
**Olive oils and olive-pomace oils —
Determination of the 2-glycerol
monopalmitate content**

*Huiles d'olive et huiles de grignons d'olive — Détermination de la teneur
en 2-glycéryl monopalmitate*

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 12872 was prepared by Technical Committee ISO/TC 34, *Food products*, Subcommittee SC 11, *Animal and vegetable fats and oils*.

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Introduction

As part of the *Trade standard applying to olive oils and olive-pomace oils*, the International Olive Council (IOC) published COI/T.20/Doc. 23:2006^[6]. COI/T.20/Doc. 23 was applicable to olive and olive-pomace oils and was used to distinguish between lampante virgin olive oils and crude olive-pomace oils. Olive pomace is the residual paste which still contains a variable amount of water and oil after pressing or centrifuging.

In 2008, the IOC submitted the document to ISO/TC 34/SC 11 for adoption as an International Standard.

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Olive oils and olive-pomace oils — Determination of the 2-glyceryl monopalmitate content

1 Scope

This International Standard specifies a procedure for the determination of the content, as a percentage mass fraction, of 2-glyceryl monopalmitate in olive oils and olive-pomace oils that are liquid at ambient temperature (20 °C).

NOTE This International Standard is based on COI/T.20/Doc. 23:2006^[6].

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 661, *Animal and vegetable fats and oils — Preparation of test sample*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

2-glyceryl monopalmitate content

mass fraction of 2-glyceryl monopalmitate in the monoacylglycerol fraction, determined according to the method specified in this International Standard

NOTE The 2-glyceryl monopalmitate content is expressed as a percentage.

4 Principle

The oil, after suitable preparation, is subjected to the action of pancreatic lipase. A partial hydrolysis takes place that is specific for positions 1 and 3 of the triacylglycerol molecule so that 2-monoacylglycerols are obtained as reaction products. The percentage of 2-glyceryl monopalmitate in the monoacylglycerol fraction is determined, after silylation, by capillary gas chromatography.

5 Reagents

WARNING — Comply with any local regulations which specify the handling of hazardous substances. Technical, organizational and personal safety measures shall be followed.

During the analysis, unless otherwise stated, use only reagents of recognized analytical grade, and distilled or demineralized water or water of equivalent purity.

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5.1 Silica gel, with a particle size of 0,063 mm to 0,200 mm (70/280 mesh), prepared as follows: put the silica gel into a porcelain cup, dry in an oven at 160 °C for 4 h, then cool at ambient temperature in a desiccator. Add a volume of water equivalent to 5 % of the mass of the silica gel as follows: weigh 152 g of silica gel into a 500 ml Erlenmeyer flask, add 8 g of water, stopper and homogenize carefully. Leave to settle for at least 12 h before using.

5.2 *n*-Hexane, chromatography grade.

5.3 Isopropanol.

5.4 Isopropanol-water mixture, volume fractions 50 ml/100 ml.

5.5 Pancreatic lipase, activity between 2,0 and 10 lipase units per milligram (see Annex C).

5.6 Buffer solution of tris(hydroxymethyl)aminomethane: prepare an aqueous solution (1 mol/l) with pH 8 and mix with concentrated HCl, volume fractions 50 ml/100 ml.

5.7 Sodium cholate, special enzyme grade, aqueous solution, mass fraction 0,1 g/100 g.

Use this solution within 15 days of preparation.

5.8 Calcium chloride, aqueous solution, mass fraction 22 g/100 g.

5.9 Diethyl ether, chromatography grade.

5.10 Elution solvent: mixture of *n*-hexane-diethyl ether, volume fraction of *n*-hexane 87 ml/100 ml and of diethyl ether 13 ml/100 ml.

5.11 Sodium hydroxide, aqueous solution, mass fraction 12 g/100 g.

5.12 Phenolphthalein, ethanolic solution, mass concentration 1 g/100 ml.

5.13 Carrier gas: hydrogen or helium, gas chromatography grade.

5.14 Auxiliary gases: hydrogen, free from moisture and organic substances, and synthetic air, gas chromatography grade.

5.15 Silylation reagent: mixture of pyridine, hexamethyldisilazane (HMDS) and trimethylchlorosilane (TMCS); volume fractions: 9 ml/13 ml, 3 ml/13 ml, and 1 ml/13 ml, respectively.

