. The elution buffer was composed of 0.15 M Na2S04, 0.09 M KH2P04 and 0.01 M K2HP04. The flow rate was 0.8 mL min-1 and the temperature 20°C.

Twenty-four hours prior to analysis, suspensions of the denatured whey protein compositions were prepared by using a sodium phosphate buffer (0.02 M) to obtain a final protein content of 0.1% (w/v). In addition, standard solutions of alpha-lactalbumin (Sigma-Aldrich Chemie GmbH, Steinheim, Germany) and beta-lactoglobulin (Sigma-Aldrich Chemie GmbH) and caseinomacropeptide at a concentration of 1 mg mL-1 were prepared. Prior to injection, the solutions were stirred and filtered (0.22 micron). A 25 microL sample was injected. The absorbance was recorded at 210 and 280 nm. For all the samples denatured whey protein compositions and the standards, the total protein content was determined according to Example 1.4

A quantitative analysis of the native whey protein content was performed by comparing the peak areas obtained for the corresponding standard proteins with those of the samples. Afterwards, the denatured whey protein content of the denatured whey protein compositions was calculated by considering the total protein content of the samples and their quantified native protein. The degree of denaturation was calculated as $(w_{\text{total protein}} - w_{\text{solutble protein}})/w_{\text{total protein}} * 100\%$, wherein $w_{\text{total protein}}$ is the weight of total protein and $w_{\text{solutble protein}}$ is the weight of soluble protein.

Example 2: Production of a high protein denatured whey protein composition

A denatured whey protein composition was prepared using the following method:

Solution:

An aqueous solution containing sweet whey protein concentrate was prepared by dissolving the whey protein concentrate in water to obtain a dry-matter content of 16% and adjusting the pH to 6.4.

Denaturation and microparticulation:

Denaturation and microparticulation was performed in a 6+6 Scraped Surface Heat Exchanger (SSHE), APV Shear Agglomerator, from APV/SPX, Denmark.

After passage through a holding cell (60 sec), the product was cooled down in a SSHE followed by a plate heat-exchanger (PHE) to 10°C.

During the heat-treatment (80 degrees C for a duration of 10 minutes) the protein was denaturated and particles in the size 0.5-10 micron were formed.

The product suspension was pumped to a storage tank, and some of it was subsequently dried to a powder by means of spray-drying.

The aqueous whey protein solution and the suspension obtained from the heat denaturation/microparticulation were subsequently characterised with respect to content of native dry-matter, total protein, total fat, total lactose, ash content, content of native beta-lactoglobulin, content of native alpha-lactalbumin, content of native CMP, degree of microparticulation, particle size and pH.

Results

The results of the characterisation of the solution of sweet WPC and the suspension of denatured, microparticulated whey protein are presented in

Table 1. As can be seen, significant amounts of native beta-lactoglobulin and alpha-lactalbumin of the solution has been denatured (approx. 88% beta-lactoglobulin and approx. 69% alpha-lactalbumin), whereas the level of CMP seems to be nearly the same in the suspension as in the solution.

Table 1 Comparison of the composition of the WPC solution and the product suspension.

	Solution of sweet WPC	Product suspension
% Dry matter	Approx. 16	Approx. 16
% Total protein	13.0	13.0
% Fat	0.90	0.90
% Lactose	0.45	0.45
% Ash	0.55	0.55
% Native beta-lactoglobulin relative to total protein	55.0	6.5
% Native alpha-lactalbumin relative to total protein	18.0	5.5
% native CMP of total protein	13.5	13.5
Particle degree*	< 10	Approx. 67
Particle size	0.1-1 micron	0.5-10 micron
pH	6.4	6.4

*Content of insoluble whey protein particles in the size range 0.5-10 micron (% w/w total protein)

The non-protein-nitrogen content of the product suspension was 0.15% (w/w).

The spray-dried denatured whey protein composition had a solid content of dry-matter content of approx. 95%.

Example 3: Production of a low casein, high protein drinking yoghurt model for testing the impact of the variation of levels of native alpha-lactalbumin in the yoghurt milk

Five different samples of a low casein, high protein drinking yoghurt model system were produced to assess how the alpha-lactalbumin concentration of a high protein drinking yoghurt milk impacts the textural and sensory properties of the final product.

Ingredients

The ingredients used in the five samples and the resulting nutrient content are presented in Table 2 and Table 3.

Table 2 Recipes for testing the effect of alpha-lactalbumin in high-protein drinking yoghurt.

	Samples				
	6	7	8	9	10
Source C % (w/w)	-	0.26	0.50	1.20	2.38
Source D % (w/w)	12.78	12.50	12.23	11.46	10.18
Lactose % (w/w)	2.50	2.50	2.50	2.50	2.50
Cream, 38% fat % (w/w)	1.80	1.80	1.80	1.80	1.80
Water % (w/w)	82.92	82.94	82.97	83.04	83.14

Table 3 Calculation of the content of selected nutrients in the high-protein, low casein, drinking yoghurt samples.

	Samples				
	6	7	8	9	10
Total protein	10.03	10.03	10.02	10.02	10.03
Native alpha-lactalbumin % (w/w) relative to total protein	5.1	6.8	8.5	13.6	22.1

The total solids of the samples were approx. 15.3 (w/w). The cream was the only source of casein which was present in an amount of approx. 0.3% (w/w) relative to the total amount of protein.

Denatured whey protein compositions containing varying amounts of alpha-lactalbumin were prepared by mixing a denatured whey protein composition (Source D) based on sweet whey protein concentrate with varying amounts of highly purified alpha-lactalbumin (Source C).

Source C was whey protein isolate powder having a total protein content of 85% (w/w) and containing native alpha-lactalbumin in an amount of 90% (w/w) relative to the total amount of protein.

Source D was the denatured, microparticulated whey protein powder produced in Example 1 having a total protein content of 82% (w/w) (Source D).

Process

The following process was used to prepare high-protein drinking yoghurts.

All dry ingredients were thoroughly mixed in the liquids using a motorized mixer and the resulting mixture was allowed to hydrate for 1 hour. The mixture was then preheated to 65°C on a plate heat-exchanger and subsequently homogenised at 150 bar. The homogenized mixture was then pasteurised at 80°C for 5 minutes and then allowed to cool to 42°C.

0.02% of the culture YC-183 from Chr. Hansen was added to the yoghurt mixture and allowed to incubate until a pH below 4.60 was reached.

The acidified mixture was then smoothed by subjecting it to homogenisation at 180 bar and finally cooled. The final product was stored at 5°C.

Characterisation

The samples were characterised by sensory testing and by measuring their viscosity and degree of syneresis 2 days after product.

The drinking yoghurt samples having the highest content of alpha-lactalbumin in the yoghurt milk also had the highest viscosity. The inventors did not see any signs of syneresis or sedimentation 2 days after production of the drinking yoghurts.

The products had an acceptable mouthfeel and no detectable off-tastes.

Rheological studies

In addition to the above experiments, the inventors investigated the rheological changes in different mixtures of Ingredients C and D in water, all mixtures having a pH of approx. 6.4 and a total protein content of 11.5% (w/w). The samples were heated to 90 degrees C for 7 minutes and continuously monitored for viscosity changes during the heating. The samples having a high level of alpha-lactalbumin (more than 7% (w/w) alpha-lactalbumin relative to the total amount of protein) were subject to significant viscosity increases after 400 seconds of heating, whereas the viscosity changes of the low alpha-lactalbumin samples (less than 7% (w/w) alpha-lactalbumin relative to the total amount of protein)) was insignificant.

Conclusion

The present example indicates that it is advantageous to reduce the level of native alpha-lactalbumin in yoghurt milk of high protein yoghurts and that this may be done by using a denatured whey protein composition having a low content of native alpha-lactalbumin.

Example 4: Production of high protein stirred yoghurt

A high protein, casein-containing, stirred yoghurt was produced with the following ingredients:

Ingredient	**Content % (w/w)**
Denatured whey protein powder of Example 2 (total protein: 82%)	3.80
WPC80	1.89
Na-Caseinate	2.21
WPC35	0.57
Whey permeate	2.13
Skimmed milk	89.40

Nutritional composition:

Component	**Content % (w/w)**
Protein	10.05
Fat	0.44
Carbohydrates	6.51
Total solids	18.38
Whey protein part in recipe	54.99
Casein part in recipe	45.01

Process

The powders were mixed with the liquid ingredients and allowed to hydrate for 1 hour at 5°C. Subsequently, the resulting suspension was preheated to 65°C and homogenized in two steps (first at 200 bar and subsequently at 50 bar). After the pasteurisation, the

suspension was pasteurised at 90°C for 5 min, cooled and incubated with 0.02% lactic acid starter culture (YC-183 from Chr. Hansen) and allowed to incubate at 42°C until the pH reached pH 4.5. The incubated product was subjected to smoothing at 9 bar using back pressure, mixed with the strawberry fruit composition and finally cooled and stored at 5 degrees C.

Evaluation

The high protein stirred yoghurt was subjected to sensory evaluation and was compared to a stirred yoghurt product containing only 7% (w/w) protein but containing a comparable amount of a lower grade, denatured whey protein powder (45% w/w protein).

The present high protein yoghurt was found to be a nice, spoonable product which, despite its higher protein content, had a lower degree of dryness and a more milky taste than the yoghurt containing the lower-grade denatured whey protein powder.

The viscosity of the present stirred yoghurt was determined to 2265 cP.

Example 5: Production of high protein drinking yoghurt

A high protein, casein-containing drinking yoghurt was produced with the following ingredients:

Ingredient	**Content % (w/w)**
Denatured whey protein powder of Example 2 (total protein: 82%)	7.05
WPC80	1.59
Sucrose	5.00
Cream, 38% fat	3.10
Skimmed milk	83.26

Component	Content % (w/w)
Protein	10.00
Fat	1.79
Carbohydrates	9.39
Total solids	22.28
Whey protein part in recipe	76.18
Casein part in recipe	23.82

Process

The powders were mixed with the liquid ingredients and allowed to hydrate for 1 hour at 5°C. Subsequently, the resulting suspension was preheated to 65°C and homogenized in two steps (first at 200 bar and subsequently at 50 bar). After the pasteurisation, the suspension was pasteurised at 90°C for 5 min, cooled and incubated with 0.02% lactic acid starter culture (YC-183 from Chr. Hansen) and allowed to incubate at 42°C until the pH reached pH 4.5. The incubated product was subjected to smoothing at 9 bar using back pressure and finally cooled and stored at 5 degrees C.

Evaluation

The high protein drinking yoghurt was subjected to sensory evaluation and was compared to a drinking yoghurt product containing only 7% (w/w) protein but containing a comparable amount of a lower grade, denatured whey protein powder (45% w/w protein).

The present high protein drinking yoghurt was found to be an easily drinkable product which, despite its higher protein content, had a lower degree of dryness and a more milky taste than the yoghurt containing the lower-grade denatured whey protein powder. The observation of lower degree of dryness and less off-taste is identical to the observations done in the previous Example relating to high protein stirred yoghurts.

The viscosity of the present high protein drinking yoghurt was determined to only 50 cP, which is surprisingly low for a high protein drinking yoghurt containing 10% (w/w) total protein and which both have a good mouth-feel and a low level of dryness.

CLAIMS

1. A denatured whey protein composition containing:
- a total amount of protein of at least 60% (w/w) on a dry weight basis,
- a total amount of soluble alpha-lactalbumin of at most 6% (w/w) relative to the total amount of protein, and
- insoluble whey protein particles having a particle size in the range of 1-10 micron, where the amount of said insoluble whey protein particles is in the range of 50-100% (w/w) relative to the total amount of protein.

2. The denatured whey protein composition according to claim 1, wherein the denatured whey protein composition is:
- a powder, or
- an aqueous suspension.

3. The denatured whey protein composition according to claim 1 or 2, wherein the total protein : ash content weight ratio is at least 15, preferably at least 20, and even more preferably at least 30, such at least 40 or at least 50.

4. The denatured whey protein composition according to any of the preceding claims, wherein the total amount of protein is at least 70% (w/w) on a dry-matter basis, preferably at least 75% (w/w) and even more preferably at least 80% (w/w) in a dry weight basis.

5. The denatured whey protein composition according to any of the preceding claims, wherein the total amount of soluble alpha-lactalbumin is at most 5% (w/w) relative to the total amount of protein, preferably at most 4% (w/w), and even more preferably at most 3% (w/w).

6. A method of producing a denatured whey protein composition according to any of the claims 1-5, the method comprising the steps of

a) providing a solution comprising whey protein, said solution having a pH in the range of 5-8, said solution comprising:
- water,
- a total amount of protein of at least 60% (w/w) on a dry weight basis,

- a total amount of soluble alpha-lactalbumin of at most 16% (w/w) relative to the total amount of protein,

b) heating said solution to a temperature in the range of 70-160 degrees C and keeping the temperature of the solution within this range for sufficient time to form insoluble whey protein micro particles having a particle size in the range of 1-10 micron,

c) optionally, cooling the heat-treated solution,

d) optionally, converting the heat-treated solution to a powder,

wherein at least step b) involves subjecting the solution to mechanical shear.

7. A high protein food product comprising
- a total amount of protein of at least 4% (w/w),
- denatured whey protein composition according to claim 1 in an amount of at least 2% (w/w),
- a total amount of soluble alpha-lactalbumin of at most 6% (w/w) relative to the total amount of protein.

8. A method of producing a high protein, acidified dairy product, the method comprising the steps of:

a) providing a dairy base comprising at least one dairy component and at least one carbohydrate,

b) pasteurising the dairy base at a temperature in the range of 70-150 degrees C and subsequently cooling the dairy base,

c) contacting the heat-treated dairy base with an acidifying agent,

d) allowing the acidifying agent to reduce the pH of the dairy base to a pH of at most 5,

e) optionally, subjecting the acidified dairy base to one or more additional processing steps,

f) optionally, packaging the acidified dairy product in a suitable container.

wherein:

I) the dairy base provided in step a) comprises a total amount of protein of at least 7% (w/w), the solids of a denatured whey protein composition according to any of the claims 1-6 in an amount of at least 2% (w/w), and a total amount of at most 6% soluble alpha-lactalbumin (w/w) relative to the total amount of protein, or

II) an ingredient comprising, or even consisting of, the solids of denatured whey protein composition according to claim 1 is added to the dairy base between steps a) and f) in an amount sufficient to form the acidified dairy product containing:

- a total amount of protein of at least 7% (w/w),
- the solids of the denatured whey protein composition according to claim 1 in an amount of at least 2% (w/w), and
- a total amount of at most 6% soluble alpha-lactalbumin (w/w) relative to the total amount of protein.

9. The method according to claim 8, wherein the dairy base provided in step a) contains a total amount of at most 5% (w/w) relative to the total amount of soluble alpha-lactalbumin of at most 5% (w/w) relative to the total amount of protein, preferably at most 4% (w/w), and even more preferably at most 3% (w/w).

10. A high protein, acidified dairy product obtainable by a method according to any of the claims 8-9, said dairy product containing a total amount of protein of at least 7% (w/w).

11. The high protein, acidified dairy product according to claim 10, having a total amount of protein of at least 10% (w/w).

12. The high protein, acidified dairy product according to any of the claims 10-11, which is a stirred yoghurt.

13. The high protein, acidified dairy product according to claim 12 having a viscosity of at most 2500 cP.

14. The high protein, acidified dairy product according to any of the claims 10-11, which is a drinking yoghurt.

15. The high protein, acidified dairy product according to claim 14 having a viscosity of at most 400 cP.

16. A food ingredient powder comprising, or even consisting of:

i. the solids of the denatured whey protein composition according to any of the claims 1-5 in an amount of at least 5% (w/w),

ii. optionally, a small amount of water

iii. one or more additional components selected from the group consisting of:

- a caseinate composition,
- a concentrate of micellar casein,
- a milk protein concentrate, and
- a milk powder, such as e.g. skimmed milk powder.

17. The food ingredient powder of claim 16, wherein the solids of the denatured whey protein composition are in an amount of at least 25% (w/w), preferably at least 40% (w/w), more preferably at least 60% (w/w).

18. The food ingredient powder of claim 16 or 17, wherein the food ingredient powder has a total protein : ash content weight ratio of at least 15, preferably at least 20, and even more preferably at least 30, such at least 40 or at least 50.

19. The food ingredient powder of any of claims 16 to 18, wherein the food ingredient powder has a lactose content of at most 35% (w/w), preferably at most 15% (w/w), more preferably at most 10% (w/w).

20. The food ingredient powder of any of claims 16 to 19, wherein the food ingredient powder has a low fat content of at most 8% (w/w).

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/072790

A. CLASSIFICATION OF SUBJECT MATTER
INV. A23J1/20 A23C9/13 A23L1/305 A23L2/66 A23C19/05
A23C21/06
ADD.
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A23J A23C A23L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, BIOSIS, FSTA, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 199 50 240 A1 (SPIEGEL THOMAS [DE]) 17 May 2001 (2001-05-17) column 3, line 22 - column 5, line 25 -----	1-7, 16-20
X Y	US 6 767 575 B1 (HUSS MANFRED [DE] ET AL) 27 July 2004 (2004-07-27) column 5, line 56 - column 6, line 32; figure 2; example 1 column 6, line 59 - column 7, line 34; claims 1-11 -----	1-7, 16-20 8-15
Y	US 2012/114795 A1 (HAVEA PALATASA [NZ] ET AL) 10 May 2012 (2012-05-10) paragraph [0032] - paragraph [0060] paragraph [0083] - paragraph [0088] paragraph [0126] - paragraph [0159]; figure 4; examples 1, 2,3 -----	8-15

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
3 February 2015	12/02/2015

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Munteanu, I

1

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2014/072790

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 19950240 A1	17-05-2001	NONE	
US 6767575 B1	27-07-2004	AT 239381 T	15-05-2003
		AU 3145600 A	04-09-2000
		DE 19906379 A1	17-08-2000
		DE 19964370 B4	11-05-2006
		EP 1154700 A1	21-11-2001
		US 6767575 B1	27-07-2004
		WO 0048473 A1	24-08-2000
US 2012114795 A1	10-05-2012	AU 2010237074 A1	01-12-2011
		CA 2758458 A1	21-10-2010
		CN 102665430 A	12-09-2012
		EP 2429305 A1	21-03-2012
		JP 2012523835 A	11-10-2012
		KR 20120052191 A	23-05-2012
		NZ 596439 A	25-10-2013
		RU 2011146143 A	20-05-2013
		US 2012114795 A1	10-05-2012
		WO 2010120199 A1	21-10-2010

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
31 August 2006 (31.08.2006)

PCT

(10) International Publication Number
WO 2006/089921 A1

(51) International Patent Classification:
C12P 21/02 (2006.01) *C12P 21/06* (2006.01)

(21) International Application Number:
PCT/EP2006/060198

(22) International Filing Date:
23 February 2006 (23.02.2006)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
05101417.3 24 February 2005 (24.02.2005) EP
05110236.6 1 November 2005 (01.11.2005) EP

(71) Applicant *(for all designated States except US)*: **DSM IP Assets B.V.** [NL/NL]; Het Overloon 1, NL-6411 TE Heerlen (NL).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **ROOS, DE, Andre Leonardus** [NL/NL]; Hof Van Azuur 33, NL-2614 TB Delft (NL). **BROECKE, VAN DEN,, Pieter Marinus** [NL/NL]; Waterdrieblad 1, NL-2631 SV Nootdorp (NL). **EDENS, Luppo** [NL/NL]; Hoflaan 118, NL-3062 JL Rotterdam (NL).

(74) Agent: **MATULEWICZ, Emil, Rudolf, Antoni**; DSM Intellectual Property, Delft Office (600-0240), P.o. Box 1, NL-2600 MA Delft, (NL).

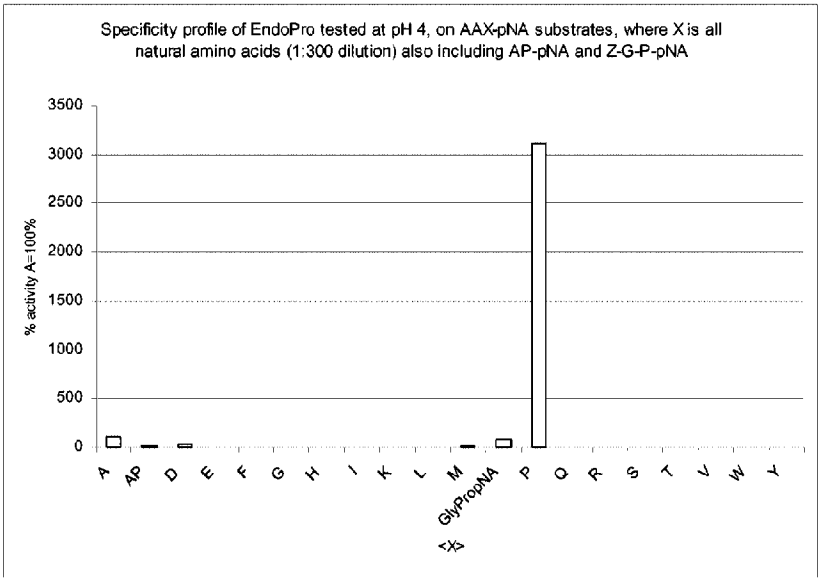
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

[Continued on next page]

(54) Title: BLOOD PRESSURE LOWERING PEPTIDES FROM GLYCOMACROPEPTIDE



(57) Abstract: A process to produce IPP from a protein source whereby the protein source comprises a protein having the -I-P-P- sequence and having in the protein amino acid sequence at least 6 times more -I-P-P- present than -V-P-P- (molar basis) which comprises hydrolysing the protein source to liberate at least 40% of the I-P-P- sequence 10 into the peptide IPP and whereby a proteolytic enzyme is used which cleaves at the carboxy-terminus of proline residues present in the protein source, the enzyme is preferably a proline specific endoprotease or proline specific oligopeptidase, more preferably a proline specific endoprotease, and optionally an amino peptidase.

WO 2006/089921 A1

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

BLOOD PRESSURE LOWERING PEPTIDES FROM GLYCOMACROPEPTIDE

Field of the invention

The present invention relates to the production of IPP.

Background of the invention

Hypertension is a relatively common disease state in humans and presents a prevalent risk factor for cardiovascular diseases, kidney failure and stroke. The availability of a large array of pharmaceutical products such as calcium blockers, beta blockers, diuretics, alpha blockers, central alpha antagonists, angiotensin II antagonists and ACE inhibitors, illustrates that the underlying physiological mechanisms for hypertension are manysided.

Of the physiological mechanisms for hypertension, especially the renin-angiotensin mechanism has received a lot of scientific attention. In this mechanism, angiotensin is secreted by the liver and is cleaved by the peptidase renin to yield the biologically inactive decapeptide angiotensin I. As angiotensin I passes through the lung capillaries, another peptidase called angiotensin converting enzyme (hereinafter referred to as ACE) acts on angiotensin I by removing the last two residues of angiotensin I (His-Leu) to form the octapeptide angiotensin II. The angiotensin II octapeptide exhibits strong vasoconstricting activity and therefore raises blood pressure. ACE inhibition leading to lower levels of the angiotensin II prevents vasoconstriction and thus high blood pressures.

Apart from cleaving angiotensin I, ACE can also hydrolyse bradykinin, a nonapeptide also participating in blood pressure regulation. In the latter mechanism ACE inhibition leads to increased bradykinine levels which promote vasodilatation and lower blood pressure as well. Inhibiting ACE thus leads to blood pressure lowering effects via at least two separate mechanisms.

It is also known that the octapeptide angiotensin II stimulates the release of aldosterone by the adrenal cortex. The target organ for aldosterone is the kidney where aldosterone promotes increased reabsorbtion of sodium from the kidney tubules. Also via this third mechanism ACE inhibition reduces blood pressure but in this case by diminishing sodium reabsorption.

Because of its multiple physiological effects, inhibiting the proteolytic activity of ACE is an effective way of depressing blood pressure. This observation has resulted in a number of effective pharmaceutical blood pressure lowering products such as captopril and enalapril (Ondetti, M.A. et al., 1977, Science, Washington DC, 196, 441-444).

Because hypertension is a relatively common disease state it would be advantageous to counteract this undesirable result of modern life style with mildly active natural ingredients. Especially mildly active natural ingredients that can be incorporated into food or beverage products because such products are consumed on a regular basis. Alternatively such mildly active natural ingredients could be incorporated into dietary supplements. During the last decades it has been discovered that specific peptides present in fermented milk have an ACE inhibiting capacity and can induce blood pressure reductions in hypertensive subjects. Nowadays numerous in vitro and a few animal trials have demonstrated ACE inhibiting effects of different peptides obtained from a variety of protein sources. Although in vitro ACE inhibition assays have revealed many different peptide sequences, it has to be emphasized that ACE inhibiting peptides need to circulate in the blood to exert an in vivo effect. The implication is that efficacious ACE inhibiting peptides should resist degradation by the gastrointestinal proteolytic digestion system and should remain intact during a subsequent transport over the intestinal wall.

A structure-function study of the various ACE inhibiting peptides has suggested that they often posses a Pro-Pro, Ala-Pro or Ala-Hyp at their C-terminal sequence (Maruyama, S.and Suzuki, H., 1982; Agric Biol Chem., 46(5): 1393-1394). This finding is partly explained by the fact that ACE is a peptidyl dipeptidase (EC3.4.15.1) unable to cleave peptide bonds involving proline. Thus from tripeptides having the structure Xaa-Pro-Pro the dipeptide Pro-Pro cannot be removed because the Xaa-Pro bond cannot be cleaved. It is therefore conceivable that if present in relatively high concentrations, tripeptides having the Xaa-Pro-Pro structure will inhibit ACE activity. As not only ACE but almost all proteolytic enzymes have difficulties in cleaving Xaa-Pro or Pro-Pro bonds, the notion that the presence of (multiple) proline residues at the carboxyterminal end of peptides results in relatively protease resistant molecules is almost self-evident. Similarly peptides containing hydroxyproline (Hyp) instead of proline are relatively protease resistant. From this it can be inferred that peptides carrying one or more (hydroxy)proline residues at their carboxyterminal end are likely to escape from proteolytic degradation in the gastro-intestinal tract. These conclusions will help us to understand the remarkable

in vivo blood pressure lowering effect of specific ACE inhibiting peptides: not only do they meet the structural requirements for ACE inhibition, they also resist degradation by the gastrointestinal proteolytic digestion system and remain intact during a subsequent transport over the intestinal wall.

