CODEX ALIMENTARIUS
INTERNATIONAL FOOD STANDARDS

Food and Agriculture Organization of the United Nations
World Health Organization

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STANDARD FOR NAMED VEGETABLE OILS

CODEX STAN 210-1999

Adopted in 1999. Revision: 2001, 2003, 2009. Amendment: 2005, 2011, 2013 and 2015.

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1. SCOPE

This Standard applies to the vegetable oils described in Section 2.1 presented in a state for human consumption.

2. DESCRIPTION

2.1 Product definitions

(Note: synonyms are in brackets immediately following the name of the oil)

Arachis oil (peanut oil; groundnut oil) is derived from groundnuts (seeds of *Arachis hypogaea* L.).

Babassu oil is derived from the kernel of the fruit of several varieties of the palm *Orbignya spp*.

Coconut oil is derived from the kernel of the coconut (*Cocos nucifera* L.).

Cottonseed oil is derived from the seeds of various cultivated species of *Gossypium spp*.

Grapeseed oil is derived from the seeds of the grape (*Vitis vinifera* L.).

Maize oil (corn oil) is derived from maize germ (the embryos of *Zea mays* L.).

Mustardseed oil is derived from the seeds of white mustard (*Sinapis alba* L. or *Brassica hirta Moench*), brown and yellow mustard (*Brassica juncea* (L.) Czernajew and Cossen) and of black mustard (*Brassica nigra* (L.) Koch).

Palm kernel oil is derived from the kernel of the fruit of the oil palm (*Elaeis guineensis*).

Palm kernel olein is the liquid fraction derived from fractionation of palm kernel oil (described above).

Palm kernel stearin is the solid fraction derived from fractionation of palm kernel oil (described above).

Palm oil is derived from the fleshy mesocarp of the fruit of the oil palm (*Elaeis guineensis*).

Palm olein is the liquid fraction derived from the fractionation of palm oil (described above).

Palm stearin is the high-melting fraction derived from the fractionation of palm oil (described above).

Palm superolein is a liquid fraction derived from palm oil (described above) produced through a specially controlled crystallization process to achieve an iodine value of 60 or higher.

Rapeseed oil (turnip rape oil; colza oil; ravison oil; sarson oil: toria oil) is produced from seeds of *Brassica napus* L., *Brassica rapa* L., *Brassica juncea* L. and *Brassica tournefortii* Gouan species.

Rapeseed oil - low erucic acid (low erucic acid turnip rape oil; low erucic acid colza oil; canola oil) is produced from low erucic acid oil-bearing seeds of varieties derived from the *Brassica napus* L., *Brassica rapa* L. and *Brassica juncea* L., species.

Rice bran oil (rice oil) is derived from the bran of rice (*Oryza sativa* L).

Safflowerseed oil (safflower oil; carthamus oil; kurdee oil) is derived from safflower seeds (seeds of *Carthamus tinctorious* L.).

Safflowerseed oil - high oleic acid (high oleic acid safflower oil; high oleic acid carthamus oil; high oleic acid kurdee oil) is produced from high oleic acid oil-bearing seeds of varieties derived from *Carthamus tinctorious* L.

Sesameseed oil (sesame oil; gingelly oil; benne oil; ben oil; till oil; tillie oil) is derived from sesame seeds (seeds of *Sesamum indicum* L.).

Soya bean oil (soybean oil) is derived from soya beans (seeds of *Glycine max* (L.) Merr.).

Sunflowerseed oil (sunflower oil) is derived from sunflower seeds (seeds of *Helianthus annuus* L.).

Sunflowerseed oil - high oleic acid (high oleic acid sunflower oil) is produced from high oleic acid oil-bearing seeds of varieties derived from sunflower seeds (seeds of *Helianthus annuus* L.).

Sunflowerseed oil - mid oleic acid (mid-oleic acid sunflower oil) is produced from mid-oleic acid oil-bearing sunflower seeds (seeds of *Helianthus annuus* L.).

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2.2 Other definitions

Edible vegetable oils are foodstuffs which are composed primarily of glycerides of fatty acids being obtained only from vegetable sources. They may contain small amounts of other lipids such as phosphatides, of unsaponifiable constituents and of free fatty acids naturally present in the fat or oil.

Virgin oils are obtained, without altering the nature of the oil, by mechanical procedures, e.g. expelling or pressing, and the application of heat only. They may have been purified by washing with water, settling, filtering and centrifuging only.

Cold pressed oils are obtained, without altering the oil, by mechanical procedures only, e.g. expelling or pressing, without the application of heat. They may have been purified by washing with water, settling, filtering and centrifuging only.

