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FAO JECFA Monographs 5



COMPENDIUM OF FOOD ADDITIVE SPECIFICATIONS

Joint FAO/WHO Expert Committee on Food Additives

69th meeting 2008

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2008

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Rome, 17 – 26 June, 2008

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INTRODUCTION

This volume of FAO JECFA Monographs contains specifications of identity and purity prepared at the 69th meeting of the Joint FAO/WHO Expert Committee on Food Additives (JECFA), held in Rome on 17-26 June 2008. In addition, a revised analytical method of assay of nickel in polyols was prepared and included in this publication. The specifications monographs are one of the outputs of JECFA's risk assessment of food additives, and should be read in conjunction with the safety evaluation, reference to which is made in the section at the head of each specifications monograph. Further information on the meeting discussions can be found in the summary report of the meeting (see Annex 1), and in the full report which will be published in the WHO Technical Report series. Toxicological monographs of the substances considered at the meeting will be published in the WHO Food Additive Series.

Specifications monographs prepared by JECFA up to the 65th meeting, other than specifications for flavouring agents, have been published in consolidated form in the Combined Compendium of Food Additive Specifications which is the first publication in the series FAO JECFA Monographs. This publication consist of four volumes, the first three of which contain the specifications monographs on the identity and purity of the food additives and the fourth volume contains the analytical methods, test procedures and laboratory solutions required and referenced in the specifications monographs. FAO maintains an on-line searchable database of all JECFA specifications monographs from the FAO JECFA Monographs, which is available at: http://www.fao.org/ag/agn/jecfa-additives/search.html . The specifications for flavourings evaluated by JECFA, and previously published in FAO Food and Nutrition Paper 52 and subsequent Addenda, are included in a database for flavourings (flavouring agent) specifications which has been updated and modernized. All specifications for flavourings that have been evaluated by JECFA since its 44th meeting, including the 69th meeting, are available in the new format online searchable database at the JECFA website at FAO: http://www.fao.org/ag/agn/jecfa-flav/search.html. The databases have query pages and background information in English, French, Spanish, Arabic and Chinese. Information about analytical methods referred to in the specifications is available in the Combined Compendium of Food Additive Specifications (Volume 4), which can be accessed from the query pages.

An account of the purpose and function of specifications of identity and purity, the role of JECFA specifications in the Codex system, the link between specifications and methods of analysis, and the format of specifications, are set out in the Introduction to the Combined Compendium, which is available in shortened format online on the query page, which could be consulted for further information on the role of specifications in the risk assessment of additives.

Chemical and Technical Assessments (CTAs) for some of the food additives have been prepared as background documentation for the meeting. These documents are available online at: http://www.fao.org/ag/agn/agns/jecfa_archive_cta_en.asp .

Contact and Feedback

More information on the work of the Committee is available from the FAO homepage of JECFA at: http://www.fao.org/ag/agn/agns/jecfa_index_en.asp . Readers are invited to address comments and questions on this publication and other topics related to the work of JECFA to:

jecfa@fao.org

SPECIFICATIONS FOR CERTAIN FOOD ADDITIVES

New and revised specifications

New (N) or revised (R) specifications monographs were prepared for the following food additives and these are provided in this publication:

Asparaginase from *Aspergillus niger* expressed in *A. niger* (N)
Calcium lignosulfonate (40-65) (N)
Carob bean gum (R)
Carob bean gum (clarified) (R)
Ethyl lauroyl arginate (N)
Guar gum (R)
Guar gum (clarified) (R)
Iron oxides (R)
Isomalt (R)
Monomagnesium phosphate (N)
Paprika extract (N) Tentative
Patent Blue V (R)
Phospholipase C expressed in *Pichia pastoris* (N)
Phytosterols, phytostanols and their esters (N)
Polydimethylsiloxane (R)
Sunset Yellow FCF (R)
Steviol glycosides (R)
Trisodium diphosphate (N)

In the specifications monographs that have been assigned a tentative status, there is information on the outstanding information and a timeline by which this information should be submitted to the FAO JECFA Secretariat.

In addition to these specifications monographs, minor revisions were made to the specifications monographs for the food additives Canthaxanthin, Chlorophyllins, copper complexes sodium and potassium salts and Fast Green FCF. The Committee decided that republication in the FAO JECFA Monongraphs of these specifications monographs were not necessary.

Canthaxanthin: The Committee was made aware that in the specifications for canthaxanthin, the wording of the criterion for the assay could be misinterpreted. The Committee decided to change the original text “Not less than 96% of total colouring matters (expressed as canthaxanthin)” in the electronic version of the specifications on the FAO JECFA website to read: “Not less than 96% total colouring matters (expressed as canthaxanthin).”

Chlorophyllins, copper complexes sodium and potassium salts: The Committee was informed that the Colour Index (C.I.) International number in the specifications for chlorophyllin, copper complexes sodium and potassium salts was incorrectly stated. The Committee decided to include the correct number, C.I. No. 75815, in the electronic version of the specifications on the FAO JECFA website.

Fast Green FCF: The Committee was informed that an error had been introduced into the specification for Fast Green FCF published in the Combined Compendium of Food Additive Specifications (2005) when the text from FAO Food and Nutrition Paper 52 was transcribed. The value for absorptivity in the determination of the quantity of leuco base was corrected to read 0.156 in the electronic version of the specifications on the FAO JECFA website.

2

New and revised INS numbers assigned to food additives by the Codex Alimentarius Commission at its 31st session in 2008, (ALINORM 08/31/12, Appendix XII) have been introduced in the corresponding JECFA food additive specifications monographs in the on-line database, as appropriate, and these are not reproduced in this publication.

The chemical abstract numbers (C.A.S.) for the food additive Dicalcium pyrophosphate has been revised to 7790-76-3 in the specifications monographs in the on-line database and is not reproduced in this publication.

ASPARAGINASE from *ASPERGILLUS NIGER* expressed in *A. NIGER*

New specifications prepared at the 69th JECFA (2008), published in FAO JECFA Monographs 5 (2008). An ADI "not specified" was established at the 69th JECFA (2008).

SYNONYMS Asparaginase II; L-asparaginase; α-asparaginase

SOURCES Asparaginase is produced by submerged fed-batch fermentation of a genetically modified strain of *Aspergillus niger* which contains the asparaginase gene derived from *A. niger*. The enzyme is isolated from the fermentation broth by filtration to remove the biomass and concentrated by ultrafiltration. The enzyme concentrate is subjected to germ filtration and is subsequently formulated and standardized to the desired activity using food-grade compounds.

Active principles: Asparaginase

Systematic names and numbers: L-Asparagine amidohydrolase; EC 3.5.1.1; CAS No. 9015-68-3

Reactions catalysed: Hydrolysis of L-asparagine to L-aspartic acid and ammonia

Secondary enzyme activities: No significant levels of secondary enzyme activities.

DESCRIPTION Yellow to brown clear liquid or off-white granulates

FUNCTIONAL USES Enzyme preparation.
Used in food processing to reduce the formation of acrylamide from asparagine and reducing sugars during baking or frying.

GENERAL SPECIFICATIONS Must conform to the latest edition of the JECFA General Specifications and Considerations for Enzyme Preparations Used in Food Processing.

CHARACTERISTICS

IDENTIFICATION

Asparaginase activity: The sample shows asparaginase activity.
See description under TESTS.

TESTS

Asparaginase activity

Principle
Asparaginase catalyses the conversion of L-asparagine to L-aspartic acid and ammonia. The liberated ammonia subsequently reacts with phenol nitroprusside and alkaline hypochlorite resulting in a blue colour (known as Berthelot reaction). The activity of asparaginase is determined by measuring the absorbance of the reaction mixture at 600 nm.

The asparaginase activity is expressed in ASPU units. One ASPU is defined as the amount of the enzyme required to liberate one micromole of ammonia from L-asparagine per minute under the conditions of the assay (pH=5.0; 37°).

Note: The measuring range of the method is 1.5 – 12 ASPU/ml.

Apparatus
Spectrophotometer (600 nm)
Water bath with thermostatic control (37±0.1°)
pH meter
Vortex mixer
Magnetic stirrer
Disposable culture tubes (glass, 10x100 mm)

Reagents and solutions
(Note: use Ultra High Quality water with conductivity of ≤ 0.10 µS/cm)

Phenol nitroprusside solution (Sigma-Aldrich P6994 or equivalent)

Sodium hypochlorite 0.2% in alkali solution (Sigma-Aldrich A1727 or equivalent)

Sodium hydroxide solution 4 M: Weigh 160 g of NaOH pellets. Dissolve in approximately 800 ml of water in a 1 l volumetric flask. Cool down to room temperature, add water to volume and mix until fully dissolved. The solution is stable for 3 months at room temperature.

Citric acid dilution buffer 0.1M, pH 5.00±0.03: Weigh 21.01 g of citric acid monohydrate (analytical reagent grade). Dissolve in approximately 900 ml of water in a 1 l volumetric flask. Adjust the pH to 5.00±0.03 with 4 M NaOH. Add water to volume and mix. The solution is stable for 1 month when stored in a refrigerator.

L-asparagine substrate solution: Weigh 1.50 g of L-asparagine (L-asparagine monohydrate ≥ 99%, Sigma-Aldrich A8381 or equivalent). Dissolve in approximately 80 ml of the citric acid dilution buffer in a 100 ml volumetric flask and stir on a magnetic stirrer until completely dissolved. Add the dilution buffer to volume and mix. The solution should be freshly prepared before the analysis.

TCA stop solution: Weigh 25 g of trichloroacetic acid (Sigma-Aldrich 27242 (Riedel-de Haen) or equivalent). Dissolve in approximately 80 ml of water in a 100 ml volumetric flask. Add water to volume and mix. The solution is stable for 1 year at room temperature.

Standard solution: Weigh to ± 0.1 mg approximately 3.9 g of ammonium sulfate (analytical reagent grade) with an officially certified content. Dissolve in approximately 40 ml of the citric acid dilution buffer in a 50 ml volumetric flask by stirring on a magnetic stirrer for about 15 min. Add the dilution buffer to volume and mix. Make five dilutions with the dilution buffer and calculate the concentration of each dilution based on the certified content of ammonium sulfate. The table below provides an example.

Label	Dilution factor	Concentration, mg/ml
S1	60	1.3
S2	30	2.6
S3	10	7.8
S4	6	13.0
S5	4	19.5

Control sample solution: Weigh to ± 0.1 mg an amount of an asparaginase preparation with known activity (for example, 18930 ASPU/g; batch KFP0445A/DIV/4; expiration date January 2020; available from DSM Food Specialties) approximately equivalent to 4000 ASPU. Dissolve in approximately 20 ml of the citric acid dilution buffer in a 25 ml volumetric flask. Add the dilution buffer to volume, and mix. Dilute the solution with the dilution buffer to a final activity of approximately 6 ASPU/ml.

Test sample solution: Weigh to ± 0.1 mg approximately 2.5 g of an asparaginase preparation. Dissolve in approximately 20 ml of the citric acid dilution buffer in a 25 ml volumetric flask. Add the dilution buffer to volume and mix. Dilute the solution with the dilution buffer to a final activity of approximately 6 ASPU/ml.

Procedure
Standard curve:

1. Label five test tubes according to the concentrations of the standard solutions (S1 to S5). Pipette 2.0 ml of the substrate solution to each tube. Incubate in the water bath for 10 minutes. To each tube, add 100 µl of the appropriate standard solution and mix. Incubate the tubes in the water bath exactly for 30 min. Add 0.4 ml of the TCA stop solution to stop the reaction. Add 2.5 ml of water and mix. This is the reaction mixture.

2. Prepare five test tubes (labeled S1 to S5). Add to each tube 800 µl of water and 20 µl of the appropriate reaction mixture**.** To develop colour, add 170 µl of the phenol nitroprusside solution, mix and add 170 µl of the alkaline sodium hypochlorite solution. Mix and incubate in the water bath for 10 min. Transfer the content of each tube to the spectrophotometer cuvette and measure the absorbance at 600 nm after zeroing the instrument against air.

3. Use linear regression to prepare the standard curve. Plot the absorbance against the concentration of ammonium sulfate in the standard solutions (mg/ml). Use the slope of the standard curve (ml/mg) to calculate the activity of the control and test samples.

(NOTE: The standard curve should be prepared immediately prior to sample analysis.)

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Control and test samples:

1. For all control and test samples, follow the procedure described in steps 1 and 2 above for the standard solutions.

2. Use a blank for each control and test sample. To prepare the blank, pipette into a test tube 2.0 ml of the substrate solution and 0.4 ml of the TCA stop reagent. Mix and add 100 µl of either the control or test sample solution. Mix and incubate in the water bath for 30 min. Add 2.5 ml of water and continue as described in step 2 of the procedure for the standard solutions.

Calculations

Calculate the activity of each control and test sample in activity units per gram of the enzyme preparation (ASPU/g) using the following formula:

$$\text{ASPU/g} = \frac{A \times V \times Df \times 2 \times 10^6}{a \times M \times W \times 30 \times 10^3}$$

Where:

A is the absorbance of the sample minus the absorbance of the blank

V is the initial volume of the sample solution (25 ml)

Df is the dilution factor

2 accounts for 2 moles of ammonia per 1 mole of ammonium sulfate

10^6 is the conversion factor from moles to µmoles

a is the slope of the standard curve (ml/mg)

M is the molar mass of ammonium sulfate (132.14 g/mol)

W is the sample weight (g)

30 is the reaction time (min)

10^3 is the conversion factor from milligrams to grams

CALCIUM LIGNOSULFONATE (40-65)

New specifications prepared at the 69th JECFA (2008), published in FAO JECFA Monographs 5 (2008). An ADI of 0-20 mg/kg bw was established at the 69th JECFA (2008).

SYNONYMS Lignosulfonic acid, calcium salt (40-65)

DEFINITION Calcium lignosulfonate (40-65) is an amorphous material obtained from the sulfite pulping of softwood. The lignin framework is a sulfonated random polymer of three aromatic alcohols: coniferyl alcohol, *p*-coumaryl alcohol, and sinapyl alcohol, of which coniferyl alcohol is the principle unit. After completion of the pulping, the water-soluble calcium lignosulfonate is separated from the cellulose, purified (ultrafiltration), and acidified. The recovered material is evaporated and spray dried. The commercial product has a weight-average molecular weight range of 40,000 to 65,000.

DESCRIPTION Light yellow-brown to brown powder

FUNCTIONAL USES Carrier

CHARACTERISTICS

IDENTIFICATION

Solubility (Vol. 4)	Soluble in water. Practically insoluble in organic solvents.
IR spectrum (Vol. 4)	The infrared absorption spectrum of a potassium bromide pellet of dried sample exhibits characteristic absorptions at 1210-1220 cm^{-1}, 1037 cm^{-1}, and 655 cm^{-1}.
UV spectrum (Vol. 4)	A 0.05% sample solution is diluted 1:10 and adjusted to a pH of 2.0-2.2 by addition of 3 drops of 5 M hydrochloric acid. This solution exhibits an absorption maximum at 280 nm.
Weight-average molecular weight	Between 40,000 to 65,000 (>90% of the sample ranges from 1,000 to 250,000) See description under TESTS
pH (Vol. 4)	2.7 - 3.3 (10% solution)
Calcium (Vol. 4)	Passes test (“General Methods, Identification Tests,” Volume 4)
Degree of sulfonation	0.3 – 0.7, on the dried basis See description under TESTS

PURITY

Calcium	Not more than 5.0 %, on the dried basis See description under TESTS
Loss on drying (Vol. 4)	Not more than 8.0% (105°, 24 h)

Reducing sugars	Not more than 5.0%, on the dried basis See description under TESTS
Sulfite	Not more than 0.5%, on the dried basis See description under TESTS
Total Ash	Not more than 14.0%, on the dried basis See description under TESTS
Arsenic (Vol. 4)	Not more than 1 mg/kg Determine by the atomic absorption hydride technique. The selection of sample size and method of sample preparation may be based on the principles of the methods described in Volume 4 (under "General Methods, Metallic Impurities"). Alternatively, determine arsenic using Method II of the Arsenic Limit Test, taking 3 g of the sample rather than 1 g, following the procedure for organic compounds.
Lead (Vol. 4)	Not more than 2 mg/kg Determine using an AAS/ICP-AES technique appropriate to the specified level. The selection of sample size and method of sample preparation may be based on the principles of the methods described in Volume 4 (under "General Methods, Metallic Impurities").

TESTS

IDENTIFICATION TESTS

Weight-average molecular weight

Principle

Size-exclusion chromatography is used to obtain the molecular-weight distribution profile of the sample.

Reagents

(NOTE: All solutions and dilutions are to be made using distilled, deionized water)

Dimethylsulfoxide (DMSO), HPLC grade.

Disodium hydrogen phosphate ($Na_2HPO_4 \cdot 7H_2O$), Reagent grade

50 % sodium hydroxide (NaOH), Reagent grade

Sodium dodecylsulfate (SDS), Gradient grade (ultra grade)

Equipment

Size-exclusion chromatograph (Agilent Technologies or equivalent) equipped with autosampler, HPLC-pump, degassing unit, UV-detector or RI-detector, MALLS (Multi-Angle Laser Light Scattering) detector (Wyatt Technology or equivalent) with interference filters.

Columns - Glucose-divinylbenzene (DVB), 10^4 Å pore size, 500x10 mm (Jordi Associates or equivalent) and TSK gel PWXL 6 mm x 4 cm guard column (TOSOH Bioscience or equivalent)

Syringe filter - 0.2 μm GHP (Pall Corp. or equivalent)

Filter paper - 0.22 μm Millipore GSWP (Millipore Corp. or equivalent)

Eluent

Weigh 1600.0 g of water into a 2 litre flask. Add 161.8 g DMSO, mix, and add 21.44 g $Na_2HPO_4 \cdot 7H_2O$. Adjust the pH to 10.5 with NaOH, add 1.6 g of SDS, and filter the mixture through the GSWP filter paper.