Strong ACE inhibiting activities have been reported for the tripeptides Leu-Pro-Pro (JP02036127), Val-Pro-Pro (EP 0 583 074) and Ile-Pro-Pro (J. Dairy Sci., 78:777-7831995)). Initially all ACE inhibiting peptides were characterized on the basis of their in vitro effect on ACE activity and the tripeptides Ile-Pro-Pro (hereinafter referred to as IPP) Val-Pro-Pro (hereinafter referred to as VPP) and Leu-Pro-Pro (hereinafter referred to as LPP) stood out because of their strong ACE inhibiting effect resulting in relatively low IC50 values. Later on the presumed antihypertensive effects of the tripeptides VPP as well as IPP could be confirmed in spontaneously hypertensive rats (Nakamura et al., J. Dairy Sci., 78:12531257 (1995)). In these experiments the inhibitory tripeptides were derived from lactic acid bacteria fermented bovine milk. During the milk fermentation the desirable peptides are produced by proteinases produced by the growing lactic acid bacteria. A drawback of this fermentative approach is that lactic acid bacteria are living organisms for which the type and quantity of excreted enzymes are difficult to control. The production of the ACE inhibiting peptides is therefore hardly reproducible and it is also unlikely that the optimal set of enzymes is being produced to ensure the maximal yield of the required peptides. Also the required fermentation times are relatively long which in combination with the low yields implies an unfavorable cost structure for the bioactive peptides. Moreover a fermented product is less suitable for direct incorporation into a.o. solid foods and creates strict organoleptic limitations. The poor palatability of such fermented milk products and the many processing difficulties encountered during the recovery of ACE inhibiting peptides from such fermented broths have been described in US 6,428,812. Despite these disadvantages fermented milk products have been put to practical application as an orally administered vasodepressor. ACE inhibiting peptides have been concentrated from fermented milk products by electrodialysis, hollow fiber membrane dialysis or chromatographic methods to enable their marketing in the form of concentrated dietary supplements like tablets or lozenges.

The above mentioned drawbacks of the fermentative production route were recognized in a.o. patent applications WO 01/68115 and EP 1 231 279. In the latter application a purely enzymatic process is described to recover the tripeptides Val-Pro-Pro and Ile-Pro-Pro from milk casein. The application claims a method for producing

these tripeptides by digesting material containing a milk casein with a proteinase and a peptidase via an intermediate peptide. Each of these enzyme incubations may take as long as 12 hours and take place under conditions that favor outgrowth of microbial contaminants. Prior to incubation with the peptidase, the intermediate peptide is preferably purified and high end concentrations of ACE inhibiting peptides can only be obtained after an additional chromatographic purification step of the intermediate peptide.

Summary of the invention

In the scientific literature many different peptides and hydrolysates have been correlated with blood pressure lowering effects. Moreover, many physiological mechanisms are known to be involved in blood pressure regulation. According to the present invention the peptides and the physiological mechanisms involved are minimised by selecting a suitable protein substrate which after hydrolysis will result in a peptide fraction having IPP as the main blood pressure lowering component. We have found that for such a peptide fraction kappa casein and more preferably the glycomacropeptide (GMP) from kappa-casein forms a preferred starting point. In the blood pressure lowering peptide mixture or fraction thus generated especially IPP plays an important role. In contrast to the prior art hydrolysis processes which result in mixtures of IPP, VPP and many other potentially bioactive peptides, the present process is directed towards the production of IPP thereby preventing for example the production of VPP. According to the present invention preferably proteins with a molecular weight below 20 kDa, preferably below 10 kDa comprising an –I-P-P- sequence in their amino acid sequence are used as starting proteins. As mentioned above GMP is the preferred substrate protein. GMP can be obtained from kappa-casein as described herein below. Cow's milk is the preferred origin of kappa-casein. Milk from other mammalians can also be used, for example milk from goats, if the GMP part of the kappa casein molecule comprises an –IPP- sequence. Because not all kappa caseins can be cleaved by the bovine chymosin, obtaining the GMP part may require the use of a more appropriate clotting enzyme.

The present invention discloses the use of proteins (or mixture of proteins or peptides) having in their amino acid sequences at least 6 times more –I-P-P- present than –V-P-P..Preferably the –V-P-P- sequence is absent in the protein or peptide sequence (or in the sequence of the protein or peptide mixtures used as the substrate for the hydrolysis). A preferred protein source is a protein or peptide which is free of –V-P-P- or a mixture of proteins or peptides comprising said protein which is free of –V-P-P-

This mixture therefore preferably comprises at least 50%, more preferably at least 80%, still more preferably at least 90%, and most preferably at least 95% (w/w) of protein(s or peptides which are free of –V-P-P-. More preferably the –V-P-P- sequence is part of a -P-V-P-P- or –A-V-P-P- sequence.

A preferred example of such a protein is GMP (glycomacropeptide obtainable from bovine milk.

It is an object of the present invention to provide the blood pressure lowering peptide IPP in a pure state, i.e. without significant amounts of contamination by the peptide VPP.

It is another object of the present invention to provide the blood pressure lowering peptide IPP in a highly concentrated form without the use of expensive purification steps.

It is yet another object of the present invention to provide the blood pressure lowering peptide IPP in a non-bitter formulation. This non-bitter formulation has preferably a bitter intensity of 2 or less as defined in Example 8.

It is yet another object of the present invention to provide an enzymatic process which selectively excises IPP from the GMP part of kappa casein, preferably using a proline specific protease, more preferably a proline specifc endoprotease and most preferably a proline specifc endoprotease with an acid pH optimum.

It is also an object of the present invention to provide an enzymatic process which selectively produces IPP from GMP, in which the GMP preferably is first incubated with an aminopeptidase and subsequently, preferably under conditions where the aminopeptidase is not longer active, with a proline specific protease.

It is also an object of the present invention to provide a composition comprising IPP without opioid peptides being present in the same formulation.

It is also an object of the present invention to provide a composition comprising IPP in a hypoallergenic formulation.

It is also an object of the present invention to provide a composition comprising IPP in a peptide mixture with a Degree of Hydrolysis below 30%, preferably below 20%, more preferably below 15%.

It is also an object of the present invention to provide a composition comprising a hydrolysate, said hydrolysate comprises IPP and has a degree of hydrolysis below 30%, preferably below 20%, more preferably below 15%. Preferably the hydrolysate has a degree of hydrolysis of at least 1%, more preferably of at least 2%.

It is also an object of the present invention to provide a composition comprising IPP and comprising free amino levels not exceeding 10% (w/w), preferably not exceeding 7 % most preferably not exceeding 3%.

It is also an object of the present invention to provide a process for the recovery of the GMP part of kappa casein from acid precipitated casein.

Moreover the present invention provides the use of the composition of the present invention or to the use the composition produced by the present process as a nutraceutical, preferably a medicament, for the manufacture of a nutraceutical, preferably a medicament, for the improvement of health or the prevention and/or treatment of diseases or for the manufacture of a nutraceutical preferably a medicament for the treatment or prevention of diseases such as high blood pressure (hypertension), heart failure, pre-diabetes or diabetes, obesity, impaired glucose tolerance or stress.

Preferably the composition of the invention is in the form of a dietary supplement, in the form of a personal care application including a topical application in the form of a lotion, gel or an emulsion or as a food, feed or pet food ingredient.

The composition of the invention can also be used for the manufacture of a functional food product for prevention of obesity or for body weight control or for the manufacture of a functional food product for the cardiovascular health maintenance, preferably the cardiovascular health maintenance comprises the inhibition of angiotensin-converting enzyme or the control of blood cholesterol levels.

The composition of the invention can be used in a functional food product capable of providing a health benefit to the consumer thereof, said health benefit is preferably selected from the prevention of obesity, body weight control and cardiovascular health maintenance.

This functional food product comprises preferably one or more B-vitamins or 3 to 25 wt% sterol.

The invention also provides a process to prepare a food product, beverage product or dietary supplement comprising production of a composition of the invention or produced by the process of the invention and incorporation of said composition into a food product, beverage product or dietary supplement.

Preferably this food product, beverage product or dietary supplement is selected from the group of margarines, spreads, butter, dairy products or whey containing beverages, preferably yoghurt or milk based products such as yoghurt or milk.

Detailed description of the invention

The present invention relates to a process in which the peptide IPP is generated in high yields from preferably a small molecular weight protein having a high amount of –I-P-P- compared to –V-P-P- in its amino acid sequence. Preferably kappa casein more preferably the GMP fraction of kappa-casein is used. The process comprises preferably a single enzyme incubation step. Although the process according to the invention is highly specific towards the protein substrate to be used, a variety of proteolytic enzyme preparations can be used to obtain the blood pressure lowering activity in a relatively pure state. Suitable proteolytic enzyme preparations ranging from a single enzyme to complex enzyme mixtures can be used. Preferably a single enzyme is used which cleaves at the carboxy terminus of proline, preferably this enzyme is a proline specific protease or a proline specific oligopeptidase. Preferably the substrate molecule incorporates an –A-I-P-P- or an –P-I-P-P- sequence. Also a proline specific endoprotease, in combination with a suitable aminopeptidase can be used. In the latter case the GMP containing fraction is preferably first incubated under preferably near neutral conditions for example pH 5 to 8 with the aminopeptidase. This approach also allows the use of substrates incorporating an –X-I-P-P- sequence in which X can represent any amino acid residue. Preferably after inactivation of the aminopeptidase or under pH conditions where the aminopeptidase is not active, the N-terminally truncated GMP molecule is incubated with the proline specific protease. Preferably the protease which cleaves at the carboxyterminus of proline, such as the proline specific endoprotease, as well as the aminopeptidase activity are free from any contaminating endoprotease activities. Preferably the protease which cleaves at the carboxyterminus of proline such as the proline specific endoprotease, as well as the aminopeptidase activity are free from contaminating carboxypeptidase activities. Proline specific endo protease which is free from contaminating endoprotease activity is an enzyme preparation having preferably an Prol Spec act/Endo ratio of more than 1, more preferable more than 100. Aminopeptidase activity which is free from contaminating endoprotease activity is an enzyme preparation having preferably an AP/Endo ratio of at least 0.1, more preferable at least 0.5 and most preferable at least 1.

Proline specific endoprotease which is free for contaminating carboxyl peptidase activity is an enzyme preparation having preferably an Pro Spec act/CPD ratio of at least 1, more preferable of at least 10.

Amino peptidase activity which is free from contaminating carboxyl peptidase activity is an enzyme preparation having preferable an AP/CPD of at least 0.1, more preferable of at least 0.3. The above mentioned ratios are determined as described in Example 5.

Preferably at least 20%, more preferably at least 40%, or still more preferably at least 60% and most preferably at least 70% of -I-P-P- sequences present in the protein sequence is converted into the peptide IPP. The proline specific protease is preferably capable of hydrolyzing large protein molecules like the substrate protein itself. The process according to the invention has in general an incubation time of less than 24 hours, preferably the incubation time is less than 10 hours and more preferably less than 4 hours. The incubation temperature is in general higher than 30°C, preferably higher than 40°C and more preferably higher than 50°C. Another aspect of the present invention is a process to purify the IPP containing peptide mixture by decanting, centrifugation or by filtration to form the soluble hydrolysate.

The present invention further discloses

- a peptide composition comprising between 1 and 5 mg IPP/g (on dry matter and on protein), or between 20 and 50 mg IPP/g (on dry matter and on protein), and
- a peptide composition comprising 15 – 90% (wt dry matter) peptides containing and at least 20 mg IPP/g (on dry matter and on protein), preferably 20 to 100mg IPP/g (on dry matter and on protein)

In the prior art the tripeptides IPP, VPP and LPP have been described as effective ACE inhibitors. As can be judged from known amino acid sequences, the whey proteins of bovine milk do not incorporate amino acid sequences corresponding to any of these three ACE inhibiting tripeptides. Therefore peptides IPP, VPP and LPP cannot be isolated from whey proteins. However, these peptides do occur in the casein fraction of bovine milk. For example, beta-casein encompasses the –I-P-P- (74-76), the –V-P-P- (84-86) as well as the –L-P-P- (151-153) sequence. Moreover, kappa-casein also encompasses an –I-P-P- but not the other two sequences. The IPP sequence present in kappa casein is located at position 109-110, i.e a few amino acids carboxyterminal of the unique chymosin Phe (105)-Met (106) cleavage site in kappa casein. Thus in kappa casein the –I-P-P- sequence is located on the GMP part of this molecule. The inventors have found that in enzyme clotted

milk the kappa casein derived IPP entity can be found in the cheese whey and in acid clotted milk in the precipitated casein part.

Despite the fact that weight-wise kappa-casein is not an important fraction of casein, the inventors have noted that from a molecular point of view its presence is quite significant. For example beta-casein is present in a concentration of almost 400 millimoles per cubic meter of milk and kappa-casein in a concentration of 180 millimoles per cubic meter of milk. Also in cheese whey GMP represents an important fraction. Whereas the concentration of the combined serum proteins is 320 millimoles per cubic meter, GMP is present in a concentration of 400 millimoles per cubic meter of cheese whey.

Surprisingly GMP can be easily obtained. According to the present invention GMP can be selectively liberated from acid precipitated caseins by an enzymatic treatment with chymosin under selected pH conditions. Although the isolation of GMP from cheese whey is more difficult, industrial processes are known in which GMP enriched whey fractions are obtained. These commercially available GMP enriched fractions obtained with these known processes are currently being used for various nutraceutical applications.

In the present application we describe the use of GMP as a preferred starting material for obtaining the blood pressure lowering IPP in a highly purified state.

The protein fraction of milk typically incorporates a micellar casein fraction and a solubilised whey protein fraction. Among the whey proteins beta-lactoglobuline and alpha-lactalbumine are quantitatively most important. Among the casein proteins the relatively hydrophobic alpha- and beta-caseines are quantitatively predominant. Casein micelles are kept in solution by kappa-casein. A hydrohilic part of kappa casein, the socalled glycomacropeptide (GMP), protrudes from the micellar surface hereby stabilizing the hydrophobic caseins in the aqueous solution.

According to a number of well established industrial processes, the casein fraction can be isolated from the milk, e.g. for making cheese. In one of these processes milk is acidified to selectively precipitate the casein fraction from the milk. The acid precipitated material incorporates all caseins, i.e. the alpha, beta, kappa and gamma-caseins. The non-precipitated acidified milk fraction is referred to as “whey serum”. In another process milk is incubated with a milk clotting enzyme, for example calf chymosin (“rennet”). Chymosin is a protease that very selectively cleaves the Phe (105)-Met (106) peptide bond of the kappa-casein. By this reaction the hydrophilic GMP part of the kappa-casein is cleaved off which results in an immediate aggregation and precipitation of the micellar casein fraction. In this case the precipitated casein fraction is referred to

as "curd". As the GMP part of the kappa casein is clipped off, in this enzymatic approach the hydrophilic GMP fragment remains in solution together with the various serum proteins forming the socalled "cheese" or "sweet" whey.

Various publications claim physiolgical benefits from consuming GMP-enriched milk fractions. Furthermore numerous publications exist describing cost-effective routes to isolate GMP-enriched cheese whey fractions. For example the use of ultrafiltration is described in EP 1037537 and the use of an anionic resin in US 6787158.

One aspect of the present invention relates to the use of a hydrolysate of GMP as blood pressure lowering agent. We have found that the relatively high level of IPP and other peptides having a carboxyterminal proline in GMP can be associated with a blood pressure lowering effect.

By hydrolysate is meant the product that is formed by the hydrolysis of the substrate protein(protein hydrolysate or hydrolysed protein), the soluble hydrolysate being the (water) soluble fraction of the protein hydrolysate which is also described herein as soluble peptide containing composition or composition comprising soluble peptides, or a mixture of a protein hydrolysate and a soluble hydrolysate.

A "peptide" or "oligopeptide" is defined herein as a chain of at least two amino acids that are linked through peptide bonds. The terms "peptide" and "oligopeptide" are considered synonymous (as is commonly recognized) and each term can be used interchangeably as the context requires. A "polypeptide" or "protein" is defined herein as a chain comprising of more than 30 amino acid residues. All (oligo)peptide and polypeptide formulas or sequences herein are written from left to right in the direction from amino-terminus to carboxy-terminus, in accordance with common practice. The one-letter code of amino acids used herein is commonly known in the art and can be found in Sambrook, et al. (Molecular Cloning: A Laboratory Manual, 2nd,ed. Cold Spring Harbor Laboratory, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY, 1989).

Opioid peptides are peptides that can bind to opiate receptors.

The internationally recognized schemes for the classification and nomenclature of all enzymes from IUMB include proteases. The updated IUMB text for protease EC numbers can be found at the internet site: http://www.chem.qmw/ac.uk/iubmb/enzyme/EC3/4/11/. In this system enzymes are defined by the fact that they catalyzes a single reaction. This has the important implication that

several different proteins are all described as the same enzyme, and a protein that catalyses more than one reaction is treated as more than one enzyme. The system categorises the proteases into endo- and exoproteases. Endoproteases are those enzymes that hydrolyze internal peptide bonds, exoproteases hydrolyze peptide bonds adjacent to a terminal α-amino group ("aminopeptidases"), or a peptide bond between the terminal carboxyl group and the penultimate amino acid ("carboxypeptidases"). The endoproteases are divided into sub-subclasses on the basis of catalytic mechanism. There are sub-subclasses of serine endoproteases (EC 3.4.21), cysteine endoproteases (EC 3.4.22), aspartic endoproteases (EC 3.4.23), metalloendoproteases (EC 3.4.24) and threonine endoproteases (EC 3.4.25).

The aminopeptidases are in class 3.4.11. Sub-classification is on the basis of the relative efficiency with which the 20 different amino acids are removed. Aminopeptidases with a narrow and a broad specificity can be distinguished. Aminopeptidases can sequentially remove a single amino-terminal amino acids from protein and peptide substrates. Aminopeptidases with a narrow specificity exhibit a strong preference for the type of amino acid residue at the P1 position that is liberated from the substrate peptide. Aminopeptidases of broad specificity are capable of releasing a range of different amino acids at the N-terminal or P1 positions (according to Schechter's nomenclature: Schechter, I. And Berger, A. 1967. Biochem Biophys Res Commun 27:157-162). Carboxypeptidases can sequentially remove single carboxy-terminal amino acids from protein and peptide substrates. Comparable with the situation for the endoproteases, carboxypeptidases are divided into sub-subclasses on the basis of catalytic mechanism The serine-type carboxypeptidases are in class EC 3.4.16, the metallocarboxypeptidases in class EC 3.4.17 and the cysteine-type carboxypeptidases in class EC 3.4.18.The value of the EC list for proteases resides in providing standard terminology for the various types of protease activity and especially in the assignment of a unique identification number and a recommended name to each protease.

The GMP part of the kappa casein molecule is a polypeptide with a length of 64 amino acid residues. If all IPP is quantitatively recovered, a pure GMP preparation can yield an IPP concentration of almost 5% (w/w) without significant contaminations by either VPP or LPP. In the present application we describe several proteolytic processes to isolate the IPP tripeptide from the GMP polypeptide optionally in a single incubation step and with high yields. Therefore according to the process of the invention it is possible to obtain a composition comprising IPP, whereby the IPP concentration is high enough to be used

directly or directly after a simple purification step so without the need of complex and costly purification process such as chromatographic isolation or purification.

According to a first proteolytic process the isolated GMP molecule is incubated with complex microbial protease enzyme preparations like Sumizyme FP (Shin Nihon) or Flavourzyme (NOVO) or Umamizyme (Amano). Sumizyme FP, Flavourzyme and Umamizyme are enzyme preparations containing various endoproteolytic enzymes plus exoproteolytic activities such as aminopeptidases and carboxypeptidases. By a careful selection of the enzyme dosage and the pH conditions we have been able to obtain the IPP tripeptide in a single incubation step using either the Sumizyme FP or the Flavourzyme preparation. However, a disadvantage of this first proteolytic strategy is that a variety of different peptides can be formed by the various enzymatic activities present. Moreover, relatively high amounts of free amino acids are generated that will impart brothy off-tastes on the final IPP containing product unless the hydrolysate is further purified.

According to a second proteolytic process the isolated GMP molecule is incubated with a proline specific oligopeptidase (EC 3.4.21.26) or a proline specific endopeptidase. In this approach the unique specificity of these two types of enzymes is advantageously used. Both types of proline specific proteases preferably hydrolyse peptide bonds C-terminal of proline residues. However, an inherent side activity of these two enzymes is directed towards hydrolysing C-terminal of alanine residues. As the –I-P-P- sequence as present in GMP is N-terminally preceded by an alanine residue, incubation of GMP with a pure proline specific oligopeptidase or a pure proline specific endopeptidase directly yields IPP. Important advantage of this route is that high IPP yields are obtained without the concomitant generation of a large number of other peptides that can lead to very bitter off-tastes and even exert undesired bioactivities. Furthermore almost no free amino acids are generated during this process so that a bland tasting product is obtained with a high concentration of IPP.

According to a further proteolytic process the isolated GMP molecule is first incubated with an aminopeptidase to remove the GMP N-terminal amino acids (Met and Ala) preceding the IPP sequence in GMP. Only after this incubation the proline specific protease is added to the reaction mixture to release the IPP peptide. Preferably the aminopeptidase is not longer active during or after the incubation with the proline specific protease. We have found that this approach leads to higher IPP yields and yet, doesnot lead to off-taste generation and hardly contributes to the amount of free amino acids present in the end product. Moreover, IPP is present at a high amount relative too other

peptides, especially relative to tripeptides. The IPP prepared can be further separated from the larger peptides. As aminopeptidases can sequentially remove amino acids from the N-terminal side of peptides, an aminopeptidolytic enzyme activity is required that can efficiently liberate the methionine ("M") and the alanine ("A") residues preceding the IPP sequence. The I-P and P-P peptide bonds present in IPP tripeptides were found to resist enzymatic cleavage, and after incubation of an intact GMP molecule such an aminopeptidolytic activity will truncate the N-terminus of the GMP molecule to start with the sequence IPP.

A commercial enzyme preparation having the desired aminopeptidase activity is Corolase LAP (AB Enzymes). Corolase LAP represents a relatively pure, cloned and overexpressed leucine aminopeptidase activity from Aspergillus. Because this preparation lacks non-specified endoproteolytic and carboxypeptidolytic activities, undesired cleavage of the GMP substrate molecule is prevented. Another cloned and overexpressed aminopeptidase with a relatively broad specificity is aminopeptidase from A. niger (SEQ ID 171 of WO 02/068623).

Finally we have noted that GMP is also advantageously used in processes in which IPP is produced by a fermentative route. As illustrated in the Examples, the incubation of GMP with specific lactobacilli yields IPP without the generation of the off-tastes that are characteristic for whole milk fermentations.

All the above mentioned aspects are of particular importance as it allows the production of a highly standardized product without unwanted bio-activities or taste or odor profiles. Such a highly standardized productt can be incorporated without subsequent purification steps in various food applications or in concentrated dietary products like tablets or lozenges. Highly standardized products containing even higher IPP concentrations, e.g. to produce smaller tablets or lozenges, can be obtained by a selective removal of peptides other than IPP. Such a removal of peptides without significant blood-pressure lowering activities can be accomplished e.g. by precipitating these non-active peptides followed by an (ultra) filtration or a decantation step. In yet another approach, the concentration of the bioactive ingredients can be further increased by subsequent purification in which use is made of the very hydrophobic character of peptide IPP. These purification methods include nanofiltration, extraction for example with butanol followed by evaporation/precipitation or contacting the acidified hydrolysate as obtained with binders like active carbon or

chromatographic resins from, for example, the Amberlite XAD range (Rohm). Also butyl-sepharose resins as supplied by, for example, Pharmacia can be used. Desorption of the blood pressure lowering peptides from such materials can be done with organic solvents like methanol/ethanol mixtures or with propanol. Furthermore supercritical extraction using CO_2 or N_2O can be used to obtain highly purified bioactive peptides.

In EP 1 231 279 a purely enzymatic process is described to recover the tripeptides VPP and IPP from milk casein. The application claims a method for producing tripeptides by digesting a material containing a milk casein with a proteinase and a peptidase via a socalled "intermediate peptide" selected from the group consisting of a peptide containing a sequence –V-P-P- but containing no Pro other than those in this sequence as well as a peptide containing a sequence –I-P-P- but containing no Pro other than those in this sequence. As described in the Examples of EP 1 231 279 the method involves a two-step process. First the intermediate peptides encompassing either VPP or IPP are produced. This is done by incubating casein with a suitable proteinase. According to one of the Examples at 37 degrees C for a 12 hours period. Then the proteinase used is inactivated by heating this first hydrolysate to 100 degrees C for 3 minutes and, after cooling down again, another enzyme preparation (in fact a preparation with exoproteolytic activity) is added. After another 12 hours incubation at 37 degrees C with this other enzyme preparation the presence of the tripeptides VPP and IPP can be demonstrated. To obtain higher yields of these ACE inhibiting peptides, EP 1 231 279 further suggests to purify and concentrate the intermediate peptide prior to exposure to the exoproteolytic activity. EP 1 231 279 also suggests that after obtaining the intermediate peptide and before the intermediate peptide is contacted with the peptidase in the procedure various operations may optionally be performed such as the removal of the unreacted protein by e.g. centrifugation at 5000 to 20000rpm for 3 to 10 minutes. So the complex mixture of the desired tripeptides is obtained in an industrially rather unwieldy two-step enzymatic process. As each of the enzyme incubations may take as long as 12 hours at pH 4.5 to 7.0 and at the temperature of 25 to 50 degrees C, it is evident that this procedure is also unacceptable from a microbiological point of view. These long incubation times combined with low incubation temperature of 25 to 50°C may easily result in infections of the protein containing solution.

Upon a comparison with the methods described in EP 1 231 279, the elegance of the inventive steps specified in the present application becomes clear. First of all, the present application describes the use of only a GMP fragment of kappa casein. As a result,

only IPP will be released and many other, potentially very bitter peptides known to be encompassed by casein, are not generated. Secondly, the incubation according to the present invention using the proline specific protease is carried out by a single, pure enzyme in a single incubation step. Because of the very selective cleavage pattern of the proline specific protease, which is inherent to this particular endoprotease, the desired IPP peptide is immediately released concomitantly with a very limited number of other peptides. Surprisingly no "intermediate peptide" as mentioned in EP 1 231 279 is formed. Thirdly, the incubation according to the present invention in which the GMP casein fragment is first incubated with a pure aminopeptidase followed by an incubation with the proline specific protease is essentially different from the route described in EP 1 231 279 and yet releases IPP with a high efficiency and with minimal levels of contaminating peptides and free amino acids. The preferred incubation starts with an aminopeptidase (a "peptidase" according to EP 1 231 279) instead of a proteinase and doesnot yield an "intermediate peptide". In the following step an endoprotease instead of a proteinase is used and again no "intermediate peptide" is formed.