3. ESSENTIAL COMPOSITION AND QUALITY FACTORS

3.1 GLC ranges of fatty acid composition (expressed as percentages)

Samples falling within the appropriate ranges specified in Table 1 are in compliance with this Standard. Supplementary criteria, for example national geographical and/or climatic variations, may be considered, as necessary, to confirm that a sample is in compliance with the Standard.

Low-erucic acid rapeseed oil must not contain more than 2% erucic acid (as % of total fatty acids).

High oleic acid safflower oil must contain not less than 70% oleic acid (as a % of total fatty acids).

High oleic acid sunflower oil must contain not less than 75% oleic acid (as % of total fatty acids).

3.3 Slip point

Palm kernel olein	between 21 to 26 °C
Palm kernel stearin	between 31 to 34 °C
Palm olein	not more than 24°C
Palm stearin	not less than 44°C
Palm superolein	not more than 19.5°C

4. FOOD ADDITIVES

No food additives are permitted in virgin or cold pressed oils.

4.1 Flavours

Natural flavours and their identical synthetic equivalents, and other synthetic flavours, except those which are known to represent a toxic hazard.

4.2 Antioxidants

INS No.	Additive	Maximum Use Level
304	Ascorbyl palmitate	500 mg/kg (Singly or in combination)
305	Ascorbyl stearate	
307a	Tocopherol, d-*alpha*-	300 mg/kg (Singly or in combination)
307b	Tocopherol concentrate, mixed	
307c	Tocopherol, dl-*alpha*	
310	Propyl gallate	100 mg/kg
319	Tertiary butyl hydroquinone (TBHQ)	120 mg/kg
320	Butylated hydroxyanisole (BHA)	175 mg/kg
321	Butylated hydroxytoluene (BHT)	75 mg/kg
Any combination of gallates, BHA, BHT, or TBHQ not to exceed 200 mg/kg within individual limits		
389	Dilauryl thiodiproprionate	200 mg/kg

4.3 Antioxidant synergists

INS No.	Additive	Maximum Use Level
330	Citric acid	GMP
331(i)	Sodium dihydrogen citrate	GMP
331(iii)	Trisodium citrate	GMP
384	Isopropyl citrates	100 mg/kg (Singly or in combination)
472c	Citric and fatty acid esters of glycerol	

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4.4 Anti-foaming agents (oils for deepfrying)

INS No.	Additive	Maximum Use Level
900a	Polydimethylsiloxane	10 mg/kg

5. CONTAMINANTS

The products covered by this Standard shall comply with the maximum levels of the *General Standard for Contaminants and Toxins in Food and Feed* (CODEX STAN 193-1995).

The products covered by this Standard shall comply with the maximum residue limits for pesticides established by the Codex Alimentarius Commission.

6. HYGIENE

It is recommended that the products covered by the provisions of this Standard be prepared and handled in accordance with the appropriate sections of the *General Principles of Food Hygiene* (CAC/RCP 1-1969), and other relevant Codex texts such as Codes of Hygienic Practice and Codes of Practice.

The products should comply with any microbiological criteria established in accordance with the *Principles and Guidelines for the Establishment and Application of Microbiological Criteria related to Foods* (CAC/GL 21-1997).

7. LABELLING

7.1 Name of the food

The product shall be labelled in accordance with the *General Standard for the Labelling of Prepackaged Foods* (CODEX STAN 1-1985). The name of the oil shall conform to the descriptions given in Section 2 of this Standard.

Where more than one name is given for a product in Section 2.1, the labelling of that product must include one of those names acceptable in the country of use.

7.2 Labelling of non-retail containers

Information on the above labelling requirements shall be given either on the container or in accompanying documents, except that the name of the food, lot identification and the name and address of the manufacturer or packer shall appear on the container.

However, lot identification and the name and address of the manufacturer or packer may be replaced by an identification mark, provided that such a mark is clearly identifiable with the accompanying documents.

8. METHODS OF ANALYSIS AND SAMPLING

8.1 Determination of GLC ranges of fatty acid composition

According to ISO 5508: 1990 and 5509: 2000; or AOCS Ce 2-66 (97), Ce 1e-91 (01) or Ce 1f-96 (02).

8.2 Determination of slip point

According to ISO 6321: 2002 for all oils; AOCS Cc 3b-92 (02) for all oils except for palm oils; AOCS Cc 3-25 (97) for palm oils only.

