

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ARLA FOODS AMBA,
Petitioner

v.

LEPRINO FOODS COMPANY,
Patent Owner.

IPR2025-01199

U.S. Patent No. 11,825,860

**PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 11,825,860**

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<i>KSR Int’l Co v. Teleflex Inc.</i> , 550 U.S. 398 (2007).....	24, 67, 68

STATUTES

35 U.S.C. §102	1, 2
35 U.S.C. §103	1, 2

OTHER AUTHORITIES

37 C.F.R. §42.10	94
37 C.F.R. §42.100	4

EXHIBIT LIST

No.	Exhibit
Ex1001	U.S. Patent No. 11,825,860 (“’860 patent”)
Ex1002	File History of the ’860 patent
Ex1003	Declaration of Mark Etzel, Ph.D. (“ <i>Etzel</i> ”)
Ex1004	Curriculum Vitae of Mark Etzel, Ph.D.
Ex1005	PCT Application Publication No. WO2021/136785 (“Nielsen785”)
Ex1006	PCT Application Publication No. WO2018/115520 (“Bertelsen”)
Ex1007	PCT Application Publication No. WO2020/002450 (“Nielsen450”)
Ex1008	Gulustan Ozturk, et al., “Glycoproteomic and Lipidomic Characterization of Industrially Produced Whey Protein Phospholipid Concentrate with Emphasis on Antimicrobial Xanthine Oxidase, Oxylipins and Small Milk Fat Globules,” Dairy, Vol. 3, Issue 2, April 20, 2022 (“Ozturk”)
Ex1009	Y. Kawasaki, et al., “pH-Dependent Molecular Weight Changes of κ -casein Glyco-macropptide and Its Preparation by Ultrafiltration,” Milchwissenschaft, Vol. 48, Issue 4, 191-196, April 1993, (“Kawasaki”)
Ex1010	“APV LeanCreme™ Microparticulation of Whey Protein with SPX Flow Technology, White Paper,” November 2012, (“LeanCreme”), Wayback Machine Capture, June 24, 2016, at https://web.archive.org/web/20160624161613/https://www.spxflow.com/en/assets/pdf/LeanCreme_22008_04_11_2012_GB_tcm11-7662.pdf
Ex1011	Affidavit of Tanya Zeif

No.	Exhibit
Ex1012	Alexander Tolkach and Ulrich Kulozik, “Fractionation of Whey Proteins and Caseinomacropeptide by Means of Enzymatic Crosslinking and Membrane Separation Techniques,” Journal of Food Engineering, Vol. 67, Issues 1-2, 13-20, March 2005
Ex1013	Andrea Hinkova, et al., “Cheese Whey Tangential Filtration Using Tubular Mineral Membranes,” Chemical Papers, Vol. 70 (3), 325-32, December 28, 2016,
Ex1014	A. V. Swaminathan, et al., “A Study of Various Chemical Pretreatments to Fractionate Lipids from Whey Protein Phospholipid Concentrate,” Journal of Dairy Sci., Vol. 104, Issue 12, 12249-12262, December 2021,
Ex1015	U.S. Pat. No. 5,280,107 to Kawasaki et al., issued January 18, 1994
Ex1016	U.S. Pat. No. 4,734,287 to Singer et al., issued March 29, 1988
Ex1017	PCT Application Publication No. WO2015059245
Ex1018	Mark Johnson, “Cheese pH—What’s Behind the Rise and Fall?” Dairy Pipeline, Vol. 14, No. 4, 1-11, December 2002
Ex1019	U.S. Pat. Appl. Pub. No. US2011/0003975, published January 6, 2011, to Arase et al.
Ex1020	U.S. Pat. Appl. Pub. No. US2016/0058025, published March 3, 2016 to Christensen et al.
Ex1021	Declaration of Tanja Christine Jæger (“ <i>Jæger</i> ”)
Ex1022	Declaration of June Ann Munford
Ex1023	J.N. De Wit and G.A.M. Swinkels, “A Differential Scanning Calorimetric Study of the Thermal Denaturation of Bovine β -lactoglobulin Thermal Behaviour at Temperatures Up to 100°C,” Biochimica et Biophysica Acta, Vol. 624, 40-50, July 24, 1980

LISTING OF CHALLENGED CLAIMS

Reference	Limitation
Claim 8	
8.pre	A method of making a denatured whey protein composition, the method comprising:
8.1	filtering cheese whey from enzymatically coagulated milk into a cheese whey retentate and a permeate; and
8.2	reducing native glycomacropeptides (GMP) in the cheese whey retentate to form a reduced-GMP cheese whey retentate composition; and
8.3	heating the reduced-GMP cheese whey retentate composition to form the denatured whey protein composition,
8.4	wherein the denatured whey protein composition is characterized by at least 60 wt. % whey protein on a dry weight basis;
8.5	less than 11 wt. % native GMP relative to a total weight of protein in the denatured whey protein composition;
8.6	a proteolysis index of at least 8.0 wt. % or a beta-lactoglobulin to alpha lactalbumin ratio of greater than 5.00; and
8.7	greater than 50 wt. % denatured whey proteins relative to the total weight of the protein in the denatured whey protein composition.

Claim 9	
9	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.
Claim 11	
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.
Claim 12	
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.
Claim 13	
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 in the denatured whey protein composition.
Claim 15	
15.pre	A denatured whey protein composition comprising:
15.1	at least 60 wt. % protein on a dry weight basis;

15.2	less than 11 wt. % native glycomacropeptide (GMP) relative to total weight of the protein;
15.3	greater than 7 wt. % fat on a dry basis;
15.4	a beta-lactoglobulin to alpha lactalbumin ratio of greater than 5.00; and
15.5	greater than 50 wt. % denatured whey proteins relative to the total weight of the protein.
Claim 16	
16	The denatured whey protein composition of claim 15, 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.
Claim 17	
17	The denatured whey protein composition of claim 15, wherein the denatured whey protein composition comprises a weight ratio of beta lactoglobulin to alpha lactalbumin of greater than or about 5.
Claim 18	
18	The denatured whey protein composition of claim 15, wherein the denatured whey proteins are characterized by a D50 particle size distribution value of less than or about 0.3 μm .
Claim 19	
19	The denatured whey protein composition of claim 15, wherein the denatured whey proteins are further characterized by a D10 particle size distribution value of less than or about 0.1 μm .

Claim 20	
20	The denatured whey protein composition of claim 15, wherein the denatured whey proteins are further characterized by a D90 particle size distribution value of less than or about 1.0 μm .

TABLE OF ABBREVIATIONS

ALA	alpha-lactalbumin
Arla	Petitioner Arla Foods amba
BLG	beta-lactoglobulin
CMP	casein macropeptide
<i>Etzel</i>	Declaration of Mark Etzel, Ph.D. (Ex. 1003)
GMP	glycomacropeptide
IPR	<i>inter partes</i> review
<i>Jæger</i>	Declaration of Tanja Christine Jæger (Ex. 1021)
MF	microfiltration
MFG	milk fat globule
MFGM	milk fat globule membrane
MW	molecular weight
PO	Patent Owner Leprino Foods Co.
POSITA	person of ordinary skill in the art
UF	ultrafiltration
WPC	whey protein concentrate
WPI	whey protein isolate
WPPC	whey protein phospholipid concentrate
'860 patent	U.S. Patent No. 11,825,860 (Ex1001)

I. INTRODUCTION

Arla petitions for IPR of U.S. Patent 11,825,860 (the “’860 patent”). Petitioner respectfully submits that claims 8-9, 11-13, and 15-20 (“challenged claims”) are unpatentable under 35 U.S.C. §§102-103.

II. GROUNDS FOR STANDING

Petitioner certifies the ’860 patent is available for IPR and Petitioner is not barred or estopped from requesting IPR.

III. STATEMENT OF RELIEF REQUESTED

A. Prior art

Nielsen785 (Ex1005), filed December 29, 2020; published July 8, 2021; prior art under 35 U.S.C. §§102(a)(1)-(a)(2)
Bertelsen (Ex1006), filed December 22, 2017; published June 28, 2018; prior art under 35 U.S.C. §§102(a)(1)-(a)(2)
Nielsen450 (Ex1007), filed June 26, 2019; published January 2, 2020; prior art under 35 U.S.C. §§102(a)(1)-(a)(2)
Ozturk (Ex1008), published April 20, 2022; prior art under 35 U.S.C. §102(a)(1)
Kawasaki (Ex1009), published 1993; prior art under 35 U.S.C. §102(a)(1)
LeanCreme (Ex1010), published June 24, 2016; prior art under 35 U.S.C. §102(a)(1)

None of the prior art references asserted here were before the Examiner during prosecution of the ’860 patent. Ex1003 (“*Etzel*”), ¶¶35-64.

B. Grounds for challenge

Ground		Claims	Prior Art
1	§102	8-9, 11, 13	Nielsen785
2	§103	8-9, 11-13	Bertelsen, Nielsen785
3	§103	8-9, 11-13, 15-20	Nielsen450
4	§103	8-9, 11-13, 15-17, 20	Ozturk, Kawasaki, LeanCreme

IV. '860 PATENT OVERVIEW

The '860 patent relates to denatured whey protein compositions. Ex1001, 1:6-8; *Etzel*, ¶¶61-64. Whey comes from cheesemaking—milk casein forms curds used to make cheese, leaving the whey byproduct. Ex1001, 1:17-23. Whey includes fat, lactose, minerals, and milk-derived proteins including β -lactoglobulin (BLG), α -lactalbumin (ALA), and glycomacropeptide (GMP). *Id.*, 4:36-65; *Etzel*, ¶¶52-57. GMP is cleaved from casein during curd production. Ex1001, 4:66-5:5; *Etzel*, ¶¶52-57. The '860 patent recognizes GMP as “an inferior source of protein for muscle recovery” and notes that high GMP content “can lead to undesirable flavor and poor process incorporation.” Ex1001, 1:30-40; *see id.* 5:5-24; *Etzel*, ¶¶52-57.

To address those known problems, the '860 patent describes high-protein whey compositions with reduced GMP. Ex1001, 5:25-30. It also describes making such compositions through filtering, reducing GMP in the retentate, and denaturation. *Id.*, 6:3-28, 6:44-59, 7:49-8:14, 8:43-59; *Etzel*, ¶58.

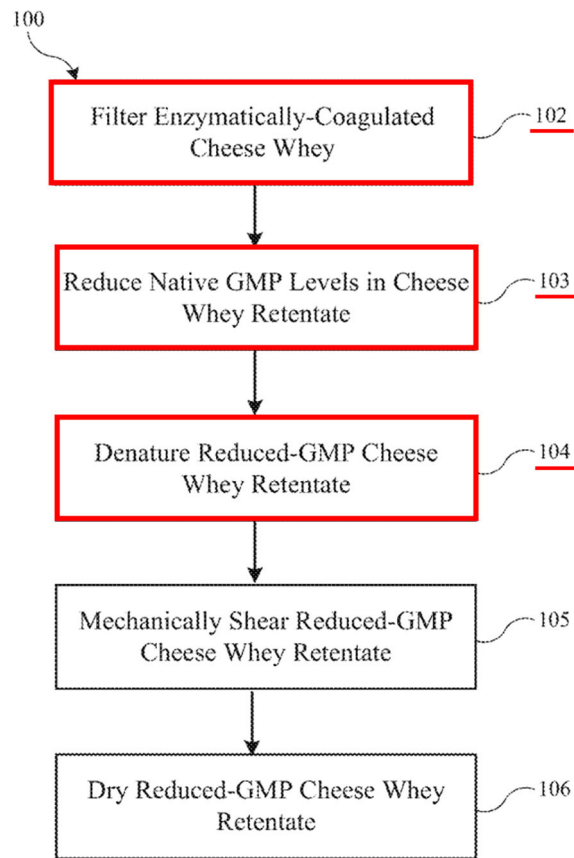


FIG. 1

Ex1001, Fig. 1 (annotated).

Filtration to form a cheese whey retentate may include ultrafiltration “or other methods as known in the art.” *Id.*, 6:14-37. The patent describes reducing GMP through enzymatic hydrolysis or microfiltration. Enzymatic hydrolysis involves adding enzymes “that selectively reduce native GMP levels.” Ex1001, 6:44-46; *see id.* 6:44-7:48, 15:61-16:11. Alternatively, microfiltration can retain denatured proteins and fat while “a portion of the GMP permeates the microfiltration

membrane.” *Id.*, 7:49-8:14, 18:16-24. Heating denatures the remaining proteins “as known in the art.” *See id.*, 8:44-52, 11:29-49, 3:28-43; *Etzel*, ¶¶58-59.

V. CLAIM CONSTRUCTION

The Board uses the same claim construction standard that would be used in a civil action. 37 C.F.R. §42.100(b). The term “native GMP” in the challenged claims should be construed to mean “non-hydrolyzed GMP.”

The ’860 specification strongly supports that construction. Describing methods to reduce GMP, the specification distinguishes between “native GMP” and GMP that has been hydrolyzed through enzymatic action. For example, “GMP that has undergone at least one hydrolysis reaction, also referred to herein as enzymatically hydrolyzed GMP” does not cause the “same adverse effects as the native GMP.” Ex1001, 10:3-8, Abstract, 1:46-48. The claims reflect the same distinction. *Id.*, 23:4-7. Similarly, the specification confirms that hydrolysis reduces “native GMP” in a composition, *id.*, 7:19-39, even though resulting GMP fragments may remain, *id.*, 3:30-35, 10:1-37. The import is clear: GMP is no longer “native GMP” after hydrolysis. Accordingly, “native GMP” should be construed to mean “non-hydrolyzed GMP.” *Etzel*, ¶¶31-34, 46-51.

For purposes of this proceeding, Petitioner does not currently believe any other term requires construction. Petitioner reserves the right to address terms in other proceedings and any constructions PO may raise here.

VI. POSITA STANDARD

A POSITA in January 2023 would have had a bachelor's degree in food science or a related field, and 2+ years of work experience or research related to processing dairy products or developing protein compositions for food products. *Etsel*, ¶11. Additional relevant education or industry experience may compensate for a deficit in the requirements stated above. *Etsel*, ¶¶1-30, 42-54.

VII. DETAILED EXPLANATION OF GROUNDS

A. Ground 1: Anticipation by Nielsen785 (incorporating Bertelsen) (Claims 8-9, 11, 13)

1. Nielsen785 (Ex1005)

Nielsen785 described producing denatured whey compositions. Ex1005, 1:5-11. Those compositions contained “whey protein nanogels,” small particles of denatured whey protein. *Id.*, 9:16-22. They included any or all proteins in whey and could be a subset of those proteins or even one species. *Id.*, 7:29-32. The compositions had high protein (e.g., BLG) concentrations. *Id.*, 1:30-2:6; *Etsel*, ¶¶65-68.

Nielsen785 started with “providing a whey protein solution,” Ex1005, 2:8-20, preferably by “dissolving BLG isolate powder produced” using Bertelsen’s methods, *id.*, 89:1-3, 18:27-31. The protein solution was heated to at least 68°C. *Id.*, 2:22-23, 19:24-20:8. Heating was “performed for a duration sufficient to denature at least 50%” and “most preferably at least 99%” of the BLG. *Id.*, 20:10-30.

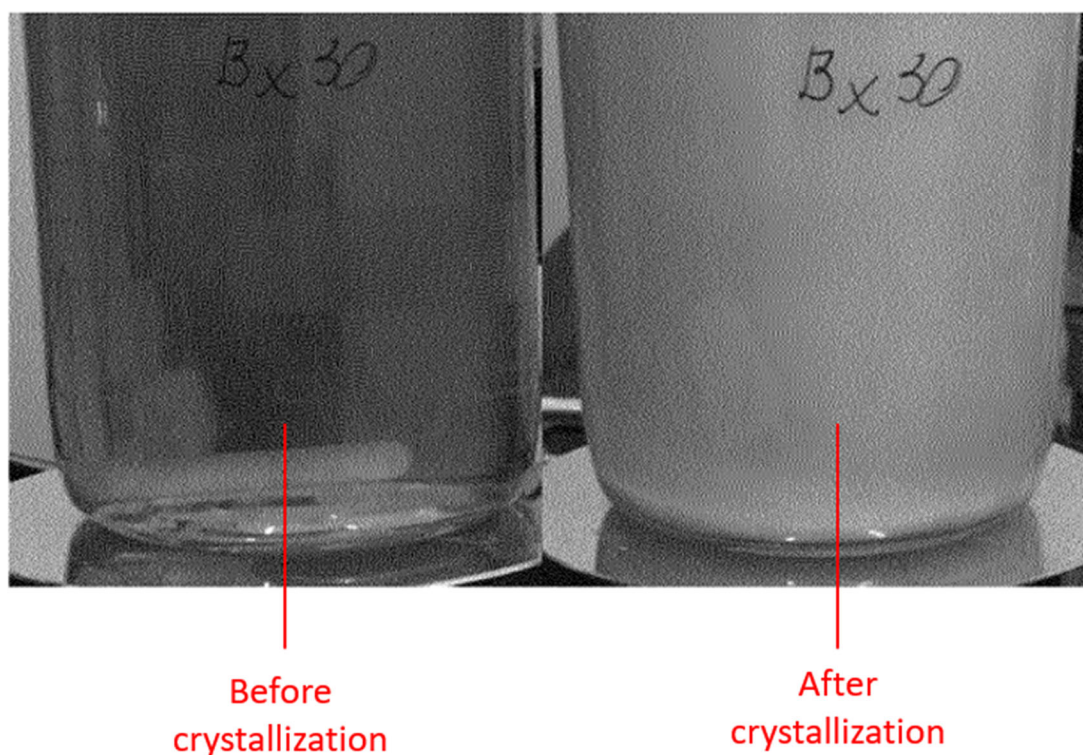
Nielsen785 expressly incorporated Bertelsen (Ex1006) in its entirety. Ex1005, 18:34-35. Accordingly, Bertelsen is “effectively part” of Nielsen785 as if “explicitly contained therein.” *Arbutus Biopharma Corp. v. ModernaTX, Inc.*, 65 F.4th 656, 662-63 (Fed. Cir. 2023). All of Bertelsen concerned producing BLG compositions, so POSITAs would have understood Nielsen785 as incorporating the full reference with detailed particularity. At minimum, disclosures about Bertelsen’s BLG isolate powder relied upon here were expressly incorporated with particularity. *Etzel*, ¶¶68.

2. Bertelsen (Ex1006)

Bertelsen described “isolated beta-lactoglobulin compositions...containing crystallised beta-lactoglobulin.” Ex1006, Abstract. Bertelsen allowed efficient production of “highly purified BLG which is safe to use as a food ingredient.” *Id.*, 3:11-13, 4:10; *Etzel*, ¶¶69-70.

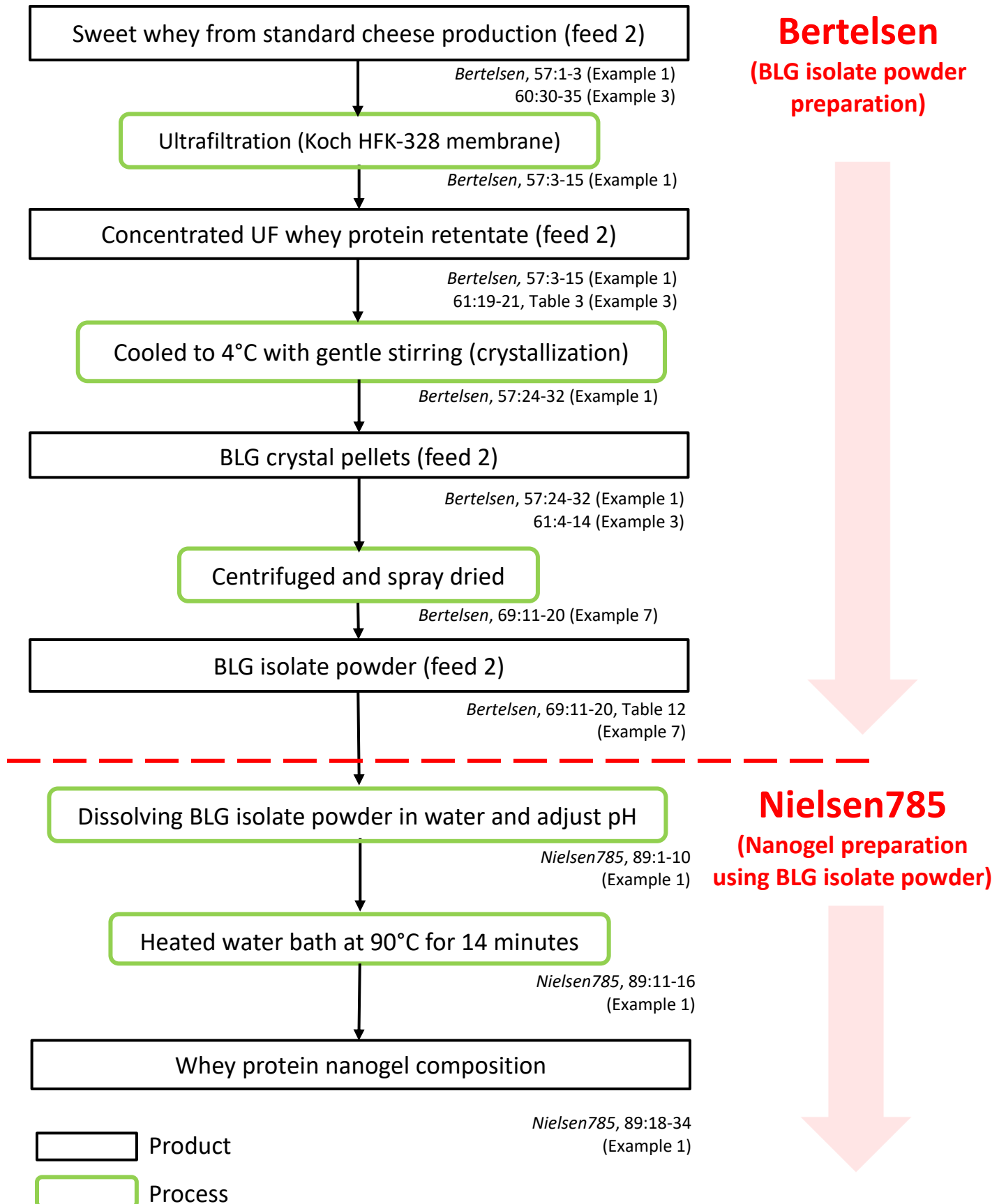
Bertelsen’s “highly pure BLG crystals” could be prepared in “crude whey protein solution.” Ex1006, 3:4-6. The process involved “providing a whey protein solution comprising BLG and at least one additional whey protein,” with the solution being “supersaturated with respect to BLG.” *Id.*, 3:19-21. For example, cheese whey was filtered to obtain a concentrated retentate containing BLG. *Id.*, 57:1-15, 60:30-62:5. BLG was then crystallized in solution. *Id.*, 3:23, 57:17-18, 60:30-65:9.