Despite all disadvantages mentioned for prior art products, fermented milk products have been put to practical application as an orally administered vasodepressor. ACE inhibiting peptides also have been concentrated from fermented milk products by electrodialysis, hollow fiber membrane dialysis or chromatographic methods to enable their marketing in the form of concentrated dietary supplements like tablets or lozenges.

It is an object of the present invention to provide the peptide IPP in a pure state, i.e. without a significant contamination by the peptides like VPP or LPP.

It is another object of the present invention to provide the peptide IPP in a highly concentrated form without the use of expensive purification steps.

It is yet an object of the present invention to provide the blood pressure lowering peptide IPP in a non-bitter formulation.

The present invention relates to a peptide containing composition for use as a nutraceutical, preferably a medicament. The invention also relates to the use of present peptide containing composition as a nutraceutical preferably a medicament, to the use of present peptide containing composition for the manufacture of a nutraceutical preferably a medicament, to the use of the present peptide containing composition for the improvement of health or the prevention and/or treatment of diseases, to the use of the present peptide containing composition for the manufacture of a nutraceutical preferably a medicament, to the use of the present peptide containing composition for the treatment

of cardiovascular diseases such as hypertension and heart failure, to the use of the present peptide containing composition for the treatment of pre-diabetes or diabetes, to the use of the present peptide containing composition for the treatment or prevention of obesity, to the use of the present peptide containing composition to increase plasma insulin or to increase the sensitivity for plasma insulin, to the use of the present peptide containing composition to increase plasma insulin or to increase the sensitivity for plasma insulin of type 2 diabetes or pre-diabetes, to the use of the present peptide containing composition to lower post-prandial glucose concentrations in blood of type 2 diabetes or pre-diabetes, to the use of the present peptide containing composition to increase post-prandial insulin secretion in blood of type 2 diabetes or pre-diabetes, to the use of the present peptide containing composition wherein the present peptide containing composition is in the form of a dietary supplement, to the use of the present peptide containing composition for the manufacture of a functional food product for the therapeutic treatment of the effects of stress, to the use of the present peptide containing composition in topical application preferably in personal care application and to the use of the present peptide containing composition in feed and pet food.

Furthermore the present invention relates to a method of treatment of type 1 and 2 diabetes, and for the prevention of type 2 diabetes in those individuals with pre-diabetes, or impaired glucose tolerance (IGT) which comprises administering to a subject in need of such treatment the present peptide containing composition and to a method of treatment of people that suffer of hypertension or heart failure or the prevention thereof which comprises administering to a subject in need of such treatment the present peptide containing composition and thus, exhibit blood pressure lowering effects. Inhibition of ACE results in reduced vasoconstriction, enhanced vasodilation, improved sodium and water excretion, which in turn leads to reduced peripheral vascular resistance and blood pressure and improved local blood flow. Thus, the present hydrolysates, comprising peptide, are particularly efficacious for the prevention and treatment of diseases that can be influenced by ACE inhibition, which include but are not limited to hypertension, heart failure, angina pectoris, myocardial infarction, stroke, peripheral arterial obstructive disease, atherosclerosis, nephropathy, renal insufficiency, erectile dysfunction, endothelial dysfunction, left ventricular hypertrophy, diabetic vasculopathy, fluid retention, and hyperaldosteronism. The compositions may also be useful in the prevention and treatment of gastrointestinal disorders (diarrhea, irritable bowel syndrome), inflammation, diabetes mellitus, obesity, dementia, epilepsy, geriatric

confusion, and Meniere's disease. Furthermore, the compositions may enhance cognitive function and memory (including Alzheimer's disease), satiety feeling, limit ischemic damage, and prevent reocclusion of an artery after by-pass surgery or angioplasty.

Diabetes mellitus is a widespread chronic disease that hitherto has no cure. The incidence and prevalence of diabetes mellitus is increasing exponentially and it is among the most common metabolic disorders in developed and developing countries. Diabetes mellitus is a complex disease derived from multiple causative factors and characterized by impaired carbohydrate, protein and fat metabolism associated with a deficiency in insulin secretion and/or insulin resistance. This results in elevated fasting and postprandial serum glucose concentrations that lead to complications if left untreated. There are two major categories of the disease, insulin-dependent diabetes mellitus (IDDM, T1DM) and non-insulin-dependent diabetes mellitus (NIDDM, T2DM). T1DM = type 1 diabetes mellitus. T2DM = type 2 diabetes mellitus.

T1DM and T2DM diabetes are associated with hyperglycemia, hypercholesterolemia and hyperlipidemia. The absolute insulin deficiency and insensitivity to insulin in T1DM and T2DM, respectively, leads to a decrease in glucose utilization by the liver, muscle and the adipose tissue and to an increase in the blood glucose levels. Uncontrolled hyperglycemia is associated with increased and premature mortality due to an increased risk for microvascular and macrovascular diseases, including nephropathy, neuropathy, retinopathy, hypertension, stroke, and heart disease. Recent evidence showed that tight glycemic control is a major factor in the prevention of these complications in both T1DM and T2DM. Therefore, optimal glycemic control by drugs or therapeutic regimens is an important approach for the treatment of diabetes.

Therapy of T2DM initially involves dietary and lifestyle changes, when these measures fail to maintain adequate glycemic control the patients are treated with oral hypoglycemic agents and/or exogenous insulin. The current oral pharmacological agents for the treatment of T2DM include those that potentate insulin secretion (sulphonylurea agents), those that improve the action of insulin in the liver (biguanide agents), insulin-sensitizing agents (thiazolidinediones) and agents which act to inhibit the uptake of glucose (α-glucosidase inhibitors). However, currently available agents generally fail to maintain adequate glycemic control in the long term due to progressive deterioration of hyperglycemia, resulting from progressive loss of pancreatic cell function. The proportion of patients able to maintain target glycemia levels decreases markedly over time

necessitating the administration of additional/alternative pharmacological agents. Furthermore, the drugs may have unwanted side effects and are associated with high primary and secondary failure rates. Finally, the use of hypoglycemic drugs may be effective in controlling blood glucose levels, but may not prevent all the complications of diabetes. Thus, current methods of treatment for all types of diabetes mellitus fail to achieve the ideals of normoglycemia and the prevention of diabetic complications. Therefore, although the therapies of choice in the treatment of T1DM and T2DM are based essentially on the administration of insulin and of oral hypoglycemic drugs, there is a need for a safe and effective nutritional supplement with minimal side effects for the treatment and prevention of diabetes. Many patients are interested in alternative therapies which could minimize the side effects associated with high-dose of drugs and yield additive clinical benefits. Patients with diabetes mellitus have a special interest in treatment considered as "natural" with mild anti-diabetic effects and without major side effects, which can be used as adjuvant treatment. T2DM is a progressive and chronic disease, which usually is not recognized until significant damage has occurred to the pancreatic cells responsible for producing insulin (β-cells of islets of Langerhans). Therefore, there is an increasing interest in the development of a dietary supplement that may be used to prevent β-cell damage and thus, the progression to overt T2DM in people at risk especially in elderly who are at high risk for developing T2DM. Protection of pancreatic β-cells may be achieved by decreasing blood glucose and/or lipid levels as glucose and lipids exert damaging effects on β-cells. The reduction of blood glucose levels can be achieved via different mechanisms, for example by enhancing insulin sensitivity and/or by reducing hepatic glucose production. The reduction of blood lipid levels can also be achieved via different mechanisms, for example by enhancing lipid oxidation and/or lipid storage. Another possible strategy to protect pancreatic β-cells would be to decrease oxidative stress. Oxidative stress also causes β-cell damage with subsequent loss of insulin secretion and progression to overt T2DM.

Therefore, T2DM is a complicated disease resulting from coexisting defects at multiple organ sites: resistance to insulin action in muscle and adipose tissues, defective pancreatic insulin secretion, unrestrained hepatic glucose production. Those defects are often associated with lipid abnormalities and endothelial dysfunction. Given the multiple pathophysiological lesions in T2DM, combination therapy is an attractive approach to its management.

The present invention relates to novel nutraceutical compositions comprising the peptide containing composition of the present invention. The nutraceutical compositions comprising the peptide containing composition of the present invention can also comprise unhydrolysed proteins and carbohydrates as the active ingredients for the treatment or prevention of diabetes mellitus, or other conditions associated with impaired glucose tolerance such as syndrome X. In another aspect the present invention relates to the use of such compositions as a nutritional supplement for the said treatment or prevention, e.g., as an additive to a multi-vitamin preparations comprising vitamins and minerals which are essential for the maintenance of normal metabolic function but are not synthesized in the body. In still another aspect, the invention relates to a method for the treatment of both type 1 and 2 diabetes mellitus and for the prevention of T2DM in those individuals with pre-diabetes, or impaired glucose tolerance (IGT) or obesity which comprises administering to a subject in need of such treatment the peptide containing composition of the present invention and protein hydrolysates or unhydrolysed proteins and/or carbohydrates.

The compositions of the present invention are particularly intended for the treatment of both T1DM and T2DM, and for the prevention of T2DM in those individuals with pre-diabetes, or impaired glucose tolerance (IGT).

It is found that the present peptide containing compositions can be used for type 2 diabetes or prediabetes, preferably to lower post-prandial glucose concentrations or to increase post-prandial insulin secretion in blood.

The compositions comprising peptide and optionally carbohydrates stimulate insulin secretion and increase glucose disposal to insulin sensitive target tissues such as adipose tissue, skeletal muscle and liver and, thus, provide synergistic effects in the treatment of diabetes mellitus.

It is generally recognised that stress-related diseases, and the negative effects of stress upon the body, have a significant impact upon many people. In recent years the effects of stress, and its contribution towards various the development of various diseases and conditions, has gained wider acceptance in the medical and scientific community. Consumers are now becoming increasingly aware of these potential problems and are becoming increasingly interested in reducing or preventing the possible negative impact of stress on their health.

It is a further object of the invention to provide a food product, or an ingredient which can be incorporated therein, which is suitable for use in helping the body deal with the effects of stress.

It is a further object to provide a food product comprising the present peptide containing composition which provides a health benefit, such as helping the body deal with the negative effects of stress.

The term nutraceutical as used herein denotes the usefulness in both the nutritional and pharmaceutical field of application. Thus, the novel nutraceutical compositions can find use as supplement to food and beverages, and as pharmaceutical formulations or medicaments for enteral or parenteral application which may be solid formulations such as capsules or tablets, or liquid formulations, such as solutions or suspensions. As will be evident from the foregoing, the term nutraceutical composition also comprises food and beverages comprising the present peptide containing composition and optionally carbohydrate as well as supplement compositions, for example dietary supplements, comprising the aforesaid active ingredients.

The term dietary supplement as used herein denotes a product taken by mouth that contains a "dietary ingredient" intended to supplement the diet. The "dietary ingredients" in these products may include: vitamins, minerals, herbs or other botanicals, amino acids, and substances such as enzymes, organ tissues, glandulars, and metabolites. Dietary supplements can also be extracts or concentrates, and may be found in many forms such as tablets, capsules, softgels, gelcaps, liquids, or powders. They can also be in other forms, such as a bar, but if they are, information on the label of the dietary supplement will in general not represent the product as a conventional food or a sole item of a meal or diet.

A multi-vitamin and mineral supplement may be added to the nutraceutical compositions of the present invention to obtain an adequate amount of an essential nutrient missing in some diets. The multi-vitamin and mineral supplement may also be useful for disease prevention and protection against nutritional losses and deficiencies due to lifestyle patterns and common inadequate dietary patterns sometimes observed in diabetes. Moreover, oxidant stress has been implicated in the development of insulin resistance. Reactive oxygen species may impair insulin stimulated glucose uptake by disturbing the insulin receptor signaling cascade. The control of oxidant stress with antioxidants such as α-tocopherol (vitamin E) ascorbic acid (vitamin C) may be of value

in the treatment of diabetes. Therefore, the intake of a multi-vitamin supplement may be added to the above mentioned active substances to maintain a well balanced nutrition.

Furthermore, the combination of the present peptide containing composition with minerals such as magnesium (Mg^{2+}), Calcium (Ca^{2+}) and/or potassium (K^{+}) may be used for the improvement of health and the prevention and/or treatment of diseases including but not limited to cardiovascular diseases and diabetes.

In a preferred aspect of the invention, the nutraceutical composition of the present invention contains the present peptide containing compositions. IPP is present in the composition according to the invention in an amount to provide a daily dosage from about 0.001 g per kg body weight to about 1 g per kg body weight of the subject to which it is to be administered. A food or beverage suitably contains about 0.05 g per serving to about 50 g per serving of IPP. If the nutraceutical composition is a pharmaceutical formulation such formulation may contain IPP, in an amount from about 0.001 g to about 1 g per dosage unit, e.g., per capsule or tablet, or from about 0.035 g per daily dose to about 70 g per daily dose of a liquid formulation. The present peptide containing compositions suitably are present in the composition according to the invention in an amount to provide a daily dosage from about 0.01 g per kg body weight to about 3 g per kg body weight of the subject to which it is to be administered. A food or beverage suitably contains about 0.1 g per serving to about 100 g per serving of protein hydrolysates. If the nutraceutical composition is a pharmaceutical formulation such formulation may contain peptide containing compositions in an amount from about 0.01 g to about 5 g per dosage unit, e.g., per capsule or tablet, or from about 0.7 g per daily dose to about 210 g per daily dose of a liquid formulation.

In yet another preferred aspect of the invention a composition comprises the present peptide as specified above and optionally carbohydrates. Carbohydrates suitably are present in the composition according to the invention in an amount to provide a daily dosage from about 0.01 g per kg body weight to about 7 g per kg body weight of the subject to which it is to be administered. A food or beverage suitably contains about 0.5 g per serving to about 200 g per serving of carbohydrates. If the nutraceutical composition is a pharmaceutical formulation such formulation may contain carbohydrates in an amount from about 0.05 g to about 10 g per dosage unit, e.g., per capsule or tablet, or from about 0.7 g per daily dose to about 490 g per daily dose of a liquid formulation.

Dosage ranges (for a 70 kg person)

IPP: 0.005-70 g/day (each)

Protein hydrolysates: 0.07-210 g/day

Unhydrolysed proteins: 0.07-210 g/day

Carbohydrates: 0.1-490 g/day

It is an object of the invention to provide an edible material which can be used to provide health benefits to a subject consuming it. It is yet a further object to provide such an edible material which can conveniently be ingested either in isolated form or incorporated into a food product.

It is a further object of the invention to provide a food product, or an ingredient which can be incorporated therein, which is suitable for use in body weight control programmes.

It is a further object of the invention to provide a food product, or an ingredient which can be incorporated therein, which is suitable for helping to maintain cardiovascular health, e.g. through ACE inhibition.

It is a further object of the invention to provide a food product, or an ingredient which can be incorporated therein, which have acceptable stability and/or organoleptic properties, in particular good taste, such as an absence of or an acceptable level of bitterness.

It is a further object to provide a food product having a high concentration of an ingredient which provides a health benefit, such as aiding the prevention of obesity/ body weight control and/or helping maintain cardiovascular health.

Surprisingly, one or more of these objects is attained according to the invention by the use of the present peptide containing composition for the preparation of a food product which provides a health benefit upon consumption.

According to a first aspect the present invention provides the use of the present peptide containing composition for the manufacture of a functional food product for the prevention of obesity or body weight control.

According to a second aspect the present invention provides the use of the present peptide containing composition for the manufacture of a functional food product for cardiovascular health maintenance.

It is especially preferred according to the present invention that cardiovascular health maintenance comprises the inhibition of angiotensin-converting (ACE) enzyme and/or the control of blood glucose levels.

According to a third aspect the present invention provides a functional food product capable of providing a health benefit to the consumer thereof, said health benefit selected from the prevention of obesity, body weight control and cardiovascular health maintenance and comprising the present peptide containing composition.

A further advantage of the peptide containing composition according to the present invention is that this peptide containing composition can be conveniently incorporated into food products, to produce, functional food products, without unacceptably affecting the stability and/or organoleptic properties thereof.

"Health benefit agent(s)" according to the present invention are materials which provide a health benefit, that is which have a positive effect on an aspect of health or which help to maintain an aspect of good health, when ingested, these aspects of good health being prevention of obesity, body weight control and cardiovascular health maintenance.

"Health benefit" means having a positive effect on an aspect of health or helping to maintain an aspect of good health.

"Functional food products" according to the present invention are defined as food products (including for the avoidance of doubt, beverages), suitable for human consumption, in which the peptide containing composition of the present invention is used as an ingredient in an effective amount, such that a noticeable health benefit for the consumer of the food product is obtained.

The term "comprising" where used herein is meant not to be limiting to any subsequently stated elements but rather to encompass non-specified elements of major or minor functional importance. In other words the listed steps, elements or options need not be exhaustive. Whenever the words "including" or "having" are used, these terms are meant to be equivalent to "comprising" as defined above.

It is yet another object of the present invention to provide an enzymatic process which selectively excises IPP from the GMP part of kappa casein, preferably using a proline specific protease, more preferably a proline specifc endoprotease and most preferably a proline specifc endoprotease with an acid pH optimum.

It is also an object of the present invention to provide a process for the recovery of the GMP part of kappa casein from acid precipitated casein.

The effective blood pressure lowering peptide IPP has two proline residues at the carboxyterminal end of the peptide. As peptide bonds incorporating prolyl residues are known to resist proteolytic cleavage , the presence of two proline residues in blood pressure lowering peptides will endow such peptides with increased resistance against

proteolytic degradation. This aspect increases the probability that the relevant tripeptide will escape total hydrolysis during incubation with complex enzym preparations. Similarly IPP is likely to survive gastro-intestinal digestion so that these peptides stand a better chance of reaching the blood stream intact. To obtain peptides with at least a single but preferably multiple proline residues at their carboxyterminal end, the use of a protease that can cleave at the carboxyterminal side of proline residues offers an interesting option. Socalled prolyl oligopeptidases (EC 3.4.21.26) have the unique possibility of preferentially cleaving peptides at the carboxyl side of proline residues and, be it with a lower efficiency, at the carboxyl side of alanine. In all adequately characterized proline specific proteases isolated from mammalian as well as microbial sources, a unique peptidase domain has been identified that excludes large peptides from the enzyme's active site. In fact these enzymes are unable to degrade polypeptides containing more than about 30 amino acid residues so that these enzymes are now referred to as "prolyl oligopeptidases" (Fulop et al : Cell, Vol. 94, 161-170, July 24,1998). As a consequence these prolyl oligopeptidases require an extensive pre-hydrolysis with other endoproteases before they can exert their hydrolytic action. However, as described in WO 02/45523, even the combination of a prolyl oligopeptidase with such another endoprotease results in hydrolysates characterized by a significantly enhanced proportion of peptides with a carboxyterminal proline residue. Because of this, such hydrolysates form an excellent starting point for the isolation of peptides with in vitro ACE inhibiting effects as well as an improved resistance to gastro-intestinal proteolytic degradation. Despite these potential benefits, we are not aware of an application specifying the use of proline specific proteases for the recovery of blood pressure lowering peptides let alone for the selective production of IPP.

WO 02/45524 describes a proline specific protease obtainable from *Aspergillus niger.* The *A. niger* derived enzyme cleaves preferentially at the carboxyterminus of proline, but can also cleave at the carboxyterminus of hydroxyproline and, be it with a lower efficiency, at the carboxyterminus of alanine. WO 02/45524 also teaches that there exists no clear homology between this *A. niger* derived enzyme and the known prolyl oligopeptidases from other microbial or mammelian sources. In contrast with known prolyl oligopeptidases, the A.niger enzyme has an acid pH optimum. Although the known prolyl oligopeptidases as well as the *A. niger* derived enzyme are socalled serine proteases, we show in Example 1 that the *A. niger* enzyme belongs to a completely different subfamily. The secreted *A. niger* enzyme appears to be a member of family S28 of serine peptidases

rather than the S9 family into which most cytosolic prolyl oligopeptidases have been grouped (Rawlings,N.D. and Barrett, A.J.; Biochim. Biophys. Acta 1298 (1996) 1-3).

In Example 2 we show the pH and temperature optima of the *A. niger* derived proline specific endoprotease in comparison with a proline specific oligopeptidase as obtained from the microorganism *Flavobacterium meningosepticum*. Aqueous solutions containing protein are highly susceptible for microbial infections, especially if kept for many hours at pH values above 5.0 and at temperatures of 50 degrees C or below. Especially microbial toxins that can be produced during such prolonged incubation steps and are likely to survive subsequent heating steps and form a potential threat to food grade processes. Unlike the conditions described in EP 1 231 279 the process according to the present invention preferably uses an incubation temperature above 50 degrees C. In combination with the one-step enzyme process in which the enzyme incubation is carried out for a period less than 24 hours, preferably less than 8 hours, more preferably less than 4 hours, the process according to the invention offers the advantage of an improved microbiological stability.

In Example 3 we demonstrate that the *A. niger* derived enzyme preparation as used in the process of the present invention exhibits a very narrow substrate specificity meaning that no significant endoproteolytic activity other than towards peptide bonds involving a proline or an alanine residue is present. In Example 4 of the present application we show that the Aspergillus enzyme is not an oligopeptidase but a true endopeptidase able to hydrolyse intact proteins, large peptides as well as smaller peptide molecules without the need of an accessory endoprotease. This new and surprising finding allows us to omit the use of an accessory endoprotease so that hydrolysates with unprecedented high contents of peptides with a carboxyterminal proline residue can be generated. Furthermore the omission of an accessory endoprotease is preferred to generate a very limited number of peptides upon hydrolysing either polypeptides or oligopeptides. As a result relatively simple peptide mixtures are obtained that are characterized by the fact that most of the peptides present have a carboxyterminal proline residue.

In Example 5 we characterize the enzyme preparations used in terms of endoproteolytic, aminopeptidolytic and carboxypeptidolytic activities present. Whereas the proline specific endoprotease has negligible side-activities, the Sumizyme FP and the Flavourzyme preparations form a rich source of many different enzyme types.

In Example 6 we describe an alternative route for the isolation of GMP i.e. an isolation from commercially available caseinate. Using the proline specific endoprotease

we also recover IPP from the GMP thus isolated. The fact that the *A. niger* derived enzyme does not contain significant amino-peptidase activity (cf. Example 5) strongly suggests that the IPP formed is released from the –A107-I108-P109-P110- sequence present in kappa-caseine. Presumably the peptide bond carboxyterminal of IPP is cleaved by the main activity of the *A. niger* derived prolyl endoprotease whereas cleavage of the preceding Ala-Ile bond is accomplished by its Ala-specific side activity. Advantage of this route is that after the selective removal of the GMP, the remaining caseinate fraction can be used for alternative applications.

In Example 7 we show that both the proline specific endoprotease as well as the complex Sumizyme FP preparation can be used to liberate IPP from commercially obtained GMP. Preferably this composition comprises between 0.1 to 100mg/g IPP (on dry matter and on protein), more preferably between 1 to 50 mg/g IPP (on dry matter and on protein) and most preferably between 2 and 35 mg/g IPP (on dry matter and on protein). We have also found that hydrolysis of GMP results in a composition comprising the tripeptide IPP and the tetrapeptide TSTP in almost identical amounts in case proline specific endoprotease is used. Therefore the present invention also relates to a composition comprising IPP and TSTP and whereby the molar ration of IPP:TSTP is between 1.5 and 0.5, preferably between 1.3 and 0.7 and more preferably between 1.2 and 0.8. Preferably this composition comprises between 0.1 to 100mg/g IPP (on dry matter and on protein), more preferably between 1 to 50 mg/g IPP (on dry matter and on protein) and most preferably between 2 and 35 mg/g IPP (on dry matter and on protein)

In Example 8 we demonstrate the organoleptical advantages of using a GMP hydrolysate.

In Example 9 we illustrate that the use of GMP also allows the preparation of IPP containing products by a fermentative approach.

Therefore the present invention results in several advantages over the prior art. Most importantly the process according to the invention generates a smaller variety of water soluble peptides and among these water soluble peptides IPP is present in major amounts. This is especially important in case a high concentration of IPP is needed in a bland tasting product. According to the present process preferably at least 20%, more preferably at least 30%, most preferably at least 40% of an -A-I-P-P sequence present in a protein is converted into IPP.

After hydrolysis the solution can be heated. Optionally the pH of the solution can be modified or the solution can be mixed with solvents.

According to one aspect of the invention the soluble peptides, including IPP, which are formed during the hydrolysis of the protein source, are separated and optionally dried. After for example decantation, filtration or low speed centrifugation to remove the precipitate formed, the supernatants containing the biologically active soluble peptides can be recovered by for example reverse osmosis or evaporation, optionally in combination with an additional filtration step optionally followed by a spray drying step to yield an economical route for obtaining a food grade paste or powder with a high bio-activity and a good water solubility. Upon the digestion of the suitable substrate protein such as GMP by a proline specific endoprotease a white and odourless powder with a high concentration of IPP and a surprisingly low Degree of Hydrolysis is obtained.

In nutraceutical applications and food and beverage applications, hydrolysates of the inventions are advantageously used. A protein hydrolysate, an soluble hydrolysate as well as an mixture thereof can be used in a nutraceutical application, a food application or a beverage. Preferably the soluble hydrolysate is used in a nutraceutical application, a food application or a beverage because of the high content of active peptides present.

If appropriately diluted to the right tripeptide concentration, a versatile starting material with an excellent palatability is obtained suitable for endowing all kinds of foods and beverages with blood pressure lowering properties.

The peptide mixture as obtained either before or after an additional purification step, such asfor example chromatography, may be used for the incorporation into food products that are widely consumed on a regular basis. Examples of such products are margarines, spreads, various dairy products such as butter or yoghurts or milk or whey containing beverages, bakery items such as cakes and cookies, liquid foods such as soups as well as candies and sweeteners and sugar lumps. As a result of the very bland taste of the IPP containing hydrolysates according to the invention, the incorporation of the hydrolysate in all kinds of beverages including bottled table water, soft drinks, sport drinks, fruit juices, lemonades and instant teas and coffees presents is possible.