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Table 1: Fatty acid composition of vegetable oils as determined by gas liquid chromatography from authentic samples [1] (expressed as percentage of total fatty acids) (see Section 3.1 of the Standard)

Fatty acid	Arachis oil	Babassu oil	Coconut oil	Cotton-seed oil	Grape-seed oil	Maize oil	Mustard-seed oil	Palm oil	Palm kernel oil	Palm olein[2]	Palm kernel olein[2]	Palm kernel stearin[2]
C6:0	ND	ND	ND-0.7	ND	ND	ND	ND	ND	ND-0.8	ND	ND-0.7	ND-0.2
C8:0	ND	2.6-7.3	4.6-10.0	ND	ND	ND	ND	ND	2.4-6.2	ND	2.9-6.3	1.3-3.0
C10:0	ND	1.2-7.6	5.0-8.0	ND	ND	ND	ND	ND	2.6-5.0	ND	2.7-4.5	2.4-3.3
C12:0	ND-0.1	40.0-55.0	45.1-53.2	ND-0.2	ND	ND-0.3	ND	ND-0.5	45.0-55.0	0.1-0.5	39.7-47.0	52.0-59.7
C14:0	ND-0.1	11.0-27.0	16.8-21.0	0.6-1.0	ND-0.3	ND-0.3	ND-1.0	0.5-2.0	14.0-18.0	0.5-1.5	11.5-15.5	20.0-25.0
C16:0	8.0-14.0	5.2-11.0	7.5-10.2	21.4-26.4	5.5-11.0	8.6-16.5	0.5-4.5	39.3-47.5	6.5-10.0	38.0-43.5	6.2-10.6	6.7-10.0
C16:1	ND-0.2	ND	ND	ND-1.2	ND-1.2	ND-0.5	ND-0.5	ND-0.6	ND-0.2	ND-0.6	ND-0.1	ND
C17:0	ND-0.1	ND	ND	ND-0.1	ND-0.2	ND-0.1	ND	ND-0.2	ND	ND-0.2	ND	ND
C17:1	ND-0.1	ND	ND	ND-0.1	ND-0.1	ND-0.1	ND	ND	ND	ND-0.1	ND	ND
C18:0	1.0-4.5	1.8-7.4	2.0-4.0	2.1-3.3	3.0-6.5	ND-3.3	0.5-2.0	3.5- 6.0	1.0-3.0	3.5-.5.0	1.7-3.0	1.0-3.0
C18:1	35.0-69	9.0-20.0	5.0-10.0	14.7-21.7	12.0-28.0	20.0-42.2	8.0-23.0	36.0-44.0	12.0-19.0	39.8-46.0	14.4-24.6	4.1-8.0
C18:2	12.0-43.0	1.4-6.6	1.0-2.5	46.7-58.2	58.0-78.0	34.0-65.6	10.0-24.0	9.0-12.0	1.0-3.5	10.0-13.5	2.4-4.3	0.5-1.5
C18:3	ND-0.3	ND	ND-0.2	ND-0.4	ND-1.0	ND-2.0	6.0-18.0	ND-0.5	ND-0.2	ND-0.6	ND-0.3	ND-0.1
C20:0	1.0-2.0	ND	ND-0.2	0.2-0.5	ND-1.0	0.3-1.0	ND-1.5	ND-1.0	ND-0.2	ND-0.6	ND-0.5	ND-0.5
C20:1	0.7-1.7	ND	ND-0.2	ND-0.1	ND-0.3	0.2-0.6	5.0-13.0	ND-0.4	ND-0.2	ND-0.4	ND-0.2	ND-0.1
C20:2	ND	ND	ND	ND-0.1	ND	ND-0.1	ND-1.0	ND	ND	ND	ND	ND
C22:0	1.5-4.5	ND	ND	ND-0.6	ND-0.5	ND-0.5	0.2-2.5	ND-0.2	ND-0.2	ND-0.2	ND	ND
C22:1	ND-0.3	ND	ND	ND-0.3	ND-0.3	ND-0.3	22.0-50.0	ND	ND	ND	ND	ND
C22:2	ND	ND	ND	ND-0.1	ND	ND	ND-1.0	ND	ND	ND	ND	ND
C24:0	0.5-2.5	ND	ND	ND-0.1	ND-0.4	ND-0.5	ND-0.5	ND	ND	ND	ND	ND
C24:1	ND-0.3	ND	ND	ND	ND	ND	0.5-2.5	ND	ND	ND	ND	ND

ND - non detectable, defined as ≤ 0.05%

[1] Data taken from species as listed in Section 2.
[2] Fractionated product from palm oil.