Sample solution
Accurately weigh and transfer 20 mg of previously dried sample into a 10-ml volumetric flask and dilute to the mark with water. Using the syringe filter, filter the solution into a vial.

Procedure
Set the oven temperature of the chromatograph at 60°. Begin the flow of eluent (1.0 ml/min - the pressure should not exceed 1000 psi.) through the chromatography system. After at least one hour has elapsed, inject the Sample solution (20 μl) onto the column and record the chromatograph. Calculate the weight-average molecular weight from the chromatogram using suitably certified software.

Degree of sulfonation

Principle
The Degree of sulfonation is the ratio of Organic sulfur to the Methoxyl content of the sample. Organic sulfur is calculated as the difference between Total sulfur (determined by elemental analysis) and Inorganic sulfur (determined by ion chromatography).

Determination of Total sulfur

Equipment and Reagents
- Elemental Analyser (Thermo Fisher Scientific or equivalent)
- Analytical balance
- Tin capsules
- BBOT standard (2,5-(Bis(5-tert-butyl-2-benzo-oxazol-2-yl) thiophene))
- Vanadium pentoxide

Analytical conditions

Carrier gas - Helium	120 ml/min
Combustion furnace temp.	1000°
Oven temp.	70°
Helium pressure	150 kPa
Oxygen pressure	150 kPa
Oxygen loop	5 ml
Run time	300 sec.

System checks
- Vanadium pentoxide
- Vanadium pentoxide and BBOT

Procedure
System checks: Introduce small amounts of the two System checks separately into two tin capsules (no need to weigh). Run the two System checks through the analyzer. Observation of a sulfur peak in the chromatogram confirms that the system is working properly.

Standards: Introduce approximately 0.2 mg of vanadium pentoxide into each of four tin capsules and weigh them. Accurately weigh 0.5, 1.0, 1.5 and 2.0 mg of BBOT standard into the four capsules. Run the four standards through the analyzer and construct a calibration curve. The calibration curve should be a straight line with a correlation coefficient of at least 0.999.

Sample: Introduce approximately 0.2 mg of vanadium pentoxide into each of two tin capsules and weigh them. Accurately weigh 1-2 mg of

sample, previously dried, into each capsule and run them through the analyzer. Run additional samples in duplicate. After every fourth sample, accurately weigh 0.5-2.0 mg of the BBOT standard into a tared tin capsule containg 0.2 mg of vanadium pentoxide to run as a control. (NOTE: The weight of BBOT taken is chosen to fall within the calibration curve.) The standard deviation of the control BBOT standard should be no more than 0.20. Obtain the weight (mg) of total sulfur for each sample (w) from the calibration curve and calculate the percent Total sulfur for each by dividing by the weight of the corresponding sample taken (W) using the formula:

$$\% \text{ Total sulfur} = 100 \times w/W$$

Compute the average % Total sulfur.

Determination of Inorganic sulfur
(NOTE: All solutions and dilutions to be made using distilled, deionized water)

Equipment
Ion Chromatograph (Dionex Corporation or equivalent) with conductivity detector and autosampler
Anion Self-Regenerating Suppressor (ASRS-Ultra 4 or equivalent)
Analytical Column - IonPac AS 11 (Dionex Corporation or equivalent)
Guard Column - IonPac AG 11 (Dionex Corporation or equivalent)
Syringe filter - 0.2 μm GHP (Pall Corp. or equivalent)

Reagents
0.1 M NaOH (sodium hydroxide): 5.265 ml 50% NaOH (Reagent grade), diluted to 1000 ml
1% NaOH (sodium hydroxide): 2 ml 50% NaOH (Reagent grade), diluted to 100 ml
3% H_2O_2 (hydrogen peroxide): 50 ml 30% H_2O_2 (Reagent grade), diluted to 500 ml
Eluent: 0.1 M NaOH/water (10/90)

Stock standard solution
1 mg/ml, prepared by dissolving 0.1479 g sodium sulfate in 100 ml of water

Standard sulfate solutions (2.0 mg/l, 5.0 mg/l, 20.0 mg/l, and 40.0 mg/l)
Pipet 0.1, 0.25, 1.0 and 2.0 ml of the Stock standard solution into separate 50-ml volumetric flasks. Add 1 ml of 3 % H_2O_2, dilute to volume with water, and mix.

Sample solution
Accurately weigh and transfer 30 mg of previously dried sample into a 50-ml volumetric flask and dissolve it in 10 ml of 1% NaOH. Add 5 ml of 3% H_2O_2 and allow to stand overnight. Then, dilute to volume with water.

Procedure
(NOTE: Filter all solutions through the syringe filter prior to injection into the ion chromatograph.) Set the eluant flow rate to 0.7 ml/min.

Separately inject 10 µl of the standard sulfate solutions and the Sample solution and record the chromatograms for a run time of 15 min. (NOTE: The sulfate retention time is 7 min.) Construct a calibration curve and determine the sulfate concentration of the Sample solution. Determine the weight (mg) of sulfate in the sample, w, and calculate the percentage of Inorganic sulfur in the sample using the following equation:

$$\% \text{ Inorganic sulfur} = 100 \times w \times 32/(W \times 96)$$

where

W is the weight (mg) of the sample taken
32 is the formula weight of sulfur
96 is the formula weight of sulfate

Determination of Organic sulfur

$$\% \text{ Organic sulfur} = (\% \text{ Total sulfur}) - (\% \text{ Inorganic sulfur})$$

Determination of Methoxyl (-OCH_3)

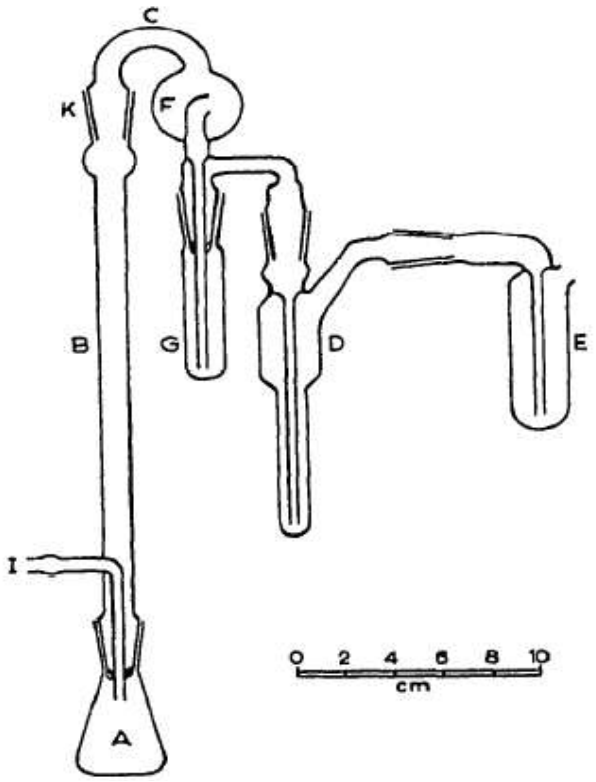
Principle

Heating with hydroiodic acid decomposes the sample to form methyl iodide which reacts to form iodine. The iodine is quantitatively determined by titration with sodium thiosulfate.

Reagents

Phenol, Reagent grade
Hydroiodic acid, HI, (min. 57%), Reagent grade
Red phosphorus
5% Cadmium sulfate ($CdSO_4$) solution
Bromine, Reagent grade
Formic acid (concentrated), Reagent Grade
1 M Sulfuric acid (H_2SO_4), Reagent grade
10% Potassium iodide solution (KI), Reagent grade
0.025 M Sodium thiosulfate ($Na_2S_2O_3$), Reagent grade
Acetic acid (glacial) saturated with Sodium acetate, Reagent grade
3 % Sodium carbonate (Na_2CO_3) solution

Equipment (Anal. Chem. Acta, vol. 15 (1956) p. 279-283)



Procedure

Accurately weigh 15-20 mg of previously dried sample on a small square of aluminium foil. Wrap the foil around the sample and put it into the reaction flask (A) to which 5 ml of hydroiodic acid, approx. 2 g of phenol, and a few glass beads have been added. Add 5 ml of 5% cadmium sulfate solution containing about 0.3 mg of red phosphorus into the washer (G). Add 10 ml of acetic acid (saturated with sodium acetate) and 10 droplets of bromine to the receiver (D). Finally, fill the U-trap (E) with sodium hydroxide or other suitable absorbant that will prevent bromine from leaving the system.

Pass nitrogen gas through a 3% Na_2CO_3 solution and into the system through the side arm (I) of the air condensor (B). Heat the reaction flask (A) to 140-145° for 1 hour in a glycerin bath. Wash the contents of the receiver (D) into a 250 ml Erlenmeyer flask containing 10 ml of acetic acid (saturated with sodium acetate). Rotate the flask and add formic acid dropwise until the colour disappears. Add 5 ml 10 % potassium iodide solution and mix. Then add 10 ml of 1 M sulfuric acid and let the flask stand for 3 minutes. Titrate the solution with 0.025 M $Na_2S_2O_3$ until the colour changes from yellowish to colourless. Calculate the percent methoxyl from the following equation:

$$\% \text{ Methoxyl} = V \times 0.025 \times 31 \times 100/(W \times 6 \times 1000)$$

where

V is the volume (ml) of sodium thiosulfate used in the titration
W is the weight (mg) of the sample taken
0.025 is the concentration of the sodium thiosulfate
31 is the formula weight of methoxyl
6 is stoichiometric conversion factor between the titrant and the methoxyl moiety

Degree of sulfonation

Calculation

(% Organic sulfur)/(% methoxyl)

PURITY TESTS

Calcium

Reagents

(NOTE: All solutions and dilutions to be made using distilled, deionized water)

Calcium reference standard, Certified 1000 ppm (Mallinckrodt or equivalent)

Nitric acid (65%), Reagent grade

Hydrogen peroxide (30%), Reagent grade

Cesium chloride, suprapur

Ionization buffer: 12.1 mg/ml of cesium chloride

Standard calcium solution

3 µg/ml, prepared by diluting with water 1.5 ml of the Calcium reference standard to 500 ml. Store in polyethylene bottles.

Sample solution

Accurately weigh 0.2 g of a previously dried sample into a graduated Pyrex flask. Add 5 ml of 65% nitric acid and 2 ml of 30% hydrogen peroxide. Boil the sample for 1 hour in a microwave oven. Dilute the sample stepwise and quantitatively to a suitable concentration level with purified water (< 0.00007 mS). A sample with 5% Calcium should be diluted by a factor of 5000 to give a final concentration of 2 µg/ml.

Procedure

Using a suitable atomic absorbtion spectrophotometer optimized according to the manufacturer's instructions, measure the absorbance of the Sample solution at 422.7 nm. By dilution of the working standard (manually or using the auto-diluter of the instrument) prepare solutions for constructing a 4-point calibration curve to correspond to a calcium content in the range 0 – 7.5 %, The sample and standard solutions and the Ionization buffer are mixed automatically by the sampling system of the instrument. Set the mixing ratio for standard/sample solutions to Ionization buffer at 3:1. Obtain the calcium concentration of the Sample solution from the calibration curve, determine the weight (g) of calcium in the sample, w, and calculate the percent of calcium in the previously dried sample from the equation:

$$\% \text{ Calcium} = 100 \times w/W$$

where W is the weight (g) of sample taken.

Reducing sugars

Principle

Reducing sugars react with p-hydroxybenzoichydrazide (PHBH) in alkaline environments. The substance formed absorbs yellow light at 410 nm. Calcium is used to enhance the colour.

Equipment

Flow Injection Analyser (O.I. Analytical or equivalent)

Cellulose membranes, Type C 25 MM (Astoria-Pacific or equivalent)

Reagents
Glucose, anhydrous quality for biochemistry analysis
Brij-35 ((Polyoxyethyleneglycol dodecyl ether), ultra grade (O.I. Analytical or equivalent)
Calcium Chloride, $CaCl_2$, Reagent grade
Citric Acid, Reagent grade
Hydrochloric Acid, HCl, Reagent grade
1 M Sodium Hydroxide, NaOH, Reagent grade
PHBH, p-Hydroxybenzoichydrazide (Sigma-Aldrich or equivalent)

Standard glucose solutions
100 mg/l, 1000 mg/l, and 2000 mg/l, prepared using deionized water

Sample solution
Accurately weigh 0.5 g of a previously dried sample into a 50-ml volumetric flask. Dissolve and dilute to volume with deionized water.

Procedure
(NOTE: Set the analyzer flow to the "low" position on both pumps and the temperature of the heater to 90°. The instrument should stabilize in about 15 minutes. The signal should be less than ±1000 micro-Absorbance Units before starting the analysis.) Introduce separately 100 µl of each of the Sample solution and Standard glucose solutions into the analyzer. For each analysis, air is introduced followed by addition of 0.2% Brij-35 at a continuous flow of 0.287 ml/min. The solutions are then dialyzed through a cellulose membrane. After dialysis, add 1M NaOH at 0.385 ml/min, $CaCl_2$ and PHBH, both at 0.074 ml/min, into the mixing chamber of the analyzer. The mixture then enters the heater (previously set at 90°) where bubbles are eliminated, after which it reaches the detector (set at 410 nm).

Run duplicate injections of every Sample solution. Construct a calibration curve from the Standard glucose solutions and obtain the concentration of reducing sugars in the Sample solution. Determine the weight (mg) of reducing sugars in the sample, w, and calculate the percentage of reducing sugars in the sample using the equation:

$$\% \text{ Reducing sugars} = 100 \times w/W$$

where
W is the weight (mg) of sample taken

Sulfite

Principle
Sulfite is stabilized in an aqueous solution with formaldehyde and subsequently separated from other anions utilizing an ion-exchange column.

Equipment
Ion Chromatograph ((Dionex Corporation or equivalent) with conductivity detector and autosampler
Anion Self-Regenerating Suppressor (ASRS-Ultra 4 or equivalent)
Analytical Column - IonPac AS 11 (Dionex Corporation or equivalent)
Guard Column - IonPac AG 11 (Dionex Corporation or equivalent)
Syringe filter - 0.2 µm GHP (Pall Corp.or equivalent)

Reagents
(NOTE: All solutions and dilutions to be made using distilled, deionized water.)
Formaldehyde (37%), Reagent grade
Formaldehyde solution: 0.5 ml Formaldehyde (37%) diluted to 1000 ml (Prepare fresh on day of use.)
Sodium Sulfite (Na_2SO_3), Reagent grade.
0.1 M Sodium Hydroxide (NaOH), Reagent grade

Eluant
0.1 M NaOH/water (10/90)

Stock standard solution
1 mg/ml, prepared with 0.1574 g Na_2SO_3 in 100 ml of Formaldehyde solution.

Standard sulfite solutions
2.0 mg/l, 5.0 mg/l, 10.0 mg/l, and 20.0 mg/l, made with freshly prepared Formaldehyde solution

Sample solution
Accurately weigh and transfer about 0.15 g of sample, previously dried, into a 50-ml volumetric flask. Dilute to mark with Formaldehyde solution.

Procedure
(NOTE: Filter all solutions before injection into the Ion Chromatograph.) The chromatographic system is run isocratically with eluent flow rate of 0.7 ml/min. Separately inject 10 µl of the Standard sulfite solutions and the Sample solution and record the chromatograms for a run time of 15 min. The sulfite retention time is 6 min. Construct a calibration curve and determine the sulfite concentration of the Sample solution. Determine the weight (mg) of sulfite in the sample, w, and calculate the percentage of sulfite in the sample using the following equation:

$$\% \text{ Sulfite} = 100 \times w/W$$

where W is the weight (mg) of sample taken.

Total Ash

Accurately weigh 0.5 -1 g of a previously dried sample in a tared platinum crucible that has been cleaned with potassium bisulfate and dried at 105°. Heat the sample cautiously over a flame. Ignite at 550° for 1 hour, and then at 900° for at least 10 minutes, until all dark particles have disappeared and the ash is white. Allow the ash to cool in a desiccator and determine the weight (mg) of the residue (W_R).

$$\% \text{ Ash} = 100 \times W_R/W_S$$

where W_S (mg) is the weight of sample taken.

CAROB BEAN GUM

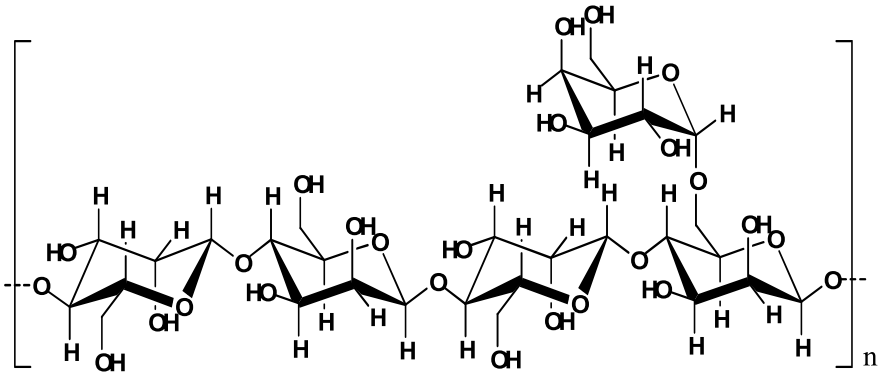
Prepared at the 69th JECFA (2008), published in FAO JECFA Monographs 5 (2008), superseding tentative specifications prepared at the 67th JECFA (2006) and published in FAO JECFA Monographs 3 (2006). An ADI "not specified" was established at the 25th JECFA (1981).