A sports drink is a beverage which is supposed to rehydrate athletes, as well as restoring electrolytes, sugar, and other nutrients. Sports drinks are usually isotonic, meaning they contain the same proportions of nutrients as found in the human body. (Source: http://en.wikipedia.org/wiki/Sports_drink)

Energy drinks are beverages which contain (legal) stimulants, vitamins (especially B vitamins) and minerals with the intent to give the user a burst of energy. Common ingredients include caffeine, guarana (caffeine from the Guarana plant), taurine, various forms of ginseng, maltodextrin, inositol, carnitine, creatine, glucuronolactone and ginkgo biloba. Some may contain high levels of sugar, or glucose. Many such beverages are flavored and/or colored. (Source: http://en.wikipedia.org/wiki/Energy_drink)

A soft drink is a drink that does not contain alcohol, as opposed to hard drinks, that do. In general, the term is used only for cold beverages. Hot chocolate, tea, and coffee are not considered soft drinks. The term originally referred exclusively to carbonated drinks, and is still commonly used in this manner.(Source: http://en.wikipedia.org/wiki/Soft_drink)

Although such compositions are typically administered to human beings, they may also be administered to animals, preferably mammals, to relief hypertension. Furthermore the high concentration of blood pressure lowering peptide in the products as obtained makes these products very useful for the incorporation into dietary supplements in the form off pills, tablets or highly concentrated solutions or pastes or powders. Slow release dietary supplements that will ensure a continuous release of the peptides are of particular interest. The peptides according to the invention may be formulated as a dry powder in, for example, a pill, a tablet, a granule, a sachet or a capsule. Alternatively the peptide mixture according to the invention may be formulated as a liquid in, for example, a syrup or a capsule. The compositions used in the various formulations and containing the enzymes according to the invention may also incorporate at least one compound of the group consisting of a physiologically acceptable carrier, adjuvant, excipient, stabiliser, buffer and diluant which terms are used in their ordinary sense to indicate substances that assist in the packaging, delivery, absorption, stabilisation, or, in the case of an adjuvant, enhancing the physiological effect. The relevant background on the various compounds that can be used in combination with the peptide mixture according to the invention in a powdered form can be found in "Pharmaceutical Dosage Forms", second edition, Volumes 1,2 and 3, ISBN 0-8247-8044-2 Marcel Dekker, Inc. or in Remington's Pharmaceutical Sciences, 20th edition Williams & Wilkins, PA, USA. For oral administration, tablets and capsules are preferably used which contain a suitable binding agent, e. g. gelatine or polyvinyl pyrrolidone, a suitable filler, e. g. lactose or starch, a suitable lubricant, e.g. magnesium stearate, and optionally further additives.

A relatively new oral application form is the use of various types of gelatin capsules or gelatin based tablets.

To a further aspect of the invention, a hydrolysate is provided which is free of phenylalanine, tryptophane and tyrosine. By using GMP as starting protein, a hydrolysate is obtained that lacks phenylalanine, tryptophane and tyrosine. This makes this hydrolysate safe for individuals with phenylketonuria (PKU).

In view of the relevance of natural peptides to fight hypertension the present new and cost effective route offers an attractive starting point for mildly hypotensive alimentary or even veterinary products. Because the present route incorporates a surprisingly simple purification step, the possibilities for blood pressure lowering concentrated dietary supplements are also enlarged.

The process according to the invention can be accomplished using any proline specific oligo- or endoprotease. By proline specific oligopeptidases according to the invention or used according to the invention are meant the enzymes belonging to EC 3.4.21.26. By the proline specific endo protease according to the invention or used according to the invention is meant a proline specific endoprotease belonging to family S28 of the serine proteases (Handbook of Proteolytic Enzymes; Barrett A. J.; Rawlings N.D.; Woessner J.F., Eds.; Academic Press, London, UK, **1998**, 369- 415) or, more preferably, the polypeptide as mentioned in claims 1-5, 11 and 13 of WO 02/45524. Therefore this proline specific endo protease is a polypeptide which has proline specific endoproteolytic activity, selected from the group consisting of:

(a) a polypeptide which has an amino acid sequence which has at least 40% amino acid sequence identity with amino acids 1 to 526 of SEQ ID NO:2 or a fragment thereof;

(b) a polypeptide which is encoded by a polynucleotide which hybridizes under low stringency conditions with (i) the nucleic acid sequence of SEQ ID NO:1 or a fragment thereof which is at least 80% or 90% identical over 60, preferably over 100 nucleotides, more preferably at least 90% identical over 200 nucleotides, or (ii) a nucleic acid sequence complementary to the nucleic acid sequence of SEQ ID NO:1. The SEQ ID NO:1 and SEQ ID NO:2 as shown in WO 02/45524. Preferably the polypeptide is in isolated form.

The preferred polypeptide used according to the present invention has an amino acid sequence which has at least 50%, preferably at least 60%, preferably at least 65%, preferably at least 70%, more preferably at least 80%, even more preferably at least 90%, most preferably at least 95%, and even most preferably at least about 97% identity with

amino acids 1 to 526 of SEQ ID NO: 2 or comprising the amino acid sequence of SEQ ID NO:2.

Preferably the polypeptide is encoded by a polynucleotide that hybridizes under low stringency conditions, more preferably medium stringency conditions, and most preferably high stringency conditions, with (i) the nucleic acid sequence of SEQ ID NO:1 or a fragment thereof, or (ii) a nucleic acid sequence complementary to the nucleic acid sequence of SEQ ID NO: 1.

The term "capable of hybridizing" means that the target polynucleotide of the invention can hybridize to the nucleic acid used as a probe (for example, the nucleotide sequence set forth in SEQ. ID NO: 1, or a fragment thereof, or the complement of SEQ ID NO: 1) at a level significantly above background. The invention also includes the polynucleotides that encode the proline specific endoprotease of the invention, as well as nucleotide sequences which are complementary thereto. The nucleotide sequence may be RNA or DNA, including genomic DNA, synthetic DNA or cDNA. Preferably, the nucleotide sequence is DNA and most preferably, a genomic DNA sequence. Typically, a polynucleotide of the invention comprises a contiguous sequence of nucleotides which is capable of hybridizing under selective conditions to the coding sequence or the complement of the coding sequence of SEQ ID NO: 1. Such nucleotides can be synthesized according to methods well known in the art.

A polynucleotide of the invention can hybridize to the coding sequence or the complement of the coding sequence of SEQ ID NO:1 at a level significantly above background. Background hybridization may occur, for example, because of other cDNAs present in a cDNA library. The signal level generated by the interaction between a polynucleotide of the invention and the coding sequence or complement of the coding sequence of SEQ ID NO: 1 is typically at least 10 fold, preferably at least 20 fold, more preferably at least 50 fold, and even more preferably at least 100 fold, as intense as interactions between other polynucleotides and the coding sequence of SEQ ID NO: 1. The intensity of interaction may be measured, for example, by radiolabelling the probe, for example with 32P. Selective hybridization may typically be achieved using conditions of low stringency (0.3M sodium chloride and 0.03M sodium citrate at about 40°C), medium stringency (for example, 0.3M sodium chloride and 0.03M sodium citrate at about 50°C) or high stringency (for example, 0.3M sodium chloride and 0.03M sodium citrate at about 60°C).

The UWGCG Package provides the BESTFIT program which may be used to calculate identity (for example used on its default settings).

The PILEUP and BLAST N algorithms can also be used to calculate sequence identity or to line up sequences (such as identifying equivalent or corresponding sequences, for example on their default settings).

Software for performing BLAST analyses is publicly available through the National Center for Biotechnology Information (http://www.ncbi.nlm.nih.gov/). This algorithm involves first identifying high scoring sequence pair (HSPs) by identifying short words of length W in the query sequence that either match or satisfy some positive-valued threshold score T when aligned with a word of the same length in a database sequence. T is referred to as the neighbourhood word score threshold. These initial neighbourhood word hits act as seeds for initiating searches to find HSPs containing them. The word hits are extended in both directions along each sequence for as far as the cumulative alignment score can be increased. Extensions for the word hits in each direction are halted when: the cumulative alignment score falls off by the quantity X from its maximum achieved value; the cumulative score goes to zero or below, due to the accumulation of one or more negative-scoring residue alignments; or the end of either sequence is reached. The BLAST algorithm parameters W, T and X determine the sensitivity and speed of the alignment. The BLAST program uses as defaults a word length (W) of 11, the BLOSUM62 scoring matrix alignments (B) of 50, expectation (E) of 10, M=5, N=4, and a comparison of both strands.

The BLAST algorithm performs a statistical analysis of the similarity between two sequences. One measure of similarity provided by the BLAST algorithm is the smallest sum probability (P(N)), which provides an indication of the probability by which a match between two nucleotide or amino acid sequences would occur by chance. For example, a sequence is considered similar to another sequence if the smallest sum probability in comparison of the first sequence to the second sequence is less than about 1, preferably less than about 0.1, more preferably less than about 0.01, and most preferably less than about 0.001.

The strains of the genus Aspergillus have a food grade status and enzymes derived from these micro-organisms are known to be from an unsuspect food grade source. According to another preferred embodiment, the enzyme is secreted by its producing cell rather than a non-secreted, socalled cytosolic enzyme. In this way enzymes can be recovered from the cell broth in an essentially pure state without expensive purification

steps. Preferably the enzyme has a high affinity towards its substrate under the prevailing pH and temperature conditions.

Description of the Figures

Figure 1: Activity profiles of the proline-specific oligopeptidase of *F. meningosepticum* and the proline-specific endoprotease from *A. niger* measured on the fluorescent substrate Z-Gly-Pro-AMC under various pH conditions. Fluorescence was measured after 30 minutes at 37 ^{0}C.

Figure 2: Specificity profile of the *A. niger* derived prolyl endoprotease

Figure 3: SDS-PAGE of intact ovalbumine and a synthetic 27-mer peptide after incubation with chromatographically purified *A. niger* derived proline specific endoprotease.

Materials and Methods

Edible sodium and potassium caseinate spray (88%) was obtained from DMV International, The Netherlands. GMP was obtained from Arla, Denmark (Lacprodan CGMP-10, lot # P340205). Synthetic chromogenic peptides were obtained from either Pepscan Systems B.V. The Netherlands or from Bachem, Switzerland. Flavourzyme 1000L Batch HPN00218 was obtained from Novozymes (Denmark), Sumizyme FP from Shin Nihon (Japan) and Corolase LAP Ch.: 4123 from AB Enzymes (UK).

Proline- specific endoprotease from *A. niger* .

Overproduction of the proline specific endoprotease from Aspergillus niger was accomplished as described in WO 02/45524. The activity of the enzyme was tested on the synthetic peptide Z-Gly-Pro-pNA at 37 degrees C in a citrate/disodium phosphate buffer pH 4.6. The reaction product was monitored spectrophotometrically at 405 nM. A unit is defined as the quantity of enzyme that liberates 1 µmol of p-nitroanilide per minute under these test conditions and at a substrate concentration of 0.37mM Z-Gly-Pro-pNA.

Chromatographic purification of the *A. niger* derived endoprotease

The culture broth obtained from an overproducting *A. niger* strain was used for chromotograhpic purification of the protease to remove any contaminating endo- and exoproteolytic activities. To that end the fermentation broth was first centrifuged to remove the bulk of the fungal mass and the supernatant was then passed through a number of filters with decreasing pore sizes to remove all cell fragments. Finally, the ultrafiltrate obtained was diluted ten times in 20 millimol/liter sodium acetate pH 5.1 and applied on a

Q-Sepharose FF column. Proteins were eluted in a gradient from 0 to 0.4 moles/liter NaCl in 20 millimol/liter sodium acetate pH 5.1. Peak fractions displaying activity towards the cleavage of Z-Gly-Pro-pNA were collected and pooled, according to the protocol described in World Journal of Microbiology & Biotechnology 11, 209 - 212 (1995), but under slightly modified assay conditions. Taking the acid pH optimum of the *A. niger* derived proline-specific endoprotease into account, the enzyme assay was carried out at pH 4.6 in a citrate/diphosphate buffer at 37°C. Pooling of the active fractions followed by concentration finally yielded a preparation which showed only a single band on SDS-PAGE and one peak on HP-SEC. Further analysis by hydrophobic interaction chromatography confirmed the purity of the enzyme preparation obtained.

Kjeldahl Nitrogen

Total Kjeldahl Nitrogen was measured by Flow Injection Analysis. Using a Tecator FIASTAR 5000 Flow Injection System equipped with a TKN Method Cassette 5000-040, a Pentium 4 computer with SOFIA software and a Tecator 5027 Autosampler the ammonia released from protein containing solutions was quantitated at 590 nm. A sample amount corresponding with the dynamic range of the method (0.5-20 mg N/l) is placed in the digestion tube together with 95-97% sulphuric acid and a Kjeltab subjected to a digestion program of 30 minutes at 200 degrees C followed by 90 minutes at 360 degrees C. After injection in the FIASTAR 5000 system the nitrogen peak is measured from which the amount of protein measured can be inferred.

Amino acid analysis

A precisely weighed sample of the proteinaceous material was dissolved in dilute acid and precipitates were removed by centrifugation in an Eppendorf centrifuge. Amino acid analysis was carried out on the clear supernatant according to the PicoTag method as specified in the operators manual of the Amino Acid Analysis System of Waters (Milford MA, USA). To that end a suitable sample was obtained from the liquid, then dried and subjected to vapour phase acid hydrolysis and derivatised using phenylisothiocyanate. The various derivatised amino acids present were quantitated using HPLC methods and added up to calculate the total level of free amino acids, including derivatiised Ile, in the weighed sample. The amino acids Cys and Trp are not included in the data obtained in this analysis.

LC/MS/MS analysis

HPLC using an ion trap mass spectrometer (Thermoquest®, Breda, the Netherlands) coupled to a P4000 pump (Thermoquest®, Breda, the Netherlands) was used in quantification of the peptides of interest, among these the tripeptides IPP, LPP and VPP,

in the enzymatic protein hydrolysates produced by the inventive enzyme mixture. The peptides formed were separated using a Inertsil 3 ODS 3, 3 mm, 150*2.1 mm (Varian Belgium, Belgium) column in combination with a gradient of 0.1% formic acid in Milli Q water (Millipore, Bedford, MA, USA; Solution A) and 0.1% formic acid in acetonitrile (Solution B) for elution. The gradient started at 100% of Solution A, kept here for 5 minutes, increasing linear to 5 % B in 10 minutes, followed by linear increasing to 45% of solution B in 30 minutes and immediately going to the beginning conditions, and kept here 15 minutes for stabilization. The injection volume used was 50 microliters, the flow rate was 200 microliter per minute and the column temperature was maintained at 55°C. The protein concentration of the injected sample was approx. 50 micrograms/milliliter.

Detailed information on the individual peptides was obtained by using dedicated MS/MS for the peptides of interest, using optimal collision energy of about 30 %. Quantification is performed in LC/MS/MS mode using electrospray positive ionization mode with a C_{13} + N_{15} labelled IPP standard, using a calibration line also with labelled internal standard to correct for matrix effect. Identification is performed by retention time, precursor ion and de ratio of characteristic fragmentions.

The tripeptide LPP (M=325.2) was used to tune for optimal sensitivity in MS mode and for optimal fragmentation in MS/MS mode, performing constant infusion of 5 mg/ml, resulting in a protonated molecule in MS mode, and an optimal collision energy of about 30 % in MS/MS mode, generating a B- and Y-ion series.

Prior to LC/MS/MS the enzymatic protein hydrolysates were centrifuged at ambient temperature and 13000 rpm for 10 minutes, filtered through a 0.22 µm filter and the supernatant was diluted 1:100 with MilliQ water.

The Degree of Hydrolysis (DH) as obtained during incubation with the various protolytic mixtures was monitored using a rapid OPA test (JFS, Vol 66, NO 5, 2001).

Example 1

The enzyme as obtained from *A. niger* represents a new class of proline specific enzymes.

From the entire coding sequence of the *A. niger* derived proline specific endoprotease as provided in WO 02/45524 a protein sequence of 526 amino acids can be determined. The novelty of the enzyme was confirmed by BLAST searches of databases such as SwissProt, PIR and trEMBL. To our surprise, no clear homology could be detected between the *A. niger* enzyme and the known prolyl oligopeptidases.

Closer inspection of the amino acid sequence, however, revealed low but significant homology to Pro-X carboxypeptidases (EC3.4.16.2), dipeptidyl aminopeptidases I (EC3.4.14.2), and thymus specific serine protease. All of these enzymes have been assigned to family S28 of serine peptidases (Handbook of Proteolytic Enzymes; Barrett A. J.; Rawlings N.D.; Woessner J.F., Eds.; Academic Press, London, UK, 1998, 369-415). Also the GxSYxG configuration around the active site serine is conserved between these enzymes and the *A. niger* derived endoprotease. Additionally, members of family S28 have an acidic pH optimum, have specificity for cleaving at the carboxy-terminal side of proline residues and are synthesized with a signal sequence and propeptide just like the *A. niger* derived proline specific endoprotease. Also the size of the *A. niger* enzyme is similar to those the members of family S28. Therefore, the *A. niger* proline specific endoprotease appears to be a member of family S28 of serine proteases rather than the S9 family into which most cytosolic prolyl oligopeptidases including the enzyme obtained from *Flavobacterium meningosepticum* have been grouped. On the basis of these structural and physiological features we have concluded that the *A. niger* enzyme belongs to the S28 rather than the S9 family of serine proteases. An additional feature that discriminates the *A. niger* derived enzyme from the prolyl oligopeptidases belonging to the S9 family is the fact that, unlike the cytosolic prolyl endoproteases belonging to the latter family, the newly identified *A. niger* enzyme is secreted into the growth medium. This is the first report on the isolation and characterization of a member of family S28 from a lower eukaryote.

Example 2

The pH activity spectra of the A. niger proline specific endoprotease and the proline specific oligopeptidase from F. meningosepticum.

To demonstrate the difference in pH optima that exist between the Aspergillus derived proline specific endoprotease and the proline specific oligopeptidase from Flavobacterium meningosepticum, we measured their activities under various pH conditions. The Aspergillus derived endoprotease was obtained as described in the Materials & Methods section. The Flavobacterium derived oligopeptidase was purchased from ICN Biomedicals (35 units/mg; cat no. 32082; Ohio,US).

To establish the pH activity spectra of the two enzymes, buffers with different pH values were prepared. Buffers ranging from pH 2.0 to 7.0 were prepared using 0.1 mol/l citrate, buffers ranging from pH 6.0 to 9.0 were prepared using 0.1 mol/l tris and buffers ranging from pH 8.0 to 12.0 were made using 0.2 mol/l glycine. The required pH values were

adjusted using either HCl or NaOH. The chromogenic synthetic peptide Z-Gly-Pro-AMC (Bachem, Switserland) was used as the substrate for both enzymes. In each well (Costar no. 3631 plates) 85 uL of buffer, 10 uL of enzyme solution and 5 uL of the substrate (4mM Z-Gly-Pro-AMC in 60% methanol) was introduced. Final concentration of the A. niger enzyme was 32 ug/ml (3.2 milli units/ml), final concentration of the F. meningosepticum enzyme was 0.21 ug/ml (7.4 milli units/ml) . After mixing the reaction was allowed to proceed for 30 minutes at 37.0°C after which the fluorescence was measured in a CytoFluor multi-well plate reader of PerSeptive Biosciences. The relative data as obtained are shown in Figure 1. Also the temperature optimum of the prolyl endoprotease was established. To that end the purified enzyme preparation was incubated in 0.1 mol/l Na-acetate containing 0.02 mol/l CaCl2 at pH 5.0 for 2 hours at different temperatures using Caseine Resorufine (Roche version 3) as the substrate and enzyme activity was quantified by measuring at 574 nm. According to the results obtained the proline specific endoprotease from *A. niger* has a temperature optimum around 50 degrees C.

Example 3

The specificity of the *A. niger* derived proline specific endoprotease.

Crude as well as chromatographically purified enzyme samples as obtained from an *A. niger* strain containing multiple copies of the expression cassette (cf WO 02/45524) were tested against a collection of chromogenic peptide substrates to establish the specificity of the encoded endoprotease. The endoproteolytic activity of the enzyme was tested on an AAXpNA substrate. The "pNA" (p-Nitroanilide) substrates cause color changes if the X-pNA peptide bond is cleaved; "X" represents different natural amino acid residues. Stock solutions of AAX-pNA substrates (150 mmol/l) were diluted 100X in 0.1M acetate buffer pH 4.0 containing 20 CaCl2. The 10 minutes kinetic measurements at 40 degrees C in a TECAN Genios MTP Reader (Salzburg, Vienna) at 405nm recorded the increases in optical density that via data processing in Excel yielded the picture shown in Figure 2. From the result it is clear that the *A. niger* derived endoprotease is highly specific for prolyl peptide bonds with a side activity towards alanyl bonds. Crude and chromatographically purified preparations showed similar activity profiles.
The contamination of the *A. niger* derived endoprotease with aminopeptidases, carboxypeptidases or non-proline specific endoproteases could be shown to be insignificant (see Example 5)

Example 4

The *A. niger* derived proline specific endoprotease can hydrolyse large proteins as well as small peptides and is thus a true endoprotease.

Owing to a specific structural feature, prolyl oligopeptidases belonging to the S9 family cannot digest peptides larger than 30 amino acids. This limitation is an obvious disadvantage for an enzyme, which is meant to hydrolyse as quickly and as efficiently as possible different proteins. To see if the *A. niger* derived proline specific endoprotease exhibits the same limitations with respect to the size of the substrate molecule, we have incubated the chromatographically purified prolyl endopeptidase from *A. niger* with a small synthetic peptide and with the large ovalbumine molecule and have analysed the hydrolysis products formed by SDS-PAGE.

The synthetic peptide used was a 27-mer of the sequence NH2-FRASDNDRVIDPGKVETLTIRRLHIPR-COOH and was a gift of the Pepscan company (Lelystad,The Netherlands). As shown by its amino acid sequence, this peptide contains 2 proline residues, one in the middle and one near the carboxy terminal end of the peptide.

The intact ovalbumine molecule (Pierce Imject, vials containing 20mg freeze dried material) consists of 385 amino acids with a molecular weight of 42 750 Da. This molecule contains 14 proline residues, one of which is located at the ultimate C-terminal end of the molecule and cannot be cleaved by a proline specific endoprotease. Ovalbumin and the oligopeptide were separately incubated at 50°C with the purified *A. niger* derived proline specific endoprotease. At several time intervals samples were taken which were then analysed using SDS-PAGE.

A chromatographically purified *A. niger* derived proline specific endoprotease with an activity of 4.5 units/ml was diluted 100-fold with 0.1 M acetate buffer pH 4 containing 20mM CaCl2. The ovalbumine was dissolved in acetate buffer pH 4 to a concentration of 1 mg/ml (22µM). The 27-mer was dissolved in the same buffer to reach a concentration of 0.48 mg/ml (152µM). The molarity of the ovalbumine and the 27-mer solution was chosen in such a way that both solutions contained the same molarity in cleavable proline residues. Ovalbumine contains 13 potential proline cleavage sites, whereas the 27-mer peptide has only two. Of both substrate solutions 0.5 ml was incubated with 10µl (0.45milliU) of the enzyme solution in an Eppendorf thermomixer at 50°C. At several time intervals 10µl samples were withdrawn from the incubation mixture

and kept at 20°C until SDS-PAGE. All materials used for SDS-PAGE and staining were purchased from Invitrogen. Samples were prepared using SDS buffer according to manufacturers instructions and separated on 12% Bis-Tris gels using MES-SDS buffer system according to manufacturers instructions. Staining was performed using Simply Blue Safe Stain (Collodial Coomassie G250).

As can be seen in Figure 3 ovalbumine is cleaved by the *Aspergillus* derived enzyme into a discrete band of about 35 to 36kD in the first 4.75 hours of incubation (lane 3). Prolonged incubation periods result in further breakdown to smaller products of various molecular weights (lane 7).

The 27-mer peptide is also broken down, as judged by the more faint bands in lanes 4, 6 and 8 as compared to lane 2. The very small molecular weight shift of the product (compare lanes 9 and 8) is most likely due to cleaving of the arginine residue at the carboxylic end of the peptide. The difference is about 200D (measured using AlphaImager 3.3d software on an AlphaImager 2000 system) and arginine has a MW of 174. This small molecular weight shift is probably the first step in the breakdown of the peptide.

The further decay of the product can only be seen by the decrease in intensity of the band on the SDS gel. The products of further decay are not visible, as in gel staining of components with a MW of about 1000 is not possible with Coomassie Brillant Blue. From this experiment it can be concluded that, unlike the known prolyl oligopeptidases belonging to the S9 family, the *A. niger* derived proline specific endoprotease has no specific preference for cleaving small sized peptides over much larger proteins. As such the *A. niger* derived enzyme represents a true endoprotease and a preferred enzyme to hydrolyse different types of proteins.

Example 5

The quantitation of desirable and contaminating enzyme activities in the production of blood pressure lowering peptides.

According to the present invention relatively pure IPP can be obtained in a simple one-step process by recovering IPP from GMP. The IPP containing fraction can be obtained from GMP by a variety of different enzyme preparations. For example, by incubating GMP with either a pure proline specific endoprotease, or a pure proline specific endoprotease plus a pure aminopeptidase, or a pure proline specific oligopeptidase in combination with a trace of another pure endopeptidase such as a

subtilisin or a metalloprotease (to cleave GMP into smaller fragments forming improved substrates for the oligopeptidase), or a pure aminopeptidase in combination with a proline specific tripeptidyl aminopeptidase (as present in the commercial "Umamizyme" preparation from Amano, Japan), or complex enzyme preparations containing different kinds of proteolytic activities. In this Example three commercial enzyme preparations were tested for their various proteolytic activities i.e.: Flavourzyme 1000L Batch HPN00218 (Novozymes), Sumizyme FP (Shin Nihon, Japan) and Corolase LAP Ch.: 4123 (AB Enzymes, UK). Both Flavourzyme and Sumizyme FP are known to be complex enzyme preparations that contain several aminopeptidolytic enzyme activities besides non-specified endoproteolytic and carboxypeptidolytic activities. Corolase LAP represents a relatively pure, cloned and overexpressed leucine aminopeptidase activity from Aspergillus.

Essentially pure meaning that the activity of contaminating endoproteases as well as contaminating carboxypeptidases or aminopeptidases under the incubation conditions used are minimal or preferably absent. The following testing procedure was devised to quantitate such contaminating endo- , amino- and carboxypeptidases activities.

The basis for the testing procedure is formed by a collection of various selective chromogenic peptides. Because only proline specific oligo- and endoproteases can release pNA from peptide Z-AAAP-pNA, this particular peptide was used to quantitate the desired proline specific endoproteolytic activity. Because many endoproteases can release pNA from peptides Z-AAAF-pNA and Z-AAAR-pNA, these two peptides were used to quantitate contaminating, non-proline specific endoproteolytic activity. Because the conversion of peptides QNIPP and VVVPP as present in the beta-caseine molecule into IPP and VPP respectively require aminopeptidases that can efficiently remove Gln and Val residues, peptides Q-pNA and V-pNA were used to quantitate desired aminopeptidase activities. Because many carboxypeptidases can release Phe and Arg residues from peptides, peptides containing these residues were selected to quantitate contaminating carboxypeptidase activities. However, no suitable chromogenic groups are available for measuring carboxypeptidase activities so that an alternative method using the synthetic peptides Z-AF and Z-AR had to be developed. This alternative method is provided underneath. In all the synthetic peptides used "Z" represents benzyloxycarbonyl and "pNA" the chromophore para-nitroanilide. All chromogenic peptides were obtained from Pepscan (Lelystad, The Netherlands). Peptides Z-AF and Z-AR were purchased from Bachem (Switserland). All incubations were carried out at

40°C. Diluted enzyme preparations were recalculated to the concentration of the commercial product.

