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Animal and vegetable fats and oils — Determination of aliphatic hydrocarbons in vegetable oils

Corp gras d'origines animale et végétale — Détermination des hydrocarbures aliphatiques en corps gras d'origines végétale

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 34, *Food products*, Subcommittee SC 11, *Animal and vegetable fats and oils*.

Introduction

The major saturated hydrocarbons present in vegetable oils are long chain *n*-alkanes, containing more than 21 carbon atoms, and having an odd carbon number preference.[1]

Mineral oils can contain *n*-alkanes with up to 60 carbon atoms with no odd carbon predominance. Chromatograms of mineral oils obtained by this method are characterized by a wide peak due to the presence of a complex mixture of saturated branched and cyclic hydrocarbons. Medium and low viscosity mineral oils are typically characterized by a complex mixture with between C10 and C25 chain length; while high viscosity mineral oils are indicated by a complex mixture with the midpoint around C30 chain length.[2] The Joint FAO/WHO Expert Committee on Food Additives (JECFA) has set several ADIs for mineral oil (2002) dividing low-medium viscosity mineral oils into three different subclasses depending on the point of toxicity. This method does not help to distinguish between different classes.

Chromatograms of diesel oil are characterized by the presence of *n*-alkanes between C10 and C25 chain length with no odd carbon predominance, i.e. both even and odd numbered hydrocarbons are present in relatively equal proportions.

Animal and vegetable fats and oils — Determination of aliphatic hydrocarbons in vegetable oils

1 Scope

This International Standard specifies a method for the determination of saturated aliphatic hydrocarbons from C10 to C56 of natural origin present in vegetable oils, and for detecting the presence of mineral oil and diesel oil.

The method is applicable to all types of crude and refined edible oils and fats, for concentrations of mineral oils from 50 mg/kg to 1 000 mg/kg.

A rapid method for refined and virgin (or cold-pressed) oils is proposed in Annex C. This rapid method is not adapted for crude oils due to a lack of retention of triglycerides observed for some samples.

A method for fat recovery from food samples by soxhlet extraction with a blend of solvents is proposed in Annex D.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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
hydrocarbon contents
sum of saturated aliphatic hydrocarbons, expressed as a mass fraction, determined according to the method specified

3.2
unresolved complex mixture
UCM
complex mixture of saturated hydrocarbons not resolved by gas chromatography, represented by a wide peak, which can be due to a contamination with mineral oil

Note 1 to entry: The width of the peak is approximately 5 min to 15 min depending on gas chromatography conditions,

Note 2 to entry: See relevant chromatograms in Annex A.

3.3
diesel
sum of saturated *n*-alkanes between C10 and C25 chain length, expressed as a mass fraction, determined according to the method

Note 1 to entry: See relevant chromatograms in Annex A.

4 Principle

The saturated aliphatic hydrocarbons of the sample are isolated by liquid chromatography on silica gel impregnated with silver nitrate and determined by capillary gas chromatography with flame ionization detection using an internal standard. From the chromatogram, the area attributed to mineral oil is calculated by the subtraction of sharp peaks due to *n*-alkanes (naturally occurred hydrocarbons) from the total area including the UCM. To indicate diesel contamination, the peak areas of individual hydrocarbons between C10 and C25 chain length are summed and quantified together.

5 Reagents

WARNING — Attention is drawn to national regulations that specify the handling of hazardous substances, and users' obligations thereunder. Technical, organizational and personal safety measures shall be followed.

Unless otherwise specified, use only reagents of recognized analytical grade.

5.1 Silica gel 60[1)], extra pure for column chromatography with particle size between 60 µm and 200 µm (70-230 mesh).

5.2 Water, distilled and cooled down to room temperature.

5.3 Anhydrous sodium sulfate, analytical grade, purity 99 % minimum.

NOTE Sodium sulfate may be replaced by sea sand, washed with *n*-hexane.

5.4 *n*-Hexane, trace organic analysis grade, purity 99 % minimum, residue after evaporation maximum 2 mg/kg.

NOTE 1 Hexane purity may be checked by concentrating 200 ml of *n*-hexane mixed with 2 ml of internal standard solution (5.6) using a rotary evaporator, dissolving the residue in 0,2 ml of *n*-hexane and the analysis of 5 µl by gas chromatography (9.3).