Fig. 12



Ex1006, Fig. 12 (annotated), 5:23-24, 63:19-21. BLG crystals were separated from solution to make “a dry product such as e.g. a powder.” *Id.*, 3:25-39; *Etzel*, ¶71. The resulting BLG powder’s GMP concentration fell below detection, compared to 17.1% GMP in the retentate used for crystallization. Ex1006, 61:19-62:5 (Table 3), 70:1-5 (Table 12); *Etzel*, ¶71.

Nielsen785 used Bertelsen’s BLG powder and incorporated Bertelsen by reference. Ex1005, 89:1-3, 18:34-35; *Etzel*, ¶72. The flow chart below illustrates the processes of Nielsen785 (incorporating Bertelsen). *Id.*



3. Cl.8

a. 8.pre

If limiting, Nielsen⁷⁸⁵ disclosed 8.pre. *Etzel*, ¶73. Nielsen⁷⁸⁵ taught methods for making denatured whey protein compositions as nanogels. *E.g.*, Ex1005, 1:30-2:29; *Etzel*, ¶73.

b. 8.1

Bertelsen's incorporated disclosures taught BLG compositions "containing crystallised beta-lactoglobulin." Ex1006, Abstract. Bertelsen's "highly pure BLG crystals" were produced using methods in Bertelsen's Examples 1, 3, and 7; *Etzel*, ¶¶74-75.

Example 1 described crystallizing BLG "from a crude whey protein concentrate." Ex1006, 56:35-36. "The term 'whey' pertains to the liquid supernatant that is left after the casein of milk has been precipitated and removed. Casein precipitation may e.g. be accomplished by acidification of milk and/or by use of rennet enzyme." *Id.*, 12:22-24. Casein precipitation was a form of coagulation. *Etzel*, ¶76. Cheese whey is the liquid remaining after casein precipitation in cheesemaking. If casein precipitated through acidification, the result was acid whey, and if casein precipitated via rennet enzyme, the result was sweet whey. Therefore, sweet whey is one type of cheese whey. *Id.* Example 1's sweet whey was made "from a standard

cheese production process” and a “whey product produced by rennet-based precipitation of casein.” Ex1006, 57:3-5, 12:26-27.

Bertelsen’s Example 1 processed “sweet whey from a standard cheese production process” through “ultrafiltration” to obtain cheese whey retentate for BLG crystallization. *Id.*, 57:1-32. POSITAs would have understood this meant a permeate was also produced containing materials that passed through the filter. *Etzel*, ¶77.

Bertelsen’s Example 3 used three different types of whey protein-containing raw materials “treated as described in Example 1,” which included filtration, to prepare concentrates for BLG crystallization. Ex1006, 67:1-15, 60:30-35. The second whey protein solution discussed in Example 3 (feed 2) was “based on sweet whey.” *Id.*, 60:33-35. Using “the same experimental and analytical setup as in Example 1,” all three feeds were crystallized. *Id.*, 60:28-61:14, 63:13-28; *Etzel*, ¶78.

Bertelsen’s Example 7 for preparing spray-dried BLG crystals used the crystals “produced in Example 3 (using feed 2).” *Id.*, 69:9-11. Nielsen⁷⁸⁵ used Bertelsen’s Example 7 BLG powder to make denatured whey protein compositions. Ex1005, 89:1-38. Accordingly, Nielsen⁷⁸⁵ (incorporating Bertelsen) taught filtering cheese whey into a retentate and permeate. *Etzel*, ¶¶79-80.

c. 8.2

In Nielsen785, “the term ‘caseinomacropeptide’ or ‘CMP’ pertains to the hydrophilic peptide, residue 106-169, originated from the hydrolysis of ‘κ-CN’ or ‘kappa-casein’ from mammal species, e.g. in native and/or glycosylated forms and includes the naturally occurring genetic variants, by an aspartic proteinase, e.g. chymosin.” Ex1005, 7:4-7. CMP and GMP thus refer to the same hydrophilic peptide released from kappa-casein. *Etzel*, ¶¶81-82. Indeed, the ’860 patent confirms that GMP is “referred to as...CMP.” Ex1001, 4:37-40.

As in §VII.A.3.b, Nielsen785 disclosed using crystalline BLG powder produced as in Bertelsen’s Examples 1, 3, and 7. The GMP in Bertelsen’s whey-protein solutions was native GMP. For example, Bertelsen described quantifying “*native* alpha-lactalbumin (C_{α}), beta-lactoglobulin (C_{β}), and caseinomacropeptide (C_{CMP})” in its analysis methods. *See* Ex1006, 72:6, 77:36-38 (emphasis added). Neither Bertelsen nor Nielsen785 described using a protease to cleave GMP. *Etzel*, ¶83.

Bertelsen quantified GMP levels during crystalline BLG powder production. *Etzel*, ¶84. For example, Table 3 (below) reported whey-protein concentrations in feed 2 of Example 3. GMP was 17.1%w/w relative to total protein.

Feed 2 standardized to 95% TS	
Protein composition (% w/w relative to total protein)	
ALA	12.2
BLG	70.0
CMP	17.1
Other components (% w/w relative to the total weight of the standardized feed)	
Ca	0.387
K	0.204
Mg	0.066
Na	0.051
P	0.174
fat	BDL
protein concentration	89

Ex1006, 61:19-20, Table 3 (annotated).

Bertelsen's Example 7 for preparing BLG powder used crystallized BLG "produced in Example 3 (using feed 2)." *Id.*, 60:30-35, 69:11. BLG crystals were separated "from the remaining whey protein solution" to make "a dry product such as e.g. a powder." *Id.*, 3:25-39, 69:9-20. Bertelsen's processes reduced CMP from over 17% to below detection. *Id.*, 70:1-3, Table 12; *Etzel*, ¶85.

Table 3 The concentration of selected components of feed 2 (ALA-reduced whey protein concentrate based on sweet whey). BDL= below detection limit in wet, non-standardized sample.

Feed 2 standardized to 95% TS	
Protein composition (% w/w relative to total protein)	
ALA	12.2
BLG	70.0
CMP	17.1
Other components (% w/w relative to the total weight of the standardized feed)	
Ca	0.387
K	0.204
Mg	0.066
Na	0.051
P	0.174
fat	BDL
protein concentration	89

Example 3 (whey protein solution)

Table 12 The concentration of selected components of the spray-dried BLG crystal preparation of Example 7. BDL= below detection limit

Spray dried BLG crystal powder	
Protein composition (% w/w relative to total protein)	
ALA	0.7
BLG	97.4
CMP	BDL
Other components (% w/w relative to total weight of the BLG crystal powder)	
Ca	0.118
K	0.026
Mg	0.017
Na	BDL
P	BDL
water	3.8
protein concentration	94

Example 7 (BLG isolate powder)

CMP
Reduction

Ex1006, 61:19-20, 70:1-3, Tables 3, 12 (both annotated). Although Bertelsen did not state the detection limit reflected in Table 12, Nielsen⁷⁸⁵ measured CMP in BLG isolate powder produced as in Bertelsen's Example 7 and reported a concentration of 0.7%.

Protein source	BLG isolate
pH	5.67
Total solids%	95.2
Protein/total solids %	98.7
Ash %	0.51
Fat %	0.11
Lactose %	<0.09
Pho % of TS	<0.025
Na % of TS	0.025
K % of TS	0.051
Ca % of TS	0.146
Mg % of TS	0.022
Native ALA %	0.2
Native BLG %	96.5
CMP %	0.7
Ca:BLG w/w ratio	0.0016

Example 1 (BLG isolate powder)

Ex1005, 88:15-20, Table 1 (annotated).

d. 8.3

As in VII.A.3.b-VII.A.3.c, Nielsen785 taught producing crystalline BLG powder (“*reduced-GMP cheese whey retentate*”). Nielsen785 described dissolving that BLG powder from Bertelsen’s Example 7 to form whey protein solutions. *See* Ex1005, 89:1-10. Those solutions were heated at 90°C for 14 minutes in a water bath. *Id.*, 89:12-16. Nielsen785 reported that heating at 90°C for 10 minutes caused “95-97% denaturation with only 3-5% non-denatured protein” remaining. *Id.*, 89:29-31. Nielsen785 also taught that “a high level of BLG denaturation gives a better heat-stability of the resulting” composition. Ex1005, 20:25-26. Adjusting heat-treatment durations achieved denaturation of “most preferably at least 99% w/w of the native BLG.” *Id.*, 20:16-23; *Etzel*, ¶¶86-87.

e. 8.4

Nielsen785's Example 1 taught using heat denaturation. *Etzel*, ¶¶88-89. Whey powders used for denaturation contained 98.7% protein/total solids and 96.5% BLG. Ex1005, 88:15-20 (Table 1). Nielsen785 described heating solutions made from that powder without adding or removing any protein. *See id.*, 89:1-16. Heating was performed at the same temperature and for a longer duration than that yielding 95-97% denaturation, so POSITAs would have understood that at least 95% of protein in the solutions of BLG powder was denatured after heat treatment. *Etzel*, ¶90. Denaturing 95% of protein in the BLG powder composition containing 98.7% protein on a dry-weight basis, 96.5% of which was the whey protein BLG, would have resulted in a denatured whey protein composition having well over 60% whey protein on a dry-weight basis. *Id.*

f. 8.5

As discussed in §VII.A.3.c, Bertelsen's Example 7 and Nielsen785's Example 1 taught reducing GMP weight percentages from a feed whey-protein solution to a BLG powder. *See* Ex1006, Tables 3, 12, 60:30-35, 61:19-20, 69:11, 70:1-3; Ex1005, 88:15-89:3. GMP content by total protein weight of the protein powder used in Nielsen785's denaturation step was 0.7%. Ex1005, 88:15-20; *Etzel*, ¶¶91-92. No protein was added or removed during thermal treatment of Nielsen785's Example 1.

Therefore, GMP weight percentages remained approximately the same (0.7% w/w relative to the total protein) in the denatured whey protein nanogel. *Id.*

Accordingly, Nielsen⁷⁸⁵ (incorporating Bertelsen) described producing a denatured whey protein composition having GMP at 0.7% w/w relative to the total weight of protein, far less than 11%. *Id.*, ¶93.

g. 8.6

Protein powder used “for preparation of whey protein nanogels” contained 0.2% ALA and 96.5% BLG:

Protein source	BLG isolate
pH	5.67
Total solids%	95.2
Protein/total solids %	98.7
Ash %	0.51
Fat %	0.11
Lactose %	<0.09
Pho % of TS	<0.025
Na % of TS	0.025
K % of TS	0.051
Ca % of TS	0.146
Mg % of TS	0.022
Native ALA %	0.2
Native BLG %	96.5
CMP %	0.7
Ca:BLG w/w ratio	0.0016

Ex1005, 88:8-20, Table 1 (annotated). That corresponded to a BLG/ALA ratio of about 482.5 (96.5/0.2). *Etzel*, ¶¶94-95. Heat-denaturation processes would not affect

the BLG/ALA ratio because Cl.8.6 does not differentiate between denatured and undenatured BLG. *Id.*

h. 8.7

Nielsen⁷⁸⁵ taught that high BLG denaturation “gives a better heat-stability of the resulting whey protein nanogels composition” and heating occurred “for a duration sufficient to denature at least 50% w/w of the native BLG...more preferably at least 90%...and most preferably at least 95% w/w of the native BLG.” Ex1005, 20:16-26. As discussed in §§VII.A.3.d-VII.A.3.e, at least 95-97% of whey protein in Nielsen’s whey protein nanogel preparations was denatured after heating. *Id.*, 89:12-31; *Etzel*, ¶¶96-97.

Denaturing at least 95% of whey protein in the BLG powder composition relative to total protein weight—corresponded to a denatured whey protein composition having well over 50wt.% denatured whey proteins relative to the total weight of protein in the composition. *Etzel*, ¶98.

4. Cl.9

As discussed in §§VII.A.2 and VII.A.3.b, Bertelsen’s Example 3 used three different whey protein inputs (feeds 1-3), of which feed 2 was “derived from sweet whey.” Ex1006, 57:1-15, 60:30-35. All three were crystallized. *Id.*, 60:28-61:14, 63:13-28. Feed 1 was centrifuged twice “on a Maxi-Spin filter with a 0.45 micron CA membrane.” *Id.*, 61:4-6. POSITAs would have known this was microfiltration

because the 0.45 μ m cut-off was within known microfiltration cut-off ranges. *Etzel*, ¶¶99-100 (citing Ex1013, 330, Table 7). POSITAs would also have understood that microfiltration with 0.45 μ m membrane causes GMP reduction. *Id.*

Feed 2 was *also* centrifuged twice, with the same amount and type of water added as feed 1. Ex1006, 61:8-10; *Etzel*, ¶101. POSITAs would understand that feed 2 thus likewise used a 0.45 μ m CA membrane because feed 2 also underwent a dual-centrifugation and water-adding process “under standard conditions.” *Id.* Similarly, the microfiltration process would have also caused GMP reduction in feed 2. *Etzel*, ¶102.

5. Cl.11

As discussed in §VII.A.3.d, Nielsen785’s protein solution produced from BLG powder was heated to 90°C for 14 minutes in a water bath. Ex1005, 89:12-16. POSITAs would have recognized that 90°C is 194°F, so Nielsen785 described heating to a temperature of at least about 160°F. *Etzel*, ¶103. POSITAs would have understood and reasonably expected that the 14-minute incubation in a 90°C (194°F) water bath would have raised temperatures of those beverage compositions to at least about 160°F because the heat-treatment step was included to denature BLG, BLG’s denaturation temperature was well known to be about 70°C/158°F, and Nielsen785 disclosed that immersion in water baths at 90°C for even ten minutes did in fact

result in 95-97% denaturation. Ex1005, 89:12-31, 19:11-16, 20:6-26; Ex1023, 40; *Etzel*, ¶103.

6. Cl.13

As in §VII.A.3.f, Nielsen785 (incorporating Bertelsen) taught a denatured whey composition having GMP at 0.7wt% relative to the total protein, which was less than 11wt% relative to the total weight of protein in the composition. Additionally, the GMP concentration corresponded to 0.007 weight ratio of GMP relative to total protein (0.7/100). *Etzel*, ¶104.

B. Ground 2: Obvious over Bertelsen and Nielsen785 (Claims 8-9, 11-13)

1. Motivation to Combine

As explained above, Nielsen785 incorporated Bertelsen. Even if considered separately, POSITAs would have been motivated to combine their teachings. *Etzel*, ¶105.

First, both were directed toward protein compositions for food products. *Compare* Ex1006, Abstract, *with* Ex1005, Abstract. Both focused on compositions high in BLG. *Compare* Ex1006, 3:1-9, *with* Ex1005, 1:32-35. And both noted the substantial benefits of using BLG in food products. *See* Ex1006, 4:10-12; Ex1005, 5:26-27; *Etzel*, ¶¶106-07.

Second, Bertelsen taught making concentrated BLG powders, and Nielsen785 taught applications of such BLG powders, such as producing denatured protein

compositions for beverages. For example, Nielsen785 taught using BLG powders prepared according to Bertelsen to produce denatured BLG compositions for high-protein beverages that are “pleasant to drink.” Ex1005, 3:34-36. Bertelsen’s Examples 1, 3, and 7 collectively described preparing “spray-dried BLG crystals.” Ex1006, 69:9-20. Bertelsen taught that crystallized BLG preparations had “several interesting nutritional uses” as a food ingredient. *Id.*, 4:10-23; *Etzel*, ¶108.

POSITAs would have looked to Nielsen785 because it described an apt use for Bertelsen’s BLG powders—making denatured whey compositions useful as food ingredients—and Nielsen785 expressly described using BLG powder as produced in Bertelsen and even incorporated Bertelsen by reference. Ex1005, 89:1-3, 18:34-35. Nielsen785’s nanogels were “suitable for high protein beverages and enable[d] the production of high protein, heat-sterilised beverage products that have a low viscosity and therefore are pleasant to drink.” *Id.*, 3:34-36. Therefore, POSITAs would have been motivated to use Bertelsen’s BLG powder compositions with Nielsen785 to make denatured whey compositions for use in beverages. *Etzel*, ¶¶108-10.

POSITAs would have reasonably expected success in using BLG powders from Bertelsen to produce Nielsen785’s compositions because Nielsen785 expressly taught that BLG powders produced as described by Bertelsen were successfully used to prepare denatured whey-protein compositions for nutritional applications. Ex1005,

88:8-90:17, 56:10-25; *Etzel*, ¶111. This combination was well within the skill of POSITAs and would have required nothing more than the application of known techniques and products (BLG isolate powders) as taught in Bertelsen to be used as described by Nielsen⁷⁸⁵. *Etzel*, ¶111. The flow chart in §VII.A.2 illustrated the combined processes of Bertelsen and Nielsen⁷⁸⁵. *Id.*

Thus, POSITAs would have understood Bertelsen and Nielsen⁷⁸⁵ were combinable and would have been motivated to combine them with reasonable expectations of success. *Etzel*, ¶112.

2. Cl.8

a. 8.pre

If limiting, the Bertelsen-Nielsen⁷⁸⁵ combination taught 8.pre. *Etzel*, ¶113. Bertelsen taught BLG compositions. Ex1006, Abstract. Bertelsen’s BLG powder was produced via methods described in Examples 1, 3, and 7. Example 1 was titled “[c]rystallization of beta-lactoglobulin from a crude whey protein concentrate.” Ex1006, 56:35-36. “[S]weet whey from a standard cheese production process” was processed through “an ultrafiltration setup” to obtain ultrafiltered retentates. *Id.*, 57:3-18. *Etzel*, ¶¶114-16. Example 3 used “the same experimental and analytical setup as in Example 1” to assess three different whey-protein inputs for BLG crystallization. Ex1006, 60:30-35. The second (feed 2) was “based on sweet whey.” *Id.*, 60:33-35. *Etzel*, ¶117. Example 7 described preparing crystallized BLG powder

using feed 2. Ex1006, 60:30-35, 69:11; *see also id.* 3:19-23. The BLG crystals were separated “from the remaining whey protein solution” to make “a dry product such as e.g. a powder.” *Id.*, 3:25-39; *Etzel*, ¶118.

As discussed in §VII.B.1, the same BLG powder of Bertelsen was used in Nielsen785 to make BLG nanogels for high-protein beverages. Ex1005, 89:1-3. Nielsen785 described dissolving BLG powder from Bertelsen in water to form whey protein solutions. *See* Ex1005, 89:8-10. The solutions were heated at 90°C in a water bath for 14 minutes. *Id.*, 89:12-16. Nielsen785 taught that heat treatment at 90°C for 10 minutes caused “95-97% denaturation with only 3-5% non-denatured protein.” *Id.*, 89:29-31. Heating as described by Nielsen785 for longer than 10 minutes would have resulted in even greater denaturation. *Etzel*, ¶¶119-20.

b. 8.1-8.7

As in §§VII.A.3.b-VII.A.3.h, Bertelsen and Nielsen taught 8.1-8.7, and as explained in §VII.B.1, POSITAs would have been motivated to combine those references with reasonable expectations of success. *Etzel*, ¶121.