Measuring AminoPeptidase activities

Stock solutions of 150mmol/l of V-pNA and Q- pNA in 100% DMSO were diluted 80 times in 0.1 M BisTris buffer pH 6 to make a 3.75 mmol/l V-pNA+ Q-pNA - substrate solution containing V-pNA and Q-pNA in a 1:1 ratio. A 200 µl aliquot of this aminopeptidase substrate solution was pipetted into separate wells of a microtiterplate (MTP) The MTP is pre-incubated at 40°C in a Tecan Genios MTP (Salzburg, Vienna) running under Magellan4 software. The reaction was started by adding 50 µl of the appropriate enzyme solution so that the incubations took place at a substrate concentration of 3mM. Typically a 1:50 dilution of the liquid enzyme samples Flavourzyme, Corolase LAP and proline-specific endo-protease was used. Of the dry Sumizyme FP product a 1% solution was used.
The yellow color as measured at 405nm by the Tecan Genios MTP developing as the result of cleavage of the amino acid-pNA bond was followed for at least 20 kinetic cycles (about 10 minutes). The software generated the data obtained as OD_{405}/min.

Measuring Proline Specific Endoprotease activity.

This measurement was carried out essentially the same as the aminopeptidase assay but in this case Z-AAAP-pNA was used as the only substrate in a final concentration of 3mmol/l. This substrate was solubilized by heating a suspension in pH 6 buffer to 50-55° C resulting in a clear solution at room temperature. Measurements were carried out at 40°C.
Typically a 1:50 dilution of the liquid enzyme samples Flavourzyme and Corolase LAP were used. Sumizyme FP was used in a 1% solution. The proline specific endo-protease was typically used in a 1:5000 dilution.
The software generated the data as OD_{405}/min.

Measuring Contaminating Non-Proline Specific Endoprotease activities.

Also this measurement was carried out essentially the same as described for the aminopeptidase assay but in this test Z-AAAF-pNA and Z-AAAR-pNA in a 1:1 ratio and in a final concentration of 3mmol/l were used as the substrate. The substrate Z-AAAF-pNA turned out to be poorly soluble under the pH 6.0 test conditions used but a test

incubation with subtilisin resulted in a rapid solubilisation of the substrate concomitantly with the pNA release. Measurements were carried out at 40°C. However, to compensate for this poor solubility the MTP reader was programmed to shake in between the kinetic cycles.

Again the software generated the data as OD_{405}/min.

Measuring Contaminating Carboxypeptidase activities

Because no sensitive chromogenic peptides are available to measure carboxypeptidase activities, a method was used based on a Boehringer protocol for quantitating Carboxypeptidase C.

Two 150mmol/l stock solutions in ethanol of Z-A-F and Z-A-R were diluted 80 times in 0.1 mol/l BisTris buffer pH 6 to make a 3.75 mmol/l Z-A-F + Z-A-R substrate solution containing Z-A-F and Z-A-R in a 1:1 ratio. Then 200 µl of the substrate solution was pipetted into an eppendorf vial and pre-incubated at 40° C. The reaction was started by adding 50 µl of an appropriate enzyme dilution. Typically a 1:50 dilution is used of Flavourzyme and Corolase LAP and the proline specific endoprotease. A 1 % solution was used for Sumizym FP. After 5 minutes the reaction was stopped by adding 250 µl of ninhydrine reagent. Ninhydrine reagent was made of 400mg ninhydrine (Merck) and 60 mg hydrindantin dissolved 15 ml DMSO, to which 5 ml of 4.0 mol/l lithium acetate buffer pH 5.2 was added. The 4.0 mol/l lithium acetate buffer was made by dissolving LiOH (Sigma) after which the pH of the solution was adjusted to pH 5.2 using glacial acetic acid (Merck).

After stopping the reaction, each sample was heated for 15 minutes at 95°C to facilitate the color formation and subsequently diluted 10 times with pure ethanol. The color formed was measured at 578nm in an Uvikon spectrophotometer. Blanks were made in the same manner as the activity samples, but ninhydrin reagent and enzyme addition were reversed. To quantitate the amount of free amino acids generated by the carboxypeptidase activity, the amino acid L-phenylalanine was used to create a calibration curve. Solutions in buffer pH 6 containing 0.1875, 0.375, 0.75, 1.5 and 3.0 mmol/l of L-phenylalanine (Sigma) were treated in the same manner as the samples, i.e. 250µl in a vial. From the OD578 values obtained, a curve was constructed in Excel. The concentrations of the free amino acids present in the samples containing the Z-A-F and Z-A-R substrates were calculated using this curve. From the values obtained the

carboxy-peptidase activity was calculated in micromoles per minute per the amount of enzyme tested.

Calculation of activity ratios

To establish the suitability of various enzyme preparations for the process according to the invention, quotients of the relevant enzyme activities were calculated. In the MTP reader based assays, enzyme activities are characterised by pNA release over time i.e. as ΔOD_{405}/min. Quotients of enzyme activities obtained by the MTP reader were calculated by simply dividing the ΔOD/min values obtained for identical quantities of enzyme.

However in case of the carboxy-peptidase assay, an OD is generated that cannot be compared directly to the ΔOD/min generated by the MTP-pNA based assays. Here the OD measured was first converted to µmol amino acid released per min (µmol/min). Then the ΔOD/min of pNA released was converted into µmol/min. To that end a calibration curve was generated in the MTP reader in which dilutions of pure pNA (Sigma) 0.25, 0.125, 0.0625, 0.0312 and 0.015 mmol/l and 250µl per well were measured. From the data obtained a calibration curve was constructed in Excel. From this calibration curve the ΔOD/min was converted into µmol/min so that the pNA based measurements could be compared with the ninhydrin based measurements.

On the basis of the data generated in the above-mentioned tests, the various enzyme preparations used were characterised. The data on the proline specific oligo- or endoproteolytic activities present in each enzyme preparation as provided are shown in Table 1 in the column "Prol Spec Activity". The data on the desired aminopeptidase activities (AP/Prol Spec Act) and the contaminating carboxypeptidase (CPD/Prol Spec Act) and endoproteolytic activities (Endo/Prol Spec Act) are shown relative to the proline specific activities present. The desired aminopeptidase activity relative to the contaminating carboxypeptidase activity as present in each preparation is shown as (AP/CPD).

Evident is that none of the commercial enzyme preparations tested contains any significant proline specific oligo- or endoproteolytic activity. Furthermore all commercial enzyme preparations tested contain carboxypeptidase and endoproteolytic activities. Enzyme combination C1 consists of a mixture of 4 units proline specific endoprotease plus 130 microliter of the commercial Corolase LAP to be applied per gram of proteinaceous substrate present. that generates high yields of ACE inhibiting IPP, VPP

and LPP peptides stands out because of its very low levels of contaminating carboxypeptidase and endoproteolytic activities.

Table 1:

	Prol Spec Activity*	CPD/ Prol spec act	AP/ Prol spec act	Endo/ Prol spec act	AP/ CPD
Sumizyme	0.004	21.7	1.2	1.7	0.06
Flavourzyme	0.0007	253.5	25.6	35.5	0.10
Corolase LAP	0.0				0.74
Prol spec A.niger	100	0.005	0.00001	0.000004	0.00
C1	75	0.001	0.00031	0.000391	0.25

* Sumizyme was measured in a 1% solution, Flavourzyme and Corolase as a 1:50 dilution. Prol specific activity as obtained from *A. niger* was measured as 1:5000 dilution and C1 as a 1:3773 dilution. Data were then calculated to the activity present in the product as provided.

On the basis of their high content of amino- and carboxypeptidase activities, incubations of GMP with the complex enzyme mixtures Sumizyme FP and Flavourzyme can be expected to generate high levels of free amino acids. These free amino acids can be expected to impart brothy off tastes as the result of increased Maillard reactions. Furthermore the presence of non-proline or non-alanine specific endoproteolytic activities in these enzyme preparations will lead to the solubilisation of additional and perhaps bioactive peptides in the final product hereby blurring the pure blood pressure lowering effect of IPP. To minimise all these undesirable side reactions, the combination of an essentially pure proline specific protease with an essentially pure aminopeptidase is preferred. Even more preferred is the use of only an essentially pure proline specific endoprotease.

Example 6

Isolating GMP and IPP from caseinate

Commercialy available GMP is obtained from cheese whey. In this process milk is incubated with chymosin to release the water-soluble GMP part from kappa-casein. As a result the caseinate precipitates to form the curd whereby the GMP part ends up in the cheese whey from which it can be isolated by a number of different processes. In this

Example we describe an alternative route for the isolation of GMP i.e. an isolation from commercially available caseinate. Advantage of this route is that after the selective removal of the GMP, the remaining caseinate fraction can be used for alternative applications. According to the present process (skim) milk is acidified according to methods known in the art to selectively precipitate the casein fraction. The precipitated fraction incorporates all caseins, i.e. the alpha, beta, kappa (including the GMP part) and gamma-caseins. This casein curd formed is separated from the "sweet whey" fraction and washed to remove remaining whey components and the ions generated by the acidification process. After dewatering the casein curd is re-dissolved by neutralization, for example using KOH, to yield the relevant "caseinate".

A 10% (w/v) potassium-caseinate solution (approx. pH 6.4) was incubated at 31 degrees C for 1 hour with calf chymosin to release the GMP part from kappa-casein. In this case 2.2 IMCU Maxiren (DSM Food Specialities, Delft, The Netherlands) was used per gram caseinate. The resulting solution was subjected to one or more filtration steps to separate the dissolved, low molecular weight GMP part from the large molecular weight fraction containing both the caseins and the chymosin. The GMP containing permeate was acidified to pH 4.5 and the *A. niger* derived proline specific endoprotease was added in a concentration of 4 units per gram of protein present. The temperature was increased to 55 degrees C to maximize the activity of the enzyme and incubation was pursued for 3 hours. The resulting solution was then concentrated by evaporation and heated for 5 minutes to 95 degrees C to inactivate the proline specific endoprotease. Finally the heated concentrate was ultrafiltered to remove precipitated proteins as much as possible and spray dried. According to LC/MS/MS analysis of the spray dried material the IPP concentration was quantitated to be 0.6 milligram of IPP per gram caseinate starting material.

Example 7

Liberating IPP from GMP in a single incubation step

A series of incubations was carried out to demonstrate that the proline specific endoprotease from A. niger and Sumizyme FP are suitable to liberate the blood pressure lowering tri-peptide IPP from GMP. In this experiment a commercially available GMP preparation was used (Lacprodan CGMP-10, lot # P340205 from Arla, Denmark). According to its specifications the powder as obtained contains approx 85% protein with

a GMP content of about 80% (of the protein present), i.e. 1 gram Lacprodan CGMP-10 powder contains approx. 0.85x 0.8= 0.7 grams of pure GMP.

The GMP was dissolved in demineralised water (50 grams GMP in 450 ml). The pH of this solution is 6.7. Of this solution 135 ml were brought to pH 4 using 4N HCl and additional water was added to reach a volume of 150 ml and a GMP concentration of 10% solids. Of the pH 6.7 solution 45 ml were brought to pH 6 with 4 N HCl and 90 ml to pH 8 using 4N KOH. To both solutions extra water was added to also reach a concentration of 10% GMP solids. The pH 4.0 of the incubation with the proline specific endoprotease was chosen as pH 4 represents the optimum for this enzyme. Because Sumizyme FP consists of a mixture of various endoproteases, aminopeptidases and carboxypeptidases all with their own pH optima, this incubation was carried out under different pH conditions.

With these three solutions adjusted to various pH values, incubations with the various enzymes were carried out as shown in Table. The proline specific endoprotease was used in a concentration of 0.4 U/ml (~ 4.2 U/gr protein) and Sumizyme FP in a 1mg/ml final concentration (~10.4mg/gr protein). All incubations were done in 50 ml conical Greiner tubes in a water bath set at 40°C for 6 hours under mild shaking. After the incubations the samples were kept frozen at –20°C until LC/MS/MS analysis. The data as obtained in the latter analysis are shown in Table and were measured using IPP, VPP and LPP reference solutions.

Table 2 Incubation scheme of GMP solutions with MaxiPro and Sumizyme FP

Incubation nr	Mls of 10% GMP solution	Mls of 10 units/ml prol spec enzyme solution	Mls of 25 mg/ml Sumizyme FP solution	pH of incubation mixture
1	48	-		6.7
2	48	2		4
3	48	-	2	4
4	48	-	2	6
5	48	-	2	8

Table 3 Yield of peptides upon enzym incubation of the various GMP solutions

Incubation No	IPP		VPP		LPP	
	microgr/ml	microgr/gr	microgr/ml	microgr/gr	microgr/ml	microgr/gr
1	nd	nd	nd	nd	nd	nd
2	**1657**	**2367**	nd		nd	
3	**41**	**59**	**3**	**4**	**6**	**9**
4	**389**	**556**	**36**	**51**	nd	
5	**570**	**814**	**44**	**63**	nd	

Microgr/ml= microgram of the relevant tripeptide per ml of 10% GMP solution

Microgr/gr= microgram of the relevant tripeptide per gram of GMP protein

nd = not detectable

From the results obtained it is clear that incubation with the pure proline specific endoprotease yields an IPP containing product devoid of the peptides VPP and LPP. The quantity of IPP as released in this non-optimized incubation represents approx 50% of the IPP moiety present in GMP.

Most importantly the incubations with the complex Sumizyme FP enzyme also lead to the formation of IPP from GMP. According to our data most efficiently under pH 8 conditions. The fact that with Sumizyme FP the IPP yields are lower than in the incubation with the proline specific endoprotease merely reflects a situation of under-dosing of the Sumizyme FP enzyme in this experiment. Quite surprisingly Sumizyme FP did not only generate IPP but also VPP and LPP from the Lacprodan material. As the tripeptides VPP and LPP occur in the beta-casein amino acid sequence only, their presence clearly illustrates the fact that the GMP material as obtained is contaminated with beta-casein.

Example 8

To demonstrate the organoleptical benefits of an IPP containing hydrolysate obtained from GMP, a tasting experiment was conducted. In this experiment three different substrates, i.e. GMP, potassium caseinate and skim milk were incubated with the proline specific endoprotease from A. niger. Using this pure enzyme, only the IPP

present in the kappa casein molecule can be excised (cf. WO 2006/005757). All three incubations contained the same protein concentration of 3.5 % (w/w) of protein and contained the same quantity of enzyme, i.e, 4 units/ gram protein. To prevent precipitation of the caseins, the pH of the solutions was adjusted to 6.2. Incubation was allowed to proceed for 3 hours and was then terminated by a short heat treatment.

In all three hydrolysates a significant precipitate was present. After centrifugation to remove these precipitates, the clear (IPP containing) supernatants were tasted by a trained panel consisting of 5 people. Panel members were trained with quinine sulphate solutions with the following concentrations:15 mg/L quinine sulphate > Intensity bitter = 1, 20 mg/L quinine sulphate > Intensity bitter = 2, 30 mg/L quinine sulphate > Intensity bitter = 3 and 50 mg/L quinine sulphate > Intensity bitter = 4. The panel scored the bitterness of each hydrolysate on a scale of 0 (not bitter) to 4 (very bitter). A reference sample of 15 mg/L quinine sulphate was given to the panellists before the taste session and was assigned a bitter intensity value of 1. The casein hydrolysate was judged to be very bitter i.e. 4 with all members of the taste panel. The skim milk hydrolysate was also bitter scoring a 3 with all members of the panel. Upon tasting the GMP hydrolysate, the panel unanimously gave a score of 1. Taking into account that the GMP hydrolysate also can be expected to yield the highest concentration of IPP, the surprising benefits of the process according to the present invention are clearly demonstrated.

Example 9

Liberating IPP from GMP by fermentation

The poor palatability of fermented milk products and the many processing difficulties encountered during the recovery of ACE inhibiting peptides from fermented broths have been described in US 6,428,812. In this Example we demonstrate that the GMP molecule also is a suitable substrate for the production of IPP by fermentation.

Two Lactobacillus strains, *Lactobacillus acidophilus* LAFTI® L10 and *Lactobacillus casei* LAFTI® L26 (DSM Food Specialties, Australia) were used in this study. Both strains were grown in anaerobic jars under CO_2 + N_2 atmosphere (AnaeroGen™, Oxoid) at 37°C in MRS broth (Oxoid) for 24 h. The resulting precultures were then inoculated in fermentation broth "a"or fermentation broth "ay". Fermentation broth "a" contained: Tween 80 (1 ml/l), K_2HPO_4 (2 g/l), NaAc (3 g/l), (NH4)3Citrate (2 g/l), MgSO4.7 H2O (0.2 g/l), MnSO4.4 H2O (0.05 g/l), glucose (20 g/l), GMP

(Lacprodan, Arla; 22 g/l). Fernentation broth "ay" also contained yeast extract (4.0 g /l). The newly inoculated fermentation broths "a" and "ay"were incubated for another 24 hours under the conditions outlined above. Thereafter, these fermentation broths were centrifuged and the supernatants were analysed by LC/MS for the the presence of the tripeptides IPP, LPP and VPP. As illustrated in Table 4, only in the incubations with strain L10 the presence of IPP could be detected at a level of 0.3 mg/l. LPP and VPP were not present. The tasting of samples 1 and 5 did not reveal significant off-tastes.

Table 4: Liberating IPP from GMP by fermentation

Tube	Fermentation broth	Strain	IPP production
1	a	L10	yes
2	ay	L10	yes
3	a	L26	not detected
4	ay	L26	not detected
5	a	without inoculum as control	not detected

CLAIMS

1. A process to produce IPP from a protein source whereby the protein source comprises a protein having the –I-P-P- sequence and having in the protein amino acid sequence at least 6 times more –I-P-P- present than –V-P-P- (molar basis) which comprises hydrolysing the protein source to liberate at least 40% of the I-P-P- sequence into the peptide IPP and whereby a proteolytic enzyme is used which cleaves at the carboxy-terminus of proline residues present in the protein source, the enzyme is preferably a proline specific endoprotease or proline specific oligopeptidase, more preferably a proline specific endoprotease, and optionally an amino peptidase.

2. A process according to claim 1 whereby the proteolytic enzym which cleaves at the carboxy terminus of proline and the amino peptidase are incubated together preferably in a single step.

3. A process according to claim 1 or 2 whereby a mixture of proteases is used.

4. A process according to anyone of the preceding claims whereby the protein source comprises a mixture of proteins comprising at least 50%, preferably at least 80%, more preferably at least 90%, and most preferably at least 95% (w/w) of protein which are free of –V-P-P-.

5. A process according to any one of the preceding claims wherein the protein source comprises GMP.

6. A process according to claim 5 wherein at least 50% (w/w), preferably at least 80% (w/w) and more preferably at least 90% (w/w) of the protein is GMP.

7. A process according to claim 5 or 6 wherein at least 20%, preferably at least 40%, more preferably at least 60% and most preferably at least 70% of -I-P-P- sequence present in GMP is converted into the peptide IPP.

8. A process to produce IPP from GMP which comprise the incubation of GMP with an aminopeptidase and a proline specific protease, preferably wherein GMP is first incubated with an aminopeptidase and subsequently incubated with a proline specific protease, preferably a proline specific endoprotease.

9. A process according to claim 8 wherein the aminopeptidase is not active when the proline specific protease is added.

10. A process according to any one of the preceding claims wherein soluble peptides, including IPP, which are formed during hydrolysing the protein source, are separated and optionally dried.

11. A composition comprising a hydrolysate, said hydrolysate comprises IPP and has a Degree of Hydrolysis below 30%, preferably below 20%, more preferably below 15%.

12. A composition comprising a hydrolysate, said hydrolysate comprises IPP and has is devoid of opioid peptides.

13. A composition comprising IPP and TSTP in a molar ration of between 1.5 and 0.5, preferably between 1.3 and 0.7.

14. A peptide composition which is obtainable by the process any of the claims 1 to 10.

15. Use of a proline specific endoprotease, or a proline specific oligopeptidase and an amino peptidase to produce IPP from GMP.

16. The use a composition according to any one of claims 11 to 14 or a composition produced according to any one of the claims 1 to 10 as a nutraceutical, preferably a medicament, for the manufacture of a nutraceutical, preferably a medicament, for the improvement of health or the prevention and/or treatment of

diseases or for the manufacture of a nutraceutical preferably a medicament for the treatment or prevention of diseases such as high blood pressure (hypertension), heart failure, pre-diabetes or diabetes, obesity, impaired glucose tolerance or stress.

17. Use of claim 16 wherein the composition is in the form of a dietary supplement, in the form of a personal care application including a topical application in the form of a lotion, gel or an emulsion or as a food, feed or pet food ingredient.

18. Use of the composition according to any one of claims 11 to 14 for the manufacture of a functional food product for prevention of obesity or for body weight control.

19. Use of the composition according to any one of claims 11 to 14 for the manufacture of a functional food product for the cardiovascular health maintenance.

20. Use according to claim 18 or 19 wherein the cardiovascular health maintenance comprises the inhibition of angiotensin-converting enzyme.

21. Use according to claim 20 wherein the cardiovascular health maintenance comprises the control of blood cholesterol levels.

22. Functional food product capable of providing a health benefit to the consumer thereof, said health benefit selected from the prevention of obesity, body weight control and cardiovascular health maintenance and comprising a composition according to any one of claims 11 to 14.

23. Functional food product according to claim 22 wherein the cardiovascular health maintenance benefit comprises inhibition of angiotensin-converting enzyme and/or the control of blood cholesterol levels.

24. Functional food product according to any of claims 22 or 23, comprising 50-200 mmol/kg K^+ and/or 15-60 mmol/kg Ca^{2+} and/or 6-25 mmol/kg Mg^{2+}.

25. Functional food product according to claim 24, 110-135 mmol/kg K^+ and/or 35-45 mmol/kg Ca^{2+} and/or 13-20 mmol/kg Mg^{2+}.

26. Functional food product according to any of claims 22 to 25, comprising one or more B-vitamins.

27. Functional food product according to claim 26, comprising folic acid, vitamin B6 and vitamin B12.

28. Functional food product according to any of claims 22 to 27, comprising 3 to 25 wt% sterol, more preferably from 7 to 15 wt% sterol.

29. A process to prepare a food product, beverage product or dietary supplement comprising
(a) production of a composition which comprises IPP according to any one of claims 1 to 10, and
(b) incorporation of said IPP containing composition into a food product, beverage product or dietary supplement.

30. A process according to claim 29 wherein in step (a), a milk protein, preferably casein is used.

31. A process according to claim 29 also comprising step (c) separation of soluble peptides from hydrolysed protein.

32. A process according to claim 31, wherein step (c) takes place after step (a) and before step (b).

33. A process according to claim 29, wherein the food product, beverage product or dietary supplement is selected from the group of margarines, spreads, butter, dairy products or whey containing beverages, preferably yoghurt or milk based products such as yoghurt or milk.

34. Food product, beverage product or dietary supplement obtainable by a process according to one or more of claims 29 to 33.

35. Food product, beverage product or dietary supplement according to claim 34, comprising from 0.05 to 10 wt%, more preferred from 0.1 to 5 wt%, most preferred from 0.2 to 4 wt% of said IPP containing composition.

36. Food product, beverage product or dietary supplement according to claim 34 or 35, comprising per 100 grams of product 0.05 to 50 mg of IPP and TSTP, respectively, more preferred from 0.1 to 40 mg, most preferred from 0.2 to 30 mg.

37. Food product, beverage product or dietary supplement according to one or more of claims 34 to 36, wherein the weight ratio of IPP to TSTP is from 1.5 to 0.5, more preferred from 1.3 to 0.7.

38. Food product, beverage product or dietary supplement according to one or more of claims 34 to 37 for use to relief hypertension of human beings.