NOTE 2 Hexane may be replaced by isooctane, *n*-heptane or a mixture of alkanes of boiling point 65 °C to 70 °C, as long as the residue after evaporation is maximum 2 mg/kg. Solvents with higher boiling point than *n*-hexane take longer to evaporate. However, they are preferred due to the toxicity of hexane.

5.5 Internal standard: *n*-octadecane (C18), purity 99 % minimum.

n-Octadecane may be replaced by *n*-eicosane (C20). Before choosing one of these two compounds as the internal standard, it should be verified that there is no co-elution with other peaks from the sample to be analysed.

n-Octadecane shall be replaced by naphthalene if the sample is contaminated with a diesel oil, in order to avoid the overlapping of the internal standard peak with the alkane peaks to be quantified.

5.6 Solution of internal standard, mass concentration ρ = 0,04 mg/ml.

As an example, weigh to the nearest mg, approximately 50 mg of *n*-octadecane (5.5) and dilute to 25 ml with *n*-hexane (5.4), and then proceed with a second dilution of this mixture of 1 ml → 50 ml with *n*-hexane. Store this solution at room temperature in order to maintain its stability.

5.7 *n*-Decane (C10), purity 99 % minimum.

1) Silica gel is available from Merck, reference 7754 or 7734. This reference is an example of a suitable product which is available commercially. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of this product.

5.8 *n*-Decane solution, mass concentration ρ = 0,04 mg/ml.

As an example, weigh to the nearest mg, approximately 50 mg of *n*-decane and dilute to 25 ml with *n*-hexane (5.4), and then proceed with a second dilution of this mixture of 1 ml → 50 ml with *n*-hexane. Store this solution at room temperature in order to maintain its stability.

5.9 Octatetracontane (C48), purity 99 % minimum. This standard is used to limit the integration of the hump to a certain retention time that will correspond to the retention time of this hydrocarbon.

5.10 Octatetracontane solution, mass concentration approximately ρ = 0,08 mg/ml.

As an example, weigh to the nearest mg approximately 2 mg of octatetracontane (5.9) and dilute to 25 ml of *n*-hexane (5.4). Store this solution at room temperature in order to maintain its stability.

NOTE Solubility of octatetracontane in hexane is limited at room temperature, due to its high melting point. However, the concentration of the solution of octatetracontane does not need to be accurate as it is used only to determine the limit of integration for the mineral oil peak.

5.11 Silver nitrate ($AgNO_3$), analytical grade.

5.12 Silver nitrate aqueous solution, mass concentration ρ = 0,75 g/ml.

As an example, to prepare silver nitrate silica gel for 3 columns, weigh approximately 4,5 g of silver nitrate in 6 ml of distilled water (5.2).

5.13 Carrier gas for gas chromatography, helium or hydrogen.

5.14 Auxiliary gases for flame ionization detector, hydrogen, air, and nitrogen suitable for gas chromatography.

5.15 Alkane standard mixture C10 to C40[2], solution in non-polar solvent.

5.16 Viscous paraffin and highly liquid paraffin[3], solution in non-polar solvent.

5.17 Solution of paraffin and *n*-octadecane, mass concentration of paraffin ρ = 0,5 mg/ml, mass concentration of *n*-octadecane ρ = 0,08 mg/ml.

As an example, weigh to the nearest mg, approximately 500 mg of viscous paraffin (5.16) and 80 mg of *n*-octadecane (5.5) and dilute to 10 ml with *n*-hexane (5.4), and then proceed with a second dilution of this mixture of 1 ml → 100 ml with *n*-hexane. Store this solution at room temperature in order to maintain its stability.

6 Apparatus

Usual laboratory apparatus and, in particular, the following.

IMPORTANT — The glassware used for the determination shall be thoroughly cleaned and rinsed with n-hexane (5.4) before use so that it is free from impurities.

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2) Alkane standard mixture at 50 mg/l is available from Sigma-Aldrich, reference 68281 (www.sigmaaldrich.com). This reference is an example of suitable products which are available commercially. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of these products.

3) A viscous paraffin is available from Merck, reference 107160. Highly liquid paraffin is available from Merck, reference 107174. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of these products.