3. Cl.9

As in §VII.A.4, Bertelsen and Nielsen785 taught reducing GMP through microfiltration. *Etzel*, ¶122. Even if Bertelsen did not expressly teach using a 0.45µm CA membrane for feed 2, it would have been obvious for a POSITA to do so based Bertelsen’s express teaching on centrifuge-based filtering feed 1 and that feed 2 was

also centrifuged twice “under standard conditions.” *Id.* Similarly, the microfiltration process would have also caused GMP reduction in feed 2. *Id.*

4. Cl.11

As in §VII.A.4, Bertelsen and Nielsen⁷⁸⁵ taught the heating limitation of claim 11. *Etzel*, ¶123.

5. Cl.12

Nielsen⁷⁸⁵ taught that heating to form whey-protein nanogels may involve mechanical shearing: “mechanical shear is not excluded from the present invention,” and in preferred embodiments heat-treatment step b) “does involve mechanical shearing.” Ex1005, 20:37-39. Step b) referred to “heating the whey protein solution” to an elevated temperature (e.g., 68°C or higher) “for a duration sufficient to form a suspension of whey protein nanogels.” *Id.*, 2:22-23; *see also id.*, 3:6-7, 11:7-8, 11:31-32, 19:24-27, 27:31-34, 28:25-28, 29:29-32, 30:15-19, 32:1-4; *Etzel*, ¶¶124-25.

Nielsen⁷⁸⁵ did not identify a specific shear rate, but it was well known to denature whey-protein solutions by heating under high-shear conditions to achieve sufficient denaturation, avoid aggregation of protein particles, and control particle-size distribution. *Etzel*, ¶126. For example, denaturing whey proteins at high temperature (e.g., 80-120°C) and “under very high shear forces” was known to reduce processing time and avoid large protein particles. *See* Ex1016, 16:19-17:13.

Particularly, “very high” shear rates of “450,000 to 600,000 and usually about 500,000 reciprocal minutes”¹ were applied. *Id.*, 17:7-11. POSITAs would have understood that $8,333\text{s}^{-1}$ qualified as high-shear conditions. *Etzel*, ¶¶126-27. The ’860 patent itself acknowledged that “[m]echanical shear conditions as used herein generally refer to high shear conditions in which at least about $1,000\text{s}^{-1}$ of shear is applied...” Ex1001, 8:66-9:1. As another example, heating under high mechanical shear denatured whey proteins (e.g., BLG) and converted whey-protein gels to whey-protein microparticles. *See* Ex1017, 1:14-19, 7:4-10, 13:31-36, 14:15-20, 18:14-36, 51:10-12. Thus, “heat denaturation and mechanical shear [could be combined] in one step” for greater efficiency. Ex1010, 3-4. Such mechanical shear could be “high-shear conditions” that enables “the formation of fine particles with a specific particle size similar to fat globules.”² *Id.*

6. Cl.13

As in §VII.A.6, Bertelsen and Nielsen⁷⁸⁵ taught the alternative limitations of claim 13. *Etzel*, ¶128.

¹ A rate of 500,000 reciprocal minutes equals about $8,333\text{s}^{-1}$. *Etzel*, ¶126.

² Ex1010, Ex1016, and Ex1017 are cited herein to demonstrate POSITAs’ knowledge. *KSR Int’l Co v. Teleflex Inc.*, 550 U.S. 398, 420 (2007).

C. Ground 3: Obvious Over Nielsen450 (Claims 8-9, 11-13, 15-20)

1. Nielsen450

Nielsen450 recognized “unique nutritional benefits for athletes” from incorporating whey protein into “[b]everages developed for sports nutrition.” Ex1007, 1:8-11. But whey-containing products may have a yellow color, *id.*, 1:17-18, and that adversely affected consumers’ “perception of a beverage comprising whey proteins.” *Id.*, 3:2-5. Nielsen450 thus described whey-protein-supplemented, heat-treated beverages that were “more colour neutral than traditional whey containing beverages.” *Id.*, 3:7-10; *Etzel*, ¶¶129-30.

Nielsen450 described whey-protein powders and beverages. Ex1007, 95:11-113:12 (Examples 2-13). Those included BLG powders prepared through crystallization (Examples 2-4) and beverage compositions made using such powders (Examples 4-13). *Id.*; *Etzel*, ¶¶131-32. In Example 11, Nielsen450 described high-protein beverage compositions made using BLG powder containing 93.97% protein (w/w), of which 95.9% was BLG:

Table 9: Chemical composition of BLG isolate powder A.

Description	A - Dry BLG (w/w%)
BLG	95.9
Ash	0.51
Ca	0.1455
Cl	0.04
Lipid	0.11
K	0.0512
Mg	0.022
Na	0.025
NO ₃	2
NO ₂	0.07
PHO	0.025
Protein	93.97
Dry matter	95.19
pH	5.7

Ex1007, 109:29-31 (citing Table 9), 108:20-32 (Table 9); *Etzel*, ¶¶132-33. Different compositions were prepared, heated in a water bath at 90°C, and tested for viscosity, turbidity, and color. Ex1007, 109:28-110:24. The results showed “a stable colourless and transparent beverage at pH 7.0 even at a high protein concentration” and “a milky beverage with remarkably low viscosity.” *Id.*, 110:11-24; *Etzel*, ¶¶132-33.

Example 12 described high-protein beverages prepared using the same BLG powder from Example 11, but “[l]ipids were added...to evaluate the opportunity to prepare nutritional beverages also in the presence of fat.” Ex1007, 111:1-10 (citing Table 9). Solutions containing dissolved BLG powders and lipid were heat-treated in a water bath at 90°C, optionally homogenized, and tested for viscosity, turbidity, and color. *Id.*, 110:11-112:12. Those results showed “it was possible to produce

stable high protein BLG beverages even with a lipid content of 25% and 50% of the total energy content and still having a remarkably low viscosity.” *Id.*, 112:3-12; *Etzetel*, ¶134.

2. Nielsen450 incorporated Bertelsen and used BLG powders produced through Bertelsen’s methods

As discussed above, Nielsen450’s Examples 11-12 described high-protein beverages prepared using BLG powder to form a solution. *See* Ex1007, 108:14-20, 109:29-110:4, 111:3-4. The powder composition was shown in Table 9, denoted “BLG isolate powder A” in Examples 11-12. *Id.*, 108:20-32 (Table 9), 109:29-30, 111:3-4. Another example in Nielsen450—Example 9—involved the same BLG powder identified as “BLG powder A” in Table 9 and Examples 11-12 but there referred to it as “BLG powder B,” corresponding to its use in a preparation labeled “Beverage B.” Ex1007, 104:20-105:3 (Example 9, Table 8). Composition data from those examples are shown in annotated tables below:

Table 9: Chemical composition of BLG isolate powder

Description	A - Dry BLG (w/w%)
BLG	95.9
Ash	0.51
Ca	0.1455
Cl	0.04
Lipid	0.11
K	0.0512
Mg	0.022
Na	0.025
NO ₃	2
NO ₂	0.07
PHO	0.025
Protein	93.97
Dry matter	95.19
pH	5.7

Table 8: Composition of protein ingredients (BDL=below detection limit)

Component	BLG powder A	BLG powder B	WPI powder
BLG	98.2	95.9	61
ALA	<0.5%	<0.5%	8
CMP	<1%	1.08	17
Ash	0.09	0.51	3.7
Ca	BDL	0.146	0.072
K	BDL	0.051	1.14
Na	BDL	0.025	0.484
Mg	BDL	0.022	0.007
pH	3.79	5.7	6.7

Ex1007, 108:20-32 (Table 9), 104:20-34 (Table 8). Matching composition values in every overlapping parameter between those tables would have made clear to POSITAs that the BLG powder identified as “BLG powder B” in Example 9 was the same powder used in Examples 11-12. *Etzel*, ¶¶135-36.

Although Examples 11-12 did not detail processes for preparing BLG powders, Nielsen⁴⁵⁰ taught that BLG powder was preferably prepared using Bertelsen’s methods. Ex1007, 74:22-24 (describing powders as “preferably obtained according to WO 2018/115520” (Bertelsen)). Example 9 confirmed the BLG powder with 95.9% BLG and 5.7 pH described in Tables 8-9 was produced using Bertelsen’s methods. Example 9 specified its “beverages were produced according to example 4,” *id.*, 104:16, and Example 4 in turn explained that non-neutral BLG powders were “produced as outlined in example 7 of PCT/EP2017/084553,” *id.*, 100:10-11.

PCT/EP2017/084553 is Bertelsen. Ex1006, (21). And as described above, Bertelsen's Example 7 (through nested citations pointing to related Examples 1, 3) described the crystallization-based method for preparing BLG isolate powders from a cheese whey feedstock. §VII.A; *Etzel*, ¶137.

Nielsen450 incorporated Bertelsen twice over, disclosing that all “references cited in the present application are hereby incorporated by reference in their entirety,” Ex1007, 79:19-20, and confirming that “the BLG-enriched composition is prepared by crystallization...as described in the PCT application PCT/EP2017/084553, which is incorporated herein by reference for all purposes,” *id.*, 62:7-9. Bertelsen is effectively a part of Nielsen450. *Arbutus*, 65 F.4th at 662-63. Bertelsen was directed to producing BLG products throughout, so POSITAs would have understood Nielsen450 to incorporate with detailed particularity Bertelsen's entire disclosure. At minimum, disclosures related to making BLG powders were expressly incorporated with particularity. *Etzel*, ¶138.

3. Denaturing high-protein beverages

Nielsen450's Examples 11-12 described preparing high-protein beverages with 6-12% (Example 11) or 3-12% (Example 12) protein by weight of the solutions. Ex1007, 109:29-30, 111:3-4. Since high-protein beverages were prepared using BLG powders of Table 9, the main whey protein in those beverages was BLG—making up 95.9% w/w of the total protein. *Id.*, 108:20-32. Furthermore,

compositions made with BLG powder “were heat treated in a water bath at 90°C for 5 min.” in Examples 11-12. *Id.*, 109:32-110:1, 111:3-12; *Etzel*, ¶139.

Nielsen450 did not teach specific degrees of denaturation achieved through heating in Examples 11-12, but did teach that when protein solutions were heat-treated, especially at 85-95°C for 5-20 minutes, the resulting degree of denaturation was “most preferably at least 80%.” Ex1007, 72:14-32; *see id.*, 39:23-27 (describing denatured, high-BLG compositions as “particularly advantageous to use for high protein beverages”). Furthermore, it was well known that heating whey-protein solutions, such as those in Examples 11-12, to a high temperature (e.g., 90°C) would have resulted in significant denaturation. *Etzel*, ¶140 (citing Ex1019, [0003]) (“[I]t is known that whey protein is poor in heat stability and is therefore rapidly denatured by heating at 70 to 90°C.”). Accordingly, it would have been obvious to POSITAs that heating as described in Examples 11-12 would have resulted in rapid, significant denaturation. *Id.*

Consistent with that understanding, Dr. Etzel confirmed—through replicating Nielsen450’s Examples 11-12—that denaturation in heat-treated beverages prepared as described would have exceeded 50% (e.g., 77-85%). *Etzel*, ¶141. Dr. Etzel visited Arla’s laboratories and directed experiments replicating compositions in Nielsen450 Examples 11-12—using the same “BLG powder A”—and measuring properties of those compositions. *Id.*, ¶142. Dr. Etzel is well-qualified to conduct such operations,

and he had access to materials that enabled faithful reproduction of the original experiments. *Id.*, ¶143; Ex1021 (“*Jæger*”), ¶¶1-14.

First, the replicated experiments used BLG powder from the same batch used in Nielsen450’s original experiments for Examples 11-12: Table 9’s BLG powder composition. *See* Ex1007, 109:29, 111:3-4. A named inventor from Nielsen450 identified and provided Dr. Etzel with a stored sample of the same batch of BLG powder that was used in the original experiments described in Examples 11-12. *Jæger*, ¶¶6-10. That stored sample had been labeled with a batch number and date (“Batch N11, 28-11-17, week 48”) that not only matched records documenting the original experiments reported as Examples 11-12 in Nielsen450, but also was consistent with the “N11” notations visible in Nielsen’s Figure 10 depicting compositions from Example 11. *Jæger*, ¶¶6-10, *Etzel*, ¶145; *see* Ex1007, Fig. 10. The retrieved BLG powder sample was determined to contain 92.18% dry matter by weight and 89.25% whey protein by weight (92.03% of total protein being BLG). *Etzel*, ¶¶144-45. The slight (~3%) decrease in dry-matter percentage compared to the value reported in Nielsen450’s Table 9 most likely reflected limited water adsorption during storage. *Id.*

Second, Petitioner is the applicant of Nielsen450, and the original experiments described in Nielsen450 were performed in Petitioner’s laboratory facilities in Denmark. *See* Ex1007, Cover (71); *Etzel*, ¶146; *Jæger* ¶¶1-13. The replicated

experiments were performed in the same facility using the same equipment. *Jæger* ¶¶1-13.

Third, as discussed more fully *infra* for each limitation, Nielsen450 provided detailed, step-by-step narratives of sample preparation in Examples 11-12. *See* Ex1007, 109:28-112:12; *Etsel*, ¶147.

Fourth, the '860 patent identified specific, well-known procedures for determining protein properties when assessing values recited in the challenged claims. *Etsel*, ¶148. For example, the '860 patent described appropriate protocols for measuring denatured whey protein in a sample. Ex1001, 14:47-15:32, 13:3-36. The patent also identified equipment and parameters that can be used for measuring particle size distributions as recited in the claims. *Id.*, 15:33-40. Dr. Etsel followed those protocols to accurately assess whether compositions prepared as described in Nielsen450's Examples 11-12 would have possessed the properties recited in the challenged claims. *Etsel*, ¶148.

4. Cl.8

a. 8.pre

If limiting, Nielsen450 taught 8.pre. *Etsel*, ¶¶149-50. As in §§VII.C.1-VII.C.2, Nielsen450's Examples 11-12 described high-protein beverages made using BLG powder produced as described by Bertelsen. Nielsen450 described dissolving BLG powder in water to form whey-protein solutions, which were then heated "in a water

bath at 90°C for 5 min.” *See* Ex1007, 109:29-110:2, 111:3-13. POSITAs would have understood and expected that the disclosed heat-treatments would have denatured BLG in those whey-protein compositions. *Etzel*, ¶150. In addition, as more fully explained *infra* at §VII.C.4.g, Dr. Etzel replicated Nielsen450’s Examples 11-12 and confirmed the understanding that those processes indeed would have made a denatured whey-protein composition. *Id.*

b. 8.1-8.2

As explained in §VII.C.2, Nielsen450 incorporated Bertelsen by reference and specifically relied on Bertelsen’s method for preparing crystalline BLG powders. And as in §§VII.A.1-VII.A.2, that method included filtering cheese whey from enzymatically coagulated milk into a permeate and cheese-whey retentate and reducing GMP in the retentate. *Etzel*, ¶¶151-52.

c. 8.3

In Nielsen450’s Examples 11-12, high-protein beverages were prepared by dissolving BLG powder produced using Bertelsen’s methods and heating the resulting liquid compositions at 90°C for five minutes. *See* Ex1007, 109:29-110:4; 111:11-13. As explained in §VII.C.3, POSITAs would have understood and expected those heat treatments to cause over 50% BLG denaturation. Additionally, and as explained in §VII.C.4.g, Dr. Etzel confirmed that whey-protein compositions

prepared and heated as described in Examples 11-12 demonstrated the vast majority of whey proteins were denatured. *Etzel*, ¶¶153-54.

d. 8.4

In Nielsen450's Examples 11-12, high-protein beverages were prepared using the Table 9 BLG powder. Ex1007, 109:29-110:4, 111:3-4. That powder contained 93.97% protein on a dry-weight basis, 95.9% of which was BLG. *Id.*, 108:20-32 (Table 9). BLG is a whey protein present in cheese whey. *Etzel*, ¶¶155-56; Ex1007, 1:13-15.

In Example 11, Nielsen450 described beverages made using the Table 9 BLG powder at, among others, 6% protein by weight of the solution. Ex1007, 109:28-110:10. POSITAs would have understood that all protein in such beverage compositions was from the input BLG powder, and the whey-protein content of such beverages is determined solely by the input BLG powder, which contained 98.7% whey protein on a dry-weight basis. *Etzel*, ¶157; Ex1007, 108:20-32 (Table 9). Therefore, POSITAs would have understood that Example 11's beverage compositions contained at least 60% whey protein on a dry-weight basis. *Etzel*, ¶157.

In Example 12, Nielsen450 described beverage compositions made using the Table 9 BLG powder in combination with added lipid. Ex1007, 111:1-112:2. For example, one disclosed beverage composition was made with 3% protein by weight of the solution and 0.45% lipid by weight of the solution. *Id.*, 111:20-30. POSITAs

would have understood that (1) all protein in such beverage compositions was from the input BLG powder, and (2) dry-matter content of such beverages would depend on the protein-powder *and* lipid inputs. *Etzel*, ¶158. As POSITAs would have understood, 100g preparation of a beverage with 3% protein and 0.45% lipid as in Example 12 would have required 0.45g lipid (0.45% w/w) and 3g protein from the BLG powder (3% w/w). *Id.* The input protein powder contained 93.97% protein by weight, *see* Ex1007, 108:20-32 (Table 9), meaning that approximately 3.2g of BLG powder would be required to provide 3g of protein. *Etzel*, ¶158. From that 3.2g of BLG powder, approximately:

- 3.04g would have been dry matter (3.2g powder $\times$ 95.19% dry matter total weight basis); and
- 3g of the 3.04g of dry matter would have been protein (3.2g powder $\times$ 93.97% protein total weight basis).

Id.

Accordingly, POSITAs would have understood the total dry matter in an exemplary 100g sample of such beverage composition to have been 3.49g (3.04g BLG powder and 0.45g lipid), and that such compositions would have contained approximately 86.0% whey protein on a dry-weight basis ($3\div 3.49$) because essentially all the protein in the BLG powder is whey protein. *Id.*, ¶159. Accordingly,

because BLG is a whey protein, POSITAs would have understood that such compositions contained at least 60% whey protein on a dry-weight basis. *Id.*

e. 8.5

POSITAs would have understood that the BLG powder used in Examples 11-12 was the only source of protein in the disclosed beverage compositions. *Etzcel*, ¶¶160-61. Because Nielsen450 taught that GMP accounted for 1.08% by weight of the BLG powder, *see* Ex1007, 104:12-105:3 (Table 8), 108:20-32 (Table 9), POSITAs would have understood that GMP could have represented no more than 1.08wt.%. *Etzcel*, ¶161. Furthermore, that is consistent with Nielsen450's disclosure indicating less than 1% GMP in BLG powder A and 1.08% GMP in powder B. *Id.*, ¶161; *see* Ex1007, 104:20-30, Table 8; §VII.C.2.

f. 8.6

POSITAs would have understood that BLG powders used in Examples 11-12 were the only source of protein in the disclosed beverage compositions. *Etzcel*, ¶¶162-63. Because Nielsen450 taught that BLG was 95.9% by weight of total protein in the powder, *see* Ex1007, 108:20-32 (Table 9), POSITAs would have understood that ALA could have represented at most 4.1% by protein weight. *Etzcel*, ¶163. Accordingly, POSITAs would have understood that the BLG-to-ALA ratio in the beverage compositions of Examples 11-12 would have been at least 23.4. *Id.* That is consistent with the Nielsen450's disclosure indicating <0.5% ALA in the BLG

powder. *Id.*, ¶163; *see* Ex1007, 104:20-30; §VII.C.2. Less than 0.5% of ALA combined with 95.9% BLG provides a BLG-to-ALA ratio of at least 191.8, exceeding 5.00 as recited in 8.6. *Etzel*, ¶163.

g. 8.7

As explained in §VII.C.4.c, Nielsen450 taught heating compositions of Examples 11-12 at 90°C, which POSITAs would have understood to cause rapid and significant denaturation of BLG. Given the use of a water bath set to temperatures (i.e., 90°C) well above the known denaturation temperature of BLG (i.e., 70°C), as well as the substantial (five-minute) heating duration, POSITAs would have understood and reasonably expected that denatured whey proteins would have made up at least 50% of the total weight of protein in the heat-treated compositions of Nielsen450's Examples 11-12. *Etzel*, ¶¶164-65.

Moreover, Dr. Etzel conducted experiments to confirm that understanding by re-creating one high-protein beverage composition from Example 11 and one from Example 12 according to the instructions in Nielsen450 and using the same BLG powder that was used during the original experiments reported in Examples 11-12. §VII.C.3; *Etzel*, ¶¶166-68.