SYNONYMS Locust bean gum, INS No. 410

DEFINITION Primarily the ground endosperm of the seeds from *Ceratonia siliqua* (L.) Taub. (Fam. *Leguminosae*) mainly consisting of high molecular weight (approximately 50,000-3,000,000) polysaccharides composed of galactomannans; the mannose:galactose ratio is about 4:1. The seeds are dehusked by treating the kernels with dilute sulfuric acid or with thermal mechanical treatments, elimination of the germ followed by milling and screening of the endosperm to obtain native carob bean gum. The gum may be washed with ethanol or isopropanol to control the microbiological load (washed carob bean gum).

C.A.S. number 9000-40-2

Structural formula



DESCRIPTION White to yellowish white, nearly odourless powder

FUNCTIONAL USES Thickener, stabilizer, emulsifier, gelling agent

CHARACTERISTICS

IDENTIFICATION

Solubility (Vol. 4) Insoluble in ethanol

Gel formation Add small amounts of sodium borate TS to an aqueous dispersion of the sample; a gel is formed.

Viscosity Transfer 2 g of the sample into a 400-ml beaker and moisten thoroughly with about 4 ml of isopropanol. Add 200 ml of water with vigorous stirring until the gum is completely and uniformly dispersed.

	An opalescent, slightly viscous solution is formed. Transfer 100 ml of this solution into another 400-ml beaker. Heat the mixture in a boiling water bath for about 10 min and cool to room temperature. There is an appreciable increase in viscosity (differentiating carob bean gums from guar gums).
Gum constituents (Vol. 4)	Proceed as directed under Gum Constituents Identification using 100 mg of the sample instead of 200 mg and 1 to 10 µl of the hydrolysate instead of 1 to 5 µl. Use galactose and mannose as reference standards. These constituents should be present.
Microscopic examination	Disperse a sample of the gum in an aqueous solution containing 0.5% iodine and 1% potassium iodide on a glass slide and examine under a microscope. Carob bean gum contains long stretched tubiform cells, separated or slightly interspaced. Their brown contents are much less regularly formed than in Guar gum.
PURITY	
Loss on drying (Vol. 4)	Not more than 14% (105°, 5 h)
Total ash (Vol. 4)	Not more than 1.2% (800°, 3-4 h)
Acid-insoluble matter (Vol. 4)	Not more than 4.0%
Protein (Vol. 4)	Not more than 7.0% Proceed as directed under Nitrogen Determination (Kjeldahl Method) in Volume 4 (under “General Methods, Inorganic components”). The percentage of nitrogen determined multiplied by 6.25 gives the percentage of protein in the sample.
Starch	To a 1 in 10 dispersion of the sample add a few drops of iodine TS; no blue colour is produced.
Residual solvents	Not more than 1% of ethanol or isopropanol, singly or in combination See description under TESTS
Lead (Vol. 4)	Not more than 2 mg/kg Determine using an AAS/ICP-AES technique appropriate to the specified level. The selection of sample size and method of sample preparation may be based on the principles of the methods described in Volume 4 (under “General Methods, Metallic Impurities”).
Microbiological criteria (Vol. 4)	Initially prepare a 10^{-1} dilution by adding a 50 g sample to 450 ml of Butterfield's phosphate-buffered dilution water and homogenizing the mixture in a high-speed blender. Total (aerobic) plate count: Not more than 5,000 CFU/g *E. coli:* Negative in 1g *Salmonella:* Negative in 25 g Yeasts and moulds: Not more than 500 CFU/g

TESTS

PURITY TESTS

Residual solvents

Determine by gas chromatography in Volume 4 (under “Analytical Techniques, Chromatography”).

Chromatography conditions
Column: 25% Diphenyl-75% dimethylpolysiloxane (60 m x 0.25 mm i.d., 0.25 μm film) [Aquatic-2 (GL-Sciences Inc.) or equivalent]
Carrier gas: Helium
Flow rate: 1.5 ml/min
Detector: Flame-ionization detector (FID)
Temperatures:
- injector: 280°
- column: Hold for 6 min at 40°, then 40-110° at 4°/min, 110-250° at 25°/min, hold for 10 min at 250°
- detector: 250°

Standard solutions
Solvent standard solution: Transfer 100 mg each of chromatography grade ethanol and isopropanol into a 100-ml volumetric flask containing about 90 ml water and dilute to 100 ml with water.
TBA standard solution: Transfer 100 mg of chromatography grade tertiary-butyl alcohol (TBA) into a 100-ml volumetric flask containing about 90 ml water and dilute to 100 ml with water.
Mixed standard solutions: Transfer 1, 2, 3, 4 and 5 ml of Solvent standard solution into each of five 100-ml volumetric flasks. Add 4 ml of TBA standard solution to each flask and dilute to volume with water.

Sample preparation
Disperse 1 ml of a suitable antifoam emulsion, such as Dow-Corning G-10 or equivalent, in 200 ml of water contained in a 1000-ml 24/40 round-bottom distilling flask. Add about 4 g of the sample, accurately weighed, and shake for 1 h on a wrist-action mechanical shaker. Connect the flask to a fractionating column, and distil about 95 ml, adjusting the heat so that foam does not enter the column. Add 4 ml of TBA standard solution to the distillate and make up to 100 ml with water to obtain the Sample solution.

Standard curves
Inject 1 μl of each Mixed standard solution into the chromatograph. Measure the peak areas for each solvent and TBA. Construct the standard curves by plotting the ratios of the peak areas of each of the solvents/TBA against the concentrations of each solvent (mg/ml) in the Mixed standard solutions.

Procedure
Inject 1 μl of the Sample solution into the chromatograph. Measure the peak areas for each solvent and TBA. Calculate the ratios of the peak areas of each solvent/TBA, and obtain the concentration of each solvent from the standard curves.

Calculate the percentage of each solvent from:

20

% Solvent = (C x 100/W x 1000) x 100

where C is the concentration of solvent (mg/ml)
W is weight of sample (g)

CAROB BEAN GUM (CLARIFIED)

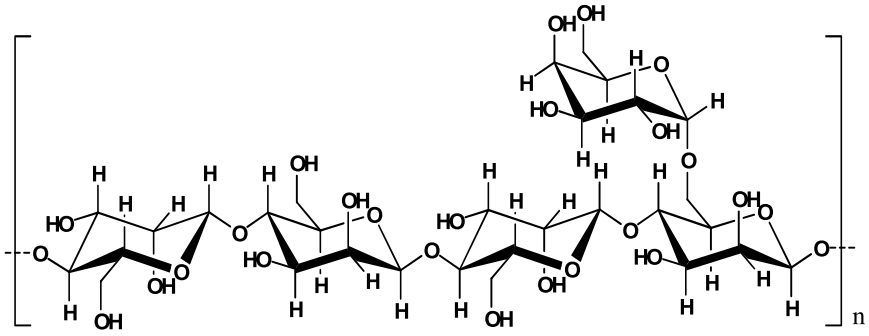
Prepared at the 69th JECFA (2008), published in FAO JECFA Monographs 5 (2008), superseding tentative specifications prepared at the 67th JECFA (2006) and published in FAO JECFA Monographs 3 (2006). An ADI "not specified" was established at the 25th JECFA (1981) for carob bean gum.

SYNONYMS Locust bean gum clarified, INS No. 410

DEFINITION Primarily the ground endosperm of the seeds from *Ceratonia siliqua* (L.) Taub. (Fam. *Leguminosae*) mainly consisting of high molecular weight (approximately 50,000-3,000,000) polysaccharides composed of galactomannans; the mannose:galactose ratio is about 4:1. The seeds are dehusked by treating the kernels with dilute sulfuric acid or with thermal mechanical treatments, elimination of the germ, followed by milling and screening of the endosperm to obtain native carob bean gum. The gum is clarified by dispersing in hot water, filtration and precipitation with ethanol or isopropanol, filtering, drying and milling. The clarified carob bean gum does not contain cell wall materials. Clarified carob bean gum in the market is normally standardized with sugars for viscosity and reactivity.

C.A.S. number 9000-40-2

Structural formula



DESCRIPTION White to yellowish white, nearly odourless powder

FUNCTIONAL USES Stabilizer, thickener, emulsifier, gelling agent

CHARACTERISTICS

IDENTIFICATION

Solubility (Vol. 4) Insoluble in ethanol

Gel formation Add small amounts of sodium borate TS to an aqueous dispersion of the sample; a gel is formed.

Viscosity Transfer 2 g of the sample into a 400-ml beaker and moisten thoroughly with about 4 ml of isopropanol. Add 200 ml of water with

	vigorous stirring until the gum is completely and uniformly dissolved. An opalescent, slightly viscous solution is formed. Transfer 100 ml of this solution into another 400-ml beaker. Heat the mixture in a boiling water bath for about 10 min and cool to room temperature. There is an appreciable increase in viscosity (differentiating carob bean gums from guar gums).
Gum constituents (Vol. 4)	Proceed as directed under Gum Constituents Identification using 100 mg of the sample instead of 200 mg and 1 to 10 µl of the hydrolysate instead of 1 to 5 µl. Use galactose and mannose as reference standards. These constituents should be present.
PURITY	Not more than 1 mg/kg Determine using an AAS/ICP-AES technique appropriate to the specified level. The selection of sample size and method of sample preparation may be based on the principles of the methods described in Volume 4 (under “General Methods, Metallic Impurities”).
Loss on drying (Vol. 4)	Not more than 14% (105°, 5 h)
Total ash (Vol. 4)	Not more than 1.2% (800°, 3-4 h) (second peak).
Acid-insoluble matter (Vol. 4)	Not more than 3.5%
Protein (Vol. 4)	Not more than 1.0% Proceed as directed under Nitrogen Determination (Kjeldahl Method) in Volume 4 (under “General Methods, Inorganic components”). The percentage of nitrogen determined multiplied by 6.25 gives the percentage of protein in the sample.
Starch	To a 1 in 10 solution of the sample add a few drops of iodine TS; no blue colour is produced
Residual solvents	Not more than 1% of ethanol or isopropanol, singly or in combination See description under TESTS
Lead (Vol. 4)	Not more than 2 mg/kg Determine using an AAS/ICP-AES technique appropriate to the specified level. The selection of sample size and method of sample preparation may be based on the principles of the methods described in Volume 4 (under “General Methods, Metallic Impurities”).

Microbiological criteria (Vol. 4)

Initially prepare a 10^{-1} dilution by adding a 50 g sample to 450 ml of Butterfield's phosphate-buffered dilution water and homogenising the mixture in a high-speed blender.

Total (aerobic) plate count: Not more than 5,000 CFU/g
E. coli: Negative in 1 g
Salmonella: Negative in 25 g
Yeasts and moulds: Not more than 500 CFU/g

TESTS

PURITY TESTS

Residual solvents

Determine by gas chromatography in Volume 4 (under “Analytical Techniques, Chromatography”).

Chromatography conditions
Column: 25% Diphenyl-75% dimethylpolysiloxane (60 m x 0.25 mm i.d., 0.25 μm film) [Aquatic-2 (GL-Sciences Inc.) or equivalent]
Carrier gas: Helium
Flow rate: 1.5 ml/min
Detector: Flame-ionization detector (FID)
Temperatures:
- injector: 280°
- column: Hold for 6 min at 40°, then 40-110° at 4°/min, 110-250° at 25°/min, hold for 10 min at 250°
- detector: 250°

Standard solutions
Solvent standard solution: Transfer 100 mg each of chromatography grade ethanol and isopropanol into a 100-ml volumetric flask containing about 90 ml water and dilute to 100 ml with water.
TBA standard solution: Transfer 100 mg of chromatography grade tertiary-butyl alcohol (TBA) into a 100-ml volumetric flask containing about 90 ml water and dilute to 100 ml with water.
Mixed standard solutions: Transfer 1, 2, 3, 4 and 5 ml of Solvent standard solution into each of five 100-ml volumetric flasks. Add 4 ml of TBA standard solution to each flask and dilute to volume with water.

Sample preparation
Disperse 1 ml of a suitable antifoam emulsion, such as Dow-Corning G-10 or equivalent, in 200 ml of water contained in a 1000-ml 24/40 round-bottom distilling flask. Add about 4 g of the sample, accurately weighed, and shake for 1 h on a wrist-action mechanical shaker. Connect the flask to a fractionating column, and distil about 95 ml, adjusting the heat so that foam does not enter the column. Add 4 ml of TBA standard solution to the distillate and make up to 100 ml with water to obtain the Sample solution.

Standard curves
Inject 1 μl of each Mixed standard solution into the chromatograph. Measure the peak areas for each solvent and TBA. Construct the standard curves by plotting the ratios of the peak areas of each of the solvents/TBA against the concentrations of each solvent (mg/ml) in the Mixed standard solutions.

Procedure

Inject 1 µl of the Sample solution into the chromatograph. Measure the peak areas for each solvent and TBA. Calculate the ratios of the peak areas of each solvent/TBA, and obtain the concentration of each solvent from the standard curves.

Calculate the percentage of each solvent from:

$$\% \text{ Solvent} = (C \times 100/W \times 1000) \times 100$$

where C is the concentration of solvent (mg/ml)
W is weight of sample (g)

ETHYL LAUROYL ARGINATE

New specifications prepared at the 69th JECFA (2008), published in FAO JECFA Monographs 5 (2008). An ADI of 0-4 mg/kg bw was established at the 69th JECFA (2008).

SYNONYMS Lauric arginate ethyl ester, lauramide arginine ethyl ester, ethyl-N^{α}-lauroyl-L-arginate·HCl, LAE, INS No. 243

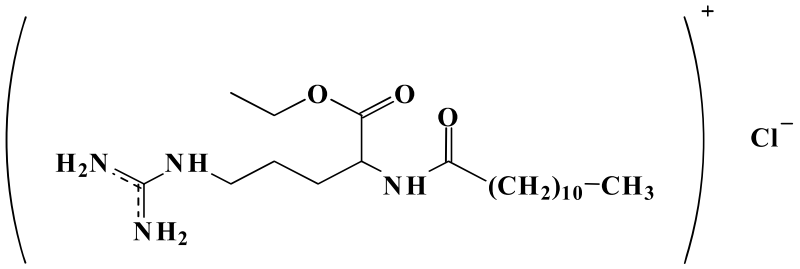
DEFINITION Ethyl lauroyl arginate is synthesised by esterifying arginine with ethanol, followed by reacting the ester with lauroyl chloride. The resultant ethyl lauroyl arginate is recovered as hydrochloride salt and is a white, solid product which is filtered off and dried.

Chemical name: Ethyl-N^{α}-dodecanoyl-L-arginate·HCl

C.A.S. number: 60372-77-2

Chemical formula: $C_{20}H_{41}N_4O_3Cl$

Structural formula



Formula weight: 421.02

Assay: Not less than 85% and not more than 95%

DESCRIPTION White powder

FUNCTIONAL USES Preservative

CHARACTERISTICS

IDENTIFICATION

pH (Vol.4): 3.0-5.0 (1% solution)

Solubility (Vol. 4): Freely soluble in water, ethanol, propylene glycol and glycerol

Chromatography — The retention time for the major peak in a HPLC chromatogram of the sample is approx. 4.3 min using the conditions described in the Method of Assay.

PURITY

Total ash (Vol. 4) — Not more than 2% (700°)

Water (Vol. 4) — Not more than 5% (Karl Fischer Titrimetric Method, "General Methods, Inorganic Components")

N^{α}-Lauroyl-L-arginine — Not more than 3%
See description under TESTS

Lauric acid — Not more than 5%
See description under TESTS

Ethyl laurate — Not more than 3%
See description under TESTS

L-Arginine·HCl — Not more than 1%
See description under TESTS

Ethyl arginate·2HCl — Not more than 1%
See description under TESTS

Lead (Vol. 4) — Not more than 1 mg/kg
Determine using an AAS/ICP-AES technique appropriate to the specified level. The selection of sample size and method of sample preparation may be based on the principles of the methods described in Volume 4 (under "General Methods, Metallic Impurities").

TESTS

PURITY TESTS

N^{α}-Lauroyl-L-arginine — Determine by HPLC in Volume 4 (under "Analytical Techniques, Chromatography") using the conditions described in the Method of Assay.
NOTE: The retention time of N^{α}-lauroyl-L-arginine is approx. 2.2 min.

Calculate the percentage of N^{α}-lauroyl-L-arginine in the test sample as follows:

$$\%\ N^{\alpha}\text{-Lauroyl-L-arginine} = \frac{C\ (\mu g/ml) \times 50\ (ml)}{W\ (mg) \times 1000} \times 100$$

where:
C= N^{α}-lauroyl-L-arginine concentration detected (μg/ml)
W= weight of sample (mg)

Lauric acid and ethyl laurate — Determine by HPLC in Volume 4 (under "Analytical Techniques, Chromatography") using the following conditions.

Chromatography
Liquid chromatograph equipped with a spectrophotometric detector.
Column: Symmetry C18, 150 x 3.9 mm, 5μm (Waters) or equivalent
Column temperature: room temperature
Mobile phase: acetonitrile/water (85:15) containing 0.1% trifluoroacetic acid
Flow rate: 1 ml/min
Wavelength: 212 nm
Injection volume: 10 μl

Standard solution
Weigh accurately about 125 mg of lauric acid standard and 75 mg ethyl laurate standard into a 50-ml volumetric flask. Dissolve and dilute with the mobile phase to obtain a solution of about 2500 μg/ml of lauric acid and 1500μg/ml of ethyl laurate. Take 5, 10 and 15 ml of the solution and dilute to 50 ml with mobile phase for the standard curves.

