



# COMPENDIUM OF FOOD ADDITIVE SPECIFICATIONS

**Joint FAO/WHO Expert Committee on Food Additives**

68th meeting 2007



**World Health  
Organization**



**Food and Agriculture  
Organization of  
the United Nations**

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## INTRODUCTION

This volume of FAO JECFA Monographs contains specifications of identity and purity prepared at the 68<sup>th</sup> meeting of the Joint FAO/WHO Expert Committee on Food Additives (JECFA), held in Geneva on 19-28 June 2007. In addition, an analytical method of assay for four flavourings and their respective sodium salts 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 65<sup>th</sup> 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?lang=en>. 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 68th 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](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 [www.fao.org/ag/agn/jecfa/index\\_en.stm](http://www.fao.org/ag/agn/jecfa/index_en.stm). Readers are invited to address comments and questions on this publication and other topics related to the work of JECFA to:

[jecfa@fao.org](mailto: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 oryzae* expressed in *Aspergillus oryzae* (N)

Carrageenan (R)

Cyclotetraglucose (N)

Cyclotetraglucose syrup (N) Tentative

Ethyl maltol (R)

Isoamylase from *Pseudomonas amyloclavata* (N)

Magnesium sulfate (R)

Maltol (R)

Nisin preparation (R)

Pectins (R)

Polyvinyl alcohol (R)

Processed *Eucheima* seaweed (R)

Sodium chlorite (N)

Sodium hydrogen sulfate (N)

Steviol glycosides (R)

Sucrose esters of fatty acids (R)

When the specifications for heavy metals (as lead), other metals and arsenic in sweeteners, were reviewed by the Committee at its 63rd meeting in 2004, Sodium L(+)-tartrate was inadvertently omitted from the list of food additives with revised specifications. In the publication of FAO JECFA Monographs 1 (2005), the limit for heavy metals (as lead) was already brought in line with the limit for sodium potassium L(+)-tartrate, but the introductory paragraph did not reflect this an appropriate way. This has now been accomplished in the on-line version of the Combined Compendium of Food Additive Specifications and the specifications for sodium L(+)-tartrate are not republished in this publication.

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.

New and revised INS numbers assigned to food additives by the Codex Alimentarius Commission at its 30<sup>th</sup> session in 2007, (ALINORM 07/30/12, Appendix XIII) 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. In addition, correction of the INS number for trimagnesium phosphate to 343iii has been made.

The chemical abstract numbers (C.A.S.) for the following food additives have been revised in the specifications monographs in the on-line database and these are not reproduced in this publication:

<u>Food additive</u>	<u>New C.A.S. number(s)</u>
Aspartame	22839-47-0
Benzoic acid	65-85-0
Erythorbic acid	89-65-6
Sucrose acetate isobutyrate	137204-24-1; 27216-37-1; 126-13-6
Trimagnesium phosphate	7757-87-1

For sucrose acetate isobutyrate multiple C.A.S. numbers have been applied over the years and are still in use. The first number is a generic description, the second is more specific in terms of description and the third is precisely based on the molecular structure.

## ASPARAGINASE FROM *ASPERGILLUS ORYZAE* EXPRESSED IN *A. ORYZAE*

*New specifications prepared at the 68th JECFA (2007) and published in FAO JECFA Monographs 4 (2007). An ADI "not specified" was established at the 68th JECFA (2007).*

### SYNONYMS

Asparaginase

### SOURCES

Asparaginase is produced by submerged fed-batch fermentation of a genetically modified strain of *Aspergillus oryzae* which has a reduced capability for producing secondary metabolites and contains the asparaginase gene derived from *A. oryzae*. The enzyme is isolated from the fermentation broth by filtration to remove the biomass and concentrated by ultrafiltration and/or evaporation. The residual production microorganism is removed from the enzyme concentrate by germ filtration. The final product is formulated using food-grade stabilizing and preserving agents and standardized to the desired activity.

### 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

Light brown liquid

### 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. Ammonia is subsequently combined with  $\alpha$ -ketoglutarate to form L-glutamic acid. The reaction is catalysed by glutamate dehydrogenase in the presence of NADH, which is oxidized to  $\text{NAD}^+$  with the concomitant loss of absorbance measured at 340 nm. The activity of asparaginase is determined by measuring the rate of consumption of NADH under standard conditions ( $\text{pH}=7.00\pm0.05$ ;  $37.0\pm0.5^\circ$ ) and is expressed in ASNU units.

One ASNU is defined as the amount of asparaginase that produces 1 micromole ammonia per minute under the conditions of the assay ( $\text{pH}=7.00\pm0.05$ ;  $37.0\pm0.5^\circ$ ).

#### Apparatus

Spectrophotometer (340 nm) with thermostatic control ( $37.0\pm0.5^\circ$ ) and a 1-cm light path.

Water bath with thermostatic control.

Vortex mixer.

Stopwatch

#### Reagents and solutions

(Note: use deionized water)

*Sodium hydroxide 4 M:* Weigh 16.0 g NaOH (Merck 106495 or equivalent). Dissolve in water in a 100-ml volumetric flask. Add water to volume and mix until fully dissolved. The solution is stable for 3 months at room temperature.

*MOPS buffer, 0.1 M, pH 7, with Triton X-100, 0.1%:* Weigh  $20.9\pm0.5$  g MOPS (Sigma M-1254 or equivalent) and dissolve in approximately 950 ml of water in a 1000-ml volumetric flask. Adjust the pH to  $7.00\pm0.05$  with 4 M NaOH. Add 1.0 ml of 100% Triton X-100 (Sigma T-9284 or equivalent). Add water to volume and mix. The solution must be used on the day of preparation.

*L-Asparagine substrate solution:* Weigh  $0.25\pm0.02$  g of L-asparagine (Sigma A-7094 or equivalent). Transfer to a 25-ml volumetric flask. Add 20 ml of the MOPS buffer with Triton X-100 and stir until dissolved. Add  $0.011\pm0.001$  g of NADH (Roche 107 735 or equivalent). Add  $0.063\pm0.005$  g of  $\alpha$ -ketoglutarate (Sigma K-3752 or equivalent) and at least 2000 units of glutamate dehydrogenase (EC 1.4.1.3) (Fluka 49392 or equivalent). Remove the stirring magnet. Add MOPS buffer with Triton X-100 to volume and mix. The composition of the solution is: L-asparagine, 10 mg/ml;  $\alpha$ -ketoglutarate, 2.5 mg/ml; NADH, 0.44 mg/ml; glutamate dehydrogenase,  $>80$  U/ml. The solution is stable for about 2 hours at room temperature.

*Control sample solution:* Accurately weigh approximately 0.72 g of an asparaginase preparation with known activity (for example, 1301 ASNU/g; batch 115-11104; expiration date January 2026;

available from Novozymes A/S). Transfer to a 100-ml volumetric flask and add the MOPS buffer with Triton X-100 to volume. Mix until fully dissolved.

*Blank:* MOPS buffer, 0.1 M, pH 7, with Triton X-100, 0.1%.

*Test sample solution:* Accurately weigh at least 1 g of the asparaginase product into a 50 ml volumetric flask and add the MOPS buffer with Triton X-100 to volume. Repeat dilution if necessary to obtain the activity of approximately 0.4-1.0 ASNU/ml (corresponds to approximately 0.1-0.25 ABS/min).

#### Procedure

1. Set the temperature of the spectrophotometer and water bath at  $37.0 \pm 0.5^\circ$ .
  2. Set the wavelength at 340 nm and use the MOPS buffer with Triton X-100 as a blank.
  3. Equilibrate 2.4 ml of the L-asparagine substrate solution in the water bath for 10 min. Add 0.1 ml of the test or control sample solution, vortex briefly, and transfer 1 ml to a 1-cm quartz cuvette.
  4. Place the cuvette in the spectrophotometer and immediately read the absorbance. If the absorbance exceeds 2.3, continue the assay. If the absorbance is below 2.3, prepare a new substrate solution. Read the absorbance every 10 sec between 3 and 5 min from the start of the reaction.
  5. Plot the absorbance (A) versus time (min) and calculate the slope ( $\Delta A/\text{min}$ ).
- (Note: Carry out steps 3-5 at least twice for each test or control sample solution. The results should agree within 15%.)

#### Calculations

Calculate the activity (pASNU/g) of the test or control sample as follows:

$$\text{pASNU/g} = \frac{\Delta A/\text{min} \times T_v \times D_v \times F}{S_v \times \epsilon \times d \times W}$$

where:

$\Delta A/\text{min}$  is the absolute value of the decrease of absorbance per min for the test or control sample solution

$T_v$  is the total assay volume (2.5 ml)

$D_v$  is the dissolution volume of the test or control sample (before dilution) (ml)

$F$  is the dilution factor

$S_v$  is the volume of the enzyme solution used in the assay (0.1 ml)

$\epsilon$  is the extinction coefficient of NADH at 340 nm ( $6.3 \text{ ml } \mu\text{mol}^{-1} \text{ cm}^{-1}$ )

$d$  is the light path (1 cm)

W is the weight of the test or control sample (g)

Calculate the ratio (R) of the known-to-calculated activity for the control sample. If  $R \neq 1$ , multiply the activity of the test sample (pASNU/g) by R to obtain the corrected activity of the test sample (ASNU/g):

$$\text{ASNU/g} = R \times \text{pASNU/g}$$

Notes:

The method is specific for asparaginase activity when up to 6 g/l ammonia is generated in samples with asparaginase activity of 1200 ASNU/g.

Asparaginase activity may vary within  $\pm 15\%$  between the replicates of the same sample.

## CARRAGEENAN

*Prepared at the 68<sup>th</sup> JECFA (2007) and published in FAO JECFA Monographs 4 (2007), superseding specifications prepared at the 57<sup>th</sup> JECFA (2001), published in the Combined Compendium of Food Additive Specifications, FAO JECFA Monographs 1 (2005). A group ADI “not specified” for carrageenan and processed Eucheuma seaweed was established at the 57<sup>th</sup> JECFA (2001).*

### SYNONYMS

Irish moss gelose (from *Chondrus* spp.); Eucheuman (from *Eucheuma* spp.); Iridophycan (from *Iridaea* spp.); Hypnean (from *Hypnea* spp.); Furcellaran or Danish agar (from *Furcellaria fastigiata*); INS No. 407.

### DEFINITION

A substance with hydrocolloid properties obtained from certain members of the class *Rhodophyceae* (red seaweeds).

The principal commercial sources of carrageenans are the following families and genera of the class of *Rhodophyceae*:

*Furcellariaceae* such as *Furcellaria*

*Gigartinaceae* such as *Chondrus*, *Gigartina*, *Iridaea*

*Hypnaeaceae* such as *Hypnea*

*Phyllophoraceae* such as *Phyllophora*, *Gymnogongrus*, *Ahnfeltia*

*Solieriaceae* such as *Eucheuma*, *Anatheca*, *Meristotheca*.

Carrageenan is a hydrocolloid consisting mainly of the ammonium, calcium, magnesium, potassium and sodium sulfate esters of galactose and 3,6-anhydrogalactose polysaccharides. These hexoses are alternately linked  $\alpha$ -1,3 and  $\beta$ -1,4 in the copolymer. The relative proportions of cations existing in carrageenan may be changed during processing to the extent that one may become predominant.

The prevalent polysaccharides in carrageenan are designated as kappa-, iota-, and lambda-carrageenan. Kappa-carrageenan is mostly the alternating polymer of D-galactose-4-sulfate and 3,6-anhydro-D-galactose; iota-carrageenan is similar, except that the 3,6-anhydrogalactose is sulfated at carbon 2. Between kappa-carrageenan and iota-carrageenan there is a continuum of intermediate compositions differing in degree of sulfation at carbon 2. In lambda-carrageenan, the alternating monomeric units are mostly D-galactose-2-sulfate (1,3-linked) and D-galactose-2,6-disulfate (1,4-linked).

Carrageenan is obtained by extraction from seaweed into water or aqueous dilute alkali. Carrageenan may be recovered by alcohol precipitation, by drum drying, or by precipitation in aqueous potassium chloride and subsequent freezing. The alcohols used during recovery and purification are restricted to methanol, ethanol, and isopropanol.

Articles of commerce may include sugars for standardization purposes, salts to obtain specific gelling or thickening characteristics, or emulsifiers carried over from drum drying



processes.

C.A.S. number 9000-07-1

**DESCRIPTION** Yellowish or tan to white, coarse to fine powder that is practically odourless.

**FUNCTIONAL USES** Thickener, gelling agent, stabilizer, emulsifier

## CHARACTERISTICS

### IDENTIFICATION

Solubility (Vol. 4) Insoluble in ethanol; soluble in water at a temperature of about 80°, forming a viscous clear or slightly opalescent solution that flows readily; disperses in water more readily if first moistened with alcohol, glycerol, or a saturated solution of glucose or sucrose in water.

Test for sulfate Dissolve a 100-mg sample in 20 ml of water (with heating if necessary), and add 3 ml of barium chloride TS and 5 ml of hydrochloric acid, dilute TS; filter if a precipitate forms. Boil the solution or the filtrate for 5 min. A white, crystalline precipitate appears.

Test for galactose and anhydrogalactose (Vol. 4) Proceed as directed in Vol.4 (under "General Methods, Organic Components, Gum Constituents Identification") using the following as reference standards: galactose, rhamnose, galacturonic acid, 3,6-anhydrogalactose, mannose, arabinose and xylose. Galactose and 3,6-anhydrogalactose should be present.

Identification of hydrocolloid and predominant type of copolymer Add 4 g of sample to 200 ml of water, and heat the mixture in a water bath at 80°, with constant stirring, until dissolved. Replace any water lost by evaporation, and allow the solution to cool to room temperature. It becomes viscous and may form a gel. To 50 ml of the solution or gel add 200 mg of potassium chloride, then reheat, mix well, and cool. A short-textured ("brittle") gel indicates a carrageenan of a predominantly kappa type, and a compliant ("elastic") gel indicates a predominantly iota type. If the solution does not gel, the carrageenan is of a predominantly lambda type.

Infrared absorption Passes test  
See description under TESTS

### PURITY

Loss on drying (Vol. 4) Not more than 12% (105° to constant weight)

<u>pH</u> (Vol. 4)	Between 8 and 11 (1 in 100 suspension)
<u>Viscosity</u>	Not less than 5 cp at 75° (1.5% solution) See description under TESTS
<u>Sulfate</u>	Not less than 15% and not more than 40% (as $\text{SO}_4^{2-}$ ) on the dried basis See description under TESTS
<u>Total ash</u>	Not less than 15% and not more than 40% on the dried basis See description under TESTS.
<u>Acid-insoluble ash</u> (Vol. 4)	Not more than 1% Use the ash from the Total ash test
<u>Acid-insoluble matter</u> (Vol. 4)	Not more than 2% Use 2 g of sample obtained from part (a) of the procedure for sulfate determination.
<u>Residual solvents</u> (Vol. 4)	Not more than 0.1% of ethanol, isopropanol, or methanol, singly or in combination See description under TESTS
<u>Microbiological criteria</u> (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 5000 cfu/g <i>Salmonella</i> spp.: Negative per test <i>E. coli</i> : Negative in 1 g
<u>Arsenic</u> (Vol. 4)	Not more than 3 mg/kg Determine by the atomic absorption hydride technique. Use Method II for sample preparation.
<u>Lead</u> (Vol. 4)	Not more than 5 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").
<u>Cadmium</u> (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 method described in Volume 4 (under "General Methods, Metallic Impurities").
<u>Mercury</u> (Vol.4)	Not more than 1 mg/kg Determine by the cold vapour atomic absorption technique

## TESTS

### IDENTIFICATION TESTS

#### Infrared absorption

Obtain infrared absorption spectra on the gelling and non-gelling fractions of the sample by the following procedure:

Disperse 2 g of the sample in 200 ml of 2.5% potassium chloride solution, and stir for 1 h. Let stand overnight, stir again for 1 h, and transfer into a centrifuge tube. (If the transfer cannot be made because the dispersion is too viscous, dilute with up to 200 ml of the potassium chloride solution.) Centrifuge for 15 min at approximately 1000 x g.

Remove the clear supernatant, resuspend the residue in 200 ml of 2.5% potassium chloride solution, and centrifuge again. Coagulate the combined supernatants by adding 2 volumes of 85% ethanol or isopropanol (NOTE: Retain the sediment for use as directed below). Recover the coagulum, and wash it with 250 ml of the alcohol. Press the excess liquid from the coagulum, and dry it at 60° for 2 h. The product obtained is the non-gelling fraction (lambda-carrageenan).

Disperse the sediment (retained above) in 250 ml of cold water, heat at 90° for 10 min, and cool to 60°. Coagulate the mixture, and then recover, wash, and dry the coagulum as described above. The product obtained is the gelling fraction (kappa- and iota-carrageenan).

Prepare a 0.2% aqueous solution of each fraction, cast films 0.5 mm thick (when dry) on a suitable non-sticking surface such as Teflon, and obtain the infrared absorption spectrum of each film. (Alternatively, the spectra may be obtained using films cast on potassium bromide plates, if care is taken to avoid moisture).

Carrageenan has strong, broad absorption bands, typical of all polysaccharides, in the 1000 to 1100  $\text{cm}^{-1}$  region. Absorption maxima are 1065 and 1020  $\text{cm}^{-1}$  for gelling and non-gelling types, respectively. Other characteristic absorption bands and their intensities relative to the absorbance at 1050  $\text{cm}^{-1}$  are as follows:

Wave number ( $\text{cm}^{-1}$ )	Molecular Assignment	Absorbance relative to 1050 ( $\text{cm}^{-1}$ )		
		Kappa	Iota	Lambda
1220-1260	ester sulfate	0.3-1.4	1.2-1.7	1.4-2.0
928-933	3,6-anhydrogalactose	0.2-0.7	0.2-0.4	0-0.2
840-850	galactose-4-sulfate	0.2-0.5	0.2-0.4	-
825-830	galactose-2-sulfate	-	-	0.2-0.4
810-820	galactose-6-sulfate	-	-	0.1-0.3
800-805	3,6-anhydrogalactose-2-sulfate	0-0.2	0.2-0.4	-

## PURITY TESTS

### Sulfate

#### Principle

Hydrolysed sulfate groups are precipitated as barium sulfate.

#### Procedure

(a) Disperse an accurately weighed 15 g sample of commercial product into 500 ml of 60% w/w isopropanol/water at room temperature. Stir gently for 4 h. Filter through ash-free filter paper. Discard the filtrate. Wash the material remaining on the filter paper with two 15-ml portions of 60% isopropanol/water. Dry the material at 105° to constant weight. Approximately 1 g of the dried matter is to be used for part (b). The remainder should be retained for determination of Total ash, Acid-insoluble matter, and viscosity.

(b) Accurately weigh a 1 g sample ( $W_1$ ) obtained from part (a). Transfer the sample to a 100-ml long-neck round-bottom flask. Add 50 ml of 0.2 N hydrochloric acid. Fit a condenser, preferably one with at least 5 condensing bulbs, to the flask and reflux for 1 h. Add 25 ml of a 10% (by volume) hydrogen peroxide solution and resume refluxing for about 5 h or until the solution becomes completely clear.

Transfer the solution to a 600-ml beaker, bring to a boil, and add dropwise 10 ml of a 10% barium chloride solution. Heat the reaction mixture for 2 h on a boiling water bath. Filter the mixture through ash-free slow-filtration filter paper. Wash with boiling distilled water until the filtrate is free from chloride. Dry the filter paper and contents in a drying oven. Gently burn and ash the paper at 800° in a tared porcelain or silica crucible until the ash is white. Cool in a desiccator.

Weigh the crucible containing the ash. Calculate the percentage sulfate from the weight in g ( $W_2$ ) of the ash (barium sulfate) using the formula:

$$(W_2/W_1) \times 100 \times 0.4116$$

### Total ash

Accurately weigh 2 g of the dried sample ( $W_1$ ) obtained from part (a) under the procedure for sulfate determination above. Transfer to a previously ignited, tared silica or platinum crucible. Heat the sample with a suitable infrared lamp, increasing the intensity gradually, until the sample is completely charred; continue heating for an additional 30 min. Transfer the crucible with the charred sample into a muffle furnace and ignite at about 550° for 1 h. Cool in a desiccator and weigh. Repeat the ignition in the muffle furnace until a constant weight ( $W_2$ ) is obtained. If a carbon-free ash is not obtained after the first ignition, moisten the charred spot with a 1-in-10 solution of ammonium nitrate and dry under an infrared lamp. Repeat the ignition step.

Calculate the percentage of total ash of the sample:

$$(W_2/W_1) \times 100$$

Retain the ash for the Acid-insoluble ash test.

#### Viscosity

Transfer 7.5 g of the dried sample obtained from part (a) under the procedure for sulfate determination into a tared, 600-ml tall-form (Berzelius) beaker, and disperse with agitation for 10 to 20 min in 450 ml of deionized water. Add sufficient water to bring the final weight to 500 g, and heat in a water bath with continuous agitation, until a temperature of 80° is reached (20 - 30 min). Add water to adjust for loss by evaporation, cool to 76-77°, and heat in a constant temperature bath at 75°.

Pre-heat the bob and guard of a Brookfield LVF or LVT viscometer to approximately 75° in water. Dry the bob and guard, and attach them to the viscometer, which should be equipped with a No. 1 spindle (19 mm in diameter, approximately 65 mm in length) and capable of rotating at 30 rpm. Adjust the height of the bob in the sample solution, start the viscometer rotating at 30 rpm and, after six complete revolutions of the viscometer, take the viscometer reading on the 0-100 scale.

If the viscosity is very low, increased precision may be obtained by using the Brookfield UL (ultra low) adapter or equivalent. (Note. Samples of some types of carrageenan may be too viscous to read when a No. 1 spindle is used. Such samples obviously pass the specification, but if a viscosity reading is desired for other reasons, use a No. 2 spindle and take the reading on the 0-100 scale or on the 0-500 scale.)

Record the results in centipoises, obtained by multiplying the reading on the scale by the factor given by the Brookfield manufacturer.

#### Residual solvents (Vol.4)

See Method 1 under Vol. 4. General Methods, Organic Components, Residual Solvents.

Prepare standard, blank, and calibration solutions as directed under Method 1.

#### 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 5 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 100 ml, adjusting the heat so that the foam does not enter the column. Quantitatively transfer the distillate to a 200-ml volumetric flask, fill to the mark with water and shake the flask to mix. Weigh accurately 8.0 g of this solution into an injection vial. Add 1.0 ml of the internal standard solution. Heat at 60° for 10 min and shake vigorously for 10 sec.

## CYCLOTETRAGLUCOSE

*New specifications prepared at the 68th JECFA (2007) and published in FAO JECFA Monographs 4 (2007). A temporary ADI “not specified” was established at the 68th JECFA (2007).*

### SYNONYMS

Cyclotetraose, Cyclic nigerosyl-(1→6)-nigerose, cycloalternan, cycloalternanotetraose

### DEFINITION

Cyclotetraglucose has been found to occur naturally in sake lees (i.e., the sediment that forms during sake production), in sake itself, and in the cells of *Saccharomyces cerevisiae*. It is a non-reducing cyclic tetrasaccharide consisting of four D-glucopyranosyl units linked by alternating  $\alpha(1\rightarrow3)$  and  $\alpha(1\rightarrow6)$  glycosidic bonds. It is produced from hydrolyzed food-grade starch by the actions of a mixture of 6- $\alpha$ -glucosyltransferase  $\alpha$ -isomaltosyltransferase derived from *Sporosarcina globispora*, and cyclodextrin glucosyltransferase derived from *Bacillus stearothermophilus*. After purification the product contains 0 to 5 molecules of water of crystallization per molecule of cyclotetraglucose.

### Chemical names

*cyclo*[ $\rightarrow 6$ ]- $\alpha$ -D-glucopyranosyl-(1 $\rightarrow$ 3)- $\alpha$ -D-glucopyranosyl-(1 $\rightarrow$ 6)- $\alpha$ -D-glucopyranosyl-(1 $\rightarrow$ 3)- $\alpha$ -D-glucopyranosyl-(1 $\rightarrow$ ]

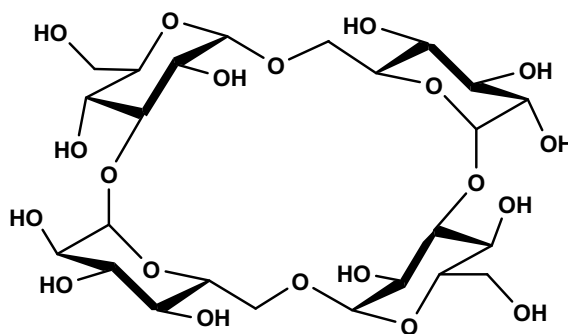
### Chemical formula

C<sub>24</sub>H<sub>40</sub>O<sub>20</sub> (anhydrous)

### C.A.S. number

Cyclotetraglucose, anhydrous: 159640-28-5  
Cyclotetraglucose, monohydrate: 532945-75-8  
Cyclotetraglucose, pentahydrate: 532945-76-9

### Structural formula



### Formula weight

648.56 (anhydrous)

### Assay

Not less than 98% on the anhydrous basis

### DESCRIPTION

Virtually odourless, white or almost white powder

### FUNCTIONAL USES

Carrier

## CHARACTERISTICS

### IDENTIFICATION

<u>Melting range</u> (Vol.4)	Decomposes above 300°
<u>Solubility</u> (Vol. 4)	Freely soluble in water
<u>Anthrone reaction</u>	Add 5 ml of Anthrone TS (Vol. 4) to 2 ml of a 0.1% aqueous solution of the test sample. React at 80° for 15 min. A deep blue colour develops.
<u>Specific rotation</u> (Vol.4)	$[\alpha]_D^{20}$ between +240° and +248° (10% solution)

### PURITY

<u>Water</u> (Vol. 4)	Not more than 15.0% (Karl Fischer Method)
<u>Total ash</u> (Vol. 4)	Not more than 0.1% (500°, 5h)
<u>Lead</u> (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").

### METHOD OF ASSAY

Determine by HPLC (Vol. 4) using the following conditions:  
NOTE: Use deionized water

#### Sample solution

Weigh accurately about 500 mg of test sample into a 50-ml volumetric flask and add about 40 ml of water. Dissolve the sample completely and dilute to the mark with water.

#### Standard solution

Dissolve accurately weighed cyclotetraglucose standard (available under the name of cyclotetraose from Hayashibara Co., Ltd, 2-3 Shimoishii 1-chome, Okayama 700, Japan) in water to obtain a solution of about 10 mg/ ml.

#### Chromatography

Liquid chromatograph equipped with a column oven and a refractive index detector.

Column and packing: strong acidic cation exchange resin

- length: 200 – 400 mm
- diameter: 8 – 10 mm
- temperature: 80°

Mobile phase: water

Flow rate: Adjust to obtain a retention time of 55 – 65 min

Injection volume: 20 µl

The retention time of cyclotetraglucose is approx. 62 min.

System suitability

Upon chromatography of a solution containing about 0.4% cyclotetraglucose and 0.4% glucose, the resolution (Vol. 4) is not less than 1.0 between glucose (first peak) and cyclotetraglucose (second peak).

Procedure

Inject the sample solution into the chromatograph, and measure the area of the cyclotetraglucose peak. Repeat for the standard solution. Calculate the percentage of cyclotetraglucose in the test sample as follows:

$$\% \text{ cyclotetraglucose (anhydrous basis)} = 100 \times (A_S/A_R)(W_R/W_S)$$

where:

$A_S$  and  $A_R$  are the areas of the peaks due to cyclotetraglucose for the sample solution and standard solution, respectively.

$W_S$  and  $W_R$  are the weights (mg) of the test sample and cyclotetraglucose standard, respectively, corrected for water content.





## CYCLOTETRAGLUCOSE SYRUP (TENTATIVE)

*New specifications prepared at the 68th JECFA (2007) and published in FAO JECFA Monographs 4 (2007). A temporary ADI “not specified” was established at the 68th JECFA (2007).*

*Information is required on (1) the level of total saccharides and the test method and (2) the unidentified saccharides. The specifications will be withdrawn if the requested information is not made available by the end of 2008.*

### SYNONYMS

Cyclotetraglucose syrup, Cyclic nigerosyl-(1→6)-nigerose syrup, cycloalternan syrup, cycloalternanotetraose syrup

### DEFINITION

A mixture consisting of mono-, di- and oligosaccharides, of which cyclotetraglucose is the major component. It is produced from hydrolyzed food-grade starch by the actions of a mixture of 6- $\alpha$ -glucosyltransferase  $\alpha$ -isomaltosyltransferase derived from *Sporosarcina globispora*, and cyclodextrin glucosyltransferase derived from *Bacillus stearothermophilus*. The final product is a syrup or a spray-dried solid.

### Assay

Not less than --- % of total saccharides (information required) and 30 – 40% of cyclotetraglucose on the anhydrous basis

### DESCRIPTION

Slightly sweet tasting, colourless and odourless, clear viscous liquid or dry white crystalline mass.

### FUNCTIONAL USES

Carrier

### CHARACTERISTICS

#### IDENTIFICATION

##### Chromatography

The retention time for the major peak in a HPLC chromatogram of the sample corresponds to that for cyclotetraglucose in a chromatogram of cyclotetraglucose standard using the conditions described in the Method of Assay. The retention time of cyclotetraglucose is approx. 62 min.

#### PURITY

##### Water (Vol. 4)

Not more than 30% for the syrup and not more than 10% for the syrup solids (Karl Fischer Method).

##### Total ash (Vol. 4)

Not more than 0.05% on the anhydrous basis (500°, 5h)

##### 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”).

Microbiological  
criteria (Vol.4)

Total (Aerobic) plate count: not more than 300 CFU/g  
Coliforms: Negative in 10 g  
Yeast and moulds: Not more than 100 CFU/g

**METHOD OF ASSAY**

Determine by HPLC (Vol. 4) using the following conditions:  
NOTE: Use deionized water.

Sample solution

Weigh accurately about 1000 mg of test sample into a 50-ml volumetric flask and add about 40 ml of water. Dissolve the sample completely and dilute to the mark with water.

Standard solution

Dissolve accurately weighed cyclotetraglucose standard (available under the name of cyclotetraose from Hayashibara Co., Ltd, 2-3 Shimoishii 1-chome, Okayama 700, Japan) in water to obtain a solution having known concentration of about 10 mg of cyclotetraglucose per ml.

Chromatography

Liquid chromatograph equipped with a column oven and a refractive index detector.

Column and packing: strong acidic cation exchange resin

- length: 200–400 mm
- diameter: 8–10 mm
- temperature: 80°

Mobile phase: water

Flow rate: Adjust to obtain a retention time of 55–65 min

Injection volume: 20 µl

The retention time of cyclotetraglucose is approx. 62 min.

System suitability

Upon chromatography of a solution containing about 0.4% cyclotetraglucose and 0.4% glucose, the resolution (Vol. 4) is not less than 1.0 between glucose (first peak) and cyclotetraglucose (second peak).

Procedure

Inject the sample solution into the chromatograph, and measure the area of the cyclotetraglucose peak. Repeat for the standard solution. Calculate the percentage of cyclotetraglucose in the test sample as follows:

$$\% \text{ cyclotetraglucose (dried basis)} = 100 \times (A_S/A_R)(W_R/W_S)$$

where:

$A_S$  and  $A_R$  are the areas of the peaks due to cyclotetraglucose for the sample solution and standard solution, respectively.

$W_S$  and  $W_R$  are the weights (mg) of the test sample and standard cyclotetraglucose, respectively, corrected for water content.

## ETHYL MALTOL

*Prepared at the 68<sup>th</sup> JECFA (2007) and published in FAO JECFA Monographs 4 (2007), superseding tentative specifications prepared at the 65<sup>th</sup> JECFA (2005) and published in the Combined Compendium of Food Additive Specifications, FAO JECFA Monographs 1 (2005). An ADI of 0-2 mg/kg bw was established at the 18<sup>th</sup> JECFA (1974).*

### SYNONYMS

INS No. 637

### DEFINITION

Ethyl maltol is obtained by chemical synthesis

Chemical names

2-Ethyl-3-hydroxy-4-pyrone

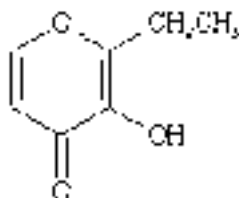
C.A.S. number

4940-11-8

Chemical formula

C<sub>7</sub>H<sub>8</sub>O<sub>3</sub>

Structural formula



Formula weight

140.14

Assay

Not less than 99.0%, calculated on the anhydrous basis

### DESCRIPTION

White, crystalline powder with a cotton-candy odour

### FUNCTIONAL USES

Flavour enhancer, flavouring agent (see 'Flavouring agents' monograph No. 1481)

### CHARACTERISTICS

#### IDENTIFICATION

Solubility (Vol.4)

Sparingly soluble in water; soluble in ethanol and in propylene glycol

Melting range (Vol. 4)

89 - 93°

Ultraviolet absorption  
(Vol. 4)

The ultraviolet spectrum of a 10 mg/l solution of the sample in 0.1 N hydrochloric acid shows an absorption maximum at about 276 nm

#### PURITY

Water (Vol. 4)

Not more than 0.5% (Karl Fischer method)

Sulfated ash (Vol. 4)

Not more than 0.2% (use 5 g sample)

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".

## METHOD OF ASSAY

### Standard solution

Transfer about 50 mg of Ethyl Maltol Reference Standard (available from the United States Pharmacopoeia, 12601 Twinbrook Parkway, Rockville, MD 20852, USA), or equivalent, accurately weighed, into a 250-ml volumetric flask, dilute to volume with 0.1 N hydrochloric acid, and mix. Pipet 5 ml of this solution into a 100-ml volumetric flask, dilute to volume with 0.1 N hydrochloric acid, and mix.

### Sample solution

Transfer about 50 mg of the sample, accurately weighed, into a 250-ml volumetric flask, dilute to volume with 0.1 N hydrochloric acid, and mix. Pipet 5 ml of this solution into a 100-ml volumetric flask, dilute to volume with 0.1 N hydrochloric acid, and mix.

### Procedure

Determine the absorbance of each solution in a 1-cm quartz cell at the absorption maximum (about 276 nm) using 0.1 N hydrochloric acid as the blank.

Calculate the percent of Ethyl maltol in the sample by the formula:

$$\% \text{ of Ethyl maltol} = 100 \times W_S \times A_A / (A_S \times W_A)$$

where

$A_A$  is the absorbance of the sample solution

$A_S$  is the absorbance of the standard solution

$W_A$  is the weight in mg of the sample in the sample solution

$W_S$  is the weight in mg of the reference standard in the standard solution

## ISOAMYLASE FROM *PSEUDOMONAS AMYLODERAMOSA*

*New specifications prepared at the 68th JECFA (2007) and published in FAO JECFA Monographs 4 (2007). An ADI "not specified" was established at the 68th JECFA (2007).*

### SYNONYMS

Debranching enzyme;  $\alpha$ -1,6-glucan hydrolase

### SOURCES

Isoamylase is produced by submerged fed-batch pure culture fermentation of *Pseudomonas amyloclavata*. The enzyme is isolated from the fermentation broth by filtration to remove the biomass and concentrated by ultrafiltration. The final product is formulated using food-grade stabilizing and preserving agents.

#### Active principles

Isoamylase

#### Systematic names and numbers

Glycogen  $\alpha$ -1,6-glucanohydrolase; EC 3.2.1.68; CAS No. 9067-73-6

#### Reactions catalysed

Hydrolysis of  $\alpha$ -1,6-D-glucosidic linkages in glycogen, amylopectin and their  $\beta$ -limit dextrins.

#### Secondary enzyme activities

Low levels of cellulase, lipase, and protease.

### DESCRIPTION

Yellow to brownish liquid

### FUNCTIONAL USES

Enzyme preparation.  
Used in the production of food ingredients from starch.

### GENERAL SPECIFICATIONS

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

### CHARACTERISTICS

#### IDENTIFICATION

##### Isoamylase activity

The sample shows isoamylase activity.  
See description under TESTS.

### TESTS

#### Isoamylase activity

##### Principle

Isoamylase activity is determined by incubating the enzyme with soluble waxy corn starch as a substrate in the presence of iodine for 30 min under standard conditions (pH=3.5; 40.0 $\pm$ 0.1 $^{\circ}$ ) and measuring absorbance of the reaction mixture at 610 nm. The change in absorbance represents the degree of hydrolysis of the substrate. Isoamylase activity is calculated in isoamylase activity units (IAU) per gram of the enzyme preparation. One IAU is defined as the amount of isoamylase that increases absorbance of the reaction mixture by 0.008 in 30 min under the conditions of the assay.

Apparatus

Spectrophotometer (UV/VIS).  
 Thermostated water bath with agitator  
 Test tubes (18x180 mm)  
 Vortex mixer  
 Digital timer or stopwatch.

Reagents and solutions

*Substrate solution:* Accurately weigh 4.17 g (dried basis) of soluble waxy corn starch (Hayashibara Biochemical Laboratories, Inc., Cat. No. CS 101, or equivalent) in a 50-ml beaker. Add approximately 30 ml of water and stir to produce a suspension. Heat to boiling approximately 300 ml of water in a 500-ml beaker with stirring. Slowly add the starch slurry to the boiling water. Rinse the empty beaker with a small amount of water and add the rinse to the boiling water. Boil the starch suspension for 5 min. Quantitatively transfer the starch solution to a 500-ml volumetric flask and cool to room temperature under running water. Stir the solution continuously during cooling. Add 50 ml of 1 M acetate buffer solution (pH 3.5) and dilute with water to volume. The solution should be freshly prepared.

*Acetate buffer solution (1 M; pH 3.5):* Mix 1 M acetic acid and 1 M sodium acetate to obtain pH 3.5. The solution is stable for up to 3 months at room temperature.

*Acetate buffer stock solution (1M; pH 4.5):* Mix 1 M acetic acid and 1 M sodium acetate to obtain pH 4.5. The solution is stable for up to 3 months at room temperature.

*Acetate buffer working solution (0.01M; pH 4.5):* Transfer 1 ml of the acetate buffer stock solution (1M, pH 4.5) to a 100-ml volumetric flask and add water to volume. The solution should be freshly prepared.

*Iodine solution (0.01 N):* Transfer 10 ml of 0.1 N iodine solution to a 100-ml volumetric flask and add water to volume. The solution should be freshly prepared.

*Sample solution:* Accurately weigh (to four decimal places) approximately 3g of the sample into a 1000-ml volumetric flask and add the acetate buffer working solution (0.01 M, pH 4.5) to volume. Repeat the dilution with the acetate buffer working solution as necessary to obtain the activity of approximately 25-50 IAU/ml. The solution should be freshly prepared.

Procedure

*Blank solution:* Place 3.0 ml of freshly prepared substrate solution in a test tube and incubate in a water bath at  $40.0 \pm 0.1^\circ$  for 10 min. Add 0.5 ml of the sample solution and mix rapidly. After 30 sec, transfer 0.5 ml of the reaction mixture to a test tube containing 15 ml of 0.02 N sulfuric acid and mix rapidly.

*Test solution:* Incubate the remaining reaction mixture in a water bath at  $40.0 \pm 0.1^\circ$  for 30 min and 30 sec. Transfer 0.5 ml of the reaction mixture to a test tube containing 15 ml of 0.02 N sulfuric

acid and mix rapidly.

Let the blank and test solutions stand at  $25 \pm 1^\circ$  for at least 15 min. Then add 0.5 ml of 0.01 N iodine solution to both solutions and let the solutions stand at  $25 \pm 1^\circ$  for another 15 min. Read the absorbance of each solution at 610 nm against water in a 10-mm cell.

#### Calculations

Calculate the activity of the sample in IAU/g according to the following equation:

$$\text{Activity (IAU/g)} = \frac{(E_{30} - E_0) \times V \times D \times F}{0.004 \times W}$$

where:

$E_0$  is the absorbance of the blank solution,

$E_{30}$  is the absorbance of the test solution,

V is the volume of the volumetric flask in which the sample was initially dissolved (ml),

D is the dilution of the sample solution,

W is the sample weight (g),

0.004 is obtained by multiplying the absorbance corresponding to one IAU (0.008) by the volume of the sample solution used in the experiment (0.5 ml), and

F is the correction factor that accounts for discrepancies between various batches of the substrate. This factor is determined for each new batch of the substrate by measuring the isoamylase activity of the same sample of the enzyme preparation using the old and new batch of the substrate. F is calculated by dividing the result obtained with the old batch by that obtained with the new batch of the substrate.



## MAGNESIUM SULFATE

*Prepared at the 68<sup>th</sup> JECFA (2007), published in FAO JECFA Monographs 4 (2007), superseding the specifications prepared at the 63<sup>rd</sup> JECFA (2004) and published the Combined Compendium of Food Additive Specifications, FAO JECFA Monographs 1 (2005). An ADI "not specified" was established at the 68<sup>th</sup> JECFA (2007).*

### SYNONYMS

Epsom salt (heptahydrate); INS No.518

### DEFINITION

Magnesium sulfate occurs naturally in sea water, mineral springs and in minerals such as kieserite and epsomite. It is recovered from them or by reacting sulfuric acid and magnesium oxide. It is produced with one or seven molecules of water of hydration or in a dried form containing the equivalent of between 2 and 3 waters of hydration.

#### Chemical names

Magnesium sulfate

#### C.A.S. number

Monohydrate: 14168-73-1  
Heptahydrate: 10034-99-8  
Dried: 15244-36-7

#### Chemical formula

Monohydrate:  $\text{MgSO}_4 \cdot \text{H}_2\text{O}$   
Heptahydrate:  $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$   
Dried:  $\text{MgSO}_4 \cdot x\text{H}_2\text{O}$ , where x is the average hydration value (between 2 and 3)

#### Formula weight

Monohydrate: 138.38  
Heptahydrate: 246.47

#### Assay

Not less than 99.0 % and not more than 100.5% on the ignited basis

### DESCRIPTION

Colourless crystals, granular crystalline powder or white powder. Crystals effloresce in warm, dry air.