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Table 1: Fatty acid composition of vegetable oils as determined by gas liquid chromatography from authentic samples [1] (expressed as percentage of total fatty acids) (see Section 3.1 of the Standard) (continued)

Fatty acid	Palm stearin[2]	Palm superolein[2]	Rapeseed oil	Rapeseed oil (low erucic acid)	Rice bran oil	Safflower seed oil	Safflowerseed oil (high oleic acid)	Sesameseed oil	Soyabean oil	Sunflower seed oil	Sunflower seed oil (high oleic acid)	Sunflower seed oil (mid- oleic acid)
C6:0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C8:0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C10:0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C12:0	0.1-0.5	0.1-0.5	ND	ND	ND-0.2	ND	ND-0.2	ND	ND-0.1	ND-0.1	ND	ND
C14:0	1.0-2.0	0.5-1.5	ND-0.2	ND-0.2	ND-1.0	ND-0.2	ND-0.2	ND-0.1	ND-0.2	ND-0.2	ND-0.1	ND-1
C16:0	48.0-74.0	30.0-39.0	1.5-6.0	2.5-7.0	14-23	5.3-8.0	3.6-6.0	7.9-12.0	8.0-13.5	5.0-7.6	2.6-5.0	4.0-5.5
C16:1	ND-0.2	ND-0.5	ND-3.0	ND-0.6	ND-0.5	ND-0.2	ND-0.2	ND- 0.2	ND-0.2	ND-0.3	ND-0.1	ND-0.05
C17:0	ND-0.2	ND-0.1	ND-0.1	ND-0.3	ND	ND-0.1	ND-0.1	ND-0.2	ND-0.1	ND-0.2	ND-0.1	ND-0.05
C17:1	ND-0.1	ND	ND-0.1	ND-0.3	ND	ND-0.1	ND-0.1	ND-0.1	ND-0.1	ND-0.1	ND-0.1	ND-0.06
C18:0	3.9-6.0	2.8-4.5	0.5-3.1	0.8-3.0	0.9-4.0	1.9-2.9	1.5-2.4	4.5-6.7	2.0-5.4	2.7-6.5	2.9-6.2	2.1-5.0
C18:1	15.5-36.0	43.0-49.5	8.0-60.0	51.0-70.0	38-48	8.4-21.3	70.0-83.7	34.4-45.5	17-30	14.0-39.4	75-90.7	43.1-71.8
C18:2	3.0-10.0	10.5-15.0	11.0-23.0	15.0-30.0	21-42	67.8-83.2	9.0-19.9	36.9-47.9	48.0 -59.0	48.3-74.0	2.1-17	18.7-45.3
C18:3	ND-0.5	0.2-1.0	5.0-13.0	5.0-14.0	0.1-2.9	ND-0.1	ND-1.2	0.2-1.0	4.5-11.0	ND-0.3	ND-0.3	ND-0.5
C20:0	ND-1.0	ND-0.4	ND-3.0	0.2-1.2	ND-0.9	0.2- 0.4	0.3-0.6	0.3-0.7	0.1-0.6	0.1-0.5	0.2-0.5	0.2-0.4
C20:1	ND-0.4	ND-0.2	3.0-15.0	0.1-4.3	ND-0.8	0.1- 0.3	0.1-0.5	ND-0.3	ND-0.5	ND-0.3	0.1-0.5	0.2-0.3
C20:2	ND	ND	ND-1.0	ND-0.1	ND	ND	ND	ND	ND-0.1	ND	ND	ND
C22:0	ND-0.2	ND-0.2	ND-2.0	ND-0.6	ND-1.0	ND-1.0	ND-0.4	NN-1.1	ND-0.7	0.3-1.5	0.5-1.6	0.6-1.1
C22:1	ND	ND	> 2.0-60.0	ND-2.0	ND	ND-1.8	ND-0.3	ND	ND-0.3	ND-0.3	ND-0.3	ND
C22:2	ND	ND	ND-2.0	ND-0.1	ND	ND	ND	ND	ND	ND-0.3	ND	ND-0.09
C24: 0	ND	ND	ND-2.0	ND-0.3	ND-0.9	ND-0.2	ND-0.3	ND-0.3	ND-0.5	ND-0.5	ND-0.5	0.3-0.4
C24:1	ND	ND	ND-3.0	ND-0.4	ND	ND-0.2	ND-0.3	ND	ND	ND	ND	ND

ND - non detectable, defined as ≤ 0.05%

[1] Data taken from species as listed in Section 2.
[2] Fractionated product from palm oil.

APPENDIX

OTHER QUALITY AND COMPOSITION FACTORS

These quality and composition factors are supplementary information to the essential composition and quality factors of the standard. A product, which meets the essential quality and composition factors but does not meet these supplementary factors, may still conform to the standard.

1. QUALITY CHARACTERISTICS

The **colour, odour and taste** of each product shall be characteristic of the designated product. It shall be free from foreign and rancid odour and taste.