39. TSTP.

1/3

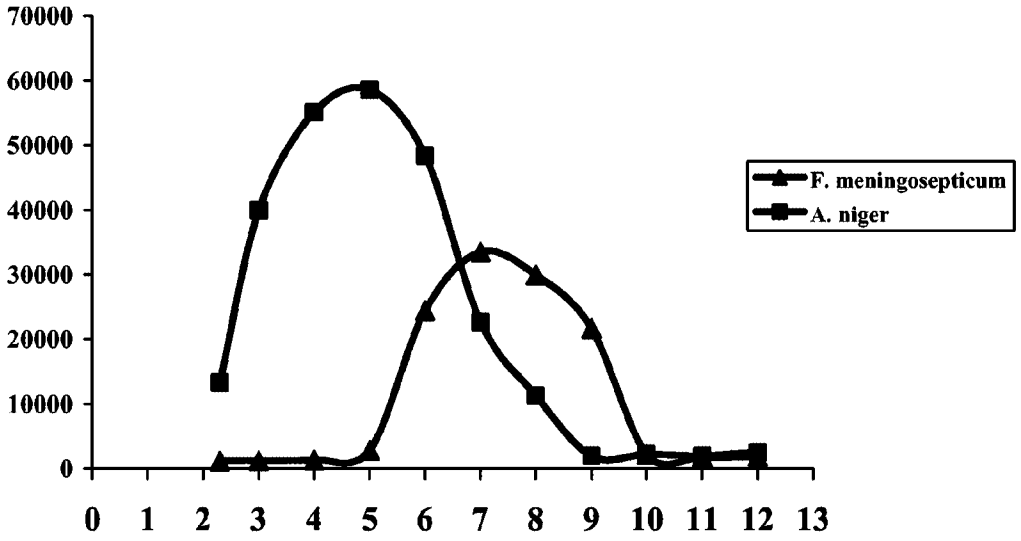

70000
60000
50000
40000
30000
20000
10000
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13
pH
F. meningosepticum
A. niger

Fig. 1

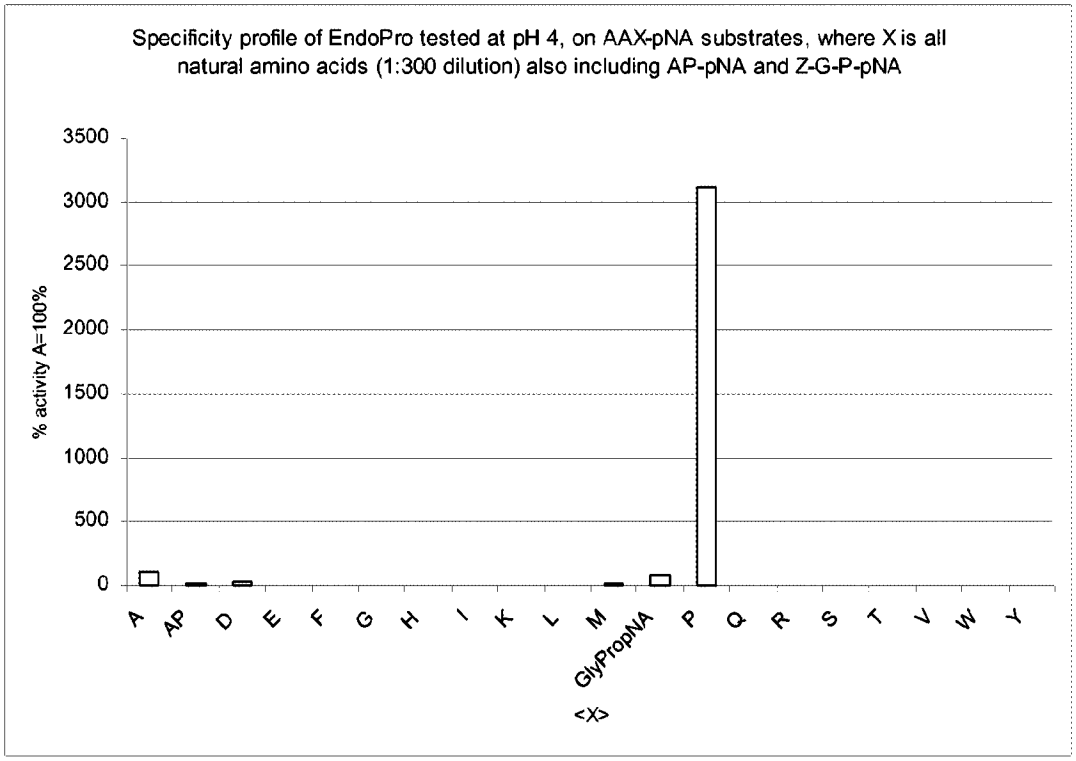

Specificity profile of EndoPro tested at pH 4, on AAX-pNA substrates, where X is all natural amino acids (1:300 dilution) also including AP-pNA and Z-G-P-pNA
% activity A=100%
3500
3000
2500
2000
1500
1000
500
0
A
AP
D
E
F
G
H
I
K
L
M
GlyPropNA
P
Q
R
S
T
V
W
Y
<X>

Fig. 2

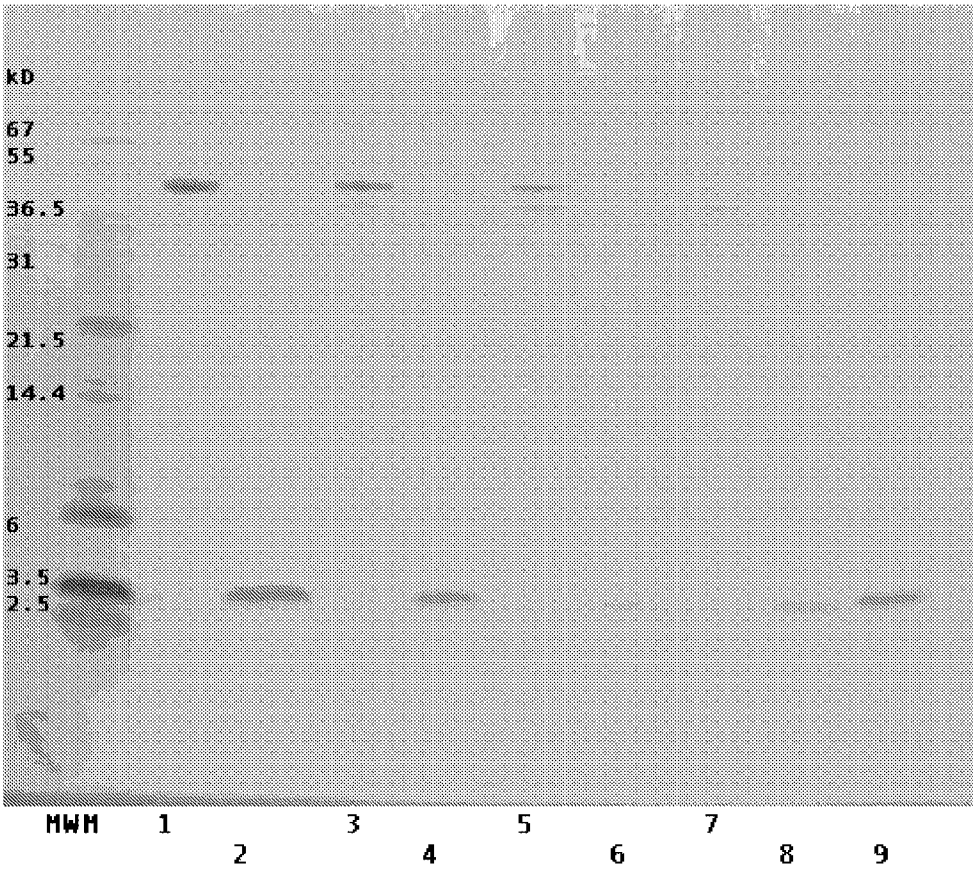


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2006/060198

A. CLASSIFICATION OF SUBJECT MATTER
C12P21/02 C12P21/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C12P

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, BIOSIS, FSTA, WPI Data, EMBASE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 1 231 279 A (CALPIS) 14 August 2002 (2002-08-14) cited in the application * See page 2 (Introduction), and page 10 (Tables 3-4) *	1-12, 14-35,38
Y	WO 2004/098309 A (UNILEVER / HINDUSTAN LEVER) 18 November 2004 (2004-11-18) * See page 3 (last #) - page 4 (first #), page 4 (fifth and penultimate #), page 7 (last #) - page 8 (first #), page 13 (second #), page 22 (Table 1), page 23 (Table 2) *	1-12, 14-35,38

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 March 2006	12/04/2006

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Korsner, S-E

Form PCT/ISA/210 (second sheet) (April 2005)

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 02/45524 A (DSM N.V.) 13 June 2002 (2002-06-13) cited in the application * See page 10 (lines 3-30, esp. lines 24-25) *	1-12, 14-35,38
Y	JAUHIAINEN (PAGE 16): "Bioactive peptides in Evolus lower the blood pressure of hypertensive subjects" VALIO FOODS & FUNCTIONALS, vol. 1, 2003, pages 1-22, XP002374765 * See page 16 (IPP) *	16-35,38
Y	MANSO ET AL: "Angiotensin I converting enzyme-inhibitory activity of bovine, ovine, and caprine kappa-casein macropeptides and their tryptic hydrolysates" JOURNAL OF FOOD PROTECTION, vol. 66, 2003, pages 1686-1692, XP008049768 * See page 1686 (Introduction), page 1688 (Table 1), and page 1691 (Discussion); CMP = GMP) *	16-35,38
P,X	WO 2005/081628 A (CHAY 13 MEDICAL RESEARCH GROUP) 9 September 2005 (2005-09-09) * Published without Sequence Listing, which is available from WIPO -> see SEQ.ID.NO. 1674 (=Thr-Ser-Thr-Pro) *	39
P,Y	WO 2006/005757 A (DSM ASSETS B.V.) 19 January 2006 (2006-01-19) * See the earlier priority documents; -> Paris Convention, Article 4 *	1-12, 14-35,38
P,A	EDENS ET AL: "Extracellular prolyl endoprotease from Aspergillus niger and its use in the debittering of protein hydrolysates" JOURNAL OF AGRICULTURAL FOOD CHEMISTRY, vol. 53, 9 September 2005 (2005-09-09), pages 7950-7957, XP002374542 * See pages 7952 and 7954 (figures 1 and 3 / compare Figures 1 and 3 of the Application), and page 7955 (figure 4) *	1-39

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2006/060198

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1231279 A	14-08-2002	AU 773587 B2	27-05-2004
		AU 1306001 A	06-06-2001
		CN 1423704 A	11-06-2003
		WO 0134828 A1	17-05-2001
		JP 2001136995 A	22-05-2001
		NZ 518957 A	29-08-2003
		US 6994987 B1	07-02-2006
WO 2004098309 A	18-11-2004	AU 2004237455 A1	18-11-2004
		CA 2523410 A1	18-11-2004
WO 0245524 A	13-06-2002	AU 1608902 A	18-06-2002
		AU 3456102 A	18-06-2002
		BR 0116003 A	30-03-2004
		BR 0116036 A	17-02-2004
		CA 2430893 A1	13-06-2002
		CA 2437081 A1	13-06-2002
		CN 1484497 A	24-03-2004
		CN 1484694 A	24-03-2004
		WO 0245523 A2	13-06-2002
		JP 2004517832 T	17-06-2004
		JP 2004519221 T	02-07-2004
		MX PA03005127 A	15-10-2004
		MX PA03005128 A	06-12-2004
		NZ 526270 A	26-11-2004
		NZ 526271 A	25-02-2005
		US 2004241791 A1	02-12-2004
		US 2004241664 A1	02-12-2004
WO 2005081628 A	09-09-2005	NONE	
WO 2006005757 A	19-01-2006	NONE	

I hereby certify that this correspondence is being filed via EFS-Web with the United States Patent and Trademark Office on January 13, 2023.

KILPATRICK TOWNSEND & STOCKTON LLP

By: /Tina Bello/
Tina Bello

PATENT
Attorney Docket No.: 088835-1359421-102300US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	Confirmation No.:
Paulos Tesfe et al.	Examiner:
Application No.:	Technology Center/Art Unit:
Filed:	
For: MICROPARTICULATED MILK PROTEINS AND METHODS OF MAKING THEM	INFORMATION DISCLOSURE STATEMENT
Customer No.: 20350	

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Commissioner:

The references cited on attached form PTO/SB/08A are being called to the attention of the Examiner. In accordance with the provisions of 37 CFR §1.98(a)(2), copies of any cited U.S. Patents and U.S. Patent Application Publications are not provided. Copies of the remaining cited references are provided.

It is respectfully requested that the cited references be expressly considered during the prosecution of this application and the references be made of record therein and appear among the "references cited" on any patent to issue therefrom.

As provided for by 37 CFR §1.97(g) and (h), no inference should be made that the information and references cited are prior art merely because they are in this statement and no

representation is being made that a search has been conducted or that this statement encompasses all the possible relevant information.

Applicant believes that no fee is required for submission of this statement. However, if any fees are due for the submission of this Information Disclosure Statement, please deduct those fees from Deposit Account No. 20-1430.

Respectfully submitted,

/alexa.j.hunter/

Alexa J Hunter
Registration No. 74,538

KILPATRICK TOWNSEND & STOCKTON LLP

Attachment

WHAT IS CLAIMED IS:

1. A denatured whey protein composition comprising:

at least 60 wt.% protein on a dry weight basis;

less than 8 wt.% native GMP and greater than 2 wt.% enzymatically hydrolyzed glycomacropeptide (GMP) relative to the total weight of the protein;

a proteolysis index of at least 8.0 wt.%; and

greater than 50 wt.% denatured whey proteins relative to the total weight of the protein.

2. The denatured whey protein composition of claim 1, wherein the denatured whey proteins comprise denatured enzymatically-hydrolyzed cheese whey proteins.

3. The denatured whey protein composition of claim 2, wherein the native GMP is less than or about 7 wt.% relative to the total weight of the protein.

4. The denatured whey protein composition of claim 1, wherein the denatured whey proteins are characterized by a D50 particle size distribution value of less than or about 4.5 μm.

5. The denatured whey protein composition of claim 4, wherein the denatured whey proteins are further characterized by a D10 particle size distribution value of less than or about 2.5 μm.

6. The denatured whey protein composition of claim 4, wherein the denatured whey proteins are further characterized by a D90 particle size distribution value of less than or about 8.0 μm.

7. The denatured whey protein composition of claim 1, further comprising at most 7.0% wt.% fat on a dry weight basis.

8. A method of making a denatured whey protein composition, the method comprising:

filtering cheese whey from enzymatically coagulated milk into a cheese whey retentate and a permeate; and

reducing native glycomacropeptides in the cheese whey retentate to form a reduced-GMP cheese whey retentate composition; and

heating the reduced-GMP cheese whey retentate composition to form the denatured whey protein composition,

wherein the denatured whey protein composition is characterized by

at least 60 wt.% protein on a dry weight basis;

less than 11 wt.% native GMP relative to the total weight of the protein;

a proteolysis index of at least 8.0 wt.% or a beta-lactoglobulin to alpha lactalbumin ratio of greater than 5.00; and

greater than 50 wt.% denatured whey proteins relative to the total weight of the protein.

9. The method of claim 8, wherein the reduction of GMP includes combining the cheese whey retentate with one or more enzymes that selectively hydrolyze GMP in the cheese whey retentate to form the reduced-GMP cheese whey retentate composition, the one or more enzymes that selectively hydrolyze GMP in the cheese whey retentate comprises at least one alkaline serine protease enzyme and at least one neutral protease enzyme or wherein the reduction of GMP occurs through the microfiltration of the cheese whey retentate.

10. The method of claim 8, wherein the heating of the reduced-GMP cheese whey retentate composition also inactivates the one or more enzymes that selectively hydrolyze the GMP in the cheese whey retentate.

11. The method of claim 8, wherein the reduced-GMP cheese whey retentate composition is heated to a temperature of greater than or about 160°F.

12. The method of claim 8, wherein the heating of the reduced-GMP cheese whey retentate composition further comprises exposing the reduced-GMP cheese whey retentate composition to high shear conditions.

13. The method of claim 8, wherein the denatured whey protein composition is characterized by a weight ratio of native GMP to total whey protein of less than or about 0.15,

and/or wherein the denatured whey protein composition is characterized by less than or about 11 wt.% GMP relative to the total weight of the protein.

14. A denatured whey protein composition comprising:
at least 60 wt.% protein on a dry weight basis;
less than 11 wt.% native GMP relative to total weight of the protein;
greater than 7 wt.% fat on a dry basis;
a beta-lactoglobulin to alpha lactalbumin ratio of greater than 5.00; and
greater than 50 wt.% denatured whey proteins relative to the total weight of the protein.

15. The denatured whey protein composition of claim 14, wherein the whey protein prior to denaturation already includes at least 30 wt.% denatured protein.

16. The denatured whey protein composition of claim 14, wherein the whey protein contains at least 60 wt.% beta lactoglobulin relative to the total weight of protein and/or wherein the whey protein contains at most 12 wt.% alpha lactalbumin relative to the total weight of protein.

17. The denatured whey protein composition of claim 14, wherein the whey protein comprises a weight ratio of beta lactoglobulin to alpha lactalbumin of greater than or about 5.

18. The denatured whey protein composition of claim 14, wherein the denatured whey proteins are characterized by a D50 particle size distribution value of less than or about 0.3 μm.

19. The denatured whey protein composition of claim 14, wherein the denatured whey proteins are further characterized by a D10 particle size distribution value of less than or about 0.1 μm.

20. The denatured whey protein composition of claim 14, wherein the denatured whey proteins are further characterized by a D90 particle size distribution value of less than or about 1.0 μm.

ABSTRACT OF THE DISCLOSURE

The present disclosure includes denatured whey protein compositions. The compositions include at least 60 wt.% protein on a dry weight basis, less than 8 wt.% native glycomacropeptide (GMP), greater than 2 wt.% enzymatically hydrolyzed GMP relative to the total weight of the protein, a proteolysis index of at least 8 wt.%, and greater than 50 wt.% denatured whey proteins relative to the total weight of the protein.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	DENATURED MILK PROTEINS AND METHODS OF MAKING THEM
First Named Inventor/Applicant Name:	Paulos Tesfe
Filer:	Alexa J. Hunter/Phoebe Young
Attorney Docket Number:	088835-1359421 (102300US)

Filed as Large Entity

Filing Fees for Track I Prioritized Examination - Nonprovisional Application under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY APPLICATION FILING	1011	1	320	320
UTILITY SEARCH FEE	1111	1	700	700
UTILITY EXAMINATION FEE	1311	1	800	800
REQUEST FOR PRIORITIZED EXAMINATION	1817	1	4200	4200
Pages:				
Claims:				
Miscellaneous-Filing:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
PUBL. FEE- EARLY, VOLUNTARY, OR NORMAL	1504	1	0	0
PROCESSING FEE, EXCEPT PROV. APPLS.	1830	1	140	140

Petition:	
Patent-Appeals-and-Interference:	
Post-Allowance-and-Post-Issuance:	
Extension-of-Time:	
Miscellaneous:	
Total in USD ($)	**6160**

Electronic Acknowledgement Receipt

EFS ID:	47368827
Application Number:	18097003
International Application Number:	
Confirmation Number:	1034
Title of Invention:	DENATURED MILK PROTEINS AND METHODS OF MAKING THEM
First Named Inventor/Applicant Name:	Paulos Tesfe
Customer Number:	20350
Filer:	Alexa J. Hunter/Phoebe Young
Filer Authorized By:	Alexa J. Hunter
Attorney Docket Number:	088835-1359421 (102300US)
Receipt Date:	13-JAN-2023
Filing Date:	
Time Stamp:	17:02:40
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$6160
RAM confirmation Number	E20231CH03190371
Deposit Account	201430
Authorized User	Phoebe Young

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.16 (National application filing, search, and examination fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Track One Request	TRACKONE-REQ.pdf	114388 042cf53e2cc252e34e6fbc89f43ec1fa2b658053	no	2
Warnings:					
Information:					
2	Application Data Sheet	ADS.pdf	1822921 fdb3046247aa3f6775a9223a2f3162ab1ece9e4b	no	9
Warnings:					
Information:					
3	Oath or Declaration filed	DECS.pdf	1767235 2c036bcaea130eeedf1c2809b5c0f4c4c002664d	no	8
Warnings:					
Information:					
4	Foreign Reference	FOR_WO2002045522A1.pdf	2316388 f96f21cd536f1159c14a2766490f70232b7b0269	no	24
Warnings:					
Information:					
5	Foreign Reference	FOR_WO15059245.pdf	5988843 cf5d608103d4d5c2c25125906f8ce3d37af0ea9c	no	64
Warnings:					
Information:					
6	Foreign Reference	FOR_WO06089921.pdf	7004922 48b1764d223218ac4231330da6e1c86f702d7924	no	61
Warnings:					
Information:					

7		IDS_088835_1359421.pdf	244749 f4e2a5d270987d370209ac619c7016e8e1ec673a	yes	4

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Transmittal Letter	1	2
Information Disclosure Statement (IDS) Form (SB08)	3	4

Warnings:

Information:

8	Drawings-only black and white line drawings	DWGS.pdf	615649 a38686c45b2626594088e4e78a5071da5f1240a5	no	5

Warnings:

Information:

9		NONPROV.pdf	380571 803e20f9a3266f9c7909df040eafb9e98dd4f49a	yes	34

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Transmittal of New Application	1	1
Specification	2	30
Claims	31	33
Abstract	34	34

Warnings:

Information:

10	Fee Worksheet (SB06)	fee-info.pdf	51074 9a7943583c0cf0e2a9b1cd27ab0419451793d81d	no	2

Warnings:

Information:

Total Files Size (in bytes):	20306740

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PATENT APPLICATION

DENATURED MILK PROTEINS AND METHODS OF MAKING THEM

Inventors: Paulos Tesfe, residing at
Commerce City, CO 80022

Jiancai Li, residing at
Englewood, CO 80111

Bradley Maier, residing at
Broomfield, CO 80023

Richard K. Merrill, residing at
Highlands Ranch, CO 80129

Assignee: Leprino Foods Company
1830 West 38th Avenue
Denver, CO 80211-2200

Entity: Large

DENATURED MILK PROTEINS AND METHODS OF MAKING THEM

FIELD

[0001] The present technology relates to denatured whey protein compositions, including denatured whey proteins having low native glycomacropeptide levels.

BACKGROUND

[0002] Powdered milk-derived products such as milk proteins, aldobionic products, and galactooligosaccharides, have become a major source of ingredients in a wide variety of foods and beverages. Milk-derived proteins, for example, have become a major source of protein-fortification in nutrition bars, sports drinks, and yogurt products. One source of milk proteins is the whey protein that is produced as a byproduct of cheese making. During cheesemaking, the casein proteins in the milk are formed into cheese curds while the liquid whey is drained from the curds and diverted for further processing. In most cheesemaking processes, the liquid whey is a mixture of whey proteins and a significant amount of lactose and minerals, and the mixture undergoes additional purification to separate the whey proteins from the lactose and minerals.

[0003] Whey proteins derived from cheesemaking also include additional byproducts, such as cheesemaking enzymes and the hydrolyzed proteins they generate. The native glycomacropeptides (GMPs) are considered an inferior source of protein for muscle recovery because they have fewer branched chain amino acids, especially leucine, that stimulate muscle protein synthesis and are a major building block in muscle tissue following periods of intense exercise and resistance training. In addition, a high native GMP content in whey protein compositions can lead to undesirable flavor and poor process incorporation, reducing the total amount of protein capable of being fortified into the product. These and other challenges are addressed by the present technology.

BRIEF SUMMARY

[0004] In general, embodiments of the present disclosure include a denatured whey protein composition. The composition includes at least 60 wt.% protein on a dry weight basis, less than 8 wt.% native glycomacropeptide (GMP), greater than 2 wt.% enzymatically hydrolyzed GMP relative to the total weight of the protein, a proteolysis index of at least 8 wt.%, and greater than 50 wt.% denatured whey proteins relative to the total weight of the protein.

[0005] In some embodiments, the denatured whey proteins can include denatured enzymatically hydrolyzed cheese whey proteins. In additional or alternative embodiments, the native GMP is less than or about 7 wt.% relative to the total weight of the protein. In further embodiments, the denatured whey proteins are characterized by a D50 particle size distribution value of less than or about 4.5 μm. In yet more embodiments, the denatured whey proteins are further characterized by a D10 particle size distribution value of less than or about 2.5 μm. In additional embodiments, the denatured whey proteins are further characterized by a D90 particle size distribution value of less than or about 8 μm. In further embodiments, the denatured whey protein composition can include at most 7.0 wt.% fat on a dry weight basis. In embodiments, the denatured whey protein composition can include at least 2% fat.

[0006] Embodiments of the present technology also include a method of making a denatured whey protein composition. The method includes filtering cheese whey from enzymatically coagulated milk, creating a retentate and a permeate, combining the cheese whey retentate with one or more enzymes that selectively hydrolyze GMP in the cheese whey retentate to form a reduced-GMP cheese whey retentate composition, and heating the reduced-GMP cheese whey retentate composition to form the denatured whey protein composition. The denatured whey protein composition may be characterized by containing at least 60 wt.% protein on a dry weight basis, less than 8 wt.% GMP and greater than 2 wt.% enzymatically hydrolyzed GMP relative to the total weight of the protein, a proteolysis index of at least 8.0 wt.%, and greater than 50 wt.% denatured whey proteins relative to the total weight of the protein.

[0007] Embodiments of the present technology also include a method of making a denatured whey protein composition. The method includes filtering cheese whey from enzymatically coagulated milk, creating a retentate and a permeate, reducing native glycomacropeptides in the cheese whey retentate to form a reduced-GMP cheese whey retentate composition, and heating the reduced-GMP cheese whey retentate composition to form the denatured whey protein composition. The denatured whey protein composition may be characterized by containing at least 60 wt.% protein on a dry weight basis, less than 11 wt.% GMP relative to the total weight of the protein, a proteolysis index of at least 8.0 wt.% or a beta-lactoglobulin to alpha lactalbumin ratio of greater than 5.00, and greater than 50 wt.% denatured whey proteins relative to the total weight of the protein.

[0008] In additional embodiments, the one or more enzymes that selectively hydrolyze GMP in the cheese whey retentate include at least one alkaline serine protease enzyme and at least one neutral protease enzyme. In embodiments, the reduction of GMP includes combining the cheese whey retentate with one or more enzymes that selectively hydrolyze GMP in the cheese whey retentate or the reduction of GMP occurs through the microfiltration of the cheese whey retentate. In more embodiments, the one or more enzymes that selectively hydrolyze GMP in the cheese whey retentate includes at least one alkaline serine protease enzyme and at least one neutral protease enzyme. In further embodiments, the heating of the reduced-GMP cheese whey retentate composition also inactivates the one or more enzymes that selectively hydrolyze the GMP in the cheese whey retentate. In still additional embodiments the reduced-GMP cheese whey retentate composition is heated to a temperature of greater than or about 160°F. In more embodiments, the heating of the reduced-GMP cheese whey retentate composition further includes exposing the reduced-GMP cheese whey retentate composition to high shear conditions. In yet further embodiments, the denatured whey protein composition is characterized by a weight ratio of native GMP to total whey protein of less than or about 0.15. Additionally, or alternatively, the denatured whey protein composition is characterized by less than or about 11 wt.% GMP relative to the total weight of the protein. In more embodiments, the denatured whey protein composition is characterized by less than or about 8 wt.% GMP relative to the total weight of the protein. In additional embodiments, the denatured whey protein composition is characterized by at most 7 wt.% fat on a dry weight basis. In further embodiments, the denatured whey proteins in the denatured whey protein composition are characterized by a D50 particle size distribution value of less than or about 5 μm.

[0009] Embodiments of the present technology also include a denatured whey protein composition. The composition includes at least 60 wt.% protein on a dry weight basis, less than 11 wt.% native GMP relative to the total weight of the protein, greater than 7 wt.% fat on a dry basis, a beta-lactoglobulin to alpha lactalbumin ratio of greater than 5.00, and greater than 50 wt.% denatured whey proteins relative to the total weight of the protein.

[0010] In some embodiments, the whey protein prior to denaturation already includes at least 30 wt.% denatured protein. In additional embodiments, the whey protein contains at least 60 wt.% beta lactoglobulin relative to the total weight of protein. Additionally or alternatively, in

embodiments, the whey protein contains at most 12 wt.% alpha lactalbumin relative to the total weight of protein. In further embodiments, the whey protein includes a weight ratio of beta lactoglobulin to alpha lactalbumin of greater than or about 7. In more embodiments, the native GMP is less than or about 10.5 wt.% relative to the total weight of the protein. In further embodiments, the denatured whey proteins are characterized by a D50 particle size distribution value of less than or about 0.3 μm. In yet more embodiments, the denatured whey proteins are further characterized by a D10 particle size distribution value of less than or about 0.1 μm. In additional embodiments, the denatured whey proteins are further characterized by a D90 particle size distribution value of less than or about 1.0 μm.

[0011] Embodiments of the present technology include a protein fortified food product. Embodiments include where the food product contains at least 3 wt.% total protein. In embodiments, the protein includes a denatured whey protein composition containing less than 8 wt.% native glycomacropeptide and greater that 2 wt.% enzymatically hydrolyzed glycomacropeptide relative to the total weight of the whey protein composition.