Sample solution
Weigh accurately about 500 mg of test sample into a 50-ml volumetric flask. Dissolve and dilute to 50 ml with mobile phase.

Procedure
Inject the standard and sample solutions into the chromatograph and measure their concentration (C μg/ml) from their peak area and their standard curves.
NOTE: The retention time of lauric acid is approx. 3.65 min and that of ethyl laurate is approx. 11.2 min.

Calculate their percentage in the test sample as follows:

$$\% \text{ Lauric acid or ethyl laurate} = \frac{C\ (\mu g/ml) \times 50\ (ml)}{W\ (mg) \times 1000} \times 100$$

where:
C= lauric acid or ethyl laurate concentration detected (μg/ml)
W= weight of sample (mg)

L-Arginine·HCl and ethyl arginate·2HCl

Determine by HPLC in Volume 4 (under "Analytical Techniques, Chromatography") using the following conditions:
NOTE: Use deionized water

Chromatography
Liquid chromatograph equipped with a post-column derivatization and a spectrophotometric detector.
Column and packing: μ Bondapack C18, 300 x 3.9 mm, 10μm (Waters) or equivalent
Mobile phase: A-B-C-D (1:1:1:1.5)
A: 15 mmole/l sodium heptanesulphonate, B: 27 mmole/l phosphoric acid solution, C: 3 mmole/l sodium di-hydrogen phosphate solution, D: methanol
Flow rate: 0.8 ml/min
Flow rate of reagent solution: 0.8 ml/min

Column temperature: 65°
Wavelength: 340 nm
Injection volume: 10 µl

Standard solution
L-Arginine·HCl: Weigh accurately about 40 mg of L-arginine·HCl standard into a 100-ml volumetric flask. Dissolve and dilute to 100 ml with water to obtain a solution of about 400 µg/ml of L-arginine·HCl.
Ethyl arginate·2HCl: Weigh accurately about 40 mg of ethyl arginate·2HCl standard into a 100-ml volumetric flask. Dissolve and dilute to 100 ml with water to obtain a solution of about 400 µg/ml of ethyl arginate·2HCl.
Take 2, 4, 6 and 8 ml of each solution and dilute to 25 ml with mobile phase separately for the standard curves.

Sample solution
Weigh accurately about 200 mg of test sample into a 25-ml volumetric flask. Dissolve and dilute to 25 ml with water.

Derivatizing solution
Mix 1 liter of 0.2M borate buffer solution (pH 9.4) with 0.8 g of *o*-phthaldialdehyde dissolved in 5 ml of methanol and 2 ml of 2-mercaptoethanol. The solution is stable 48 h at room temperature and without additional preventive measure but It is advisable to keep the solution under nitrogen and to prepare it freshly every 24-48 h.

Procedure
Inject the standard and sample solutions into the chromatograph and measure the area of the peak.
NOTE: The retention time of L-arginine·HCl is approx. 5.03 min and ethyl arginate·2HCl is approx. 6.70 min.

Calculate the percentage of L-arginine·HCl and ethyl arginate·2HCl in the test sample as follows:

$$\% \text{ L-Arginine·HCl or ethyl arginate·2HCl} = \frac{C\ (\mu g/ml) \times 50\ (ml)}{W\ (mg) \times 1000} \times 100$$

where:
C= L-arginine·HCl and ethyl arginate·2HCl concentration detected (µg/ml)
W= weight of sample (mg)

METHOD OF ASSAY

Determine by HPLC in Volume 4 (under "Analytical Techniques, Chromatography") using the following conditions:
NOTE: Use deionized water

Standards
Ethyl-N^{α}-lauroyl-L-arginate·HCl standard
N^{α}-lauroyl-L-arginine standard
(available from Laboratorios Miret, S.A, Géminis 4, Políg. Ind. Can Parellada, 08228 Terrassa, Spain)

Chromatography
Liquid chromatograph equipped with a spectrophotometric detector.
Column and packing: Symmetry C18, 150 x 3.9 mm, 5μm (Waters) or equivalent
Column temperature: room temperature
Mobile phase: acetonitrile/water (50:50) containing 0.1% trifluoroacetic acid
Flow rate: 1 ml/min
Wavelength: 215 nm
Injection volume: 10 μl

Standard solution
Weigh accurately about 25 mg of N^{α}-lauroyl-L-arginine standard into a 25-ml volumetric flask. Dissolve and dilute to 25 ml with mobile phase (solution A). Weigh accurately about 150 mg of ethyl-N^{α}-lauroyl-L-arginate·HCl standard into a 50-ml volumetric flask and dissolve with some milliliters of the mobile phase. Then, add 5 ml of solution A and dilute to 50 ml with mobile phase to obtain a solution of about 3000 μg/ml of ethyl-N^{α}-lauroyl-L-arginate·HCl and 100 μg/ml of N^{α}-lauroyl-L-arginine (solution B). Take 2, 4, 6, 8 and 10 ml of solution B and dilute to 25 ml with mobile phase for the standard curves.

Sample solution
Weigh accurately about 50 mg of test sample into a 50-ml volumetric flask. Dissolve and dilute to 50 ml with mobile phase.

Procedure
Inject the standard and sample solutions into the chromatograph and measure the area of the peak.
Note: The retention time of ethyl-N^{α}-lauroyl-L-arginate·HCl is approx. 4.3 min.

Calculate the percentage of ethyl-N^{α}-lauroyl-L-arginate·HCl in the test sample as follows:

$$\% \text{ Ethyl-}N^{\alpha}\text{-lauroyl-L-arginate·HCl} = \frac{C\ (\mu g/ml) \times 50\ (ml)}{W\ (mg) \times 1000} \times 100$$

where:
C= ethyl-N^{α}-lauroyl-L-arginate·HCl concentration detected (μg/ml)
W= weight of sample (mg)

GUAR GUM

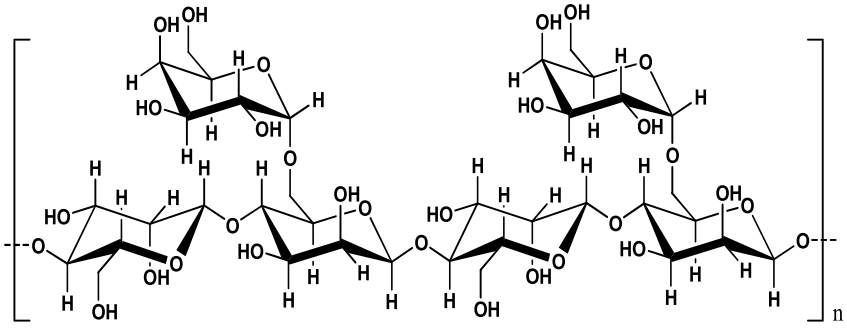
Prepared at the 69th JECFA (2008), published in FAO JECFA Monographs 5 (2008), superseding tentative specifications prepared at the 67th JECFA (2006) and published in FAO JECFA Monographs 3 (2006). An ADI "not specified" was established at the 19th JECFA (1975).

SYNONYMS Gum cyamopsis, guar flour; INS No. 412

DEFINITION Primarily the ground endosperm of the seeds from Cyamopsis tetragonolobus (L.) Taub. (Fam. Leguminosae) mainly consisting of high molecular weight (50,000-8,000,000) polysaccharides composed of galactomannans; the mannose:galactose ratio is about 2:1. The seeds are crushed to eliminate the germ, the endosperm is dehusked, milled and screened to obtain the ground endosperm (native guar gum). The gum may be washed with ethanol or isopropanol to control the microbiological load (washed guar gum).

C.A.S. number 9000-30-0

Structural formula



DESCRIPTION White to yellowish-white, nearly odourless, free-flowing powder

FUNCTIONAL USES Thickener, stabilizer, emulsifier

CHARACTERISTICS

IDENTIFICATION

Solubility (Vol. 4) Insoluble in ethanol

Gel formation Add small amounts of sodium borate TS to an aqueous dispersion of the sample; a gel is formed.

Viscosity Transfer 2 g of the sample into a 400-ml beaker and moisten thoroughly with about 4 ml of isopropanol. Add 200 ml of water with vigorous stirring until the gum is completely and uniformly dispersed. An opalescent, viscous solution is formed. Transfer 100 ml of this solution into another 400-ml beaker, heat the mixture in a boiling water bath for about 10 min and cool to room temperature. There is no substantial increase in viscosity (differentiating guar gums from carob bean gums).

Gum constituents (Vol. 4)	Proceed as directed under Gum Constituents Identification using 100 mg of the sample instead of 200 mg and 1 to 10 µl of the hydrolysate instead of 1 to 5 µl. Use galactose and mannose as reference standards. These constituents should be present.
Microscopic examination	Place some ground sample in an aqueous solution containing 0.5% iodine and 1% potassium iodide on a glass slide and examine under a microscope. Guar gum shows close groups of round to pear formed cells, their contents being yellow to brown.
PURITY	
Loss on drying (Vol. 4)	Not more than 15.0% (105°, 5 h)
Borate	Absent by the following test Disperse 1 g of the sample in 100 ml of water. The dispersion should remain fluid and not form a gel on standing. Mix 10 ml of dilute hydrochloric acid with the dispersion, and apply one drop of the resulting mixture to turmeric paper. No brownish red colour is formed.
Total ash (Vol. 4)	Not more than 1.5% (800°, 3-4 h)
Acid-insoluble matter (Vol. 4)	Not more than 7.0%
Protein (Vol. 4)	Not more than 10.0% Proceed as directed under Nitrogen Determination (Kjeldahl Method) in Volume 4 (under “General Methods, Inorganic components”). The percentage of nitrogen determined multiplied by 6.25 gives the percentage of protein in the sample.
Residual solvents	Not more than 1% of ethanol or isopropanol, singly or in combination See description under TESTS
Lead (Vol. 4)	Not more than 2 mg/kg Determine using an AAS/ICP-AES technique appropriate to the specified level. The selection of sample size and method of sample preparation may be based on the principles of the methods described in Volume 4 (under “General Methods, Metallic Impurities”).
Microbiological criteria (Vol. 4)	Initially prepare a 10^{-1} dilution by adding a 50 g sample to 450 ml of Butterfield's phosphate-buffered dilution water and homogenizing the mixture in a high-speed blender. Total (aerobic) plate count : Not more than 5,000 CFU/g E. coli: Negative in 1g Salmonella: Negative in 25g Yeasts and moulds: Not more than 500 CFU/g

TESTS

PURITY TESTS

Residual solvents

Determine by gas chromatography in Volume 4 (under “Analytical Techniques, Chromatography”).

Chromatography conditions
Column: 25% Diphenyl-75% dimethylpolysiloxane (60 m x 0.25 mm i.d., 0.25 μm film) [Aquatic-2 (GL-Sciences Inc.) or equivalent]
Carrier gas: Helium
Flow rate: 1.5 ml/min
Detector: Flame-ionization detector (FID)
Temperatures:
- injector: 280°
- column: Hold for 6 min at 40°, then 40-110° at 4°/min, 110-250° at 25°/min, hold for 10 min at 250°
- detector: 250°

Standard solutions
Solvent standard solution: Transfer 100 mg each of chromatography grade ethanol and isopropanol into a 100-ml volumetric flask containing about 90 ml water and dilute to 100 ml with water.
TBA standard solution: Transfer 100 mg of chromatography grade tertiary-butyl alcohol (TBA) into a 100-ml volumetric flask containing about 90 ml water and dilute to 100 ml with water.
Mixed standard solutions: Transfer 1, 2, 3, 4 and 5 ml of Solvent standard solution into each of five 100-ml volumetric flasks. Add 4 ml of TBA standard solution to each flask and dilute to volume with water.

Sample preparation
Disperse 1 ml of a suitable antifoam emulsion, such as Dow-Corning G-10 or equivalent, in 200 ml of water contained in a 1000-ml 24/40 round-bottom distilling flask. Add about 4 g of the sample, accurately weighed, and shake for 1 h on a wrist-action mechanical shaker. Connect the flask to a fractionating column, and distil about 95 ml, adjusting the heat so that foam does not enter the column. Add 4 ml of TBA standard solution to the distillate and make up to 100 ml with water to obtain the Sample solution.

Standard curves
Inject 1 μl of each Mixed standard solution into the chromatograph. Measure the peak areas for each solvent and TBA. Construct the standard curves by plotting the ratios of the peak areas of each of the solvents/TBA against the concentrations of each solvent (mg/ml) in the Mixed standard solutions.

Procedure
Inject 1 μl of the Sample solution into the chromatograph. Measure the peak areas for each solvent and TBA. Calculate the ratios of the peak areas of each solvent/TBA, and obtain the concentration of each solvent from the standard curves.

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Calculate the percentage of each solvent from:

$$\% \text{ Solvent} = (C \times 100/W \times 1000) \times 100$$

where C is the concentration of solvent (mg/ml)
W is weight of sample (g)

GUAR GUM (CLARIFIED)

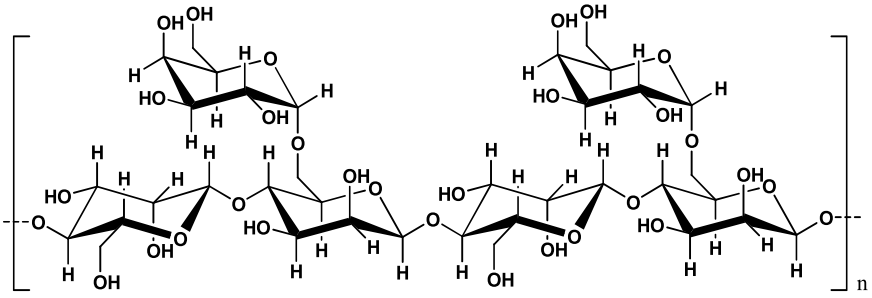
Prepared at the 69th JECFA (2008), published in FAO JECFA Monographs 5 (2008), superseding tentative specifications prepared at the 67th JECFA (2006) and published in FAO JECFA Monographs 3 (2006). An ADI "not specified" was established at the 19th JECFA (1975) for guar gum.

SYNONYMS INS No. 412

DEFINITION Primarily the ground endosperm of the seeds from Cyamopsis tetragonolobus (L.) Taub. (Fam. Leguminosae) mainly consisting of high molecular weight (50,000-8,000,000) polysaccharides composed of galactomannans; the mannose:galactose ratio is about 2:1. The seeds are crushed to eliminate the germ, the endosperm is dehusked, milled and screened to obtain the ground endosperm (native guar gum). The gum is clarified by dissolution in water, filtration and precipitation with ethanol or isopropanol. Clarified guar gum does not contain cell wall materials. Clarified guar gum in the market is normally standardized with sugars.

C.A.S. number *9000-30-0*

Structural formula



DESCRIPTION White to yellowish white, nearly odourless, free-flowing powder

FUNCTIONAL USES Thickener, stabilizer, emulsifier

CHARACTERISTICS

IDENTIFICATION

Solubility (Vol. 4) Insoluble in ethanol

Gel formation Add small amounts of sodium borate TS to an aqueous solution of the sample; a gel is formed.

Viscosity Transfer 2 g of the sample into a 400-ml beaker and moisten thoroughly with about 4 ml of isopropanol. Add 200 ml of water with vigorous stirring until the gum is completely and uniformly dispersed. An opalescent, viscous solution is formed. Transfer 100 ml of this solution into another 400-ml beaker, heat the mixture in a boiling water bath for about 10 min and cool to room temperature. There is no substantial increase in viscosity

	(differentiating guar gums from carob bean gums).
Gum constituents (Vol. 4)	Proceed as directed under Gum Constituents Identification using 100 mg of the sample instead of 200 mg and 1 to 10 µl of the hydrolysate instead of 1 to 5 µl. Use galactose and mannose as reference standards. These constituents should be present.
PURITY	
Loss on drying (Vol. 4)	Not more than 15.0% (105°, 5 h)
Borate	Absent by the following test Disperse 1 g of the sample in 100 ml of water. The dispersion should remain fluid and not form a gel on standing. Mix 10 ml of dilute hydrochloric acid with the dispersion, and apply one drop of the resulting mixture to turmeric paper. No brownish red colour is formed.
Total ash (Vol. 4)	Not more than 1.0% (800°, 3-4 h)
Acid-insoluble matter (Vol. 4)	Not more than 1.2%
Protein (Vol. 4)	Not more than 1.0% Proceed as directed under Nitrogen Determination (Kjeldahl Method) in Volume 4 (under “General Methods, Inorganic components”). The percentage of nitrogen determined multiplied by 6.25 gives the percentage of protein in the sample.
Residual solvents	Not more than 1% of ethanol or isopropanol, singly or in combination See description under TESTS
Lead (Vol. 4)	Not more than 2 mg/kg Determine using an AAS/ICP-AES technique appropriate to the specified level. The selection of sample size and method of sample preparation may be based on the principles of the methods described in Volume 4 (under “General Methods, Metallic Impurities”).
Microbiological criteria (Vol. 4)	Initially prepare a 10^{-1} dilution by adding a 50 g sample to 450 ml of Butterfield's phosphate-buffered dilution water and homogenizing the mixture in a high-speed blender. Total (aerobic) plate count: Not more than 5,000 CFU/g E. coli: Negative in 1g Salmonella: Negative in 25g Yeasts and moulds: Not more than 500 CFU/g

TESTS

PURITY TESTS

Residual solvents	Determine by gas chromatography in Volume 4 (under “Analytical Techniques, Chromatography”). Chromatography conditions

Column: 25% Diphenyl-75% dimethylpolysiloxane (60 m x 0.25 mm i.d., 0.25 μm film) [Aquatic-2 (GL-Sciences Inc.) or equivalent]
Carrier gas: Helium
Flow rate: 1.5 ml/min
Detector: Flame-ionization detector (FID)
Temperatures:
- injector: 280°
- column: Hold for 6 min at 40°, then 40-110° at 4°/min, 110-250° at 25°/min, hold for 10 min at 250°
- detector: 250°

Standard solutions
Solvent standard solution: Transfer 100 mg each of chromatography grade ethanol and isopropanol into a 100-ml volumetric flask containing about 90 ml water and dilute to 100 ml with water.
TBA standard solution: Transfer 100 mg of chromatography grade tertiary-butyl alcohol (TBA) into a 100-ml volumetric flask containing about 90 ml water and dilute to 100 ml with water.
Mixed standard solutions: Transfer 1, 2, 3, 4 and 5 ml of Solvent standard solution into each of five 100-ml volumetric flasks. Add 4 ml of TBA standard solution to each flask and dilute to volume with water.