5.16 Reference samples: pure monoacylglycerols and mixtures of monoacylglycerols with a known composition similar to that of the sample.

6 Apparatus

Usual laboratory equipment and in particular the following.

6.1 Erlenmeyer flasks, of capacity 25 ml.

6.2 Beakers, of capacities 100 ml, 250 ml, and 300 ml.

6.3 Glass chromatography column, 21 mm to 23 mm internal diameter, 400 mm in length, with septum and stopcock.

6.4 Measuring cylinders, of capacities 10 ml, 50 ml, 100 ml, and 200 ml, ISO 4788^[2] class A.

6.5 Round-bottomed flasks, of capacities 100 ml and 250 ml.

6.6 Rotary evaporator.

- 6.7 Centrifuge tubes**, conical bottom, of capacity 10 ml, with ground-glass stopper.
- 6.8 Centrifuge**, suitable for 10 ml and 100 ml tubes.
- 6.9 Water bath**, capable of maintaining a temperature of $(40 \pm 0,5)$ °C.
- 6.10 Graduated pipettes**, of capacities 1 ml and 2 ml, ISO 835^[1] class A.
- 6.11 Hypodermic syringe**, 1 ml.
- 6.12 Microsyringe**, 100 µl.
- 6.13 Separating funnel**, 1 000 ml.
- 6.14 Gas chromatograph**, suitable for use with capillary columns, equipped with the components specified in 6.14.1 to 6.14.5.
- 6.14.1 Cold on-column injector.**
- 6.14.2 Flame ionization detector.**
- 6.14.3 Column oven**, capable of maintaining the temperature to within ± 1 °C.
- 6.14.4 Computer-based integration system.**
- 6.14.5 Fused silica capillary column**, of length 8 m to 12 m and internal diameter 0,25 mm to 0,32 mm, coated with methylpolysiloxane or 5 % phenyl-methylpolysiloxane, with a film thickness of 0,10 µm to 0,30 µm, suitable for use at 370 °C.
- 6.15 Microsyringe**, 10 µl, with hardened needle, of minimum length 7,5 cm in length, suitable for on-column injection.

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7 Sampling

Sampling is not part of the method specified in this International Standard. A recommended sampling method is given in ISO 5555^[3].

It is important that the laboratory receive a truly representative sample which has not been damaged or changed during transport or storage.

8 Preparation of the test sample

Prepare the test sample in accordance with ISO 661. Oils with a free acidity greater than 3 % require a neutralization step as specified here.

Introduce 50 g of the oil into a 1 000 ml separating funnel (6.13) and dissolve it in 200 ml of *n*-hexane (5.2). Add 100 ml of isopropanol (5.3) and a volume of sodium hydroxide solution (5.11) corresponding to the free acidity of the oil plus an excess of 5 %. Shake vigorously for 1 min, add 100 ml of water, shake again and leave to settle.

After separation, remove the lower soapy layer. Also remove any intermediate layer of mucilage and insoluble matter which often forms. Wash the *n*-hexane solution of the oil with successive 50 ml to 60 ml portions of the isopropanol-water mixture (5.4) until the washed phase is neutral to phenolphthalein (5.12).

Remove most of the hexane by distillation under vacuum, e.g. by using a rotary evaporator (6.6), and transfer the oil to a 100 ml round-bottomed flask (6.5). Dry it under vacuum to complete solvent removal.

By the end of this procedure, ensure that the acidity of the oil is below 0,5 %.

9 Procedure

9.1 Preparatory steps

9.1.1 Introduce 1,0 g of the oil, pretreated (Clause 8) where necessary, into a 25 ml Erlenmeyer flask (6.1) and dissolve it in 10 ml of elution solvent (5.10). Leave the solution to settle for at least 15 min before starting the silica gel column chromatography procedure.

If the solution is cloudy, centrifuge it to ensure optimal conditions for chromatography.

Ready-to-use 500 mg silica gel solid phase extraction (SPE) cartridges may be used.

9.1.2 Fill the chromatography column (6.3) with about 30 ml of elution solvent (5.10), insert a wad of cotton wool at the bottom of the column using a glass rod; press to remove the air.

In a beaker, prepare a suspension of 25 g of silica gel (5.1) in about 80 ml of elution solvent and transfer it to the column by means of a funnel.