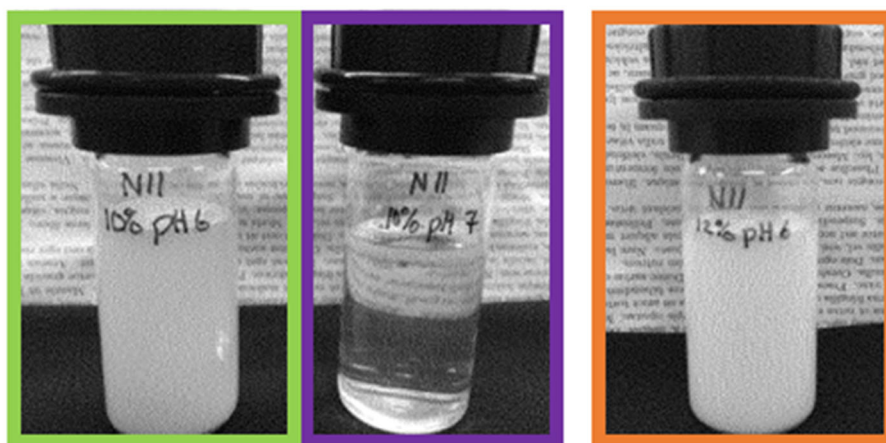
(i) Experiments confirmed Example 11 taught greater than 50% denatured whey proteins

In Example 11, Nielsen450 taught that the Table 9 BLG powder was solubilized to prepare whey-protein beverages comprising 6, 10, or 12w/w% protein. Ex1007, 109:29-110:6; *Etzel*, ¶169. “The pH was adjusted to pH 6.0 and 7.0 with 3%w/w NaOH or HCL.” Ex1007, 109:31-32. Properties of Example 11’s high-protein beverages were listed in Table 10, and some of the compositions were depicted in Figure 10:

Table 10. Properties of high protein BLG beverages at pH 6.0 and pH 7.0. Grey cells = not determined due to sample gelation.

Pow- der	Pro- tein w/ w%	pH	Vis- cosity cP	Turbid- ity NTU	De- script ion	L*	a*	b*	Δb^*	Insol- uble protein matter %
A	6	6.0								
			1.9	-	Milky	90.73	-1.96	1.76	-1.54	0
		7.0	4.1	14.6	Clear	39.87	-0.11	0.04	0.26	0
	10	6.0	2.8	>11000	Milky	90.47	-2.54	-2.4	-2.18	0
		7.0	57.7	11.1	Clear	39.74	-0.11	0.04	0.26	0
	12	6.0								
			4.5	-	Milky	90.38	-2.24	1.92	-1.70	0
		7.0	Gel							

Figure 10



Ex1007, 110:6-10, Table 10, Fig. 10 (both annotated).

Dr. Etzel directed experiments to prepare one of Example 11's high-protein beverages—particularly, with 6% protein at pH 7.0, as indicated below:

Table 10. Properties of high protein BLG beverages at pH 6.0 and pH 7.0. Grey cells = not determined due to sample gelation.

Pow- der	Pro- tein w/ w%	pH	Vis- cosity cP	Turbid- ity NTU	De- script ion	L*	a*	b*	Δb*	Insol- uble protein matter %
A	6	6.0								
			1.9	-	Milky	90.73	-1.96	1.76	-1.54	0
		7.0	4.1	14.6	Clear	39.87	-0.11	0.04	0.26	0
	10	6.0	2.8	>11000	Milky	90.47	-2.54	-2.4	-2.18	0
		7.0	57.7	11.1	Clear	39.74	-0.11	0.04	0.26	0
	12	6.0								
			4.5	-	Milky	90.38	-2.24	1.92	-1.70	0
		7.0	Gel							

Ex. 1007, 110:6-10, Table 10 (annotated); *Etzel*, ¶170. As explained in §VII.C.3, Dr. Etzel was able to prepare that composition using the same BLG powder, in the same laboratory facility, using the same equipment that was used in the original experiments described in Nielsen450's Example 11.

Dr. Etzel directed preparation and processing steps matching those defined in Example 11. *Etzel*, ¶171; Ex1007, 109:28-110:2, 100:24-33. Particularly, a batch of Example 11's (6% protein, pH 7.0) composition was prepared by mixing 16.8g of the retrieved BLG powder (containing 89.25% whey protein by weight) with water to a total mass of 250g and adjusting the pH to 7.0 with 3w/w% NaOH. *Id.*, ¶¶171-73. The resulting composition was split in two: one portion was maintained at

ambient temperature with no heat treatment (Sample 1), and a second portion was subjected to heat treatment as described in Example 11 (Sample 2):

Sample No.	Protein w/w%	pH	Heat treatment
1	6	7	No
2	6	7	Yes

Id.

The portion designated for heating as Sample 2 was used to fill five of the same “thin-walled glass vials” described and depicted in Nielsen⁴⁵⁰. *Id.*, ¶174; see Ex1007, 100:30-33 (Ex.5), 109:32-110:2 (Ex.11, heating “according to Example 5”), Fig. 10. Each vial received 20 ml of the beverage composition. *Etzel*, ¶174. The vials were then capped, except for one vial that was covered with foil to permit measuring the composition’s temperature while heating. *Id.* Sample 2 vials were then incubated for five minutes in a water bath preequilibrated to 90°C, followed by cooling in ice water and incubation at room temperature until the samples reached ambient temperature. *Id.*

Denaturation degrees in Samples 1-2 were then determined per the same standard procedure designated for that purpose in the ’860 patent. *Id.*, ¶175; Ex1001, 14:47-15:32. That procedure is substantially similar to the method for measuring protein denaturation described in Nielsen⁴⁵⁰’s Example 1.3; both methods depend

on selective precipitation of denatured whey protein at pH 4.6 as was well known in the art. *Compare* Ex1007, 80:28-81:10, *with* Ex1001, 14:47-15:40; *Etzel*, ¶176. The results showed that the heat-treated Sample 2 composition contained 85% denatured protein relative to the total protein weight, while the Sample 1 portion that was not heated contained only 1% denatured protein:

Calculation of Degree of Denaturation

	6% protein pH 7 -HT	6% protein pH 7 +HT
Final weight of dilution	49,9483	50,0651
Weight of solution diluted	25,0072	24,9919
TKN%	1,23	1,2
DWP%	0,61	0,09
Degree of denaturation	1%	85%

Sample 1 **Sample 2**

Etzel, ¶177. Those results showed that the retrieved BLG powder sample used in Dr. Etzel's experiments had remained almost entirely undenatured during storage. *Id.* The results also confirmed the reasonable understanding a POSITA would have had reading Nielsen450 that the heat-treated, 6% protein, pH 7.0 high-protein beverage composition described in Example 11—which was prepared and treated in the same way using the same BLG powder—would have contained greater than 50% denatured whey proteins relative to the total weight of protein. *Id.*

(ii) Experiments confirmed Example 12 taught greater than 50% denatured whey proteins

In Example 12, Nielsen450 taught the same Table 9 BLG powder was solubilized to prepare whey-protein beverages comprising 3, 6, 10, or 12w/w% protein. Ex1007, 111:1-112:2; *Etzel*, ¶178. Those compositions also contained lipid at 0.45-5.4w/w% “to evaluate the opportunity to prepare nutritional beverages also in the presence of fat.” Ex1007, 111:4-6. The pH was adjusted to 6.0 or 7.0, and the samples were heat-treated at 90°C, with an optional homogenization step. Ex1007, 111:7-16. Properties of the resulting high-protein beverages were reported in Table 11:

Table 11. Properties of milky BLG beverages with added lipids.

Pro- tein w/w%	Lipid w/w% (%E)	pH	Viscos- ity cP	Turbid- ity NTU	De- scrip- tion	L*	a*	b*	Δb^*	Insolu- ble protein matter %
3	0.45 (25%E)	6.0	2.1	-	Milky	89.36	-0.78	-0.92	-0.70	0
		7.0	1.4	7652	Milky	58.35	-1.46	-6.76	-6.54	0
	1.35 (50%E)	6.0	1.9	-	Milky	88.76	-0.8	-1.13	-0.91	0
		7.0	2.0	>11000	Milky	69.07	-1.47	-4.97	-4.75	0
6	0.9 (25%E)	6.0	1.9	>11000	Milky	90.7	-2.34	-2.4	-2.18	0
		7.0	5.0	2122	Milky	33.87	-0.18	-2.23	-2.01	0
	2.7 (50%E)	6.0	1.9	>11000	Milky	90.71	-2.42	-2.49	-2.27	0
		7.0	4.7	2951	Milky	37.71	-0.32	-2.3	-2.08	0
10	1.5 (25%E)	6.0	3.8	>11000	Milky	90.96	-2.83	-2.46	-2.24	0
		7.0	178.3	3628	Milky	37.44	-0.41	-1.49	-1.27	0
	4.5 (50%E)	6.0	4.8	>11000	Milky	90.6	-2.66	-2.11	-1.89	0
		7.0	5.5	>11000	Milky	90	-2.94	-2.85	-2.63	0
12	1.8 (25%E)	6.0	5.7	>11000	Milky	90.7	-2.16	-2.2	-1.98	0
		7.0	Gel							
	5.4 (50%E)	6.0	7.8	>11000	Milky	89.09	-2.35	-2.9	-2.68	0
		7.0	Gel							

Ex1007, 111:24-112:2.

Dr. Etzel directed repeat preparation of a composition from Example 12—particularly, the one having 3% protein, 0.45% lipid, and pH 7.0, as indicated below:

Table 11. Properties of milky BLG beverages with added lipids.

Protein w/w%	Lipid w/w% (%E)	pH	Viscosity cP	Turbidity NTU	Description	L*	a*	b*	Δb^*	Insoluble protein matter %
3	0.45 (25%E)	6.0	2.1	-	Milky	89.36	-0.78	-0.92	-0.70	0
		7.0	1.4	7652	Milky	58.35	-1.46	-6.76	-6.54	0
	1.35 (50%E)	6.0	1.9	-	Milky	88.76	-0.8	-1.13	-0.91	0
		7.0	2.0	>11000	Milky	69.07	-1.47	-4.97	-4.75	0
6	0.9 (25%E)	6.0	1.9	>11000	Milky	90.7	-2.34	-2.4	-2.18	0
		7.0	5.0	2122	Milky	33.87	-0.18	-2.23	-2.01	0
	2.7 (50%E)	6.0	1.9	>11000	Milky	90.71	-2.42	-2.49	-2.27	0
		7.0	4.7	2951	Milky	37.71	-0.32	-2.3	-2.08	0
10	1.5 (25%E)	6.0	3.8	>11000	Milky	90.96	-2.83	-2.46	-2.24	0
		7.0	178.3	3628	Milky	37.44	-0.41	-1.49	-1.27	0
	4.5 (50%E)	6.0	4.8	>11000	Milky	90.6	-2.66	-2.11	-1.89	0
		7.0	5.5	>11000	Milky	90	-2.94	-2.85	-2.63	0
12	1.8 (25%E)	6.0	5.7	>11000	Milky	90.7	-2.16	-2.2	-1.98	0
		7.0	Gel							
	5.4 (50%E)	6.0	7.8	>11000	Milky	89.09	-2.35	-2.9	-2.68	0
		7.0	Gel							

Ex1007, 111:24-112:2, Table 11 (annotated).

Dr. Etzel directed preparation and processing steps matching Example 12. *Etzel*, ¶¶179-80; Ex1007, 111:1-112:12, 100:24-33. A 500g batch of the (6% protein, 0.45% lipid, pH 7.0) Example 12 composition was prepared as follows. Separate vessels containing water and canola oil were equilibrated at 70°C in a water bath. *Etzel*, ¶¶181-82; Ex1007, 111:7, 33:28-30. Approximately 0.02g of Grindsted Citrem LR10 emulsifier was dissolved in heated oil to a total mass of 10g (0.02% LR10 in oil), and 2.25g of the LR10/oil was slowly mixed with 480.95g of the heated water. *Etzel*, ¶¶181-82; Ex1007, 111:7-8. The resulting oil/water solution was then immersed in a water bath set to 50°C, and its temperature was monitored until the

solution reached 60°C. *Etzel*, ¶¶181-82; Ex1007, 111:8-9. At that point, 16.8g of the retrieved BLG powder (containing 89.25% whey protein by weight) was added and stirred for 45 minutes. The solution was then adjusted to a pH of 7.0 using 3%w/w NaOH. *Etzel*, ¶¶181-82; Ex1007, 111:8-9.

The solution was then split in half. The first half was split again into portions denoted Samples 3 and 4. The second half was subjected to homogenization at 200/50 bar and then split into portions denoted Samples 5 and 6. *Etzel*, ¶¶183-84. Samples 3 and 5 were maintained at ambient temperature, while Samples 4 and 6 were subjected to heat treatment as described in Example 12. Specifically, Samples 4 and 6 were each used to fill five of the same “thin-walled glass vials” described and depicted in Nielsen450. *Etzel*, ¶¶183-84; *see* Ex1007, 100:30-33 (Ex.5), 111:12-13 (Ex.12, describing heat treatment “according to example 5”), Fig. 10. Each vial received 20 ml. *Etzel*, ¶¶183-84. The vials were capped, except for one that was covered with foil to permit temperature measurements while heating. *Id.*, ¶¶183-84. The vials were then immersed in a water bath preequilibrated to 90°C and incubated for five minutes, cooled in ice water for approximately 15 minutes, and incubated at room temperature until the samples reached ambient temperature. *Id.*, ¶¶183-84; Ex1007, 111:13. Samples 3-6 are summarized below:

Sample No.	Protein w/w%	Fat%	pH	Heat treatment	Homogenization
3	3	0.45	7	No	No
4	3	0.45	7	Yes	No
5	3	0.45	7	No	Yes
6	3	0.45	7	Yes	Yes

Etzel, ¶¶183-84.

Denaturation degrees in the heat-treated and untreated beverage samples were then determined according to the same standard procedure designated for that purpose in the '860 patent. *Id.*, ¶185; Ex1001, 14:47-15:32. The results showed that the heat-treated compositions (Samples 4, 6) contained over 70% denatured protein relative to the total protein weight, while unheated compositions (Samples 3, 5) contained minimal denatured protein:

	3%0,45%oil PH 7 - homo - HT	3%0,45%oil PH 7 - homo + HT
Final weight of dilution	49,816	50,004
Weight of solution diluted	24,977	24,998
TKN%	1,26	1,29
DWP%	0,61	0,17
Degree of denaturation	3,4%	73,6%

Sample 3

Sample 4

	3%0,45%oil PH 7 + homo - HT	3%0,45%oil PH 7+ homo + HT
Final weight of dilution	49,9891	50,0803
Weight of solution diluted	25,004	25,0042
TKN%	1,23	1,22
DWP%	0,59	0,14
Degree of denaturation	4%	77%

Sample 5

Sample 6

Etzel, ¶185.

Those results confirmed POSITAs’ reasonable expectation and understanding upon reading Nielsen⁴⁵⁰ that the heat-treated, 3% protein, 0.45% lipid, pH 7.0 composition described in Example 12—prepared and treated in the same way using the same BLG powder—would have contained greater than 50% denatured whey proteins relative to the total weight of protein in the composition, just like Samples 4 and 6. *Id.*, ¶186.

5. Cl.9

As explained in §VII.C.2, Nielsen⁴⁵⁰ incorporated Bertelsen by reference and relied on Bertelsen’s method for preparing BLG powders. And as in §VII.A.2, that method included filtering cheese whey. Sections VII.A.4 and VII.B.3 explained that Bertelsen taught or would have made it obvious to reduce GMP through microfiltration. *Etzel*, ¶187.

6. Cl.11

As discussed in §VII.C.4.g, Examples 11-12 involved heating solutions produced from BLG powder to “90°C for 5 min.” Ex1007, 109:32-110:1, 111:11-13. As POSITAs would have known, 90°C equals 194°F, well above 160°F. *Etzel*, ¶188. POSITAs would have understood and reasonably expected that the five-minute incubation in a 194°F water bath of small-volume samples in thin-walled glass tubes described by Nielsen⁴⁵⁰ would have raised the beverage compositions in those tubes from ambient temperature to at least about 160°F because the heat-treatment step was included to denature BLG in the compositions, and BLG’s denaturation temperature was well known as about 70°C/158°F. *Etzel*, ¶188; Ex1007, 72:14-32. Furthermore, Dr. Etzel’s experiments replicating Examples 11-12 confirmed that understanding by measuring the temperature of the compositions during heat treatment. Dr. Etzel’s experiments confirmed that the samples produced according to Examples 11-12 reached temperatures of 88.3°C and 88.4°C when heated—over 190°F in each case. *Etzel*, ¶189.

7. Cl.12

Nielsen⁴⁵⁰ taught applying high shear simultaneously with heat treatment on the liquid BLG compositions of Examples 11-12 as discussed in Sections VII.C.4.c-VII.C.4.d. Specifically, Nielsen⁴⁵⁰’s heat treatments of BLG liquid solutions “may take place under high shear conditions, e.g. using scraped surface heat exchangers

or similar high shear equipment.” Ex1007, 72:19-20; *see also id.*, 6:4-7; 109:29-110:4; 111:11-13; *Etzel*, ¶¶190-94.

8. Cl.13

As in §VII.C.4.e, Nielsen⁴⁵⁰ taught denatured whey-protein compositions produced using a BLG powder in which native GMP accounted for 1.08% by weight of the total protein in the BLG powder, so POSITAs would have understood that native GMP could have represented no more than 1.08% by weight relative to the total protein in those compositions. *Etzel*, ¶195; Ex1007, 108:20-32 (Table 9).

9. Cl.15

Claim 15 recites a composition with limitations mirroring 8.4-8.7. *Etzel*, ¶196. Claim 15 further recites “greater than 7 wt. % fat.” Ex1001, 24:31.

a. 15.pre-15.2

Nielsen⁴⁵⁰’s Example 12 taught 15.pre, 15.1, and 15.2 for the same reasons as 8.pre, 8.4, and 8.5, respectively. §§VII.C.4.a, VII.C.4.d, VII.C.4.e; *Etzel*, ¶¶196-99.

b. 15.3

As in §VII.C.4.g(ii), Example 12 taught high-protein compositions prepared using BLG powder. Ex1007, 111:1-112:2. Those included one comprising 3% protein and 0.45% lipid, at pH 7.0. *Id.*, (Table 11). The 0.45% lipid specified weight percentage in the composition. *Etzel*, ¶200. As POSITAs would have understood,

the composition's fat content on a dry-weight basis could be determined using information Nielsen⁴⁵⁰ provided. *Id.* Example 12 confirmed the BLG powder used to make the composition was provided in Table 9:

Table 9: Chemical composition of BLG isolate powder A.

Description	A - Dry BLG (w/w%)
BLG	95.9
Ash	0.51
Ca	0.1455
Cl	0.04
Lipid	0.11
K	0.0512
Mg	0.022
Na	0.025
NO ₃	2
NO ₂	0.07
PHO	0.025
Protein	93.97
Dry matter	95.19
pH	5.7

8

Ex1007, 111:3-6, 108:20-32 (Table 9, annotated). That BLG powder contained 93.97w/w% protein and had a dry-matter content of 95.19w/w%. To produce solutions containing 3w/w% protein, the total wt.% of BLG powder included in the solution required dividing 3w/w% by the percentage of protein in the powder (93.97w/w%), which equals 3.19w/w%. *Etzel*, ¶200. Of that 3.19%, 3.04% would be dry matter (3.19×0.9519 , the proportion of total dry matter in the powder). In other words, POSITAs would have recognized that the disclosed BLG solution of

3w/w% protein in Example 12 contained about 3.04w/w% of dry matter from the BLG powder in Table 9. Lipid was added to 0.45w/w% of the solution, resulting in total dry content of 3.49w/w% (3.04+0.45w/w%). *Etzel*, ¶200.

Therefore, POSITAs would have understood that fat content of the composition (3% protein, 0.45% lipid, pH 7.0) in Example 12 was approximately 12.9w/w% fat on a dry basis (i.e., dividing 0.45w/w% by 3.49w/w%), exceeding the 7w/w% recited in 15.3. *Etzel*, ¶201.

c. 15.4-15.5

Nielsen⁴⁵⁰'s Example 12 described 15.4-15.5 for the same reasons as 8.6-8.7, respectively. §§VII.C.4.f-VII.C.4.g; *Etzel*, ¶¶202-03.

10. Cl.16

As in §VII.C.4.d, POSITAs would have recognized that compositions in Example 12 were prepared using BLG powder of Table 9, and that the compositions containing 3% protein and 0.45% lipid would have had about 95.9% BLG and less than 0.5% ALA relative to a total weight of protein. This BLG value exceeded 60wt.% BLG relative to the total weight of protein in the composition. *Etzel*, ¶204.

Additionally, POSITAs would have understood that the same composition from Example 12 met claim 16's alternative limitation requiring at most about 12wt.% ALA relative to the total weight of the protein. The input BLG powder was the sole source of protein in the composition, and that BLG powder contained less

than 0.5wt.% ALA weight relative to the weight of the total protein. *Etz*el, ¶205; *see* Ex1007, 104:20-30, Table 8; §VII.C.2.

11. Cl.17

As in §VII.C.10, POSITAs would have recognized that the composition containing 3% protein, 0.45% lipid in Example 12 contained 95.9% BLG and at most 0.5% ALA by weight of the protein. POSITAs would have understood that meant the BLG-to-ALA weight ratio of that composition was at least 192 ($95.9\% \div 0.5\%$). *Etz*el, ¶¶206-07.