Sample preparation
Disperse 1 ml of a suitable antifoam emulsion, such as Dow-Corning G-10 or equivalent, in 200 ml of water contained in a 1000-ml 24/40 round-bottom distilling flask. Add about 4 g of the sample, accurately weighed, and shake for 1 h on a wrist-action mechanical shaker. Connect the flask to a fractionating column, and distil about 95 ml, adjusting the heat so that foam does not enter the column. Add 4 ml of TBA standard solution to the distillate and make up to 100 ml with water to obtain the Sample solution.

Standard curves
Inject 1 μl of each Mixed standard solution into the chromatograph. Measure the peak areas for each solvent and TBA. Construct the standard curves by plotting the ratios of the peak areas of each of the solvents/TBA against the concentrations of each solvent (mg/ml) in the Mixed standard solutions.

Procedure
Inject 1 μl of the Sample solution into the chromatograph. Measure the peak areas for each solvent and TBA. Calculate the ratios of the peak areas of each solvent/TBA, and obtain the concentration of each solvent from the standard curves.

Calculate the percentage of each solvent from:

$$\% \text{ Solvent} = (C \times 100/W \times 1000) \times 100$$

where C is the concentration of solvent (mg/ml)
W is weight of sample (g)

IRON OXIDES

Prepared at the 69th JECFA (2008), published in FAO JECFA Monographs 5 (2008), superseding the specifications prepared at the 63rd JECFA (2004), published in the Combined Compendium of Food Additive Specifications, FAO JECFA Monographs 1 (2005). An ADI of 0-0.5 mg/kg bw was established at the 53rd JECFA (1999).

SYNONYMS

Iron Oxide yellow: CI Pigment Yellow 42 and 43; CI(1975) No. 77492; INS No. 172(iii)
Iron Oxide Red: CI Pigment Red 101 and 102; CI (1975) No. 77491; INS No. 172(ii)
Iron Oxide Black: CI Pigment Black 11; CI (1975) No. 77499; INS No. 172(i)

DEFINITION

Iron oxides are produced from ferrous sulfate by heat soaking, removal of water, decomposition, washing, filtration, drying and grinding. They are produced in either anhydrous or hydrated forms. Their range of hues includes yellows, reds, browns and blacks. The food-quality iron oxides are primarily distinguished from technical grades by their comparatively low levels of contamination by other metals; this is achieved by the selection and control of the source of the iron or by the extent of chemical purification during the manufacturing process.

Chemical names

Iron Oxide Yellow:	Hydrated ferric oxide, hydrated iron (III) oxide
Iron Oxide Red:	Iron sesquioxide, anhydrous ferric oxide, anhydrous iron (III) oxide
Iron Oxide Black:	Ferroso ferric oxide, iron (II,III) oxide

C.A.S. number

Iron Oxide Yellow:	51274-00-1
Iron Oxide Red:	1309-37-1
Iron Oxide Black:	1317-61-9

Chemical formula

Iron Oxide Yellow:	$FeO(OH) \cdot xH_2O$
Iron Oxide Red:	Fe_2O_3
Iron Oxide Black:	$FeO \cdot Fe_2O_3$

Formula weight

88.85 $FeO(OH)$
159.70 Fe_2O_3
231.55 $FeO \cdot Fe_2O_3$

Assay

Not less than 60% of iron

DESCRIPTION

Yellow, red, brown or black powder.

FUNCTIONAL USES

Colour

CHARACTERISTICS

IDENTIFICATION

Solubility (Vol. 4)	Insoluble in water and organic solvents; soluble in concentrated mineral acids

PURITY

Loss on drying (Vol. 4)	Iron Oxide Red : Not more than 1.0% (105°, 4 h)
Water-soluble matter	Not more than 1.0% See description under TESTS
Arsenic (Vol. 4)	Not more than 3 mg/kg Determine by the atomic absorption hydride technique. The selection of sample size and method of sample preparation may be based on the principles of the methods described in Volume 4 (under "General Methods, Metallic Impurities").
Cadmium (Vol. 4)	Not more than 1 mg/kg Determine using an atomic absorption/ICP technique appropriate to the specified level. The selection of sample size and method of sample preparation may be based on the principles of the methods described in Volume 4 (under “General Methods, Metallic Impurities”).
Lead (Vol. 4)	Not more than 10 mg/kg Determine using an atomic absorption/ICP technique appropriate to the specified level. The selection of sample size and method of sample preparation may be based on the principles of the methods described in Volume 4 (under “General Methods, Metallic Impurities”).
Mercury (Vol. 4)	Not more than 1 mg/kg Determine by the cold vapour atomic absorption technique.

TESTS

PURITY TESTS

Water-soluble matter

Weigh accurately 5.0 g of iron oxide, transfer to a 250 ml beaker, add 200 ml of water and boil for 5 minutes; stir to avoid bumping. Cool the mixture, transfer the contents to a 250 ml volumetric flask, rinse the beaker with 25 ml of water, adding the rinsings to the flask; bring to volume with water and mix. Allow the mixture to stand for 10 minutes and filter the solution. Transfer 100 ml of filtrate into a clean dry tared beaker and carefully evaporate the solution to dryness on a boiling water bath. Dry the residue at 105 -110° for 2 hours, cool the beaker with residue in a desiccator, weigh the beaker, and calculate the amount of residue.

$$\text{Water-soluble matter (\%)} = 250 \times W_R/W_S$$

where W_R is the weight of residue (g) and W_S is the weight of sample taken (g).

METHOD OF ASSAY Weigh accurately about 0.2 g of the sample, add 10 ml of 5 N hydrochloric acid, and heat cautiously to boiling in a 200-ml conical flask until the sample has dissolved. Allow to cool, add 6 to 7 drops of 30% hydrogen peroxide solution and again heat cautiously to boiling until all the excess hydrogen peroxide has decomposed (about 2-3 min). Allow to cool, add 30 ml of water and about 2 g of potassium iodide and allow to stand for 5 min. Add 30 ml of water and titrate with 0.1 N sodium thiosulfate adding starch TS as the indicator towards the end of the titration. Each ml of 0.1N sodium thiosulfate is equivalent to 5.585 mg of Fe (III).

ISOMALT

Prepared at the 69th JECFA (2008), published in FAO JECFA Monographs 5 (2008), superseding specifications prepared at the 46th JECFA (1996), published in the Combined Compendium of Food Additive Specifications, FAO JECFA Monographs 1 (2005). An ADI 'not specified' was established at the 29th JECFA (1985).

SYNONYMS Hydrogenated isomaltulose; INS No. 953

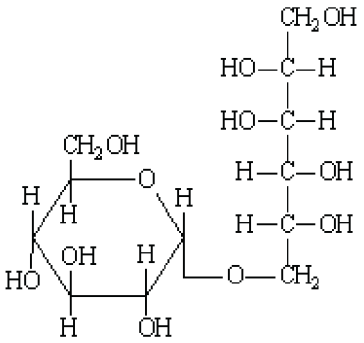
DEFINITION A mixture of hydrogenated mono- and disaccharides whose principal components are the disaccharides:

Chemical names
6-O-alpha-D-Glucopyranosyl-D-sorbitol (1,6-GPS) and
1-O-alpha-D-Glucopyranosyl-D-mannitol dihydrate (1,1-GPM)

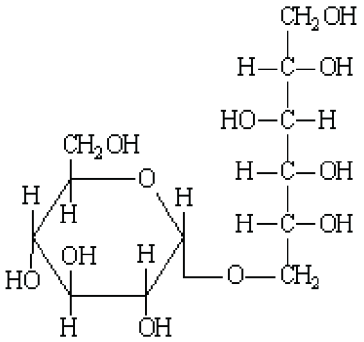
C.A.S. number
64519-82-0

Chemical formula
6-O-alpha-D-Glucopyranosyl-D-sorbitol: $C_{12}H_{24}O_{11}$
1-O-alpha-D-Glucopyranosyl-D-mannitol dihydrate: $C_{12}H_{24}O_{11} \cdot 2H_2O$

Structural formula



6-O-alpha-D-Glucopyranosyl-D-sorbitol



1-O-alpha-D-Glucopyranosyl-D-mannitol (without molecules of crystal water)

Formula weight	6-O-alpha-D-Glucopyranosyl-D-sorbitol: 344.32 1-O-alpha-D-Glucopyranosyl-D-mannitol dihydrate: 380.32
Assay	Not less than 98% of hydrogenated mono- and disaccharides and not less than 86% of the mixture of 6-O-alpha-D-glucopyranosyl-D-sorbitol and 1-O-alpha-D-glucopyranosyl-D-mannitol on the anhydrous basis

DESCRIPTION Odourless, white, crystalline slightly hygroscopic substance

FUNCTIONAL USES Sweetener, bulking agent, anticaking agent, glazing agent

CHARACTERISTICS

IDENTIFICATION

Solubility (Vol. 4)	Soluble in water, very slightly soluble in ethanol
Thin layer chromatography (Vol. 4)	Passes test See description under TESTS

PURITY

Water (Vol. 4)	Not more than 7.0% (Karl Fischer Titrimetric Method, “General Methods, Inorganic Components”)
Sulfated ash (Vol. 4)	Not more than 0.05% Test 5 g of the sample (Method I)
D-Mannitol	Not more than 3% See Method of Assay
D-Sorbitol	Not more than 6% See Method of Assay
Reducing sugars (Vol. 4)	Not more than 0.3% Proceed as directed under *Reducing Substances (as glucose),* Method II (under “General Methods, Organic Components”). The weight of cuprous oxide shall not exceed 50 mg.
Nickel (Vol. 4)	Not more than 2 mg/kg Proceed as directed under *Nickel in Polyols* (under “General Methods, Inorganic Components”).
Lead (Vol. 4)	Not more than 1 mg/kg Determine using an AAS/ICP-AES technique appropriate to the specified level. The selection of sample size and method of sample preparation may be based on the principles of the methods described in Volume 4 (under “General Methods, Metallic Impurities”).

TESTS

IDENTIFICATION TESTS

Thin layer chromatography

TLC plates
TLC aluminium foils or plates of approx. 12 cm length and coated with a layer of approx. 0.2 mm, Kieselgel 60 F_{254}, Art. 5554, Merck, or equivalent

Reference solution
Dissolve 500 mg of each of the following sugar alcohols in 100 ml of water: Sorbitol, mannitol, lactitol, maltitol, 1-O-alpha-D-gluco-pyranosyl-D-mannitol (1,1-GPM), and 6-O-alpha-D-glucopyranosyl-D-sorbitol (1,6-GPS)

Test solution
Dissolve 500 mg of sample in 100 ml of water

Solvent A
Isopropanol:n-butanol:aqueous boric acid solution (25 mg/ml):acetic acid:propionic acid (50:30:20:2:16;v/v)

Solvent B
Ethylacetate:pyridine:water:acetic acid:propionic acid (50:50:10:5:5;v/v)

Detecting solutions
I 0.1% Na-metaperiodate in water (w/w)
II ethanol:sulfuric acid:anisaldehyde:acetic acid (90:5:1:1;v/v)

Procedure
Apply approximately 0.3 µl each of the reference and test solution to the bottom of the TLC plate. Dry the spots in warm air. Develop the plate to a height of 10 cm in a developing chamber containing either solvent A or solvent B. Allow the plate to dry in warm air and dip the plate for up to 3 sec into Detecting solution I.

Dry the plate in hot air. Note: The plate should be completely dry on both sides. Dip the plate in Detecting solution II up to 3 sec and dry in hot air until coloured spots become visible. Optionally, the background colour may be brightened in warm steam.

The approximate R_f values and colours of the spots on the TLC-plate of the substances specified above are described as "Compound / Colour / Solvent A(R_f) / Solvent B(R_f)". See below.

mannitol / reddish (light) / 0.36 / 0.40
sorbitol / brown / 0.36 / 0.36
GPM / blue-grey / 0.28 / 0.16
GPS / blue-grey / 0.25 / 0.13
maltitol / green / 0.26 / 0.22
lactitol / olive-green / 0.23 / 0.14

The R_f values may vary slightly depending on the commercial source of the silica gel plates.

The principal spots in the chromatogram obtained from a test solution of isomalt are similar in R_f value and colour to GPM and GPS.

PURITY TESTS

METHOD OF ASSAY

Internal standard solution
Dissolve suitable quantities of phenyl-ß-D-glucopyranoside and maltitol in water to obtain a solution of about 1 mg phenyl-ß-D-glucopyranoside and 50 mg maltitol per g water.

Standard solutions
Dissolve accurately weighed quantities of 1-O-alpha-D-glucopyranosyl-D-mannitol (1,1-GPM) and 6-O-alpha-D-glucopyranosyl-D-sorbitol (1,6-GPS), calculated as dry substance, in water to obtain two separate solutions having a concentration of about 50 mg per g each. Also prepare an aqueous standard solution containing approx. 1 mg mannitol and 1 mg sorbitol per g.

Sample solution
Dissolve an accurately weighed quantity of the sample (approx. 1 g) in water to obtain a concentration of about 10 g per 100 g.

Procedure
Pipet 100.0 mg of standard solution or sample solution into a glass tube fitted with a screw cap and add 100.0 mg of internal standard solution. Remove the water by lyophilization and dissolve the residue in 1.0 ml of pyridine. Add 4 mg O-benzyl-hydroxylamine hydrochloride, and cap the tube and set it aside for 12 h at room temperature. Then, add 1 ml of N-methyl-N-trimethylsilyl-trifluoroacetamide (MSTFA) and heat to 80° for 12 h shaking occasionally and allow to cool. Inject 1 µl portions of these solutions directly into a gas chromatograph under the following operating conditions:
- Column: Fused silica HT-8 (25 m x 0.22 mm x 0.25 µm), or equivalent
- Injector: Programmed temperature vaporizer: 30°; 270°/min to 300° (49 min)
- Detector: Flame ionization detector; 360°
- Temperature program: 80° (3 min); 10°/min to 210°; 5°/min to 350° (6 min)
- Carrier gas: Helium
- Flow rate: initial flow rate: approx. 1 ml/min at 80° and 1 atm; split flow: 25 ml/min

Approximate retention times
Hydrogenated monosaccharides:
Mannitol 19.5 min
Sorbitol 19.6 min
Internal standards:
Phenyl-ß-D-glucopyranoside 26.8 min
Maltitol 33.5 min
Hydrogenated disaccharides (32 - 36 min)
1,1-GPS 33.9 min
1,1-GPM 34.5 min

1,6-GPS 34.6 min

Calculate the percentages of the individual components, w_I, in the sample according to the following formula:

$$W_I\ (\%) = \frac{a_I \times m_s}{F_I \times a_s \times m_{ISOMALT}} \times 100$$

where
a_I = peak area of component I (µV·s)
a_S = peak area of internal standard (µV·s)
m_S = mass of internal standard used for derivatization (mg d.s.)
$m_{ISOMALT}$ = mass of sample used for derivatization (mg d.s.)
F_I = relative response factor f_I/f_S
f_I = response factor of component I: $f_I = (a_I/m_I) \times (100/\%\ \text{purity})$
f_S = response factor of internal standard: $f_S = (a_S/m_S) \times (100/\%\ \text{purity})$
m_I, m_S = mass of component I or internal standard used for derivatization of standard sample (mg d.s.)

(NOTE: Use maltitol as internal standard for the calculation of hydrogenated disaccharides (e.g. 1,1-GPM, 1,6-GPS) and phenyl-ß-D-glucoside for the calculation of hydrogenated monosaccharides (mannitol, sorbitol). For the total of other saccharides (hydrogenated or not), subtract the sum of 1,1-GPM, 1,6-GPS, sorbitol and mannitol from 100%.)

MONOMAGNESIUM PHOSPHATE

Prepared at the 69th JECFA (2008), published in FAO JECFA Monographs 5 (2008), based on the previously withdrawn tentative specifications prepared at the 61st JECFA and published in FNP 52, Add 11 (2003). A group MTDI of 70 mg/kg bw, expressed as phosphorus from all food sources, was established at the 26th JECFA (1982).

SYNONYMS Monomagnesium orthophosphate, Magnesium dihydrogen phosphate; Magnesium phosphate, monobasic; Magnesium biphosphate; Acid magnesium phosphate; INS No. 343(i)

DEFINITION Monomagnesium phosphate is manufactured by partial neutralization of phosphoric acid with magnesium oxide and drying of the resultant product.