	Maximum level
Matter volatile at 105°C	0.2 % m/m
Insoluble impurities	0.05 % m/m
Soap content	0.005 % m/m
Iron (Fe):	
Refined oils	1.5 mg/kg
Virgin oils	5.0 mg/kg
Crude palm kernel olein	5.0 mg/kg
Crude palm kernel stearin	7.0 mg/kg
Copper (Cu)	
Refined oils	0.1 mg/kg
Virgin oils	0.4 mg/kg
Acid value	
Refined oils	0.6 mg KOH/g Oil
Cold pressed and virgin oils	4.0 mg KOH/g Oil
Virgin palm oils	10.0 mg KOH/g Oil
Peroxide value:	
Refined oils	up to 10 milliequivalents of active oxygen/kg oil
Cold pressed and virgin oils	up to 15 milliequivalents of active oxygen/kg oil

2. COMPOSITION CHARACTERISTICS

The **arachidic and higher fatty acid content** of arachis oil should not exceed 48g/kg.

The **Reichert values** for coconut, palm kernel and babassu oils should be in the ranges 6-8.5, 4-7 and 4.5-6.5, respectively.

The **Polenske values** for coconut, palm kernel and babassu oils should be in the ranges 13-18, 8-12 and 8-10, respectively.

The **Halphen test** for cottonseed oil should be positive.

The **erythrodiol content** of grapeseed oil should be more than 2% of the total sterols.

The **total carotenoids** (as beta-carotene) for unbleached palm oil, unbleached palm olein and unbleached palm stearin should be in the range 500-2000, 550-2500 and 300-1500 mg/kg, respectively.

The **Crismer value** for low erucic acid rapeseed oil should be in the range 67-70.

The **concentration of brassicasterol** in low erucic acid rapeseed oil should be greater than 5% of total sterols.

The **Baudouin test** should be positive for sesameseed oil.

The **gamma oryzanols** in crude rice bran oil should be in the range of 0.9-2.1 %.

3. CHEMICAL AND PHYSICAL CHARACTERISTICS

Chemical and Physical Characteristics are given in Table 2.

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4. IDENTITY CHARACTERISTICS

Levels of desmethylsterols in vegetable oils as a percentage of total sterols are given in Table 3.

Levels of tocopherols and tocotrienols in vegetable oils are given in Table 4.

5. METHODS OF ANALYSIS AND SAMPLING

Determination of moisture and volatile matter at 105°C

According to ISO 662: 1998.

Determination of insoluble impurities

According to ISO 663: 2000.

Determination of soap content

According to BS 684 Section 2.5; or AOCS Cc 17-95 (97).

Determination of copper and iron

According to ISO 8294: 1994; or AOAC 990.05; or AOCS Ca 18b-91 (03)

Determination of relative density

According to IUPAC 2.101, with the appropriate conversion factor.

Determination of apparent density

According to ISO 6883: 2000, with the appropriate conversion factor; or AOCS Cc 10c-95 (02)

Determination of refractive index

According to ISO 6320: 2000; or AOCS Cc 7-25 (02)

Determination of saponification value (SV)

According to ISO 3657: 2002; or AOCS Cd 3-25 (03)

Determination of iodine value (IV)

Wijs - ISO 3961: 1996; or AOAC 993.20; or AOCS Cd 1d-1992 (97); or NMKL 39(2003)

The method to be used for specific named vegetable oils is stipulated in the Standard

Determination of unsaponifiable matter

According to ISO 3596: 2000; or ISO 18609: 2000; or AOCS Ca 6b-53 (01)

Determination of peroxide value (PV)

According to AOCS Cd 8b-90 (03); or ISO 3960: 2001

Determination of total carotenoids

According to BS 684 Section 2.20.

Determination of acidity

According to ISO 660: 1996, amended 2003; or AOCS Cd 3d-63 (03)

Determination of sterol content

According to ISO 12228: 1999; or AOCS Ch 6-91 (97)

Determination of tocopherol content

According to ISO 9936: 1997; or AOCS Ce 8-89 (97)

Halphen test

According to AOCS Cb 1-25 (97).

Crismer value

According to AOCS Cb 4-35 (97) and AOCS Ca 5a-40 (97).

Baudouin test (modified Villavecchia test or sesameseed oil test)

According to AOCS Cb 2-40 (97).

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Reichert value and Polenske value

According to AOCS Cd 5-40 (97)

Determination of gamma oryzanol content

Definition

This method is used to determine gamma oryzanol content (%) in oils from spectrophotometer absorption measurements at the wavelength of maximum absorption near 315nm.

Scope

Applicable to crude rice bran oil.

Apparatus

- Spectrophotometer - for measuring extinction in the ultraviolet between 310 and 320 nm.
- Rectangular quartz cuvettes - having an optical light path of 1 cm.
- Volumetric flask - 25mL.
- Filter paper - Whatman no.2, or equivalent.

Reagents

- n-Heptane - Spectrophotometrically pure.

Procedure

(i) Before using, the spectrophotometer should be properly adjusted to a zero reading filling both the sample cuvette and the reference cuvette with n-Heptane.

(ii) Filter the oil sample through filter paper at ambient temperature.