[0012] Embodiments of the present technology also include a protein fortified food product. The food product contains at least 3 wt.% total protein. The protein includes a denatured whey protein composition containing less than 11 wt.% native glycomacropeptide relative to the total weight of the whey protein composition, greater than 7 wt.% fat and a beta-lactoglobulin to alpha -lactalbumin ratio of greater than 5.00.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] A further understanding of the nature and advantages of selected embodiments of the present technology may be realized by reference to the remaining portions of the specification and the drawings wherein like reference numerals may be used throughout the several drawings to refer to similar components. In some instances, a sublabel is associated with a reference numeral and follows a hyphen to denote one of multiple similar components. When reference is made to a reference numeral without specification to an existing sublabel, it is intended to refer to all such multiple similar components.

[0014] **FIG. 1** shows selected operations in a formation method according to some embodiments of the present technology;

[0015] **FIG. 2A** is a graph illustrating the particle size distribution of an undenatured whey protein composition (WPC) having 80% protein on a dry basis;

[0016] **FIG. 2B** is a graph illustrating the particle size distribution of a denatured whey protein composition according to embodiments of the present disclosure;

[0017] **FIG. 2C** is a graph comparing the particle size distribution of FIGS. 2A and 2B;

[0018] **FIG. 3A** is a graph showing a capillary electrophoresis profile of an undenatured whey protein composition (WPC) having 80% protein on a dry basis;

[0019] **FIG. 3B** is a graph showing a capillary electrophoresis profile of a denatured whey protein composition according to embodiments of the present disclosure;

[0020] **FIG. 4A** is a graph illustrating the particle size distribution of an undenatured high fat whey protein composition;

[0021] **FIG. 4B** is a graph illustrating the particle size distribution of a denatured high fat whey protein composition according to embodiments of the present disclosure;

[0022] **FIG. 4C** is a graph comparing the particle size distribution of FIGS. 4A and 4B; and

[0023] **FIG. 5** is an illustration of the samples according to Example 3.

[0024] Several of the figures are included as schematics. It is to be understood that the figures are for illustrative purposes, and are not to be considered of scale unless specifically stated to be of scale. Additionally, as schematics, the figures are provided to aid comprehension and may not include all aspects or information compared to realistic representations, and may include exaggerated material for illustrative purposes.

[0025] In the figures, similar components and/or features may have the same numerical reference label. Further, various components of the same type may be distinguished by following the reference label by a letter that distinguishes among the similar components and/or features. If only the first numerical reference label is used in the specification, the description is applicable to any one of the similar components and/or features having the same first numerical reference label irrespective of the letter suffix.

DETAILED DESCRIPTION

[0026] Whey protein, as referred to herein, is actually a collection of different proteins that primarily include β-lactoglobulin (β-Lg) and α-lactalbumin (α-La), as well as glycomacropeptides (GMPs, sometimes referred to as cGMP or CMP) cleaved by chymosin activity from the native kappa-casein protein in the milk resulting in milk coagulation into the cheese curd. Depending on the purification process and the extent of purification, a whey protein concentrate (WPC) may be formed through concentration of the whey protein to 25-90 wt.% of protein as a percentage of the total weight of solids, or whey protein isolate (WPI) may be formed through the concentration of the whey proteins to 90-99 wt.% of protein as a percentage of the total weight of solids.

[0027] Whey proteins derived from cheesemaking also include additional byproducts, such as cheesemaking enzymes and the hydrolyzed proteins they generate. For instance, conventional compositions of whey obtained from enzymatically coagulated Bovine milk* typically contain:

Beta-lactoglobulin (wt.%)	Alpha-lactalbumin (wt.%)	Ratio of Beta-lg to Alpha-lg	Glycomacropeptide (wt.%)	Total Protein (WPC)	Ratio of GMP to Total Protein
50-60	12-16	3.13 to 5.00	15-21	25-80	0.19 to 1.00

* 1 Walstra P, Wouters JTM, Geurts TJ. Milk Components, Dairy Science and Technology. 2nd ed. CRC Press; 2006:Chapter 2.
2 Foegeding EA, Luck P, Vardhanabhuti B. Encyclopedia of Dairy Sciences. 2nd ed. Elsevier Ltd.; 2011:Whey Protein Products.

The hydrolyzed proteins include glycomacropeptides (GMPs) that are hydrolyzed from κ-casein so that the resulting para-κ-casein can form a major component of cheese curd. The smaller, more soluble GMPs are carried away with the whey proteins and can constitute 13-20 wt.% of the protein present in the whey protein fraction on a dry weight basis. Unfortunately, the GMPs are considered an inferior source of protein for muscle recovery because they have fewer branched chain amino acids that stimulate muscle protein synthesis and are a major building block in muscle tissue following periods of intense exercise and resistance training.

[0028] In addition, a high native GMP content in whey protein compositions can lead to undesirable flavor and poor process incorporation. Namely, high native GMP content, such as 12 wt.% or more of the protein present in the whey protein fraction on a dry weight basis, contributes to increased cardboard flavor, a common off-flavor and/or artificial flavor in liquid

whey, dried whey, dairy protein concentrates and milk, and a reduction of natural milky flavor. In addition, native whey proteins can also interact with water in a food or beverage product, negatively increasing the viscosity of the food or beverage product. The interactions are problematic, as it can cap the amount of a whey protein composition that can be incorporated, reducing the total amount of protein fortified into the product.

[0029] The present technology overcomes these issues by providing denatured whey protein compositions, such as powdered or denatured whey protein compositions, that exhibit a high total percentage of protein by weight, but with a reduced percentage of such protein attributable to native GMP. Namely, the present technology has surprisingly found that by carefully processing a whey protein composition to selectively reduce native GMP levels without hydrolyzing the remaining proteins (*e.g.,* β-lactoglobulin (β-Lg), and α-lactalbumin (α-La)) in the whey protein composition, a high protein denatured whey protein composition with a low percentage of native GMP can be provided. It was observed that such denatured whey protein compositions do not exhibit the negative effects of compositions that contain high weight percentages of native GMP.

[0030] For instance, compositions according to one or more embodiments of the present disclosure may exhibit lower in process viscosity and reduced cardboard flavor and more milky flavor. Namely, the present disclosure has surprisingly found that when the native GMP is enzymatically reduced in the whey protein composition there is a reduction in process viscosity such that the viscosity is about 10% less than a viscosity of a composition where the native GMP is not enzymatically reduced, such about 20% less, such as about 30% less, such as about 40% less, such as about 50% less than a viscosity of a non-enzymatically reduced composition. For instance, in a composition that has not been enzymatically reduced as discussed herein, the process viscosity of the composition may be greater than 200 centipoise, such as from 201 centipoise to 500 centipoise. Conversely, compositions according to the present technology exhibit a process viscosity of less than 200 centipoise, such as about 175 centipoise or less, such as about 150 centipoise or less, such as about 125 centipoise or less, such as about 100 centipoise or less, such as about 75 centipoise or less, such as about 50 centipoise or less, such as down to about 25 centipoise, or any ranges or values therebetween. In some embodiments, compositions according to the present technology may also have reduced ability to bind water. Thus,

compositions according to the present technology may be uniquely suited to fortify water-containing foods to levels higher than previously believed possible with whey protein compositions, as there is lower observed viscosity increases typically associated with these formulations, due at least in part to the reduced interactions with water.

[0031] FIG. 1 shows exemplary operations in a method 100 according to some embodiments of the present technology. The method may be performed in a variety of processing apparatus as known in the art. Method 100 may include a number of optional operations, which may or may not be specifically associated with some embodiments of methods according to the present technology. For example, many of the operations are described to provide a broader scope of the composition formation, but are not critical to the technology, or may be performed by alternative methodology as would be readily appreciated.

[0032] The whey composition feedstock utilized herein may be obtained from a cheesemaking process, a whey protein concentrate, a whey protein isolate, such as derived from cow's milk, or a combination thereof. In some embodiments, the whey feedstock may be generated from the cheesemaking process and may be referred to as "sweet whey" when the cheesemaking process uses rennet enzymes like chymosin, and "acid whey" when acids are used to form the curds. The pH of sweet whey typically ranges from about 5.6 to 6.6, while the pH of acid whey typically ranges from 4.3 to 4.6. While any appropriate whey feedstock may be utilized, in some embodiments, the whey feedstock utilized to form a denatured whey protein composition is a "sweet whey" and may therefore be considered to be filtered 102 from lactose and minerals.

[0033] For instance, in some embodiments, the whey protein feedstock may be a whey protein retentate filtered 102 from sweet whey having a protein composition of 25 % protein or greater, on a dry weight basis, such as about 50 % or greater, such as about 60 % or greater, such as about 70 % or greater, such as about 80 % or greater, or any ranges or values therebetween. In embodiments the whey protein retentate may be concentrated utilizing ultrafiltration, or other methods as known in the art. Nonetheless, in some embodiments, the whey protein retentate may be diluted prior to processing, such as by mixing with water to form a whey protein feedstock having a protein concentration in the solution of about 30% or less, such as about 18% or less, such as about 16% or less, such as about 15% or less, such as about 14% or less, or any ranges or values therebetween.

[0034] In some embodiments, the native GMP levels of the whey protein feedstock may be reduced 103 utilizing one or more enzymes that selectively reduce native GMP levels without hydrolyzing the β-lactoglobulin and/or α-lactalbumin. GMP may also be reduced through the use of expensive chromatography systems, or by blending native whey protein isolate purified directly from milk that has not undergone cheesemaking with whey protein concentrates from cheese-making. In embodiments, the one or more enzymes can be one or more protease enzymes. Sources for the one or more protease enzymes may include microorganisms, fungi, plant, and/or animal sources, among others. For example, the one or more protease enzymes may be derived from fungi of the genus *Aspergillus*, bacteria of the genus *Bacillus* (e.g., *Bacillus subtilis*), and/or animals (e.g., trypsin, chymotrypsin, etc.), among other sources. Nonetheless, in some embodiments, the one or more protease enzymes include an acid protease enzyme, a neutral protease enzyme, an alkaline protease enzyme, or a combination thereof. However, in some embodiments, the one or more protease enzymes include a neutral protease enzyme, an alkaline protease enzyme, or a combination thereof. Additionally, or alternatively, the protease enzyme can be an endoprotease, an exoprotease, or a combination thereof. Thus, in some embodiments, the one or more protease enzymes can include an aspartic protease, serine protease, a cysteine protease, or a combination thereof. Nonetheless, in one embodiment, the one or more protease enzymes can include a serine protease, such as an alkaline serine protease, alone or in combination with at least one neutral protease enzyme.

[0035] Notwithstanding the one or more enzymes selected, the one or more enzymes selected may be added to the whey protein feedstock in an amount of about 0.001 wt.% or greater, based upon the weight of the total protein in the composition, such as about 0.0025 wt.% or greater, such as about 0.005 wt.% or greater, such as about 0.0075 wt.% or greater, such as about 0.01 wt.% or greater, or any ranges or values therebetween. It should be understood that the foregoing ranges may refer to a total amount of enzymes included in the whey protein feedstock, or to an amount of each enzyme added to the whey protein feedstock.

[0036] However, in one aspect, the amount of the one or more enzymes added is selected so as to hydrolyze at least about 10 wt.% or more of the native GMP present in the whey protein feedstock, such as about 15 wt.% or more, such as about 20 wt.% or more, such as about 25 wt.% or more, such as about 30 wt.% or more, such as about 35 wt.% or more, such as about 40

wt.% or more, such as about 45 wt.% or more, such as about 50 wt.% or more, such as about 60 wt.% or more, such as about 65 wt.% or more, such as about 70 wt.% or more, such as about 72.5 wt.% or more, such as about 75 wt.% or more, such as about 80 wt.% or more, such as about 85 wt.% or more, or any ranges or values therebetween. Stated differently, in some embodiments, the denatured whey protein composition according to the present technology may have a reduced amount of native GMP as compared to a whey protein feedstock, according to any one or more of the above percentages.

[0037] Regardless of the amount of the one or more enzymes selected, the GMP selective enzyme(s) are added to the whey protein feedstock to hydrolyze the native GMP in the whey protein composition. In some embodiments, the hydrolysis phase can continue for about 72 hours or less, such as about 60 hours or less, such as about 48 hours or less, such as about 36 hours or less, such as about 24 hours or less, such as about 12 hours or less, such as about 10 hours or less, such as about 8 hours or less, such as about 5 hours or more, or any ranges or values therebetween. The hydrolysis may occur at a temperature of about 60° F or less, such as about 55° F or less, such as about 50° F or less, such as about 45° F or less, or any ranges or values therebetween.

[0038] Nonetheless, in some embodiments, the native GMP levels of the whey protein feedstock may be reduced 103 by utilizing a high-fat feedstock. By using the whey protein retentate from a microfiltration process in which a portion of the GMP permeates the microfiltration membrane a whey protein feedstock can be provided with desirably low native GMP levels and high denatured whey protein levels. Thus, in some embodiments of the present technology, a high fat content feedstock can be utilized having a fat content of about 7% or greater, based upon the dry basis weight of the whey protein feedstock, such as about 8% or greater, such as about 9% or greater, such as about 10% or greater, such as about 11% or greater, such as about 12% or greater, such as about 13% or greater, such as about 14% or greater, such as about 15% or greater, such as about 16% or greater, such as about 17% or greater, such as about 18% or greater, such as about 19% or greater, such as about 20% or greater, such as about 20.5% or greater, or any ranges or values therebetween.

[0039] In some embodiments, the low native GMP and high fat levels discussed above in the high fat feedstock can be obtained or improved by utilizing a microfiltration membrane (such as

a microfiltration membrane having a pore size of about 0.5 micrometers or less, such as about 0.4 micrometers or less, such as about 0.3 micrometers or less, or such as about 0.08 micrometers or greater, or any ranges therebetween) filtration process. Namely, in some embodiments, a microfiltration membrane process can be selected so as to retain denatured whey proteins and fat while allowing some or all native proteins, including native GMP to pass through to a permeate side. It should be understood that, in some embodiments, other filtration methods may be utilized to provide the high fat, low native GMP feedstock.

[0040] However, in embodiments where a microfiltration membrane was utilized, it was also surprisingly found that the ratio of β-lactoglobulin to α-lactalbumin can be increased. Namely, without wishing to be bound by theory, β-lactoglobulin may be more prone to early denaturation compared to α-lactalbumin. Thus, the β-lactoglobulin may largely be retained by the membrane with the denatured whey proteins whereas a higher proportion of the α-lactalbumin passes through with the permeate. In some embodiments, a whey protein feedstock composition according to the present technology exhibits a ratio of β-lactoglobulin to α-lactalbumin of about 2.75 or greater, such as about 3 or greater, such as about 3.5 or greater, such as about 4 or greater, such as about 4.5 or greater, such as about 5 or greater, such as about 5.5 or greater, such as about 6 or greater, such as about 6.5 or greater, such as about 7 or greater, such as about 7.5 or greater, or any ranges or values therebetween.

[0041] For instance, in some embodiments, a whey protein feedstock composition can include about 65 wt.% β-lactoglobulin or more, such as about 67.5 wt.% or greater, such as about 70 wt.% or greater, such as about 72.5 wt.% or greater, such as about 75 wt.% or greater, or any ranges or values therebetween. Additionally, or alternatively, in embodiments, a whey protein feedstock composition can include about 15 wt.% or less α-lactalbumin, such as about 12.5 wt.% or less, such as about 10 wt.% or less, such as about 7.5 wt.% or less, or any ranges or values therebetween.

[0042] Notwithstanding of the method utilized to reduce the native GMP, the reduced native GMP feedstock may be subjected to denaturation 104 as known in the art. For instance, in some embodiments, the whey protein composition may be heated to a temperature of about 176° F or greater, such as about 140° F to about 300° F, such as about 160° F to about 210° F, such as about 170° F to about 200° F, or any ranges or values therebetween, where the heating converts

at least a portion of the starting whey protein to denatured whey protein. Advantageously, such heating also denatures any enzymes, if utilized. Concurrent with the heating, the slurry may be mixed or agitated to reduce the level of aggregation of the denaturing whey proteins. The slurry may be mixed and heated for about 1 second to about 120 seconds, such as about 2.5 seconds to about 105 seconds, such as about 5 seconds to about 90 seconds, or any ranges or values therebetween.

[0043] During or after heating, the denatured whey protein composition can be subjected to mechanical shear conditions 105. In some embodiments, mechanical shear conditions may further denature the whey proteins and/or deactivate the one or more enzymes or may reduce the aggregates that may have formed as the whey proteins denature. Mechanical shear conditions as used herein generally refer to high shear conditions in which at least about 1,000 s^{-1} of shear is applied, such as greater than or about 10,000 s^{-1} of shear is applied, such as greater than or about 50,000 s^{-1} of shear is applied, such as greater than or about 100,000 s^{-1} of shear is applied, up to about 500,000 s^{-1} of shear is applied. In some embodiments, the denatured whey protein composition is typically sheared by a high-shear mixer, colloid mill, or swept surface heat exchanger at a temperature of about 120 to 300° F for about 0.1 to 120 seconds.

[0044] However, it should be understood that, in some embodiments, at least a portion of the proteins in the whey protein composition are denatured prior to heating. For instance, in some embodiments, the whey protein feedstock may have about 5 wt.% or more denatured protein based upon the total weight of the protein in the whey protein feedstock, such as about 20 wt.% or more, such as about 25 wt.% or more, such as about 30 wt.% or more, such as about 35 wt.% or more, such as about 40 wt.% or more, or any ranges or values therebetween.

[0045] Nonetheless, after heating, or in the denatured whey protein composition of the present technology, the final protein contains about 45 wt.% or more denatured whey proteins relative to the total weight of the protein in the whey protein composition, such as about 50 wt.% or more, such as about 55 wt.% or more, such as about 60 wt.% or more, such as about 65 wt.% or more, such as about 70 wt.% or more, such as about 75 wt.% or more, such as about 77.5 wt.% or more, such as about 80 wt.% or more, such as about 85 wt.% or more, such as about 90 wt.% or more, or any ranges or values therebetween.

[0046] As discussed above, in some embodiments, the denatured whey protein composition can be a high protein denatured whey protein composition and may therefore contain about 50 wt.% or more of protein on a dry weight basis, such as about 55 wt.% or more, such as about 60 wt.% or more, such as about 65 wt.% or more, such as about 70 wt.% or more, such as about 75 wt.% or more, such as about 80 wt.% or more, or any ranges or values therebetween.

[0047] Notwithstanding the final composition of proteins, the denatured whey protein composition may be optionally cooled and concentrated after heating and shearing, following by drying 106 to produce a powdered or denatured whey protein composition. Drying processes may include spray drying, heating, and evaporation, among other processes. As will be discussed in greater detail below, the denatured whey protein composition may then be packaged or added directly to other ingredients for making a food or beverage composition.

[0048] Regardless of the method utilized to reduce the native GMP, a denatured whey protein composition according to the present technology can include less than 12 wt.% native GMP based upon the total weight of protein in the denatured whey protein composition, such as about 11 wt.% or less, such as about 10 wt.% or less, such as about 9 wt.% or less, such as about 8 wt.% or less, such as about 7 wt.% or less, such as about 6.5 wt.% or less, such as about 6 wt.% or less, such as about 5.9 wt.% or less, such as about 5 wt.% or less, such as about 4 wt.% or less, such as about 3 wt.% or less, such as about 2 wt.% or less, such as about 1 wt.% or less, or any ranges or values therebetween.

[0049] Thus, in some embodiments, the denatured whey protein composition may exhibit a weight ratio of native GMP to denatured whey protein of about 0.15 or less, such as about 0.125 or less, such as about 0.1 or less, such as about 0.09 or less, such as about 0.085 or less, or any ranges or values therebetween.

[0050] In addition, as may be understood from the above, during hydrolysis of the GMP in the whey protein feedstock, hydrolyzed GMP is formed, and can advantageously remain in the denatured whey protein composition based upon the desired end use. Namely, the present technology has found that the denatured GMP (GMP that has undergone at least one hydrolysis reaction, also referred to herein as enzymatically hydrolyzed GMP) does not exhibit the same adverse effects as the native GMP (such as cardboard flavor/artificial flavor). Thus, in some embodiments, the denatured whey protein composition can contain about 1 wt.% or more of

denatured GMP based upon the total weight of protein in the denatured whey protein composition, such as about 2 wt.% or more, such as about 3 wt.% or more, such as about 4 wt.% or more, such as about 5 wt.% or more, such as about 6 wt.% or more, such as about 7 wt.% or more, such as about 8 wt.% or more, such as about 9 wt.% or more, or any ranges or values therebetween.

[0051] Similarly, as the native GMP is acted upon by one or more enzymes, the denatured whey protein composition may have an increased proteolysis index in some embodiments. Proteolysis index is a measure of the increase of non-protein nitrogen (NPN) in relation to the total Kjeldahl nitrogen (TKN) of a sample, for which the method for determining is described in the examples below. Namely, the proteolysis index (PI) increases in a sample as protein is broken down by enzymatic activity to its primary amino acids or small peptides that become soluble in trichloroacetic acid, known as non-protein nitrogen, and can therefore be an indicator for protein hydrolysates. Thus, in some embodiments, the denatured whey protein composition according to the present technology may have a proteolysis index of about 6 wt.% or greater, such as about 7 wt.% or greater, such as about 8 wt.% or greater, such as about 9 wt.% or greater, such as about 10 wt.% or greater, such as about 12.5 wt.% or greater, such as about 15 wt.% or greater, such as about 17.5 wt.% or greater, such as about 20 wt.% or greater, such as about 22.5 wt.% or greater, such as about 25 wt.% or greater, or any ranges or values therebetween.

[0052] Furthermore, while, in some embodiments as discussed above, the denatured whey protein composition may be considered to be "high fat" and have a fat content of about 7% or greater, based upon the dry basis weight of the whey protein feedstock, such as about 8% or greater, such as about 9% or greater, such as about 10% or greater, such as about 11% or greater, such as about 12% or greater, such as about 13% or greater, such as about 14% or greater, such as about 15% or greater, such as about 16% or greater, such as about 17% or greater, such as about 18% or greater, such as about 19% or greater, such as about 20% or greater, such as about 20.5% or greater, or any ranges or values therebetween However, in some embodiments, the denatured whey protein composition contains less than 7 wt.% of fat, such as about 6.5 wt.% or less, such as about 6 wt.% or less, such as about 2 wt.% or greater, or any ranges or values therebetween.

[0053] Nonetheless, the particles of the denatured whey protein composition according to the present technology can have an average particle diameter of about 0.001 μm to about 11 μm, such as about 0.005 μm to about 9 μm, such as about 0.01 μm to about 7 μm, such as about 0.015 μm to about 5 μm, or any ranges or values therebetween.

[0054] Surprisingly, the present technology has found that by forming a low native GMP denatured whey protein composition as discussed herein, a narrow particle size distribution of the whey proteins can be obtained, which can further improve the flavor attributes of the denatured whey protein composition of the present technology. For instance, the particles can have a D90 particle size distribution value, which is the particle diameter where 90% of the sample's mass includes particles of that size or smaller, of about 8 μm or less, such as about 7 μm or less, such as about 6 μm or less, such as about 5 μm or less, such as about 4 μm or less, such as about 3 μm or less, such as about 2 μm or less, such as about 1.75 μm or less, such as about 1.5 μm or less, such as about 1.25 μm or less, or any ranges or values therebetween.

[0055] Furthermore, the particles can have a D50 particle size distribution value, which is the particle diameter where 50% of the sample's mass includes particles of that size or smaller, of about 5 μm or less, such as about 4.5 μm or less, such as about 4 μm or less, such as about 3.5 μm or less, such as about 3 μm or less, such as about 2.5 μm or less, such as about 2 μm or less, such as about 1.5 μm or less, such as about 1 μm or less, such as about 0.75 μm or less, such as about 0.5 μm or less, such as about 0.3 μm or less, or any ranges or values therebetween.

[0056] Additionally or alternatively, the particles can have a D10 particle size distribution value, which is the particle diameter where 10% of the sample's mass includes particles of that size or smaller, of about 3 μm or less, such as about 2.5 μm or less, such as about 2 μm or less, such as about 1.5 μm or less, such as about 1 μm or less, such as about 0.5 μm or less, such as about 0.4 μm or less, such as about 0.3 μm or less, such as about 0.2 μm or less, such as about 0.1 μm or less, such as about 0.05 μm or less, or any ranges or values therebetween.

[0057] As discussed above, the denatured whey protein composition can be packed in denatured form or can be incorporated into a food or beverage product to produce a fortified food and/or beverage. Suitable food and beverage products can include protein bars, granola bars, yogurts, drinkable yogurts, pudding products, ready to drink beverages, ready to mix beverage

powders, bakery products, medical nutrition products, nutraceutical products, meat products, cheese, butter, grain products, cream cheese, milk products, and the like.

[0058] As an example only of a product and a method for fortifying the product utilizing a denatured whey protein composition as discussed herein, a yogurt composition may be formed as known in the art. For instance, a spoonable or drinkable yogurt milk, which may contain whole milk, defatted milk, or a combination thereof fortified with a denatured whey protein composition according to the present technology, may be sent to a fermenter, where yogurt cultures are added, yielding a yogurt mix. The yogurt mix may then be combined with further ingredients or flavorings and packaged.

[0059] A fortified food and/or beverage product as discussed herein may have a viscosity, the method for which will be discussed in greater detail in the examples, of about 500 centipoise (cP) or less, such as about 400 centipoise or less, such as about 300 centipoise or less, such as about 250 centipoise or less, such as about 200 centipoise or less, such as about 150 centipoise or less, such as about 100 centipoise or less, such as about 50 centipoise or less, or any ranges or values therebetween.

[0060] Furthermore, a fortified food and/or beverage product as discussed herein can be fortified to a protein level of greater than 3%, or about 8 wt.% or greater, based upon the weight of the food and/or beverage product, such as about 8.5 wt.% or greater, such as about 9 wt.% or greater, such as about 9.5 wt.% or greater, such as about 10 wt.% or greater, such as about 12.5 wt.% or greater, such as about 15 wt.% or greater, such as about 17.5 wt.% or greater, such as about 20 wt.% or greater, such as about 22.5 wt.% or greater, such as about 25 wt.% or greater, such as about 27.5 wt.% or greater, such as about 30 wt.% or greater, or any ranges or values therebetween.

[0061] Furthermore, certain embodiments of the present disclosure may be better understood according to the following examples, which are intended to be non-limiting and exemplary in nature.

EXAMPLES

Test Methods and Procedures

Quantification of Glycomacropeptide (GMP), Alpha-lactalbumin (Alpha-La) and Beta-lactoglobulin (Beta-Lg)

[0062] Quantification of GMP was determined by Beckman Capillary Electrophoresis system. The capillary is a DOV-1701OH Deactivated TSP standard FS tubing (600 mm x 50 μm) with a slit opening of 100 x 800 μm and regenerated/activated with 0.1N HCl solution.