Chemical names: Monomagnesium dihydrogen phosphate

C.A.S. number: 13092-66-5 (Anhydrous)
15609-87-7 (Dihydrate)

Chemical formula: $Mg(H_2PO_4)_2 \cdot x\ H_2O$ (x = 0 to 4)

Formula weight: 218.3 (Anhydrous)
254.3 (Dihydrate)
290.3 (Tetrahydrate)

Assay: Not less than 96% and not more than 102% as $Mg_2P_2O_7$ on the ignited basis

DESCRIPTION White, odourless, crystalline powder

FUNCTIONAL USES Acidity regulator, nutrient

CHARACTERISTICS

IDENTIFICATION

Solubility (Vol. 4): Slightly soluble in water

Magnesium (Vol. 4): Passes test

Phosphate (Vol. 4): Passes test

PURITY

Loss on drying (Vol. 4): Anhydrous: Not more than 1.5 % (105°, 4 h)

Lost of ignition (Vol. 4): Anhydrous: Not more than 18.5 %
Dihydrate: Not more than 33 %
Tetrahydrate: Not more than 43%

Accurately weigh about 2 g of sample, and ignite, preferably in a muffle furnace at about 800° for 30 min. Allow the crucible to cool

in a desiccator to constant weight. Save the residue for the Assay.

Fluoride (Vol. 4) — Not more than 10 mg/kg
See description under TESTS

Arsenic (Vol. 4) — Not more than 3 mg/kg
Determine by the atomic absorption hydride technique. The selection of sample size and method of sample preparation may be based on the principles of the methods described in Volume 4 (under “General Methods, Metallic Impurities”).

Lead (Vol. 4) — Not more than 4 mg/kg
Determine using an atomic absorption/ICP technique appropriate to the specified level. The selection of sample size and method of sample preparation may be based on the principles of the methods described in Volume 4 (under “General Methods, Metallic Impurities”).

TESTS

PURITY TESTS

Fluoride (Vol. 4) — Use Method III. The standard curve constructed in Method III may not be suitable for samples containing low fluoride levels. Therefore, it will be necessary to prepare standard solutions with concentrations other than those specified for Method III for the construction of a standard curve and to choose a sample size that will bring the fluoride concentration within the standard curve.

METHOD OF ASSAY

Accurately weigh 200 mg of the residue obtained in the test for Loss on ignition in a high 250 ml beaker. Dissolve the residue in 2 ml of hydrochloric acid (16 %) and add 100 ml of water. Heat the solution to 50° to 60° and add 10 ml of 0.1 M disodium EDTA from a buret. Add a magnetic stirring bar and, while stirring, adjust with 1 N sodium hydroxide to pH 10. Add 10 ml of ammonia-ammonium chloride buffer TS (Vol. 4), 12 drops of Eriochrome black TS and continue the titration with 0.1 M disodium EDTA until the red colour changes to green. [NOTE: The solution must be clear when the end point is reached] Calculate the weight (mg) of $Mg_2P_2O_7$ in the residue taken by the formula

$$9.14 \times V$$

where V is the volume (ml) of 0.1 M disodium EDTA required in the titration.

PAPRIKA EXTRACT
(TENTATIVE)

New tentative specifications prepared at the 69th JECFA (2008), published in FAO JECFA Monographs 5 (2008). No ADI was allocated at the 69th JECFA (2008).

Information required on batches of commercially available products:

- *analytical data on composition*
- *levels of capsaicinoids*
- *levels of arsenic*

SYNONYMS INS No. 160c, Capsanthin, Capsorubin

DEFINITION Paprika extract is obtained by solvent extraction of the dried ground fruit pods of *Capsicum annuum.* The major colouring compounds are capsanthin and capsorubin. Other coloured compounds, such as other carotenoids are also present. The balance of the extracted material is lipidic in nature and varies depending on the primary extraction solvent. Commercial preparations may be diluted and standardised with respect to colour content using refined vegetable oil.

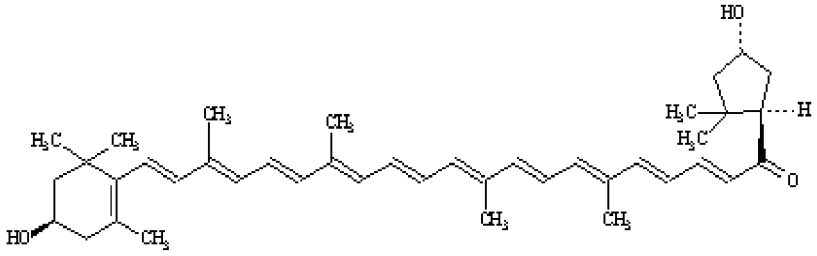
Only methanol, ethanol, 2-propanol, acetone, hexane, ethyl acetate and supercritical carbon dioxide may be used as solvents in the extraction.

Chemical names: Capsanthin: (3R, 3'S, 5'R)-3,3'-dihydroxy-β,κ-carotene-6-one
Capsorubin: (3S, 3'S, 5R, 5'R)-3,3'-dihydroxy-κ,κ-carotene-6,6'-dione

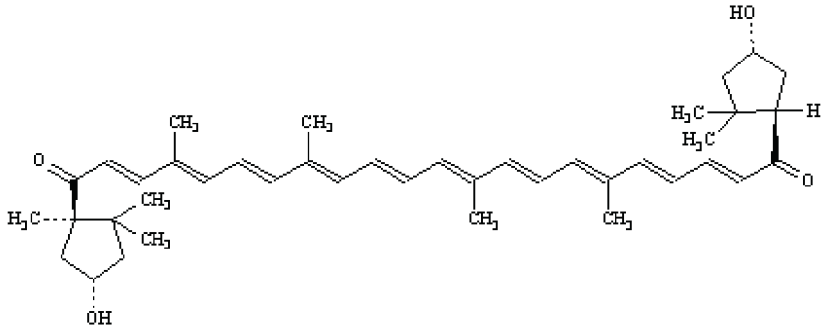
C.A.S number: Capsanthin: 465-42-9
Capsorubin: 470-38-2

Chemical formula: Capsanthin: $C_{40}H_{56}O_3$
Capsorubin: $C_{40}H_{56}O_4$

Structural formula



Capsanthin



Capsorubin

Formula weight

Capsanthin: 584.85
Capsorubin: 600.85

Assay

Total carotenoids: not less than declared.
Capsanthin/capsorubin: Not less than 30% of total carotenoids.

DESCRIPTION

Dark-red viscous liquid

FUNCTIONAL USE

Colour

CHARACTERISTICS

IDENTIFICATION

Solubility

Practically insoluble in water, soluble in acetone

Spectrophotometry

Maximum absorption in acetone at about 462 nm and in hexane at about 470 nm.

Colour reaction

To one drop of sample add 2-3 drops of chloroform and one drop of sulfuric acid. A deep blue colour is produced.

High Performance Liquid Chromatography (HPLC)

Passes test.
See Method of assay, Capsanthin/capsorubin

PURITY

Residual solvents (Vol. 4)

Ethyl acetate, methanol, ethanol, acetone, 2-propanol, hexane: Not more than 50 mg/kg either singly or in combination

Capsaicinoids

Information required on levels in commercial products
See description under TESTS

Arsenic (Vol. 4)

Not more than 3 mg/kg
Determine by the atomic absorption hydride technique. The selection of sample size and method of sample preparation may be based on the principles of the methods described in Volume 4 (under “General Methods, Metallic Impurities”).

Lead (Vol. 4)

Not more than 2 mg/kg
Determine using an atomic absorption/ICP technique appropriate to the specified level. The selection of sample size and method of sample preparation may be based on the principles of the methods described in Volume 4 (under “General Methods, Metallic Impurities”).

TESTS

PURITY TESTS

Capsaicinoids

Capsaicinoids are determined by reversed-phase HPLC (Volume 4 under “Chromatography”) using a reference standard to allow quantification.

Preparation of standard
Prepare all standard solutions in ethanol and keep out of direct sunlight.
- Standard solution A,150 µg/ml: Accurately weigh and transfer 75 mg of N-vanillyl-n-nonenamide, >99 % (CAS Registry Number 2444-46-4) into a 500 ml volumetric flask, dissolve and dilute to volume. Mix thoroughly.
- Standard solution B, 15 µg/ml: Pipet 10 ml standard solution A into a 100 ml volumetric flask, dilute to volume, and mix well.
- Standard solution C, 0.75 µg/ml: Pipet 5 ml of standard solution B into 100 ml volumetric flask, dilute to volume, and mix well.

Preparation of sample
Accurately weigh up to 5 g extract into a 50 ml volumetric flask, do not allow the extract to coat the sides of the flask. Add 5 ml acetone (ACS Grade) to the flask and swirl until the sample is completely dispersed. Ensure the extract has not coated the bottom of flask when neck is at a 45° angle. Slowly add ethanol (95% or denatured) with mixing until the solution becomes cloudy. Dilute to volume and mix well. Directly pipet 5 ml sample mixture into a 10 ml syringe attached to a 6 ml C-18 SEP-PAK cartridge. Take care to avoid coating of sample on the sides of syringe. Allow the aliquot to pass through the SEP-PAK and collect the eluent in a 25 ml volumetric flask. Rinse the SEP-PAK with three 5 ml portions of ethanol, and collect in the flask. Dilute to volume with ethanol and mix. Filter through a 0.45 µm syringe filter and collect in a glass vial.

Apparatus
Liquid chromatograph equipped with a 20 µl sample loop injector, a fluorescence detector and/or ultraviolet detector and integrator.
Column: LC-18 (150 x 4.6 mm id, 5 µm)
Detector:
Fluorescence - Excitation 280 nm and emission 325 nm
UV Detector - 280 nm
Mobile phase: 40% acetonitrile and 60% deionised H_2O containing 1% Acetic acid (v/v).
Flow rate: 1.5 ml/min

Procedure

Inject 20 µl of the sample solution in duplicate. Inject the appropriate standard solution (Standard solution C is appropriate for samples expected to contain low levels of capsaicins) prior to the first sample injection and after every 6 sample injections. Purge the column with 100% acetonitrile for 30 min at 1.5 ml/min after no more than 30 sample injections. Equilibrate with mobile phase prior to further determinations.

Calculations

Calculate individual capsaicinoids (µg/ml) as follows:

Nordihydrocapsaicin: $C_N = (N/A) \times (Cs/RN)$
Capsaicin: $C_C = (C/A) \times (Cs/RC)$
Dihydrocapsaicin: $C_D = (D/A) \times (Cs/RD)$

Total capsaicins (µg/ml) = nordihydrocapsaicin + capsaicin + dihydrocapsaicin

where

A = average peak area of standard;
N, C, and D = average peak areas for respective capsaicinoids (nordihydrocapsaicin, capsaicin and dihydrocapsaicin) from duplicate injections;
Cs = concentration of std in µg/ml;
$C_{N,C,D}$ = concentration of compound in extract expressed as µg/ml;
RN, RC, and RD = response factors of respective capsaicinoids relative to standard.

Response factors:
Nordihydrocapsaicin (N) UV: RN = 0.98; FLU: RN = 0.92
Capsaicin (C) UV: RC = 0.89; FLU: RC = 0.88
Dihydrocapsaicin (D) UV: RD = 0.93; FLU: RD = 0.93
N-vanillyl-n-nonenamide UV: R = 1.00; FLU: R = 1.00
Relative retention times: Nordihydrocapsaicin 0.90; N-vanillyl-n-nonenamide 1.00, Capsaicin 1.00; Dihydrocapsaicin 1.58

Capsanthin/capsorubin

Determine the total carotenoids in paprika extract by spectrophotometry.

Accurately weigh 300 to 500 mg of sample, and transfer quantitatively to a 100 ml volumetric flask. Dilute with acetone to volume, dissolve by shaking and leave to stand for 2 min. Pipet 1 ml of this extract into another 100 ml volumetric flask, dilute to volume with acetone, and shake well. Transfer a portion to the spectrophotometer cell, and read the absorbance A at 462 nm. Adjust the sample concentration to obtain an absorbance between 0.3 and 0.7.

Determine total pigment (%) as capsanthin and capsorubin

$$\text{Total} = \frac{a}{2100} x \frac{10000}{W}$$

where

a = absorbance of sample
2100 = $A^{1\%}_{1cm}$ for capsanthin/capsorubin in acetone at 462 nm
W = weight of sample (g)

Determine the identity and relative purity of paprika extract by reversed-phase HPLC. See Volume 4 under “Chromatography”. The sample is saponified to release the parent hydroxy-carotenoids from the extracts prior HPLC analysis.

Sample preparation

Dissolve 0.2 g of the sample in acetone, quantitatively transfer into a 500 ml separatory funnel and add enough acetone to make up to 100 ml. Add 100 ml diethyl ether and mix well. Remove any insoluble particles by filtration. Add 100 ml of KOH-methanol (20%) and leave the solution for one hour. Shake periodically. Remove the aqueous phase and wash the organic phase several times with distilled water until the washings are neutral. Filter through a bed of anhydrous Na_2SO_4 and evaporate to dryness in a rotary evaporator at a temperature below 35°. Dissolve the pigments in acetone and make up to 25 ml in a volumetric flask. Keep the samples refrigerated until analysis by HPLC. Thoroughly disperse the samples, e.g. by sonication, and filter through a 0.45 µm filter before analysis.

Chromatography

Filter acetone (HPLC grade) and deionised water and de-gas before use.
Column: Reversed-phase C-18 (250 x 4 mm i.d.)
Precolumn: Reversed-phase C-18 (50 x 4 mm i.d.)
Mobile phase: Program a gradient acetone/water as follows:

Time (min)	Acetone (%)	Water (%)
-10 (pre-injection)	75	25
0	75	25
5	75	25
10	95	5
17	95	5
22	100	0
27	75	25

Flow rate: 1.5 ml/min
Detector: Diode array detector, store spectra in the range of 350-600 nm.
Detection wavelength: 450 nm
Injection volume: 5 µl

Identify peaks by comparing the peaks obtained with known standards and quantify the individual carotenoids. Saponified carotenoids will elute in the same order, with capsorubin and some minor carotenoids eluting first and β-carotene in last place. The order of elution is:

- Neoxanthin
- Capsorubin
- Violaxanthin
- Capsanthin
- Antheraxanthin
- Mutatoxanthin
- Cucurbitaxanthin A (Capsolutein)
- Zeaxanthin
- Cryptocapsin
- β-Cryptoxanthin
- β -Carotene

Calculate the percent of each peak using the total area of the peaks in the chromatogram. Sum the percentages of capsanthin and capsorubin to get the total value.

PATENT BLUE V

Prepared at the 69th JECFA (2008), published in FAO JECFA Monographs 5 (2008), superseding specifications prepared at the 31st JECFA (1987), published in the combined Compendium of Food Additive Specifications, FAO JECFA Monographs 1 (2005). No ADI could be allocated at the 26th JECFA (1982).

SYNONYMS CI Food Blue 5, Patent Blue 5; CI (1975) No. 42051; INS No. 131

DEFINITION Patent Blue V consists essentially of the calcium or sodium salt of 2-[(4-diethylaminophenyl)(4-diethylimino-2,5-cyclohexadien-1-ylidene)methyl]-4-hydroxy-1,5-benzenedisulfonate and subsidiary colouring matters. Water, sodium chloride, sodium sulfate, calcium chloride, and calcium sulfate can be present as the principal uncoloured components.

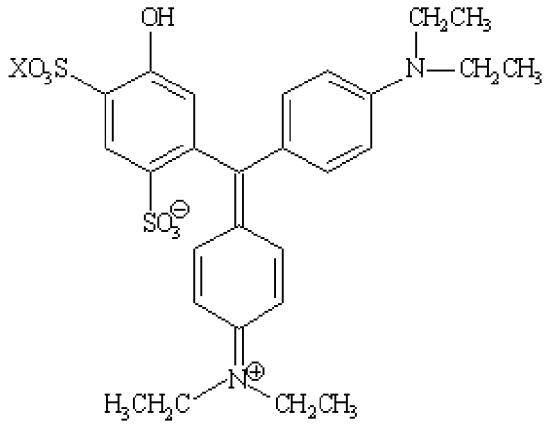
Patent Blue V may be converted to the corresponding aluminium lake, in which case only the *General Specifications for Aluminium Lakes of Colouring Matters* applies.