12. Claims 18-20

Claims 18-20 recite particle-size distribution values for compositions of claim 15. Specifically, claim 18 recites a D50 value of less than or about 0.3µm, which POSITAs would have known as 50% of particles being less than or about 0.3µm in size. *Etz*el, ¶¶208-09; Ex1001, 11:8-18. Similarly, claims 19 and 20 recite D10 and D90 values of less than or about 0.1µm and 1µm, which POSITAs would have known as 10% and 90% of particles being less than or about 0.1µm and 1µm in size, respectively. *Etz*el, ¶¶210-11; Ex1001, 10:65-11:7, 11:19-28.

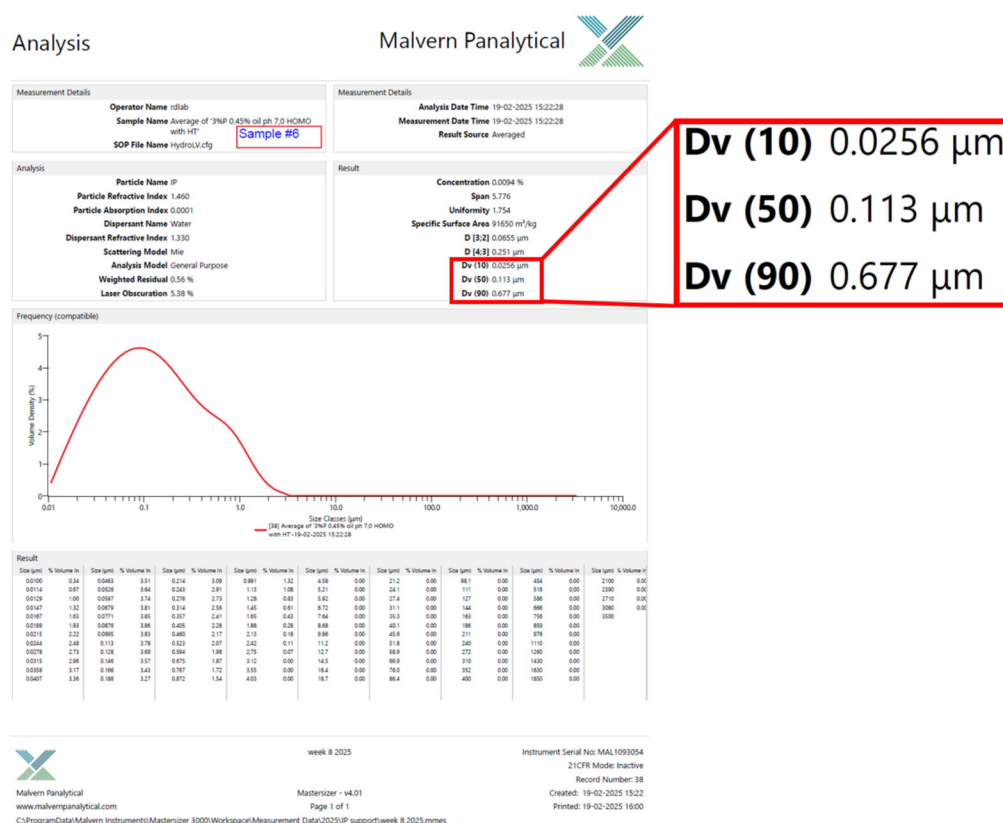
Claims 18-20 would have been obvious over Nielsen⁴⁵⁰'s Example 12. It was well known that particle size could be easily controlled in denatured whey-protein compositions by applying different levels of shear force using known equipment, like a homogenizer. *Etz*el, ¶212. Minimizing particle size in such compositions also

had known benefits, such as reducing satiety, improving suitability for opaque beverages, improving drinkability, facilitating higher protein content in beverages, and improving mouthfeel. *Id.*, ¶213; Ex1007, 37:27-39, 38:1-7, 39:18-27. Nielsen450 linked such benefits to the presence of “submicron sized particles” identified as “nanogels.” *Etzel*, ¶213; Ex1007, 38:1-3. POSITAs reading Nielsen450 thus would have been motivated to prepare beverage compositions with submicron-sized particles. *Etzel*, ¶214.

POSITAs reading Nielsen450 also would have reasonably expected to succeed preparing compositions according to Example 12 having small particles consistent with claims 18-20. Nielsen450 taught that submicron nanogel particles could be prepared using the 95.9% BLG powder used in Example 12. *Id.* ¶215; Ex1007, 104:10-105:22, 108:14-109:24. Additionally, Example 12 expressly suggested incorporating a homogenization step when producing the compositions, Ex1007, 111:15-16, which POSITAs would have known could be used and customized to yield a composition characterized by particles of desired size, such as submicron particles as in claims 18-20, *Etzel*, ¶215.

In addition, Dr. Etzel’s replication of Example 12 bore out that understanding. His testing included measuring particle-size distributions in heat-treated Samples 4 and 6. *Id.*, ¶216. Milk homogenization was and still is common throughout the world. Sample 6 was homogenized using conventional equipment and techniques known

and available by the time of Nielsen450, and Sample 4 was included for comparison of an analogous composition prepared without homogenization. *Id.* The particle-size distributions in Samples 4 and 6 were determined using well-known methods in the art. *Id.* The observed particle-size values in Sample 4 were relatively large, likely indicating detection of coalescing lipid droplets in the non-homogenized sample. *Id.* But with conventional dairy homogenization, Sample 6 had a D10 value of 0.0256 μ m, D50 value of 0.113 μ m, and D90 value of 0.677 μ m, as shown below:



Id. Those values met the limitations of claims 18-20, further supporting the obviousness of those claims in view of the motivation to prepare nanogel-sized

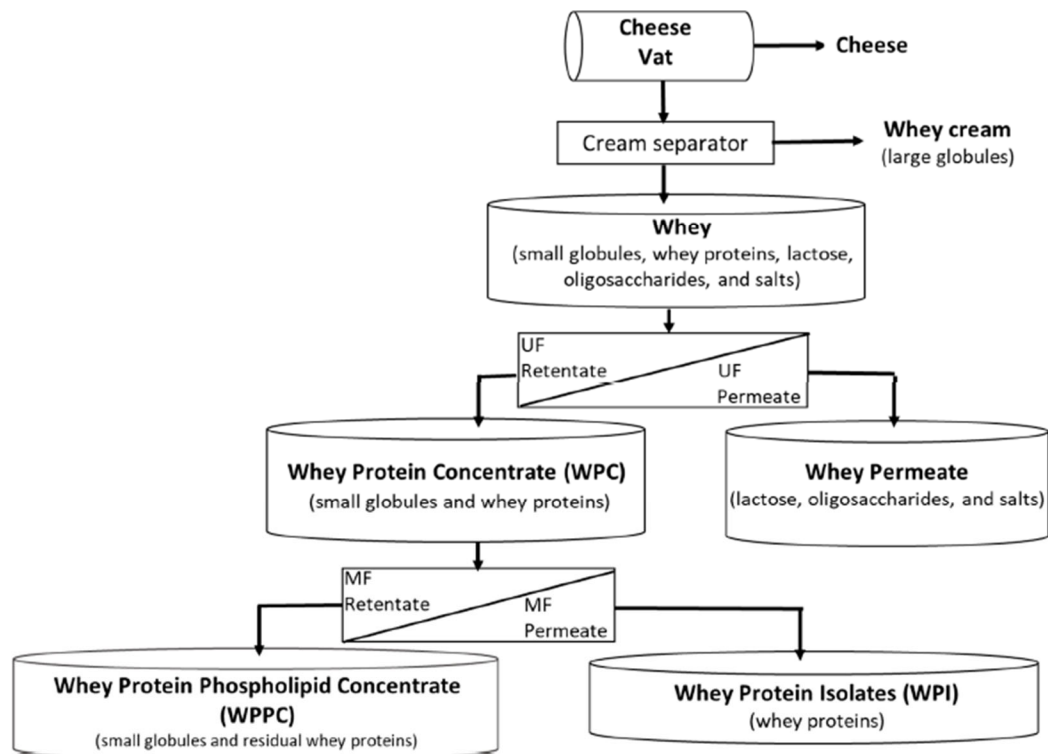
particles and Nielsen⁴⁵⁰'s express suggestions to incorporate homogenization when preparing the compositions in Example 12. *Id.*

D. Ground 4: Obvious Over Ozturk, Kawasaki, and LeanCreme (Claims 8-9, 11-13, 15-17, 20)

1. Ozturk (Ex1008)

Ozturk published on April 20, 2022, in *Dairy*—a peer-reviewed journal on dairy science. Ex1008, 277; *Etzel*, ¶¶217-18; Ex1022, 7-9.

Ozturk described filtration-based processing steps applied to cheese whey to derive several types of concentrated whey-protein compositions. Ex1008, 278-79, Fig. 1. Ozturk confirmed that applying ultrafiltration to cheese whey was “a widely-adopted process used commercially to recover whey protein concentrate (WPC).” *Id.*, 278. To produce higher-purity protein products such as whey protein isolate (WPI), WPC underwent microfiltration “separat[ing] the majority of the whey proteins from the residual fat.” *Id.* Microfiltration of WPC produced WPI and a “co-product known as whey protein phospholipid concentrate (WPPC).” *Id.* Figure 1 showed process steps for manufacturing WPC, WPI, and WPPC from cheese whey:



Ex1008, Fig. 1, 278-79; *Etzel*, ¶219.

WPPC should contain a minimum of 50% protein (dry basis) that consists primarily of whey protein and at least 12% fat (dry basis), and Ozturk aimed to characterize the composition of WPPC. Ex1008, 279; *Etzel*, ¶220. Ozturk assessed commercially available WPPCs by measuring the “total protein, fat, solids as well as protein profile.” Ex1008, 280. Those products contained BLG and ALA among numerous other proteins from the input cheese whey. *Etzel*, ¶220.

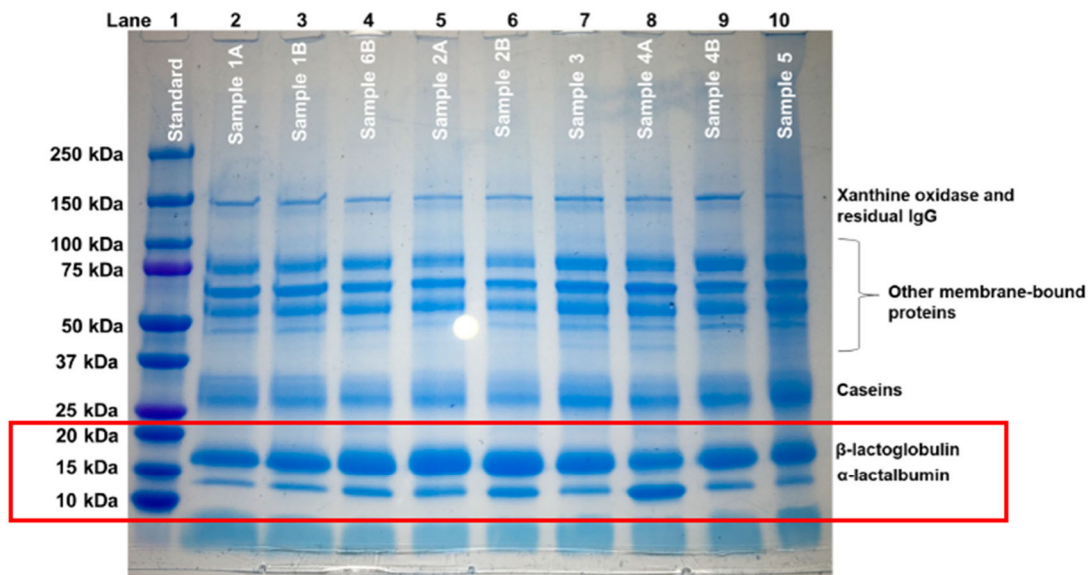


Figure 2. SDS-PAGE profile of whey protein phospholipid concentrate (WPPC) from different manufacturers. Lane 1: standard; Lane 2: sample 1A; Lane 3: sample 1B; Lane 4: sample 6B; Lane 5: sample 2A; Lane 6: sample 2B; Lane 7: sample 3; Lane 8: sample 4A; Lane 9: sample 4B; and Lane 10: sample 5. Annotation based on [57] with the exception of xanthine oxidase and IgG.

Ex1008, Fig. 2 (annotated), 287.

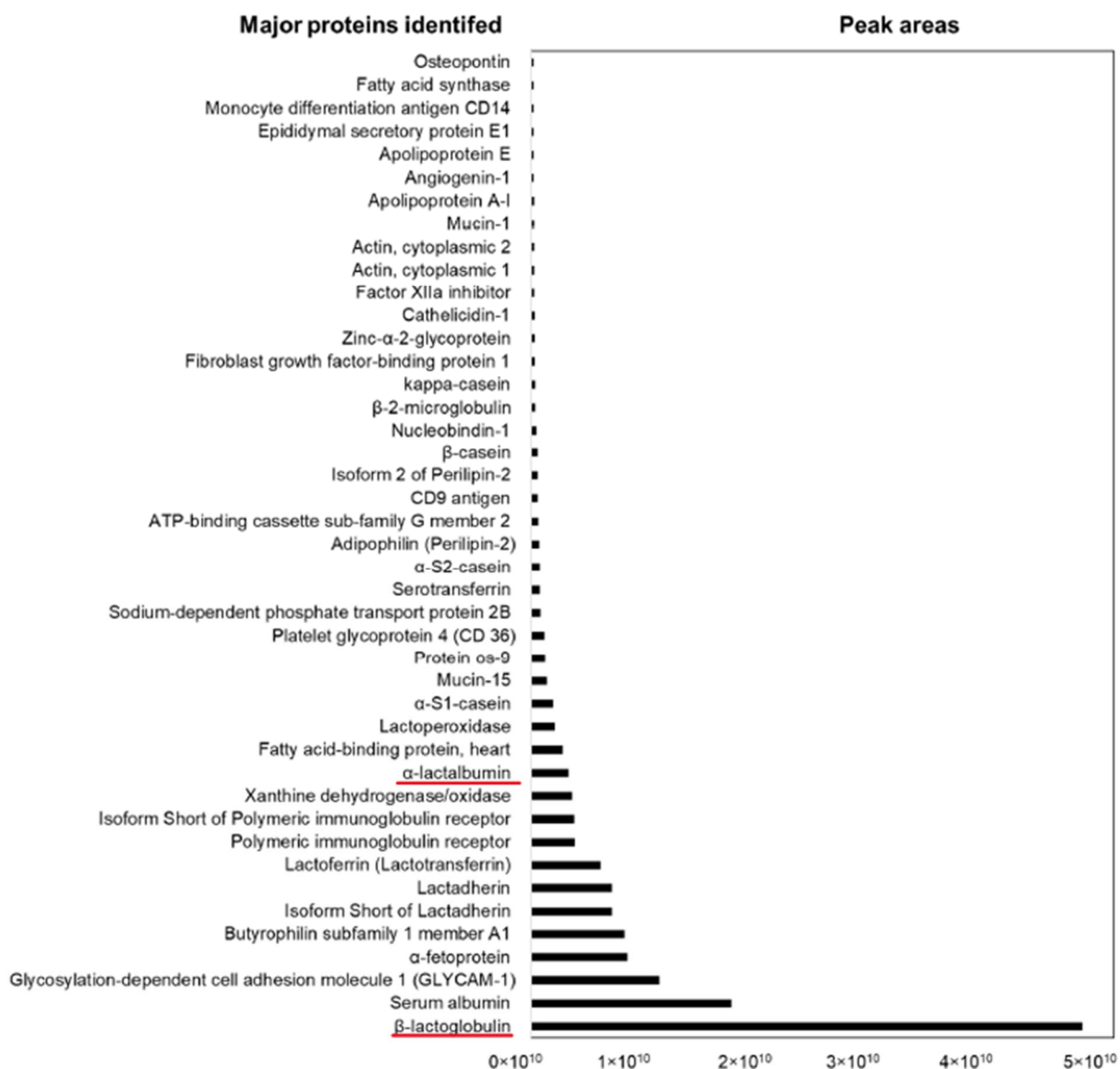


Figure 3. Relative abundance of major proteins identified in WPPC by proteomics.

Ex1008, Fig. 3 (annotated), 289.

2. Kawasaki (Ex1009)

Kawasaki published in *Milk Science International—Milchwissenschaft*, a peer-reviewed dairy-science journal, in 1993.³ *Etzel*, ¶¶221-22; Ex1009, 192-94; Ex1022, 5-7.

Kawasaki taught benefits of using GMP “as an ingredient in dietetic foods and pharmaceuticals” and recognized that cheese whey is “suitable for the production of GMP on an industrial scale.” Ex1009, 191. Several studies had separated GMP from whey proteins (e.g., BLG) by heat coagulation, but those compositions were “inferior to those of whey protein concentrates (WPC) produced by ultrafiltration.” *Id.*, 192. As such, Kawasaki developed filtration methods to isolate GMP. *Id.*, 192-93; *Etzel*, ¶223. Kawasaki’s “simple procedure for isolating GMP from WPC by UF” took advantage of GMP’s pH-dependent change of molecular weight (“MW”). *See* Ex1009, 192-93. Kawasaki found that GMP’s MW was lower at pH 3.5 and higher at pH 7.0. *Id.*, 193, Fig. 2. The change was “completely reversible.” *Id.*, 193; *Etzel*, ¶224.

Figure 3 depicted Kawasaki’s multi-stage ultrafiltration “[p]rocedure to isolate GMP by UF.” Ex1009, 193, Fig. 3. WPC was acidified to reduce GMP’s MW to between 10-30kDa. Ex1009, 192-93, Figs. 1, 3; *Etzel*, ¶225. The WPC was then

³ <https://openjournals.hs-hannover.de/milkscience/about>

filtered through a first ultrafiltration membrane stage (“UF#1”) resulting in retentate (“Retentate #1”) and permeate (“Permeate #1”). *See* Ex1009, 193, Fig. 3. GMP with decreased MW was small enough to pass through the membrane, but “the majority of whey proteins such as β -lactoglobulin, α -lactalbumin, immunoglobulin and bovine serum albumin were rejected by the membrane.” *See id.*, 192-93, Figs. 1, 3; *Etzet*, ¶225. Retentate #1 proceeded through additional ultrafiltration steps (red path annotated Figure 3 below) to produce WPC with reduced GMP, while Permeate #1 proceeded through separate ultrafiltration steps (green path) to produce isolated GMP. *See id.*

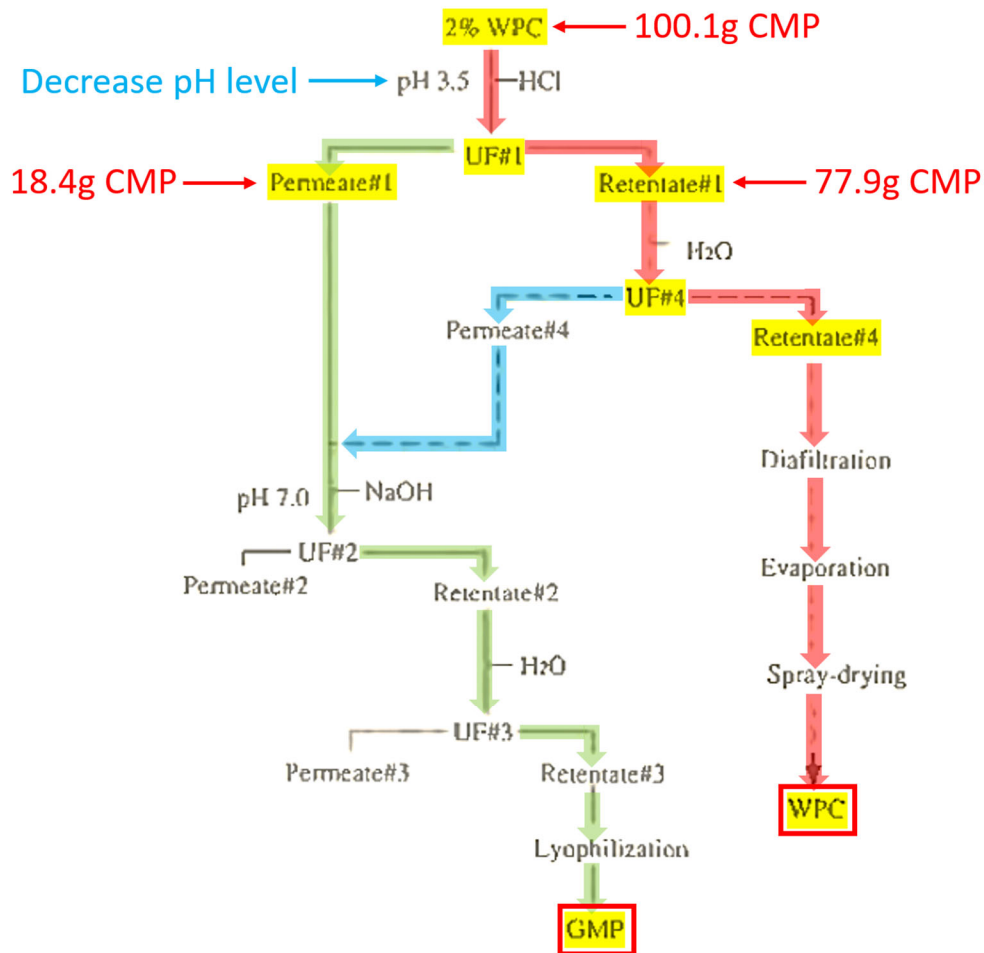


Fig. 3 Procedure to isolate GMP by UF

Ex1009, 192-93, Fig. 3 (annotated); *Etzel*, ¶225.