### FUNCTIONAL USES

Nutrient; flavour enhancer; firming agent; and processing aid (fermentation aid in the production of beer and malt beverages)

### CHARACTERISTICS

#### IDENTIFICATION

##### Solubility (Vol. 4)

Freely soluble in water, very soluble in boiling water, and sparingly soluble in ethanol.

##### Test for magnesium (Vol. 4)

Passes test

##### Test for sulfate (Vol. 4)

Passes test

## PURITY

<u>Loss on ignition</u> (Vol. 4)	Monohydrate: between 13.0 and 16.0 %, Heptahydrate: between 40.0 and 52.0 %, Dried: between 22.0 and 32.0 % (105°, 2h, then 400° to constant weight)
<u>pH</u> (Vol. 4)	Between 5.5 and 7.5 (1 in 20 solution)
<u>Chloride</u> (Vol. 4)	Not more than 0.03% Test 1g of the sample as described under "Chloride Limit Test" using 0.9 ml of 0.01 N hydrochloric acid in the control
<u>Arsenic</u> (Vol. 4)	Not more than 3 mg/kg Determine by the atomic absorption hydride technique. Use Method I for sample preparation.
<u>Iron</u> (Vol. 4)	Not more than 20 mg/kg Use 1 ml of Iron Standard TS
<u>Selenium</u> (Vol. 4)	Not more than 30 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").
<u>Lead</u> (Vol. 4)	Not more than 2mg/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").

## METHOD OF ASSAY

Accurately weigh about 0.5 g of the ignited sample, dissolve in 5 ml of hydrochloric acid TS, Dilute, dilute with water to 100 ml, and mix. Transfer 50 ml of this solution into a 250-ml conical flask; add 10 ml of Ammonia/Ammonium Chloride Buffer TS and 0.1 ml of Eriochrome Black TS. Titrate with 0.05 M disodium EDTA until the colour of red-purple solution changes to blue. Each ml of 0.05 M disodium EDTA is equivalent to 12.04 mg of  $\text{MgSO}_4$ .

## MALTOL

*Prepared at the 68<sup>th</sup> JECFA (2007) and published in FAO JECFA Monographs 4 (2007), superseding tentative specifications prepared at the 65<sup>th</sup> JECFA (2005) and published in the Combined Compendium of Food Additive Specifications, FAO JECFA Monographs 1 (2005). An ADI of 0-1 mg/kg bw was established at the 25<sup>th</sup> JECFA (1981).*

### SYNONYMS

INS No. 636

### DEFINITION

Maltol is obtained by chemical synthesis

Chemical names

3-Hydroxy-2-methyl-4-pyrone

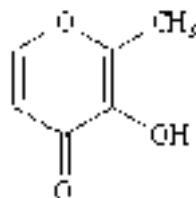
C.A.S. number

118-71-8

Chemical formula

C<sub>6</sub>H<sub>6</sub>O<sub>3</sub>

Structural formula



Formula weight

126.11

Assay

Not less than 99.0%, calculated on the anhydrous basis

### DESCRIPTION

White crystalline powder having a characteristic caramel-butterscotch odour

### FUNCTIONAL USES

Flavour enhancer, flavouring agent (see 'Flavouring agents' monograph No. 1480)

### CHARACTERISTICS

#### IDENTIFICATION

Solubility (Vol. 4)

Sparingly soluble in water, soluble in ethanol and in propylene glycol

Melting range (Vol. 4)

160 - 164°

Ultraviolet absorption (Vol. 4)

The ultraviolet spectrum of a 10 mg/l solution of the sample in 0.1 N hydrochloric acid shows an absorption maximum at about 274 nm

#### PURITY

Water (Vol. 4)

Not more than 0.5% (Karl Fischer)

Sulfated ash (Vol. 4)

Not more than 0.2% (use 5 g sample)

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".

## METHOD OF ASSAY

### Standard solution

Transfer about 50 mg of Maltol Reference Standard (available from the United States Pharmacopoeia, 12601 Twinbrook Parkway, Rockville, Md. 20852, USA), or equivalent, accurately weighed, into a 250-ml volumetric flask, dilute to volume with 0.1 N hydrochloric acid, and mix. Pipet 5 ml of this solution into a 100-ml volumetric flask, dilute to volume with 0.1 N hydrochloric acid, and mix.

### Assay solution

Transfer about 50 mg of the sample, accurately weighed, into a 250-ml volumetric flask, dilute to volume with 0.1 N hydrochloric acid, and mix. Pipet 5 ml of this solution into a 100-ml volumetric flask, dilute to volume with 0.1 N hydrochloric acid, and mix.

### Procedure

Determine the absorbance of each solution in a 1-cm quartz cell at the absorption maximum (about 274 nm) using 0.1 N hydrochloric acid as the blank.

Calculate the percent of Maltol in the sample by the formula:

$$\% \text{ of Maltol} = 100 \times W_S \times A_A / (A_S \times W_A)$$

where

$A_A$  is the absorbance of the sample solution

$A_S$  is the absorbance of the standard solution

$W_A$  is the weight in mg of sample in the sample solution

$W_S$  is the weight in mg of the reference standard in the standard solution

## NISIN PREPARATION

*Prepared at the 68<sup>th</sup> JECFA (2007), published in FAO JECFA Monographs 4 (2007), superseding specifications for nisin prepared at the 12th JECFA (1968) and published in the Combined Compendium of Food Additive Specifications, FAO JECFA Monographs 1 (2005). Metals and arsenic specifications revised at the 63rd JECFA (2004). An ADI of 0-33,000 units/kg bw was established at the 12th JECFA (1968).*

### SYNONYMS

INS No. 234

### DEFINITION

Nisin is a mixture of closely related antimicrobial polypeptides produced by strains of *Lactococcus lactis* subsp. *lactis*. The structure of a major component of nisin is shown below. Nisin may be produced in a sterilized medium of non-fat milk solids or of a non-milk-based fermentation source, such as yeast extract and carbohydrate solids. Nisin can be recovered from the fermentation medium by various methods, such as injecting sterile, compressed air (froth concentration); membrane filtration; acidification; salting out; and spray-drying.

Nisin preparation consists of nisin and sodium chloride with an activity of not less than 900 units per mg. The activity is adjusted by addition of sodium chloride. Non-fat milk solids or solids from other fermentation sources are present in the preparation. Nisin preparation is stable at ambient temperatures and upon heating under acid conditions (maximum stability at pH 3).

(NOTE: The International Unit for nisin activity is the amount of nisin required to inhibit one cell of *Streptococcus agalactiae* in 1 ml of broth. A standard preparation has been defined by Tramer and Fowler, *J.Sci.Fd.Agric.*, 15, 522 (1964) as 10<sup>6</sup> IU of nisin per gram of preparation.)

C.A.S. number

1414 - 45 -5

Chemical formula

C<sub>143</sub>H<sub>230</sub>N<sub>42</sub>O<sub>37</sub>S<sub>7</sub>

Structural formula

Abu=alpha-aminobutyric acid, Dha=dehydroalanine,  
Dhb=dehydrobutyrine

Assay	Not less than 900 IU of nisin per milligram and not less than 50% sodium chloride
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**FUNCTIONAL USES** Antimicrobial preservative

## IDENTIFICATION

<u>Differentiation from other antimicrobial substances</u>	<p>Passes tests</p> <p>See description under TESTS</p>
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<u>Lead</u> (Vol. 4)	<p>Not more than 1 mg/kg</p> <p>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").</p>
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*Escherichia coli*: Absent in 25 g sample

## TESTS

### IDENTIFICATION TESTS

#### Differentiation from other antimicrobial substances

##### Stability to acid

Suspend a 100-mg sample in 0.02 N hydrochloric acid as described in "Standard stock solution" under Method of Assay. Boil this solution for 5 min.

Using the method of assay described below, determine the nisin activity. No significant loss of activity is noted following this heat treatment. The calculated nisin concentration of the boiled sample is 100% +/- 5% of the assay value. Adjust the pH of the nisin solution to 11.0 by adding 5N sodium hydroxide. Heat the solution at 65° for 30 min, and then cool. Adjust the pH to 2.0 by adding hydrochloric acid dropwise. Again determine the nisin concentration using the assay method described below. Complete loss of the antimicrobial activity of nisin is observed following this treatment.

##### Tolerance of *Lactococcus lactis* to high concentrations of nisin

Prepare cultures of *Lactococcus lactis* (ATCC 11454, NCIMB 8586) in sterile skim (<1% fat) milk by incubating for 18 h at 30°. Prepare one or more flasks containing 100 ml of litmus milk, and sterilize at 121° for 15 min. Suspend 0.1 g of sample in the sterilized litmus milk, and allow to stand at room temperature for 2 h. Add 0.1 ml of the *L. lactis* culture, and incubate at 30° for 24 h. *L. lactis* will grow in this concentration of sample (about 1000 IU/ml); however, it will not grow in similar concentrations of other antimicrobial substances. This test will not differentiate nisin from subtilin.

### **METHOD OF ASSAY** *Determination of nisin activity* (Based on the method of Friedman and Epstein, *J. Gen. Microbiol.* 5: 830, 1951)

#### Preparation of the test organism

*Lactococcus lactis* sbsp. *cremoris* (ATCC 14365, NCDO 495) is subcultured daily in sterile separated milk by transferring one loopful to a McCartney bottle of litmus milk and incubating at 30°. Prepare inoculated milk for the assay by inoculating a suitable quantity of sterile skim milk with 2 percent of a 24 h culture, and place it in a water-bath at 30° for 90 min. Use immediately.

#### Standard stock solution

Dissolve an accurately weighed quantity of standard nisin in 0.02N hydrochloric acid to give a solution containing 5 000 units/ml. Immediately before use, dilute the solution further with 0.02N hydrochloric acid to give 50 units/ml. (NOTE: Nisin preparation containing 2.5 % nisin, minimum potency of 10<sup>6</sup> IU/g, obtainable from Sigma, St Louis, USA or Fluka, Buchs, Switzerland, may be used for the Standard Stock Preparation, as well as, the preparation under the name of Nisaplin, available from Danisco, Copenhagen, Denmark).

Sample solution

Weigh an amount of sample sufficient to ensure that corresponding tubes of the sample and standard series match, i.e. within close limits, the nisin content in the sample and standard is the same. Dilute the sample solution in 0.02 N hydrochloric acid to give an estimated concentration of 50 units of nisin per ml.

Resazurin solution

Prepare a 0.0125% solution of resazurin in water immediately before use.

Procedure

Pipet graded volumes (0.60, 0.55, 0.50, 0.45, 0.41, 0.38, 0.34, 0.31, 0.28, 0.26 ml) of the 50 unit per ml sample and standard solutions into rows of 10 dry 6-inches x 5/8-inch bacteriological test-tubes. Add 4.6 ml of the inoculated milk to each by means of an automatic pipetting device. The addition of inoculated milk is made in turn across each row of tubes containing the same nominal concentration, not along each row of ten tubes. Place the tubes in a water-bath at 30° for 15 min, then cool in an ice water bath while adding 1 ml resazurin solution to each. The addition is made with an automatic pipetting device, in the same order used for the addition of inoculated milk. Thoroughly mix the contents of the tubes by shaking. Continue incubation at 30° in a water-bath for a further 3-5 min.

Examine the tubes under fluorescent light in a black matt-finish cabinet. The sample tube of the highest concentration which shows the first clear difference in colour (i.e. has changed from blue to mauve) is compared with tubes of the standard row to find the nearest in colour. Make further matches at the next two lower concentrations of the sample and standard. Interpolation of matches may be made at half dilution steps. As the standard tubes contain known amounts of nisin, calculate the concentration of nisin in the sample solution. Obtain three readings of the solution and average them. Calculate the activity in terms of IU per gram of preparation.

*Determination of sodium chloride*

Accurately weigh about 100 mg of sample, and transfer to a porcelain casserole. Add 100 ml water, 2 ml 2% dextrin soln, and 1 ml 0.1% dichlorofluorescein soln. Mix, and titrate with 0.1 N silver nitrate soln until the silver chloride flocculates and the mixture acquires a faint pink colour.

$$\text{Sodium chloride, \% (w/w)} = \frac{V \times N \times 100 \times 58.5}{W}$$

where:

V is the volume of silver nitrate solution consumed (ml),  
 N is the normality of the silver nitrate solution,  
 58.5 is the formula weight of sodium chloride, and  
 W is the weight of the sample (mg).



## PECTINS

*Prepared at the 68th JECFA (2007) and published in FAO JECFA Monographs 4 (2007), superseding specifications prepared at the 57th JECFA (2001) and published in the Combined Compendium of Food Additive Specifications, FAO JECFA Monographs 1 (2005). A group ADI "not specified" was established for pectins and amidated pectins, singly or in combination at the 25th JECFA in 1981.*

### SYNONYMS

INS No. 440

### DEFINITION

Consists mainly of the partial methyl esters of polygalacturonic acid and their sodium, potassium, calcium and ammonium salts; obtained by extraction in an aqueous medium of appropriate edible plant material, usually citrus fruits or apples; no organic precipitants shall be used other than methanol, ethanol and isopropanol; in some types a portion of the methyl esters may have been converted to primary amides by treatment with ammonia under alkaline conditions. Sulfur dioxide may be added as a preservative.

The commercial product is normally diluted with sugars for standardization purposes. In addition to sugars, pectins may be mixed with suitable food-grade buffer salts required for pH control and desirable setting characteristics. The article of commerce may be further specified as to pH value, gel strength, viscosity, degree of esterification, and setting characteristics.

C.A.S. number

9000-69-5

### DESCRIPTION

White, yellowish, light greyish or light brownish powder

### FUNCTIONAL USES

Gelling agent, thickener, stabilizer, emulsifier

### CHARACTERISTICS

#### IDENTIFICATION

##### Test for pectins

Passes test  
See description under TESTS

##### Test for amide group

Passes test (amidated pectins only)  
Add 2 ml of hydrochloric acid and 50 ml of 60% ethanol to 0.5 g of the sample, and stir well for 20 min. Transfer to a fritted glass filter tube wash with six 10 ml portions of the HCl-60% ethanol mixture. Dissolve in 100 ml distilled water; it may be necessary to add a few drops 0.1 mol/L sodium hydroxide to achieve solution. Transfer 4 ml of this solution into a test tube (recommended dimensions 15.5 mm inner diameter and 146 mm length). Add 1 ml 5 mol/L sodium hydroxide and mix. The mixture will form a gel. Fill a small glass tube (recommended

dimensions 7.8 mm inner diameter and 79 mm length) with 2.5 ml boric acid TS and let glide into the test tube. Close with parafilm and incubate overnight at 30°. In case of presence of amide groups the indicator changes its colour from red to green, due to release of ammonia.

## PURITY

<u>Loss on drying</u> (Vol. 4)	Not more than 12% (105°, 2 h)
<u>Sulfur dioxide</u>	Not more than 50mg/kg See description under TESTS
<u>Residual solvents</u> (Vol. 4)	Not more than 1% methanol, ethanol and 2-propanol, singly or in combination  See description under TESTS
<u>Acid-insoluble ash</u> (Vol. 4)	Not more than 1%
<u>Total insolubles</u>	Not more than 3% See description under TESTS
<u>Nitrogen content</u> (Vol. 4)	Not more than 2.5% after washing with acid and ethanol
<u>Galacturonic acid</u>	Not less than 65% calculated on the ash-free and dried basis See description under TESTS
<u>Degree of amidation</u>	Not more than 25% of total carboxyl groups of pectin See description under TESTS
<u>Lead</u> (Vol. 4)	Not more than 5 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.")

## TESTS

### IDENTIFICATION TESTS

<u>Test for Pectins</u>	Moisten 0.05 g of the sample with 2-propanol. Add 50 ml of water on a magnetic stirrer. Adjust pH to 12 using 0.5 mol/l sodium hydroxide and let the solution remain without stirring for 15 min. Reduce pH to 7.0 with 0.5 mol/l hydrochloric acid. Adjust to 100.0 ml with water. Make up samples in 1 cm quartz cuvettes as follows:
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	<u>Buffer</u> pH 7.0 *)	<u>Sample soln</u>	<u>Water</u>	<u>Enzyme</u> soln **)
Enzyme blank	0.5 ml	1.0 ml	1.0 ml	-
Sample blank	0.5 ml	-	1.5 ml	0.5 ml
Sample	0.5 ml	1.0 ml	0.5 ml	0.5 ml

\*) Dissolve 6.055 g of tris(hydroxymethyl)aminomethane (e.g. TRIZMA Base, Sigma) and 0.147 g of calcium chloride dihydrate in water to 1 l. Adjust pH to 7.0 with 1 mol/l hydrochloric acid.

\*\*) Dilute pure pectate lyase 1:100 with buffer pH 7.0  
Shake the solutions well, and measure the absorbance at 235 nm at 0 and 10 min.

#### Calculations

$A_0$  = absorbance at 0 min = Sample - (enzyme blank + sample blank)

$A_{10}$  = absorbance at 10 min = Sample - (enzyme blank + sample blank)

The amount of unsaturated product produced is proportional to the change in absorbance ( $A_{10} - A_0$ ). This value should be greater than 0.023. This distinguishes pectins from other gums, which show essentially no change.

### PURITY TESTS

#### Sulfur dioxide

Suspend 100 g of the sample in 500 ml of methanol in a 1000-ml round-bottom flask, which is provided with a gas inlet tube reaching almost the bottom and connected to the neck with a reflux condenser. Prepare a glass joint connection from the condenser to an absorption flask or U-tube containing 10 ml of 3% hydrogen peroxide solution neutralized to methyl red TS. Connect the gas inlet tube with an oxygen-free source of carbon dioxide or nitrogen, and maintain a gas stream so as to cause steady bubbling. As soon as the apparatus is flushed free of air, pour 30 ml of hydrochloric acid solution (10 ml conc. HCl + 20 ml H<sub>2</sub>O) into the reflux condenser, and immediately connect the absorption flask or U-tube. Heat slowly until methanol starts refluxing, and reflux gently for 2 h. Disconnect the apparatus and titrate the hydrogen peroxide solution against methyl red TS with 0.01 mol/l sodium hydroxide. Each ml of 0.01 mol/l sodium hydroxide corresponds to 0.32 mg of SO<sub>2</sub>.

#### Total insolubles

Dry a 70 mm glass fiber filter paper (GF/B (Whatman code 1821 070) in an oven with fan set at 105° for about 1 h. Transfer the filter paper to a desiccator containing silica gel and allow to cool. Weigh the paper ( $M_1$ ). Weigh about 1 g (= S) of the sample into a 250-ml beaker. Add 5 ml of 2-propanol to disperse the sample. While stirring magnetically, add 100 ml of 0.03 mol/l sodium hydroxide containing 0.1% (w/w) ethylene diamine tetra-acetic acid (Na salt), which has been filtered through GF/B paper. Stir for about 30 min at room temperature,

then heat to boiling (remove heat if excessive foaming occurs). Filter the hot solution through the glass fiber paper under vacuum using, e.g. a vacuum filtration kit with 3 piece Hartley funnel (70 cm), with heat resistant plate. Rinse the beaker five times and filter the rinsings with 100 ml of warm (about 50°)

water that has been filtered through GF/B paper.

Dry the filter paper with the residue at 105° for 1 h. Transfer to desiccator containing silica gel and leave to cool. Weigh the paper ( $M_2$ ). Calculate the percentage of total insolubles from

$$\text{Total insolubles (\%)} = [(M_2 - M_1)/S] \times 100$$

#### Galacturonic acid and Degree of amidation

Weigh 5 g of the sample to the nearest 0.1 mg, and transfer to a suitable beaker. Stir for 10 min with a mixture of 5 ml of hydrochloric acid TS, and 100 ml of 60% ethanol. Transfer to a fritted-glass filter tube (30 to 60 ml capacity) and wash with six 15-ml portions of the HCl-60% ethanol mixture, followed by 60% ethanol until the filtrate is free of chlorides. Finally wash with 20 ml of ethanol, dry for 2.5 h in an oven at 105°, cool and weigh. Transfer exactly one-tenth of the total net weight of the dried sample (representing 0.5 g of the original unwashed sample) to a 250-ml conical flask and moisten the sample with 2 ml of ethanol TS. Add 100 ml of recently boiled and cooled distilled water, stopper and swirl occasionally until a complete solution is formed. Add 5 drops of phenolphthalein TS, titrate with 0.1 mol/l sodium hydroxide and record the results as the initial titre ( $V_1$ ).

Add exactly 20 ml of 0.5 mol/l sodium hydroxide TS, stopper, shake vigorously and let stand for 15 min. Add exactly 20 ml of 0.5 mol/l hydrochloric acid and shake until the pink colour disappears. Titrate with 0.1 mol/l sodium hydroxide to a faint pink colour which persists after vigorous shaking; record this value as the saponification titre ( $V_2$ ).

Quantitatively transfer the contents of the conical flask into a 500-ml distillation flask fitted with a Kjeldahl trap and a water-cooled condenser, the delivery tube of which extends well beneath the surface of a mixture of 150 ml of carbon dioxide-free water and 20.0 ml of 0.1 mol/L hydrochloric acid in a receiving flask. To the distillation flask add 20 ml of a 1-in-10 sodium hydroxide solution, seal the connections, and then begin heating carefully to avoid excessive foaming. Continue heating until 80-120 ml of distillate has been collected. Add a few drops of methyl red TS to the receiving flask, and titrate the excess acid with 0.1 mol/l sodium hydroxide recording the volume required, in ml, as S. Perform a blank determination on 20.0 ml of 0.1 mol/l hydrochloric acid, and record the volume required, in ml, as B. The amide titre is (B - S).

Transfer exactly one-tenth of total net weight of the dried sample (representing 0.5 g of the original unwashed sample) and wet with about 2 ml ethanol in a 50-ml beaker. Dissolve the pectin in 25 ml 0.125 mol/l sodium hydroxide. Let the solution stand for 1 h with agitation at room temperature. Transfer

quantitatively the saponified pectin solution to a 50-ml measuring flask and dilute to the mark with distilled water. Transfer 20.00 ml of the diluted pectin solution to a distillation apparatus and add 20 ml of Clark's solution, which consists of 100 g of magnesium sulfate heptahydrate and 0.8 ml of

concentrated sulphuric acid and distilled water to a total of 180 ml. This apparatus consists of a steam generator connected to a round-bottom flask to which a condenser is attached. Both steam generator and round-bottom flask are equipped with heating mantles.

Start the distillation by heating the round-bottom flask containing the sample. Collect the first 15 ml of distillate separately in a measuring cylinder. Then start the steam supply and continue distillation until 150 ml of distillate have been collected in a 200-ml beaker. Add quantitatively the first 15 ml distillate and titrate with 0.05 mol/l sodium hydroxide to pH 8.5 and record volume required, in ml, as A.

Perform a blank determination on 20 ml distilled water. Record the required volume, in ml, as  $A_0$ . The acetate ester titre is  $(A - A_0)$ . Calculate degree of amidation (as % of total carboxyl groups) by the formula:

$$100 \times \frac{B - S}{V_1 + V_2 + (B - S) - (A - A_0)}$$

Calculate mg of galacturonic acid by the formula:

$$19.41 \times [V_1 + V_2 + (B - S) - (A - A_0)]$$

The mg of galacturonic acid obtained in this way is the content of one-tenth of the weight of the washed and dried sample. To calculate % galacturonic acid on a moisture- and ash-free basis, multiply the number of mg obtained by  $1000/x$ ,  $x$  being the weight in mg of the washed and dried sample.

Note 1: If the pectin is known to be of the nonamidated type, only  $V_1$  and  $V_2$  need to be determined and  $(B - S)$  may be regarded as zero.

Note 2: For pectins from apple or citrus  $(A - A_0)$  is usually insignificant in calculating galacturonic acid and degree of amidation.

Note 3: If desired, calculate degree of esterification (as % of total carboxyl groups) by the formula:

$$100 \times \frac{V_2 - (A - A_0)}{V_1 + V_2 + (B - S) - (A - A_0)}$$

Note 4: If desired, calculate degree of acetate ester (as % of total carboxylic groups from galacturonic acid) by the formula:

$$100 \times \frac{A - A_0}{V_1 + V_2 + (B - S) - (A - A_0)}$$

Residual solvents (Vol. 4) Apply Method I in Volume 4, General Methods, Organic Components

*Standard stock solution:* To 500 ml of water in a 1000-ml volumetric flask, add about 5 g each of methanol, ethanol and 2-propanol, accurately weighed. Make up to the mark with water.

*Internal standard solution:* To 500 ml of water in a 1000-ml volumetric flask, add about 5 g of 2-butanol ( $W_{\text{standard}}$ ), accurately weighed. Make up to the mark with water.

*Blank Solution:* Omit the blank determination

*Samples:* Store the sample in a cool, dry place. Mix the sample thoroughly before analysis.

Weigh accurately about 1 g of sample ( $W_{\text{sample}}$ ) in a 100 ml beaker and mix with about 5 g of sucrose. Into a 100-ml Erlenmeyer flask with magnetic stirrer bar, add 95 ml water and 1.0 ml internal standard solution. While stirring fast, slowly add the pectin-sucrose mixture. Stopper the flask and stir for 2 h. The pectin must be completely dissolved. Accurately weigh about 1 g of this solution ( $M_{\text{sample}}$ ) into a headspace vial for GC analysis.

*Calibration solution:* Pipette 2.0 ml of standard stock solution and 2.0 ml of internal standard solution into a 200-ml volumetric flask and make up to the mark with water. Accurately weigh about 1 g of this solution ( $M_{\text{standard}}$ ) is filled into a head space vial and used for GC analysis.

### Procedure

Continue the analysis as described in Vol.4 'Residual solvents', using the given conditions except for the sample heating temperature, which should be 70°, and syringe temperature, which should be 80°.

### Calculation

Calculate the concentration of each residual solvent using the following equation:

$$\% \text{ of solvent} = \frac{R_{\text{sample}} \times W_{\text{s tan dard}} \times M_{\text{s tan dard}}}{R_{\text{s tan dard}} \times W_{\text{sample}} \times M_{\text{sample}} \times 1000} \times 100$$

where

$R_{\text{sample}}$	is the relative peak area of the sample
$R_{\text{standard}}$	is the relative peak area of the standard
$W_{\text{sample}}$	is the weight of sample (g)
$W_{\text{standard}}$	is the weight of solvent used for the standard stock solution
$M_{\text{sample}}$	is the weight of sample solution used for the GC analysis
$M_{\text{standard}}$	is the weight of Calibration solution used for the GC analysis

## POLYVINYL ALCOHOL

*Prepared at the 68<sup>th</sup> JECFA (2007) and published in FAO JECFA Monographs 4 (2007), superseding specifications prepared at the 63<sup>rd</sup> JECFA (2004) and published in the Combined Compendium of Food Additive Specifications, FAO JECFA Monographs 1 (2005). An ADI of 50 mg/kg bw was established at 61<sup>st</sup> JECFA (2003).*

### SYNONYMS

Vinyl alcohol polymer, PVOH, INS No. 1203

### DEFINITION

Polyvinyl alcohol is a synthetic resin prepared by the polymerization of vinyl acetate, followed by partial hydrolysis of the ester in the presence of an alkaline catalyst. The physical characteristics of the product depend on the degree of polymerization and the degree of hydrolysis.

Chemical names

Ethenol homopolymer

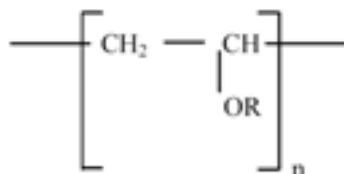
C.A.S. number

9002-89-5

Chemical formula

$(C_2H_3OR)_n$  where R=H or  $COCH_3$  (randomly distributed)

Structural formula



Where R=H or  $COCH_3$  (randomly distributed)

### DESCRIPTION

Odourless, translucent, white or cream-coloured granular powder.

### FUNCTIONAL USES

Coating, binder, sealing agent and surface-finishing agent.

### CHARACTERISTICS

#### IDENTIFICATION

Solubility (Vol. 4)

Soluble in water, sparingly soluble in ethanol.

pH (Vol. 4)

5.0 – 6.5 ( 1 in 25)

Infrared spectrum (Vol. 4)

The infrared absorption spectrum of a potassium bromide dispersion of the sample corresponds to that of a polyvinyl alcohol standard (see Appendix).

Colour reaction A

Dissolve 0.01 g of the sample in 100 ml of water with warming and let the solution cool to room temperature. To 5 ml of the solution, add one drop of iodine TS and a few drops of boric acid solution (1 in 25). A blue colour is produced.



Colour reaction B Dissolve 0.5 g of the sample in 10 ml of water with warming and let the solution cool to room temperature. Add 1 drop of iodine TS to 5 ml of solution and allow to stand. A dark red to blue colour is produced.

Precipitation reaction Add 10 ml of ethanol to the remaining 5 ml of solution prepared for Colour reaction B. A white, turbid or flocculent precipitate is formed.

## PURITY

Loss on drying (Vol. 4) Not more than 5.0% (105°, 3 h)

Residue on ignition  
(Vol. 4) Not more than 1.0%

Water insoluble substances  
(Vol. 4) Not more than 0.1%  
Substitute a 100-mesh screen for the sintered-glass filter specified in Volume 4

Particle size Not less than 99.0% material to pass through a 100 mesh sieve  
Determine by sieving for 30 min 100g of sample through a 100 mesh sieve and weigh the material passing through the sieve.

Methanol and methyl acetate Not more than 1.0 % of each  
See description under TESTS

Acid value Not more than 3.0  
See description under TESTS

Ester value Between 125 and 153 mg KOH/g  
See description under TESTS

Degree of hydrolysis Between 86.5 and 89.0%  
See description under TESTS

Viscosity 4.8 - 5.8 mPa·s (4% solution at 20°)  
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 Vol. 4 (under "General Methods, Metallic Impurities).

## TESTS

### PURITY TESTS

Methanol and methyl acetate Place 2.0 g of the sample into a 100 ml screw-cap bottle, and add a magnetic stirrer. Add 98 ml of water and 30 µl of acetone. Close the bottle tightly with the screw cap and heat in a water-bath, stirring continuously. Once the solution becomes clear, remove the bottle from the water bath and allow it to cool to room temperature.

Prepare a standard by taking 2 ml of a mixed solution of methanol and methyl acetate (1.2 % v/v solution), 98 ml of water and 30µl acetone; proceed as above starting from “close the bottle...Temperature”.

GC Conditions:

Column:	Sunpak A (3.2 mm i.d. x 3 m) or equivalent
Column temperature:	160°
Injector temperature:	160°
Detector temperature:	160°

Inject  $0.4 \pm 0.1 \mu\text{l}$  of the standard solution into the gas chromatograph and record the peak areas (PAs) for methanol, methyl acetate and acetone. Inject  $0.4 \pm 0.1 \mu\text{l}$  of the sample solution and record the peak areas (PAs) for methanol, methyl acetate, and acetone.

Calculate the methanol and methyl acetate content using the formulae:

$$\text{Methanol (wt\%)} = \text{PA(methanol)/PA(acetone)} \times \text{PR}_1 \times 0.024 \times 100/2$$

$$\text{Methyl acetate (wt \%)} = \text{PA(methyl acetate)/ PA(acetone)} \times \text{PR}_2 \times 0.024 \times 100/2$$

where

0.024 is the conversion factor to obtain the masses of methanol and methyl acetate added to 30 µl acetone (density = 0.8) for the methanol/methyl acetate standard; and

PR<sub>1</sub> and PR<sub>2</sub> are the peak area ratios PA(acetone)/PA(methanol) and PA(acetone)/PA(methyl acetate), respectively, of the standard 1.2% methanol and methyl acetate aqueous solutions.

Acid value

Add 200 ml of water and a stir bar into a 500-ml round-bottom flask, attach a reflux condenser and begin heating in a boiling water bath. Add 10.0 g of the sample and continue heating for 30 min while stirring continuously. Remove the flask from the water bath and continue stirring until the solution reaches room temperature. Quantitatively transfer this solution to a 250-ml volumetric flask and dilute to volume with water. Take 50 ml of the solution, add 1 ml of phenolphthalein TS and titrate with 0.05 M potassium hydroxide until the pink colour persists for 15 sec; record the titre in ml (V). Calculate the acid value, A:

$$A = 5.0(56.1 \times V \times M)/W$$

where

56.1 is the formula weight of KOH,  
M is the molarity of the KOH solution, and  
W is the weight of sample (g).

Ester value

Accurately weigh about 1.0 g of sample into a 250-ml round-bottom flask, add 25 ml 0.5 M alcoholic potassium hydroxide, 25.0 ml of water and a few glass beads. Attach a condenser and allow the contents to reflux for 30 minutes in a boiling water-bath. Let cool to room temperature, remove the condenser, add 1 ml of phenolphthalein TS and titrate immediately with 0.5 M hydrochloric acid; record the titre in ml ( $V_1$ ).

Carry out a blank test under the same conditions. Titrate with 0.5 M hydrochloric acid and record the titre in ml ( $V_2$ ). Calculate the saponification value, S:

$$S = 56.1(V_2 - V_1) \times M/W$$

where

56.1 is the formula weight of KOH,  
M is the molarity of the hydrochloric acid solution, and  
W is the weight of the sample in (g).

Calculate the ester value, E:

$$E = S - A$$

where

S is the saponification value and  
A is acid value.

Degree of hydrolysis

Convert the saponification value obtained during the determination of the ester value to the "dried basis" ( $S_{db}$ ):

$$S_{db} = (S \times 100)/(100 - LOD)$$

where

LOD is Loss on Drying

The degree of hydrolysis is:

$$100 - [7.84 S_{db} / (100 - 0.075 S_{db})]$$

ViscosityCalibration of capillary-type viscometers

An oil of known viscosity is used to determine the viscometer constant (k).

*Ostwald-Type Viscometer:* Fill the tube with the exact amount of oil (adjusted to  $20.0 \pm 0.1^\circ$ ), as specified by the manufacturer. Use either pressure or suction to adjust the meniscus of the column of liquid in the capillary tube to the level of the top graduation line. Allow the liquid to flow into the reservoir against atmospheric pressure by opening both the filling and capillary tubes. If either tube is not open, false values might be obtained. Record the time (seconds), for the liquid to flow from the upper mark to the lower mark of the capillary tube (efflux time).

*Ubbelohde-Type Viscometer:* Place a quantity of the oil (adjusted to  $20.0 \pm 0.1^\circ$ ) in the filling tube, and transfer to the capillary tube by gentle suction. Keep the air vent tube closed in order to prevent bubble formation in the liquid. Adjust the meniscus of the

column of liquid in the capillary tube to the level of the top graduation line. Allow the liquid to flow into the reservoir against atmospheric pressure by opening both the filling and capillary tubes. If either tube is not open, false values might be obtained. Record the efflux time (seconds).

The viscosity constant for *capillary-type* viscometers is given by:

$$k = v/dt,$$

where  $v$  is the known viscosity (mPa•s) of the oil used for viscometer calibration;  $d$  is the density (g/ml) of the liquid tested at 20°/20°; and  $t$  (seconds) is the efflux time.

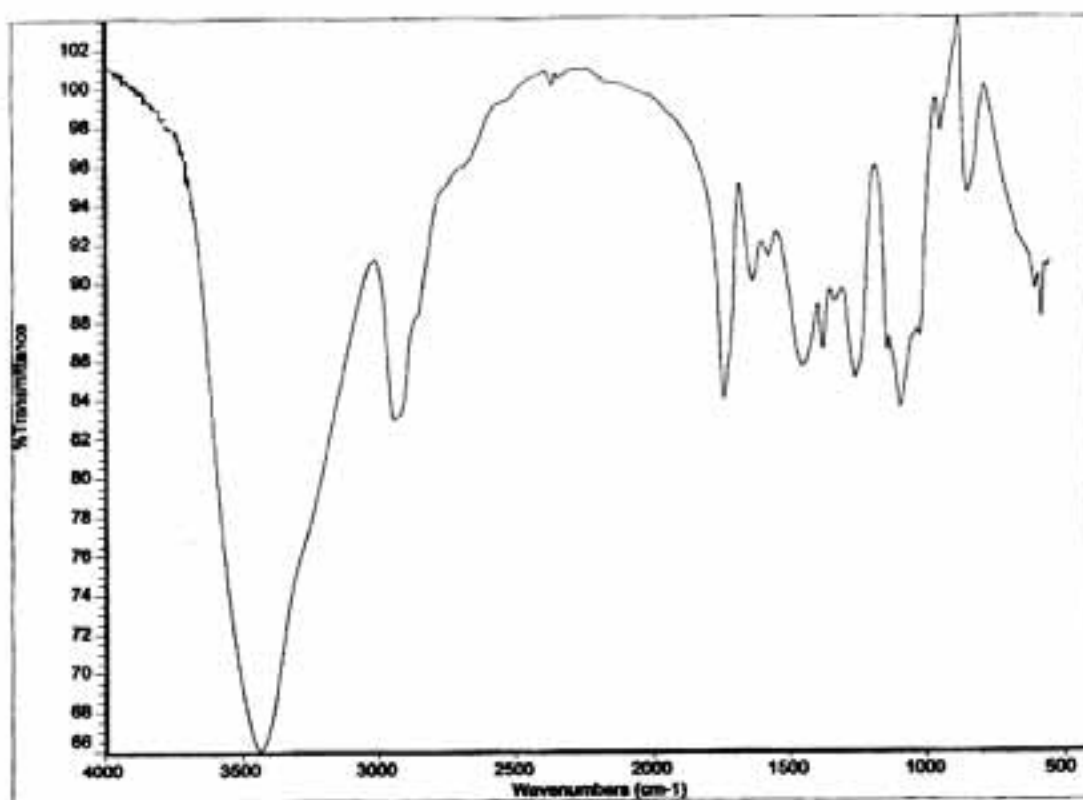
#### Procedure

Weigh a quantity of undried sample equivalent to 6.00 g on the dried basis. Into a tared 250-ml flask containing a magnetic stir bar and approximately 140 ml of water, quickly (seconds) transfer the sample, while simultaneously stirring slowly and continuously. Once the sample appears thoroughly saturated, slowly increase the stirring rate to minimize the entrainment of air in the mixture. Heat the mixture to 90°, and maintain it at this temperature for approximately 5 minutes; discontinue heating and continue stirring for 1 hour. Add water in small amounts to attain a total mixture weight of 150 g, and resume stirring until the mixture appears homogenous. Filter the mixture through a tared 100-mesh screen into a 250 ml conical flask, cool the filtrate to about 15°, mix, and determine its viscosity at 20° using an appropriate viscometer (follow the manufacturer's instructions). NOTE: The temperature at which the viscosity measurement is made must be strictly controlled.

For measurements using *capillary-type* viscometers, the viscosity is given by:

$$v = kdt$$

where  $t$  is the efflux time for the sample solution and  $d$  is its density at 20°.

Appendix

POLYVINYL ALCOHOL

## PROCESSED *EUCHEUMA* SEAWEED

*Prepared at the 68th JECFA (2007) and published in FAO JECFA Monographs 4 (2007), superseding specifications prepared at the 57th JECFA (2001) and published in the Combined Compendium of Food Additive Specifications, FAO JECFA Monographs 1 (2005). A group ADI "not specified" for carrageenan and processed Eucheuma seaweed was established at the 57th JECFA (2001).*

### SYNONYMS

PES, PNG-carrageenan, semi-refined carrageenan; INS No. 407a

### DEFINITION

A substance with hydrocolloid properties obtained from either *Eucheuma cottonii* or *E. spinosum* (from the *Rhodophyceae* class of red seaweeds). In addition to carrageenan polysaccharides, processed eucheuma seaweed may contain up to 15% of insoluble algal cellulose and minor amounts of other insoluble matter. Articles of commerce may include sugars for standardization purposes or salts to obtain specific gelling or thickening characteristics. It is distinguished from carrageenan (INS No. 407) by its higher content of cellulosic matter and by the fact that it is not solubilized and precipitated during processing.

The functional component of the product obtained from *E. cottonii* is kappa-carrageenan (a copolymer of D-galactose-4-sulfate and 3,6-anhydro-D-galactose). From *E. spinosum* it is iota-carrageenan (a copolymer of D-galactose-4-sulfate and 3,6-anhydro-D-galactose-2-sulfate).

Processing consists of soaking the cleaned seaweed in alkali for a short time at elevated temperatures. The material is then thoroughly washed with water to remove residual salts followed by purification, drying, and milling to a powder. Alcohols that may be used during purification are restricted to methanol, ethanol, and isopropanol.

### DESCRIPTION

Light tan to white coarse to fine powder

### FUNCTIONAL USES

Thickener, gelling agent, stabilizer, emulsifier

### CHARACTERISTICS

#### IDENTIFICATION

##### Solubility (Vol. 4)

Forms cloudy viscous suspensions in water; insoluble in ethanol. A 1 g sample disperses and partially dissolves in 100 ml of water at 80° giving a cloudy opalescent solution. (The sample disperses in water more readily if first moistened with alcohol, glycerol, or a saturated solution of glucose or sucrose in water).

##### Test for sulfate

Dissolve a 100-mg sample in 20 ml of water. Heat to boiling, cool to room temperature, and add 3 ml of barium chloride TS and 5 ml of hydrochloric acid, dilute TS. Filter the mixture. Boil the filtrate for 5 min. A white, crystalline precipitate appears.

