

Codex Standard for Named Vegetable Oils

CODEX-STAN 210 (Amended 2003, 2005)

Die Anforderungen an Speisefette, ihre Eigenschaften und Zusammensetzung haben sich in den letzten zehn bis zwanzig Jahren geändert. Durch gezielte Pflanzenzüchtungen versucht man, den Konsumentenwünschen besser gerecht zu werden. Waren vor rund zwanzig Jahren Sonnenblumenöle mit möglichst hohem Linolsäuregehalt gefragt, geht heute der Trend zu Sonnenblumenölen mit hohem Ölsäuregehalt. Die geänderte Nachfrage bedingt neue Rohstoffspezifikationen. Die Codexorganisationen (weltweit, europäisch oder national) tragen diesen Entwicklungen Rechnung. So wurden der WHO/FAO Codex Standards for Named Vegetable Oils (Codex-Stan 210) 2003 und 2005 überarbeitet. Eine Überarbeitung wäre auch für das Kapitel B 30 des Codex Alimentarius Austriacus notwendig, um mit der internationalen Entwicklung Schritt halten zu können. Schließlich ist Österreich rohstoffseitig keineswegs Selbstversorger und daher auf Material angewiesen, das den internationalen Handelsbräuchen entspricht.

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The Appendix to this Standard is intended for voluntary application by commercial partners and not for application by governments.

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)

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

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

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

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

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

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

2.1.7 **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).

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

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

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

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

2.1.12 **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.

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

2.1.14 **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 campestris* L. and *Brassica juncea* L., species.

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

2.1.16 **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.

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

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

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

2.1.20 **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.).

2.1.21 **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.).

2.2 Other definitions

2.2.1 **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.

2.2.2 **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.

2.2.3 **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.

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

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

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

3.3 Slip point

| | |
|-----------------|----------------------|
| 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

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

4.2 Flavours

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

4.3 Antioxidants

| | | Maximum Level |
|-----|--|---|
| 304 | Ascorbyl palmitate | 500 mg/kg |
| 305 | Ascorbyl stearate | individually or in combination |
| 306 | Mixed tocopherols concentrate | GMP |
| 307 | Alpha-tocopherol | GMP |
| 308 | Synthetic gamma-tocopherol | GMP |
| 309 | Synthetic delta-tocopherol | GMP |
| 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 and BHT and/or TBHQ | 200 mg/kg but limits above not to be exceeded |
| 389 | Dilauryl thiodipropionate | 200 mg/kg |

4.4 Antioxidant synergists

| | | |
|-----|-----------------------|--|
| 330 | Citric acid | GMP |
| 331 | Sodium citrates | GMP |
| 384 | Isopropyl citrates | 100 mg/kg individually or in combination |
| | Monoglyceride citrate | |

4.5 Anti-foaming agents (oils for deepfrying)

| | | |
|------|----------------------|----------|
| 900a | Polydimethylsiloxane | 10 mg/kg |
|------|----------------------|----------|

5. Contaminants

5.1 Heavy metals

The products covered by the provisions of this Standard shall comply with maximum limits being established by the Codex Alimentarius Commission but in the meantime the following limits will apply:

Maximum permissible concentration

| | |
|--------------|-----------|
| Lead (Pb) | 0.1 mg/kg |
| Arsenic (As) | 0.1 mg/kg |

5.2 Pesticide residues

The products covered by the provisions of this Standard shall comply with those maximum residue limits established by the Codex Alimentarius Commission for these commodities.