Chemical names: Calcium or sodium salt of 2-[(4-diethylaminophenyl)(4-diethylimino-2,5-cyclohexadien-1-ylidene)methyl]-4-hydroxy-1,5-benzene-disulfonate; Calcium or sodium salt of [4-[*alpha*-(4-diethyl-aminophenyl)-5-hydroxy-2,4-disulfonatophenylmethylidene]-2,5-cyclohexadien-1-ylidene] diethylammonium hydroxide inner salt

C.A.S. number: 3536-49-0

Chemical formula: Calcium salt: $C_{27}H_{31}N_2O_7S_2{}^1/_2Ca$
Sodium salt: $C_{27}H_{31}N_2O_7S_2Na$

Structural formula:



where
X = ½Ca for the calcium salt
X = Na for the sodium salt

Formula weight: ½Calcium salt: 579.14
Sodium salt: 582.15

Assay: Not less than 85% total colouring matter

DESCRIPTION Blue powder or granules

FUNCTIONAL USES Colour

CHARACTERISTICS

IDENTIFICATION

Solubility (Vol. 4)	Soluble in water; slightly soluble in ethanol
Colouring matters, Identification (Vol. 4)	Passes test

PURITY

Water content (Loss on drying) (Vol. 4)	Not more than 15% together with chloride and sulfate calculated as sodium salts
Water-insoluble matter (Vol. 4)	Not more than 0.5%
Lead (Vol. 4)	Not more than 2 mg/kg Determine using an AAS/ICP-AES technique appropriate to the specified level. The selection of sample size and method of sample preparation may be based on the principles of the methods described in Volume 4 (under “General Methods, Metallic Impurities”).
Chromium (Vol. 4)	Not more than 50 mg/kg Determine using an AAS/ICP-AES technique appropriate to the specified level. The selection of sample size and method of sample preparation may be based on the principles of the methods described in Volume 4 (under “General Methods, Metallic Impurities”)
Subsidiary colouring matter content (Vol. 4)	Not more than 2% Use the following conditions: Chromatography solvent: n-butanol:water:ethanol:ammonia (s.g. 0.880) (600:264:135:6) Height of ascent of solvent front: approximately 17 cm
Organic compounds other than colouring matters	Not more than 0.5% (Sum of 3-hydroxybenzaldehyde, 3-hydroxybenzoic acid, 3-hydroxy-4-sulfonatobenzoic acid and *N,N*-diethylaminobenzenesulfonic acids) See description under TESTS
Leuco base (Vol. 4)	Not more than 4% Proceed as directed in Volume 4 using the following parameters: - Sample: 110 mg - Ratio of the formula weight of the colouring matter to the formula weight of its leuco base: Sodium salt: 582.15/606.66 = 0.95960 ½Calcium salt: 579.14/600.76 = 0.96401 - Absorptivity: 0.200 l/(mg·cm) at 638 nm
Unsulfonated primary aromatic amines (Vol. 4)	Not more than 0.01%, calculated as aniline

Ether-extractable matter (Vol. 4) — Not more than 0.2%

TESTS

PURITY TESTS

Organic compounds other than colouring matters (Vol. 4) — Proceed as directed under *Determination by High Performance Liquid Chromatography* using the following conditions:
Instrument: High Performance Liquid Chromatograph fitted with a gradient elution accessory

Detector: A UV detector monitored at 254 nm
Column: 250 x 4 mm (Kartusche). LiChrosorb RP 18, 7 µm or equivalent.
Mobile phase:
(A) Acetate buffer pH 4.6: water (10% w/v) - prepared using 1 M sodium hydroxide, 1 M acetic acid and water (5:10:35)
(B) Acetonitrile

Gradient

Min	*% (A)*	*% (B)*	*Flow rate (ml/min)*
0	85	15	1
12	85	15	1
25	20	80	2
28	20	80	2
40	85	15	1

METHOD OF ASSAY

Proceed as directed under *Colouring Matters Content by Titration with Titanous Chloride* (Volume 4), under *Food Colours, Colouring Matters*), using the following:
Weight of sample: 1.3-1.4 g
Buffer: 15 g sodium hydrogen tartrate
Weight (*D*) of colouring matters equivalent to 1.00 ml of 0.1 N TiCl3:
28.98 mg of the calcium salt
29.13 mg of the sodium salt.

PHOSPHOLIPASE C EXPRESSED IN *PICHIA PASTORIS*

New specifications prepared at the 69th JECFA (2008), published in FAO JECFA Monographs 5 (2008). An ADI "not specified" was established at the 69th JECFA (2008).

SYNONYMS Phospholipase C; lecithinase C; lipophosphodiesterase C; phosphatidase C

SOURCES Phospholipase C is produced by submerged fed-batch fermentation of a genetically modified strain of Pichia pastoris which contains the phospholipase C gene derived from a soil sample. The enzyme is recovered from the fermentation broth. The recovery process includes the separation of cellular biomass, clarification, ultrafiltration, diafiltration, and polish filtration. The final product is formulated using food-grade stabilizing and preserving agents and is standardized to the desired activity.

Active principles: Phospholipase C

Systematic names and numbers: Phosphatidylcholine cholinephosphohydrolase; EC 3.1.4.3; CAS No. 9001-86-9

Reactions catalysed: Hydrolysis of phosphodiester bonds at the sn-3 position in glycerophospholipids including phosphatidylcholine, phosphatidylethanolamine, and phosphatidylserine to yield 1,2-diacylglycerol and the corresponding phosphate esters

Secondary enzyme activities: No significant levels of secondary enzyme activities.

DESCRIPTION Yellow to brown liquid

FUNCTIONAL USES Enzyme preparation.
Used in refining vegetable oils intended for human consumption.

GENERAL SPECIFICATIONS Must conform to the latest edition of the JECFA General Specifications and Considerations for Enzyme Preparations Used in Food Processing.

CHARACTERISTICS

IDENTIFICATION

Phospholipase C activity: The sample shows phospholipase C activity.
See description under TESTS.

TESTS

Enzyme activity

Principle
Phospholipase C catalyses the hydrolysis of phosphatidylcholine to 1,2-diacylglycerol and phosphorylcholine. Phosphorylcholine is subsequently titrated with potassium hydroxide. The activity of phospholipase C is determined by measuring the rate of

consumption of potassium hydroxide required to maintain pH 7.3 at 37°.

The enzyme activity is expressed in phospholipase C units (PLCU). One phospholipase C unit is defined as the quantity of the enzyme that will hydrolyse 1 µmol phosphatidylcholine per minute under standard conditions (pH=7.3; 37°).

Apparatus
Auto-titrator (Brinkmann Instruments, Titrandos® 835 or equivalent)
pH meter (Beckman Coulter, model F350 or equivalent)
Homogenizer (M133/1281-0, 2-speed, BioSpec Products, catalog # 1281, or equivalent)
Circulating water bath

Reagents and solutions
(NOTE: use deionized water)

Potassium hydroxide (0.01 N): 0.01 N KOH certified titration reagent (Brinkmann Instruments 019091104 or equivalent). Use for titration of phosphorylcholine in the phospholipase C activity assay.

Zinc sulfate solution (100 mM): Weigh 2.88 g of zinc sulfate heptahydrate (crystalline, certified ACS) and dissolve in water in a 100-ml volumetric flask. Add water to volume. The solution is stable for up to 30 days at room temperature.

Calcium chloride solution (100 mM): Weigh 1.47 g of calcium chloride dihydrate (certified ACS) and dissolve in water in a 100-ml volumetric flask. Add water to volume. The solution is stable for up to 30 days at room temperature.

Triton X-100 solution (approximately 10%): Weigh 10 g of Triton X-100 (Sigma-Aldrich T9284 or equivalent) into a 200-ml beaker. Add 100 ml of water and mix for at least 1 hr on a rotating table. The solution is stable in a closed container for up to 30 days at room temperature.

Substrate solution (20 mM phosphatidylcholine, approximately 2.5% Triton X-100, 5 mM calcium chloride): Weigh 3.24 g of phosphatidylcholine (Phospholipon 90G (containing at least 94% phosphatidylcholine), American Lecithin Company or equivalent) into a 500 ml beaker. Add 50 ml of 10% Triton X-100 solution and 10.0 ml of 100 mM calcium chloride solution. Adjust volume to 200 ml with water and mix. Homogenize the solution using a hand-held homogenizer at low setting (7,000 rpm) for approx. 45 sec or until a uniform dispersion is obtained. Check the pH and, if necessary, adjust to the range of 6.5-7.0 using 0.2 N sodium hydroxide solution certified, Fisher Scientific SS274-1 or equivalent). The solution should be prepared on the day of testing.

Dilution buffer (0.1% Triton X-100, 1 mM zinc sulfate, 1% gum arabic): Weigh 0.5 g of Triton X-100 and 5.0 g of gum arabic (Sigma-Aldrich G9752 or equivalent). Dissolve with stirring in 450 ml of water in a 1000 ml beaker. Add 5 ml of 100 mM zinc sulfate solution and adjust the pH to the range 7.0-7.2 using 0.2 N sodium hydroxide solution. Transfer to a 500 ml volumetric flask and add

water to volume. The solution is stable for up to 30 days at 4°.

Sample solution: Weigh to ±0.1 mg approximately 1 g of the phospholipase C enzyme preparation into a 50 ml volumetric flask. Add the dilution buffer to volume and mix. Dilute with the dilution buffer to obtain a solution with an activity of approximately 12 PLCU/ml. The solution should be prepared on the day of testing.

Procedure

1. Program the titrator to maintain the pH 7.3 and measure the consumption of 0.01 N KOH in milliliters per minute.
2. Set the temperature of the recirculating water bath at 37°.
3. Calibrate the pH electrode at pH 4, 7, and 10.
4. Transfer 20 ml of the substrate solution into the water-jacketed titration vessel of 50 ml capacity connected to the recirculating water bath, cover with the lid and stir.
5. Allow the substrate solution to equilibrate to 37°.
6. Start the titration program.
7. The titrator will adjust the pH of the substrate solution to 7.3 using 0.01 N KOH.
8. Add 50 µl of the sample solution.
9. Allow the titration to proceed automatically. The titrator will record the titration curve and calculate the slope. The slope between 2 and 6 minutes is used by the titrator to calculate the phospholipase C activity. Alternatively, the calculation can be performed manually.

NOTE: The slope must be within 0.02-0.1 ml/min. If the slope is outside this range or if the titration has not started within the first two minutes, adjust the activity of the sample solution.

Calculation

Use the following formula for manual calculation of phospholipase C activity:

$$\text{Activity (PLCU/g)} = \frac{V \times DF \times S \times N \times 1000}{V_s \times W}$$

Where:

V is the initial volume of the sample solution (50 ml)

DF is the dilution factor

S is the slope of the titration curve (ml/min)

N is the normality of potassium hydroxide (0.01 mmol/ml)

1000 is the conversion factor from millimoles to micromoles

Vs is the volume of the sample solution used in the assay (0.05 ml)

W is the sample weight (g)

PHYTOSTEROLS, PHYTOSTANOLS AND THEIR ESTERS

New specifications prepared at the 69th JECFA (2008), published in FAO JECFA Monographs 5 (2008). An ADI of 0-40 mg/kg bw, expressed as the sum of phytosterols and phytostanols in their free form, was established at the 69th JECFA (2008).

SYNONYMS

Plant sterols/stanols, Plant sterol/stanol esters, Phytosterol/Phytostanol esters

DEFINITION

Phytosterols, phytostanols and their esters are a group of steroid alcohols and esters that occur naturally in plants. The B-ring of the steroidal moiety of phytosterols is unsaturated in the 5-6 position and is saturated in phytostanols. Phytosterols and phytostanols are isolated from deoderizer distillate (a by-product of edible oil production), or derived from tall oil (a by-product of wood pulp manufacture). They are purified by distillation, extraction, crystallization and washing resulting in products of high purity. Phytosterol blends derived from either vegetable oils or tall oil may be converted to the corresponding phytostanols by catalytic saturation. Some phytosterols and phytostanols may be extracted as esters of fatty acids. Esters are also produced by reacting the sterol/stanols with fatty acids derived from food grade vegetable oils. The fatty acid ester chain may be saturated, mono- or polyunsaturated depending on the source of the vegetable oil. Commercial products may be mixtures of phytosterols, phytostanols and their esters. The production process may include the use of hexane, 1-propanol, ethanol and methanol.

Chemical names

The major free phytosterols and phytostanols are listed below. In some preparations they are esterified with vegetable oil fatty acids.

Sitosterol: (3β)-Stigmast-5-en-3-ol
Sitostanol: (3β,5α)-Stigmastan-3-ol
Campesterol: (3β)-Ergost-5-en-3-ol
Campestanol: (3β,5α)-Ergostan-3-ol
Stigmasterol: (3β)-Stigmasta-5,22-dien-3-ol
Brassicasterol: (3β)-Ergosta-5,22-dien-3-ol

Esters of sitostanol: for example, sitostanyl oleate
Esters of campesterol: for example, campesteryl oleate

C.A.S numbers

The major free phytosterols and phytostanols are listed below. In some preparations they are esterified with vegetable oil fatty acids. Esterified forms have not been assigned C.A.S numbers

Sitosterol: 83-46-5
Sitostanol: 83-45-4
Campesterol: 474-62-4
Campestanol: 474-60-2
Stigmasterol: 83-48-7
Brassicasterol: 474-67-9

Chemical formula

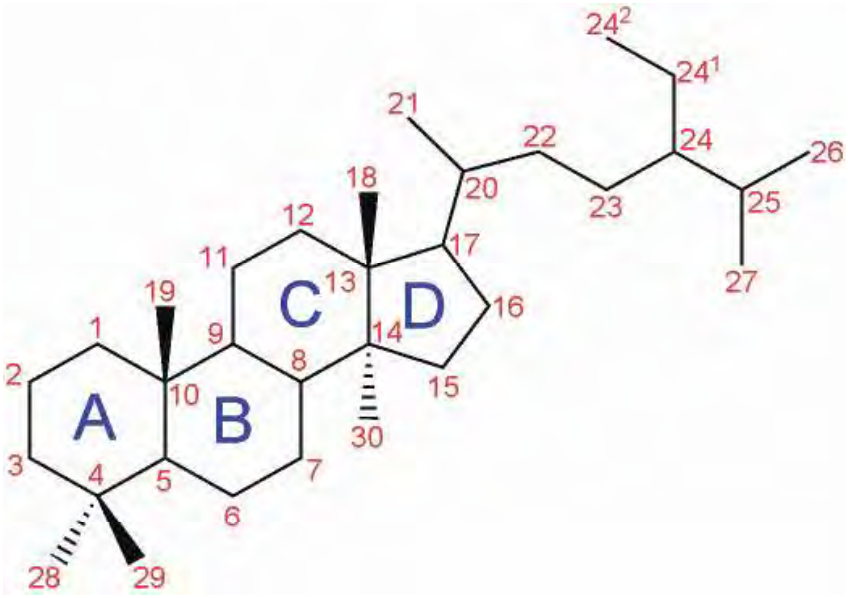
The major free phytosterols and phytostanols are listed below. In some preparations they are esterified with vegetable oil fatty acids ranging in chain-length from C14 to C18.

Sitosterol: $C_{29}H_{50}O$
Sitostanol: $C_{29}H_{52}O$
Campesterol: $C_{28}H_{48}O$
Campestanol: $C_{28}H_{50}O$
Stigmasterol: $C_{29}H_{48}O$
Brassicasterol: $C_{28}H_{46}O$

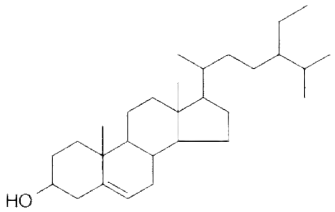
Examples of phytosteryl and phytostanyl esters:
Campesteryl oleate: $C_{46}H_{81}O_2$
Sitostanyl oleate: $C_{47}H_{85}O_2$

Structural formulae

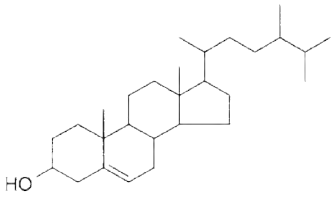
Steroid skeleton



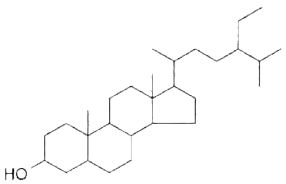
Some examples of phytosterols, phytostanols and a phytostanyl ester



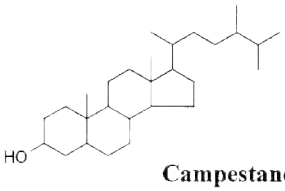
Sitosterol



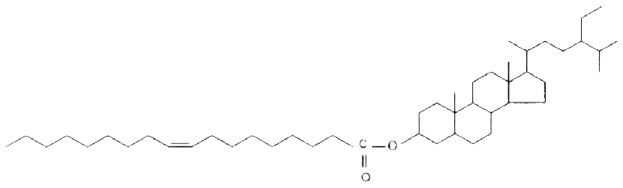
Campesterol



Sitostanol



Campestanol



Sitostanyl oleate

Formula weight

Sitosterol: 414.72
Sitostanol: 416.73
Campesterol: 400.69
Campestanol: 402.70
Stigmasterol: 412.67
Brassicasterol: 398.67

Examples of phytosteryl and phytostanyl esters:
Campesteryl oleate: 683.19
Sitostanyl oleate: 699.19

Assay

Products containing only free sterols and stanols: not less than 95% on a total free sterol/stanol basis.
Products containing only esterified sterols and stanols: not less than 55% sterol/stanol on a saponifed sample.
Products that are mixtures of free and esterified sterols and stanols: the content of stanols/sterols ranges between 55 and 95% as determined by measurement of free sterols/stanols in a native and saponified sample.
Difference between 55% and 95% is attributable to the fatty acid ester component.

DESCRIPTION

Free-flowing, white to off-white powders, pills or pastilles; colourless to pale yellow liquids

FUNCTIONAL USE

This preparation serves no technological purpose in food. It is added to food as a source of phytosterols and phytostanols.

CHARACTERISTICS

IDENTIFICATION

Solubility

Practically insoluble in water.
Phytosterols and phytostanols are soluble in acetone and ethyl acetate.
Phytosterol and phytostanol esters are soluble in hexane, iso-octane and 2-propanol

Gas Chromatography (Vol. 4)

The retention time for the major peak of a saponified sample in a GC chromatogram of the sample corresponds to that of the β-sitosterol/sitostanol standard using the conditions described in the Method of Assay. The relative retention times of β-sitosterol/sitostanol are approximately 1.066 and 1.073, respectively.

PURITY

Total ash (Vol. 4)

Not more than 0.1 %

Residual solvents (Vol. 4)

Hexane, 1-propanol, ethanol or methanol: 50 mg/kg either singly or

in combination

Water (Vol. 4) — Not more than 4% (Karl Fischer). The selection of sample size and method of sample preparation may be based on the principles of the methods described in Volume 4 (under “General Methods, Water Determination”)

Arsenic (Vol. 4) — Not more than 3 mg/kg
Determine by the atomic absorption hydride technique. The selection of sample size and method of sample preparation may be based on the principles of the methods described in Volume 4 (under “General Methods, Metallic Impurities”).

Lead (Vol. 4) — Not more than 1 mg/kg
Determine using an AAS/ICP-AES technique appropriate to the specified level. The selection of sample size and method of sample preparation may be based on the principles of the method described in Volume 4 (under “General Methods, Metallic Impurities”).