(iii) Weigh accurately approximately 0.02g of the sample so prepared into a 25mL volumetric flask, make up to the mark with n-Heptane.

(iv) Fill a cuvette with the solution obtained and measure the extinction at the wavelength of maximum absorption near 315nm, using the same solvent as a reference.

(v) The extinction values recorded must lie within the range 0.3-0.6. If not, the measurements must be repeated using more concentrated or more diluted solutions as appropriate.

Calculation

Calculate gamma oryzanol content as follows:

$$\text{Gamma oryzanol content, \%} = 25 \times (1 / W) \times A \times (1 / E)$$

Where W = mass of sample, g

A = extinction (absorbance) of the solution

E = specific extinction $E^{1\%}_{1cm} = 359$

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Table 2: Chemical and physical characteristics of crude vegetable oils (see Appendix of the Standard)

	Arachis oil	Babassu oil	Coconut oil	Cotton seed oil	Grape-seed oil	Maize oil	Mustard-seed oil	Palm oil	Palm kernel oil	Palm kernel olein[2]	Palm kernel stearin[2]
Relative density (x°C/water at 20°C)	0.912-0.920 x=20°C	0.914-0.917 x=25°C	0.908-0.921 x=40°C	0.918-0.926 x=20°C	0.920-0.926 x=20°C	0.917-0.925 x=20°C	0.910-0.921 x=20°C	0.891-0.899 x=50°C	0.899-0.914 x=40°C	0.906-0.909 x=40°C	0.902-0.908 x=40°C
Apparent density (g/ml)								0.889-0.895 (50°C)		0.904-0.907	0.904-0.906
Refractive index (ND 40°C)	1.460-1.465	1.448-1.451	1.448-1.450	1.458-1.466	1.467-1.477	1.465-1.468	1.461-1.469	1.454-1.456 at 50°C	1.448-1.452	1.451-1.453	1.449-1.451
Saponification value (mg KOH/g oil)	187-196	245-256	248-265	189-198	188-194	187-195	168-184	190-209	230-254	231-244	244-255
Iodine value	86-107	10-18	6.3-10.6	100-123	128-150	103-135	92-125	50.0-55.0	14.1-21.0	20-28	4-8.5
Unsaponifiable matter (g/kg)	≤ 10	≤ 12	≤ 15	≤ 15	≤ 20	≤ 28	≤ 15	≤ 12	≤ 10	<15	<15
Stable carbon isotope ratio *						-13.71 to -16.36					

* See the following publications:

Woodbury SP, Evershed RP and Rossell JB (1998). Purity assessments of major vegetable oils based on gamma 13C values of individual fatty acids. *JAOCS*, **75** (3), 371-379.

Woodbury SP, Evershed RP and Rossell JB (1998). Gamma 13C analysis of vegetable oil, fatty acid components, determined by gas chromatography-combustion-isotope ratio mass spectrometry, after saponification or regiospecific hydrolysis. *Journal of Chromatography* A, **805**, 249-257.

Woodbury SP, Evershed RP, Rossell JB, Griffith R and Farnell P (1995). Detection of vegetable oil adulteration using gas chromatography combustion / isotope ratio mass spectrometry. *Analytical Chemistry* **67** (15), 2685-2690.

Ministry of Agriculture, Fisheries and Food (1996). Authenticity of single seed vegetable oils. Working Party on Food Authenticity, MAFF, UK.

[2] Fractionated product from palm oil.

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Table 2: Chemical and physical characteristics of crude vegetable oils (see Appendix of the Standard) (continued)

	Palm olein[2]	Palm stearin[2]	Palm superolein[2]	Rape-seed oil	Rape-seed oil (low erucic acid)	Rice bran oil	Safflower-seed oil	Safflower-seed oil (high oleic acid)	Sesame-seed oil	Soya-bean oil	Sunflower-seed oil	Sunflower-seed oil (high oleic acid)	Sunflower-seed oil (mid-oleic acid)
Relative density (x° C/water at 20°C)	0.899-0.920 x=40°C	0.881-0.891 x=60°C	0.900-0.925 x=40°C	0.910-0.920 x=20°C	0.914-0.920 x=20°C	0.910–0.929	0.922-0.927 x=20°C	0.913-0.919 x=20°C; 0.910-0.916 x=25°C	0.915-0.924 x=20°C	0.919-0.925 x=20°C	0.918-0.923 x=20°C	0.909-0.915 x=25°C	0.914-0.916 x=20°C
Apparent density (g/ml)	0896-0.898 at 40°C	0.881-0.885 at 60°C	0.897-0.920					0.912-0.914 at 20°C					
Refractive index (ND 40°C)	1.458-1.460	1.447-1.452 at 60°C	1.463-1.465	1.465-1.469	1.465-1.467	1.460 – 1.473	1.467-1.470	1.460-1.464 at 40°C; 1.466-1.470 at 25°C	1.465-1.469	1.466-1.470	1.461-1.468	1.467-1.471 at 25°C	1.461-1.471 at 25°C
Saponification value (mg KOH/g oil)	194-202	193-205	180-205	168-181	182-193	180 – 199	186-198	186-194	186-195	189-195	188-194	182-194	190-191
Iodine value	≥ 56	≤ 48	≥ 60	94-120	105-126	90-115	136-148	80-100	104-120	124-139	118-141	78-90	94-122
Unsaponifiable matter (g/kg)	≤ 13	≤ 9	≤ 13	≤ 20	≤ 20	≤ 65	≤ 15	≤ 10	≤ 20	≤ 15	≤ 15	≤ 15	≤15