Kawasaki taught that a single ultrafiltration step at UF#1 using a membrane with 20kDa cutoff (e.g., UF-membrane GR61pp) removed about 22.2% of GMP from the initial WPC solution. *See* Ex1009, 193, Fig. 3, Table 1; *Etzel*, ¶226. Additional ultrafiltration could be performed on Retentate #1 (UF#4) to further remove GMP. Again, GMP passed through the membrane into the permeate

(Permeate #4) which could be mixed with Permeate #1 (blue path in annotated Figure 3) to increase GMP recovery. Ex1009, 193-94; *Etzel*, ¶226.

3. LeanCreme (Ex1010)

SPX Flow, a food-plant manufacturer,⁴ published LeanCreme on its official website by June 26, 2016. *See* Ex1011, 1-3; *Etzel*, ¶¶227-28. LeanCreme described methods and equipment for producing APV LeanCreme—a creamy liquid containing microparticulated whey proteins. Ex1010, 3-4. APV LeanCreme could be tailored to “a long line of different products,” such as drinking yogurts. *See id.*, 3, 22; *Etzel*, ¶228.

WPC was the raw material for producing APV LeanCreme. Ex1010, 5. WPC with added dairy fat could also be used. *Id.*, 8 (“WPC can be mixed with cream prior to the APV LeanCreme™ process”). BLG was the most prominent and important protein in WPC that “determines the overall denaturation kinetics.” *Id.*, 5, Table 1 (BLG representing 48-58% of the total whey protein). LeanCreme’s Figure 2 showed the typical protein composition in sweet whey.

⁴ SPX FLOW spun off from SPX in 2015. <https://www.spxflow.com/about/our-company/>

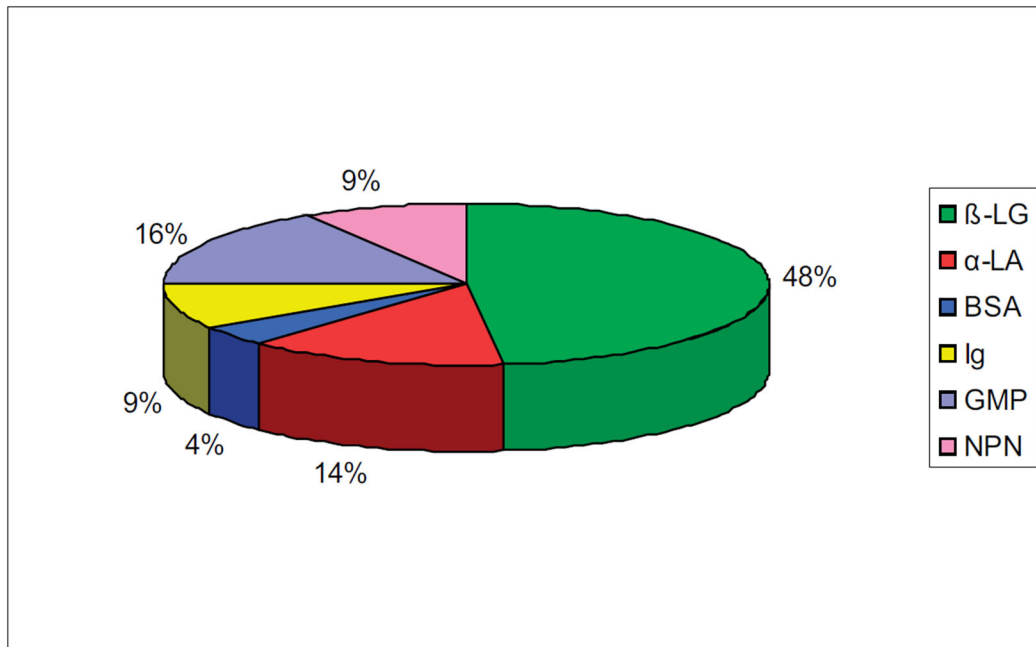


Fig. 2: Typical composition of whey proteins in sweet whey

Ex1010, Fig. 2; *Etzel*, ¶229.

LeanCreme taught it was known to microparticulate whey protein via heat denaturation and mechanical shear separately or by performing them together in a one-step process. Ex1010, 4. “[S]imultaneous heat denaturation of the protein” and “controlled high shear” ensured “production of denatured whey protein particles with the desired smooth mouthfeel instead of a sandy or gritty mouthfeel.” *Id.*, 3-5, 14; *Etzel*, ¶230. According to LeanCreme, whey proteins were known to denature at 60-85°C. Ex1010, 6. Obtaining small particles “normally requires a high denaturation degree” and LeanCreme recommended using a denaturation temperature of 85°C. *Id.*, 7, 15; *Etzel*, ¶230.

LeanCreme also taught that particle-size distribution could be “easily” controlled. Ex1010, 7. For example, mean particle size decreased from 4 μ m to 2.5 μ m by increasing from 35% to 65% of the maximum speed of the dashers in the SSHE.

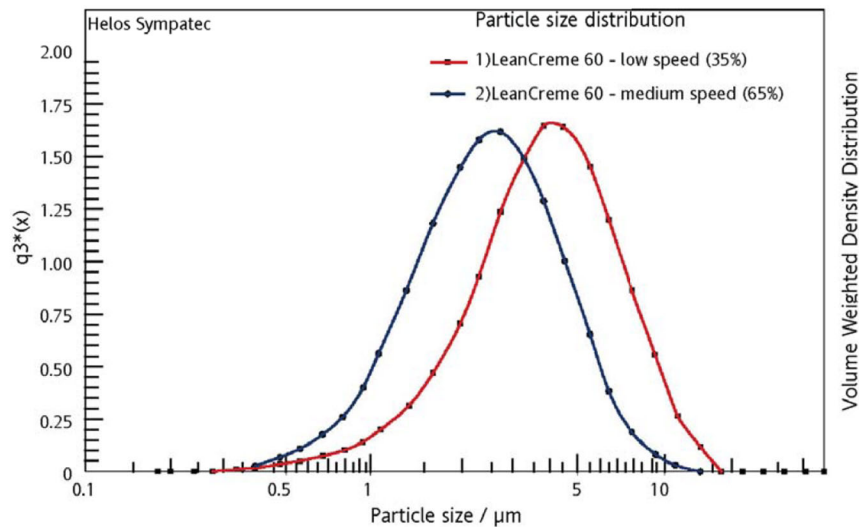


Fig. 3: Particle size distribution of APV LeanCreme™ based on WPC60 with 35% and 65% of max speed respectively

Ex1010, Fig. 3, 13; *Etzel*, ¶231.

4. Motivations to Combine

a. Motivations to Combine Ozturk with Kawasaki

Both references were directed toward the same field of endeavor concerning preparation of protein compositions for food products. *Etzel*, ¶¶232-33.

In addition, Kawasaki taught that GMP⁵ from whey could be useful in certain food products and pharmaceuticals, and POSITAs would have been motivated to separate GMP from Ozturk's WPPC products. *See* Ex1009, 191; *Etzel*, ¶¶234-35. It was well known to POSITAs that purified GMP had certain uses, such as inhibiting the adhesion of strep bacteria to red blood cells and inhibiting “the binding of cholera toxin to its receptor.” Ex1009, 191; *Etzel*, ¶¶234-35.

Additionally, it was well known that products containing GMP were not suitable for certain infants because “high content of the amino acid threonin” in GMP causes infant hyperthreoninemia. *See* Ex1012, 14; *Etzel*, ¶235. Ozturk investigated suitability of whey products for use as functional foods or nutraceuticals, and particularly infant-food products. *See* Ex1008, 293, 288; *see id.*, 289, 290-93. Additionally, GMP contained an undesirable “off-flavor...described as ‘stale’ or ‘chemical’.” *Etzel*, ¶236 (citing Ex1018, 8-9). Indeed, the '860 patent admitted it was known that GMP suffers from disadvantages including being an inferior source of protein for muscle building and imparting an “undesirable flavor” to food products. *See* Ex1001, 1:36-40; *Etzel*, ¶236.

⁵ As explained in §VII.A.3.c, CMP and GMP refer to the same hydrophilic peptide released from kappa-casein.

For all those reasons, POSITAs would have been motivated to separate GMP from Ozturk's WPPC products. Implementing Kawasaki's teachings of filtration techniques in WPPC to remove GMP would have provided benefits to Ozturk's products, such as improving flavor and rendering WPPC more suitable for infant food, and in turn, GMP isolated from WPPC could have been used as an ingredient for adult dietetic foods. *Etzel*, ¶236. The combination would have used a known technique (Kawasaki's GMP isolation process) to improve Ozturk's known product (WPPC) in the same way (filtration-based GMP removal). *KSR*, 550 U.S. at 417; *Etzel*, ¶236.

To the extent PO argues Ozturk did not explicitly teach GMP levels in its WPPC compositions, POSITAs would have known Ozturk's WPPC-production process started with materials containing GMP. For example, Ozturk was directed to "investigat[ing] the composition" of WPPC, which is made from cheese whey. *See* Ex1008, Abstract, 279, Fig.1 (showing whey is produced from cheese vat). It was well known to POSITAs that whey contains GMP. *See* Ex1012, Abstract, 13 ("Whey, therefore, consists of...caseinomacropptide (CMP)"); Ex1013, 325 ("Whey proteins represent approximately 90% of all present milk proteins, the

remaining 10% is represented by casein or caseinomacropeptide (CMP), respectively”)⁶; *Etzel*, ¶237.

POSITAs would have had a reasonable expectation of success with predictable results in combining Ozturk with Kawasaki. *Etzel*, ¶238.

First, Kawasaki is evidence that POSITAs would have known the benefits of separating GMP. *See* Ex1009, 191. Kawasaki is also evidence that POSITAs would have known how to implement ultrafiltration processes to isolate GMP—indeed, Ozturk already used ultrafiltration. *See* Ex1008, 278, 293 (steps (ii) and (iii)), Figure 1 (“UF”); *see* Ex1009, 192-93, Fig. 3; *see also* Ex1012, 14; *see also* Ex1013, Abstract, Table 7, 330-31; *Etzel*, ¶239.

Second, because Kawasaki’s filtration was performed on a whey-protein composition (e.g., WPC), POSITAs would have similarly implemented Kawasaki’s filtration step on the whey-protein phospholipid concentrate (WPPC) in Ozturk. *Compare* Ex1008, Fig. 1, *with* Ex1009 Fig. 3; *Etzel*, ¶240. POSITAs would have had a reasonable expectation of success because the fat and whey proteins in Ozturk’s WPPC had already been retained during an earlier ultrafiltration step and

⁶ Ex1012 (Tolkach) and Ex1013 (Hinkova) are cited to demonstrate POSITAs’ knowledge and/or as evidence supporting motivation to modify Ozturk. *KSR*, 550 U.S. at 420. These exhibits are not part of the unpatentability grounds.

had also been retained during a coarser microfiltration step, *see* Ex1008, Fig. 1, so POSITAs would have expected the proteins and fat in Ozturk's WPPC to be retained during ultrafiltration according to Kawasaki's method while allowing the reduced-size GMP to pass through the filter, *Etzel*, ¶240.

Third, implementing Kawasaki would have called for filtration as depicted in Kawasaki's Figure 3, which produced retentate having reduced GMP. According to Kawasaki, whey proteins (e.g., BLG) were retained in the retentate. Ex1009, 192-93, Fig. 3; *Etzel*, ¶241.

b. Motivations to Combine Ozturk and Kawasaki with LeanCreme

First, all three references were directed toward the same field of endeavor concerning whey-protein compositions for use in food products. *Etzel*, ¶242.

Second, Ozturk taught that whey-protein compositions such as WPPC were readily available as sources of functional compounds and further encouraged using WPPC to "pursue innovations beyond the traditional vision of dairy components used for nutritional purposes." Ex1008, 298. LeanCreme developed "an innovative microparticulation process" that heated whey-protein concentrate under high-shear conditions that denatured whey proteins while forming microparticulated protein aggregates. Ex1010, 4. According to LeanCreme, heating produced stable particles, "partly due to a high degree of denaturation." *Id.*, 20. POSITAs would have been

motivated to modify the reduced-GMP version of WPPC from Ozturk/Kawasaki by further processing it to produce denatured microparticulates as taught by LeanCreme. That would have involved heating the Ozturk/Kawasaki WPPC to between 60-85°C as taught by LeanCreme to achieve “a high degree of denaturation.” *See* Ex1010, 6, 20; *Etzel*, ¶243. The heating process would have been performed simultaneously under high-shear conditions to form fine particles. *See* Ex1010, 3-4, 19; *Etzel*, ¶243.

Third, POSITAs would have reasonably expected success with predictable results in combining LeanCreme with the Ozturk/Kawasaki process because Ozturk/Kawasaki’s WPPC and LeanCreme’s cream-added WPC both had BLG as the dominant whey protein. *Compare* Ex1008 Table 2 (BLG at 30.11%), *with* Ex1010, Table 1 (BLG at 48-58%); *Etzel*, ¶244. According to LeanCreme, BLG was “the most important protein influencing the properties” of protein aggregation and “determines the overall denaturation kinetics.” Ex1010, 5. Although APV LeanCreme contained GMP, GMP does not denature through heat or impede denaturation of other whey proteins. *See id.*, 6 (“GMP cannot be unfolded and denatured.”); Ex1012, 14 (heat treatment of “rennet whey or WPC at 90°C for 1h leads to a complete denaturation and aggregation of whey proteins,” with GMP concentrated by ultrafiltration).

5. Cl.8

a. 8.pre

As in §§VII.D.1, VII.D.3, Ozturk described making WPPC, and LeanCreme taught heat-treating whey-protein compositions to form denatured whey-protein compositions. *See* Ex1008, Abstract, 279-81, 287, 290-91, Figs. 1-3, Table 2; Ex1010, 3-8; *Etzel*, ¶¶245-46. As explained in §VII.D.4, POSITAs would have been motivated to combine these teachings.

b. 8.1

Ozturk taught producing whey protein compositions such as WPPC. Ex1008, Fig. 1, 278-79, 293, Abstract. Ozturk's processes began with cheese whey. *Id.*, Fig. 1, 278-79. Ozturk taught that cheese whey was a "co-product of cheesemaking" using milk. *Id.*, 277-78. It was well known to POSITAs that cheese whey is produced from enzymatically coagulated milk. *Etzel*, ¶¶247-49 (citing Ex1012, 13).

Ozturk's Figure 1 depicted a process for producing WPPC. The first step involved ultrafiltration of cheese whey to produce (1) a retentate, whey protein concentrate (WPC) ("*cheese whey retentate*") containing fat and whey proteins; and (2) a permeate containing lactose, oligosaccharides, and salts. Ex1008, 278-79, 293, Fig. 1; *Etzel*, ¶¶250.

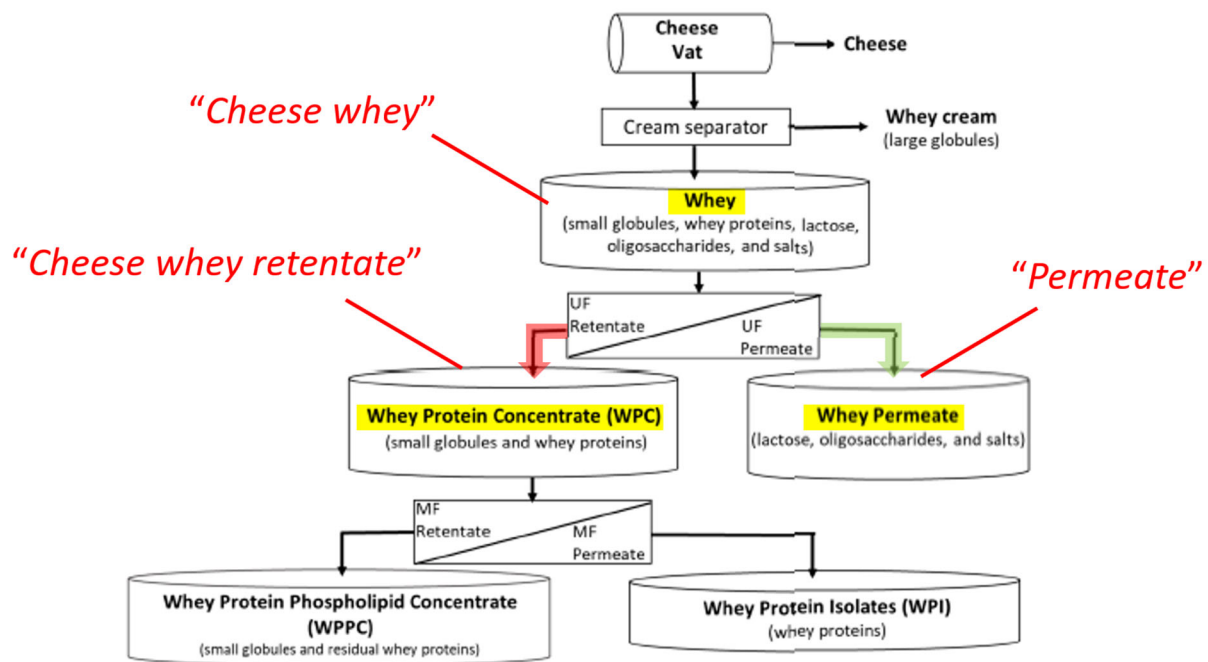


Figure 1. Manufacture of whey protein concentrate and isolate, which results in the accumulation of whey protein phospholipid concentrate (WPPC). Figure adapted from [40].

Ex1008, Fig. 1 (annotated).

Ozturk's ultrafiltration of cheese whey yielding retentate and permeate is consistent with the '860 patent's filtering step 102 to obtain a cheese whey retentate as resulting in the whey feedstock being "filtered 102 from lactose and minerals."

Ex1001, 6:24-28, Fig. 1, 15:44-50; *Etzel*, ¶251.

c. 8.2

As explained in §VII.D.5.b, Ozturk taught ultrafiltering cheese whey to form WPC retentate. Ex1008, Fig. 1, 278-79, 293. WPC was then microfiltered to yield a retentate containing fat and whey proteins (WPPC) and a permeate containing whey proteins (whey protein isolate; WPI). *Id.*

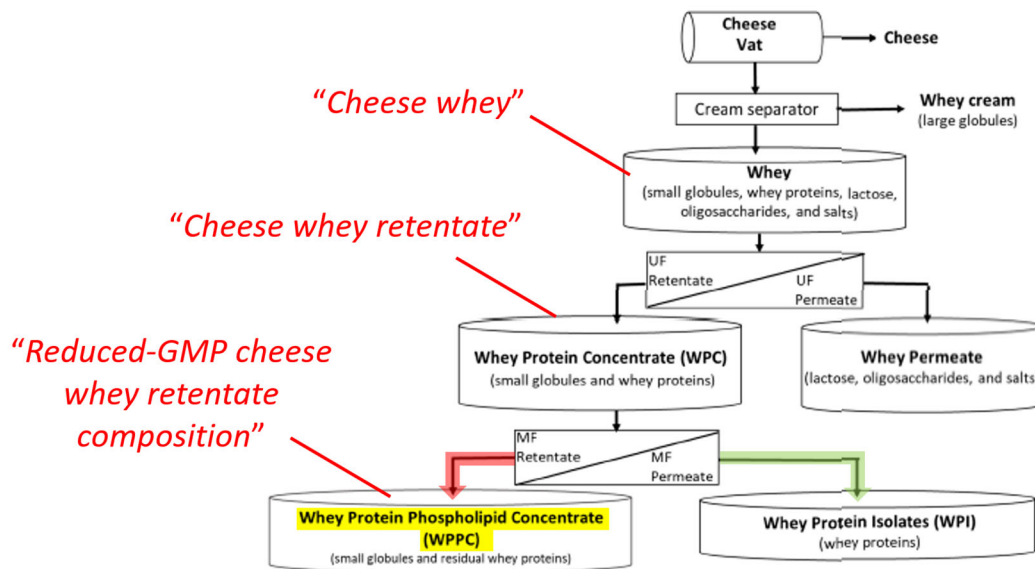


Figure 1. Manufacture of whey protein concentrate and isolate, which results in the accumulation of whey protein phospholipid concentrate (WPPC). Figure adapted from [40].

Ex1008, Fig. 1 (annotated); *Etzel*, ¶¶252-53.