<u>Test for galactose and anhydrogalactose</u> (Vol.4)	Proceed as directed in Volume 4 (under "General Methods, Organic Components, Gum Constituents Identification") using the following as reference standards: galactose, rhamnose, galacturonic acid, 3,6-anhydrogalactose, mannose, arabinose and xylose. Galactose and 3,6-anhydrogalactose should be present.
<u>Identification of hydrocolloid and predominant type of copolymer</u>	Add 4 g of sample to 200 ml of water, and heat the mixture in a water bath at 80°, with constant stirring until dissolved. Replace any water lost by evaporation, and allow the solution to cool to room temperature. The solution becomes viscous and may form a gel. To 50 ml of the solution or gel, add 200 mg of potassium chloride, then reheat, mix well, and cool. A short-textured ("brittle") gel indicates a carrageenan of a predominantly kappa-type. A compliant ("elastic") gel indicates a predominantly iota-type.
<u>Infrared absorption</u>	Passes test See description under TESTS
PURITY	
<u>Loss on drying</u> (Vol. 4)	Not more than 12% (105° to constant weight)
<u>pH</u> (Vol. 4)	Between 8 and 11 (1 in 100 suspension)
<u>Viscosity</u>	Not less than 5 cp at 75° (1.5% solution) See description under TESTS
<u>Sulfate</u>	Not less than 15% and not more than 40% (as $\text{SO}_4^{2-}$ ) on the dried basis See description under TESTS
<u>Total ash</u>	Not less than 15% and not more than 30% on the dried basis See description under TESTS
<u>Acid-insoluble ash</u> (Vol. 4)	Not more than 1% Use the ash from the Total ash test
<u>Acid-insoluble matter</u> (Vol. 4)	Not less than 8% and not more than 15% on the dried basis Use 2 g of sample obtained from part (a) of the procedure for sulfate determination
<u>Residual solvents</u> (Vol. 4)	Not more than 0.1% of ethanol, isopropanol, or methanol, singly or in combination See description under TESTS
<u>Microbiological criteria</u> (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 5000 cfu/g <i>Salmonella</i> spp.: Negative per test <i>E. coli</i> : Negative in 1 g

<u>Arsenic</u> (Vol. 4)	Not more than 3 mg/kg Determine by the atomic absorption hydride technique. Use Method II for sample preparation.
<u>Lead</u> (Vol. 4)	Not more than 5 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").
<u>Cadmium</u> (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 method described in Volume 4 (under "General Methods, Metallic Impurities").
<u>Mercury</u> (Vol.4)	Not more than 1 mg/kg Determine by the cold vapour atomic absorption technique

## TESTS

### IDENTIFICATION TESTS

Infrared absorption Prepare a 0.2% aqueous solution of the sample. Cast films of 0.5 mm thickness (when dry) on a suitable non-sticking surface such as Teflon and obtain the infrared absorption spectrum of each film. (Alternatively, the spectra may be obtained using films cast on potassium bromide plates if care is taken to avoid moisture).

Iota- and kappa-carrageenan have strong, broad absorption bands, typical of all polysaccharides, in the 1000 to 1100  $\text{cm}^{-1}$  region. Other characteristic absorption bands and their intensities relative to the absorbance at 1050  $\text{cm}^{-1}$  are as follows:

<i>Wave number (<math>\text{cm}^{-1}</math>)</i>	<i>Molecular Assignment</i>	<i>Absorbance Relative to 1050 <math>\text{cm}^{-1}</math></i>	
		Kappa	Iota
1220-1260	ester sulfate	0.6-1.0	0.9-1.2
928-933	3,6-anhydrogalactose	0.3-0.6	0.2-0.6
840-850	galactose-4-sulfate	0.3-0.5	0.2-0.4
800-805	3,6-anhydrogalactose-2-sulfate	0.0-0.2	0.2-0.4

### PURITY TESTS

#### Sulfate

##### Principle:

Hydrolysed sulfate groups are precipitated as barium sulfate.

##### Procedure:

(a) Disperse an accurately weighed 15 g sample of commercial



product into 500 ml of 60% w/w isopropanol/water at room temperature. Stir gently for 4 h. Filter through ash-free filter paper. Discard the filtrate. Wash the material remaining on the filter paper with two 15-ml portions of 60% isopropanol/water. Dry the material at 105° to constant weight.

Approximately 1 g of the dried matter is to be used for part (b). The remainder should be retained for determination of Total ash, Acid-insoluble matter, and viscosity.

(b) Accurately weigh a 1 g sample ( $W_1$ ) obtained from part (a), Transfer the sample to a 100-ml long-neck round-bottom flask and add 50 ml of 0.2 N hydrochloric acid. Fit a condenser, preferably one with at least 5 condensing bulbs, to the flask and reflux for 1 h. Add 25 ml of a 10% (by volume) hydrogen peroxide solution and resume refluxing for about 5 h or until the solution becomes completely clear. Transfer the solution to a 600-ml beaker, bring to a boil, and add dropwise 10 ml of a 10% barium chloride solution. Heat the reaction mixture for 2 h on a boiling water bath. Filter the mixture through ash-free slow-filtration filter paper. Wash with boiling distilled water until the filtrate is free from chloride. Dry the filter paper and contents in a drying oven. Gently burn and ash the paper at 800° in a tared porcelain or silica crucible until the ash is white. Cool in a desiccator.

Weigh the crucible containing the ash. Calculate the percentage sulfate from the weight in g ( $W_2$ ) of the ash (barium sulfate) using the formula:

$$(W_2/W_1) \times 100 \times 0.4116.$$

#### Total ash

Accurately weigh 2 g of the dried sample ( $W_1$ ) obtained from part (a) under the procedure for Sulfate determination. Transfer to a previously ignited, tared, silica or platinum crucible. Heat the sample with a suitable infrared lamp, increasing the intensity gradually, until the sample is completely charred; continue heating for an additional 30 min. Transfer the crucible with charred sample into a muffle furnace and ignite at about 550° for 1 h. Cool in a desiccator and weigh. Repeat the ignition in the muffle furnace until a constant weight ( $W_2$ ) is obtained. If a carbon-free ash is not obtained after the first ignition, moisten the charred spot with a 1 in 10 solution of ammonium nitrate and dry under an infrared lamp. Repeat the ignition step. Calculate the percentage of total ash of the sample:

$$(W_2/W_1) \times 100.$$

Retain the ash for the Acid-insoluble ash test.

#### Viscosity

Transfer 7.5 g of the dried sample obtained from part (a) under the procedure for sulfate determination into a tared, 600-ml tall-form (Berzelius) beaker, and disperse with agitation for 10 to 20 min in 450 ml of deionized water. Add sufficient water to bring the final weight to 500 g and heat in a water bath, with continuous agitation, until a temperature of 80° is reached (20-30 min). Add 7.5 g of diatomaceous earth or perlite filter aid.

Stir for two minutes. Add water to adjust for loss by evaporation. Filter the solution through a Büchner funnel (pre-heated with hot water to 80°) equipped with a coarse filter paper. Place the filter assembly in a vacuum receiver bottle.

Filter 200 ml of solution. Cool to 76-77°, and heat in a constant temperature bath at 75°. Pre-heat the bob and guard of a Brookfield LVF viscometer to approximately 75° in water. Dry the bob and guard and attach them to the viscometer, which should be equipped with a No. 1 spindle (19 mm in diameter, approximately 65 mm in length) and capable of rotating at 30 rpm. Adjust the height of the bob in the sample solution, start the viscometer rotating at 30 rpm and, after six complete revolutions of the viscometer, take the viscometer reading on the 0-100 scale.

If the viscosity is very low, increased precision may be obtained by using the Brookfield UL (ultra low) adapter or equivalent.

Record the results in centipoises, obtained by multiplying the reading on the scale by the factor given by the Brookfield manufacturer.

Residual solvents  
(Vol. 4)

See Method 1 under Vol. 4. General Methods, Organic Components, Residual Solvents.

Prepare standard, blank, and calibration solutions as directed under Method 1.

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 5 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 100 ml, adjusting the heat so that the foam does not enter the column. Quantitatively transfer the distillate to a 200-ml volumetric flask, fill to the mark with water and shake the flask to mix. Weigh accurately 8.0 g of this solution into an injection vial. Add 1.0 ml of the internal standard solution. Heat at 60° for 10 min and shake vigorously for 10 sec.

## SODIUM CHLORITE

*New specifications prepared at the 68<sup>th</sup> JECFA (2007) and published in FAO JECFA Monographs 4 (2007). An ADI of 0.03 mg/kg bw for chlorite was established at the 68<sup>th</sup> JECFA (2007).*

### SYNONYMS

Chlorous acid sodium salt

### DEFINITION

Sodium chlorite is manufactured by first reducing, chemically or electrochemically, sodium chlorate, in the presence of hydrochloric acid, to produce chlorine dioxide. The chlorine dioxide is then reduced with hydrogen peroxide in a sodium hydroxide solution to yield a solution containing 30 to 50 percent sodium chlorite, which can be dried to give a solid with ca. 80% sodium chlorite.

Alternatively, chlorine dioxide may be obtained by reacting together sodium chlorate, hydrogen peroxide, and sulfuric acid. The chlorine dioxide is then reduced with hydrogen peroxide in sodium hydroxide solution to yield a solution of sodium chlorite, which can be neutralized with sulfuric acid. The resulting solution may be dried to a solid and the sodium chlorite content may be adjusted to ca. 80% by the addition of sodium chloride, sodium sulfate, or sodium carbonate.

Sodium chlorite is marketed as a solid or an aqueous solution.

C.A.S. number

7758-19-2

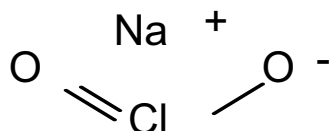
Chemical formula

$\text{NaClO}_2$

Formula weight

90.44

Structural Formula



Assay

79-86%

### DESCRIPTION

White crystalline powder, solutions can be colourless to greenish yellow

### FUNCTIONAL USES

Antimicrobial agent (for use in antimicrobial washing solutions)

### CHARACTERISTICS

#### IDENTIFICATION

Solubility (Vol. 4)

Soluble in water, sparingly soluble in polar solvents and insoluble in non-polar solvents.

Chlorite

Add 2 g of sample into a 250-ml Erlenmeyer flask and add 50 g of deionized water to dissolve. Add 10 ml of 1.0N hydrochloric acid and swirl flask until a yellow colour appears. Add 2 g potassium iodide and swirl to dissolve. The solution turns brown and a grey precipitate

forms.

Sodium (Vol. 4)

Passes test

#### PURITY

Loss on drying (Vol.4)

Not more than 6% (105°, 24 h, use 5 g of sample)

Sodium carbonate

Not more than 8% on the dried basis  
See description under TESTS

Sodium hydroxide

Not more than 3% on the dried basis  
See description under TESTS

Sodium sulfate

Not more than 5% on the dried basis  
See description under TESTS

Sodium chlorate

Not more than 4% on the dried basis  
See description under TESTS

Sodium chloride

Not more than 19% on the dried basis  
See description under TESTS

Lead (Vol. 4)

Not more than 5 mg/kg on the dried basis  
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 Vol. 4 (under "General Methods, Metallic Impurities").

## TESTS

#### PURITY TESTS

Sodium chlorate and  
Sodium sulfate

#### Determination by Ion Chromatography

##### Apparatus

Ion Chromatograph with anion suppressor, autosampler, conductivity detector and a data station (Dionex or equiv.)

Analytical Column: [Dionex AS9-HC, 2 mm or 4 mm or equiv.]

Guard column: [Dionex AG9-HC, 2 mm or 4mm or equiv.]

Mobile phase: 9 mM Na<sub>2</sub>CO<sub>3</sub> at flow rate of 0.4 ml/min

##### Reagents

*Deionized water*: Ultra high quality (UHQ) passing through 0.20 µm filter, Milli Q or equiv.

*Mobile phase [sodium carbonate solution (9mM)]*: Dissolve 1.91 g Na<sub>2</sub>CO<sub>3</sub> in deionized water and dilute to 2 liters.

*Chlorate (ClO<sub>3</sub><sup>-</sup>) stock standard solution (1000 mg/l)*: Transfer 0.1275 g of sodium chlorate, accurately weighed, into a 100-ml volumetric flask. Dissolve the sample in deionized water, make up to volume and mix.

*Sulfate (SO<sub>4</sub><sup>2-</sup>) stock standard solution (1000 mg/l)*: Transfer 0.1814 g of potassium sulfate, accurately weighed, into a 100-ml volumetric

flask. Dissolve the sample in deionized water, make up to volume, and mix.

*Ethylenediamine (EDA) preservation solution (100 mg/ml):* Dissolve 2.5 g of EDA in 25 ml of deionized water. Prepare fresh monthly.  
*Surrogate solution:* Transfer 0.065 g of potassium dichloroacetate into a 100-ml volumetric flask, dissolve in deionized water, make up to volume, and mix. (prepare fresh every 3 months)

*Working standard solutions for standard curve:* Prepare a series of 5 standards covering the entire calibration range by diluting the stock chlorate and sulfate standards with deionized water in suitable volumetric flasks. Add enough EDA preservation solution to the chlorate working standards to obtain a final concentration of 50 mg/l, in order to normalize any bias from the presence of EDA in analysis samples.

*Sample solutions:* Accurately weigh about 2.0 g of solid sample, dissolve in deionized water, quantitatively transfer into a 100-ml volumetric flask, make up to volume, and mix. Prepare sample solution fresh prior to analysis. If analysis is delayed, refrigerate solution. Draw solution into a 10-ml plastic syringe, attach a 0.45  $\mu\text{m}$  filter and filter into an auto sampler vial.

#### Procedure

*Construction of standard curve:* Set up the ion chromatograph, purge the column with the mobile phase and check the base line stability. Inject 10  $\mu\text{l}$  each of working standards for analysis of sulfate and 50  $\mu\text{l}$  each for analysis of chlorate using the 2 mm column (inject 50 and 200  $\mu\text{l}$  samples, respectively, when using 4 mm column). Construct standard curves for sulfate and chlorate and check curves for linearity ( $R^2 > 0.99$ ). Verify calibration curve acceptability each day prior to analysis by injecting a middle standard as a sample and confirm acceptance (error shall not be more than 5%). If the error is more than 5%, repeat construction of standard curve.

*System calibration:* Transfer a 10.0 ml aliquot of sample solution and 20  $\mu\text{l}$  of the surrogate solution to a 20 ml disposable plastic beaker and mix. Draw the solution into a 10-ml plastic syringe, attach a 0.45  $\mu\text{m}$  filter and filter the solution into an auto-sampler vial. Inject the solution [10  $\mu\text{l}$  for determination of sulfate and 50  $\mu\text{l}$  for determination of chlorate using a 2 mm column (inject 50 and 200  $\mu\text{L}$  samples, respectively, when using 4 mm column)]. Record retention times and peak areas. Calculate the surrogate recovery from the surrogate concentration obtained and surrogate concentration fortified. The percent surrogate recovery shall fall between 90-115%. If the surrogate recovery falls outside the 90-115% window, an analysis error is evident and the analysis should be repeated.

Inject sample solutions. If the analyte response exceeds the calibration range then dilute and inject again. Obtain the concentration of sulfate and chlorate from the respective standard curves and calculate the sulfate and chlorate content in the samples from the weight of sample and concentration of analyte in the injected solution.

Sodium ChlorideDetermination by potentiometric titration with silver nitrate solutionApparatus

pH meter capable of reading millivolts (mV) and equipped with a chloride-specific-ion electrode or silver/silver chloride electrodes

Procedure

Electrode calibration: Connect the electrodes to the pH meter and set the meter to read mV. Transfer about 2 g of sample into a beaker and dissolve in water. Place the electrodes in the solution. Titrate with 0.1N silver nitrate (0.5 ml increments), recording the volume of titrant added along with the mV reading after each incremental addition. Plot the titer value (ml) on the X-axis and mV on the Y-axis. Determine the mV reading at the inflection point of the titration curve and use this point as the endpoint in subsequent titrations. Repeat the endpoint determination on a regular basis.

Accurately weigh about 1 g of solid sample and dissolve in about 100 ml of deionized water in a beaker. Add 2 drops of phenolphthalein indicator and nitric acid (1:3 by volume) drop-wise until the phenolphthalein endpoint is reached (alternatively, test with pH test paper). Place the electrodes in sample solution. Titrate with 0.1N silver nitrate solution until the endpoint determined in the electrode calibration is reached. Record the titer value in ml (T).

Calculation:

$$\text{NaCl, \% (w / w)} = \frac{T \times N \times 5.845}{W}$$

where:

58.45 is the formula weight of sodium chloride,

N is the normality of silver nitrate solution,

W is the weight of sample (g), and

$$\text{the factor 5.845 is } \frac{58.45 \times 100}{1000}$$

**METHOD OF ASSAY** Determination of sodium chlorite content by an iodometric method

Accurately weigh about 4.0 g of solid sample (W), dissolve in deionized water, quantitatively transfer into a 100-ml volumetric flask, make up to volume and mix. Pipet 50 ml of into a 500-ml volumetric flask, dilute to volume and mix to obtain the test sample solution.

Pipette 25 ml of sample solution into a 500 ml narrow-mouth Erlenmeyer flask, add 100 ml of deionized water and 10 ml 0.5N Hydrochloric acid. Add about 2 g of potassium iodide, stopper the flask, mix and keep in a dark place for 2 min. Titrate the liberated iodine with 0.1N Sodium thiosulfate until most of the iodine colour has disappeared. Add 2 ml Starch TS and titrate until the blue colour is discharged. Record the titer value in ml (T<sub>1</sub>). Conduct a blank determination and record the titer value in ml (T<sub>2</sub>).

## Calculation

$$\text{NaClO}_2 \%(\text{w} / \text{w}) = \frac{(\text{T}_1 - \text{T}_2) \times \text{N} \times 90.44}{\text{W}}$$

where:

22.61 is the equivalent weight of sodium chlorite,  
 N is the normality of sodium thiosulfate,  
 W is the weight of sample (g), and

the factor 90.44 is  $\frac{22.61 \times 100 \times 500 \times 100}{1000 \times 50 \times 25}$

## SODIUM HYDROGEN SULFATE

*New specifications prepared at the 68<sup>th</sup> JECFA (2007), published in FAO JECFA Monographs 4 (2007). No ADI has been allocated to sodium hydrogen sulfate for use in production of acidified sodium chlorite. An ADI “not specified” was established for sodium sulfate at the 57<sup>th</sup> JECFA (2001) and no ADI was allocated for sulfuric acid at the 20<sup>th</sup> JECFA (1976).*

### SYNONYMS

Sodium acid sulfate; nitre cake; sodium bisulfate; sulfuric acid, monosodium salt.

### DEFINITION

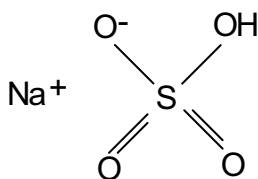
Sodium chloride and sulfuric acid are combined at elevated temperatures to produce molten sodium hydrogen sulfate. The molten sodium hydrogen sulfate is sprayed and cooled to form a solid product with uniform particle size.

C.A.S. number 7681-38-1

Chemical formula  $\text{NaHSO}_4$

Formula weight 120.06

Structural Formula



Assay Not less than 85%

### DESCRIPTION

White crystals or granules

### FUNCTIONAL USES

For use in antimicrobial washing solutions

### CHARACTERISTICS

#### IDENTIFICATION

Solubility (Vol. 4) Freely soluble in water

Sodium (Vol. 4) Passes test

Sulfate (Vol. 4) Passes test

#### PURITY

Loss on drying (Vol.4) Not more than 0.8% (105°, 3h, use 25 g of sample),

Water-insoluble matter (Vol. 4) Not more than 0.05% (Use 50 g of sample and 300 ml hot water)



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 principles of methods described in Volume 4 (under "General Methods, Metallic Impurities").

Selenium (Vol. 4)

Not more than 5 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").

**METHOD OF ASSAY**

Accurately weigh about 5 g of sample, dissolve in 125 ml of water, and add phenolphthalein TS. Titrate with 1 N sodium hydroxide. Each milliliter of sodium hydroxide is equivalent to 120.06 mg of  $\text{NaHSO}_4$ .

## STEVIOI GLYCOSIDES

*Prepared at the 68<sup>th</sup> JECFA (2007) and published in FAO JECFA Monographs 4 (2007), superseding tentative specifications prepared at the 63<sup>rd</sup> JECFA (2004), in the Combined Compendium of Food Additive Specifications, FAO JECFA Monographs 1 (2005). A temporary ADI of 0-2 mg/kg bw (expressed as steviol) was established at the 63<sup>rd</sup> JECFA (2004).*

### SYNONYMS

INS no. 960

### DEFINITION

The product is obtained from the leaves of *Stevia rebaudiana* Bertonii. 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 methanol to release the glycosides and product is recrystallized with methanol. 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

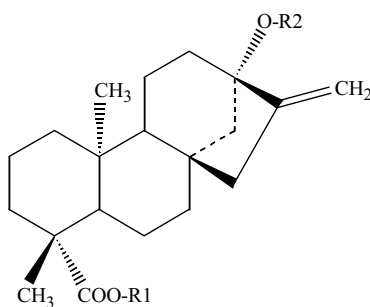
Stevioside: 57817-89-7  
Rebaudioside A: 58543-16-1

### Chemical formula

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

### Structural formula

The seven named steviol glycosides:



<u>Compound name</u>	<u>R1</u>	<u>R2</u>
<i>Stevioside</i>	$\beta$ -Glc	$\beta$ -Glc- $\beta$ -Glc(2→1)
<i>Rebaudioside A</i>	$\beta$ -Glc	$\beta$ -Glc- $\beta$ -Glc(2→1)   $\beta$ -Glc(3→1)
<i>Rebaudioside C</i>	$\beta$ -Glc	$\beta$ -Glc- $\alpha$ -Rha(2→1)   $\beta$ -Glc(3→1)
<i>Dulcoside A</i>	$\beta$ -Glc	$\beta$ -Glc- $\alpha$ -Rha(2→1)
<i>Rubusoside</i>	$\beta$ -Glc	$\beta$ -Glc
<i>Steviolbioside</i>	H	$\beta$ -Glc- $\beta$ -Glc(2→1)
<i>Rebaudioside B</i>	H	$\beta$ -Glc- $\beta$ -Glc(2→1)   $\beta$ -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 and in ethanol

Stevioside and rebaudioside A      The main peak in the chromatogram obtained by following the procedure in Method of Assay corresponds to either stevioside or rebaudioside A.

pH (Vol. 4)      Between 4.5 and 7.0 (1 in 100 solution)

### PURITY

Total ash (Vol. 4)      Not more than 1%

Loss on drying (Vol. 4)      Not more than 6% (105°, 2h)

<u>Residual solvents</u> (Vol. 4)	Not more than 200 mg/kg methanol (Method I in Vol. 4, General Methods, Organic Components, Residual Solvents)
<u>Arsenic</u> (Vol. 4)	Not more than 1 mg/kg Determine by the atomic absorption hydride technique (Use Method II to prepare the test (sample) solution)
<u>Lead</u> (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 Vol. 4 (under "General Methods, Metallic Impurities).

**METHOD OF ASSAY** Determine the percentages of the individual steviol glycosides by high pressure liquid chromatography (Volume 4).

#### Standards

Stevioside, >99.0% purity and rebaudioside A, >97% purity (available from Wako pure Chemical Industries, Ltd. Japan).

#### Mobile phase

Mix HPLC-grade acetonitrile and water (80:20). Adjust the pH to 3.0 with phosphoric acid (85% reagent grade). Filter through 0.22 µm Millipore filter or equivalent.

#### Standard solutions

- (a) Accurately weigh 50 mg of dried (105°, 2 h) stevioside standard into a 100-ml volumetric flask. Dissolve with mobile phase and dilute to volume with mobile phase.
- (b) Repeat with previously dried rebaudioside A standard.

#### Sample solution

Accurately weigh 60-120 mg of dried (105°, 2 h) sample into a 100-ml volumetric flask. Dissolve with mobile phase and dilute to volume with the mobile phase.

#### Chromatography Conditions

Column: Supelcosil LC-NH2 or equivalent (length: 15-30 cm; inner diameter: 3.9-4.6 mm)

Mobile phase: A 80:20 mixture of acetonitrile and water (see above)

Flow rate: Adjust so that the retention time of rebaudioside A is about 21 min.

Injection volume: 5-10 µl

Detector: UV at 210 nm

Column temperature: 40°

Procedure

Equilibrate the instrument by pumping mobile phase through it until a drift-free baseline is obtained. Record the chromatograms of the

sample solution and of the standard solutions.

The retention times relative to rebaudioside A (1.00) are:

0.45-0.48 for stevioside	0.12-0.16 for rubusoside
0.25-0.30 for dulcoside A	0.35-0.41 for steviolbioside
0.63-0.69 for rebaudioside C	0.73-0.79 for rebaudioside B

Measure the peak areas for the seven steviol glycosides from the sample solution (the minor components might not be detected). Measure the peak area for stevioside for the standard solution.

Calculate the percentage of each of the seven steviol glycosides, X, in the sample from the formula:

$$\%X = [W_S/W] \times [f_X A_X/A_S] \times 100$$

where

$W_S$  is the amount (mg) of stevioside in the standard solution

$W$  is the amount (mg) of sample in the sample solution

$A_S$  is the peak area for stevioside from the standard solution

$A_X$  is the peak area of X for the sample solution

$f_X$  is the ratio of the formula weight of X to the formula weight of stevioside: 1.00 (stevioside), 0.98 (dulcoside A), 1.20 (rebaudioside A), 1.18 (rebaudioside C), 0.80 (rubusoside), 0.80 (steviolbioside), and 1.00 (rebaudioside B).

Calculate the percentage of total steviol glycosides (sum the seven percentages).

## SUCROSE ESTERS OF FATTY ACIDS

*Prepared at the 68th JECFA (2007) and published in FAO JECFA Monographs 4 (2007), superseding tentative specifications prepared at the 65th JECFA (2005) and published in the Combined Compendium of Food Additive Specifications, FAO JECFA Monographs 1 (2005). An ADI of 0-30 mg/kg bw for this substance together with sucroglycerides was established at the 49th JECFA (1997).*

### SYNONYMS

Sucrose fatty acid esters, INS No. 473

### DEFINITION

Mono-, di- and tri-esters of sucrose with food fatty acids, prepared from sucrose and methyl and ethyl esters of food fatty acids by esterification in the presence of a catalyst or by extraction from sucroglycerides. Only the following solvents may be used for the production: dimethylformamide, dimethyl sulfoxide, ethyl acetate, isopropanol, propylene glycol, isobutanol and methyl ethyl ketone.

### Assay

Not less than 80% of sucrose esters

### DESCRIPTION

Stiff gels, soft solids or white to slightly greyish white powders

### FUNCTIONAL USES

Emulsifier

### CHARACTERISTICS

#### IDENTIFICATION

##### Solubility (Vol.4)

Sparingly soluble in water, soluble in ethanol

##### Fatty acids

Add 1 ml of ethanol to 0.1 g of the sample, dissolve by warming, add 5 ml of dilute sulfuric acid TS, heat in a waterbath for 30 min and cool. A yellowish white solid or oil is formed, which has no odour of isobutyric acid, and which dissolves when 3 ml of diethyl ether are added. Use the aqueous layer separated from the diethyl ether in the Test for sugars.

##### Sugars

To 2 ml of the aqueous layer separated from the diethyl ether in the test for fatty acids, carefully add 1 ml of anthrone TS down the inside of a test tube; the boundary surface of the two layers turns blue or green.

#### PURITY

##### Sulfated ash (Vol.4)

Not more than 2%  
Test 1 g of the sample (Method I)

##### Acid value (Vol.4)

Not more than 6

##### Free sucrose

Not more than 5%  
See description under TESTS

<u>Dimethylformamide</u>	Not more than 1 mg/kg See description under TESTS
<u>Dimethyl sulfoxide</u>	Not more than 2 mg/kg See description under TESTS
<u>Ethyl acetate, isopropanol and propylene glycol</u>	Not more than 350 mg/kg, singly or in combination See description under TESTS
<u>Isobutanol</u>	Not more than 10 mg/kg See description under TESTS
<u>Methanol</u>	Not more than 10 mg/kg See description under TESTS
<u>Methyl ethyl ketone</u>	Not more than 10 mg/kg See description under TESTS
<u>Lead (Vol.4)</u>	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

### PURITY TESTS

<u>Free sucrose</u>	Determine by gas liquid chromatography described in Volume 4 using the following conditions.  <u>Standard solutions</u> Prepare a stock solution containing 5.0 mg/ml of sucrose in <i>N,N</i> -dimethylformamide. Prepare a range of standard solutions containing 0.5, 1.25 and 2.5 mg/ml of sucrose by dilutions of the stock solution with <i>N,N</i> -dimethylformamide.  <u>Internal standard solution</u> Weigh accurately 0.25 g of octacosane into a 50-ml volumetric flask, add 25 ml of tetrahydrofuran to dissolve the octacosane, and add tetrahydrofuran to the mark.  <u>Chromatography conditions</u> Column: 100%-Dimethylpolysiloxane (30 m x 0.32 mm i.d. with 0.25 µm film) Carrier gas: Helium Flow rate: 1.5 ml/min Detector: Flame-ionization detector (FID) Temperatures: <ul style="list-style-type: none"> <li>- injection: 280°</li> <li>- column: Hold for 1 min at 100°, then 100-300° at 12°/min, hold for 45 min at 300°</li> <li>- detector: 320°</li> </ul> The retention times of free sucrose and octacosane measured
---------------------	--

under the above conditions are approx. 18.8 and 19.3 min, respectively.

#### Procedure

Weigh accurately 20-50 mg of the sample into a centrifugation tube, add 1 ml internal standard solution, 1 ml *N,N*-dimethylformamide, 0.4 ml of *N,O*-bis(trimethylsilyl)acetamide (BSA) and 0.2 ml trimethylchlorosilane (TMCS). After sealing the tube, shake and let stand for 5 min at room temperature. Inject 1 µl into the gas liquid chromatograph.

#### Standard curve

Prepare silylated standard solutions following the above procedure using 1 ml each of the standard solutions in place of the sample and *N,N*-dimethylformamide. Draw a standard curve by plotting amount of sucrose (mg) in 1 ml of the standard solution (X-axis) vs. ratio of peak area of sucrose/internal standard (Y-axis).

Measure the peak areas for sucrose and internal standard. Calculate the ratio of their peak areas, and obtain the amount of sucrose from the standard curve.

Calculate the percentage of free sucrose from:

$$\% \text{ free sucrose} = \frac{\text{amount of sucrose determined (mg)}}{\text{weight of sample (mg)}} \times 100$$

#### Dimethylformamide

Determine by gas liquid chromatography described in Volume 4 using the following conditions.

#### Standard solutions

Prepare a stock solution containing 1.00 mg/ml of dimethylformamide in tetrahydrofuran. Prepare a range of standard solutions containing 0.05, 0.1 and 0.2 µg/ml of dimethylformamide by diluting the stock solution with tetrahydrofuran.

#### Chromatography conditions

Column: Polyethylene glycol (30 m x 0.32 mm i.d. with a 0.5 µm film)

Carrier gas: Helium

Pressure: 150 kPa (constant pressure)

Detector: Nitrogen/phosphorus detector or thermionic specific detector)

Temperatures:

- injection: 180°
- column: Hold for 2 min at 40°, then 40-160° at 20°/min, hold for 2 min at 160°
- detector: 325°

Injection method: Splitless injection of 1.0 µl with auto-injector, followed by start of purge after 1.0 min.

The retention time of dimethylformamide measured under the above conditions is approx. 6.4 min.



Procedure

Weigh accurately 2 g of sample into a 20-ml volumetric flask, add 10 ml of tetrahydrofuran to dissolve the sample, add tetrahydrofuran to the mark, and mix the solution well. Inject 1.0 µl of the sample solution into the chromatograph.

Standard curve

Prepare daily by injecting 1.0 µl of each of the standard solutions into the chromatograph.

Calculate the concentration of dimethylformamide in mg/kg ( $C_{DFA}$ ) from:

$$C_{DFA} \text{ (mg/kg)} = C \times 20 / W$$

where

C is dimethylformamide concentration determined (µg/ml)

W is weight of sample (g)

Note: The nitrogen/phosphorus detector is insensitive to components that do not contain nitrogen or phosphorus. As a consequence, the capillary column can become obstructed with compounds of low volatility, although the baseline of the chromatogram is stable. Accordingly, the column must be reconditioned frequently. Overnight reconditioning (flow carrier gas in the reverse direction at 180°) is required after about every 15 samples.

Dimethyl sulfoxide

Determine by gas liquid chromatography described in Volume 4 using following conditions.

Standard solutions

Prepare a 0.25 mg/ml stock solution of dimethyl sulfoxide in tetrahydrofuran. Prepare a range of solutions containing 0.1, 0.2, 0.4 and 1.0 µg/ml of dimethyl sulfoxide by dilutions of the stock solution with tetrahydrofuran.

Chromatography conditions

Column: 10% PEG 20M and 3% KOH on Chromosorb W AW DMCS 60/80 mesh (2 m x 3 mm i.d.) or equivalent. Raise the oven temperature to 180° at a rate of 10°/min and let stabilize for 24 to 48 h with 30 to 40 ml/min of nitrogen for conditioning

Carrier gas: Nitrogen

Flow rate: 30 ml/min

Detector: Flame photometric detector (using 394 nm sulfur filter)

Temperatures

- injection: 210°

- column: 160°

The retention time of dimethyl sulfoxide measured under the above conditions is approx. 3.4 min.

Procedure

Weigh accurately 5 g of the sample into a 25-ml volumetric flask, add 10 ml of tetrahydrofuran to dissolve the sample, add

tetrahydrofuran to the mark, and mix the solution well. Inject 3 µl of the sample solution into the chromatograph.

#### Standard curve

Prepare daily by injecting 3 µl of each of the standard solutions into the chromatograph.

Calculate the concentration of dimethyl sulfoxide in mg/kg ( $C_{\text{DMSO}}$ ) from:

$$C_{\text{DMSO}} (\text{mg/kg}) = C \times 25 / W$$

where

C is dimethyl sulfoxide concentration determined (µg/ml)

W is weight of sample (g)

#### Propylene glycol

Determine by gas liquid chromatography described in Volume 4 using the following conditions.

#### Internal standard solution

Prepare a 500 µg/ml solution of ethylene glycol in tetrahydrofuran.

#### Standard solutions

Prepare a range of standard solutions containing 1, 5, 10, 25 and 50 µg/ml of propylene glycol with 5 µg/ml of ethylene glycol in tetrahydrofuran.

#### Chromatography conditions

Column: Polydimethylsiloxane (30 m x 0.32 mm i.d. with 0.25 µm film)

Carrier gas: Helium

Flow rate: 1.5 ml/min (Constant flow)

Detector: FID

Temperatures:

- injection: 230°
- column: Hold for 3 min at 40°, then 40-250° at 20°/min, hold for 5 min at 250°
- detector: 270°

The retention times of ethylene glycol and propylene glycol derivatives are approx. 7.6 min and 7.8 min, respectively.

#### Procedure

Weigh accurately 1 g of the sample into a 10-ml volumetric flask, and add 100 µl of the internal standard solution. Dissolve and make to volume with tetrahydrofuran. Take 0.5 ml of the sample solution in a centrifugation tube, and add 0.25 ml of 1,1,1,3,3,3-hexamethyldisilazane and 0.1 ml of trimethylchlorosilane. After sealing the tube, shake it vigorously, let stand for 30 min at room temperature, then centrifuge. Inject 1.0 µl of this centrifugal supernatant into the chromatograph.

#### Standard curve

Prepare following the same procedure using 0.5 ml of the standard solutions in place of the sample solution.

Calculate the concentration of propylene glycol in mg/kg ( $C_{PG}$ ) from:

$$C_{PG} \text{ (mg/kg)} = C \times 10 / W$$

where

$C$  = propylene glycol concentration determined ( $\mu\text{g/ml}$ )

$W$  = weight of sample (g)

Methanol, isopropanol, isobutanol, ethyl acetate and methyl ethyl ketone

Determined by gas chromatography with a head space sampler using the following methods.

#### Standard solutions

Prepare standard solution A containing 4000 mg/l each of methanol, isopropanol, isobutanol, ethyl acetate and methyl ethyl ketone by weighing accurately 0.2 g of each solvent into a 50-ml volumetric flask containing approx. 20 ml of water, then adding water to volume. By dilutions of this solution, prepare solutions containing 2000 mg/l (standard solution B) and 1000 mg/l (standard solution C).

#### Procedure:

Weigh accurately 1 g of the sample into each of four sample vials. To one vial add 5  $\mu\text{l}$  of water, to the second, third and fourth, add, respectively, standard solutions A, B and C, and seal them quickly with a septum. (The concentrations of each solvent after adding 5  $\mu\text{l}$  of standard solutions A, B and C to 1 g of the sample are equal to 20, 10 and 5 mg/kg of sample, respectively). Place the sample vials in a head space sampler and analyse using the following conditions: Column: 100% Polydimethylsiloxane (30 m x 0.53 mm i.d. with 1.5  $\mu\text{m}$  film)

Carrier gas: Nitrogen

Flow rate: 3.5 ml/min

Detector: FID

Temperatures

- injection: 110°

- column: 40°

- detector: 110°

Head space sampler:

- sample heat insulating temperature: 80°

- sample heat insulating period: 40 min

- syringe temperature: 85°

- sample gas injection: 1.0 ml

#### Calculation

Plot the relationship between the added amount against the peak area for each solvent using the analytical results. The relationship should be linear. Extrapolate and determine the x-intercept ( $w_i$ ), and calculate the solvent concentrations ( $C_i$ ) in the sample from:

$$C_i \text{ (mg/kg)} = w_i / W$$

where

$w_i$  is x-intercept of relationship line using the standard addition method ( $\mu\text{g}$ )

$W$  is weight of sample (g)

**METHOD OF ASSAY** Determine by HPLC using the following conditions:

Procedure

Accurately weigh 250 mg of the sample into a 50-ml volumetric flask. Dilute to volume with tetrahydrofuran and mix. Filter through a 0.45  $\mu\text{m}$  membrane filter. Inject 50  $\mu\text{l}$  of the sample into the pre-stabilized chromatograph.

Chromatography conditions

Column: Styrene-divinylbenzene copolymer for gel permeation chromatography (TSK-GEL G2000HXL (Tosoh) x 4 column in series or equivalent)

Mobile phase: HPLC-grade degassed tetrahydrofuran

Flow rate: 1.0 ml/min

Detector: Refractive index

Temperatures:

- Column: 40°

- Detector: 40°

Record the chromatogram for about 30 min.

Calculate the percentage of sucrose ester content in the sample from:

$$\% \text{ sucrose ester} = 100 A/T$$

where

A is the sum of peak areas for the three main components, the mono-, di- and tri-esters, eluting at about 24.9, 23.6 and 22.8 min, respectively

T is the sum of all peak areas eluting within 30 min

## WITHDRAWAL OF SPECIFICATIONS FOR CERTAIN FOOD ADDITIVES

### *Anisyl acetone and furfural*

The food additives specifications monographs for anisyl acetone and furfural were withdrawn, as the Committee concluded that these substances only have flavouring functions.

### *Zeaxanthin rich extract from *Tagetes erecta**

The tentative specifications for zeaxanthin rich extract from *Tagetes erecta* were withdrawn as insufficient information was received to allow removal of the tentative designation.

## ANALYTICAL METHODS

The following analytical methods were prepared by the Committee at the 68<sup>th</sup> meeting. This method will be made available in the on-line database for flavourings.

### HPLC Method for Flavourings

**3-methyl-2-oxobutanoic acid (631)**

**Sodium 3-methyl-2-oxobutanoate (631.1)**

**3-methyl-2-oxopentanoic acid (632)**

**Sodium 3-methyl-2-oxopentanoate (632.1)**

**4-methyl-2-oxopentanoic acid (633)**

**Sodium 4-methyl-2-oxopentanoate (633.1)**

**2-oxo-3-phenylpropionic acid (1478)**

**Sodium 2-oxo-3-phenylpropionate (1479)**

Determine by HPLC using the following:

Note: All solutions should be prepared with ultra high quality (UHQ) deionized water

#### Apparatus:

HPLC system with a suitable pump, injector, and a data station

Column:	Stainless steel; 300 x 7.6 mm
Stationary phase:	Bio-Rad Aminex <sup>®</sup> HPX-87H or equivalent
Detector:	UV

#### HPLC conditions:

Column temperature:	35°
Mobile phase:	0.004 M Sulfuric acid
Flow rate:	0.6 ml/min
Injection volume:	50 µl
Detection:	210 nm
Run time:	30 min

Note: *The retention times of the compounds are as follows:*

3-methyl-2-oxobutanoic acid is 13.0 min  
 3-methyl-2-oxopentanoic acid is 14.8 min  
 4-methyl-2-oxopentanoic acid is 16.7 min  
 2-oxo-3-phenylpropionic acid is 24.7 min

#### Procedure:

Weigh about 100 mg of the sample, dissolve in a minimum amount of 0.2 M sodium hydroxide solution, and make up to 100 ml in a volumetric flask. Set up and condition the HPLC using the mobile phase. Inject the sample solution and determine the purity of the sample by the area normalization method.

## SPECIFICATIONS FOR CERTAIN FLAVOURINGS

At its 44th meeting JECFA considered a new approach to the safety evaluation of flavourings. This approach incorporates a series of criteria whose use enables the evaluation of a large number of these agents in a consistent and timely manner. At the current meeting of the Committee specifications of identity and purity were revised for 12 flavourings (page 78) and adopted for 160 new flavourings (page 80).

Information on specifications for flavourings is given on the following tables under the following headings, most of which are self-explanatory:

Name; Chemical name (Systematic name); Synonyms; Flavour and Extract Manufacturers' Association of the United States (FEMA) No; FLAVIS (FL) No; Chemical Abstract Service Registry (CAS) No; Chemical formula; Molecular weight; Physical form/odour; Solubility; Solubility in ethanol, Boiling point (B.P. - for information only); Identification test (ID) referring to type of test (NMR: Nuclear Magnetic Resonance spectrometry; IR: Infrared spectrometry; MS: Mass spectrometry); Assay min (Gas chromatographic (GC) assay of flavouring agents); Acid value max; Refractive index (at 20°, if not otherwise stated); Specific gravity (at 25°, if not otherwise stated)

The field called "Other requirements" contains three types of entry:

1. Items in normal type are additional requirements, such as further purity criteria or other tests
2. Items contained in square brackets are provided for information, for example the typical isomer composition of the flavouring agent. These are not considered to be requirements.
3. Substances which are listed as secondary constituents which have been taken into account in the safety evaluation of the named flavouring agent. If the commercial product contains less than 95% of the named compound, it is a requirement that the major part of the product (i.e. not less than 95%) is accounted for by the sum of the named compound and one or more of the secondary constituents.