[2] Fractionated product from palm oil.

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Table 3: Levels of desmethylsterols in crude vegetable oils from authentic samples[1] as a percentage of total sterols (see Appendix 1 of the Standard)

	Arachis oil	Babassu oil	Coconut oil	Cotton-seed oil	Grapeseed oil	Maize oil	Palm oil	Palm olein[2]	Palm kernel oil	Palm kernel olein[2]	Palm kernel stearin[2]
Cholesterol	ND-3.8	1.2-1.7	ND-3.0	0.7-2.3	ND-0.5	0.2-0.6	2.6-6.7	2.6-7.0	0.6-3.7	1.5-1.9	1.4-1.7
Brassicasterol	ND-0.2	ND-0.3	ND-0.3	0.1- 0.3	ND-0.2	ND-0.2	ND	ND	ND-0.8	ND-0.2	ND-2.2
Campesterol	12.0-19.8	17.7-18.7	6.0-11.2	6.4-14.5	7.5-14.0	16.0-24.1	18.7-27.5	12.5-39.0	8.4-12.7	7.9-9.1	8.2-9.7
Stigmasterol	5.4-13.2	8.7-9.2	11.4-15.6	2.1-6.8	7.5-12.0	4.3-8.0	8.5-13.9	7.0-18.9	12.0-16.6	13.4-14.7	14.1-15.0
Beta-sitosterol	47.4-69.0	48.2-53.9	32.6-50.7	76.0-87.1	64.0-70.0	54.8-66.6	50.2-62.1	45.0-71.0	62.6-73.1	67.1-69.2	67.0-70.0
Delta-5-avenasterol	5.0-18.8	16.9-20.4	20.0-40.7	1.8-7.3	1.0-3.5	1.5-8.2	ND-2.8	ND-3.0	1.4-9.0	3.3-4.6	3.3-4.1
Delta-7-stigmastenol	ND-5.1	ND	ND-3.0	ND-1.4	0.5-3.5	0.2-4.2	0.2-2.4	ND-3.0	ND-2.1	ND-0.6	ND-0.3
Delta-7-avenasterol	ND-5.5	0.4-1.0	ND-3.0	0.8-3.3	0.5-1.5	0.3-2.7	ND-5.1	ND-6.0	ND-1.4	ND-0.5	ND-0.3
Others	ND-1.4	ND	ND-3.6	ND-1.5	ND-5.1	ND-2.4	ND	ND-10.4	ND-2.7	2.9-3.7	1.0-3.0
Total sterols (mg/kg)	900-2900	500-800	400-1200	2700-6400	2000-7000	7000-22100	300-700	270-800	700-1400	816-1339	775-1086

	Palm stearin[2]	Palm superolein[2]	Rapeseed oil (low erucic acid)	Rice bran oil	Safflower-seed oil	Safflower-seed oil (high oleic acid)	Sesame-seed oil	Soyabean oil	Sunflower-seed oil	Sunflower-seed oil (high oleic acid)	Sunflower-seed oil (mid-oleic acid)
Cholesterol	2.5-5.0	2.0-3.5	ND-1.3	ND - 0.5	ND- 0.7	ND-0.5	0.1-0.5	0.2-1.4	ND-0.7	ND-0.5	0.1-0.2
Brassicasterol	ND	ND	5.0-13.0	ND-0.3	ND-0.4	ND-2.2	0.1-0.2	ND-0.3	ND-0.2	ND-0.3	ND-0.1
Campesterol	15.0-26.0	22.0-26.0	24.7-38.6	11.0 – 35.0	9.2-13.3	8.9-19.9	10.1-20.0	15.8-24.2	6.5-13.0	5.0-13.0	9.1-9.6
Stigmasterol	9.0-15.0	18.2-20.0	0.2-1.0	6.0 – 40.0	4.5-9.6	2.9-8.9	3.4-12.0	14.9-19.1	6.0-13.0	4.5-13.0	9.0-9.3
Beta-sitosterol	50.0-60.0	55.0-70.0	45.1-57.9	25.0 – 67.0	40.2-50.6	40.1-66.9	57.7-61.9	47.0-60	50-70	42.0-70	56-58
Delta-5-avenasterol	ND-3.0	0-1.0	2.5-6.6	ND – 9.9	0.8-4.8	0.2-8.9	6.2-7.8	1.5-3.7	ND-6.9	1.5- 6.9	4.8-5.3
Delta-7-stigmastenol	ND-3.0	0-0.3	ND-1.3	ND – 14.1	13.7-24.6	3.4-16.4	0.5-7.6	1.4-5.2	6.5-24.0	6.5-24.0	7.7-7.9
Delta-7-avenasterol	ND-3.0	0-0.3	ND-0.8	ND – 4.4	2.2-6.3	ND-8.3	1.2-5.6	1.0-4.6	3.0-7.5	ND-9.0	4.3-4.4
Others	ND-5.0	0-2.0	ND-4.2	7.5-12.8	0.5-6.4	4.4-11.9	0.7-9.2	ND-1.8	ND-5.3	3.5-9.5	5.4-5.8
Total sterols (mg/kg)	250-500	100	4500-11300	10500-31000	2100-4600	2000-4100	4500-19000	1800-4500	2400-5000	1700-5200	