POSITAs would have understood that Ozturk’s microfiltration removed GMP from the WPC retentate, resulting in a WPPC composition having reduced GMP. *Etzel*, ¶254. First, it was known that cheese whey as used for input into Ozturk’s process typically included 12-20% GMP of total whey protein. *Id.*, ¶255 (citing Ex1010, 5, Table 1). Second, undenatured proteins mostly pass through microfiltration membranes while denatured proteins aggregate and, especially denatured BLG, are preferentially retained. *Id.*, ¶256 (citing Ex1014, 12249, 12253, 12255, Fig. 5). Third, as explained in §VII.D.4, GMP cannot be denatured and thus would have passed through the membrane into the permeate. *Id.*, ¶257 (citing Ex1010, 5-7). Ozturk taught that its microfiltration step used “a 0.1 µm pore size”

resulting in accumulation of “residual whey proteins in the microfiltration retentate.” Ex1008, 293. POSITAs would have understood that membranes with “0.1 μ m pore size” would have allowed substantial GMP removal. *Etzel*, ¶257 (citing Ex1013, Table 7 (showing GMP rejection rate is 70.2 ± 7.6 for membranes with 100nm⁷ cut off)).

To the extent that PO argues Ozturk did not teach or suggest reducing GMP levels, POSITAs would have been motivated to modify Ozturk using the GMP-removing techniques taught by Kawasaki to reap the well-known benefits of low-GMP foods and to isolate GMP as a separate ingredient for novel adult food products. *Etzel*, ¶258.

As explained in §§VII.D.2 and VII.D.4, Kawasaki described filtration techniques for removing GMP from WPC. Ex1009, 193-94. Kawasaki’s method involved acidifying the composition and performing ultrafiltration, which removed GMP by rendering its MW small enough to pass through ultrafiltration membranes. *Id.*, 192-93. Kawasaki taught that ultrafiltration with a 20kDa-cutoff filter resulted in most whey proteins being rejected by the membrane, “whereas GMP, lactose, and minerals permeated.” *Id.*, 193. It was well known to POSITAs that WPC contained fat globules and whey proteins. *Etzel*, ¶259 (citing Ex1008, Fig. 1). POSITAs would

⁷ 0.1 μ m equals 100 nm. *Etzel*, ¶257.

also have known that WPPC contained similar complements of whey proteins, and both contained fat. *Etzel*, ¶260. If anything, POSITAs would have expected non-GMP proteins (e.g., BLG) to be more effectively retained in WPPC relative to WPC because WPPC is more enriched for large proteins and denatured proteins than WPC. *Id* (citing Ex1014, Fig. 5 (compare lanes 2 and 3), 12249, 12253, 12255). Therefore, performing ultrafiltration on Ozturk's WPPC using Kawasaki's ultrafiltration techniques would have been expected to remove GMP but retain non-GMP proteins and fat. *Etzel*, ¶261.

POSITAs would have implemented Kawasaki's ultrafiltration procedure into the process depicted in Ozturk's Figure 3. *Etzel*, ¶¶262. Kawasaki taught that acidification to pH 3.5 decreased GMP's molecular weight to between 10 and 30kDa. Ex1009, 192-93, Fig. 3. GMP with decreased MW was small enough to pass through the ultrafiltration membrane, but "the majority of whey proteins such as β -lactoglobulin, α -lactalbumin...were rejected by the membrane." Ex1009, 192-93, Figs. 1, 3; *Etzel*, ¶262. Retentate #1 proceeded through an additional ultrafiltration step (red path in annotated Figure 3 below) to produce WPC having reduced GMP, whereas Permeate #1 proceeded through a separate set of processing steps (green path) to produce GMP isolated from WPC. Ex1009, 192-93, Figs. 1, 3.

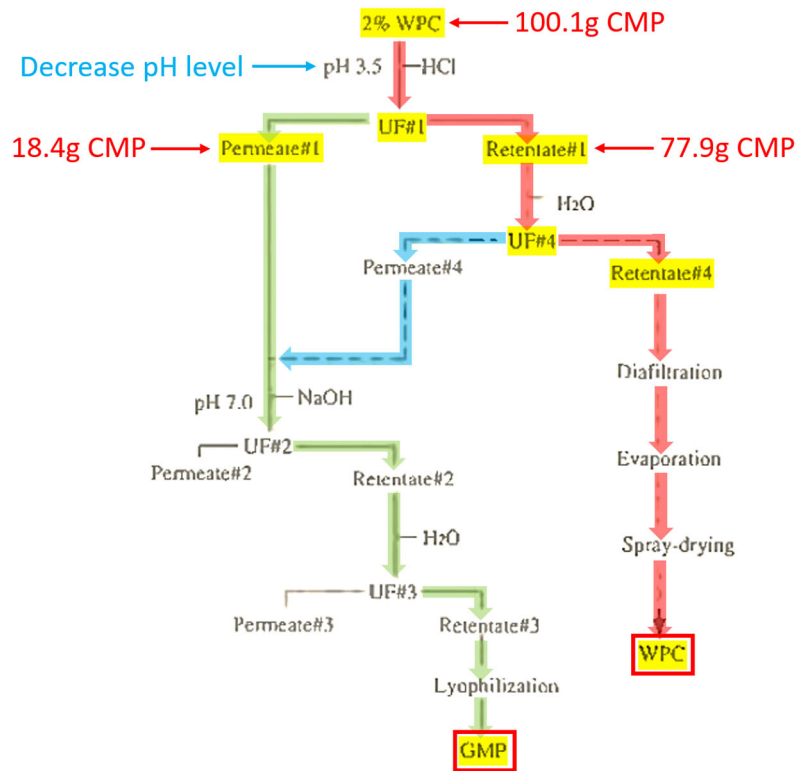


Fig. 3 Procedure to isolate GMP by UF

Ex1009, 192-93, Fig. 3 (annotated); *Etzel*, ¶262. POSITAs would have modified Ozturk by performing Kawasaki's ultrafiltration step on WPPC to obtain reduced-GMP WPPC while retaining the non-GMP proteins and fat in WPPC, as shown in modified and annotated Ozturk Figure 1 below.

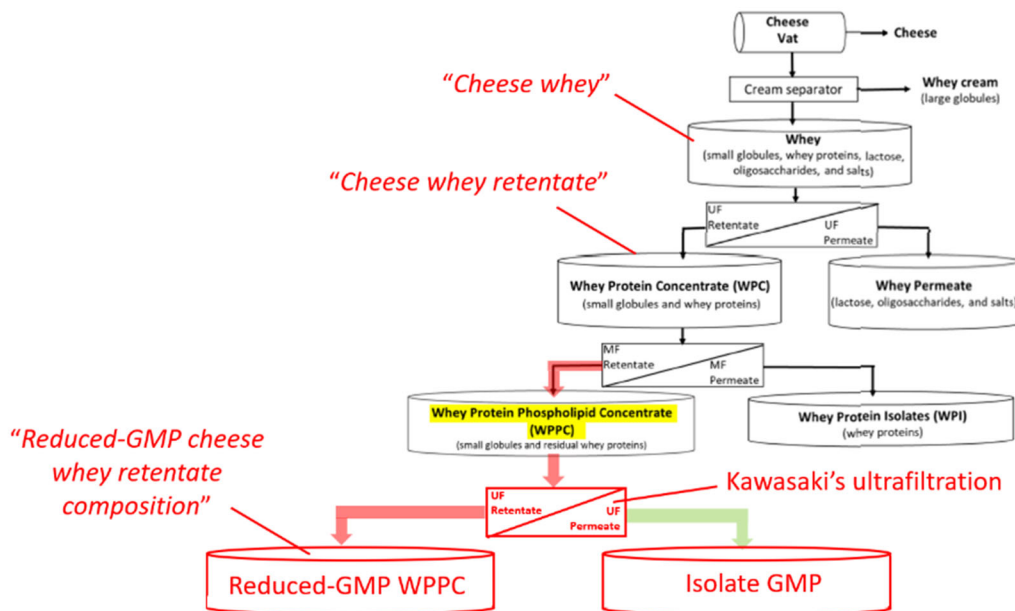


Figure 1. Manufacture of whey protein concentrate and isolate, which results in the accumulation of whey protein phospholipid concentrate (WPPC). Figure adapted from [40].

Ex1008, Fig. 1 (annotated).

POSITAs would have expected Kawasaki's technique to work similarly on Ozturk's WPPC because WPPC and WPC contain similar complements of proteins, and both contain fat. Ex1008, 278-79, 293, Fig. 1; Ex1014, Fig. 5; *Etzel*, ¶263. If anything, POSITAs would have expected non-GMP proteins to be more effectively retained in WPPC relative to WPC because WPPC is more enriched for large proteins and denatured proteins than WPC. Ex1014, Fig. 5 (compare lanes 2 and 3), 12249, 12253, 12255; *Etzel*, ¶263.

POSITAs would have had reasonable expectations of success because according to Kawasaki, fat and proteins (other than GMP) in Ozturk's WPPC would be retained by Kawasaki's 20kDa membrane. Ex1009, 193. Those components had

already been retained during Ozturk's much coarser (0.1 μ m) microfiltration step. Ex1008, 293; *Etzal*, ¶264. In contrast, POSITAs would have expected that GMP in Ozturk's WPPC would convert to smaller effective sizes after acidification and preferentially pass through the Kawasaki filter. Ex1009, 192-93, Fig. 3, Table 1; *Etzal*, ¶264.

d. 8.3

As discussed in §§VII.D.3-VII.D.4, LeanCreme taught denaturing whey protein compositions by applying heat with mechanical shearing. *See* Ex1010, 4-5. LeanCreme disclosed that the composition can be WPC made from sweet whey, but other options can also be used, including WPC mixed with cream (i.e., whey protein compositions with high fat content). *Id.*, 8; *Etzal*, ¶¶265-66.

LeanCreme taught that it was well known to microparticulate whey protein either by separately employing heat denaturation and mechanical shear, or by performing those steps together. *See* Ex1010, 4. “[S]imultaneous heat denaturation of the protein” and “controlled high shear” ensured “production of denatured whey protein particles with the desired smooth mouthfeel instead of a sandy or gritty mouthfeel.” Ex1010, 5, 6; *Etzal*, ¶267.

According to LeanCreme, whey proteins were known to denature at 60-85°C. LeanCreme, 6 (“In general whey proteins denature between 60°C and 85°C (140-185°F) at natural pH”). Obtaining desired small particles “normally requires a high

denaturation degree,” and LeanCreme recommended using a temperature of 85°C. *Id.*, 7, 15. Whey-protein composition affected denaturation degree, and “up to 75% of the protein can be microparticulated” for the composition shown in Figure 2. Ex1010, 7, Fig. 2; *Etzel*, ¶268.

As discussed in §VII.D.4, POSITAs would have been motivated to modify Ozturk/Kawasaki’s WPPC by further processing to produce “novel products” such as APV LeanCreme. Such modification would have involved heating the Ozturk/Kawasaki reduced-GMP WPPC to between 60-85°C as taught by LeanCreme to achieve “a high degree of denaturation.” *See* Ex1010, 6, 20; *Etzel*, ¶269. Heating would have been performed simultaneously under high-shear conditions to form “fine particles with a specific particle size similar to fat globules.” *See* Ex1010, 3-4, 19. Heating provided “very stable particles” because of a high degree of denaturation. *Id.*, 20. Additionally, heating and shearing “ensure[d] production of denatured whey protein particles with the desired smooth mouthfeel.” *Id.*, 5, 9, 11; *Etzel*, ¶269.

e. 8.4

As §§VII.D.1 and VII.D.5.a-VII.D.5.b explained, Ozturk taught ultrafiltering cheese whey to form a WPC retentate. *See* Ex1008, Fig. 1, 278-79, 293. WPC retentate was further processed through microfiltration to yield a retentate (WPPC) and a permeate (WPI). *Id.*; *Etzel*, ¶¶270-71.

Ozturk performed detailed testing to determine gross compositions of WPPC, comparing solids, protein, and fat percentages across samples. *See* Ex1008, Table 1, 280. Particularly, WPPC Sample 6B was a liquid WPPC containing 63.43% protein.⁸ *Id.*, Table 1. “[P]rotein values were converted to dry basis values.” *Id.*

Table 1. Comparison between %solids, %protein, and %fat of the fat globule population measured from all WPPC samples.

Sample Description	Total Solids (%)	Protein (%)	Fat (%)
Sample 1A (liquid)	20.47	65.46 *	27.25 *
Sample 1B (liquid)	21.56	62.15 *	28.10 *
Sample 1 (powder)	-	62.7	24.4
Sample 2A (powder)	-	>72	-
Sample 2B (powder)	-	>73	-
Sample 3 (powder)	-	75.09	18.11
Sample 4A (powder)	-	76.19	13.08
Sample 4B (powder)	-	69.39	16.45
Sample 5 (powder)	-	67.61	-
Sample 6A (powder)	-	52.63	13.08
Sample 6B (liquid)	13.40	63.43	20.20
Bovine milk (liquid)	13	24.92 *	26.92 *

* % Fat and protein values were converted to dry basis values.

Ex1008, Table 1 (annotated); *Etzel*, ¶272; *see also* Ex1001, 4:36-53, 12:35-50, 14:47-15:32, 16:41-47 (discussing and calculating whey-protein content).

Therefore, Ozturk taught that its WPPC contained whey protein of 63.43% on a dry-weight basis, exceeding 60% as the claim recited. *Etzel*, ¶273. As explained below, performing Kawasaki’s GMP-reduction process would have lowered GMP

⁸ Sample 6B’s percentages were missing an asterisk. As Dr. Etzel explained, POSITAs would have understood this to be a clerical oversight. *Etzel*, ¶273.

in Ozturk's WPPC, with the resulting whey protein level remaining above 60%. *Id.* Additionally, heating whey compositions causes protein denaturation but does not alter protein content. *Id.*, ¶274.

Although Ozturk did not explicitly teach GMP levels in the initial whey input prior to ultrafiltration, POSITAs would have known that typical GMP levels in sweet whey ranged from 12%-20% of the total whey protein. *See* Ex1010, Table 1; *Etzel*, ¶275. POSITAs would also have known that GMP of Ozturk's WPPC was below such level due to the microfiltration step. If Ozturk's WPPC had GMP within such range (e.g., 13%) of the total whey protein, the GMP content would constitute 8.24% of the WPPC on a dry-weight basis ($63.43\% \times 0.13 = 8.24\%$ dry basis). *Id.* According to Kawasaki, a single filtration step removed 22.1% of the GMP ($1 - \frac{77.9}{100.1} = 0.221$). *See* Ex1009, 193, Table 1 (retentate #1 maintaining 77.9% of the original GMP content).

Table 1: Recovery of GMP in each fraction during processing from WPC*	
Fraction	Content of GMP (g)
2 % WPC	100.1
Retentate #1	77.9
Permeate #1	18.4
Permeate #2	17.8
Permeate #2	0.1
Retentate #3	17.8
GMP powder	18.0
* GR61pp was employed.	

Ex1009, Table 1 (annotated).

Performing Kawasaki's UF#1 step on Ozturk's WPPC would have removed 22.1% of GMP from WPPC, corresponding to 1.82% of the WPPC's dry matter ($8.24\% \times 0.221 = 1.82\%$). *Etzel*, ¶276. This process would have resulted in a GMP level at 6.42% of dry matter ($8.24\% - 1.82\% = 6.42\%$) and protein at about 61.61% of dry matter ($63.43\% - 1.82\% = 61.61\%$), for a final GMP level of about 10.42% of total protein ($\frac{6.42}{61.61}\% = 10.42\%$). *Id.*

Therefore, performing Kawasaki's GMP-reduction process would have lowered GMP content in Ozturk's WPPC (e.g., from 13% to 10.42%) with the resulting whey-protein level remaining above 60% (e.g., 61.61%). *Etzel*, ¶277.

f. 8.5

As explained in §VII.D.5.e, the Ozturk-Kawasaki-LeanCreme combination taught this limitation because Kawasaki's GMP-reduction process would lower GMP in Ozturk's WPPC to a level below 11% (e.g., from 13% to 10.42%). *Etzel*, ¶¶278-79. Additionally, POSITAs would have reduced GMP to any suitable levels because Kawasaki taught that reiterative filtration steps could be performed to remove additional GMP. POSITAs would have been motivated to perform any number of cycles to remove further GMP as needed. For example, POSITAs would have depleted GMP from WPC using additional ultrafiltration cycles to make the resulting product suitable for infant food. *Id.* POSITAs would have been motivated

to monitor GMP levels at each stage of the process to ensure proper functioning of the filtration system and would have known how to do so based on Kawasaki's teachings. For example, Kawasaki taught that Retentate #1 can undergo ultrafiltration UF#4 (blue path) to further reduce GMP. *See* Ex1009, 193-94, Fig. 3. Indeed, POSITAs would have understood that extra filtration steps using the same membrane would have resulted in additional GMP removal. *Etzet*, ¶280 (citing Ex1015, 4:61-5:14).

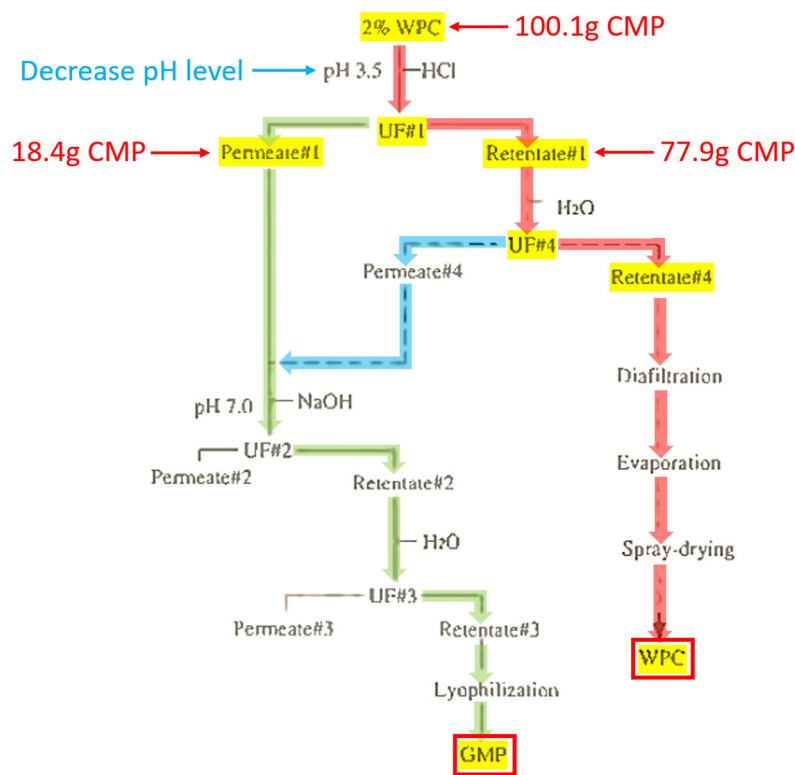


Fig. 3 Procedure to isolate GMP by UF

Ex1009, 192-93, Fig. 3 (annotated).

g. 8.6

Ozturk taught that WPPC had a BLG/ALA ratio of greater than 5. Testing of WPPC sample 6B revealed BLG as 30.11% of total protein and ALA as 2.07% of total protein, resulting in a BLG/ALA ratio of 14.5, exceeding 5.00. *See* Ex1008, 291, Table 2. *Etzel*, ¶¶281-82.

Table 2. Comparative protein results in each sample expressed as the relative percentage of total and relative percentages of the milk fat globule membrane (MFGM), milk, other protein results.

	This Study		Brink et al. (2020)							
	Whey Based		Formula				Cream Based			
	WPPC	MFGM-10	PF	SF	PL-20	BPC-50	BSP2	PLC1	SM2	
MFGM proteins	22.81	10.71	5.06	2.85	24	25.73	23.33	23.93	26.39	
Butyrophilin	5.11	1.65	1.14	0.1	4.99	5.7	5.42	5.44	5.2	
Fatty acid-binding protein	1.75	2.35	1.35	1.03	2.60	4.26	4	4.54	3.18	
GLYCAM-1	7.00	3.94	2.17	1.32	7.16	3.88	3.64	4.52	7.74	
Lactadherin	4.45	1.36	0.1	0.1	5.42	4.93	4.21	4.24	4.26	
Adipophilin (Perilipin-2)	0.44	0.1	0.1	0.1	2.3	3.63	2.94	3.11	3.13	
Platelet glycoprotein 4 (CD36)	0.74	1.21	0.1	0.1	0.1	1.05	1.15	0.1	1.09	
Xanthine oxidase	2.25	0.1	0.1	0.1	1.43	2.28	1.97	1.98	1.79	
Mucin-15	0.90	-	-	-	-	-	-	-	-	
Mucin-1	0.18	-	-	-	-	-	-	-	-	
Milk proteins	43.42	55.64	61.64	68.5	56.5	50.58	51.39	52.4	52.34	
α-lactalbumin	2.07	0.1	1.4	2.65	1.05	1.12	1.2	0.1	1.4	
α-S1-casein	1.22	0.1	8.20	12.23	9.80	9.45	9.90	10.45	9.07	
α-S2-casein	0.48	0.1	8.24	11.92	11.60	10.64	11.24	14.5	10.22	
β-lactoglobulin	30.11	46.29	13.62	14.14	15.30	10.07	13.64	10.69	10.91	
Serum albumin	10.95	7.10	4.58	4.17	1.97	1.70	2.23	1.51	2.03	
β-casein	0.36	0.1	15.05	24.27	16.58	17.5	12.98	13.79	18.51	
Kappa-casein	0.24	0.1	0.1	0.1	0.1	0.1	0.1	1.26	0.1	
Lactoferrin (Lactotransferrin)	3.80	1.75	10.45	1.81	0.1	0.1	1.1	0.1	0.1	
Other proteins	31.32	33.65	33.3	28.65	19.5	76.31	25.28	23.67	21.27	

Milk fat globule membrane. Mucin-15, Mucin-1, and serum albumin values were not reported in the reference paper [70]. GLYCAM-1: glycosylation-dependent cell adhesion molecule 1; WPPC: whey protein phospholipid concentrate; MFGM-10: lactoprotein MFGM-10; PF: premium formula; SF: standard formula; PL-20: lactoprotein PL-20; BPC-50: bovine serum concentrate; BSP2: bovine serum product; PLC1: phospholipid concentrate; and SM2: sweet buttermilk powder.