The field named Session contains the number of the meeting at which the specifications were prepared and the status of the specification. R means "specifications revised", S means "existing specifications maintained", S,T means "existing tentative specifications maintained, (further information required)", N means "new specifications", N,T means "new tentative specifications, (further information required)", and N,C means "new specifications for a flavouring agent with a conditional safety evaluation".

The spectra used for identification tests are provided from page 103 onwards.

A comprehensive index listing all names, chemical names, and synonyms is added on page 141.

## REVISED SPECIFICATIONS

No	Name Chemical name Synonyms	FEMA No Flavis No CAS No	Formula M.W.	Physical form; Odour	Solubility Solubility in ethanol	B.P.	ID test Assay min max	A.V. max	R.I. S.G.	Other requirements/ SC (secondary constituents)	Session
631	<b>3-Methyl-2-oxobutanoic acid</b> 3-Methyl-2-oxobutyric acid Butanoic acid, 3-methyl-2-oxo; Dimethylpyruvic acid; 2-Oxoisovaleric acid	3869 759-05-7	C5H8O3 116.1	Pale yellow liquid; fruity aroma	Soluble in water Soluble	251°	NMR MS 97%	1.436-1.446 1.115-1.120		mp = 17°	68th/R
631.1	<b>3-Methyl-2-oxobutanoic acid, sodium salt</b> Sodium 3-methyl-2-oxobutyrate Butanoic acid, 3-methyl-2-oxo, sodium salt; Sodium alpha-ketoisovalerate	3869 08.051 3715-29-5	H5H7NaO3 138.1	White powder; slight fruity aroma	Soluble in water Soluble	NA	NMR 99%		NA NA	mp = 231.7° with decomposition	68th/R
632	<b>3-Methyl-2-oxopentanoic acid</b> 3-Methyl-2-oxovaleric acid	3870 1460-34-0	C6H10O3 130.1	White crystalline powder; slight fruity aroma	Soluble in water Soluble	233°	IR 99%		NA NA	mp = 41.5°	68th/R
632.1	<b>3-Methyl-2-oxopentanoic acid, sodium salt</b> Sodium 3-methyl-2-oxovalerate Pentanoic acid, 3-methyl-2-oxo, sodium salt; Valeric acid, 3-methyl-2-oxo, sodium salt	3870 08.093 3715-31-9	C6H9NaO3 152.1	White powder; slight fruity aroma	Soluble in water Soluble	NA	NMR IR 99%		NA NA		68th/R
633	<b>4-Methyl-2-oxopentanoic acid</b> 4-Methyl-oxovaleric acid	3871 816-66-0	C6H10O3 130.1	Pale yellow liquid; fruity aroma	Soluble in water Soluble	251°	IR 99%	1.432-1.442 1.053-1.058			68th/R
633.1	<b>4-Methyl-2-oxopentanoic acid, sodium salt</b> Sodium 4-methyl-2-oxovalerate Oxopentanoate, 4-methyl-2-oxo, sodium salt; Sodium 4-methyl-2-ketopentanoate; Sodium 4-methyl-2-oxo-pentanoate; Valeric acid, 4-methyl-2-oxo, sodium salt	3871 08.052 4502-00-5	C6H9NaO3 152.1	White powder; slight fruity aroma	Soluble in water Soluble	NA	NMR 99%		NA NA		68th/R
1479	<b>2-Oxo-3-phenylpropionic acid, sodium salt</b> Benzenepropionic acid, alpha-oxo, sodium salt	3892 114-76-1	C9H7NaO3 186.14	White crystalline powder; very faint savory aroma	Soluble in water Soluble	NA	NMR 98%		NA NA	Decomposes without melting starting at 175°	68th/R



No	Name Chemical name Synonyms	FEMA No Flavis No CAS No	Formula M.W.	Physical form; Odour	Solubility Solubility in ethanol	B.P.	ID test Assay min max	A.V. max	R.I. S.G.	Other requirements/ SC (secondary constituents)	Session
1480	<b>Maltol</b> 3-Hydroxy-2-methyl-4-pyrone 2-Methylpyromeconic acid; Larixinic acid; INS No. 636	2656 07.014 118-71-8	C6H6O3 126.11	White, crystalline powder; Caramel- butterscotch aroma	Sparingly soluble in water, soluble in propylene glycol Soluble	-	NMR 99% (anhydrous basis)		- -	mp = 162°	68th/R
1481	<b>Ethyl maltol</b> 2-Ethyl-3-hydroxy-4-pyrone 2-Ethyl-3-hydroxy-4H-pyran-4-one; 2-Ethylpyromeconic acid; INS No. 637	3487 07.047 4940-11-8	C7H8O3 140.14	White, crystalline powder; Sweet fruit-like aroma	Sparingly soluble in water, soluble in propylene glycol Soluble	-	NMR 99% (anhydrous basis)		- -	mp = 89-93°	68th/R
1482	<b>Maltol isobutyrate</b> 2-Methyl-4H-pyran-4-one-3-yl 2-methylpropanoate 2-Methyl-4-oxo-4H-pyran-3-yl isobutyrate; Maltol 2-methylpropanoate; 2-Methyl-4-pyran-3-yl 2-methylpropanoate	3462 09.525 65416-14-0	C10H12O4 196.20	Colourless to yellow liquid; Strawberry aroma	Insoluble in water; Soluble in propylene glycol and fixed oils Soluble	100° (0.01 mm Hg)	IR 96%	10	1.497-1.499 1.145-1.149		68th/R
1506	<b>3-Acetyl-2,5-dimethylfuran</b> 3-Acetyl-2,5-dimethylfuran 2,5-Dimethyl-3-acetyl-furan	3391 13.066 10599-70-9	C8H10O2 138.17	Clear to yellow liquid; Powerful, slightly roasted, nutty aroma	Slightly soluble in water; soluble in propylene glycol and most fixed oils Soluble	83° (11 mm Hg)	NMR 99%	1	1.488-1.490 1.037-1.039		68th/R
1559	<b>2,4,5-Trimethyl-delta-3-oxazoline</b> 2,4,5-Trimethyl-delta-3-oxazoline 2,4,5-Trimethyl-2,5-dihydrooxazole	3525 13.039 22694-96-8	C6H11NO 113.16	Yellow orange liquid; Powerful, musty, slight green, wood, nut aroma	Soluble in water, propylene glycol; insoluble in most fixed oils Soluble	96-97°	NMR 94%		1.413-1.421 0.913-0.920	Also contains trimethyloxazole	68th/R

NEW SPECIFICATIONS

No	Name Chemical name Synonyms	FEMA No Flavis No CAS No	Formula M.V.	Physical form; Odour	Solubility Solubility in ethanol	B.P. Assay min	ID test Assay max	AV max	R.I. S.G.	Other requirements/ SC (secondary constituents)	Session
1616	<b>Methyl 4-pentenoate</b> Methyl 4-pentenoate <i>Allylacetate</i> <i>Allylacetate</i>	4353 818-57-5	C6H10O2 114.14	Colourless liquid; Green fruity aroma	Insoluble in water; soluble in propylene glycol Soluble	125-127°	MS 95%		1.412-1.418 0.882-0.890		68th/N
1617	<b>2-Methylbut-2-en-1-ol</b> 2-Methylbut-2-en-1-ol	4178 02.174 4675-87-0	C5H10O 86.13	Colourless liquid; Green oily aroma	Slightly soluble Soluble	136-138°	MS 98%		1.439-1.445 0.863-0.869		68th/N
1618	<b>Ethyl 4-pentenoate</b> Ethyl 4-pentenoate <i>4-Ethoxycarbonylbut-1-ene</i>	4360 1968-40-7	C7H12O2 128.17	Colourless liquid; Green fruity aroma	Insoluble in water; soluble in propylene glycol Soluble	143-145°	MS 95%		1.410-1.420 0.893-0.903		68th/N
1619	<b>4-Pentalen</b> 4-Pentalen	4262 05.174 2100-17-6	C5H8O 84.12	Colourless liquid; Cooked brown and roasted aroma	Slightly soluble in water; soluble in pentane and diethyl ether Soluble	97-99°	NMR IR MS 97%		1.413-1.418 0.853-0.857		68th/N
1620	<b>3-Isopropenylpentanedioic acid</b> 3-Isopropenylpentanedioic acid	4352 6839-75-4	C8H12O4 172.18	Crystalline solid imparting a savoury, cooked brown or roasted flavour	Soluble in water; insoluble in non-polar organic solvents Soluble	NA	NMR IR MS 95%		NA NA	mp = 110°	68th/N
1621	<b>trans-3-Hexenol</b> 3(E)-Hexenol (3E)-Hexenol; (E)-3-Hexen-1-ol; (E)-3-Hexenol; trans-3-Hexen-1-ol; Leaf alcohol; beta-gamma-hexenol	4356 928-97-2	C6H12O 100.16	Colourless liquid; Grassy green aroma	Soluble in water and most fixed oils Soluble	155-157°	MS 98%		1.437-1.442 0.830-0.845		68th/N
1622	<b>trans-4-Hexenal</b> 4(E)-Hexenal <i>Hex-4-enal</i> ; <i>trans-Hex-4-enal</i> ; 4-Hexenal trans; E-4-Hexenal	4046 25166-87-4	C6H10O 98.14	Colourless liquid; Green vegetable aroma	Soluble in hexane and diethyl ether; insoluble in water Soluble	125-129° 92% (sum of cis and trans isomers)	IR MS		1.417-1.424 0.824-0.832	Contains 76% min trans-4-hexenal, 16- 20% cis-4-hexenal, 2- 4% 3-hexen-1-ol and 1- 2% hexenal	68th/N

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<b>1623</b>	<b>5-Hexenol</b> 5-Hexenol 1-Hexen-6-ol; 5-Hexene-1-ol; 6-Hydroxy-1-hexene	4351 821-41-0	C6H12O 100.16	Colourless liquid; Green aroma	Soluble in water and most fixed oils Soluble	154-155°	NMR MS 95%	1.434-1.437 0.845-0.849			68th/N
<b>1624</b>	<b>Methyl (Z)-3-hexenoate</b> Methyl 3(Z)-hexenoate Methyl cis-3-hexenoate	4164 13894-62-7	C7H12O2 128.17	Clear, colourless liquid; Fruity, floral aroma	Soluble in fats and non- polar solvents; slightly soluble in water Soluble	85° (80 mm Hg)	NMR 95%	1.422-1.430 0.916-0.923			68th/N
<b>1625</b>	<b>cis-4-Octenol</b> 4(Z)-Octenol (Z)-4-Octen-1-ol	4354 2.244 54393-36-1	C8H16O 128.21	Clear, colourless liquid; Powerful, sweet, earthy odour with a strong herbaceous note	Insoluble in water; soluble in non-polar organic solvents Soluble	174-176°	MS 99%	1.444-1.450 0.844-0.851			68th/N
<b>1626</b>	<b>Ethyl (Z)-3-hexenoate</b> Ethyl 3(Z)-hexenoate Ethyl cis-3-hexenoate	4112 64187-83-3	C8H14O2 142.20	Clear, colourless liquid; Green, wine-like aroma	Soluble in fats and non- polar solvents; slightly soluble in water Soluble	90° (50 mm Hg)	NMR IR 96%	1.420-1.429 0.895-0.901			68th/N
<b>1627</b>	<b>3-Octenoic acid</b> 3-Octenoic acid delta-3-Octenoic acid; 2-Heptene-1-carboxylic acid	4362 1577-19-1	C8H14O2 142.20	White solid; Oily, fatty aroma	Slightly soluble in water; soluble in most organic solvents Soluble	240-242°	MS 95%	1.443-1.450 0.928-0.938 (20°)			68th/N
<b>1628</b>	<b>(Z)-3-Octenyl propionate</b> 3(Z)-Octenyl propionate	4189 94134-03-9	C11H20O2 184.28	Colourless to pale yellow liquid; Unique pear-like aroma with a honeydew melon nuance	Insoluble in water; soluble in most organic solvents Soluble	69-71° (1 mm Hg)	MS 95%	1.434-1.440 0.882-0.889		Also contains 2% trans isomer	68th/N
<b>1629</b>	<b>trans-4-Octenoic acid</b> 4(E)-Octenoic acid 4-Octenoic acid, (E)-	4357 18776-92-6	C8H14O2 142.20	Colourless liquid; Greasy aroma	Slightly soluble in water; soluble in most organic solvents Soluble	105-106° (5 mm Hg)	MS 95%	1.436-1.440 0.924-0.930			68th/N
<b>1630</b>	<b>Methyl (Z)-5-octenoate</b> Methyl 5(Z)-octenoate	4165 41654-15-3	C9H16O2 156.22	Colourless liquid; Dairy, coconut aroma	Soluble in fat; slightly soluble in water Soluble	184°	NMR MS IR 95%	1.429-1.435 0.921-0.925			68th/N

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1631	<b>cis-5-Octenoic acid</b> 5(Z)-Octenoic acid (Z)-5-Octenoic acid	4350 41653-97-8	C8H14O2 142.20	Colourless liquid; Fatty, greasy aroma	Slightly soluble in water; soluble in most organic solvents Soluble	239-241°	MS 95%	1.444-1.450 0.955-0.971			68th/N
1632	<b>Ethyl 3-octenoate</b> Ethyl 3-octenoate Ethyl oct-3-enoate	4361 09.377 1117-65-3	C10H18O2 170.25	Colourless liquid; Tropical fruity aroma	Insoluble in water; soluble in most organic solvents Soluble	65-70° (1 mm Hg)	MS 95%	1.434-1.438 0.881-0.887			68th/N
1633	<b>cis-4-Decenol</b> 4(Z)-Decenol (Z)-4-Decen-1-ol	4349 57074-37-0	C10H20O 156.27	Colourless liquid; Waxy, fruity aroma	Soluble in diethyl ether, mineral oil, propylene glycol and most fixed oils; insoluble in glycerol and water Soluble	234-236°	MS 95%	1.449-1.455 0.844-0.850			68th/N
1634	<b>Isobutyl 10-undecenoate</b> Isobutyl 10-undecenoate	4358 5421-27-2	C15H28O2 240.39	Colourless liquid; Fatty, fruit-like aroma	Insoluble in water; soluble in most organic solvents Soluble	264-266°	NMR IR MS 98%	1.438-1.442 0.868-0.873 (20°)			68th/N
1635	<b>11-Dodecenoic acid</b> 11-Dodecenoic acid	4355 65423-25-8	C12H22O2 198.31	Colourless liquid; Fatty, citrusy aroma	Insoluble in water; soluble in most organic solvents Soluble	272-274°	MS 95%	1.447-1.457 0.890-0.897			68th/N
1636	<b>(Z)-4-Dodecenal</b> 4(Z)-Dodecenal cis-Dodec-4-en-1-al; Tangerinal	4036 21944-98-9	C12H22O 182.31	Colourless liquid; Fruity, citrusy aroma	Soluble in fats and non- polar solvents; insoluble in water Soluble	254°	NMR IR MS 94%	1.443-1.449 0.843-0.847		Also contains 3-4% dodecanal	68th/N
1637	<b>cis-9-Octadecenol</b> 9(Z)-Octadecenol (Z)-9-Octadecen-1-ol; (Z)-9- Octadecenol; 9-cis-Octadecenol; cis- delta-9-Octadecenol; cis-9-Octadecen- 1-ol; cis-9-Octadecenyl alcohol	4363 143-28-2	C18H36O 268.48	Colourless to light yellow liquid; Fatty aroma with animal undertones	Insoluble in water; soluble in non-polar organic solvents Soluble	207° (13 mm Hg)	MS 85%	1.450-1.466 0.842-0.854 (20°)		Also contains 8-9% hexadecanol and 5-6% octadecanol	68th/N
1638	<b>cis-9-Octadecenyl acetate</b> 9(Z)-Octadecenyl acetate (Z)-9-Octadecenyl acetate; cis-9-Octadecen-1-yl acetate; Oleyl acetate	4359 693-801-1	C20H38O2 310.52	Colourless to light yellow liquid; Fatty aroma with fruity undertones	Insoluble in water; soluble in non-polar organic solvents Soluble	205-207° (13 mm Hg)	NMR MS IR 92%	1.446-1.453 0.865-0.874 (20°)		Also contains 2-3% hexadecyl acetate and 2-3% octadecyl acetate	68th/N

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<b>1639</b>	<b>Methyl 10-undecenoate</b> Methyl 10-undecenoate	4253 111-81-9	C12H22O2 198.31	Colourless liquid; Oily aroma	Slightly soluble in water Soluble	243-247°	MS 98%	1.436-1.442 0.885-0.891 (20°)			68th/N
<b>1640</b>	<b>(Z)-8-Tetradecenal</b> 8(Z)-Tetradecenal (Z)-Tetradec-8-enal	4066 05.208 169054-69-7	C14H26O 210.36	Clear liquid; Fruity, citrusy aroma	Soluble in water Soluble	295-299°	NMR IR MS 99%	1.446-1.450 0.833-0.845			68th/N
<b>1641</b>	<b>9-Octadecenal</b> 9-Octadecenal Olealdehyde; Elialdehyde; Octadecenyl aldehyde; Oleic aldehyde	4059 05.203 5090-41-5	C18H34O 266.47	Colourless liquid; Fatty aroma	Soluble in hexane and diethyl ether; insoluble in water Soluble	352-367°	NMR IR MS 94% (sum of cis and trans isomers)	1.448-1.458 0.837-0.845		Also contains 3-5% octadecenal	68th/N
<b>1642</b>	<b>(E)-4-Nonenal</b> 4(E)-Nonenal (E)-Non-4-enal; trans-4-Nonenal	4302 2277-16-9	C9H16O 140.23	Clear, colourless or pale yellow liquid; Fruity aroma	Sparingly soluble in water; soluble in many non-polar solvents Soluble	72-75°	NMR 93%	1.434-1.439 0.843-0.847		Also contains 1-2% 2- nonen-4-ol and 5-6% 2E,4E-nonadienal	68th/N
<b>1643</b>	<b>2,3,4-Trimethyl-3-pentanol</b> 2,3,4-Trimethyl-3-pentanol Diisopropyl methyl carbinol	3903 02.245 3054-92-0	C8H18O 130.23	Clear liquid; Fruity aroma	Soluble in heptane; insoluble in water Soluble	156-157°	NMR IR MS 97%	1.433-1.438 0.846-0.850			68th/N
<b>1644</b>	<b>(+/-)-2,4,8-Trimethyl-7-nonen-2-ol</b> 2,4,8-Trimethyl-7-nonen-2-ol	4212 437770-28-0	C12H24O 184.32	Clear, colourless liquid; Fruity aroma	Insoluble in water; soluble in non-polar organic solvents Soluble	60-70° (1-2 mm Hg)	NMR IR 96%	1.448-1.455 0.846-0.853			68th/N
<b>1645</b>	<b>(E)- and (Z)-2,4,8-Trimethyl-3,7-nonadien-2-ol</b> 2,4,8-Trimethyl-3,7-nonadien-2-ol	4211 479547-57-4	C12H22O 182.31	Clear, colourless liquid; Fruity aroma	Insoluble in water; soluble in non-polar organic solvents Soluble	70-72° (1.5 mm Hg)	NMR 96%	1.463-1.471 0.858-0.864			68th/N
<b>1646</b>	<b>Nerolidol</b> 3,7,11-Trimethyl-1,6(cis),10-dodecatrien-3-ol Methyl vinyl homogeranyl carbinol; 3,7-11-Trimethyl-1,6-10-dodecatrien-3-ol	2772 02.018 721244-4	C15H26O 222.37	Colourless or very pale straw-coloured oily liquid; Faint woody-floral, slightly rose apple aroma	Soluble in most fixed oils and propylene glycol; slightly soluble in water; insoluble in glycerol Soluble	275-277°	NMR 97%	1.478-1.483 0.872-0.879			68th/N

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1647	<b>6-Acetoxydihydrotheaspirane</b> 2,6,10,10-Tetramethyl-1-oxaspiro[4.5]decan-6-yl acetate [2 <i>alpha</i> ,5 <i>alpha</i> (S)]-2,6,10,10- Tetramethyl-1-oxaspiro[4.5]decan-6-yl, acetate	3651 13.087 57893-27-3	C15H26O3 254.37	Crystalline solid; Fermented, earthy, spice-like aroma	Soluble in fats; insoluble in water Soluble	NA	NMR IR 97%	NA NA	NA NA	mp = 50-53°	68th/N
1648	<b>6-Hydroxydihydrotheaspirane</b> 2,6,10,10-Tetramethyl-1-oxaspiro[4.5]decan-6-ol 6-Hydroxy-2,6,10,10-tetramethyl-1-oxaspiro[4.5]decane	3549 13.076 65620-50-0	C13H24O2 212.33	Colourless to yellow liquid; Camphoraceous woody green aroma	Soluble in fats; insoluble in water Soluble	211-212°	MS 98%	1.481-1.487 1.006-1.010			68th/N
1649	<b>1-Phenyl-3-methyl-3-pentanol</b> 3-Methyl-1-phenyl-3-pentanol Phenylethyl methyl ethyl carbinol	2883 02.037 10415-87-9	C12H18O 178.27	Colourless, slightly viscous liquid; Warm, rose-like aroma	Slightly soluble in water Soluble	253-255°	IR MS 98%	1.508-1.514 0.958-0.965 (20°)			68th/N
1650	<b>p-alpha,alpha-Trimethylbenzyl alcohol</b> 2-(4-Methylphenyl)propan-2-ol p-Cymen-8-ol; Dimethyl p-tolyl carbinol; 2-(4-Methylphenyl)-2-propanol; 2-p-Tolyl-2-propanol	3242 02.042 1197-01-9	C10H14O 150.22	Colourless liquid; Green, aromatic aroma	Slightly soluble in water Soluble	64° (0.6 mm Hg)	NMR 90%	1.516-1.520 0.974-0.980 (20°)		Also contains 9-11% p-isopropenyltoluene	68th/N 5
1651	<b>(+/-)-Ethyl 2-hydroxy-2-methylbutyrate</b> Ethyl 2-hydroxy-2-methylbutyrate	4268 77-70-3	C7H14O3 146.19	Clear, colourless liquid; Caramelised, nutty aroma	Sparingly soluble in water; soluble in most non-polar organic solvents Sparingly soluble	92° (64-68 mm Hg)	NMR 98%	1.409-1.416 0.964-0.974			68th/N
1652	<b>(+/-)-Ethyl 2-hydroxy-3-methylvalerate</b> Ethyl 2-hydroxy-3-methylpentanoate	4269 24323-38-4	C8H16O3 160.21	Clear, colourless liquid; Fruity aroma with berry notes	Sparingly soluble in water; soluble in most non-polar organic solvents Sparingly soluble	204-206°	NMR 96%	1.422-1.429 0.922-0.930			68th/N
1653	<b>alpha,alpha-Dimethylphenethyl alcohol</b> 2-Methyl-1-phenylpropan-2-ol Benzyl dimethyl carbinol; 2-Benzyl-2-propanol; alpha,alpha-Dimethylphenethanol; 2-Hydroxy-2-methyl-1-phenylpropane	2393 02.035 100-86-7	C10H14O 150.22	Colourless to pale yellow viscous liquid or white crystalline solid; Warm, herbaceous, floral aroma Soluble	Soluble in mineral oil, most fixed oils and propylene glycol; insoluble in water liquid)	214-216°	NMR IR 97%	1.514-1.517 (as supercooled liquid) 0.972-0.977		mp = 23.7-24.5°	68th/N

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1654	<b>alpha, alpha-Dimethylphenethyl formate</b> 2-Methyl-1-phenyl-2-propyl formate <i>Benzyl dimethyl carbiny/ formate</i> ; 2-Benzyl-2-propyl formate; <i>Dimethyl benzyl carbiny/ formate</i>	2395 09.086 10058-43-2	C11H14O2 178.23	Colourless liquid; Dry, herbaceous, green, floral aroma	Soluble in mineral oil, most fixed oils and propylene glycol; insoluble in water Soluble	217-222°	NMR 93%	1.494-1.502 1.018-1.030 (20°)		Also contains 5-7% alpha, alpha- dimethylphenethyl alcohol	68th/N
1655	<b>alpha, alpha-Dimethylphenethyl acetate</b> 1,1-Dimethyl-2-phenethyl acetate <i>Benzyl dimethyl carbiny/ acetate</i> ; 2-Benzyl-2-propyl acetate; <i>Dimethyl benzyl carbiny/ acetate</i> ; 2-Methyl-1-phenyl-2-propyl acetate	2392 09.227 151-05-3	C12H16O2 192.26	White to colourless liquid or crystals at room temperature; Powerful floral, fruity aroma	Soluble in mineral oil, most fixed oils and propylene glycol; insoluble in water Soluble	249-251°	NMR 98%	1.490-1.495 0.995-1.002		mp = 29-30°	68th/N
1656	<b>alpha, alpha-Dimethylphenethyl butyrate</b> 1,1-Dimethyl-2-phenethyl butyrate <i>Benzyl dimethyl carbiny/ butyrate</i> ; 2-Benzyl-2-propyl butyrate; <i>Dimethyl benzyl carbiny/ butyrate</i> ; 2-Methyl-1-phenyl-2-propyl butyrate	2394 09.232 10094-34-5	C14H20O2 220.31	Colourless liquid; Mild, herbaceous, fruity aroma	Soluble in mineral oil and most fixed oils; insoluble in water and propylene glycol Soluble	237-255°	NMR 95%	1.484-1.489 0.960-0.971			68th/N
1657	<b>alpha, alpha-Dimethylbenzyl isobutyrate</b> 1-Methyl-1-(2-phenylethyl) isobutyrate <i>alpha, alpha-Dimethylbenzyl 2-methyl- propanoate</i> ; 2-Methyl-1-phenyl-2-propyl isobutyrate; <i>Phenyl dimethyl carbiny/ isobutyrate</i> ; 2-Phenylpropan-2-yl isobutyrate	2388 09.509 7774-60-9	C13H18O2 206.28	White solid; Fruity aroma	Soluble in oils; Insoluble in water Soluble	NA	NMR 95%	NA NA		mp = 71-72°	68th/N
1659	<b>Ethanethiol</b> Ethanethiol <i>Ethyl mercaptan</i>	4258 12.017 75-08-1	C2H6S 62.14	Colourless to yellow liquid; Fruity, sulfur aroma	Slightly soluble in water Soluble	35°	NMR IR 99%	1.425-1.431 0.833-0.839			68th/N
1660	<b>Ethane-1,1-dithiol</b> Ethane-1,1-dithiol	4111 69382-62-3	C2H6S2 94.20	Colourless liquid; Meaty, roasted aroma	Soluble in water Soluble	Product distills at 71-78°	NMR 1%; see 'Other requirements'	1.369-1.375 0.829-0.833		Product is a 1% solution of ethane-1,1- dithiol, purity 99% min, in ethanol	68th/N

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1661	<b>Dimercaptomethane</b> Methanedithiol	4097 12.243 6725-64-0	CH4S2 80.17	Colourless liquid; Pungent odour	Soluble in water Soluble	117-119°	NMR 95%	1.578-1.584 0.827-0.831		68th/N
1662	<b>1-Pentanethiol</b> Pentane-1-thiol <i>Amyl mercaptan; Pentyl mercaptan; Amyl hydrosulfide; Amyl sulfhydrate</i>	4333 12.191 110-66-7	C5H12S 104.22	Colourless liquid; Meaty aroma	Sparingly soluble in water Soluble	124-126°	NMR MS 97%	1.441-1.450 0.831-0.844		68th/N
1663	<b>Heptane-1-thiol</b> Heptane-1-thiol <i>Heptyl mercaptan</i>	4259 12.130 1639-09-4	C7H16S 132.27	Colourless liquid; Onion aroma	Practically insoluble to insoluble in water Soluble	175-176°	NMR IR MS 98%	1.497-1.503 0.840-0.846		68th/N
1664	<b>2-Heptanethiol</b> Heptane-2-thiol <i>(+/-)-2-Heptanethiol</i>	4128 628-00-2	C7H16S 132.27	Colourless liquid; Pungent, sulfurous odour	Slightly soluble in water Soluble	98-99° (103 mm Hg)	NMR 98%	1.442-1.445 (25°) 0.839-0.844		68th/N
1665	<b>(+/-)-1-Phenylethylmercaptan</b> 1-Phenylethanethiol <i>1-Phenylethylthiol; 1-Phenyl ethanethiol</i>	4061 6263-65-6	C8H10S 138.23	Yellow oily liquid; Meat- like, pungent odour	Insoluble in water Soluble	207-208°	NMR MS 98%	1.579-1.585 1.017-1.021		68th/N
1666	<b>2-Mercaptoanisole</b> 2-Methoxybenzene-1-thiol <i>o-Methoxythiophenol; o-Methoxybenzenethiol; 2-Methoxythiophenol; Thioguaiacol</i>	4159 12.139 7217-59-6	C7H8OS 140.21	Colourless to yellowish liquid; Pungent, onion aroma	Practically insoluble or insoluble in water Soluble	225-228°	MS IR NMR 95%	1.589-1.595 1.137-1.149		68th/N
1667	<b>Propyl 2-mercaptopropionate</b> Propyl 2-mercaptopropionate	4207 19788-50-2	C6H12O2S 148.23	Colourless liquid; Cooked brown and roasted meat aroma	Sparingly soluble in water; soluble in pentane and diethyl ether Soluble	191-194°	NMR IR MS 97%	1.447-1.453 1.014-1.020		68th/N
1668	<b>Methionyl butyrate</b> 3-(Methylthio)propyl butyrate	4160 16630-60-7	C8H16O2S 176.28	Colourless liquid; Cabbage/sewer odour	Practically insoluble to insoluble in water Soluble	232°	IR 99%	1.458-1.463 0.995-1.001		68th/N
1669	<b>(+/-)-4-Mercapto-4-methyl-2-pentanol</b> 4-Mercapto-4-methyl-2-pentanol	4158 12.252 31539-84-1	C6H14OS 134.24	Clear, colourless to pale yellow liquid; Floral, fruity aroma	Soluble in water Soluble	50-51° (1 mm Hg)	NMR 98%	1.463-1.468 1.154-1.158		68th/N



No	Name Chemical name Synonyms	FEMA No Flavis No CAS No	Formula M.W.	Physical form; Odour	Solubility Solubility in ethanol	B.P.	ID test Assay min max	AV	R.I. S.G.	Other requirements/ SC (secondary constituents)	Session
1670	4-Mercapto-2-pentanone 4-Mercapto-2-pentanone 4-Mercaptopentan-2-one	4157 92585-08-5	C5H10OS 118.20	Clear, colourless liquid; Strong, pungent, meaty aroma	Soluble in ether and chloroform; insoluble in water Soluble	258-260°	MS IR NMR 1% see 'Other requirements'	MS IR NMR 95%	NA NA	Product is a 1% solution of 4-mercapto- 2-pentanone, purity 95% min, in acetoin	68th/N
1671	(S)-1-Methoxy-3-heptanethiol (S)-1-Methoxy-3-heptanethiol	4162 400052-49-5	C8H18OS 162.30	Colourless liquid; Sulfureous aroma	Practically insoluble or insoluble in water Soluble	181-183°	IR NMR MS 95%	1.442-1.449 0.901-0.905	1.442-1.449 0.901-0.905		68th/N
1672	Diisopentyl thiomalate Di(3-methylbutyl) but-2(cis)-enebis(thioate) Diisoamyl thiomalate; bis(3-Methylbutyl)mercaptosuccinate	4096 12.108 68084-03-7	C14H26O4S 290.42	Colourless to yellow liquid; Fruity, onion odour	Practically insoluble or insoluble in water Soluble	140-150°	NMR 94%	1.453-1.459 1.006-1.013	1.453-1.459 1.006-1.013	Also contains 2-3% diisopentyl thiotartronate	68th/N
1673	cis- and trans-Mercapto-p- menthan-3-one 1-Mercapto-p-menthan-3-one	4300 12.259 29725-66-4	C10H18OS 186.32	Colourless to pale yellow liquid; Citrus aroma	Insoluble in water Soluble	119-123° (10 mm Hg)	NMR 89%	1.487-1.497 0.989-0.999	1.487-1.497 0.989-0.999	Also contains 8-9% piperitone and 1-2% alpha-terpineol	68th/N
1674	Methyl 3-mercaptoputanoate Methyl 3-mercaptoputanoate	4167 54051-19-3	C5H10O2S 134.20	Colourless liquid; Pungent, onion-like aroma	Sparsingly soluble Soluble	75° (16 mm Hg)	NMR 98%	1.453-1.459 1.053-1.057	1.453-1.459 1.053-1.057		68th/N
1675	Methylthiomethylmercaptan (Methylthio)methanethiol	4185 12.242 29414-47-9	C2H6S2 94.20	Almost colourless liquid; Pungent, sulfurous aroma	Soluble in water Soluble	40° (20 mm Hg)	NMR 97%	1.552-1.556 1.040-1.046	1.552-1.556 1.040-1.046		68th/N
1676	Thioacetic acid Ethanedithioic acid	4210 12.199 507-09-5	C2H4OS 76.12	Pale yellow liquid; Cooked brown and roasted meat aroma	Soluble in water, diethyl ether and acetone Soluble	88-93°	NMR IR MS 96%	1.459-1.466 1.063-1.067	1.459-1.466 1.063-1.067		68th/N
1677	(+/-)-Isobutyl 3-methylthiobutyrate 2-Methylpropyl 3-(methylthio)butanoate Isobutyl 3-(methylthio)butyrate; 2-Methylpropyl 3-(methylthio) butanoate; 2-Methylpropyl 3-(methylthio) butyrate	4150 12.214 127931-21-9	C9H18O2S 190.31	Colourless liquid; Pungent aroma with fruity undertones	Soluble in pentane and diethyl ether; slightly soluble in water Soluble	93-96°	IR NMR MS 97%	1.453-1.469 0.968-0.972	1.453-1.469 0.968-0.972		68th/N
1678	S-Methyl propanethioate S-Methyl propanethioate	4172 12.165	C4H8OS 104.17	Colourless liquid; Fruity, milk-like aroma	Insoluble in water Soluble	119-120°	MS 97%	1.458-1.464 0.990-0.996	1.458-1.464 0.990-0.996	68th/N	

No	Name Chemical name Synonyms	FEMA No Flavis No CAS No 5925-75-7	Formula M.W.	Physical form; Odour	Solubility Solubility in ethanol	B.P.	ID test Assay min max	A.V. max	R.I. S.G.	Other requirements/ SC (secondary constituents)	Session
1679	<b>S-Isopropyl 3-methylbut-2-enethioate</b> S-Isopropyl 3-methylbut-2-enethioate S-Isopropyl thiosenecioate; S-isopropyl 3-methylthiocrotonate	4260 12.134 34365-79-2	C8H14OS 158.26	Colourless to yellowish liquid; Fruity, onion aroma	Practically insoluble to insoluble in water Soluble	235-236°	NMR 95%	1.486-1.492 1.006-1.012			68th/N
1680	<b>S-Ethyl 2-acetylamino ethanethioate</b> S-Ethyl 2-acetylamino ethanethioate N-Acetylthioglycine, S-Ethyl ester; N-Acetylglycin-thiolethyl ester; S-Ethyl 2-acetylamino ethanethiolate	4039 4396-62-7	C6H11NO2S 161.22	Crystalline solid; Pungent meat-like odour	Soluble in diethylether; very slightly soluble in water and hexane Soluble	NA	NMR MS IR 99%	NA NA	NA NA	mp = 60-62°	68th/N
1681	<b>Allyl thiohexanoate</b> Allyl butanethioate Hexanethioic acid, S-2-propenyl ester; 2-(Allylsulfanyl)-1-heptene hydrate	4076 12.275 156420-69-8	C9H16OS 172.29	Clear, colourless liquid; Fruity, sulphurous aroma	Soluble in heptane and triacetin; insoluble in water Soluble	195-196°	NMR MS IR 99%	1.473-1.479 0.930-0.934			68th/N
1683	<b>2-Methyl-1-methylthio-2-butene</b> 2-Methyl-1-methylthio-2-butene	4173 89534-74-7	C6H12S 116.23	Clear, colourless liquid; Cooked brown and roasted meat aroma	Very slightly soluble in water; soluble in non-polar solvents Soluble	78°	NMR MS IR 99%	1.468-1.474 0.859-0.864			68th/N
1684	<b>2,4,6-Trithiaheptane</b> 2,4,6-Trithiaheptane	4214 12.240 6540-86-9	C4H10S3 154.32	Clear, almost colourless liquid; Cooked brown roasted aroma	Soluble in triacetin Soluble	250-255°	NMR IR MS 10%; see 'Other requirements'	NA NA	NA NA	Product is a 10% solution of trithiaheptane, purity 95% min, in triacetin	68th/N
1685	<b>(+/-)-2,8-Epithio-cis-p-menthane</b> 2,8-Epithio-p-menthane 4,7,7-Trimethyl-6-thiabicyclo[3.2.1]octane	4108 12.120 68398-18-5	C10H18S 170.32	Colourless to pale yellow clear liquid; Earthy, citrus aroma with menthol-like undertones	Insoluble in water Soluble	80° (0.9 mm Hg)	MS IR 93%	2	1.513-1.521 0.997-1.001	Also contains 5-6% limonene	68th/N
1686	<b>3,5-Diethyl-1,2,4-trithiolane</b> 3,5-Diethyl-1,2,4-trithiolane isomers)	4030 15.049 54644-28-9	C6H12S3 180.36	Clear, yellow liquid; Powerful, sulfurous aroma	Soluble in heptane and triacetin; insoluble in water Soluble	70-72° (1 mm Hg)	NMR 95% (sum of cis and trans		1.558-1.570 1.147-1.160		68th/N

No	Name Chemical name <i>Synonyms</i>	FEMA No Flavis No CAS No	Formula M.W.	Physical form; Odour	Solubility Solubility in ethanol	B.P.	ID test Assay min max	R.I. S.G.	Other requirements/ SC (secondary constituents)	Session
<b>1687</b>	<b>3,6-Diethyl-1,2,4,5-tetrathiane, mixture with 3,5-diethyl-1,2,4-trithiolane</b> Mixture of 3,6-Diethyl-1,2,4,5-tetrathiane and 3,5-Diethyl-1,2,4-trithiolane	4094 12.274 54717-12-3/ 54644-28-9	C6H12S4/ C6H12S3 212.43/180.36	Clear, colourless liquid; Cooked brown and roasted aroma	Insoluble in water Soluble	64-70° (1 mm Hg)	NMR 1%; see 'Other requirements'	NA NA	Product is a 1% solution of a mixture of the named components, purity 95% min, in vegetable oil	68th/N
<b>1688</b>	<b>3-(Methylthio)-2-butanone</b> 3-(Methylthio)-2-butanone	4181 53475-15-3	C5H10OS 118.20	Colourless to yellow liquid; Pungent odour	Sparingly soluble Soluble	50-54° (20 mm Hg)	NMR IR 97%	1.469-1.471 0.975-0.979		68th/N
<b>1689</b>	<b>4-(Methylthio)-2-pentanone</b> 4-(Methylthio)-2-pentanone	4182 143764-28-7	C6H12OS 132.23	Almost colourless liquid; Pungent odour	Slightly soluble Soluble	181-183°	NMR MS 98%	1.4680-1.4720 0.973-0.979		68th/N
<b>1690</b>	<b>Methyl 3-(methylthio)butanoate</b> Methyl 3-(methylthio)butanoate 3-(Methylthio) butyric acid methyl ester; 3-Methylsulfanyl-butyric acid methyl ester	4166 207983-28-6	C6H12O2S 148.23	Colourless liquid; Sweet, cooked aroma	Insoluble in water Soluble	87° (58 mm Hg)	NMR 98%	1.468-1.474 1.029-1.033		68th/N
<b>1691</b>	<b>Methyl (methylthio)acetate</b> Methyl (methylthio)acetate Methyl 2-(methylthio)acetate; (Methylthio)acetic acid methyl ester	4003 12.146 16630-66-3	C4H8O2S 120.17	Clear, colourless liquid; Fruity, pungent aroma	Soluble in non-polar solvents; insoluble in water Soluble	144-145°	NMR IR MS 98%	1.464-1.466 1.105-1.115 (20°)		68th/N
<b>1692</b>	<b>(+/-)-3-(Methylthio)heptanal</b> 3-(Methylthio)heptanal	4183 12.273 51755-70-5	C8H16OS 160.28	Clear, colourless liquid; Cooked brown and roasted aroma	Insoluble in water; soluble in heptane and triacetin Soluble	95-96°	NMR IR MS 92%	1.469-1.475 0.943-0.947	Also contains 5-7% 2- (E)-heptenal	68th/N
<b>1693</b>	<b>Ethyl methyl disulfide</b> Ethyl methyl disulfide Methyldisulfanyl-ethane; 2,3-Dithiapentane	4040 12.153 20333-39-5	C3H8S2 108.23	Clear, colourless or pale yellow liquid; Sulfurous aroma	Soluble in non-polar solvents; Insoluble in water Soluble	136-138°	NMR MS IR 80%	1.410-1.418 1.017-1.027 (20°)	Also contains 7-8% diethyl disulfide and 8- 10% dimethyl disulfide	68th/N
<b>1694</b>	<b>Ethyl propyl disulfide</b> Ethyl propyl disulfide 1-Ethyl disulfanyl-propane; 3,4-Dithiaheptane	4041 12.126 30453-31-7	C5H12S2 136.28	Clear, colourless or pale yellow liquid; Sulfurous aroma	Soluble in non-polar solvents; insoluble in water Soluble	179-181°	NMR MS IR 95%	1.483-1.493 0.943-0.953		68th/N