| Fatty acid | Arachis oil | Babassu oil | Coconut oil | Cottonseed oil | Grapeseed oil | Maize oil | Mustardseed oil | Palm oil | Palm kernel oil | Palm olein ² | Palm stearin |
|------------|-------------|-------------|-------------|----------------|---------------|-----------|-----------------|-----------|-----------------|-------------------------|--------------|
| C6:0 | ND | ND | ND-0.7 | ND | ND | ND | ND | ND | ND-0.8 | ND | ND |
| C8:0 | ND | 2.6-7.3 | 4.6-10.0 | ND | ND | ND | ND | ND | 2.4-6.2 | ND | ND |
| C10:0 | ND | 1.2-7.6 | 5.0-8.0 | ND | ND | ND | ND | ND | 2.6-5.0 | ND | ND |
| 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 | 0.1-0.5 |
| 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 | 1.0-2.0 |
| 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 | 48.0-74.0 |
| 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-0.2 |
| 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-0.2 |
| C17:1 | ND-0.1 | ND | ND | ND-0.1 | ND-0.1 | ND-0.1 | ND | ND | ND | ND-0.1 | ND-0.1 |
| 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 | 3.9-6.0 |
| 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 | 15.5-36.0 |
| 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 | 3.0-10.0 |
| 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-0.5 |
| 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-1.0 |
| 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-0.4 |
| C20:2 | ND | ND | ND | ND-0.1 | ND | ND-0.1 | ND-1.0 | 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-0.2 |
| C22:1 | ND-0.3 | ND | ND | ND-0.3 | ND-0.3 | ND-0.3 | 22.0-50.0 | ND | ND | ND | ND |
| C22:2 | ND | ND | ND | ND-0.1 | ND | ND | ND-1.0 | 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 |
| C24:1 | ND-0.3 | ND | ND | ND | ND | ND | 0.5-2.5 | ND | ND | ND | ND |

| Fatty acid | Palm superolein ² | Rapeseed oil | Rapeseed oil (low erucic acid) | Safflowerseed oil | Safflowerseed oil (high oleic acid) | Sesameseed oil | Soyabean oil | Sunflowerseed oil | Sunflowerseed oil (high oleic acid) | Sunflowerseed oil (mid-oleic acid) |
|------------|------------------------------|--------------|--------------------------------|-------------------|-------------------------------------|----------------|--------------|-------------------|-------------------------------------|------------------------------------|
| C6:0 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| C8:0 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| C10:0 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| C12:0 | 0.1-0.5 | ND | ND | ND | ND-0.2 | ND | ND-0.1 | ND-0.1 | ND | ND |
| C14:0 | 0.5-1.5 | ND-0.2 | ND-0.2 | ND-0.2 | ND-0.2 | ND-0.1 | ND-0.2 | ND-0.2 | ND-0.1 | ND-1 |
| C16:0 | 30.0-39.0 | 1.5-6.0 | 2.5-7.0 | 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-0.5 | ND-3.0 | ND-0.6 | ND-0.2 | ND-0.2 | ND-0.2 | ND-0.2 | ND-0.3 | ND-0.1 | ND-0.05 |
| C17:0 | ND-0.1 | ND-0.1 | ND-0.3 | ND-0.1 | ND-0.1 | ND-0.2 | ND-0.1 | ND-0.2 | ND-0.1 | ND-0.05 |
| C17:1 | ND | ND-0.1 | ND-0.3 | ND-0.1 | ND-0.1 | ND-0.1 | ND-0.1 | ND-0.1 | ND-0.1 | ND-0.06 |
| C18:0 | 2.8-4.5 | 0.5-3.1 | 0.8-3.0 | 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 | 43.0-49.5 | 8.0-60.0 | 51.0-70.0 | 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 | 10.5-15.0 | 11.0-23.0 | 15.0-30.0 | 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 | 0.2-1.0 | 5.0-13.0 | 5.0-14.0 | 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-0.4 | ND-3.0 | 0.2-1.2 | 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-0.2 | 3.0-15.0 | 0.1-4.3 | 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-1.0 | ND-0.1 | ND | ND | ND | ND-0.1 | ND | ND | ND |
| C22:0 | ND-0.2 | ND-2.0 | ND-0.6 | 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 | > 2.0-60.0 | ND-2.0 | ND-1.8 | ND-0.3 | ND | ND-0.3 | ND-0.3 | ND-0.3 | ND |
| C22:2 | ND | ND-2.0 | ND-0.1 | ND | ND | ND | ND | ND-0.3 | ND | ND-0.09 |
| C24:0 | ND | ND-2.0 | ND-0.3 | 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-3.0 | ND-0.4 | 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.