Ex1008, Table 2 (annotated).

Further, adding Kawasaki's acid ultrafiltration step would not have been expected to materially alter the BLG/ALA ratio. *Etzel*, ¶283. For Kawasaki's ultrafiltration, both ALA and BLG were rejected by the UF membrane (Ex1009, 193), so POSITAs would not have expected any material change in Ozturk's BLG/ALA ratio, much less a change anywhere near enough to reduce the ratio from 14.5 to less than 5. *Id.*

h. 8.7

As explained in §VII.D.5.d, LeanCreme taught denaturing whey protein compositions by simultaneously applying heat with mechanical shearing. *See* Ex1010, 4-5; *Etzet*, ¶¶284-85.

Whey proteins were known to denature at 60-85°C. *See id.*, 6; *see also* Ex1023, 40. Obtaining the desired small particles “normally requires a high denaturation degree” and LeanCreme recommended denaturing at 85°C to achieve this goal. *Id.*, 7, 15. Protein composition affects the denaturation degree, and “up to 75% of the protein can be microparticulated” for the composition of Figure 2. Ex1010, 7, 20, Fig. 2; *Etzet*, ¶286. POSITAs would also have understood that the percentage of 75% was calculated on a weight-ratio basis. *See* Ex1008, 10, 17; *Etzet*, ¶286. As LeanCreme explained, whey-protein microparticulation resulted directly from applying heat and shear simultaneously. *See* Ex1010, 4. “[S]imultaneous heat denaturation of the protein” and “controlled high shear” ensured “production of denatured whey protein particles with the desired smooth mouthfeel instead of a sandy or gritty mouthfeel.” Ex1010, 5, 6; *Etzet*, ¶286.

Accordingly, POSITAs would have found it obvious to apply LeanCreme’s denaturation step to GMP-depleted WPPC to achieve at least 75wt.% denatured whey proteins relative to the total weight of the protein in the denatured whey protein composition. *Etzet*, ¶287.

6. Cl.9

As explained in §VII.D.5.c, POSITAs would have understood that Ozturk's microfiltration would have removed GMP from the WPC retentate resulting in a WPPC having reduced GMP. *Etzel*, ¶¶288-89 (citing Ex1010, 5-7, Table 1; Ex1014, 12249, 12253, 12255, Fig. 5; Ex1008, 293; Ex1013, Table 7 (showing GMP rejection rate of 70.2 ± 7.6 for membranes with 100nm cut-off)).

7. Cl.11

As explained in §VII.D.5.d, the Ozturk-Kawasaki-LeanCreme combination taught this limitation. LeanCreme taught that “whey proteins denature between 60°C and 85°C (140-185°F) at natural pH.” Ex1010, 6. LeanCreme's heat treatment was performed at temperatures between 60°C-85°C, and particularly at 85°C to achieve the smallest particle size. *See id.*, 7 (“The smallest particles are, typically produced around 85°C (185°F), depending on other factors.”) 85°C equals 185°F and exceeds 160°F. *Etzel*, ¶¶290-91.

8. Cl.12

As explained in §VII.D.5.c, Ozturk alone or in combination with Kawasaki taught a “*reduced-GMP cheese whey retentate composition*.” LeanCreme further taught claim 12's remaining limitations. *Etzel*, ¶¶292-93.

LeanCreme's whey-protein microparticulation resulted from applying heat and shear simultaneously. *See* Ex1010, 4. “[S]imultaneous heat denaturation of the

protein” and “controlled high shear” ensured “production of denatured whey-protein particles with the desired smooth mouthfeel.” Ex1010, 3, 5-6; *Etzel*, ¶294. Although LeanCreme did not expressly teach a specific shear rate for its “controlled high shear,” POSITAs would have known to denature whey-protein solutions using shear rates exceeding $1,000\text{s}^{-1}$. For example, POSITAs knew that denaturing whey proteins under high temperature (e.g., $80\text{-}120^{\circ}\text{C}$) and high shear could include “450,000 to 600,000 and usually about 500,000 reciprocal minutes.”⁹ Ex1016, 17:7-11. POSITAs would have understood that shear rates such as $8,333\text{s}^{-1}$ were examples of high-shear conditions. *Etzel*, ¶294. Indeed, the ’860 patent itself acknowledged that “[m]echanical shear conditions as used herein generally refer to high shear conditions in which at least about $1,000\text{s}^{-1}$ of shear is applied...” Ex1001, 8:66-9:1. As another example, heating performed simultaneously with high-mechanical shearing caused denaturation of whey proteins (e.g., BLG) and converted whey-protein gels to whey-protein microparticles. *See* Ex1017, 1:14-19, 7:4-10, 13:31-36, 14:15-20, 18:14-36, 51:10-12. *Etzel*, ¶294.

9. Cl.13

As explained in §VII.D.5.f, the Ozturk-Kawasaki combination taught claim 13’s additional limitations. *Etzel*, ¶¶295-96.

⁹ 500,000 reciprocal minutes equals about $8,333\text{s}^{-1}$. *Etzel*, ¶294.

10. Cl.15

Claim 15 recites a whey protein composition with limitations mirroring those recited in 8.4-8.7. *Etzel*, ¶297. Claim 15 further requires the composition to comprise “greater than 7 wt. % fat.” Ex1001, 24:31.

a. 15.pre-15.2

The Ozturk-Kawasaki-LeanCreme combination taught 15.pre, 15.1, and 15.2 for the same reasons as 8.pre, 8.4, and 8.5, respectively. §§VII.D.5.a, VII.D.5.e, VII.D.5.f; *Etzel*, ¶¶298-300.

b. 15.3

Ozturk tested WPPC samples to determine their compositions and compared solids, protein, and fat percentages across samples. *See* Ex1008, Table 1, 280. WPPC Sample 6B was a liquid WPPC containing 20.20% fat¹⁰, which exceeded 7%. *Id.*, Table 1. The “[f]at and protein values were converted to dry basis values.” *Id.*

¹⁰ *See supra*, footnote 8.

Table 1. Comparison between %solids, %protein, and %fat of the fat globule population measured from all WPPC samples.

Sample Description	Total Solids (%)	Protein (%)	Fat (%)
Sample 1A (liquid)	20.47	65.46 *	27.25 *
Sample 1B (liquid)	21.56	62.15 *	28.10 *
Sample 1 (powder)	-	62.7	24.4
Sample 2A (powder)	-	>72	-
Sample 2B (powder)	-	>73	-
Sample 3 (powder)	-	75.09	18.11
Sample 4A (powder)	-	76.19	13.08
Sample 4B (powder)	-	69.39	16.45
Sample 5 (powder)	-	67.61	-
Sample 6A (powder)	-	52.63	13.08
Sample 6B (liquid)	13.40	63.43	20.20
Bovine milk (liquid)	13	24.92 *	26.92 *

* % Fat and protein values were converted to dry basis values.

Ex1008, Table 1 (annotated); *Etzel*, ¶¶301-02. The composition percentages of solid, protein, and fat are calculated based on weight percentages. *Etzel*, ¶¶301-02.

c. 15.4-15.5

The Ozturk-Kawasaki-LeanCreme combination described 15.4-15.5 for the same reasons as 8.6-8.7, respectively. §§VII.D.5.g, VII.D.5.h; *Etzel*, ¶¶303-04.

11. Cl.16

Ozturk taught that WPPC samples had ALA contents below 12 wt.% of the total protein weight. *Etzel*, ¶¶305-06. Testing of Ozturk's WPPC revealed ALA as 2.07% of total protein, lower than 12%. See Ex1008, 291, Table 2; *Etzel*, ¶¶305-06. As Dr. Etzel explained, the comparative protein results listed in Table 2 of Ozturk are based on weight percentages. *Etzel*, ¶¶305-06.

Table 2. Comparative protein results in each sample expressed as the relative percentage of total and relative percentages of the milk fat globule membrane (MFGM), milk, other protein results.

	This Study		Brink et al. (2020)							
	Whey Based		Formula				Cream Based			
	WPPC	MFGM-10	PF	SF	PL-20	BPC-50	BSP2	PLC1	SM2	
MFGM proteins	22.81	10.71	5.06	2.85	24	25.73	23.33	23.93	26.39	
Butyrophilin	5.11	1.65	1.14	0.1	4.99	5.7	5.42	5.44	5.2	
Fatty acid-binding protein	1.75	2.35	1.35	1.03	2.60	4.26	4	4.54	3.18	
GLYCAM-1	7.00	3.94	2.17	1.32	7.16	3.88	3.64	4.52	7.74	
Lactadherin	4.45	1.36	0.1	0.1	5.42	4.93	4.21	4.24	4.26	
Adipophilin (Perilipin-2)	0.44	0.1	0.1	0.1	2.3	3.63	2.94	3.11	3.13	
Platelet glycoprotein 4 (CD36)	0.74	1.21	0.1	0.1	0.1	1.05	1.15	0.1	1.09	
Xanthine oxidase	2.25	0.1	0.1	0.1	1.43	2.28	1.97	1.98	1.79	
Mucin-15	0.90	-	-	-	-	-	-	-	-	
Mucin-1	0.18	-	-	-	-	-	-	-	-	
Milk proteins	45.42	55.64	61.64	68.5	56.5	50.58	51.39	52.4	52.34	
α-lactalbumin	2.07	0.1	1.4	2.65	1.05	1.12	1.2	0.1	1.4	
α-S1-casein	1.22	0.1	8.20	12.23	9.80	9.45	9.90	10.45	9.07	
α-S2-casein	0.48	0.1	8.24	11.92	11.60	10.64	11.24	14.5	10.22	
β-lactoglobulin	30.11	46.29	13.62	14.14	15.30	10.07	13.64	10.69	10.91	
Serum albumin	10.95	7.10	4.58	4.17	1.97	1.70	2.23	1.51	2.03	
β-casein	0.36	0.1	15.05	24.27	16.58	17.5	12.98	13.79	18.51	
Kappa-casein	0.24	0.1	0.1	0.1	0.1	0.1	0.1	1.26	0.1	
Lactoferrin (Lactotransferrin)	3.80	1.75	10.45	1.81	0.1	0.1	1.1	0.1	0.1	
Other proteins	31.32	33.65	33.3	28.65	19.5	76.31	25.28	23.67	21.27	

Milk fat globule membrane. Mucin-15, Mucin-1, and serum albumin values were not reported in the reference paper [70]. GLYCAM-1: glycosylation-dependent cell adhesion molecule 1; WPPC: whey protein phospholipid concentrate; MFGM-10: lactoprotein MFGM-10; PF: premium formula; SF: standard formula; PL-20: lactoprotein PL-20; BPC-50: bovine serum concentrate; BSP2: bovine serum product; PLC1: phospholipid concentrate; and SM2: sweet buttermilk powder.

Ex1008, Table 2 (annotated).

12. Cl.17

Ozturk taught that the WPPC's BLG/ALA ratio was greater than 5. Ozturk's testing revealed BLG as 30.11% of total protein and ALA as 2.07% of total protein, resulting in a BLG/ALA ratio of 14.5, exceeding 5. *See* Ex1008, 291, Table 2; *Etzel*, ¶¶307-08. As explained in §VII.D.11, the comparative protein results listed in Table 2 of Ozturk were based on weight percentages.

Table 2. Comparative protein results in each sample expressed as the relative percentage of total and relative percentages of the milk fat globule membrane (MFGM), milk, other protein results.

	This Study		Brink et al. (2020)							
	Whey Based		Formula				Cream Based			
	WPPC	MFGM-10	PF	SF	PL-20	BPC-50	BSP2	PLC1	SM2	
MFGM proteins	22.81	10.71	5.06	2.85	24	25.73	23.33	23.93	26.39	
Butyrophilin	5.11	1.65	1.14	0.1	4.99	5.7	5.42	5.44	5.2	
Fatty acid-binding protein	1.75	2.35	1.35	1.03	2.60	4.26	4	4.54	3.18	
GLYCAM-1	7.00	3.94	2.17	1.32	7.16	3.88	3.64	4.52	7.74	
Lactadherin	4.45	1.36	0.1	0.1	5.42	4.93	4.21	4.24	4.26	
Adipophilin (Perilipin-2)	0.44	0.1	0.1	0.1	2.3	3.63	2.94	3.11	3.13	
Platelet glycoprotein 4 (CD36)	0.74	1.21	0.1	0.1	0.1	1.05	1.15	0.1	1.09	
Xanthine oxidase	2.25	0.1	0.1	0.1	1.43	2.28	1.97	1.98	1.79	
Mucin-15	0.90	-	-	-	-	-	-	-	-	
Mucin-1	0.18	-	-	-	-	-	-	-	-	
Milk proteins	45.42	55.64	61.64	68.5	56.5	50.58	51.39	52.4	52.34	
α-lactalbumin	2.07	0.1	1.4	2.65	1.05	1.12	1.2	0.1	1.4	
α-S1-casein	1.22	0.1	8.20	12.23	9.80	9.45	9.90	10.45	9.07	
α-S2-casein	0.48	0.1	8.24	11.92	11.60	10.64	11.24	14.5	10.22	
β-lactoglobulin	30.11	46.29	13.62	14.14	15.30	10.07	13.64	10.69	10.91	
Serum albumin	10.95	7.10	4.58	4.17	1.97	1.70	2.23	1.51	2.03	
β-casein	0.36	0.1	15.05	24.27	16.58	17.5	12.98	13.79	18.51	
Kappa-casein	0.24	0.1	0.1	0.1	0.1	0.1	0.1	1.26	0.1	
Lactoferrin (Lactotransferrin)	3.80	1.75	10.45	1.81	0.1	0.1	1.1	0.1	0.1	
Other proteins	31.32	33.65	33.3	28.65	19.5	76.31	25.28	23.67	21.27	

Milk fat globule membrane. Mucin-15, Mucin-1, and serum albumin values were not reported in the reference paper [70]. GLYCAM-1: glycosylation-dependent cell adhesion molecule 1; WPPC: whey protein phospholipid concentrate; MFGM-10: lactoprotein MFGM-10; PF: premium formula; SF: standard formula; PL-20: lactoprotein PL-20; BPC-50: bovine serum concentrate; BSP2: bovine serum product; PLC1: phospholipid concentrate; and SM2: sweet buttermilk powder.

Ex1008, Table 2 (annotated).

13. Cl.20

As in §VII.D.5.d, LeanCreme taught heating to form “fine particles with a specific particle size similar to fat globules,” and that “[o]ptimal particle size depends on the application and can be varied.” See Ex1010, 3-4, 9, 19. LeanCreme’s “mean particle size must be minimum 0.5-1 micron and maximum 7-10 micron,” preferably combined with a “narrow distribution.” *Id.*, 9. LeanCreme’s particle sizes were within the size range of fresh raw bovine milk and WPPC which ranged from smaller (e.g., about 0.5µm) to larger fat globules.

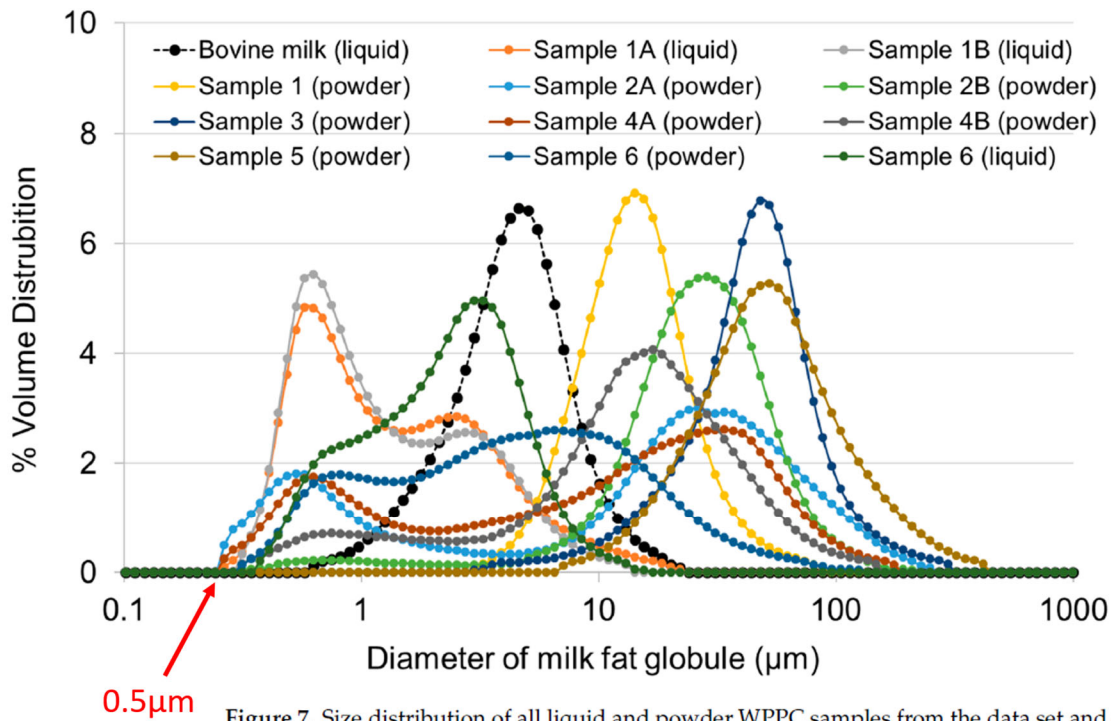


Figure 7. Size distribution of all liquid and powder WPPC samples from the data set and comparison with fresh raw bovine milk.

See Ex1008, Fig. 7 (annotated); *Etzel*, ¶309.

POSITAs would have been motivated to keep most particles (e.g., D90) under 1 μm. First, LeanCreme’s mean particle size must be at minimum 0.5-1 μm and kept at “a narrow distribution” with a bell-shaped curve. Ex1010, 9. POSITAs would have understood such distribution for a mean particle size such as 0.5 μm would have resulted in D90 under 1 μm or less. Second, “particle size similar to fat globules” led to customers’ perception of “creaminess,” and fat globules can be as small as 0.5 μm as taught by Ozturk. Third, smaller particle sizes were beneficial because larger particle sizes would have led to undesirable “gritty and mealy mouthfeel.” Ex1010, 5, 9; *Etzel*, ¶¶310-13.

POSITAs would have also known how to achieve low particle sizes because LeanCreme taught decreasing particle size by, for example, increasing shear rate. *See* Ex1010, 11, 14, Fig. 9, 13, Table 5; *Etzel*, ¶314.

VIII. CONCLUSION

IPR and cancellation of the challenged claims are respectfully requested.¹¹

IX. MANDATORY NOTICES

A. Real Party in Interest

Arla identifies itself as the real party-in-interest.

B. Related Matters

To the best of Petitioner's knowledge, the '860 patent has been involved in no prior matters.

¹¹ Currently, the memorandum on interim processes for PTAB workload management applies, and the Office has stated the petition should not address discretionary issues; instead, those issues should be raised in opposition to PO's discretionary denial brief (if filed). *See* Coke Stewart, Interim Processes for PTAB Workload Mgmt. (Mar. 26, 2025), and FAQs, <https://www.uspto.gov/patents/ptab/faqs/interim-processes-workload-management>.

C. Notice of Counsel and Service Information

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Petitioner consents to electronic service. All services and communications to the attorneys listed above may be sent to: Arla- LeprinoIPR@perkinscoie.com.

D. Power of Attorney

A power of attorney is filed herewith according to 37 C.F.R. §42.10(b).

Respectfully submitted,

/ Jessica Kaiser /

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Date: July 15, 2025

CERTIFICATE OF WORD COUNT UNDER 37 C.F.R. §42.24(d)

Petitioner hereby certifies under 37 C.F.R. §42.24(a) that the number of words in this petition for *inter partes* review of U.S. Patent No. 11,825,860, in accordance with and reliance on the word count provided by the word-processing system used to prepare this petition, is 13,472. Pursuant to 37 C.F.R. §42.24(a), this word count excludes the table of contents, table of authorities, mandatory notices under §42.8, certificate of service, certificate of word count, appendix of exhibits, and any claim listing. This word count was prepared using Microsoft Word.

Respectfully submitted,

/ Jessica Kaiser /

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that true copies of the Petition for *inter partes* review of U.S. Patent No. 11,825,860 and supporting materials (Exhibits and Power of Attorney) were served via overnight delivery on the Patent Owner at the correspondence address of record as listed on the PTO's Patent Center:

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Respectfully submitted,

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