No	Name Chemical name Synonyms	FEMA No Flavis No CAS No	Formula M.W.	Physical form; Odour	Solubility Solubility in ethanol	B.P.	ID test Assay min max	A.V. max	R.I. S.G.	Other requirements/ SC (secondary constituents)	Session
<b>1695</b>	<b>Ethyl propyl trisulfide</b> Ethyl propyl trisulfide 3,4,5-Trithianonane	4042 12.256 31499-70-4	C5H12S3 168.35	Clear, pale yellow liquid; Spicy, herb-like aroma	Soluble in non-polar solvents; insoluble in water Soluble	234-237°	NMR MS IR 98% (sum of three components)	1.544-1.559 1.071-1.083 (20°)		Contains 48-50% ethyl propyl trisulfide, 20- 30% diethyl trisulfide and 20-30% dipropyl trisulfide	68th/N
<b>1696</b>	<b>Methyl isopentyl disulfide</b> Methyl 3-methylbutyl disulfide	4168 72437-56-0	C6H14S2 150.31	Colourless to yellow liquid; Brown, roasted aroma	Sparingly soluble in water Soluble	183-185°	NMR 92%	1.516-1.522 0.943-0.948		Also contains 3-5% crotonic acid	68th/N
<b>1697</b>	<b>Amyl methyl disulfide</b> Pentyl methyl disulfide 1-Methyldisulfanyl-pentane; 2,3-Dithiaoctane	4025 12.253 72437-68-4	C6H14S2 150.31	Clear, pale yellow liquid; Sulfureous aroma	Soluble in non-polar solvents; insoluble in water Soluble	198-202°	NMR MS IR 97%	1.485-1.495 0.943-0.953 (20°)			68th/N
<b>1698</b>	<b>Butyl ethyl disulfide</b> Butyl ethyl disulfide 1-Ethyl-disulfanyl-butane; 3,4-Dithiaoctane	4027 12.254 63986-03-8	C6H14S2 150.31	Clear, colourless or pale yellow liquid; Sulfureous aroma	Soluble in non-polar solvents; insoluble in water Soluble	198-202°	NMR MS IR 90%	1.492-1.502 0.954-0.964 (20°)		Also contains 2-3% diethyl disulfide and 5- 6% dibutyl disulfide	68th/N
<b>1699</b>	<b>Diethyl disulfide</b> Diethyl disulfide 3,4-Dithiahexane; Ethyl disulfide	4093 12.012 110-81-6	C4H10S2 122.26	Colourless to yellowish liquid; Onion/cabbage odour	Practically insoluble to insoluble in water Soluble	151-152°	MS IR 99%	1.502-1.508 0.990-0.996			68th/N
<b>1700</b>	<b>Allyl propyl disulfide</b> Allyl propyl disulfide 4,5-Dithia-1-octene; Propyl allyl disulfide	4073 12.021 2179-59-1	C6H12S2 148.29	Colourless to yellowish liquid; Fruity, garlic odour	Practically insoluble to insoluble in water Soluble	66° (10 mm Hg)	NMR 93%	1.497-1.517 0.999-1.005		Also contains 1-2% allyl propyl sulfide and 1-2% dipropylsulfide	68th/N
<b>1701</b>	<b>Diethyl trisulfide</b> Diethyl trisulfide 3,4,5-Trithiaheptane	4029 12.114 3600-24-6	C4H10S3 154.32	Clear, colourless or pale yellow liquid; Powerful sulfureous aroma	Soluble in non-polar solvents; insoluble in water Soluble	216-218°	NMR MS 95%	1.556-1.560 1.121-1.231 (20°)			68th/N
<b>1702</b>	<b>Propyl propane thiosulfonate</b> Propyl propane thiosulfonate	4263 1113-13-9	C6H14O2S2 182.31	Colourless to yellow liquid; Cooked brown roasted aroma	Sparingly soluble in water; moderately soluble in pentane; soluble in toluene Moderately soluble	113° (1-2 mm Hg)	NMR MS IR 95%	1.481-1.488 1.119-1.123			68th/N

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1703	(+/-)-3-(Ethylthio)butanol 3-(Ethylthio)butanol	4282 117013-33-9	C6H14OS 134.24	Pale yellow to colourless liquid; Cooked brown roasted nutty aroma	Insoluble in water; slightly soluble in heptane and triacetin Slightly soluble	79-81° (1 mm Hg)	NMR IR MS 96%	1.468-1.476 0.941-0.947			68th/N
1704	Hexyl 3-mercaptobutanoate Hexyl 3-mercaptobutanoate 3-Mercaptobutanoic acid hexyl ester; Hexyl 3-mercaptobutyrate	4136 796857-79-9	C10H20O2S 204.33	Almost colourless liquid; Fruit/spice/herb aroma	Sparingly soluble in water; soluble in triacetin and propylene glycol Soluble	82° (2 mm Hg)	NMR 98%	1.462-1.463 0.949-0.954			68th/N
1705	(+/-)-3-Mercapto-1-butyl acetate 3-Mercapto-1-butyl acetate 3-Mercaptobutyl acetate; 3-Thiobutyl acetate	4325 89534-38-3	C6H12O2S 148.23	Clear, colourless liquid; Fruit aroma	Slightly soluble in water; soluble in many non-polar solvents Soluble	77° (10 mm Hg)	NMR 95%	1.458-1.459 1.025-1.029			68th/N
1706	3-Mercapto-3-methyl-1-butyl acetate 3-Mercapto-3-methylbutyl acetate 3-Methyl-3-sulfanylbuthyl acetate	4324 50746-09-3	C7H14O2S 162.25	Clear, colourless liquid; Fruit aroma	Slightly soluble in water; soluble in many non-polar solvents Soluble	69° (6 mm Hg)	NMR 95%	1.455-1.456 1.003-1.007			68th/N
1707	2,5-Dithiahexane 2,5-Dithiahexane 1,2-bis(Methylthio)ethane; 1,2-bis(Methylmercapto)ethane	4298 6628-18-8	C4H10S2 122.26	Clear, colourless or pale yellow liquid; Dairy aroma with sulfurous note	Insoluble in water; soluble in non-polar solvents Soluble	178-179°	NMR 99%	1.526-1.533 1.039-1.049			68th/N
1708	3-Mercaptoheptyl acetate 3-Mercaptoheptyl acetate	4289 548774-80-7	C9H18O2S 190.31	Colourless liquid; Sulfury, fruity aroma	Soluble in water and in fats Soluble	242°	NMR MS IR 99%	1.457-1.463 0.980-0.984			68th/N
1709	bis(1-Mercaptopropyl)sulfide bis(1-Mercaptopropyl)sulfide	4297 53897-60-2	C6H14S3 182.38	Liquid; Sulphury odour	Slightly soluble in water; soluble in many non-polar solvents Soluble	225-226° (76 mm Hg)	NMR IR 92% (sum of two components) See 'Other requirements'	1.545-1.551 1.080-1.084		Contains 56% min bis(1- mercapto)propyl)sulfide, 36% min 3,5-diethyl- 1,2,4-trithiolane; contains approx. 5% dipropylsulfide	68th/N

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1710	<b>S-Allyl-L-cysteine</b> S-Allyl-L-cysteine (2R)-2-Amino-3-(prop-2-en-1-ylsulfanyl) propanoic acid; (2R)-3-(Allylthio)-2-aminopropanoic acid; (R)-Allylthio-2-aminopropionic acid; S-Allylcysteine; (+)-S-Allylcysteine; S-2-Propenylcysteine	4322 21593-77-1	C6H11NO2S 161.22	White powder; Cooked roasted brown aroma	Sparingly soluble in water Slightly soluble	NA	NMR MS IR 95%	NA NA	NA NA	mp = 214-216°	68th/N
1711	<b>2,4-Dimethyl-1,3-dioxolane</b> 2,4-Dimethyl-1,3-dioxolane Acetaldehyde cyclic propylene acetal; Propylene acetal	4099 3390-12-3	C5H10O2 102.13	Colourless liquid; Dairy aroma with fruity overtones	Slightly soluble in water Soluble	100-101°	NMR 95%	1 0.921-0.928	1.390-1.401 0.921-0.928		68th/N
1712	<b>2-Hexyl-4,5-dimethyl-1,3-dioxolane</b> 2-Hexyl-4,5-dimethyl-1,3-dioxolane Heptanal 2,3-butanediol acetal	4048 06.089 6454-22-4	C11H22O2 186.29	Clear, colourless liquid; Dairy aroma with fruity overtones	Soluble in non-polar solvents Soluble	101° (9 mm Hg)	NMR MS IR 96%	1 0.876-0.886	1.425-1.430 0.876-0.886		68th/N
1715	<b>cis- and trans-Ethyl 2,4-dimethyl-1,3-dioxolane-2-acetate</b> Ethyl 2,4-dimethyl-1,3-dioxolane-2-acetate	4294 06.087 6290-17-1	C9H16O4 188.22	Colourless liquid; Soft, fruity notes	Insoluble in water Soluble	85°	IR 95%	1 1.422-1.432 1.048-1.054	1.422-1.432 1.048-1.054		68th/N
1716	<b>Dihydroxyacetone dimer</b> 2,5-Dihydroxy-1,4-dioxane-2,5-dimethanol	4033 62147-49-3	C6H12O6 180.16	Hygroscopic, crystalline, white to off-white powder, Sweet, cooling, aroma	Slightly soluble in water Soluble	NA	NMR MS 97%	NA NA	NA NA	mp = 75-80°	68th/N
1717	<b>1-Hydroxy-2-butanone</b> 1-Hydroxybutan-2-one 2-Oxo-1-butanol; Propionyl carbinol; Ethyl hydroxymethyl ketone; 1-Butanol-2-one	3173 07.090 5077-67-8	C4H8O2 88.11	Colourless liquid; Fruity aroma	Insoluble in water; soluble in diethyl ether Soluble	152-154°	MS 90%		1.417-1.423 1.017-1.022 (20°)	Also contains 5-10% acetoin	68th/N
1718	<b>Ethyl 3-acetoxy-2-methylbutyrate</b> Ethyl 3-acetoxy-2-methylbutyrate 3-Acetoxy-2-methyl butyric acid ethyl ester	4038 09.919 139564-43-5	C9H16O4 188.22	Clear, colourless liquid; Fruity aroma	Soluble in non-polar solvents; insoluble in water Soluble	205-206°	NMR MS IR 95%		1.417-1.420 1.003-1.013		68th/N

No	Name Chemical name Synonyms	FEMA No Flavis No CAS No	Formula M.W.	Physical form; Odour	Solubility Solubility in ethanol	B.P.	ID test Assay min	A.V. max	R.I. S.G.	Other requirements/ SC (secondary constituents)	Session
1719	<b>Methyl 5-acetoxyhexanoate</b> Methyl 5-acetoxyhexanoate 5-Acetoxyhexanoic acid methyl ester	4055 09.632 35234-22-1	C9H16O4 188.22	Clear, colourless liquid; Fruity aroma	Soluble in non-polar solvents; insoluble in water Soluble	194-196°	NMR MS IR 97%		1.519-1.529 1.017-1.027		68th/N
1726	<b>(+/-)-1-Acetoxy-1-ethoxyethane</b> 1-Acetoxy-1-ethoxyethane Ethoxyethyl acetate	4069 1608-72-6	C6H12O3 132.16	Clear, colourless liquid; Refreshing, fruity aroma	Soluble in water Soluble	136-138°	MS NMR 95%		1.386-1.392 0.947-0.951		68th/N
1727	<b>Acetaldehyde hexyl isoamyl acetal</b> 1-Hexyloxy-1-(3-methylbutyloxy)propane	4365 06.114 233665-90-2	C13H28O2 216.36	Colourless liquid; Sweet, fruity aroma	Insoluble in water; soluble in organic solvents Soluble	240-241°	MS 97% (sum of three components)		1.418-1.423 0.833-0.838	Contains acetaldehyde hexyl isoamyl acetal (51-53%), acetaldehyde dihexyl acetal (26-28%) and acetaldehyde diisoamyl acetal (17-19%)	68th/N
1728	<b>1,1-Dimethoxy-trans-2-hexene</b> 1,1-Dimethoxyhex-2(E)-ene trans-2-Hexenal dimethyl acetal	4098 06.072 18318-83-7	C8H16O2 144.21	Colourless liquid; Green fruity aroma	Practically insoluble to insoluble in water Soluble	158°	NMR 95%		1.420-1.424 0.867-0.871		68th/N
1729	<b>Acetaldehyde diisoamyl acetal</b> 1,1-Di(3-methylbutoxy)ethane 3-Methyl-1-[1-(3-methyl-butoxy)- ethoxy]-butane; 1,1-Di-isopentyloxyethane	4024 06.055 13002-09-0	C12H26O2 202.34	Clear, colourless liquid; Strong, sweet, fruity aroma	Soluble in non-polar solvents; insoluble in water Soluble	70° (2.5 mm Hg)	NMR MS IR 95%	1	1.410-1.420 0.822-0.832		68th/N
1730	<b>Isovaleraldehyde diethyl acetal</b> 1,1-Diethoxy-3-methylbutane 1,1-Diethoxyisopentane; 3-Methylbutanal diethyl acetal	4371 06.059 3842-03-3	C9H20O2 160.26	Clear, colourless liquid; Fruity, fatty aroma	Insoluble in water; soluble in organic solvents Soluble	159-162°	NMR MS IR 95%		1.395-1.403 0.825-0.832		68th/N
1731	<b>Valeraldehyde dibutyl acetal</b> 1,1-Dibutoxypentane	4375 13112-65-7	C13H28O2 216.36	Clear, colourless liquid; Sweet, nutty aroma	Insoluble in water; soluble in organic solvents Soluble	251-252°	MS 97%		1.417-1.423 0.833-0.839		68th/N
1732	<b>Isovaleraldehyde propyleneglycol acetal</b> 2-Isobutyl-4-methyl-1,3-dioxolane 4-Methyl-2-(2-methylpropyl)-1,3-dioxolane	4286 18433-93-7	C8H16O2 144.21	Clear, colourless liquid; Fruity, slightly fatty aroma	Insoluble in water; soluble in organic solvents Soluble	164-165°	NMR MS IR 95%	1	1.412-1.420 0.895-0.902		68th/N



No	Name Chemical name <i>Synonyms</i>	FEEMA No Flavis No CAS No	Formula M.W.	Physical form; Odour	Solubility Solubility in ethanol	B.P.	ID test Assay min max	A.V. max	R.I. S.G.	Other requirements/ SC (secondary constituents)	Session
1733	<b>Isovaleraldehyde glyceryl acetal</b> 4-Hydroxymethyl-2-(2-methylpropyl)- 1,3-dioxolane and 5-Hydroxy-2-(2- methylpropyl)-1,3-dioxane	4380 54355-74-7	C8H16O3 160.21	Clear, colourless liquid; Fruity, fatty aroma	Insoluble in water; soluble in organic solvents Soluble	238-239°	NMR MS IR 98% (sum of two components)	1	1.443-1.450 1.024-1.031	Contains 67-69% 4- Hydroxymethyl-2-(2- methylpropyl)-1,3- dioxolane and 28-30% 5-Hydroxy-2-(2- methylpropyl)- 1,3-dioxane	68th/N
1734	<b>Valeraldehyde propyleneglycol acetal</b> 2-Butyl-4-methyl-1,3-dioxolane	4372 74094-60-3	C8H16O2 144.21	Clear, colourless liquid; Nutty, fatty aroma	Insoluble in water; soluble in organic solvents Soluble	176-177°	MS 98%	1	1.415-1.420 0.900-0.906		68th/N
1735	<b>Hexanal hexyl isoamyl acetal</b> 1-Hexyloxy-1-(3-methylbutyl)oxyhexane	4369 896447-13-5	C17H36O2 272.47	Clear, colourless liquid; Sweet, green aroma	Insoluble in water; soluble in organic solvents Soluble	305-306°	NMR MS IR 97% (sum of three components)	1	1.427-1.432 0.835-0.840	Contains hexanal hexyl isoamyl acetal (50- 52%), hexanal dihexyl acetal (25-27%) and hexanal diisoamyl acetal (20-22%)	68th/N
1736	<b>Hexanal octane-1,3-diol acetal</b> 2,4-Dipentyl-1,3-dioxane	4377 202188-46-3	C14H28O2 228.38	Clear, colourless liquid; Fatty, green aroma	Insoluble in water; soluble in organic solvents Soluble	287-288°	MS 96%	1	1.425-1.432 0.869-0.875		68th/N
1737	<b>Hexanal butane-2,3-diol acetal</b> 4,5-Dimethyl-2-pentyl-1,3-dioxolane	4384 155639-75-1	C10H20O2 172.27	Clear, colourless liquid; Sweet, fatty, green aroma	Insoluble in water; soluble in organic solvents Soluble	211-213°	MS 98%	1	1.430-1.437 0.845-0.851		68th/N
1738	<b>Hexanal dihexyl acetal</b> 1,1-bis(Hexyloxy)hexane	4370 33673-65-3	C18H38O2 286.50	Clear, colourless liquid; Mild, green, grassy aroma	Insoluble in water; soluble in organic solvents Soluble	326-327°	NMR MS 95%	1	1.431-1.436 0.838-0.844		68th/N
1739	<b>Heptanal propyleneglycol acetal</b> 2-Hexyl-4-methyl-1,3-dioxolane <i>Heptanal, cyclic propylene acetal</i>	4368 4351-10-4	C10H20O2 172.27	Clear, colourless liquid; Green, fatty aroma	Insoluble in water; soluble in organic solvents Soluble	217-218°	MS 98%	1	1.425-1.430 0.889-0.895		68th/N
1740	<b>2,6-Dimethyl-5-heptenal propyleneglycol acetal</b> 2-(1,5-Dimethyl-4-hexenyl)-4-methyl- 1,3-dioxolane	4382 74094-63-6	C12H22O2 198.31	Clear, colourless liquid; Strong, green, citrusy aroma	Insoluble in water; soluble in organic solvents Soluble	243-244°	MS 97%	1	1.447-1.453 0.910-0.916		68th/N



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1741	<b>Octanal propyleneglycol acetal</b> 2-Heptyl-4-methyl-1,3-dioxolane	4383 74094-61-4	C11H22O2 186.29	Clear, colourless liquid; Green, woody aroma	Insoluble in water; soluble in organic solvents Soluble	236-237°	NMR MS IR 97%	1	1.427-1.434 0.886-0.893		68th/N
1742	<b>Nonanal dimethyl acetal</b> 1,1-Dimethoxynonane <i>Pelargonaldehyde dimethyl acetal</i> ; <i>Pelargonic aldehyde dimethyl acetal</i>	4367 18824-63-0	C11H24O2 188.31	Clear, colourless liquid; Fresh, fruity aroma	Insoluble in water; soluble in organic solvents Soluble	214-215°	MS 98%	1	1.418-1.424 0.847-0.853		68th/N
1743	<b>Nonanal propyleneglycol acetal</b> 4-Methyl-2-octyl-1,3-dioxolane 2-Octyl-4-methyl-1,3-dioxolane	4373 68391-39-9	C12H24O2 200.32	Clear, colourless liquid; Fruity aroma	Insoluble in water; soluble in organic solvents Soluble	253-254°	NMR MS IR 98%	1	1.430-1.436 0.884-0.889		68th/N
1744	<b>Decanal propyleneglycol acetal</b> 4-Methyl-2-nonyl-1,3-dioxolane 2-Nonyl-4-methyl-1,3-dioxolane	4364 5421-12-5	C13H26O2 214.35	Clear, colourless liquid; Green, floral aroma	Insoluble in water; soluble in organic solvents Soluble	270-271°	NMR MS IR 98%	1	1.433-1.439 0.881-0.887		68th/N
1745	<b>Undecanal propyleneglycol acetal</b> 2-Decyl-4-methyl-1,3-dioxolane	4374 74094-62-5	C14H28O2 228.38	Clear, colourless liquid; Sweet, fatty, floral aroma	Insoluble in water; soluble in organic solvents Soluble	286-287°	MS 95%	1	1.435-1.441 0.879-0.885		68th/N
1746	<b>Dodecanal dimethyl acetal</b> 1,1-Dimethoxydodecane 1,1'-bis(Methoxy)dodecane; <i>Dodecanal dimethyl acetal</i> ; <i>Lauryl aldehyde dimethyl acetal</i>	4366 14620-52-1	C14H30O2 230.39	Clear, colourless liquid; Fatty, citrus-like aroma	Insoluble in water; soluble in organic solvents Soluble	268-269°	MS 98%	1	1.428-1.434 0.847-0.853		68th/N
1747	<b>Acetaldehyde di-cis-3-hexenyl acetal</b> 1,1-bis[3(Z)-Hexenyloxy]propane	4381 63449-64-9	C14H26O2 226.36	Clear, colourless liquid; Strong, green, herbaceous aroma	Insoluble in water; soluble in organic solvents Soluble	278-279°	NMR MS 96%	1	1.442-1.448 0.864-0.870		68th/N
1748	<b>Isobutanol propyleneglycol acetal</b> 2-Isopropyl-4-methyl-1,3-dioxolane 4-Methyl-2-(1-methylethyl)-1,3-dioxolane	4287 67879-60-1	C7H14O2 130.19	Clear, colourless liquid; Penetrating, winery aroma	Insoluble in water; soluble in organic solvents Soluble	142-143°	NMR MS IR 96%	1	1.407-1.412 0.903-0.909		68th/N
1749	<b>Acetaldehyde 1,3-octanediol acetal</b> 2-Methyl-4-pentyl-1,3-dioxane	4376 202188-43-0	C10H20O2 172.27	Clear, colourless liquid; Green, ethereal aroma	Insoluble in water; soluble in organic solvents Soluble	219-220°	MS 96%	1	1.429-1.433 0.900-0.906		68th/N

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1750	1-(3-Hydroxy-5-methyl-2-thienyl)ethanone 1-(3-Hydroxy-5-methyl-2-thienyl)ethanone	4142 15,127 133860-42-1	C7H8O2S 156.21	White, cream-coloured solid; Meaty, cooked, brown or roasted aroma	Slightly soluble in water Soluble	NA	NMR 98%		NA NA	mp = 73-75°	68th/N
1751	2-(5-Methyl-4-thiazolyl)ethyl formate 2-(5-Methyl-4-thiazolyl)ethyl formate	4275 90731-56-9	C7H9NO2S 171.22	Colourless to yellow liquid; Nutty, brown, roasted aroma	Soluble in non-polar solvents; slightly soluble in water Soluble	155-156°	NMR MS 95%	2	1.518-1.524 1.215-1.221		68th/N
1752	2-(4-Methyl-5-thiazolyl)ethyl propionate 2-(4-Methyl-5-thiazolyl)ethyl propionate	4276 324742-96-3	C9H13NO2S 199.27	Colourless to yellow liquid; Roasted, nutty aroma	Soluble in non-polar solvents; insoluble in water Soluble	99-105° (1 mm Hg)	NMR 98%	1	1.502-1.506 1.136-1.140		68th/N
1753	2-(4-Methyl-5-thiazolyl)ethyl butanoate 2-(4-Methyl-5-thiazolyl)ethyl butanoate	4277 94159-31-6	C10H15NO2S 213.30	Colourless to yellow liquid; Roasted, nutty aroma	Soluble in non-polar solvents; insoluble in water Soluble	101-107° (1 mm Hg)	NMR 98%	1	1.496-1.510 1.106-1.112		68th/N
1754	2-(4-Methyl-5-thiazolyl)ethyl isobutyrate 2-(4-Methyl-5-thiazolyl)ethyl isobutyrate	4278 324742-95-2	C10H15NO2S 213.30	Colourless to yellow liquid; Roasted nutty aroma	Soluble in non-polar solvents; slightly soluble in water Soluble	100-104° (2 mm Hg)	NMR 98%	1	1.494-1.500 1.102-1.108		68th/N
1755	2-(4-Methyl-5-thiazolyl)ethyl hexanoate 2-(4-Methyl-5-thiazolyl)ethyl hexanoate	4279 94159-32-7	C12H19NO2S 241.35	Colourless to yellow liquid; Roasted, nutty aroma	Soluble in non-polar solvents; Slightly soluble in water Soluble	143-145° (2 mm Hg)	NMR 98%	1	1.492-1.497 1.065-1.071		68th/N
1756	2-(4-Methyl-5-thiazolyl)ethyl octanoate 2-(4-Methyl-5-thiazolyl)ethyl octanoate	4280 163266-17-9	C14H23NO2S 269.41	Colourless to yellow liquid; Roasted, nutty aroma	Soluble in non-polar solvents; insoluble in water Soluble	154-156° (2 mm Hg)	NMR 98%	1	1.498-1.494 1.036-1.042		68th/N

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1757	2-(4-Methyl-5-thiazolyl)ethyl decanoate 2-(4-Methyl-5-thiazolyl)ethyl decanoate	4281 101426-31-7	C16H27NO2S 297.46	Colourless to yellow liquid; Roasted, nutty aroma	Soluble in non-polar solvents; insoluble in water Soluble	177-179° (1.5 mm Hg)	NMR 95%	1 1.486-1.492 1.012-1.018			68th/N
1758	2,5-Dimethylthiazole 2,5-Dimethylthiazole	4035 15,063 4175-66-0	C5H7NS 113.18	Yellow liquid; Cooked, brown and roasted nutty aroma	Soluble in non-polar solvents; slightly soluble in water Soluble	148-150°	NMR MS IR 95%		1.523-1.527 1.114-1.124 (20°)		68th/N
1759	2-Acetyl-2-thiazoline 2-Acetyl-2-thiazoline Acetyl thiazoline-2; 2-Acetyl-4,5-dihydrothiazole	3817 15,010 29926-41-8	C5H7NOS 129.18	Brown solid; Green, onion, herbal, grassy aroma	Insoluble in water and heptane Soluble	NA	NMR MS IR 98%		NA NA	mp = 26-28°	68th/N
1760	2-Propionyl-2-thiazoline 2-Propionyl-2-thiazoline 1-(4,5-Dihydro-1,3-thiazol-2-yl)-1- propanone	4064 15,128 29926-42-9	C6H9NOS 143.21	Colourless to light yellow liquid; Meaty, nutty, cooked, brown roasted aroma	Soluble in heptane; insoluble in water Soluble	237-241°	NMR MS IR 99%		1.514-1.517 1.230-1.245		68th/N
1761	cis- and trans-5-Ethyl-4- methyl-2-(2-methylpropyl)-thiazoline 5-Ethyl-4-methyl-2-(2-methylpropyl)- thiazoline 5-Ethyl-2,5-dihydro-4-methyl-2-(2- methylpropyl)-thiazole; 2-Isobutyl-4- methyl-5-ethylthiazoline	4319 83418-53-5	C10H19NS 185.33	Yellow liquid; Meaty, nutty, cooked, brown roasted aroma	Soluble in water Soluble	252-253°	NMR MS 96%		1.483-1.489 0.942-0.947		68th/N
1762	cis- and trans-5-Ethyl-4- methyl-2-(1-methylpropyl)-thiazoline 5-Ethyl-4-methyl-2-(1-methylpropyl)- thiazoline 5-Ethyl-2,5-dihydro-4-methyl-2-(1- methylpropyl)-thiazole	4318 83418-54-6	C10H19NS 185.33	Yellow liquid; Meaty, nutty, cooked, brown roasted aroma	Soluble in water Soluble	253°	NMR MS 97%		1.487-1.493 0.950-0.956		68th/N

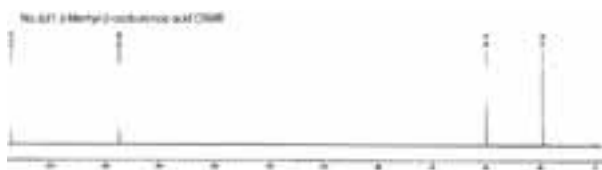
No	Name Chemical name Synonyms	FEMA No Flavis No CAS No	Formula M.W.	Physical form; Odour	Solubility Solubility in ethanol	B.P.	ID test Assay min max	A.V. max	R.I. S.G.	Other requirements/ SC (secondary constituents)	Session
1763	<b>Pyrrolidino-[1,2e]-4H-2,4-dimethyl-1,3,5-dithiazine</b> 2,4-Dimethyl-1-aza-3,5-dithiabicyclo[4.3.0]nonane 2,4-Dimethyltetrahydropyrrolo[2,1-d][1,3,5]-dithiazine; 2,4-Dimethyl(4H)pyrrolidino[1,2e]-1,3,5-dithiazine	4321 116505-60-3	C8H15NS2 189.35	Crystalline solid; Meaty, cooked, brown roasted aroma	Practically insoluble or insoluble in water; soluble in pentane and diethyl ether Soluble	NA	NMR MS IR 96%		NA NA	mp > 50°	68th/N
1764	<b>2-Hexylthiophene</b> 2-Hexylthiophene	4137 15.076 18794-77-9	C10H16S 168.30	Colourless to pale yellow liquid; Meat-like aroma	Soluble in most organic solvents; Insoluble in water Soluble	229-230°	MS 99%		1.492-1.498 0.930-0.938 (20°)		68th/N
1765	<b>3-(Methylthio)methylthiophene</b> 3-(Methylthio)methylthiophene	4184 15.126 61675-72-7	C6H8S2 144.26	Clear, colourless liquid; Cooked, brown and roasted dairy aroma	Soluble in most organic solvents; insoluble in water Soluble	210-211°	NMR IR MS 97%		1.580-1.585 1.522-1.525		68th/N
1766	<b>5-Acetyl-2,3-dihydro-1,4-thiazine</b> 5-Acetyl-2,3-dihydro-1,4-thiazine	4296 143.21 164524-93-0	C6H9NOS 143.21	Brown crystals; Nutty, cooked, brown and roasted aroma	Insoluble in water; soluble in methylene chloride Slightly soluble	NA	NMR 99%		NA NA	mp = 120-125°	68th/N
1767	<b>N-Heptan-4-yl)benzo[d][1,3]dioxole-5-carboxamide</b> N-(1-Propylbutyl)-1,3-benzodioxole-5-carboxamide	4232 745047-51-2	C15H21NO3 263.34	Off-white powder; Savoury, meat-like aroma	Soluble in non-polar organic solvents; insoluble in water Sparingly soluble	NA	NMR IR MS 99%		NA NA	mp = 116-117°	68th/N
1768	<b>N1-(2,4-Dimethoxybenzyl)-N2-(2-(pyridin-2-yl)ethyl)oxalamide</b> N-[(2,4-Dimethoxyphenyl)methyl]-N'-[2-(pyridinyl)ethyl]ethanediamide	4233 745047-53-4	C18H21N3O4 343.38	Off-white powder; Savoury, meat-like aroma	Soluble in non-polar organic solvents; insoluble in water Sparingly soluble	NA	NMR IR MS 99%		NA NA	mp = 123-124°	68th/N
1769	<b>N1-(2-Methoxy-4-methylbenzyl)-N2-(2-(5-methylpyridin-2-yl)ethyl)oxalamide</b> N-[(2-Methoxy-4-methylphenyl)methyl]-N'-[2-(5-methyl-2-pyridinyl)ethyl]ethanediamide	4234 745047-94-3	C19H23N3 O3 341.41	Off-white powder; Savoury, meat-like aroma	Soluble in non-polar organic solvents; insoluble in water Sparingly soluble	NA	NMR IR MS 99%		NA NA	mp = 132-133°	68th/N

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1770	<b>N1-(2-Methoxy-4-methylbenzyl)-N2-(2-(pyridin-2-yl)ethyl)oxalamide</b> N-[(2-Methoxy-4-methylphenyl)methyl]-N'-[2-(pyridinyl)ethyl]ethanediamide	4231 745047-97-6	C18H21N3O3 327.38	Off-white powder; Savoury, meat-like aroma	Soluble in non-polar organic solvents; insoluble in water Sparingly soluble	NA	NMR IR 99%	NA NA	mp = 128-129°	68th/N
1771	<b>4-Aminobutyric acid</b> 4-Aminobutyric acid	4288 17.055 56-12-2	C4H9NO2 103.12	White, powdery solid; Savoury, meat-like aroma	Slightly soluble in water; soluble in many non-polar solvents Insoluble	NA	NMR MS IR 99%	NA NA	mp = 200-202°	68th/N
1772	<b>N-Gluconyl ethanolamine</b> N-(2-Hydroxyethyl)galactonamide	4254 686298-93-1	C8H17NO7 239.23	White, crystalline powder; Cooked brown and roasted aroma	Very soluble in water; insoluble in pentane Slightly soluble	NA	NMR MS IR 99%	NA NA	mp = 99-100°	68th/N
1773	<b>N-Gluconyl ethanolamine phosphate</b> N-[2-(Phosphonoxy)ethyl]galactonamide	4255 791807-20-0	C8H18NO10P 319.21	White, crystalline powder; Cooked brown and roasted aroma	Very soluble in water; insoluble in pentane Slightly soluble	NA	NMR MS 95%	NA NA	mp = 138-139°	68th/N
1774	<b>N-Lactoyl ethanolamine</b> 2-Hydroxy-N-(2-hydroxyethyl)propanamide	4256 5422-34-4	C5H11NO3 133.15	Viscous, brownish liquid; Cooked brown roasted aroma	Very soluble in water; insoluble in pentane and diethyl ether Slightly soluble	372-380°	NMR IR MS 90%	1.475-1.481 1.182-1.186	Also contains 6-8% 2-aminoethanol lactate	68th/N
1775	<b>N-Lactoyl ethanolamine phosphate</b> 2-Hydroxy-N-[2-(phosphonoxy)ethyl]propanamide	4257 782498-03-7	C5H12NO6P 213.13	Viscous, oily liquid; Cooked brown and roasted aroma	Very soluble in water; insoluble in pentane Slightly soluble	387-400°	NMR IR MS 90%	1.498-1.514 1.517-1.524	Also contains 6-10% ammonium formate	68th/N
1776	<b>N-[(Ethoxycarbonyl)methyl]-p-menthane-3-carboxamide</b> N-[(Ethoxycarbonyl)methyl]-p-menthane-3-carboxamide [1R-(1alpha,2beta,5alpha)]-N-[5-Methyl-2-(1-methylethyl)cyclohexyl]carbonyl glycine ethyl ester	4309 68489-14-5	C15H27NO3 269.38	White crystals or powder; Cool menthol aroma	Practically insoluble or insoluble in water; slightly soluble in heptane; very slightly soluble in propylene glycol and ethyl acetate Soluble	151° (2 mm Hg)	NMR IR MS 99%	NA NA	mp = 80-82°	68th/N

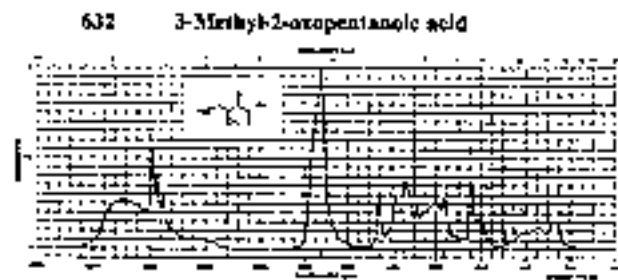
No	Name Chemical name Synonyms	FEMA No Flavis No CAS No	Formula M.W.	Physical form; Odour	Solubility Solubility in ethanol	B.P.	ID test Assay min max	A.V. max	R.I. S.G.	Other requirements/ SC (secondary constituents)	Session
1777	<b>N-[2-(3,4-Dimethoxyphenyl)ethyl]-3,4-dimethoxycinnamic acid amide</b> N-[2-(3,4-Dimethoxyphenyl)ethyl]-3,4-dimethoxycinnamic acid amide 2-Propenamide, 3-(3,4-dimethoxyphenyl)-N-[2-(3,4-dimethoxyphenyl)ethyl]-; Rubenamin	4310 16.090 69444-90-2	C21H25NO5 371.43	Solid; Savoury, meat-like aroma	Insoluble in water; soluble in non-polar solvents Insoluble	NA	NMR IR MS 99%		NA NA	mp = 128°	68th/N
1779	<b>N-3,7-Dimethyl-2,6-octadienyl cyclopropylcarboxamide</b> N-[(2E)-3,7-Dimethyl-2,6-octadienyl]-cyclopropanecarboxamide	4267 744251-93-2	C14H23NO 221.34	Colourless to pale yellow solid; Cooked brown and roasted meaty aroma	Sparingly soluble in water; very soluble in non-polar organic solvents Sparingly soluble	NA	IR NMR 98%		NA NA	mp = 53-57°	68th/N
1780	<b>2,4-Hexadienyl acetate</b> Hexa-2,4-dienyl acetate Sorbyl acetate	4132 09.573 1516-17-2	C8H12O2 140.18	Colourless liquid; Powerful, sweet, pineapple aroma	Practically insoluble or insoluble in water Soluble	100° (20 mm Hg)	NMR 98%		1.470-1.476 0.928-0.932		68th/N
1781	<b>2,4-Hexadienyl propionate</b> Hexa-2,4-dienyl propionate Sorbyl propionate	4131 16491-25-1	C9H14O2 154.21	Colourless liquid; Sweet, fruity, pineapple, wine-like aroma	Practically insoluble or insoluble in water Soluble	75° (15 mm Hg)	NMR 98%		1.453-1.459 0.918-0.922		68th/N
1782	<b>2,4-Hexadienyl isobutyrate</b> Hexa-2,4-dienyl isobutyrate Sorbyl isobutyrate	4134 16491-24-0	C10H16O2 168.24	Light yellow liquid; Sweet, pineapple aroma with cinnamon undertones	Practically insoluble or insoluble in water Soluble	80° (15 mm Hg)	NMR 98%		1.464-1.470 0.902-0.906		68th/N
1783	<b>2,4-Hexadienyl butyrate</b> Hexa-2,4-dienyl butyrate Sorbyl butyrate	4133 16930-93-1	C10H16O2 168.24	Light yellow liquid; Fruity, wine-like aroma with cheesy undertones	Practically insoluble or insoluble in water Soluble	80° (15 mm Hg)	NMR 98%		1.467-1.473 0.908-0.912		68th/N
1784	<b>2,4-Heptadien-1-ol</b> Hepta-2,4-dien-1-ol	4127 02.153 33467-79-7	C7H12O 112.17	Colourless liquid; Green, fruity aroma	Slightly soluble Soluble	80° (14 mm Hg)	MS 95%		1.487-1.493 0.877-0.881		68th/N
1785	<b>Nona-2,4,6-trienal</b> Nona-2,4,6-trienal	4187 05.173 57018-53-8	C9H12O 136.19	Colourless liquid; Green, cucumber aroma	Practically insoluble or insoluble in water Soluble	193-194°	MS 95%		1.550-1.556 0.867-0.873		68th/N
1786	<b>2,4,7-Decatrienal</b> Deca-2,4,7-trienal	4089 05.141 51325-37-2	C10H14O 150.22	Orange liquid; Green, citrusy aroma	Practically insoluble or insoluble in water Soluble	232-234°	IR 98% (sum of three isomers)		1.538-1.544 0.900-0.904		68th/N

## Spectra of certain flavouring agents

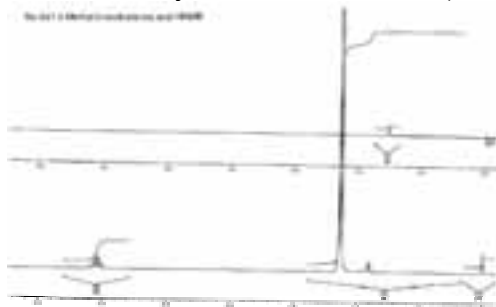
631 3-Methyl-2-oxobutanoic acid (13C-NMR)



632 3-Methyl-2-oxopentanoic acid (IR)



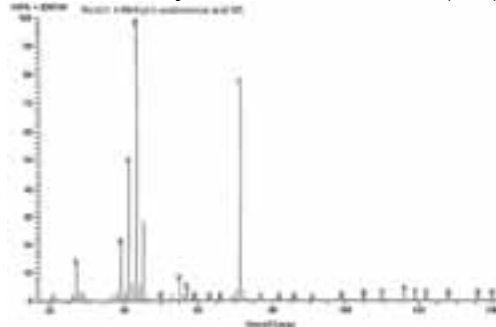
631 3-Methyl-2-oxobutanoic acid (1H-NMR)



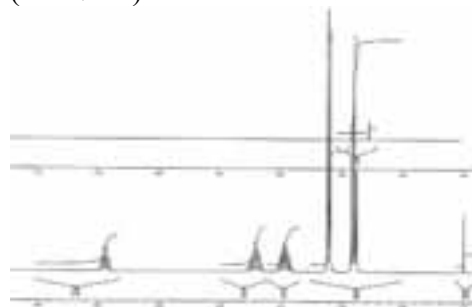
632.1 3-Methyl-2-oxopentanoic acid, sodium salt (13C-NMR)



631 3-Methyl-2-oxobutanoic acid (MS)



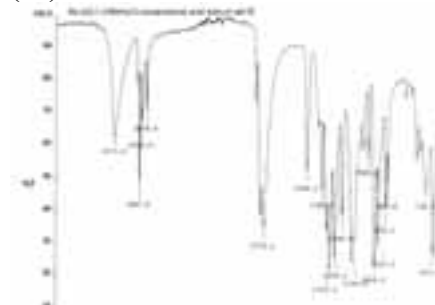
632.1 3-Methyl-2-oxopentanoic acid, sodium salt (1H-NMR)



631.1 3-Methyl-2-oxobutanoic acid, sodium salt (1H-NMR)



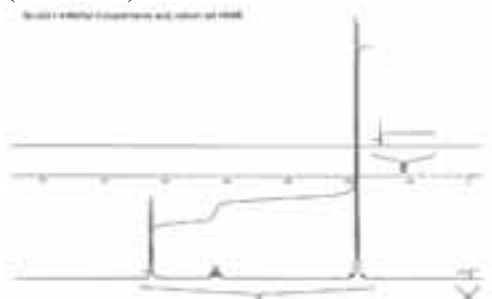
632.1 3-Methyl-2-oxopentanoic acid, sodium salt (IR)



633 4-Methyl-2-oxopentanoic acid (IR)