Tab. 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)

6. Hygiene

6.1 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 Recommended International Code of Practice – General Principles of Food Hygiene (CAC/RCP 1-1969, Rev. 3-1997), and other relevant Codex texts such as Codes of Hygienic Practice and Codes of Practice.

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

7. Labelling

7.1 Name of the food

The product shall be labelled in accordance with the Codex General Standard for the Labelling of Prepackaged Foods (CODEX STAN 1-1985, Rev. 1-1991; Codex Alimentarius, Volume 1A). 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.

8.3 Determination of arsenic

According to AOAC 952.13; AOAC 942.17; or AOAC 986.15.

8.4 Determination of lead

According to; AOAC 994.02; or ISO 12193: 2004; or AOCS Ca 18c-91 (03).

Appendix

Other Quality and Composition Factors

This text is intended for voluntary application by commercial partners and not for application by governments.

1. Quality Characteristics

1.1 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

1.2 Matter volatile at 105°C 0.2% m/m

1.3 Insoluble impurities 0.05% m/m

1.4 Soap content 0.005% m/m

1.5 Iron (Fe):

Refined oils 1.5 mg/kg

Virgin oils 5.0 mg/kg

1.6 Copper (Cu)

Refined oils 0.1 mg/kg

Virgin oils 0.4 mg/kg

1.7 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

1.8 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

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

2.2 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.

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

2.4 The Halphen test for cottonseed oil should be positive.

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

2.6 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.

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

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

2.9 The Baudouin test should be positive for sesame-seed oil.

3. Chemical and Physical Characteristics

Chemical and Physical Characteristics are given in *Tab. 2*.

4. Identity Characteristics

4.1 Levels of desmethylsterols in vegetable oils as a percentage of total sterols are given in *Tab. 3*.

4.2 Levels of tocopherols and tocotrienols in vegetable oils are given in *Tab. 4*.

| | Arachis oil | Babassu oil | Coconut oil | Cottonseed oil | Grapeseed oil | Maize oil | Mustard-seed Oil | Palm oil | Palm kernel | Palm olein |
|-------------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------------|-----------------------|------------------------|
| Relative density | 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 | 0.899-0.920 x=40°C |
| Apparent density (g/mL) | | | | | | | | 0.889-0.895 (50°C) | | 0.896-0.898 at 40°C |
| 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 | 1.458-1.460 |
| Saponification value (mg KOH/g oil) | 187-196 | 245-256 | 248-265 | 189-198 | 188-194 | 187-195 | 168-184 | 190-209 | 230-254 | 194-202 |
| 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 | ≤56 |
| Unsaponifiable matter (g/kg) | ≤10 | ≤12 | ≤15 | ≤15 | ≤20 | ≤28 | ≤15 | ≤12 | ≤10 | ≤13 |
| Stable carbon isotope ratio * | | | | | | -13.71 to -16.36 | | | | |

| | Palm stearin | Palm superolein | Rapeseed oil | Rapeseed oil (low erucic) | Safflower-seed oil | Safflower-seed oil (high oleic) | Sesameseed oil | Soyabean oil | Sunflower-seed oil | Sunflower-seed oil (high oleic) | Sunflower-seed oil (mid oleic) |
|--------------------------------------|------------------------|-----------------------|-----------------------|---------------------------|-----------------------|---|------------------------|-----------------------|-----------------------|---------------------------------|--------------------------------|
| Relative density (x°C/water at 20°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 | 0.922-0.927 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) | 0.881-0.885 at 60°C | 0.897-0.920 | | | | 0.912-0.914 at 20°C | | | | | |
| Refractive index (ND 40°C) | 1.447-1.452 at 60°C | 1.463-1.465 | 1.465-1.469 | 1.465-1.467 | 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) | 193-205 | 180-205 | 168-181 | 182-193 | 186-198 | 186-194 | 186-195 | 189-195 | 188-194 | 182-194 | 190-191 |
| Iodine value | ≤48 | ≥60 | 94-120 | 105-126 | 136-148 | 80-100 | 104-120 | 124-139 | 118-141 | 78-90 | 94-122 |
| Unsaponifiable matter (g/kg) | ≤9 | ≤13 | ≤20 | ≤20 | ≤15 | ≤10 | ≤20 | ≤15 | ≤15 | ≤15 | ≤15 |