ND - Non-detectable, defined as ≤ 0.05%

[1] Data taken from species as listed in Section 2.
[2] Fractionated product from palm oil.

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Table 4: Levels of tocopherols and tocotrienols in crude vegetable oils from authentic samples [1] (mg/kg) (see Appendix 1 of the Standard)

	Arachis oil	Babassu oil	Coconut oil	Cotton-seed oil	Grape-seed oil	Maize oil	Palm oil	Palm olein[2]	Palm kernel oil	Palm kernel olein[2]	Palm kernel stearin[2]
Alpha-tocopherol	49-373	ND	ND-17	136-674	16-38	23-573	4-193	30-280	ND-44	ND-11	ND-10
Beta-tocopherol	ND-41	ND	ND-11	ND-29	ND-89	ND-356	ND-234	ND-250	ND-248	ND-6	ND-2
Gamma-tocopherol	88-389	ND	ND-14	138-746	ND-73	268-2468	ND-526	ND-100	ND-257	ND-3	ND-1
Delta-tocopherol	ND-22	ND	ND	ND-21	ND-4	23-75	ND-123	ND-100	ND	ND-4	ND
Alpha-tocotrienol	ND	25-46	ND-44	ND	18-107	ND-239	4-336	50-500	ND	ND-70	ND-73
Gamma-tocotrienol	ND	32-80	ND-1	ND	115-205	ND-450	14-710	20-700	ND-60	1-10	ND-8
Delta-tocotrienol	ND	9-10	ND	ND	ND-3.2	ND-20	ND-377	40-120	ND	ND-2	ND-1
Total (mg/kg)	170-1300	60-130	ND-50	380-1200	240-410	330-3720	150-1500	300-1800	ND-260	ND-90	ND-89

	Palm stearin[2]	Palm superolein[2]	Rapeseed oil (low erucic acid)	Rice bran oil	Safflower-seed oil	Safflower-seed oil (high oleic acid)	Sesameseed oil	Soyabean oil	Sunflower-seed oil	Sunflower-seed oil (high oleic acid)	Sunflower-seed oil (mid-oleic acid)
Alpha-tocopherol	ND-100	130-240	100-386	49-583	234-660	234-660	ND-3.3	9-352	403-935	400-1090	488-668
Beta-tocopherol	ND-50	ND-40	ND-140	ND – 47	ND-17	ND-13	ND	ND-36	ND-45	10-35	19-52
Gamma-tocopherol	ND-50	ND-40	189-753	ND – 212	ND-12	ND-44	521-983	89-2307	ND-34	3-30	2.3-19.0
Delta-tocopherol	ND-50	ND-30	ND-22	ND-31	ND	ND-6	4-21	154-932	ND-7.0	ND-17	ND-1.6
Alpha-tocotrienol	20-150	170-300	ND	ND – 627	ND	ND	ND	ND-69	ND	ND	ND
Gamma-tocotrienol	10-500	230-420	ND	142 – 790	ND-12	ND-10	ND-20	ND-103	ND	ND	ND
Delta-tocotrienol	5-150	60-120	ND	ND – 59	ND	ND	ND	ND	ND	ND	ND
Total (mg/kg)	100-700	400-1400	430-2680	191 - 2349	240-670	250-700	330-1010	600-3370	440-1520	450-1120	509-741

ND - Non-detectable.
Note: Maize oil also contains ND-52 mg/kg beta tocotrienol.

[1] Data taken from species as listed in Section 2.
[2] Fractionated product from palm oil.

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