633.1 4-Methyl-2-oxopentanoic acid, sodium salt (1H-NMR)



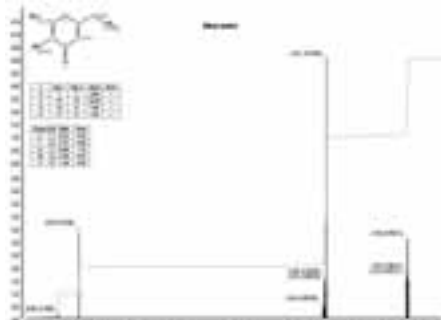
1479 2-Oxo-3-phenylpropionic acid, sodium salt



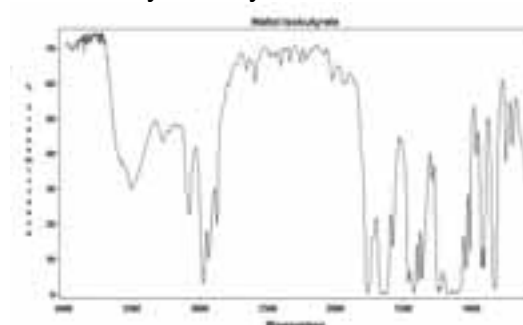
1480 Maltol



1481 Ethyl maltol



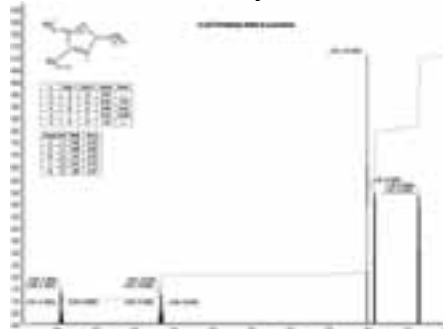
1482 Maltol isobutyrate



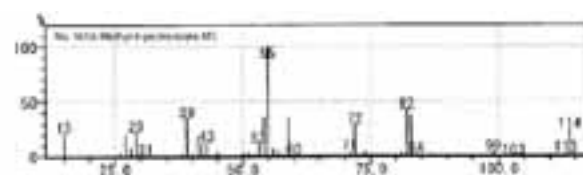
1506 3-Acetyl-2,5-dimethylfuran



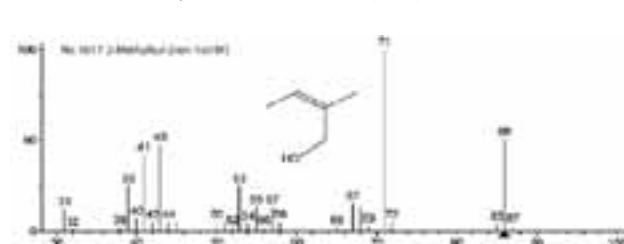
1559 2,4,5-Trimethyl-delta-oxazoline



1616 Methyl 4-pentenoate (MS)

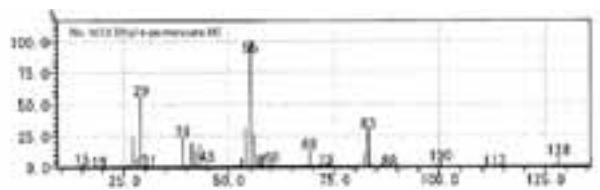


1617 2-Methylbut-2-en-1-ol (MS)

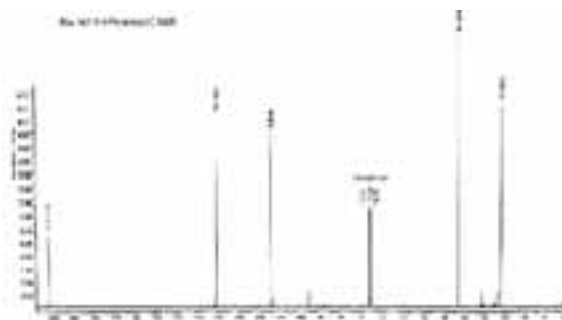




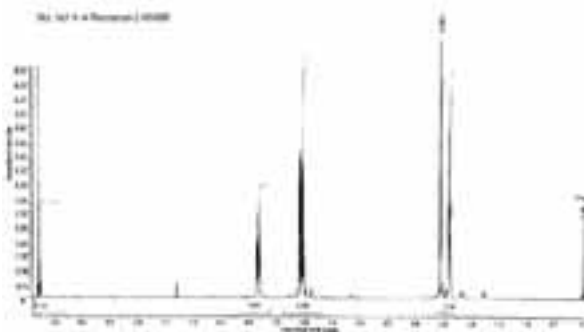
1618 Ethyl 4-pentenoate (MS)



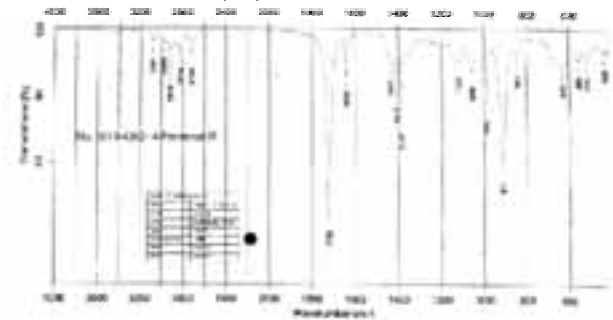
1619 4-Pentenal (13C-NMR)



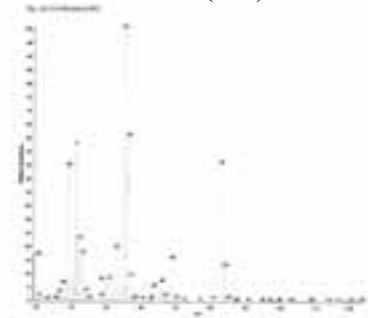
1619 4-Pentenal (1H-NMR)



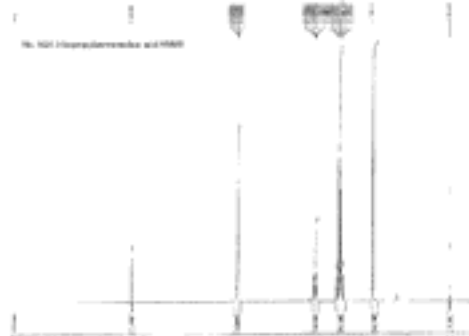
1619 4-Pentenal (IR)



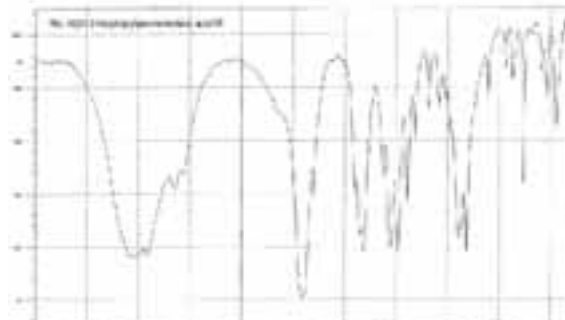
1619 4-Pentenal (MS)



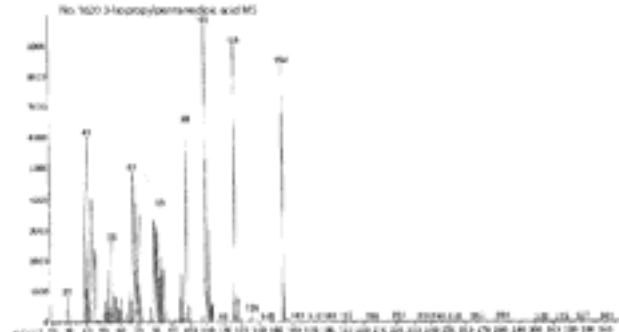
1620 3-Isopropenylpentanedioic acid (1H-NMR)



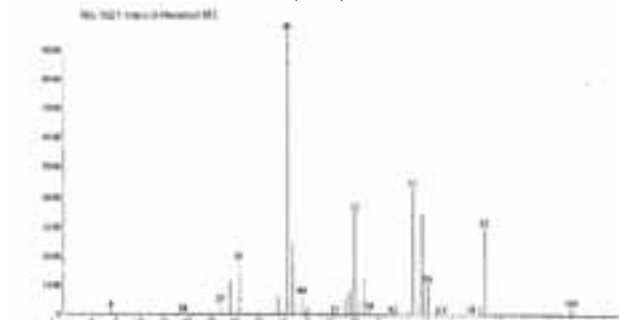
1620 3-Isopropenylpentanedioic acid (IR)



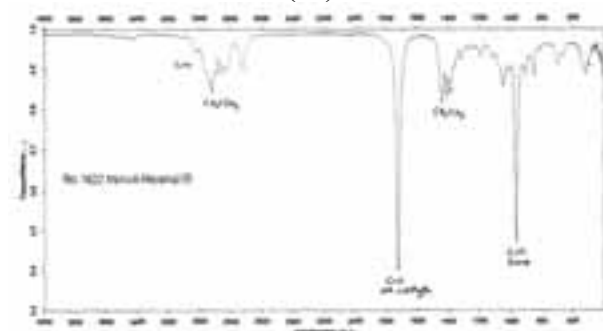
1620 3-Isopropenylpentanedioic acid (MS)



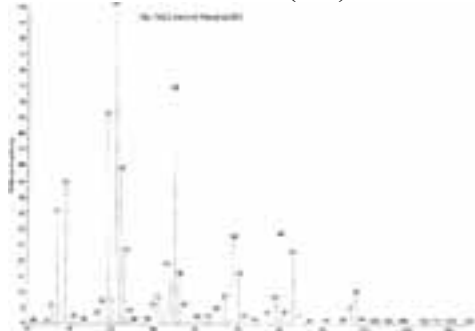
1621 trans-3-Hexenol (MS)



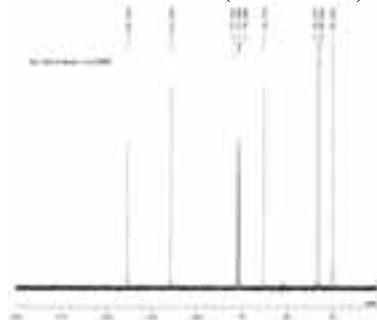
1622 trans-4-Hexenal (IR)



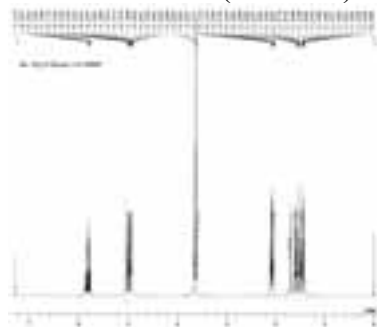
1622 trans-4-Hexenal (MS)



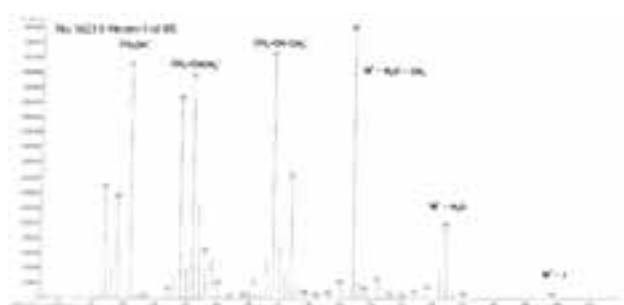
1623 5-Hexenol (13C-NMR)



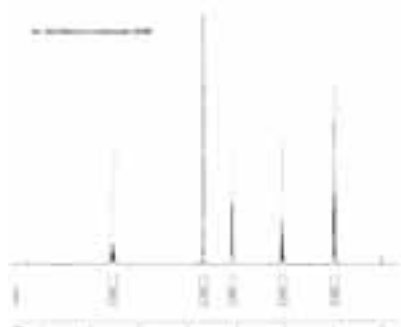
1623 5-Hexenol (1H-NMR)



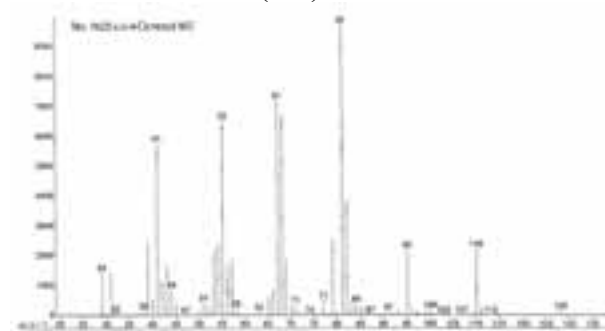
1623 5-Hexenol (MS)



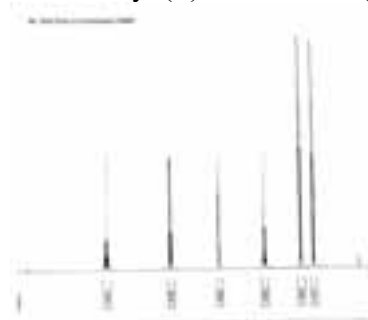
1624 Methyl (Z)-3-hexenoate (1H-NMR)



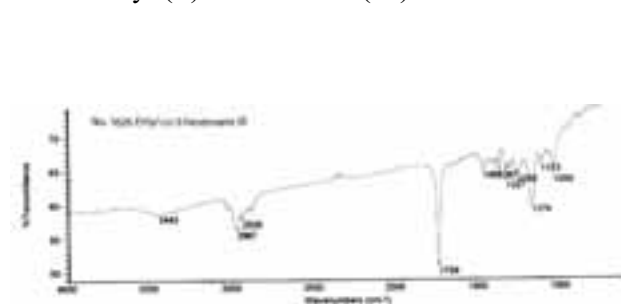
1625 cis-4-Octenol (MS)



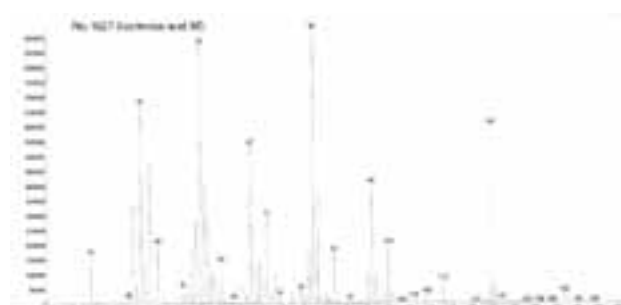
1626 Ethyl (Z)-3-hexenoate (1H-NMR)



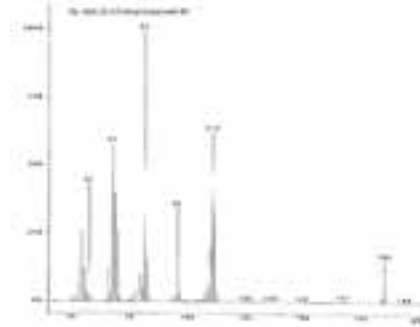
1626 Ethyl (Z)-3-hexenoate (IR)



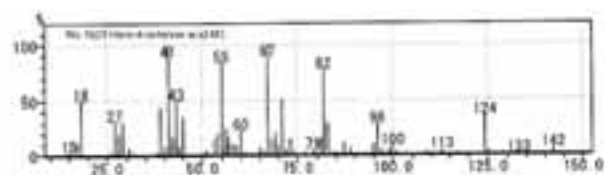
1627 3-Octenoic acid (MS)



1628 (Z)-3-Octenyl propionate (MS)



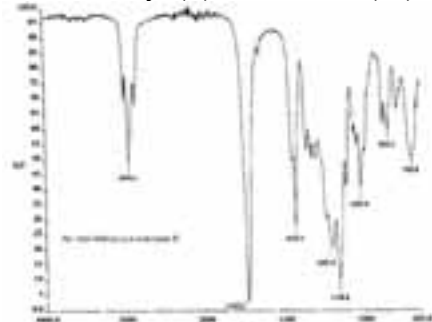
1629 trans-4-Octenoic acid (MS)



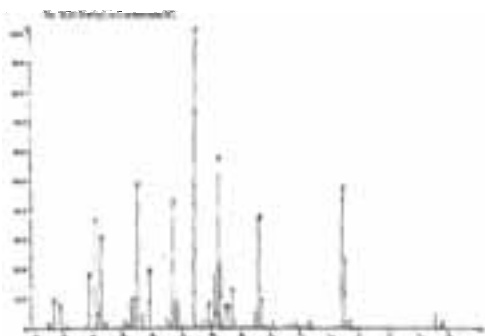
1630 Methyl (Z)-5-octenoate (1H-NMR)



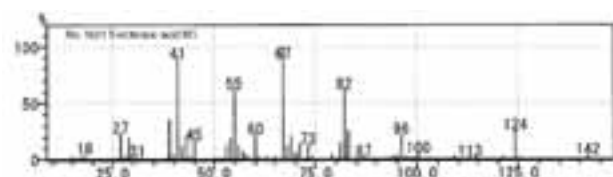
1630 Methyl (Z)-5-octenoate (IR)



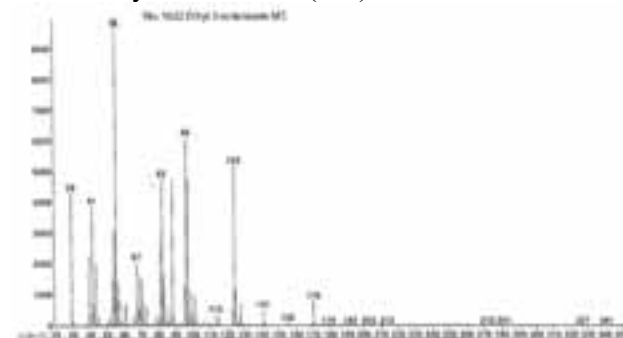
1630 Methyl (Z)-5-octenoate (MS)



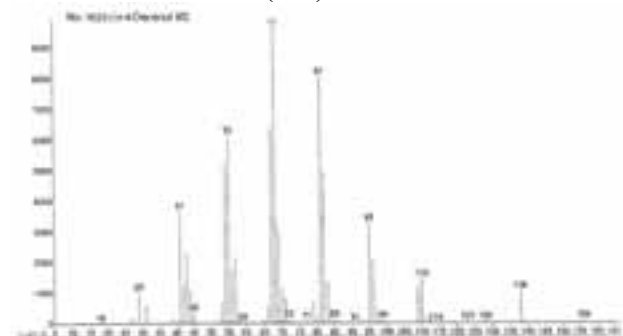
1631 cis-5-Octenoic acid (MS)



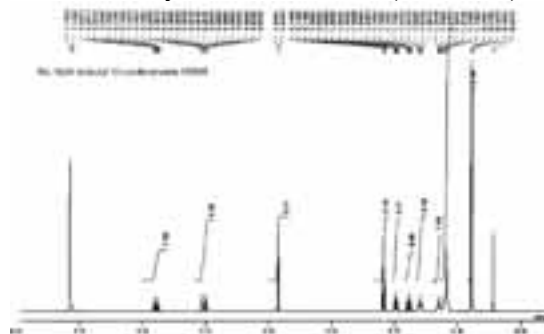
1632 Ethyl 3-octenoate (MS)



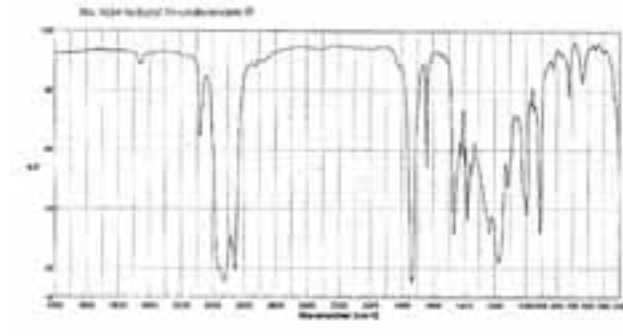
1633 cis-4-Decenol (MS)



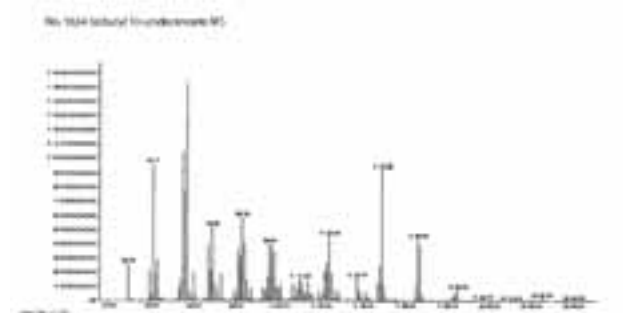
1634 Isobutyl 10-undecenoate (1H-NMR)



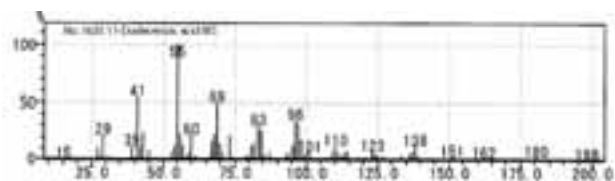
1634 Isobutyl 10-undecenoate (IR)



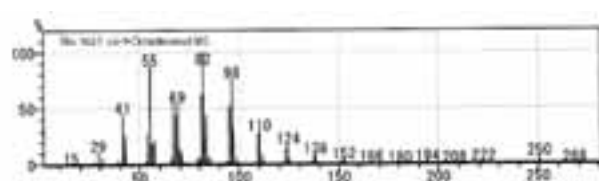
1634 Isobutyl 10-undecenoate (MS)



1635 11-Dodecenoic acid (MS)



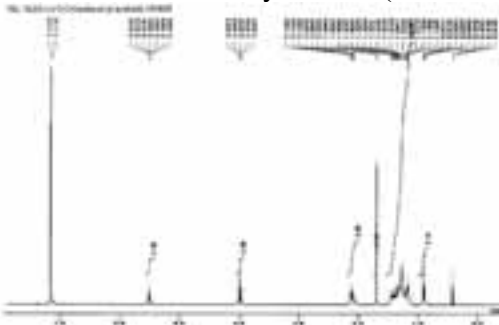
1637 cis-9-Octadecenol (MS)



1636 (Z)-4-Dodecenal (13C-NMR)



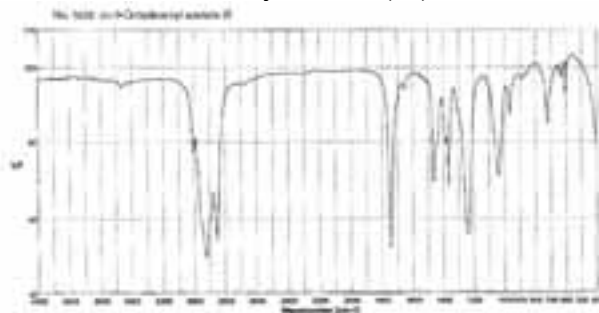
1638 cis-9-Octadecenyl acetate (1H-NMR)



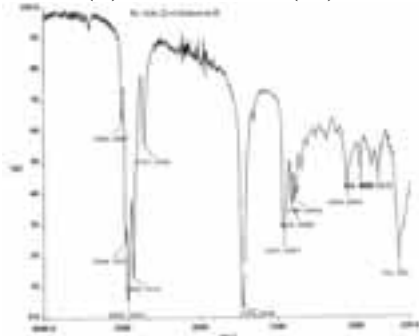
1636 (Z)-4-Dodecenal (1H-NMR)



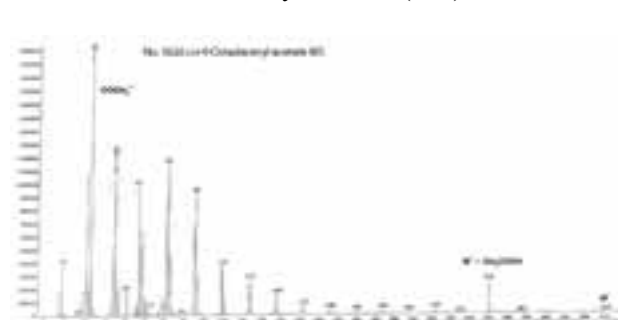
1638 cis-9-Octadecenyl acetate (IR)



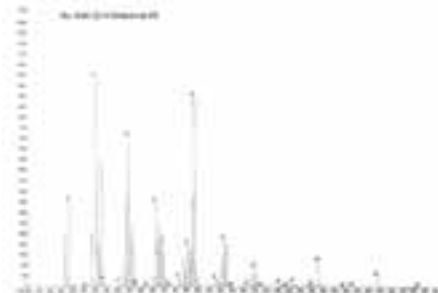
1636 (Z)-4-Dodecenal (IR)



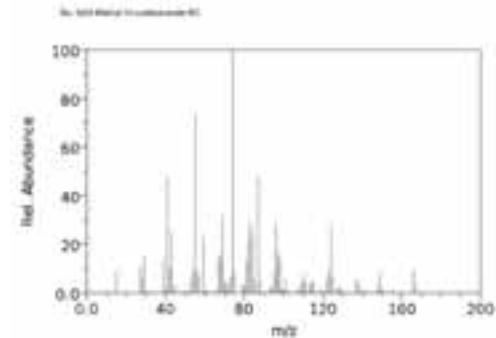
1638 cis-9-Octadecenyl acetate (MS)



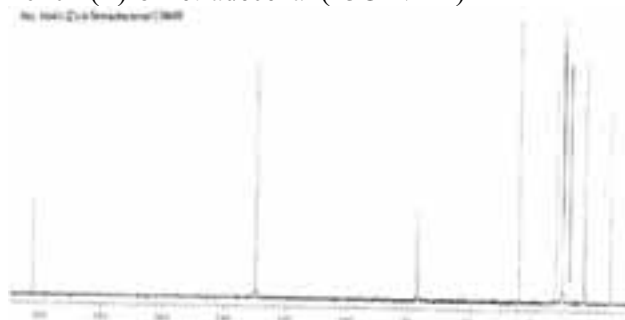
1636 (Z)-4-Dodecenal (MS)



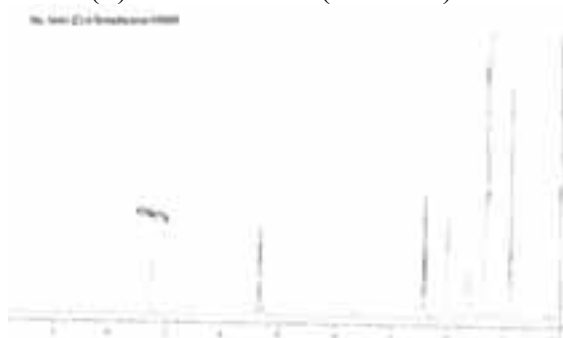
1639 Methyl 10-undecenoate (MS)



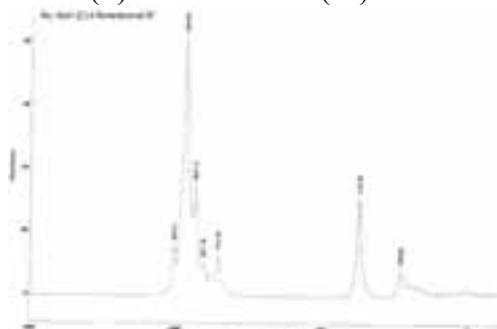
1640 (Z)-8-Tetradecenal (13C-NMR)



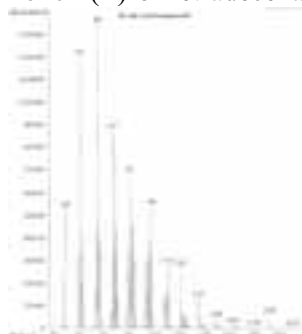
1640 (Z)-8-Tetradecenal (1H-NMR)



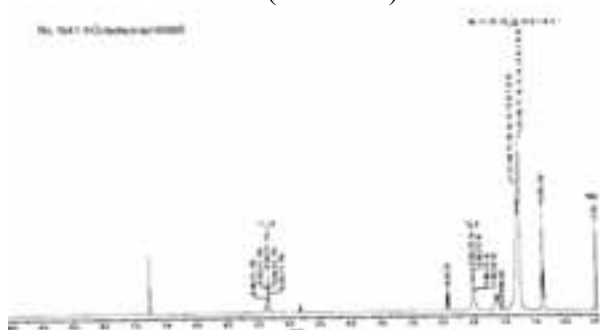
1640 (Z)-8-Tetradecenal (IR)



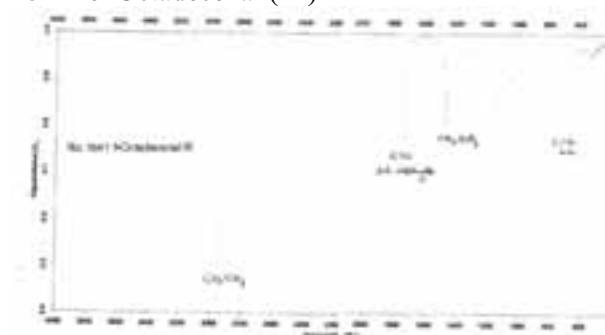
1640 (Z)-8-Tetradecenal (MS)



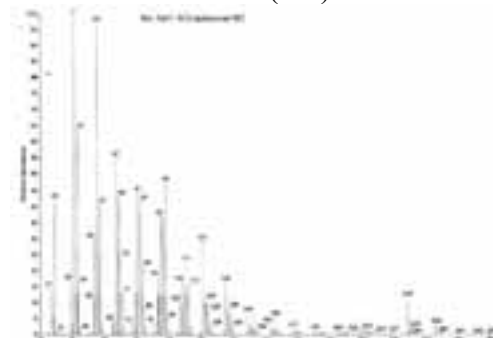
1641 9-Octadecenal (1H-NMR)



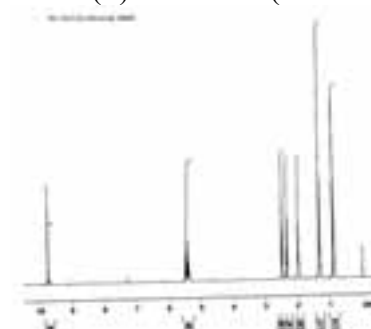
1641 9-Octadecenal (IR)



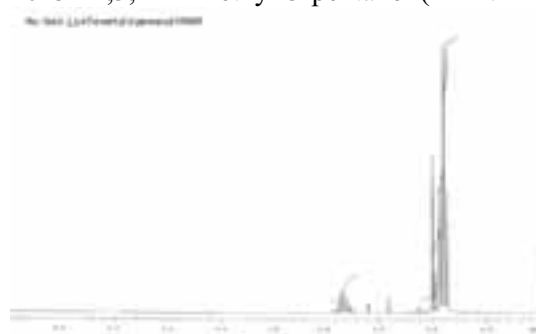
1641 9-Octadecenal (MS)



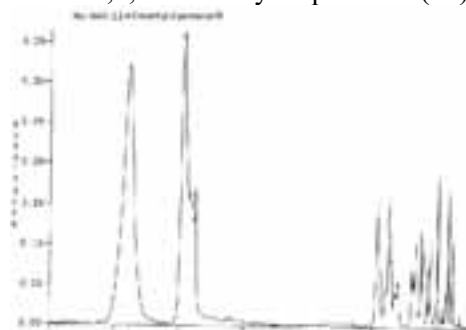
1642 (E)-4-Nonenal (1H-NMR)



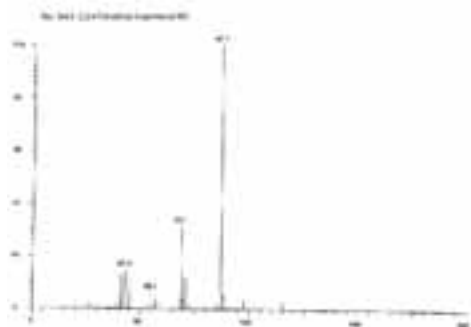
1643 2,3,4-Trimethyl-3-pentanol (1H-NMR)



1643 2,3,4-Trimethyl-3-pentanol (IR)



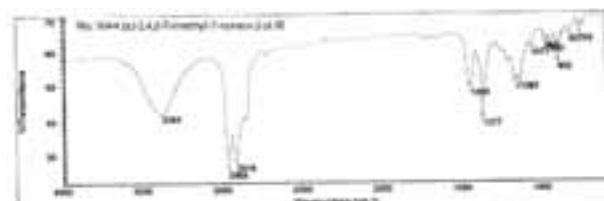
1643 2,3,4-Trimethyl-3-pentanol (MS)



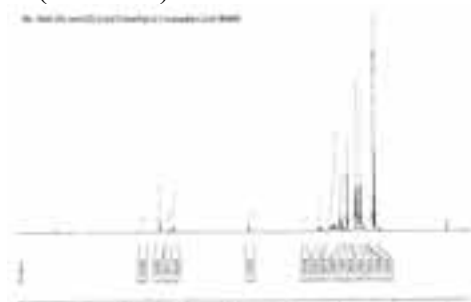
1644 (+/-)-2,4,8-Trimethyl-7-nonen-2-ol (1H-NMR)



1644 (+/-)-2,4,8-Trimethyl-7-nonen-2-ol (IR)



1645 (E)- and (Z)-2,4,8-Trimethyl-3,7-nonadien-2-ol (1H-NMR)



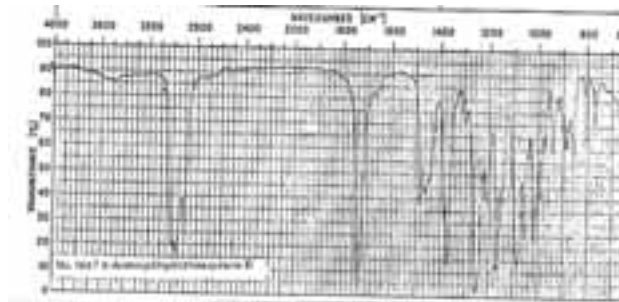
1646 Nerolidol (1H-NMR)



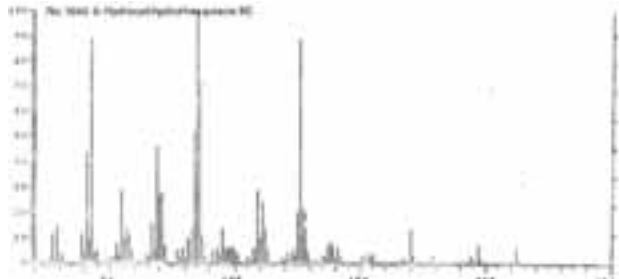
1647 6-Acetoxydihydrotheaspirane (1H-NMR)



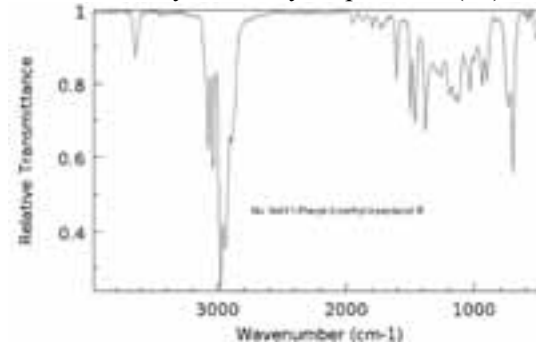
1647 6-Acetoxydihydrotheaspirane (IR)



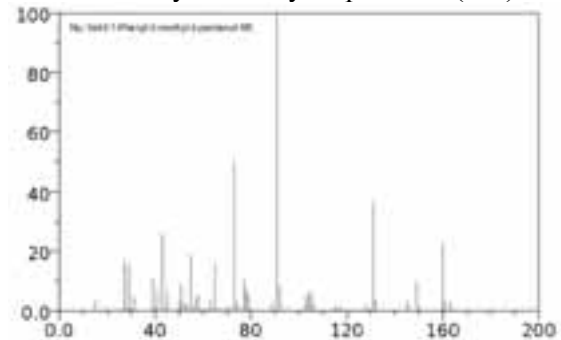
1648 6-Hydroxydihydrotheaspirane (MS)



1649 1-Phenyl-3-methyl-3-pentanol (IR)



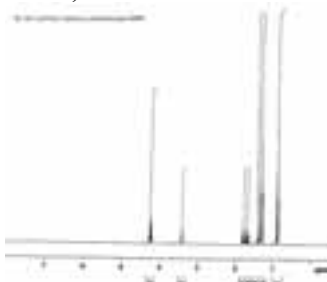
1649 1-Phenyl-3-methyl-3-pentanol (MS)



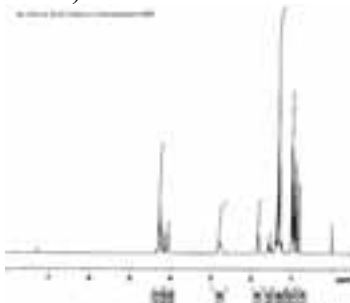
1650 p- $\alpha,\alpha$ -Trimethylbenzyl alcohol (1H-NMR)



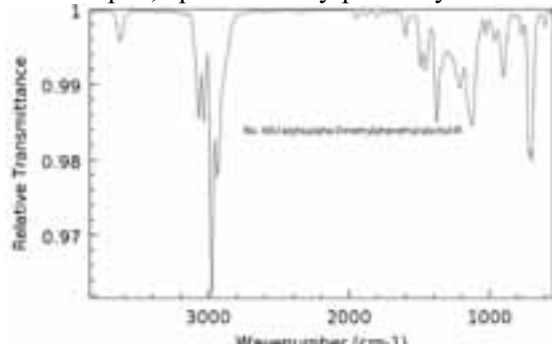
1651 (+/-)-Ethyl 2-hydroxy-2-methylbutyrate (1H-NMR)



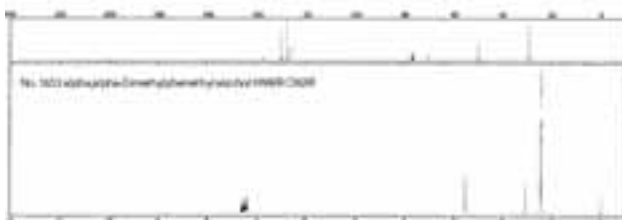
1652 (+/-)-Ethyl 2-hydroxy-3-methylvalerate (1H-NMR)



1653  $\alpha,\alpha$ -Dimethylphenethyl alcohol (IR)



1653  $\alpha,\alpha$ -Dimethylphenethyl alcohol (NMR)



1654  $\alpha,\alpha$ -Dimethylphenethyl formate (1H-NMR)



1655  $\alpha,\alpha$ -Dimethylphenethyl acetate (1H-NMR)



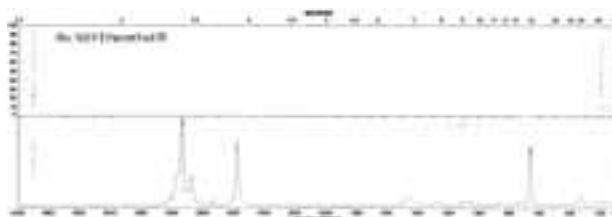
1656  $\alpha,\alpha$ -Dimethylphenethyl butyrate (1H-NMR)



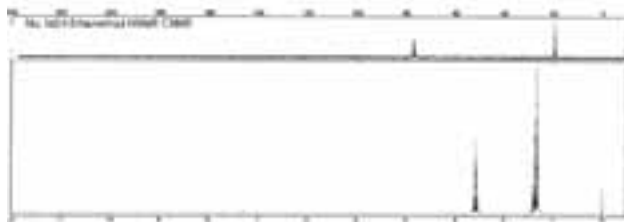
1657  $\alpha,\alpha$ -Dimethylbenzyl isobutyrate (1H-NMR)



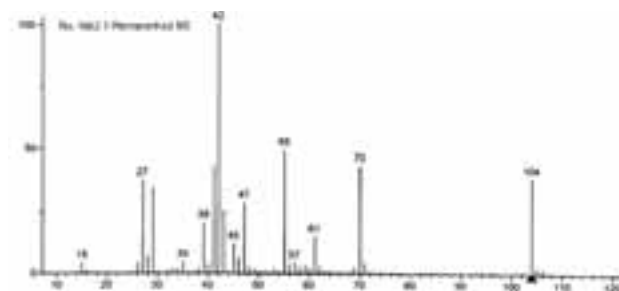
1659 Ethanethiol (IR)



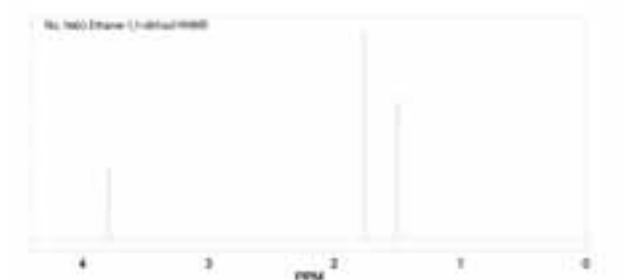
1659 Ethanethiol (NMR)



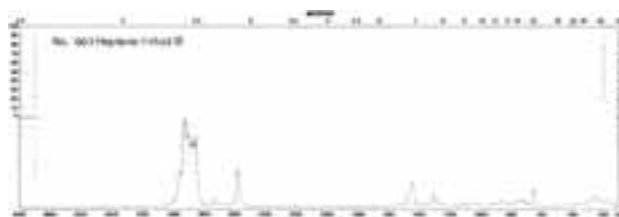
1662 1-Pentanethiol (MS)



1660 Ethane-1,1-dithiol (1H-NMR)



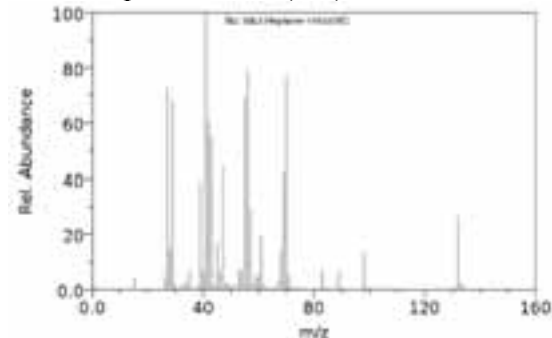
1663 Heptane-1-thiol (IR)