* 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.

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

5. Methods of Analysis and Sampling

5.1 Determination of moisture and volatile matter at 105°C

According to ISO 662: 1998.

5.2 Determination of insoluble impurities

According to ISO 663: 2000.

5.3 Determination of soap content

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

5.4 Determination of copper and iron

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

5.5 Determination of relative density

According to IUPAC 2.101, with the appropriate conversion factor.

5.6 Determination of apparent density

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

5.7 Determination of refractive index

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

5.8 Determination of saponification value (SV)

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

5.9 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

5.10 Determination of unsaponifiable matter

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

| | Arachis oil | Babassu oil | Coconut oil | Cottonseed oil | Grapeseed oil | Maize oil | Palm oil | Palm olein | Palm kernel oil | Palm stearin |
|-----------------------|-------------|-------------|-------------|----------------|---------------|------------|-----------|------------|-----------------|--------------|
| 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 | 2.5-5.0 |
| 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 |
| 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 | 15.0-26.0 |
| 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 | 9.0-15.0 |
| 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 | 50.0-60.0 |
| 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 | ND-3.0 |
| Delta-7-stigmasterol | 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-3.0 |
| 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-3.0 |
| Others | ND-1.4 | ND | ND-3.6 | ND-1.5 | ND-5.1 | ND-2.4 | ND | ND-10.4 | ND-2.7 | ND-5.0 |
| Total sterols (mg/kg) | 900-2900 | 500-800 | 400-1200 | 2700-6400 | 2000-70*00 | 7000-22100 | 300-700 | 270-800 | 700-1400 | 250-500 |

| | Palm superolein | Rapeseed oil (low erucic acid) | Safflowerseed oil | Safflowerseed oil (high oleic acid) | Sesameseed oil | Soyabean oil | Sunflowerseed oil | Sunflowerseed oil (high oleic acid) | Sunflowerseed oil (mid-oleic acid) |
|-----------------------|-----------------|--------------------------------|-------------------|-------------------------------------|----------------|--------------|-------------------|-------------------------------------|------------------------------------|
| Cholesterol | 2.0-3.5 | ND-1.3 | 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 | 5.0-13.0 | ND-0.4 | ND-2.2 | 0.1-0.2 | ND-0.3 | ND-0.2 | ND-0.3 | ND-0.1 |
| Campesterol | 22.0-26.0 | 24.7-38.6 | 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 | 18.2-20.0 | 0.2-1.0 | 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 | 55.0-70.0 | 45.1-57.9 | 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 | 0-1.0 | 2.5-6.6 | 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-stigmasterol | 0-0.3 | ND-1.3 | 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 | 0-0.3 | ND-0.8 | 2.2-6.3 | ND-8.3 | 1.2-5.6 | 1.0-4. | 3.0-7.5 | ND-9.0 | 4.3-4.4 |
| Others | 0-2.0 | ND-4.2 | 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) | 100 | 4500-11300 | 2100-4600 | 2000-4100 | 4500-19000 | 1800-4500 | 2400-5000 | 1700-5200 | |

ND – Non-detectable, defined as $\leq 0.05\%$

¹ Data taken from species as listed in Section 2.

² Fractionated product from palm oil.