Preparation of Sample solution:

-Prepare a 1% Protein solution with deionized (DI) water of each sample

-Vortex samples until homogenous.

-Let powder samples hydrate for at least 30 minutes before continuing with sample prep.

-Prepare sample buffer using 0.0787 g of DTT (threo-1,4-Dimercapto-2,3-butanediol) and 30 g of reducing buffer. Reducing buffer consists of 167 mM Tris, 42 mM 3-morpholino-propanesulfonic acid, 67 mM ethylenedinitrilotetraacetic acid disodium, 0.5g/L methyl hydroxypropyl cellulose in 8M urea solution.

-After samples are hydrated, mix sample buffer and sample in a 1:1 ratio to a total of 4 mL.

-Vortex the sample and let sit for one hour.

-Filter samples into glass vials using PVDF 0.22μm syringe filter. Put caps on glass vials. Sample solution is injected for 10 s at 3.4 Kpa. The separation is conducted under 45°C at 25 KV (increasing from 0 to 25 KV within 3 min initially). Detection of milk proteins is performed at 214nm. Quantity of each protein component is determined by comparing the peak area of each component peak to the total peak areas. On this example:

$$GMP\% = \frac{\text{Peak area for GMP}}{\text{Sum of Peak areas for all proteins}} x100\%$$

$$\frac{Beta\_Lg}{\text{Alpha\_La}} = \frac{\text{Peak area for Beta\_Lg}}{\text{Peak area for Alpha\_La}}$$

Quantification of Fat

[0063] The fat component is determined by the Mojonnier modification of the Roese-Gottlieb procedure for fat extraction (Reference method AOAC 989.05). The Roese-Gottlieb procedure uses ether to extract the fat from dairy products.

Calculate:

$$Fat\% = \frac{\text{Weight of Fat } - \text{ Blank}}{\text{weight of sample}} x100\%$$

Where:

-Weight of Fat: (weight sample beaker after extraction) – (the weight of the empty beaker).

-Blank: an analytical blank determination must be subtracted from the weight of fat obtained.

-Weight of Sample: weight of sample prior to extraction procedure.

Quantification of Protein Analysis by Total Kjeldahl Nitrogen (TKN)

[0064] The protein analysis by Kjeldahl Nitrogen (Reference method AOAC 991.20) is used to determine the percent of nitrogenous compounds by weight. Sulfuric acid digests proteins and other nitrogenous compounds converting the nitrogen into ammonium sulfate. A catalyst is used to increase the reaction rate and to raise the boiling point of sulfuric acid. Titration of the ammonia with standard hydrochloric acid gives the amount of nitrogen associated with protein and soluble nitrogen.

Determination of TKN (Crude Total Protein)

[0065]

$$TKN\% = \frac{\Delta\text{mL} * \text{N} * 14.007 * 6.38}{10 * \text{W}}$$

Where:

-ΔmL = the amount of standardized HCl added to the sample – the amount added to the blank in mL (often calculated by the distillation apparatus and given as ΔmL).

-N = the exact normality of the standardized HCl from the Certificate of Analysis in meq/mL units.

-14.007 = Formula weight of nitrogen in mg/meq.

-The constant 6.38 is the number of grams of dairy protein per gram of nitrogen. Other constants are 4.7218 for ammonium sulfate, and 7.2904 for l-tryptophan.

-W = the sample size in grams.

-Division by 10 gives the result as g per 100 grams.

-The result is expressed as the percentage of protein by weight (# of grams per 100 grams sample).

Determination of NPN (non-protein nitrogen)

[0066] Non-protein nitrogen (NPN) consists of urea, ammonia, free amino acids, creatine, uric acid, peptides, and amino alcohols of phospholipids (Ruska and Jonkus 2014) which are soluble in trichloroacetic acid. Generally greater than 30 amino acids are sufficient to qualify a polypeptide as protein, though not a definitive rule, peptide consisting of less than 30 amino acids likely are found in the TCA soluble fraction and classified as non-protein nitrogen. The method uses addition of trichloroacetic acid (TCA) to precipitate proteins. The protein is filtered out and the non-protein nitrogen determined in the filtrate. The amount of non-protein nitrogen can then be determined.

Sample Preparation

A. Mix sample well.
B. Tare a 150 mL beaker or 4 oz snap-cap. For powder or solid samples, add 10-15 glass balls to the beaker or snap cap before tare.
C. Transfer appropriate number of samples to the tared beaker base on the table below. Record sample weight to nearest 0.0001g. For powder or solid samples, add 20mL of DI water and shake to constitute the sample.
D. Using a graduated cylinder or automatic dispenser, add 15 mL of 33% TCA to the sample.
E. Place the beaker or snap-cap back on the balance.
F. Add DI water to the sample until the total mass of sample, TCA solution, and added water, is approximately 50 g. Record gross weight.
G. Mix well, let solution stand for 10 minutes.
H. Filter through slow filter paper, into a clean snap cap or beaker.
I. Transfer approximately 7-10 g filtrate to a Kjeldahl digestion tube. Record the exact mass of filtrate added.
J. Test on TKN (Total Kjeldahl Nitrogen) method to determine Nitrogen in the filtrate (N) for the calculation below:

$$NPN\% = \frac{\mathrm{mL} * \mathrm{N} * 14.007 * 6.38}{\mathrm{W} * \mathrm{A/B}/10}$$

- mL = the amount of standardized HCl required to titrate the sample distillate.
- N = the exact normality (meq/mL) of the standardized HCl from the lot Certificate of Analysis (COA) or as determined in the laboratory.
- 14.007 = Formula weight of nitrogen in mg/meq.

- 6.38 is factor converting nitrogen to dairy protein
- W = The grams of sample filtrate used
- A = the grams of sample used
- B = the total grams of sample solution
- 10 convert the result to grams per 100 grams.

Determination of True Protein

[0067] True protein is the measure of total nitrogen (TKN) (sometimes referred to as crude protein), with the non-protein nitrogen (NPN) content subtracted out. True Protein = TKN – NPN and is expressed as a percentage of true protein by weight (grams of true protein per 100 grams of sample).

Determination of Proteolysis Index (PI)

[0068] Proteolysis index is a measure of the increase of non-protein nitrogen (NPN) in relation to the total Kjeldahl nitrogen (TKN) of a sample. The proteolysis index (PI) increases in a sample as protein is broken down by enzymatic activity to its primary amino acids or small peptides that become soluble in trichloroacetic acid, known as non-protein nitrogen.

$$PI = \frac{\text{NPN\%}}{\text{TKN\%}} x100\%$$

Proteolysis index is expressed as NPN percentage of total crude protein (TKN) by weight (# of grams of NPN per 100 grams of Total crude protein).

Determination of denatured whey protein

[0069] The denatured whey protein (DWP) method is a measure of whey proteins that have undergone a disruption and possible destruction of both secondary and tertiary structures rendering the protein insoluble in an environment in which the native protein would typically be soluble.

Sample Preparation

-Prepare a solution of sample at approximately 1.2% (w/w) protein. Adjust pH to 6.8 using either 0.1N HCl or 0.1N NaOH.

-Record sample weight and final solution weight after pH adjustment.

-Split volume into two fractions for testing –

-10ml for Total TKN. Test for TKN. This will be % Total TKN.

-25g for DWP fractions in a beaker for treatment as follows.

Determination of Denatured Whey Protein (pH 4.6) Fraction

-Add ~ 10 mL distilled water to the beaker containing the DWP fraction.

-Place small magnetic stir bar into beaker. Place beaker on stir plate, insert pH probe and temperature compensator into the solution. Start stirrer.

-Adjust the pH to 4.60 ± 0.02 by adding 1 normal HCI for gross adjustment and 0.1 normal HCI for fine adjustment.

-Place the beaker on the balance. Bring weight of solution to ~ 50 g (e.g., tare weight plus 50 g) with distilled water. Record weight to nearest 0.0001 g.

-Let solution rest at room temperature for one hour. Swirl the beaker contents for 10-15 seconds to mix. Transfer contents to a centrifuge tube.

-Place tubes in centrifuge, ensuring that tubes are counterbalanced. Centrifuge at 10°C at 10,000 rpm for 15 minutes. Do not use brake to speed deceleration.

-Without transferring any of the pellet material, transfer ~ 10 mL of the supernatant liquid to an identified culture tube. This is the undenatured whey protein fraction. Test this supernatant for TKN. This is the "%TKN in the undenatured whey protein fraction".

Calculate Denatured whey protein (DWP):

$$DWP = 1 - \left(\frac{TKN\%\ in\ undenatured\ whey\ protein\ fraction * \left(\frac{final\ weight\ of dilution}{Weight\ of\ solution\ diluted}\right)}{TKN\%}\right)$$

Determination of Particle Size Distribution

[0070] Particle size distribution analysis was determined using a Malvern Mastersizer 3000 with Hydro EV. The method parameters were 1.46 Particle refractive index, 0.0001 particle absorption index and 1.33 dispersant refractive index and water as dispersant. The Mie scattering model was used for analysis.

Example 1

[0071] A reduced-glycomacropeptide (GMP) denatured whey protein composition was made using a whey protein composition (WPC) that is greater than 25% protein on a dry weight basis from sweet whey of mozzarella cheese making. The process begins with WPC retentate (80% protein on dry basis) that is concentrated using ultrafiltration (UF) of pasteurized sweet whey separated from cheese curd. The 80% WPC (WPC80) retentate is transferred to a temperature-controlled holding tank and kept cold at about 45˚F or less, where it is mixed with water to make

a 14%, protein solution. The holding tank contained a 5,000 lb batch of the whey protein mixture, where 700 pounds of protein from the 80% WPC retentate is mixed with water to form the diluted whey protein solution. The diluted whey protein solution remains in the holding tank at about 45˚F or less until the addition of a protease enzymes.

[0072] Addition of one or more enzymes, in this case, one or more protease enzymes began an incubation phase of protein hydrolysis that selectively hydrolyzes GMP in the whey protein mixture, leaving the other whey proteins such as alpha-lactalbumin and beta-lactoglobulin largely unhydrolyzed. In this experiment, the protease enzyme included at least one alkaline serine protease enzyme and at least one neutral protease enzyme. The one or more protease enzymes were added to the whey protein mixture at a level of about 0.001% to about 5%, or about 0.012% by wt. or less of the total protein in the substrate in this example. For the 5,000-pound batch, about 38 g of enzyme was added.

[0073] The hydrolysis phase lasted for at least 5 hours with agitation at ≤45˚F but can continue for up to 72 hours or more without hydrolysis of the major whey proteins i.e., alpha-lactalbumin and beta-lactoglobulin. Thereafter the enzyme-treated whey protein mixture was subjected to heating to 190°F, 6 seconds (operating range of 176-195°F and 5-90 seconds) and simultaneous mechanical shearing to achieve enzyme deactivation and whey protein denaturation. Following heating and mechanical shearing, the resulting denatured whey protein mixture is subjected to optional cooling (e.g., 50°F) and concentration (e.g., by evaporation or nanofiltration), followed by spray drying to produce a powdered reduced-GMP denatured whey protein composition.

[0074] As illustrated in FIGS. 2A to 2C, particle size distribution of the microparticulated denatured whey protein composition as compared to the whey protein feedstock (characterized by a D90) was of less than or about 1.7 micrometers (mm) and exhibited a narrower range than that of the feedstock.

[0075] FIG. 2A illustrates the undenatured (feed) particle size with a particle size range of 0.011 to 9.86 micrometer. Following enzyme hydrolysis of the GMP and subsequent enzyme inactivation and whey protein denaturation the particle size is reduced to a range of 0.017 to 4.03 micrometers as shown in Figure 2B. FIG. 2C provides a comparison overlay of the particle size distribution for both the whey protein feedstock and Sample 1.

[0076] The level of native GMP by weight of the total protein of the whey protein composition feedstock and the microparticulated denatured whey protein composition is determined by capillary electrophoresis (CE) and defined as a division of peak area of the native GMP by total protein peak area on the CE graph as illustrated in FIGS. 3A and 3B.

[0077] As discussed above denatured whey protein (DWP) and proteolysis index (PI), defined as a division of non-protein nitrogen by total nitrogen, are determined by wet chemistry analysis. Table 1 illustrates the reduction of native GMP from typical cheese whey levels of 12-25%, in this case 20.52% to less than 8%, and specifically 5.84%. Likewise, as GMP hydrolysis occurs there is a concomitant increase in the proteolysis index as the native GMP protein is broken into smaller pieces that result in increased amounts of non-protein nitrogen. FIGS. 3A and 3B illustrate that while GMP is substantially reduced during the hydrolysis it is a result of the controlled hydrolysis that alpha-lactalbumin (a-La) and beta-lactoglobulin (b-Lg) remain largely unhydrolyzed, and further illustrated by the minimal reduction (<10%) in the beta-lactoglobulin to alpha-lactalbumin ratio (Table 1). The increase in denatured whey protein is a direct result of time and temperature treatment during the enzyme inactivation procedures.

Table 1:

Sample Description	Dx (10) (µm)	Dx (50) (µm)	Dx (90) (µm)	PDB %[2]	FDB %^	DWP (%)*	PI (%)[1]	Native GMP (%)	Beta-lactoglobulin to Alpha-lactalbumin ratio
80% WPC Retentate	0.026	0.110	0.480	81.03	6.35	17.27	6.35	20.52	3.37
Reduced-GMP denatured WPC 80	0.138	0.650	1.690	81.03	6.35	78.76	14.90	5.84	3.13

*-Denatured whey protein %
^-Fat on a dry basis%
1 – proteolysis index
2 - Protein on a dry basis%

Example 2

[0078] Feed material of high fat whey protein composition (hfWPC) feedstock was obtained from a microfiltration membrane filtration process. The composition of feed material taken from the retentate side of the microfiltration process was 75.48% protein on a dry basis and 17.66% fat on a dry basis. The high fat whey protein composition feed was adjusted to 14% protein (operating range 10-24%) by adding water.

[0079] Denaturation of the protein was achieved by preheating the feed to 130°F (operating range 120-150°F), then heating to a denaturation temperature of 176-195°F and holding for 5-90 sec, and mechanically shearing simultaneously during the heating for particle size control. Following the heating and shear process, the denatured whey protein composition was cooled to a temperature below 50°F, dried to powder by spray drying to form Sample 2.

[0080] The denatured high fat whey protein composition was analyzed for total solids, fat, protein, denatured whey protein, and particle size distribution the results of which are illustrated in Table 2 and FIGS. 4A-4C, namely, the results of undenatured high fat whey protein composition before (feed) and after denaturation-shearing process. FIG. 4A illustrates the high fat WPC feedstock had particle size range of 0.011 to 11.2 micrometers. Following denaturation and shearing processes, the particle size was reduced to a range of 0.011 to 2.75 micrometer as illustrated in FIG. 4B. FIG. 4C provides a comparison overlay of the particle size distribution for both the feed high fat WPC feedstock and denatured high fat WPC.

[0081] As noted above, the present technology has found that the high fat WPC formed herein exhibits a different chemistry compared to the WPC 80 as is shown Table 1. The starting feedstock of the high fat WPC has a lower GMP (10.5 vs 20.5%), higher denatured whey protein (DWP) (45.10 vs 17.27%), higher fat on a dry bases (17.66 vs 6.35) and higher ratio of Beta-lactoglobulin to Alpha-lactalbumin (7.65 vs 3.37) compared to the starting feed WPC 80. The production of the high fat WPC uses ultrafiltration and microfiltration while production of WPC80 uses only ultrafiltration. One explanation may be that due to the pore size of microfiltration membranes, the majority of DWP and fat are captured in the retentate while some of GMP, alpha-lactalbumin, beta-lactoglobulin and other whey proteins pass through to the permeate side. It is thought that, as Beta-lactoglobulin is more prone to denaturation during milk and subsequent sweet whey pasteurization compared to alpha-lactalbumin, the retained protein contains more denatured beta-lactoglobulin than alpha-lactalbumin. Therefore, the ratio of beta-lactoglobulin to alpha-lactalbumin in high fat WPC is higher than that in WPC80. Interestingly despite different DWP values in the starting feed materials, the final denatured high fat WPC (hfWPC) and denatured WPC80 achieved similar particle size distributions and denatured whey protein (DWP) values (compare FIGS 2C vs. 4C and Tables 1 vs 2).

Table 2:

Product	Dx (10) (µm)	Dx (50) (µm)	Dx (90) (µm)	Denatured whey protein %	Protein on a dry basis%	Fat on a dry basis%	Beta-lactoglobulin to Alpha-lactalbumin ratio	GMP %
Starting Feed - Undenatured Reduced-GMP hfWPC	0.0246	0.101	0.676	45.10	75.48	17.66	7.65	10.50
Denatured - hfWPC	0.0453	0.266	0.821	82.70	75.48	17.66	7.65	10.50

Example 3

[0082] Denatured whey protein compositions were utilized to fortify drinkable yogurt applications to observe the functional benefit in managing viscosity of high protein products. The samples according to Example 3 were formed using the following process of yogurt making:

1. Blend ingredients of base recipe (Table 3) and achieve homogenous solution
2. Pasteurize at 80-85°C (176-185°F) for 30min.
3. Cool to 42°C (108°F).
4. Inoculate starter culture (CHR Mild 2.0) at 0.02%
5. Maintain temperature at 42°C (108°F) during the fermentation process
6. Stop the fermentation process when pH reaches 4.6.
7. Store at 4°C (39°F)

Table 3

Drinkable Yogurt base Recipes	Control (no added WPC) 10% protein fortified w/ Ultrafiltered Milk	10% Protein fortified w/ regular-GMP undenatured WPC80	10% Protein fortified w/ reduced-GMP denatured WPC80	10% Protein fortified w/ reduced-GMP Undenatured hfWPC	10% Protein fortified w/ reduced-GMP denatured hfWPC
Ingredients	**W/W % in base recipe**	**W/W % in base recipe**	**W/W % in base recipe**	**W/W % in base recipe**	**W/W % in base recipe**
Skim milk	14.6	90.8	90.8	90.8	90.8
Ultrafiltered Milk	68.9	0.0	0.0	0.0	0.0
Regular-GMP undenatured WPC80	0.0	9.2	0.0	0.0	0.0
Reduced-GMP denatured WPC80	0.0	0.0	9.2	0.0	0.0
Reduced-GMP Undenatured HfWPC	0.0	0.0	0.0	9.2	0.0
Reduced-GMP denatured HfWPC	0.0	0.0	0.0	0.0	9.2
Sweet cream	3.8	0.0	0.0	0.0	0.0
Lactose	1.7	0.0	0.0	0.0	0.0
Water	11.0	0.0	0.0	0.0	0.0
Total	100	100	100	100	100

[0083] The samples and control were then analyzed for protein, total percent solids, and viscosity, the results of which are shown in Table 4:

Table 4

Drinkable Yogurt - fortified with	Protein %	Total Solids %	Viscosity (cP)
Control (no added WPC)	10.00	18.00	>25,000
Regular-GMP undenatured WPC80 (Control)	8.32	14.42	4,040
Reduced-GMP denatured WPC80	10.08	16.54	90
Reduced-GMP undenatured hfWPC (Control)	9.94	16.93	860
Reduced-GMP denatured hfWPC	10.03	17.06	80
Commercial Reference	7.54	14.02	580

**Brookfield viscosity meter via spindle #6@100rpm, 42°F temperature*

[0084] Various levels of protein fortification may be of interest to consumers. Examples of protein fortification in drinkable yogurt is illustrated in Tables 3 and 4 and FIG. 5. As illustrated, drinkable yogurt fortified to 10% Protein with a reduced-GMP denatured WPC80 composition and reduced-GMP denatured hfWPC according to the present technology, have a preferred lower viscosity when compared to a commercially available product having a 7.54% protein level. Thus, the present technology exhibits a marked decrease in viscosity even at higher fortification levels. The reduced viscosity is beneficial for consumer experience due to increasing protein per serving and ease of consuming the product.

[0085] As illustrated, increasing protein in yogurt applications is challenging. Yogurt's viscosity commonly increases as protein increases. The reason is that proteins such as casein proteins and undenatured whey proteins commonly used to fortify foods bind and interact with water resulting in a higher viscosity texture. A benefit of using denatured whey compositions according to the present technology in products such as yogurt is to fortify the protein content and maintain acceptable viscosity. This is illustrated in Table 4 comparing the viscosity data of yogurt fortified with Control (no added WPC), Regular-GMP undenatured WPC80, and reduced-GMP denatured WPC80, and demonstrating the practical solution that reduced-GMP denatured whey protein composition brings to viscosity. As illustrated, the control yogurt (no added WPC) is very viscous with >25000 cP viscosity and is therefore not pourable and not acceptable as a drinkable yogurt product. Similarly, the drinkable yogurt fortified with regular-GMP undenatured WPC80 has a viscosity of 4040 cP, which is still too viscous to be acceptable for a

drinkable yogurt product. On the other hand, yogurts fortified with reduced-GMP denatured-WPC80 according to the present technology exhibited an acceptable viscosity of 90 cP for pourability and as a drinkable yogurt product. In addition, the reduced-GMP denatured-WPC80 exhibited greatly preferred performance as compared to the commercial reference at a 580 cP viscosity.

[0086] Table 4 illustrates the viscosity data of the Control (no added WPC), reduced-GMP undenatured hfWPC, and reduced-GMP denatured hfWPC in an example that demonstrates the practical solution that reduced-GMP denatured whey protein composition brings to products with desired low viscosity. As the data illustrates, the control yogurt (no added WPC) was very viscous with a >25000 cP viscosity and was therefore not pourable and not acceptable as a drinkable yogurt product. Comparably, the drinkable yogurt fortified with reduced-GMP undenatured hfWPC exhibited a lower viscosity of 860 cP, which is still too viscous to be acceptable for a drinkable yogurt product. On the other hand, yogurts fortified with reduced-GMP denatured hfWPC according to the present technology exhibited an acceptable viscosity of 80 cP for pourability and as a drinkable yogurt product.

Example 4

[0087] Denatured whey protein compositions were utilized to fortify spoonable yogurt applications to observe the functional benefit in managing viscosity of high protein product

Table 5:

Spoon-able Yogurt Base-recipe	**14.7% Protein fortified with Undenatured reduced-GMP hfWPC**	**14.7% Protein fortified with reduced-GMP denatured hfWPC**	**14.7% Protein fortified with reduced-GMP denatured WPC80**
Ingredients	**% (w/w) in base recipe**	**% (w/w) in base recipe**	**% (w/w) in base recipe**
Skimmed milk liquid	0	0	0
Ultrafiltered Milk liquid	46.7	46.7	45.78
Reduced-GMP undenatured hfWPC	11.50	0	0
Reduced-GMP denatured hfWPC	0	11.50	0
Reduced-GMP denatured WPC80	0	0	11.00
Sweet Cream	0	0	3.52
Lactose	2.57	2.57	1.56

Water	39.23	39.23	38.14
Total	100	100	100

[0088] The samples and control were then analyzed for protein, total percent solids, and viscosity, the results of which are shown in Table 6:

Table 6

Spoonable yogurt fortified with	Protein %	Total Solids %	Viscosity (cP)
Commercial Reference	10	22.04	11,000
Reduced-GMP undenatured hfWPC (Control)	14.6	20.17	63,000
Reduced-GMP denatured hfWPC	14.75	20.4	12,000
Reduced-GMP denatured WPC80	14.93	20.83	9,000

[0089] Tables 5 and 6 show examples of protein fortified spoonable yogurt. The data illustrates that reduced-GMP denatured whey protein compositions according to the present disclosure exhibit higher leverage in increasing protein content of a spoonable yogurt without corresponding increases in viscosity or changes in acceptable texture. The commercial reference spoonable yogurt with 10% Protein had a viscosity of 11,000 cP. When protein is increased to 14.7% using reduced-GMP undenatured hfWPC, the viscosity was 63,000 cP which is too high for a spoonable yogurt product. However, when reduced-GMP denatured hfWPC or reduced-GMP denatured WPC80 according to the present technology were used to increase protein to 14.7%, the viscosities were 9,000 to 12,000 cP which are equivalent to the commercial reference yogurt at 10% protein. This demonstrates the advantage of using the reduced-GMP denatured whey protein composition according to the present technology to achieve an increase in protein content of spoonable yogurt while maintaining viscosity. Such improvements also improve the consumer experience due to the more familiar viscosity and texture.

Example 5

[0090] Samples of 80% protein on a dry basis undenatured whey protein concentrate, reduced-GMP denatured WPC 80, undenatured high fat WPC, and denatured WPC were each prepared for descriptive flavor analysis. Whey proteins were rehydrated at 10% (w/v). Products were dispensed into lidded soufflé cups with 3-digit codes and evaluated. Beverages were evaluated in

duplicate by 7 trained panelists using an established sensory language for whey proteins. Descriptive analysis of flavor utilizes a 0-to-15-point universal intensity scale with the Spectrum™ method (Meilgaard and others 1999; Drake and Civille 2003). Paper ballots were used. Each panelist evaluated each product in duplicate in different sessions. Data were analyzed by a general linear model analysis of variance with Fisher's least significant difference (LSD) as a post hoc test (SAS version 9.1, Cary, NC).

[0091] Table 7 summarizes the trained panelists analysis of the samples. It is an unexpected observation that by reducing GMP and denaturing the whey proteins according to the present technology exhibit a significant reduction in cardboard flavor which is often considered an off-flavor and present in many dairy proteins. In addition, the reduction in GMP resulted in an improvement in milky flavor which is considered to be a beneficial flavor attribute in products suitable for dairy applications.

[0092] The results of the reduced-GMP denatured WPC are further substantiated by similar flavor observations when evaluating the denatured high fat whey protein composition that is naturally lower in GMP. Again, it's observed lower GMP combined with denaturing of proteins results directionally less carboard flavor, and a significant increase in milky flavor.

Table 7

	Aroma Intensity	Sweet Aromatic	Cardboard	Milky	Astringency
Undenatured WPC 80	2.2^{a}	1.3^{a}	2.5^{a}	ND	2.9^{a}
Reduced-GMP Denatured WPC80	2.4^{a}	0.8^{b}	1.5^{b}	2.2^{a}	3.2^{a}
Undenatured hfWPC	1.6^{b}	0.5^{b}	2.6^{a}	ND	2.9^{a}
Denatured hfWPC	2.3^{a}	ND	2.3^{a}	1.4^{b}	2.5^{b}

Aroma and flavor intensities were scored on a 0 to 15-point universal intensity scale (Spectrum method, Meilgaard et al., 1999). ND – not detected.
Means in a column followed by a different letter are different ($p<0.05$). Attributes not listed were not detected in these samples.