1661 Dimercaptomethane (1H-NMR)



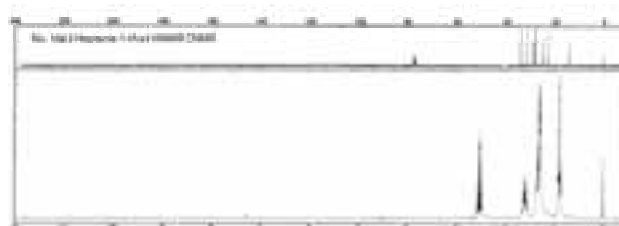
1663 Heptane-1-thiol (MS)



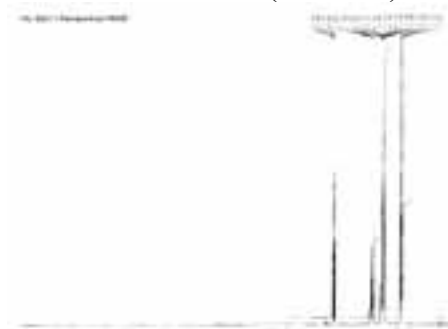
1662 1-Pentanethiol (13C-NMR)



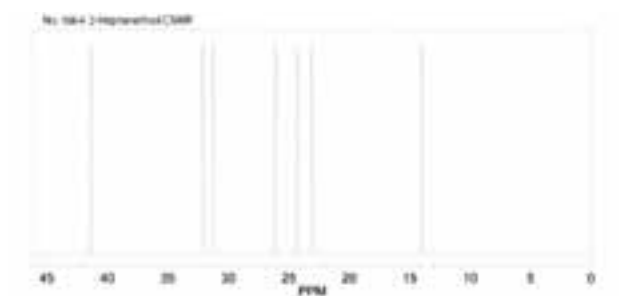
1663 Heptane-1-thiol (NMR)



1662 1-Pentanethiol (1H-NMR)

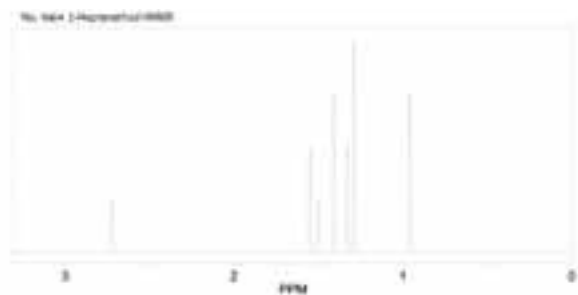


1664 2-Heptanethiol (13C-NMR)

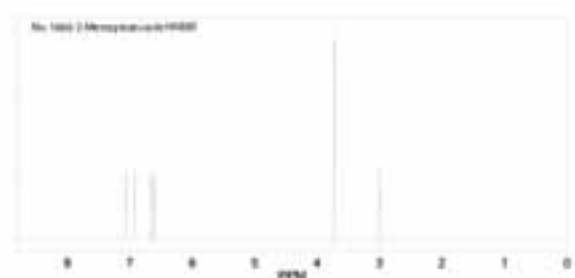




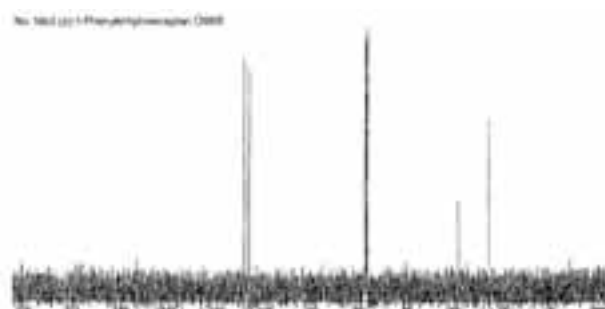
1664 2-Heptanethiol (1H-NMR)



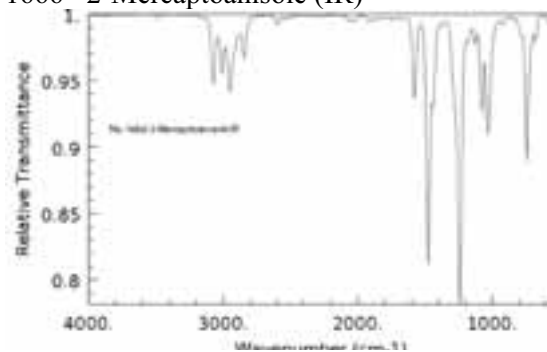
1666 2-Mercaptoanisole (1H-NMR)



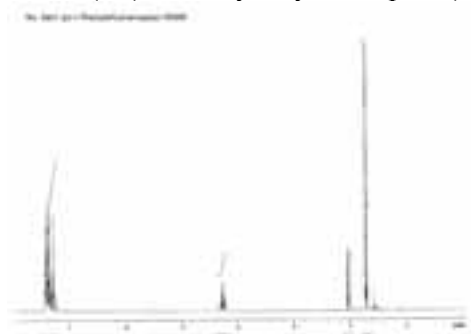
1665 (+/-)-1-Phenylethylmercaptan (13C-NMR)



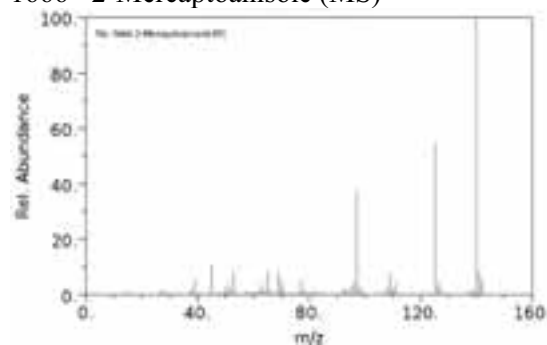
1666 2-Mercaptoanisole (IR)



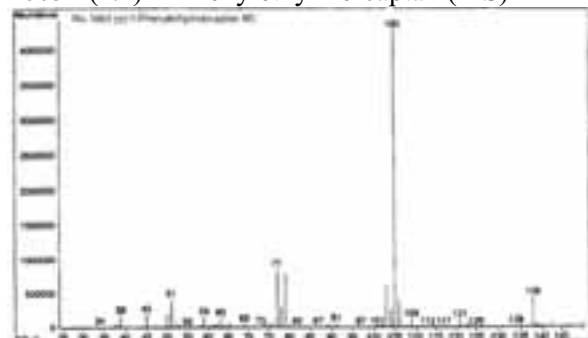
1665 (+/-)-1-Phenylethylmercaptan (1H-NMR)



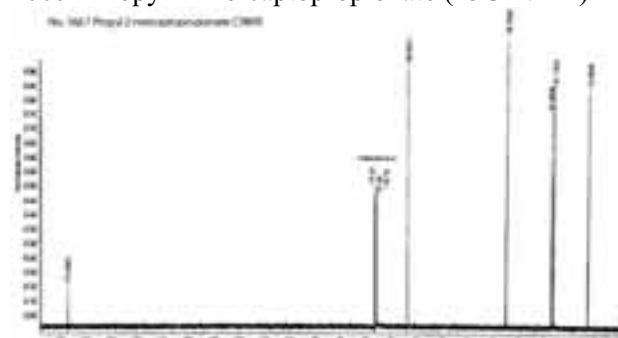
1666 2-Mercaptoanisole (MS)



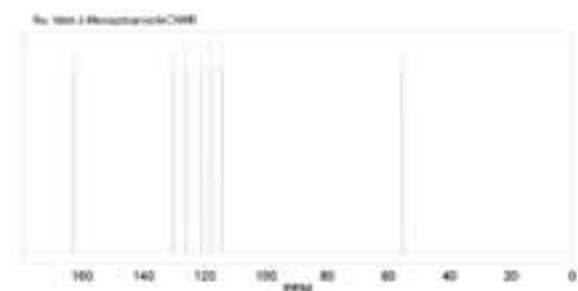
1665 (+/-)-1-Phenylethylmercaptan (MS)



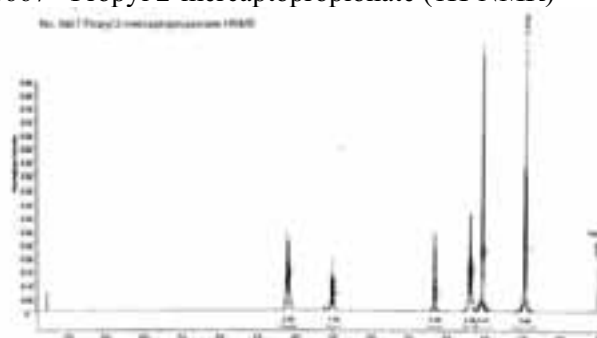
1667 Propyl 2-mercaptopropionate (13C-NMR)



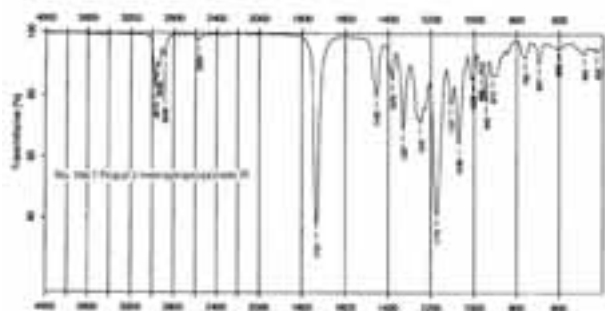
1666 2-Mercaptoanisole (13C-NMR)



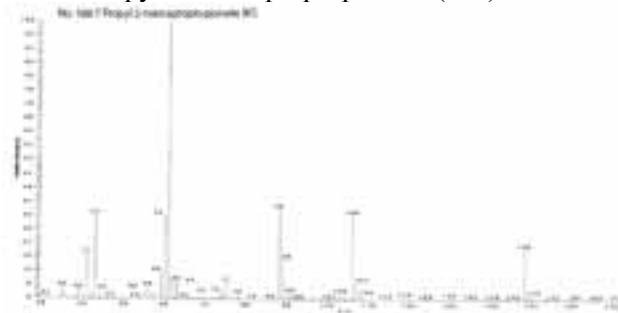
1667 Propyl 2-mercaptopropionate (1H-NMR)



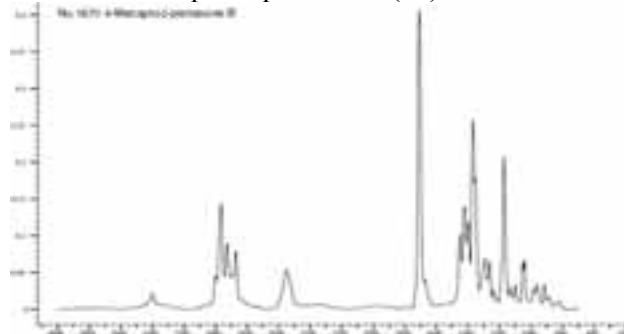
1667 Propyl 2-mercaptopropionate (IR)



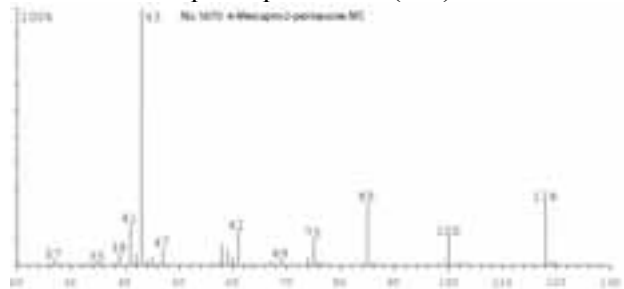
1667 Propyl 2-mercaptopropionate (MS)



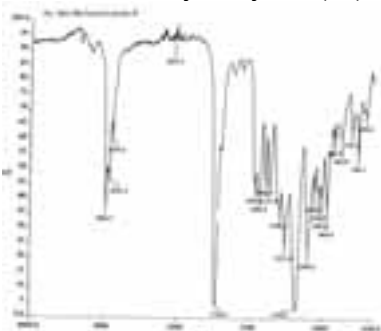
1670 4-Mercapto-2-pentanone (IR)



1670 4-Mercapto-2-pentanone (MS)



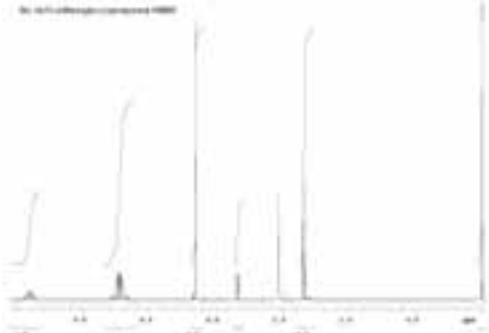
1668 Methionyl butyrate (IR)



1669 (+/-)-4-Mercapto-4-methyl-2-pentanol (1H-NMR)



1670 4-Mercapto-2-pentanone (1H-NMR)



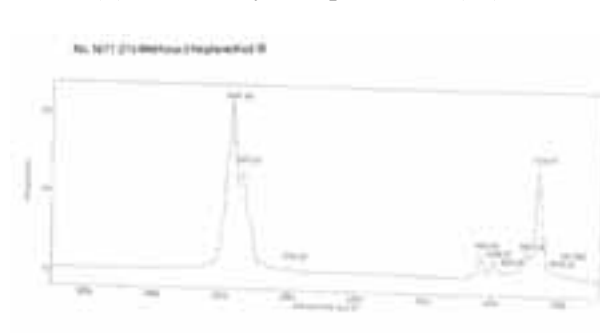
1671 (S)-1-Methoxy-3-heptanethiol (13C-NMR)



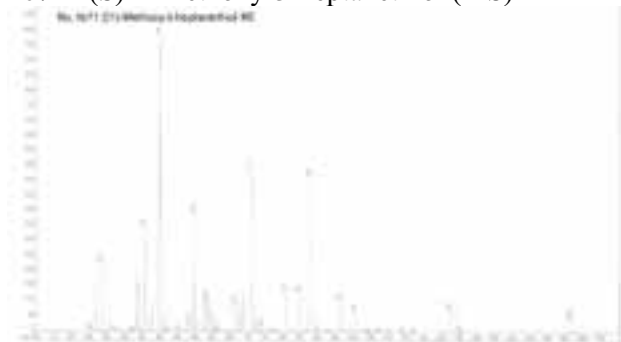
1671 (S)-1-Methoxy-3-heptanethiol (1H-NMR)



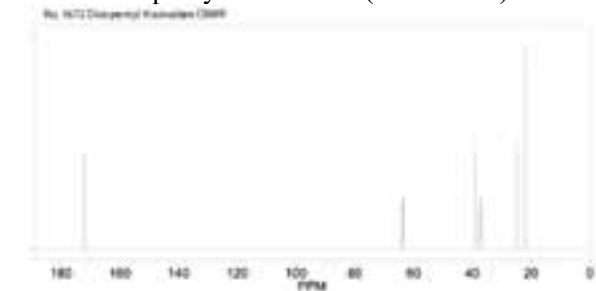
1671 (S)-1-Methoxy-3-heptanethiol (IR)



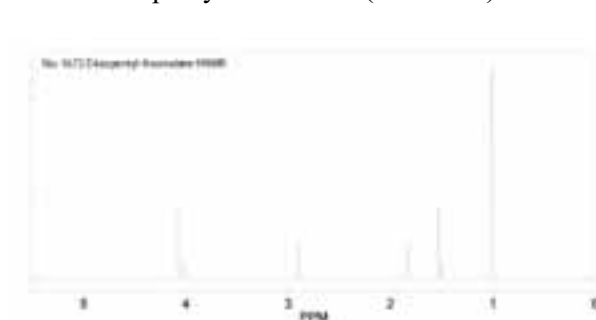
1671 (S)-1-Methoxy-3-heptanethiol (MS)



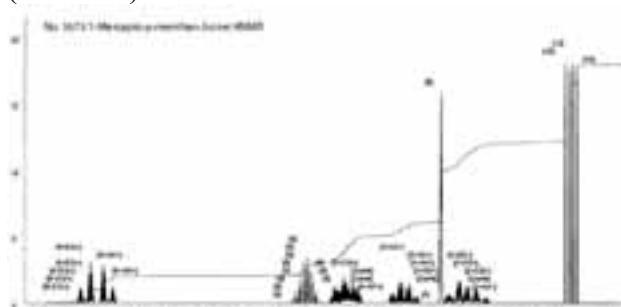
1672 Diisopentyl thiomalate (13C-NMR)



1672 Diisopentyl thiomalate (1H-NMR)



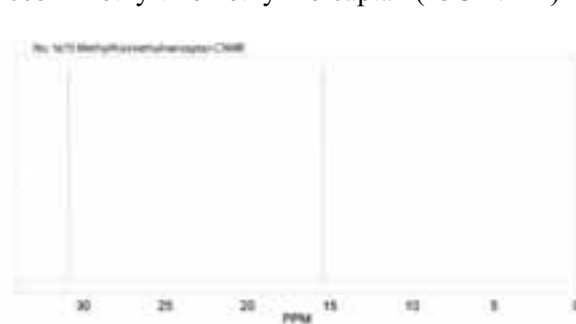
1673 cis- and trans-Mercapto-p-menthan-3-one (1H-NMR)



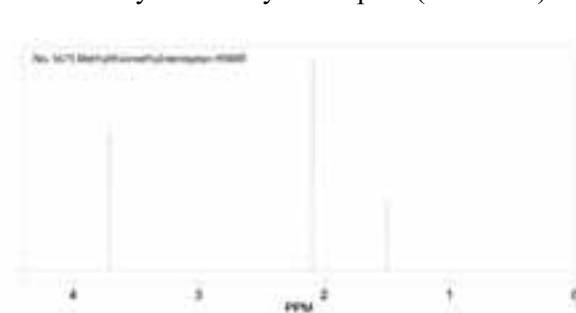
1674 Methyl 3-mercaptoputanoate (1H-NMR)



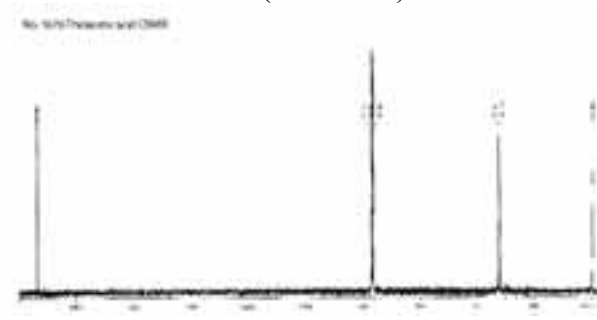
1675 Methylthiomethylmercaptan (13C-NMR)



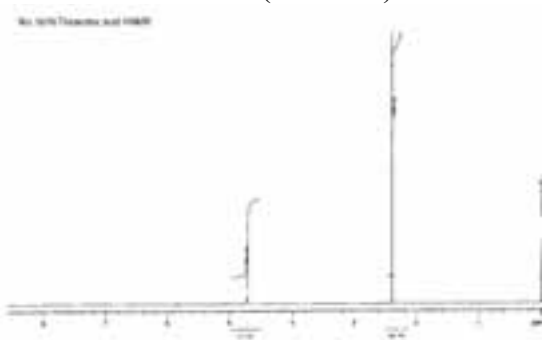
1675 Methylthiomethylmercaptan (1H-NMR)



1676 Thioacetic acid (13C-NMR)



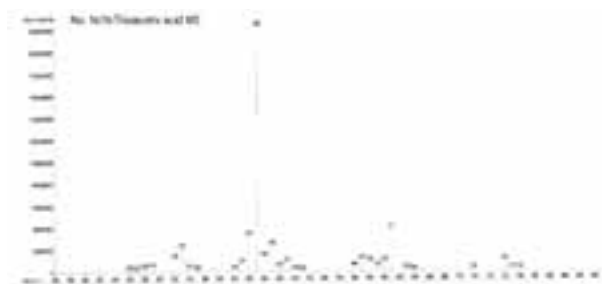
1676 Thioacetic acid (1H-NMR)



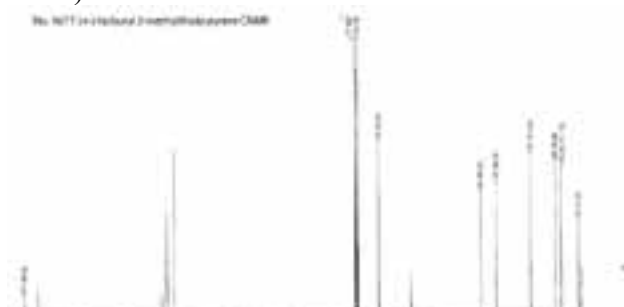
1676 Thioacetic acid (IR)



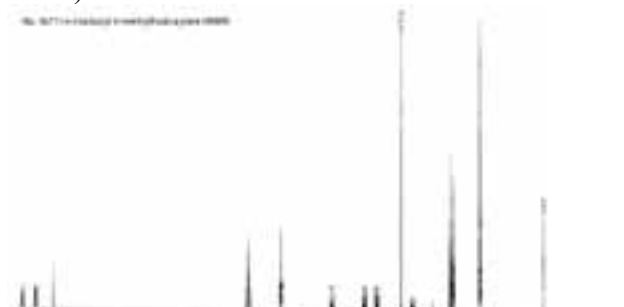
1676 Thioacetic acid (MS)



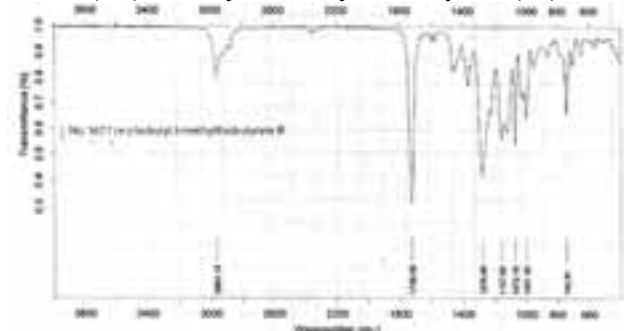
1677 (+/-)-Isobutyl 3-methylthiobutyrate (13C-NMR)



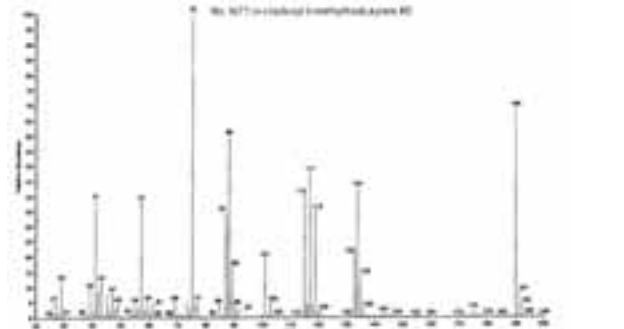
1677 (+/-)-Isobutyl 3-methylthiobutyrate (1H-NMR)



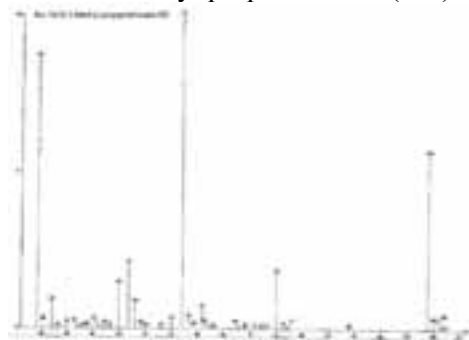
1677 (+/-)-Isobutyl 3-methylthiobutyrate (IR)



1677 (+/-)-Isobutyl 3-methylthiobutyrate (MS)



1678 S-Methyl propanethioate (MS)



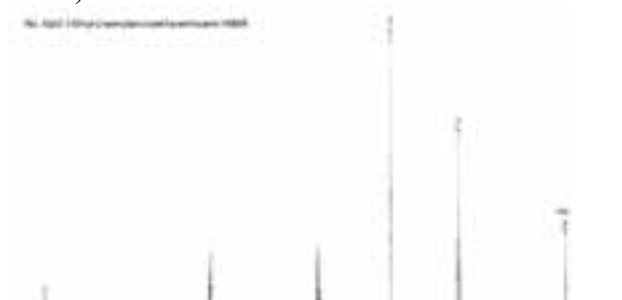
1679 S-Isopropyl 3-methylbut-2-enethioate (1H-NMR)



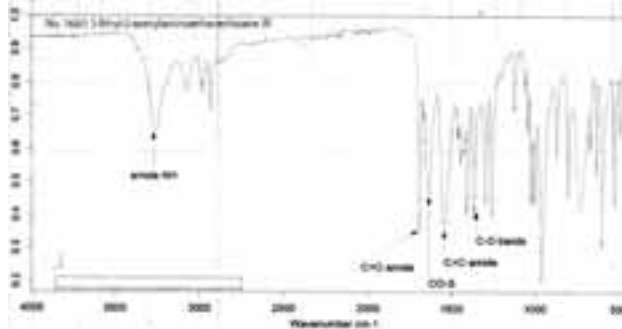
1680 S-Ethyl 2-acetylamino ethanethioate (13C-NMR)



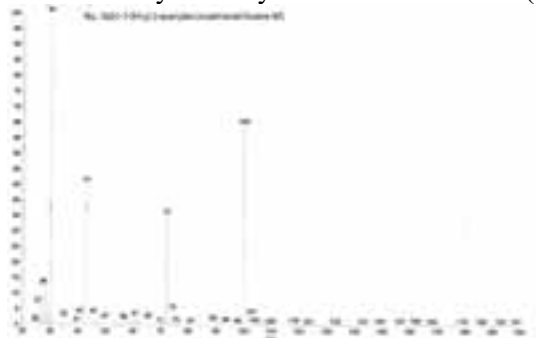
1680 S-Ethyl 2-acetylamino ethanethioate (1H-NMR)



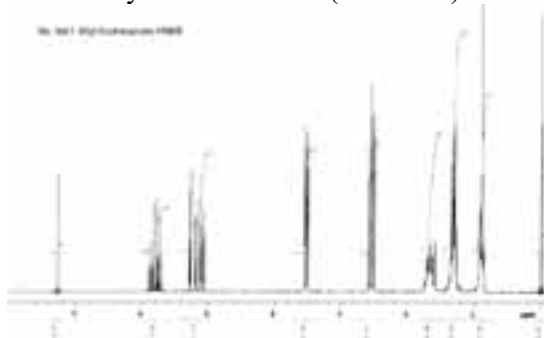
1680 S-Ethyl 2-acetylamino ethanethioate (IR)



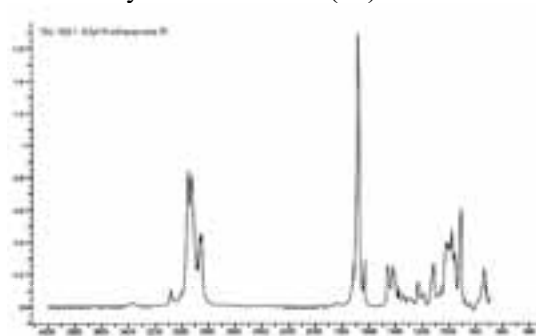
1680 S-Ethyl 2-acetylamino ethanethioate (MS)



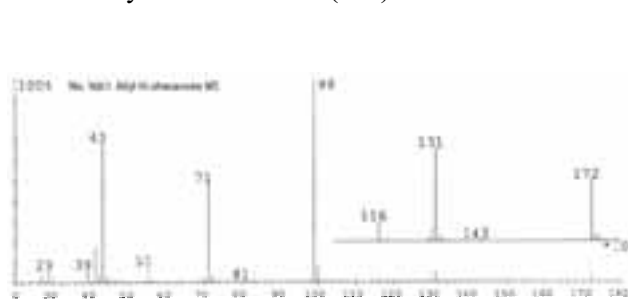
1681 Allyl thiohexanoate (1H-NMR)



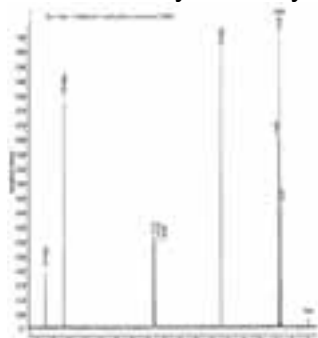
1681 Allyl thiohexanoate (IR)



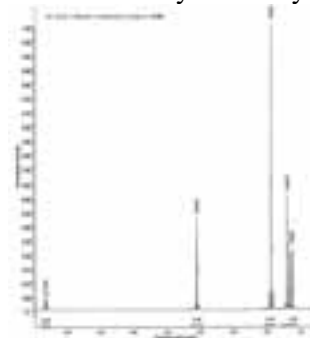
1681 Allyl thiohexanoate (MS)



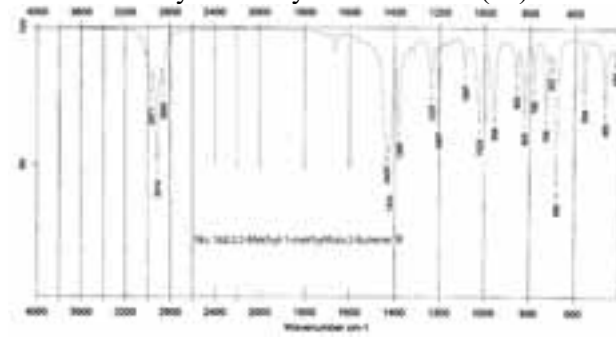
1683 2-Methyl-1-methylthio-2-butene (13C-NMR)



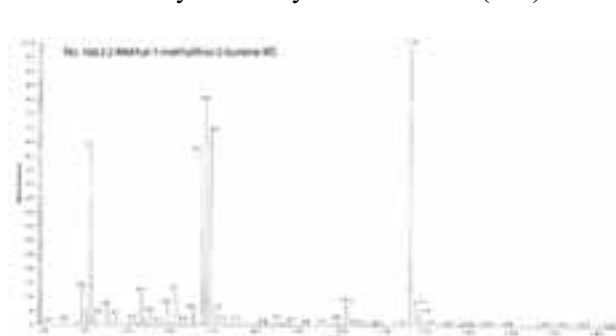
1683 2-Methyl-1-methylthio-2-butene (1H-NMR)



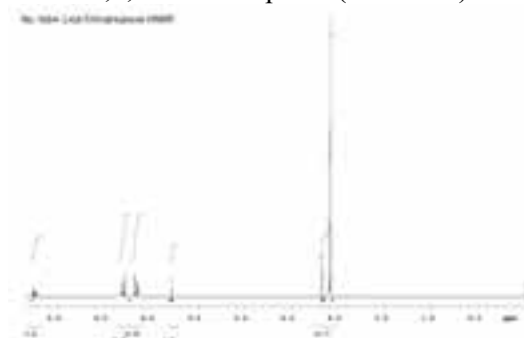
1683 2-Methyl-1-methylthio-2-butene (IR)



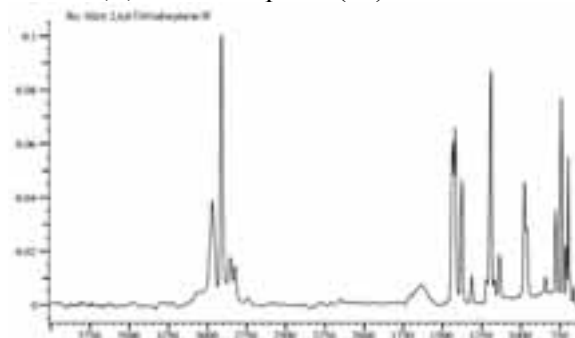
1683 2-Methyl-1-methylthio-2-butene (MS)



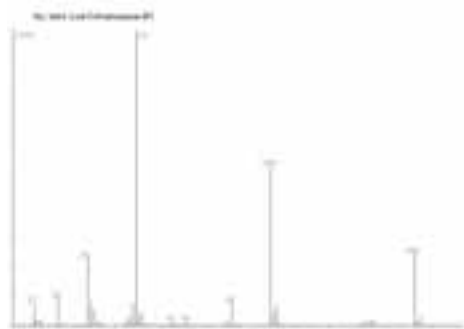
1684 2,4,6-Trithiaheptane (1H-NMR)



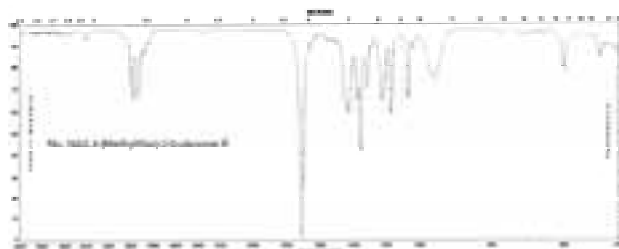
1684 2,4,6-Trithiaheptane (IR)



1684 2,4,6-Trithiaheptane (MS)



1688 3-(Methylthio)-2-butanone (IR)



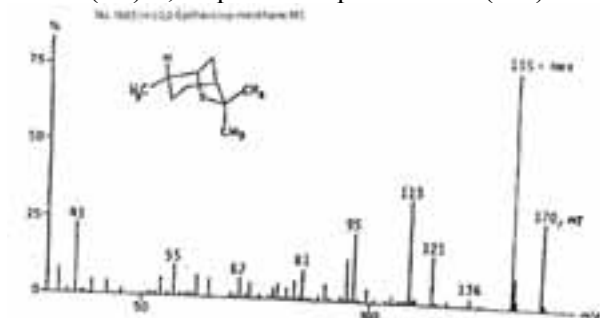
1685 (+/-)-2,8-Epithio-cis-p-menthane (IR)



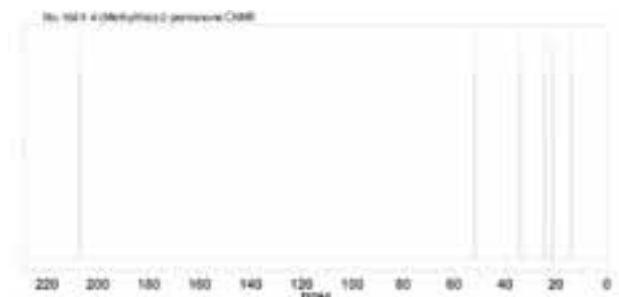
1688 3-(Methylthio)-2-butanone (NMR)



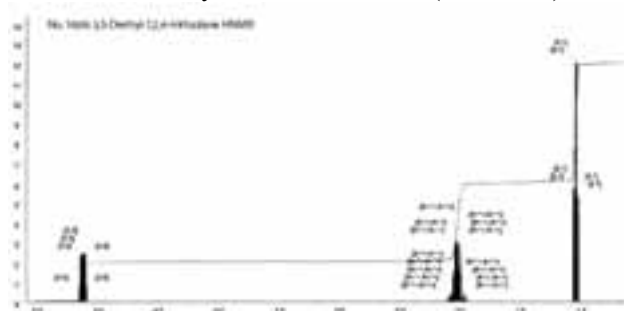
1685 (+/-)-2,8-Epithio-cis-p-menthane (MS)



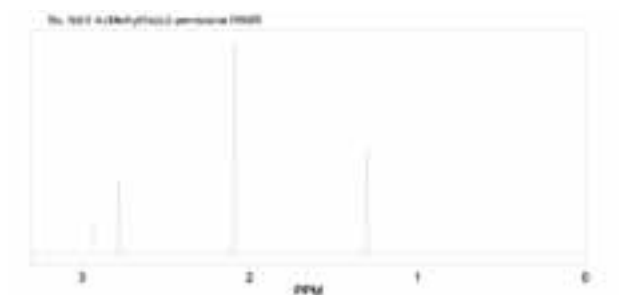
1689 4-(Methylthio)-2-pentanone (13C-NMR)



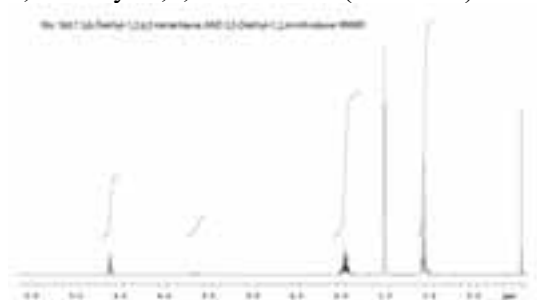
1686 3,5-Diethyl-1,2,4-trithiolane (1H-NMR)



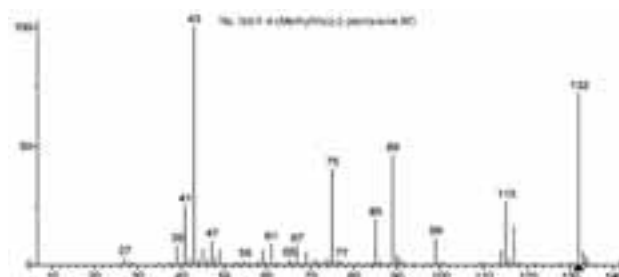
1689 4-(Methylthio)-2-pentanone (1H-NMR)

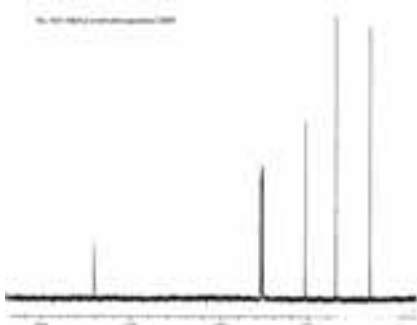
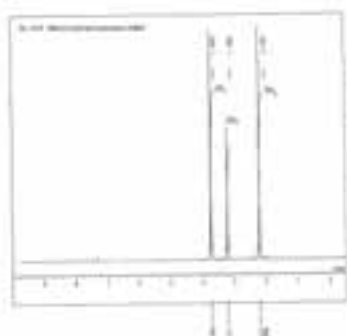


1687 3,6-Diethyl-1,2,4,5-tetrathiane, mixture with 3,5-diethyl-1,2,4-trithiolane (1H-NMR)

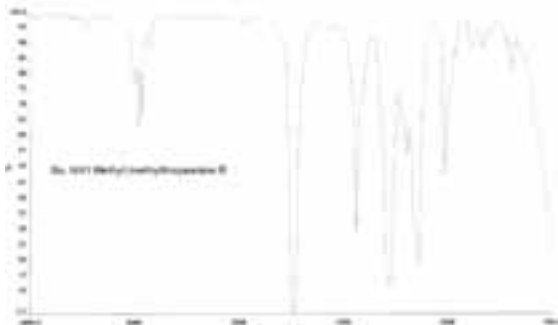


1689 4-(Methylthio)-2-pentanone (MS)

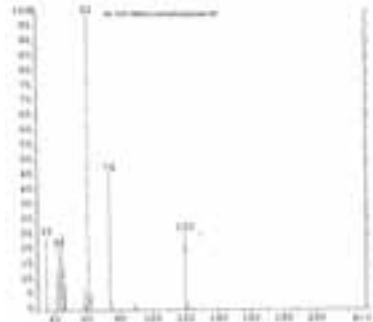
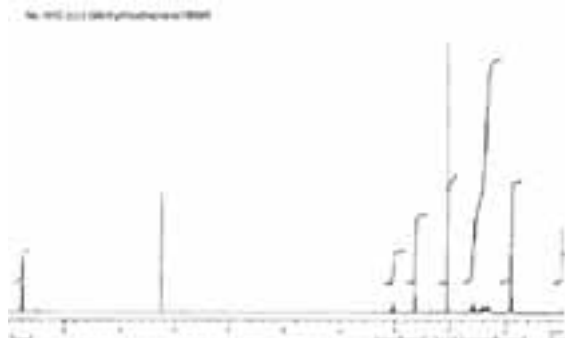


1690 Methyl 3-(methylthio)butanoate ( $^1\text{H}$ -NMR)1691 Methyl (methylthio)acetate ( $^{13}\text{C}$ -NMR)1691 Methyl (methylthio)acetate ( $^1\text{H}$ -NMR)

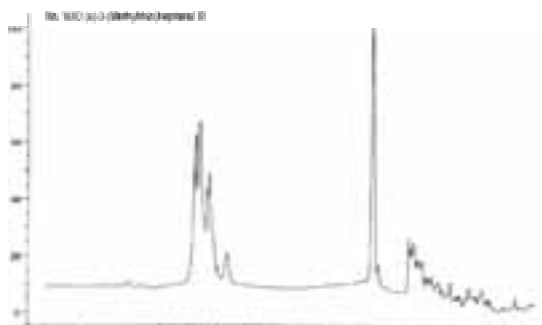
1691 Methyl (methylthio)acetate (IR)



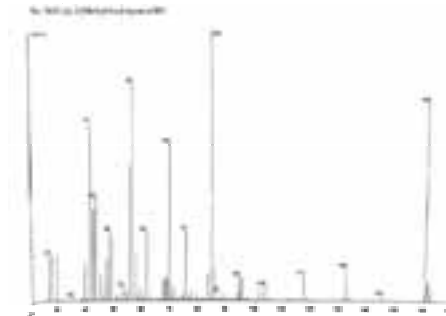
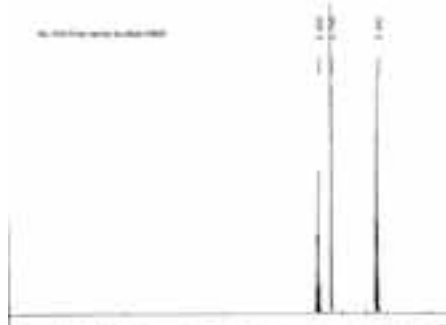
1691 Methyl (methylthio)acetate (MS)

1692 (+/-)-3-(Methylthio)heptanal ( $^1\text{H}$ -NMR)

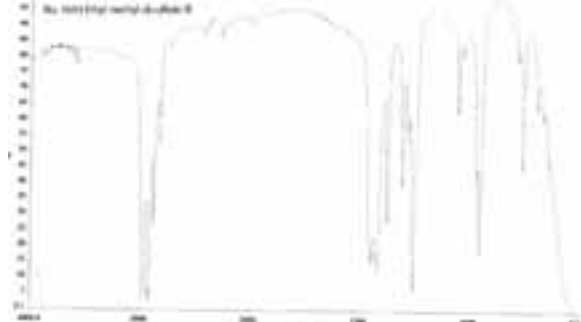
1692 (+/-)-3-(Methylthio)heptanal (IR)