Make sure that all the silica gel is transferred to the column; wash with elution solvent, open the stopcock and allow the solvent to drain until the solvent level is about 2 mm above the silica gel.

9.2 Column chromatography

9.2.1 Conventional procedure

Weigh 1,0 g of prepared test sample (9.1.1), to the nearest 0,1 mg, into a 25 ml Erlenmeyer flask (6.1).

Dissolve the sample in 10 ml of elution solvent (5.10). Transfer the solution on to the chromatography column (9.1.2). Avoid moving the surface of the column.

Open the stopcock and let the sample solution drain until it reaches the level of the silica gel. Elute with 150 ml of elution solvent. Regulate the flow to a rate of 2 ml/min (150 ml shall pass through the column in about 60 min to 70 min).

Collect the eluate in a previously weighed 250 ml round-bottomed flask (6.5). Evaporate the solvent under vacuum and remove the last traces of solvent under a stream of nitrogen.

Weigh the flask and calculate the mass recovered by difference.

9.2.2 Procedure when ready-to-use silica SPE cartridges are employed

Introduce 1 ml of the solution (9.1.1) into the cartridges, previously conditioned with 3 ml of *n*-hexane (5.2). After percolation of the solution, elute with 4 ml of the *n*-hexane-diethyl ether elution solvent (5.10). Recover the eluate in a 10 ml tube and evaporate to dryness under a stream of nitrogen. Subject the dry residue to the action of pancreatic lipase (5.5). Check the fatty acid composition before and after passage through the SPE cartridge.

9.3 Hydrolysis with pancreatic lipase

9.3.1 Weigh 0,1 g of the oil into a centrifuge tube (6.7). Add 2 ml of buffer solution (5.6), 0,5 ml of sodium cholate solution (5.7) and 0,2 ml of calcium chloride solution (5.8), shaking well after each addition. Cover the tube with the glass stopper and place it in the water bath (6.9) at $(40 \pm 0,5) ^\circ\text{C}$.

9.3.2 Add 20 mg of lipase (5.5), mix carefully (to avoid wetting the stopper) and place in the water bath for exactly 2 min, then remove, shake vigorously for exactly 1 min and cool.

9.3.3 Add 1 ml of diethyl ether (5.9), stopper and shake vigorously, then centrifuge and transfer the ether solution to another clean, dry tube by means of a microsyringe.

9.4 Preparation of the silylated derivatives and gas chromatography

Take 100 µl of solution (9.3.3) using a microsyringe and transfer to a 10 ml tube with a conical bottom (6.7). Eliminate the solvent under a gentle stream of nitrogen, add 200 µl of silylation reagent (5.15), stopper the tube and leave to settle for 20 min.

After 20 min, add 5 ml of *n*-hexane (5.2). The solution is then ready for gas chromatography.

9.5 Gas chromatography

9.5.1 Operating conditions

The following operating conditions are recommended:

- injector temperature: below solvent boiling point (68 °C);
- detector temperature: 350 °C;
- oven temperature programming: isothermal at 60 °C for 1 min; then increase at a rate of 15 °C/min to 180 °C, then at a rate of 5 °C/min to 340 °C; finally maintain at 340 °C for 20 min;
- carrier gas: hydrogen or helium, regulated to the suitable linear speed in order to obtain the resolution shown in Annex A;
- retention time of triacylglycerol C₅₄: (40 ± 5) min (see Figure A.2);
- injection volume: 0,5 µl to 1 µl of the solution obtained in 9.4.

Optimize the separation conditions to get the required resolution. Ensure that the height of the peak for 2-glyceryl monopalmitate is at least 10 % of the full-scale value.

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9.5.2 Identification of peaks

The individual monoacylglycerols are identified by comparing the retention times obtained with those obtained for standard monoacylglycerol mixtures analysed under the same test conditions.

9.5.3 Quantitative evaluation

The area of each peak is calculated by electronic integration.

10 Expression of results

The content of glyceryl monopalmitate, w_{MP} , expressed as a percentage mass fraction, is calculated from the ratio between the area of the relevant peak and the sum of the peak areas of all the monoacylglycerols (see Figure A.2) as follows:

$$w_{MP} = \frac{A_{MP}}{\sum A} \times 100$$

where

A_{MP} is the peak area of the glyceryl monopalmitate peak;

$\sum A$ is the sum of the peak areas of all monoacylglycerols.

Report the result to one decimal place.