METHOD OF ASSAY

Principle

Sterols/stanols are silylated and analysed by gas chromatography with flame ionization detection (Volume 4, “Analytical Techniques, Chromatography”). Esterified sterols/stanols are first saponified and the non-polar components are extracted, dried and silylated. For quantification an internal standard is added to the sample.

Sample preparation

a. Free sterols/stanols

Accurately weigh approximately 15 mg 5α-cholestane and approximately 50 mg sterol concentrate into a reaction vial. Add approximately 1 ml methyl tert-butyl ether (MTBE) to dissolve the sample. Warm to 40 – 50° to improve solubility. Add 4.0 ml hexane and mix. Transfer 50 µl of the solution to a small test-tube and evaporate to dryness under nitrogen at 50 – 60°. Add 60 µl N,O-Bis(trimethylsilyl)trifluoroacetamide (BSTFA) and 240 µl pyridine, mix, cap the tube and heat at 60 – 70° for approximately 30 minutes. Mix the solution after 5 – 10 minutes. Add 1.7 ml heptane, mix and transfer the solution to a GC vial.

b. Sterol/stanol esters

Accurately weigh approximately 15 mg 5α-cholestane and approximately 100 mg sterol ester accurately into a reaction vial. Add 2 ml ethanolic potassium hydroxide solution (6.6 g KOH in 50 ml ethanol), mix and heat for 90 minutes at 70°. Mix the solution every 15 minutes during saponification. Add 1 ml water and 4 ml heptane to the saponified solution and mix thoroughly for 15 seconds. Wait until the two layers separate completely and transfer the heptane extract to a test-tube. Repeat the extraction twice with 4 ml heptane, collect all three heptane extracts in the same test tube and mix thoroughly. Transfer 50 µl of the solution to a small test-tube and evaporate to dryness under nitrogen at 70 – 80°. Add 60 µl BSTFA and 240 µl pyridine, mix, cap the tube and heat at 60 – 70° for approximately 30 minutes. Mix the solution after 5 – 10 minutes. Add 1.7 ml heptane, mix and transfer the solution to a GC vial.

Equipment

Gas chromatograph, suitable for capillary columns equipped with:

- flame ionization detector (FID)
- cold on-column injector
- autosampler

Capillary column:
- Precolumn: uncoated fused silica capillary, (apolar deactivated), 1.0 m x 0.53 mm i.d. (e.g. Interscience, HRGC precolumn, code 26060370, or equivalent)
- Analytical column 1: CP SIL 13CB, (length 25 m, 0.25 mm i.d.) 0.2 µm film thickness (the dimensions of the column may be altered to accommodate commercially available columns)
- Analytical column 2: CP SIL 8CB, (length 30 m, 0.25 mm i.d.) 0.25 µm film thickness (the dimensions of the column may be altered to accommodate commercially available columns)
All columns are to be connected together with glass quick-seal connectors.

Suitable GC conditions:
- Helium carrier gas flow: 0.9 ml/min
- Detector Temperature: 325°
- FID flow air: 300 ml/min
- FID flow H_2: 30 ml/min
- FID flow makeup N_2: 30 ml/min

Procedure
Inject 0.5 µl of the sample into the gas chromatograph and run according to the following oven temperature program: 60° (for 1 min), then 15°/min up to 250°, then 2°/min up to 300° (hold for 18 min).

Peak assignment and identification of individual components
Identify the main components using a reference sample of known composition. The table of relative retention times given below should be used as a further guide. All other peaks should be identified as unknown.

Component	Relative retention time (-)
5α-cholestane (internal standard)	0.761
Cholesterol	0.929
Cholestanol	0.934
Brassicasterol	0.958
Cholestanone	0.967
24-methylcholesterol	0.989
Campesterol	1.000
Campestanol	1.007
Stigmasterol	1.021
Unidentified stanol	1.028
δ7-campesterol	1.044
Unidentified sterol 1	1.048
Clerosterol	1.053
Sitosterol	1.066
Sitostanol	1.073
δ5-avenasterol	1.080
Unidentified sterol 2	1.094
δ7-stigmastenol	1.103

δ7-avenasterol	1.115
Unidentified sterol 3	1.133

Calculation of result

Calculation of the concentration of the individual components (mg/kg)

$$C_I = \frac{C_{IS} \times V_{IS} \times A_{component} \times PURITY_{IS} \times 10^6}{A_{IS} \times W_s \times RF}$$

where:
C_I = component
C_{IS} = internal standard concentration (mg/ml)
V_{IS} = internal standard volume (ml)
$A_{component}$ = peak area of individual component
$PURITY_{IS}$ = purity internal standard (%)
A_{IS} = internal standard peak area
W_s = sample weight (mg)
RF = response factor of FID, RF = 1.05 for stanols and 1.00 for other components

Report all sterols/stanols individually. Report the sum of the unidentified sterols/stanols as “unknown sterols/stanols”. Report all other peaks in the chromatogram as unknowns (sum value).

POLYDIMETHYLSILOXANE

Prepared at the 69th JECFA (2008), published in FAO JECFA Monographs 5 (2008), superseding specifications prepared at the 37th JECFA (1990), published in the Combined Compendium of Food Additive Specifications, FAO JECFA Monographs 1 (2005). A temporary ADI of 0-0.8 mg/kg bw was established at the 69th JECFA (2008).

SYNONYMS Poly(dimethylsiloxane), dimethylpolysiloxane, dimethylsilicone fluid, dimethylsilicone oil; dimethicone; INS No. 900a

DEFINITION Polydimethylsiloxane consists of fully methylated linear siloxane polymers containing repeating units of the formula $[(CH_3)_2SiO]$ with trimethylsiloxy end-blocking units of the formula $(CH_3)_3SiO$-. The additive is produced by hydrolysis of a mixture of dimethyldichlorosilane and a small quantity of trimethylchlorosilane. The average molecular weights of the linear polymers range from approximately 6,800 to 30,000.

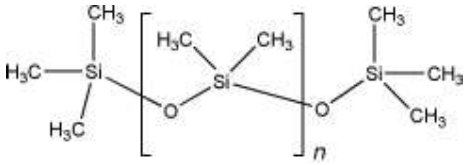
(NOTE: In commerce, polydimethylsiloxane is frequently used in preparations usually containing silica gel. The pure substance described in this monograph can be isolated from silica gel-containing liquids by centrifuging at about 20,000 rpm. Before testing the Polydimethylsiloxane for *Identification, Refractive index*, *Specific gravity*, and *Viscosity*, any silica gel present must be removed by centrifugation.)

(NOTE: This monograph does not apply to aqueous formulations of Polydimethylsiloxane containing emulsifying agents and preservatives, in addition to silica gel.)

Chemical names α-(Trimethylsilyl)-ω-methylpoly(oxy(dimethylsilylene))

C.A.S. number 9006-65-9

Structural formula



n ranges from 90 to 410

Assay Silicon content not less than 37.3% and not more than 38.5% of the total

DESCRIPTION Clear, colourless, viscous liquid.

FUNCTIONAL USES Antifoaming agent, anticaking agent

CHARACTERISTIS

IDENTIFICATION

Solubility (Vol. 4)	Insoluble in water and in ethanol; soluble in most aliphatic and aromatic hydrocarbon solvents
Specific gravity (Vol. 4)	d^{25}_{25} : 0.964 - 0.977
Refractive index (Vol. 4)	n^{25}_{D} : 1.400 - 1.405
Infrared absorption	The infrared absorption spectrum of a liquid film of the sample between two sodium chloride plates exhibits relative maxima at the same wavelengths as those of a similar preparation of USP Dimethylpolysiloxane Reference Standard (available through http://www.usp.org/referenceStandards/catalog.html or by mail to USP 12601 Twinbrook Pkwy, Rockville, MD 20852 USA).

PURITY

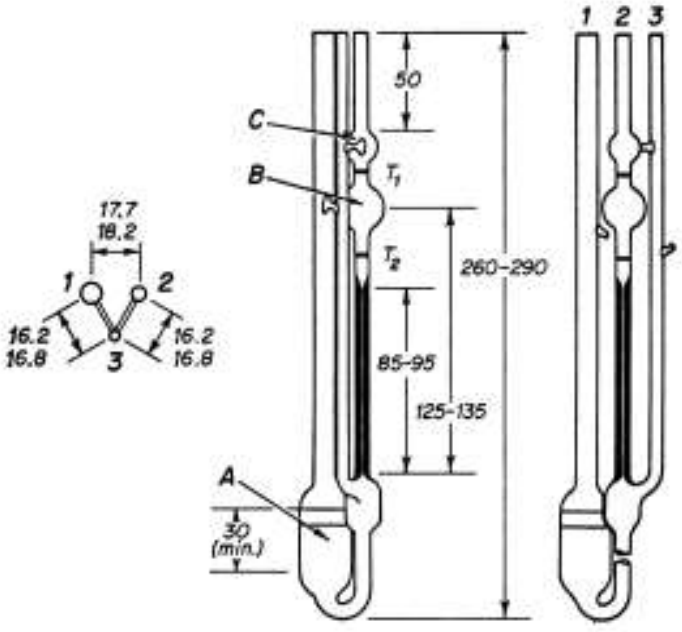
Loss on drying (Vol.4)	Not more than 0.5% (150°, 4h)
Viscosity	100 - 1500 cSt at 25° See description under TESTS
Lead (Vol. 4)	Not more than 1 mg/kg Determine using an AAS/ICP-AES technique appropriate to the specified level. The selection of sample size and method of sample preparation may be based on principles of methods described in Volume 4 (under “General Methods, Metallic Impurities”).

TESTS

PURITY TESTS

Viscosity

The Ubbelohde suspended level viscometer, shown in the accompanying diagram, is preferred for the determination of the viscosity.



(Dimensions in mm)

For use in the range of 100 to 1,500 centistokes, a No. 3 size viscometer, having a capillary diameter of 2.00 + 0.04 mm, is required. The viscometer should be fitted with holders that satisfy the dimensional positions of the separate tubes as shown in the diagram, and that hold the viscometer vertical. Filling lines in bulb *A* indicate the minimum and maximum volumes of liquid to be used for convenient operation. The volume of bulb *B* is approximately 5 ml.

Calibration of the viscometer

Determine the viscosity constant, *k*, for each viscometer by using an oil of known viscosity. [NOTE: Choose an oil with a viscosity as close as possible to that of the sample to be tested.] Charge the viscometer by tilting the instrument about 30 degrees from the vertical, with bulb *A* below the capillary, and then introduce enough of the sample into tube *1* to bring the level up to the lower filling line. The level should not be above the upper filling line when the viscometer is returned to the vertical position and the sample has drained from tube *1.* Charge the viscometer in such a manner that the U-tube at the bottom fills completely without trapping air.

After the viscometer has been in a constant-temperature bath long enough for the sample to reach temperature equilibrium, place a finger over tube *3* and apply suction to tube *2* until the liquid reaches the center of bulb *C*. Remove suction from tube *2*, then remove the finger from tube *3* and place it over tube *2* until the sample drops away from the lower end of the capillary. Remove the finger from tube *2,* and measure the time, to the nearest 0.1 sec required for the meniscus to pass from the first time mark (T_1) to the second (T_2). In order to obtain accurate results within a reasonable time, the apparatus should be adjusted to give an elapsed time of from 80 to 100 sec.

Calculate the viscometer constant *k* by the equation

$$k = v/t_1,$$

in which *v* is the viscosity, in centistokes, and t_1 is the efflux time, in sec, for the standard liquid.

Viscosity determination of Polydimethylsiloxane

Charge the viscometer with the sample in the same manner as described for the calibration procedure; determine the efflux time, t_2; and calculate the viscosity of the sample, v_s, by the equation

$$v_s = kt_2.$$

METHOD OF ASSAY

Principle

Silicon in the sample is converted to a soluble form by fusion with sodium peroxide. Soluble silicon is measured in the percent range as total silicon by atomic absorption spectrophotometry.

Apparatus

- Fusion apparatus: Parr-type fusion cup; 500-ml nickel beaker; and nickel lid for beaker - or equivalent (avoid use of glassware during fusion and solubilization).
- Instrument: atomic absorption spectrophotometer with silicon hollow cathode lamp; nitrous oxide - acetylene burner, or equivalent.

Reagents
- Sodium peroxide, glacial acetic acid, silica (of known purity for use as standard).

Procedure
[CAUTION: Normal safe laboratory practices for Parr-type bomb fusion should be followed.]

Equivalent fusions must be performed on sample(s), reagent blank(s) and silica standards for each series of samples. For each sample weigh a portion (*W*) not to exceed 0.3 g into a Parr-type fusion cup (use gelatin capsules for liquid samples). Add 15.0±0.5 g of sodium peroxide.

Assemble the fusion apparatus and place it in a protective ignition rack. Fill the cavity above the cap with water and keep it full during ignition to prevent the gasket from melting. Heat the bottom of the cup with a blast lamp until the cup becomes cherry red about 100 mm up from the bottom within 90 sec. Quench the apparatus in ice water and disassemble the apparatus. Place the cup in the nickel beaker containing 150 to 200 ml of distilled water. Rinse any material adhering to the inside of the assembly cap into the beaker with distilled water. Cover the beaker with the nickel lid. When dissolution is complete and the solution has cooled, remove the cup from the beaker and rinse it with distilled water into the beaker. Add 55.0 ml of reagent grade glacial acetic acid to the beaker. Cool the solution to room temperature and transfer it to a 500 ml volumetric flask. Dilute to volume with distilled water. The solution should contain about 100 µg silicon/ml for a sample weight of about 0.13 g. This method performs best if the silicon concentration of the final analysis solution is 1 to 200 µg/ml. Prepare a series of standards using the same fusion technique that brackets the sample.

Measure the absorbance of sample(s), reagent blank and standards at 251.6 nm with the spectrophotometer according to the manufacturer's operating instructions to obtain optimum analysis conditions for maximum lamp output and fuel and oxidant flow rate to the burner (or equivalent procedures for other vaporizing techniques). Adjust the zero absorbance while aspirating the solvent blank (water) used to dilute the samples. Measure the absorbance of sample(s), reagent blank and standards. Estimate the concentration of silicon in the sample solution from the standards, correcting for the reagent blank. Calculate the percent total silicon in the sample by the equation

$$\%\text{Silicon} = 0.05 \times C/W$$

where
C is the silicon concentration of the sample solution (µg/ml)
W is the weight of sample taken (g)

STEVIOL GLYCOSIDES

Prepared at the 69th JECFA (2008), published in FAO JECFA Monographs 5 (2008), superseding specifications prepared at the 68th JECFA (2007), published in FAO JECFA Monographs 5 (2008). An ADI of 0 - 4 mg/kg bw (expressed as steviol) was established at the 69th JECFA (2008).

SYNONYMS

INS no. 960

DEFINITION

The product is obtained from the leaves of *Stevia rebaudiana* Bertoni. The leaves are extracted with hot water and the aqueous extract is passed through an adsorption resin to trap and concentrate the component steviol glycosides. The resin is washed with a solvent alcohol to release the glycosides and product is recrystallized from methanol or aqueous ethanol. Ion exchange resins may be used in the purification process. The final product may be spray-dried.

Stevioside and rebaudioside A are the component glycosides of principal interest for their sweetening property. Associated glycosides include rebaudioside C, dulcoside A, rubusoside, steviolbioside, and rebaudioside B generally present in preparations of steviol glycosides at levels lower than stevioside or rebaudioside A.

Chemical name

Stevioside: 13-[(2-O-β-D-glucopyranosyl-β-D-glucopyranosyl)oxy] kaur-16-en-18-oic acid, β-D-glucopyranosyl ester

Rebaudioside A: 13-[(2-O-β-D-glucopyranosyl-3-O-β-D-glucopyranosyl-β-D-glucopyranosyl)oxy]kaur-6-en-8-oic acid, β-D-glucopyranosyl ester

C.A.S. number

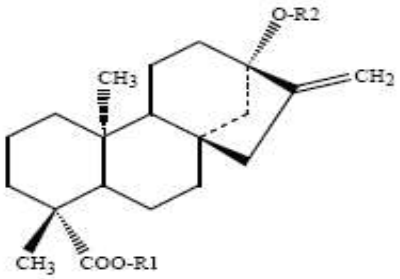
Stevioside: 57817-89-7
Rebaudioside A: 58543-16-1

Chemical formula

Stevioside: $C_{38}H_{60}O_{18}$
Rebaudioside A: $C_{44}H_{70}O_{23}$

Structural Formula

The seven named steviol glycosides:



Compound name	*R1*	*R2*
Stevioside	*β*-Glc	*β*-Glc-*β*-Glc(2→1)
Rebaudioside A	*β*-Glc	*β*-Glc-*β*-Glc(2→1) | *β*-Glc(3→1)
Rebaudioside C	*β*-Glc	*β*-Glc-*α*-Rha(2→1) | *β*-Glc(3→1)
Dulcoside A	*β*-Glc	*β*-Glc-*α*-Rha(2→1)
Rubusoside	*β*-Glc	*β*-Glc
Steviolbioside	H	*β*-Glc-*β*-Glc(2→1)
Rebaudioside B	H	*β*-Glc-*β*-Glc(2→1) | *β*-Glc(3→1)

Steviol (R1 = R2 = H) is the aglycone of the steviol glycosides. Glc and Rha represent, respectively, glucose and rhamnose sugar moieties.

Formula weight

Stevioside: 804.88
Rebaudioside A: 967.03

Assay

Not less than 95% of the total of the seven named steviol glycosides, on the dried basis.

DESCRIPTION

White to light yellow powder, odourless or having a slight characteristic odour. About 200 - 300 times sweeter than sucrose.

FUNCTIONAL USES

Sweetener

CHARACTERISTICS

IDENTIFICATION

Solubility (Vol. 4)

Freely soluble in water