Tab. 3: Levels of desmethylsterols in crude vegetable oils from authentic samples¹ as a percentage of total sterols (see Appendix 1 of the Standard)

| | Arachis oil | Babassu oil | Coconut oil | Cottonseed oil | Grapeseed oil | Maize oil | Palm oil | Palm olein | Palm kernel oil | Palm stearin |
|-------------------|-------------|-------------|-------------|----------------|---------------|-----------|----------|------------|-----------------|--------------|
| Alpha-tocopherol | 49-373 | ND | ND-17 | 136-674 | 16-38 | 23-573 | 4-193 | 30-280 | ND-44 | ND-100 |
| Beta-tocopherol | ND-41 | ND | ND-11 | ND-29 | ND-89 | ND-356 | ND-234 | ND-250 | ND-248 | ND-50 |
| Gamma-tocopherol | 88-389 | ND | ND-14 | 138-746 | ND-73 | 268-2468 | ND-526 | ND-100 | ND-257 | ND-50 |
| Delta-tocopherol | ND-22 | ND | ND | ND-21 | ND-4 | 23-75 | ND-123 | ND-100 | ND | ND-50 |
| Alpha-tocotrienol | ND | 25-46 | ND-44 | ND | 18-107 | ND-239 | 4-336 | 50-500 | ND | 20-150 |
| Gamma-tocotrienol | ND | 32-80 | ND-1 | ND | 115-205 | ND-450 | 14-710 | 20-700 | ND-60 | 10-500 |
| Delta-tocotrienol | ND9-10 | ND | ND | ND-3.2 | ND-20 | ND-377 | 40-120 | ND | 5-150 | |
| Total (mg/kg) | 170-1300 | 60-130 | ND-50 | 380-1200 | 240-410 | 330-3720 | 150-1500 | 300-1800 | ND-260 | 100-700 |

| | Palm superolein | Rapeseed oil (low erucic acid) | Safflowerseed oil | Safflowerseed oil (high oleic acid) | Sesameseed oil | Soyabean oil | Sunflowerseed oil | Sunflowerseed oil (high oleic acid) | Sunflowerseed oil (mid-oleic acid) |
|-------------------|-----------------|--------------------------------|-------------------|-------------------------------------|----------------|--------------|-------------------|-------------------------------------|------------------------------------|
| Alpha-tocopherol | 130-240 | 100-386 | 234-660 | 234-660 | ND-3.3 | 9-352 | 403-935 | 400-1090 | 488-668 |
| Beta-tocopherol | ND-40 | ND-140 | ND-17 | ND-13 | ND | ND-36 | ND-45 | 10-35 | 19-52 |
| Gamma-tocopherol | ND-40 | 189-753 | ND-12 | ND-44 | 521-983 | 89-2307 | ND-34 | 3-30 | 2.3-19.0 |
| Delta-tocopherol | ND-30 | ND-22 | ND | ND-6 | 4-21 | 154-932 | ND-7.0 | ND-17 | ND-1.6 |
| Alpha-tocotrienol | 170-300 | ND | ND | ND | ND | ND-69 | ND | ND | ND |
| Gamma-tocotrienol | 230-420 | ND | ND-12 | ND-10 | ND-20 | ND-103 | ND | ND | ND |
| Delta-tocotrienol | 60-120 | ND | ND | ND | ND | ND | ND | ND | ND |
| Total (mg/kg) | 400-1400 | 430-2680 | 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.

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

5.11 Determination of peroxide value (PV)

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

5.12 Determination of total carotenoids

According to BS 684 Section 2.20.

5.13 Determination of acidity

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

5.14 Determination of sterol content

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

5.15 Determination of tocopherol content

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

5.16 Halphen test

According to AOCS Cb 1-25 (97).

5.17 Crismer value

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

5.18 Baudouin test (modified Villavecchia test or sesameseed oil test)

According to AOCS Cb 2-40 (97).

5.19 Reichert value and Polenske value

According to AOCS Cd 5-40 (97)