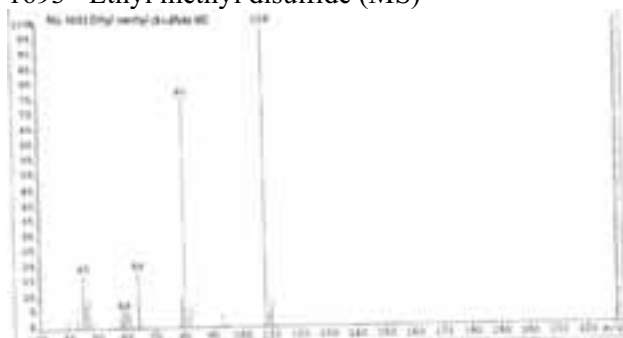
1692 (+/-)-3-(Methylthio)heptanal (MS)

1693 Ethyl methyl disulfide ( $^1\text{H}$ -NMR)

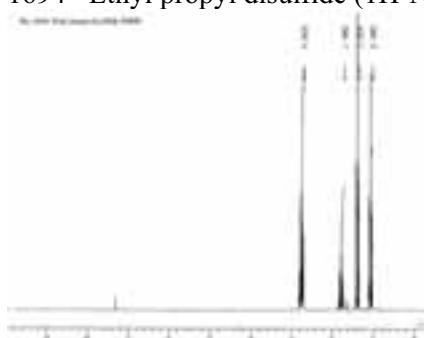
1693 Ethyl methyl disulfide (IR)



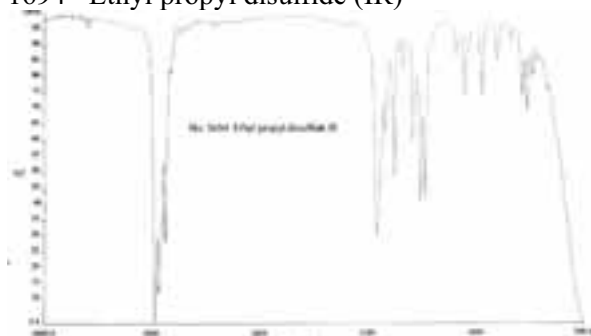
1693 Ethyl methyl disulfide (MS)



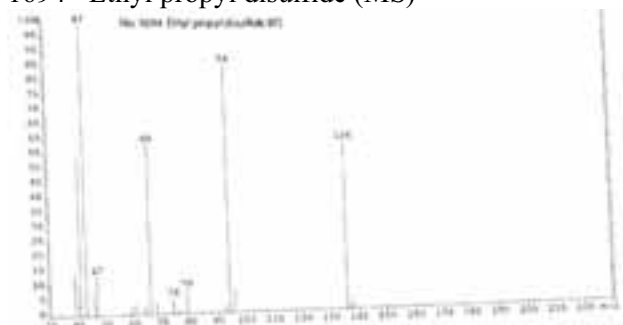
1694 Ethyl propyl disulfide (1H-NMR)



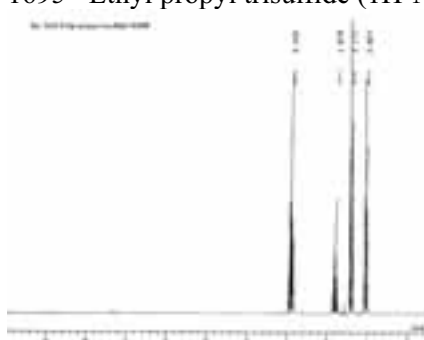
1694 Ethyl propyl disulfide (IR)



1694 Ethyl propyl disulfide (MS)



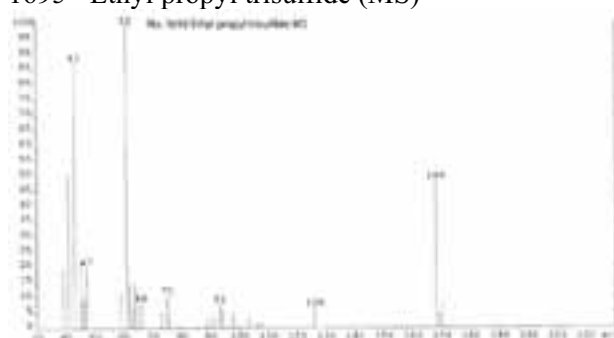
1695 Ethyl propyl trisulfide (1H-NMR)



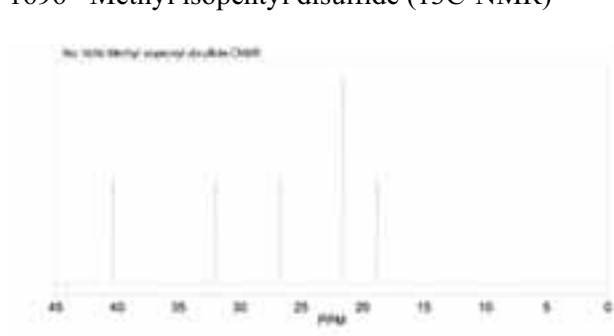
1695 Ethyl propyl trisulfide (IR)



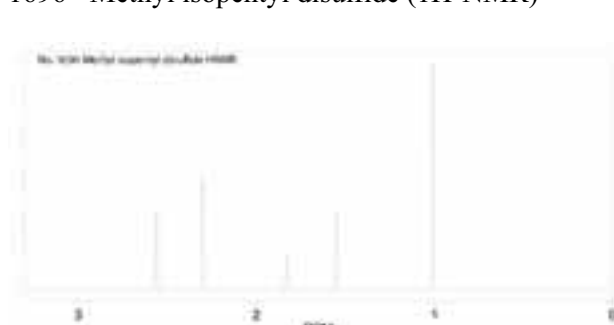
1695 Ethyl propyl trisulfide (MS)



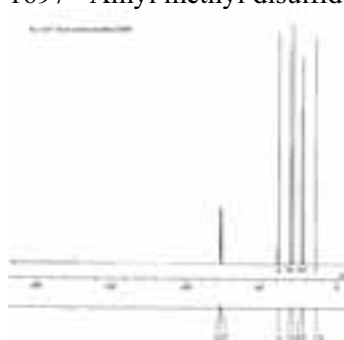
1696 Methyl isopentyl disulfide (13C-NMR)



1696 Methyl isopentyl disulfide (1H-NMR)

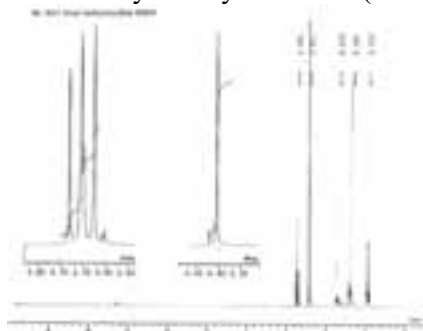


1697 Amyl methyl disulfide (13C-NMR)

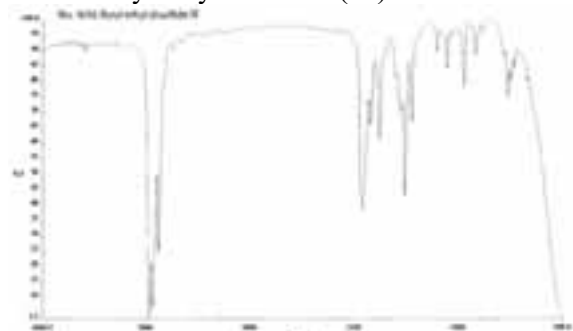




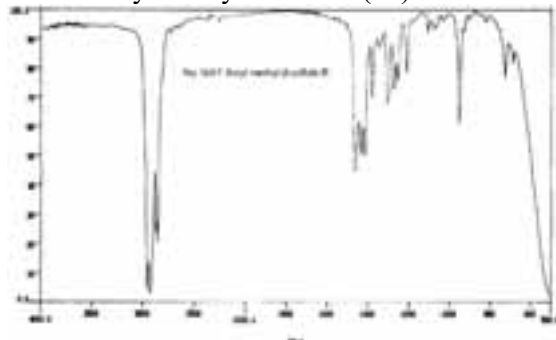
1697 Amyl methyl disulfide (1H-NMR)



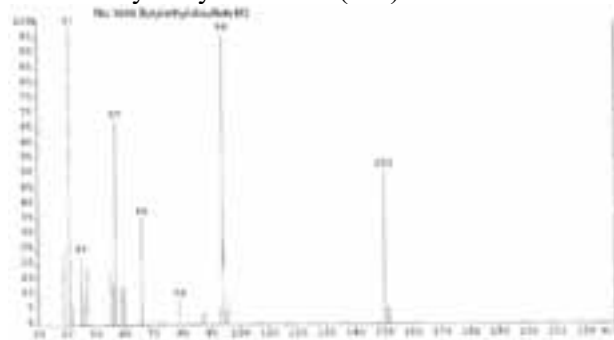
1698 Butyl ethyl disulfide (IR)



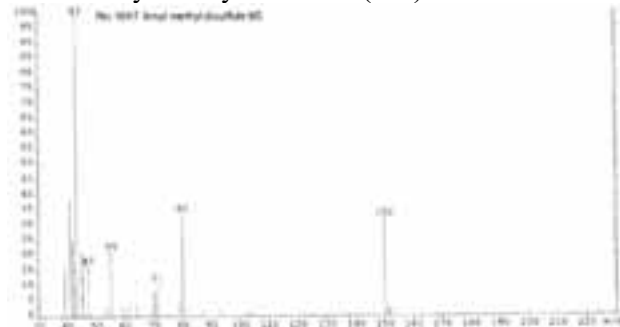
1697 Amyl methyl disulfide (IR)



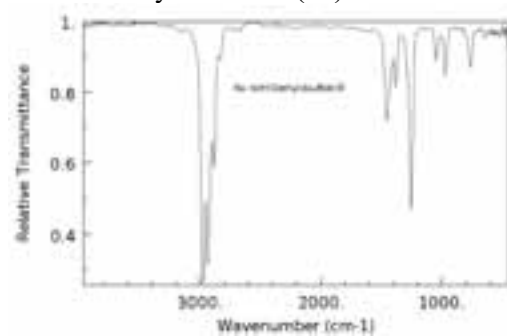
1698 Butyl ethyl disulfide (MS)



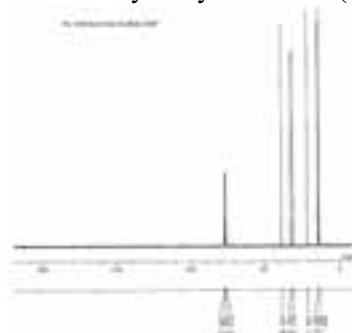
1697 Amyl methyl disulfide (MS)



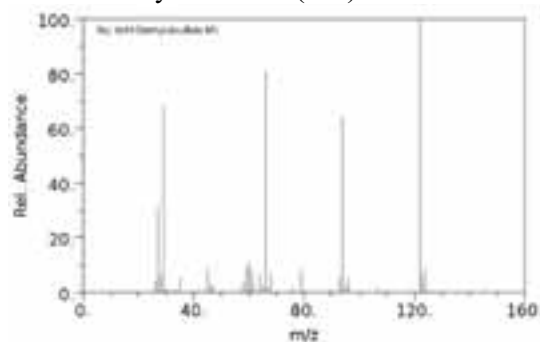
1699 Diethyl disulfide (IR)



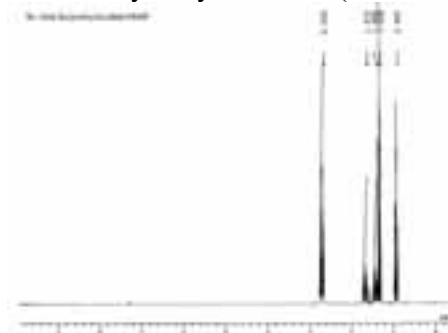
1698 Butyl ethyl disulfide (13C-NMR)



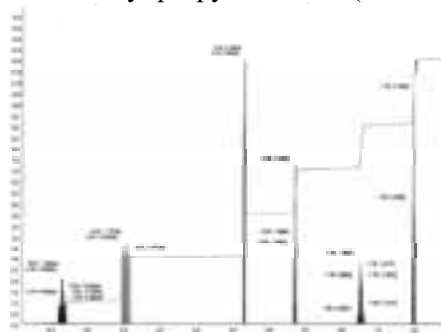
1699 Diethyl disulfide (MS)



1698 Butyl ethyl disulfide (1H-NMR)



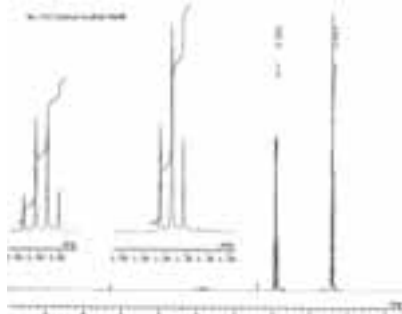
1700 Allyl propyl disulfide (1H-NMR)



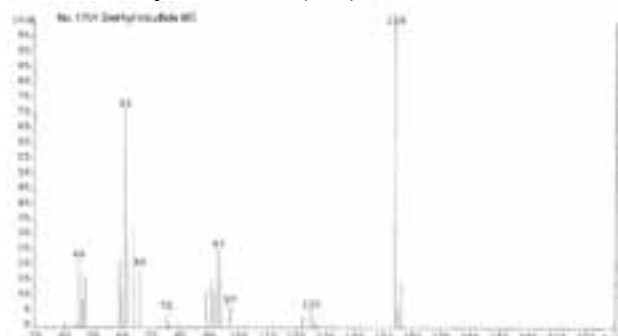
1701 Diethyl trisulfide (13C-NMR)



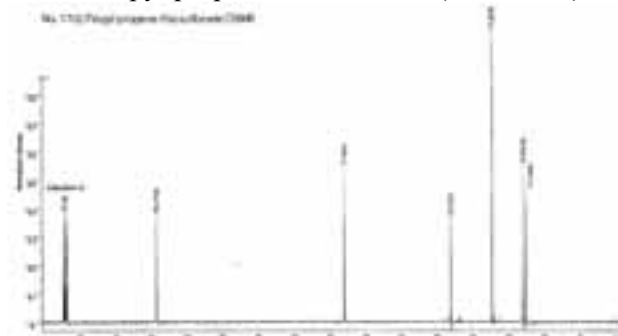
1701 Diethyl trisulfide (1H-NMR)



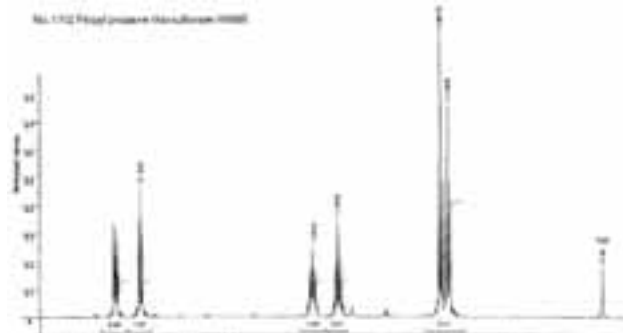
1701 Diethyl trisulfide (MS)



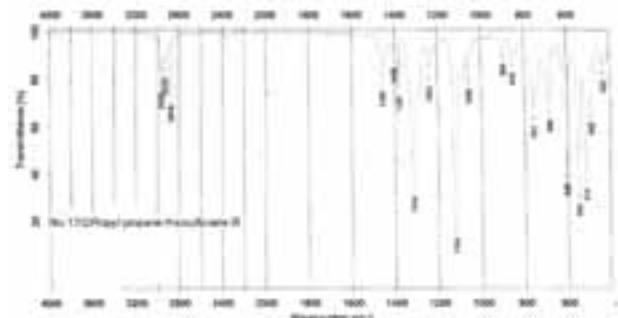
1702 Propyl propane thiosulfonate (13C-NMR)



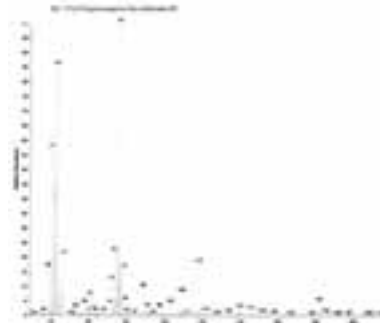
1702 Propyl propane thiosulfonate (1H-NMR)



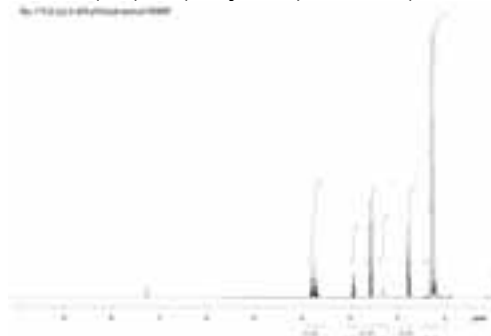
1702 Propyl propane thiosulfonate (IR)



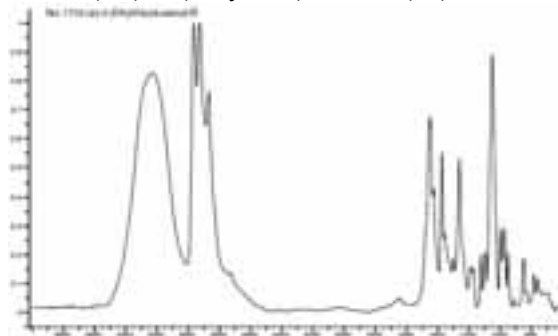
1702 Propyl propane thiosulfonate (MS)



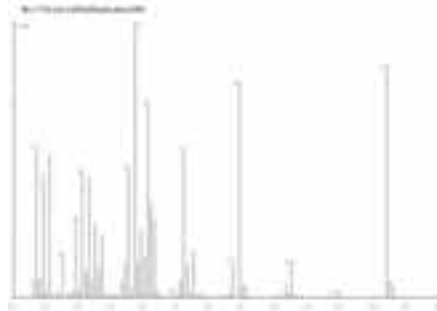
1703 (+/-)-3-(Ethylthio)butanol (1H-NMR)



1703 (+/-)-3-(Ethylthio)butanol (IR)



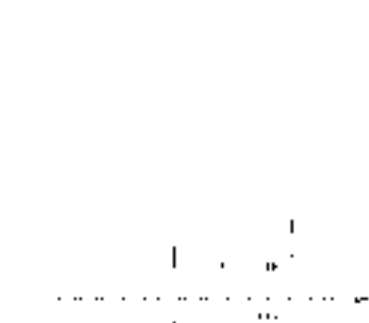
1703 (+/-)-3-(Ethylthio)butanol (MS)



1704 Hexyl 3-mercaptoputanoate (1H-NMR)



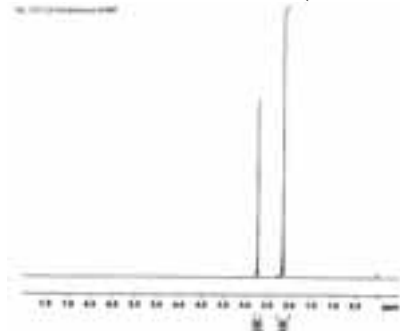
1705 (+/-)-3-Mercapto-1-butyl acetate (1H-NMR)



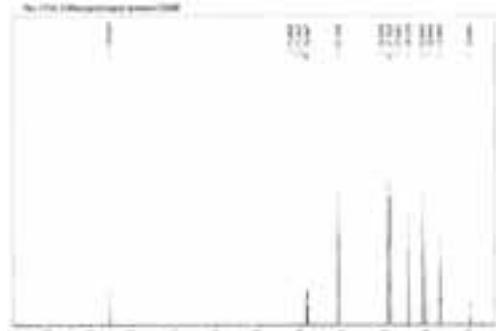
1706 3-Mercapto-3-methyl-1-butyl acetate (1H-NMR)



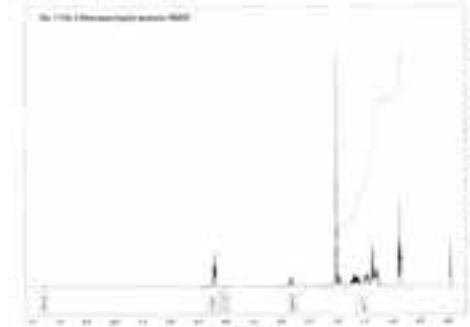
1707 2,5-Dithiahexane (1H-NMR)



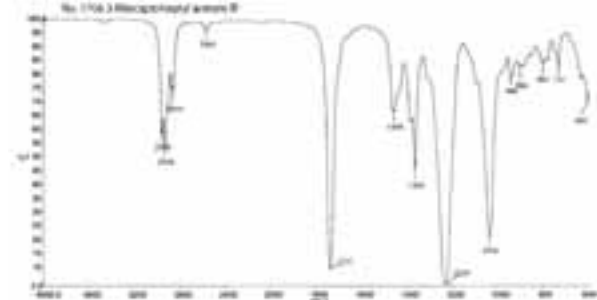
1708 3-Mercaptoheptyl acetate (13C-NMR)



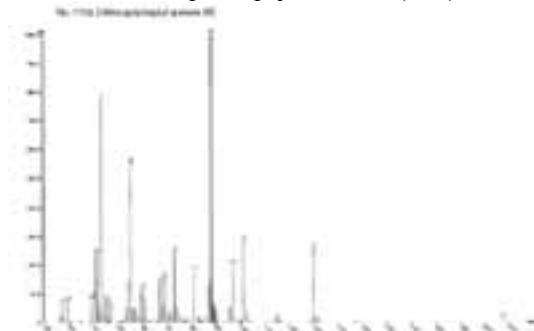
1708 3-Mercaptoheptyl acetate (1H-NMR)



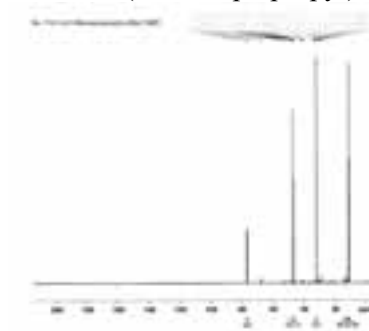
1708 3-Mercaptoheptyl acetate (IR)



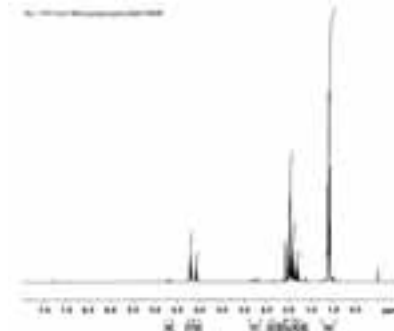
1708 3-Mercaptoheptyl acetate (MS)



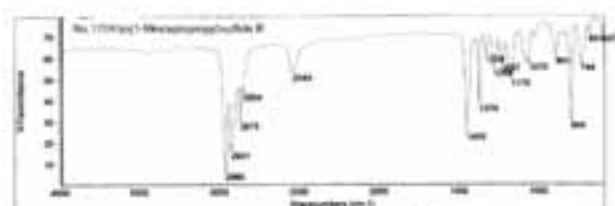
1709 bis(1-Mercaptopropyl)sulfide (13C-NMR)



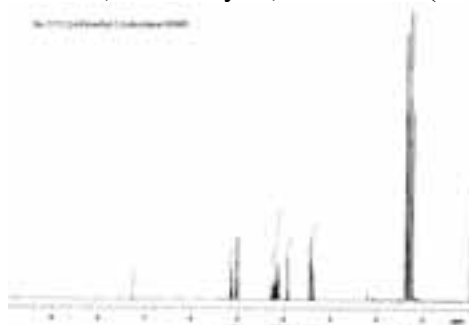
1709 bis(1-Mercaptopropyl)sulfide (1H-NMR)



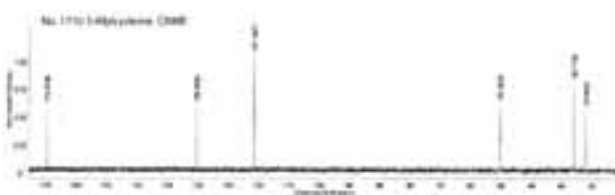
1709 bis(1-Mercaptopropyl)sulfide (IR)



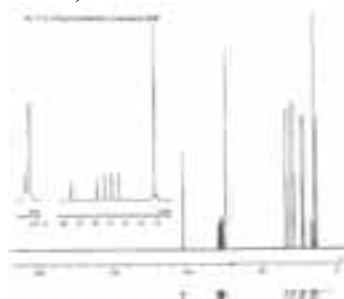
1711 2,4-Dimethyl-1,3-dioxolane (1H-NMR)



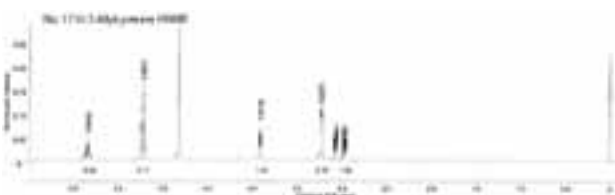
1710 S-Allyl-L-cysteine (13C-NMR)



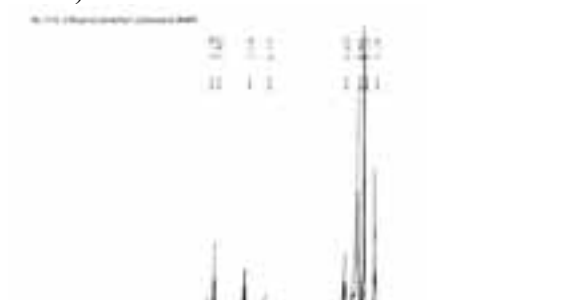
1712 2-Hexyl-4,5-dimethyl-1,3-dioxolane (13C-NMR)



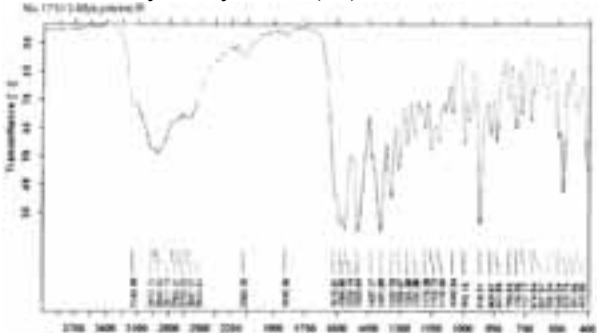
1710 S-Allyl-L-cysteine (1H-NMR)



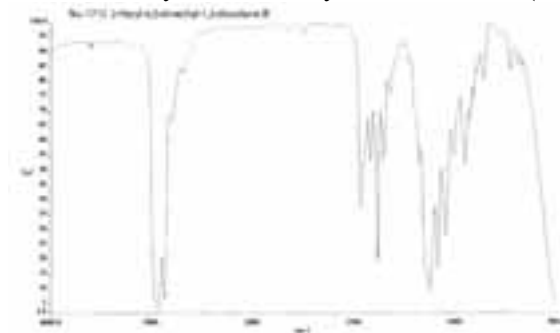
1712 2-Hexyl-4,5-dimethyl-1,3-dioxolane (1H-NMR)



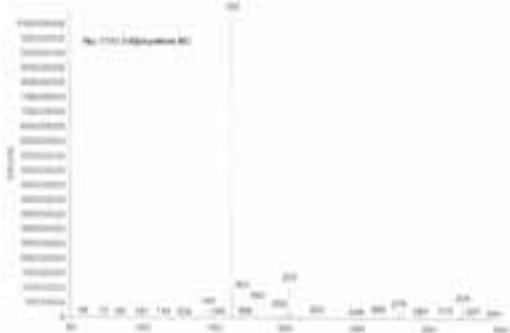
1710 S-Allyl-L-cysteine (IR)



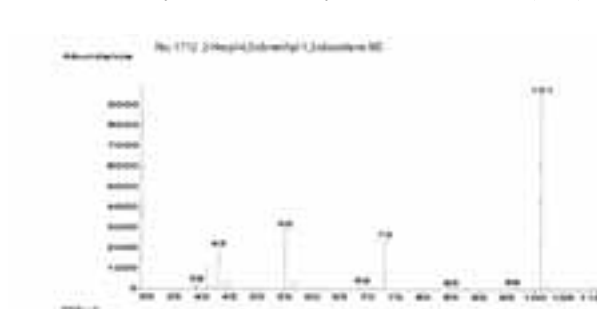
1712 2-Hexyl-4,5-dimethyl-1,3-dioxolane (IR)



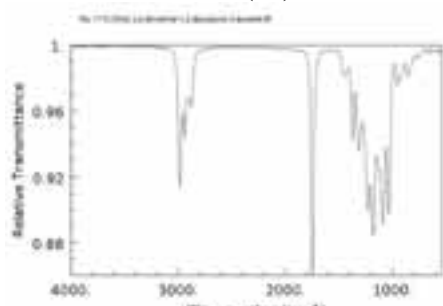
1710 S-Allyl-L-cysteine (MS)



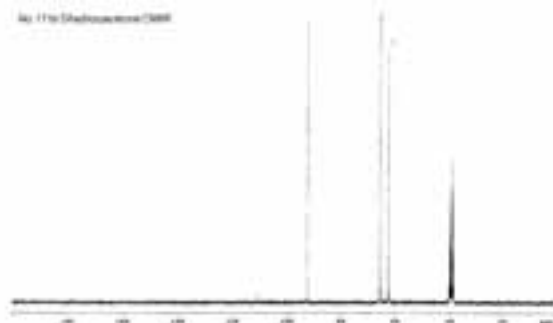
1712 2-Hexyl-4,5-dimethyl-1,3-dioxolane (MS)



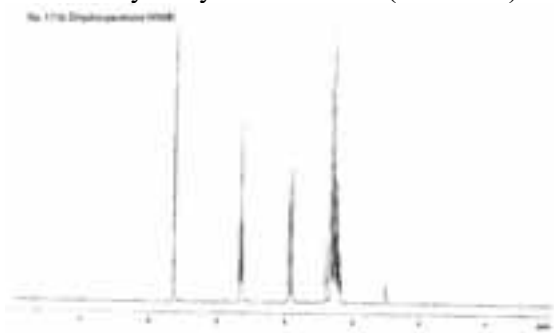
1715 cis- and trans-Ethyl 2,4-dimethyl-1,3-dioxolane-2-acetate (IR)



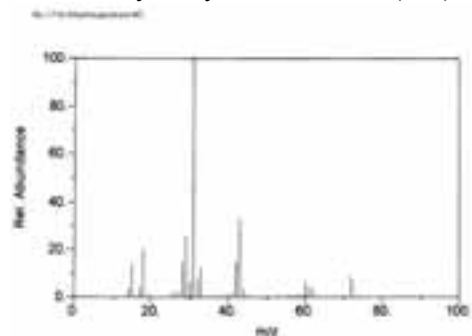
1716 Dihydroxyacetone dimer (13C-NMR)



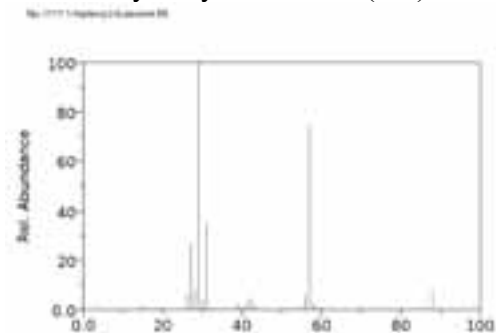
1716 Dihydroxyacetone dimer (1H-NMR)



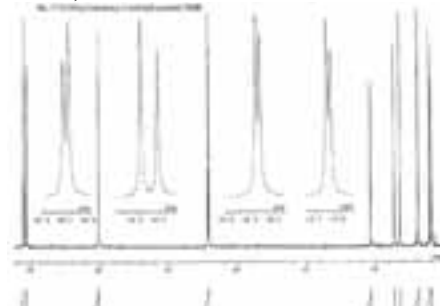
1716 Dihydroxyacetone dimer (MS)



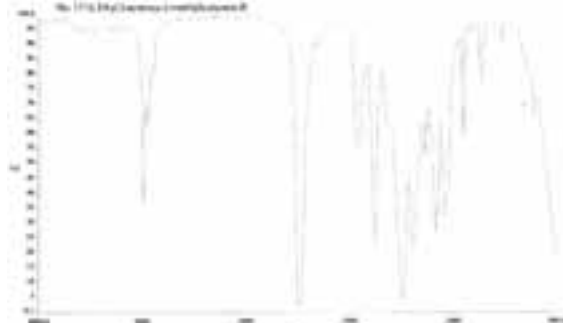
1717 1-Hydroxy-2-butanone (MS)



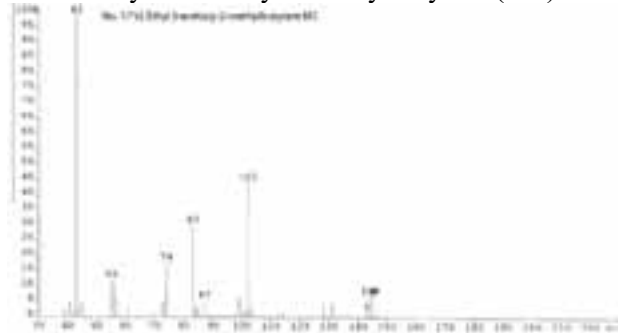
1718 Ethyl 3-acetoxy-2-methylbutyrate (13C-NMR)



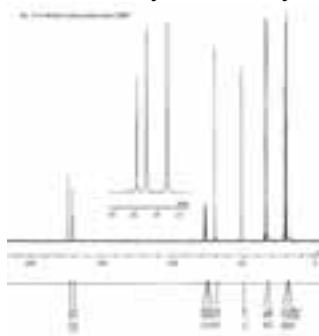
1718 Ethyl 3-acetoxy-2-methylbutyrate (IR)



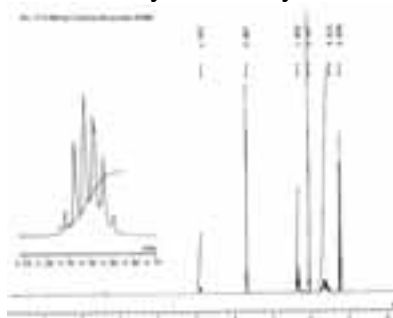
1718 Ethyl 3-acetoxy-2-methylbutyrate (MS)



1719 Methyl 5-acetoxyhexanoate (13C-NMR)



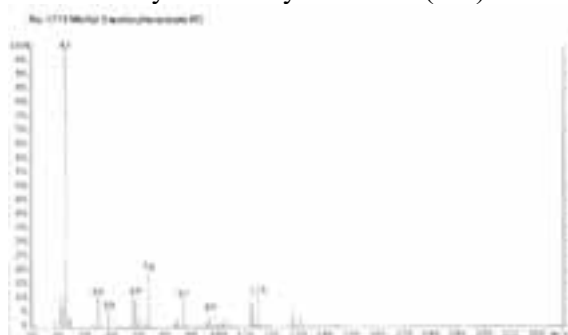
1719 Methyl 5-acetoxyhexanoate (1H-NMR)



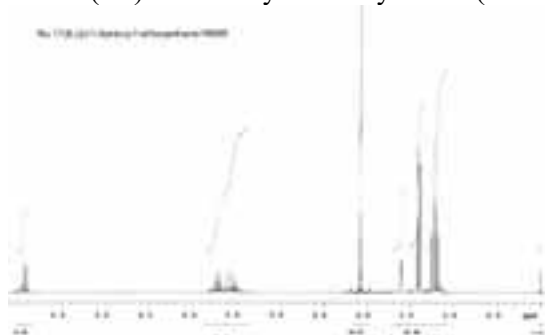
1719 Methyl 5-acetoxyhexanoate (IR)



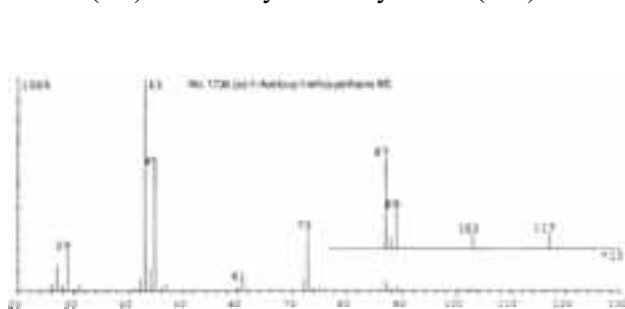
1719 Methyl 5-acetoxyhexanoate (MS)



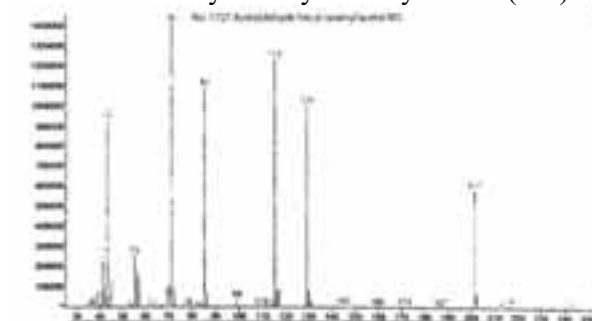
1726 (+/-)-1-Acetoxy-1-ethoxyethane (1H-NMR)



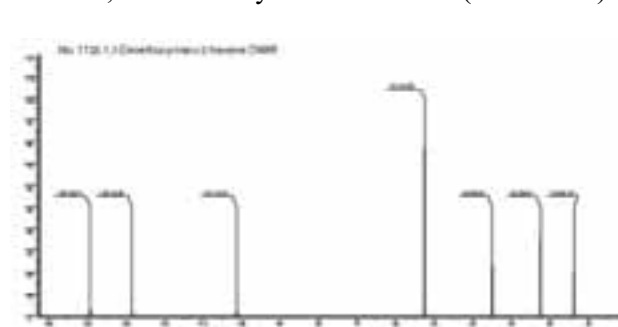
1726 (+/-)-1-Acetoxy-1-ethoxyethane (MS)



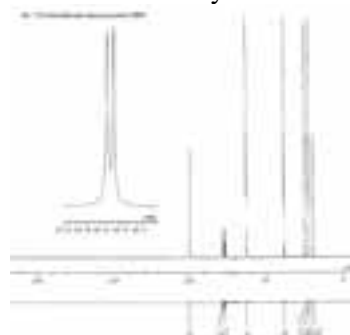
1727 Acetaldehyde hexyl isoamyl acetal (MS)



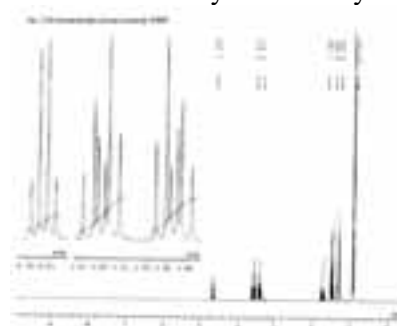
1728 1,1-Dimethoxy-trans-2-hexene (13C-NMR)



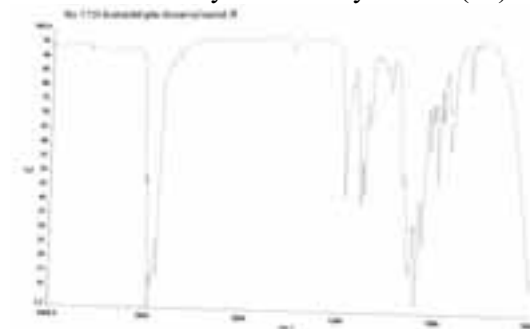
1729 Acetaldehyde diisoamyl acetal (13C-NMR)



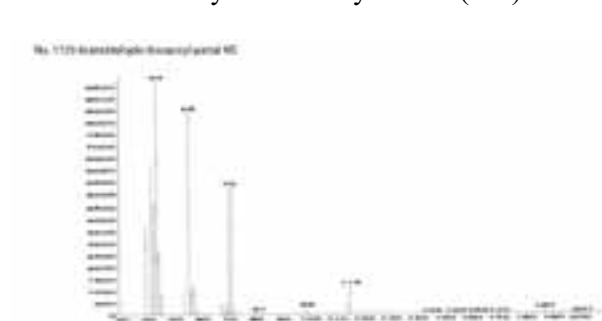
1729 Acetaldehyde diisoamyl acetal (1H-NMR)



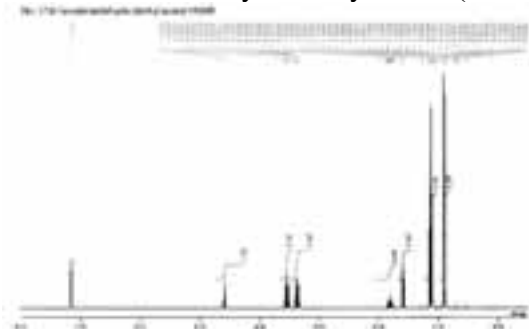
1729 Acetaldehyde diisoamyl acetal (IR)



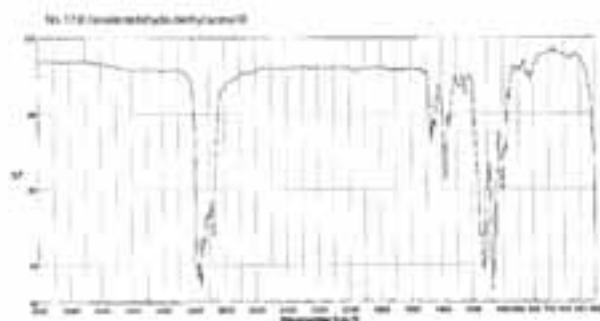
1729 Acetaldehyde diisoamyl acetal (MS)



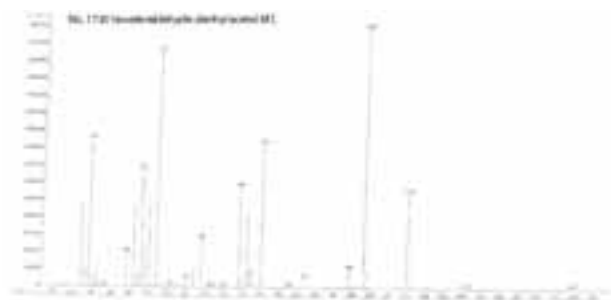
1730 Isovaleraldehyde diethyl acetal (1H-NMR)



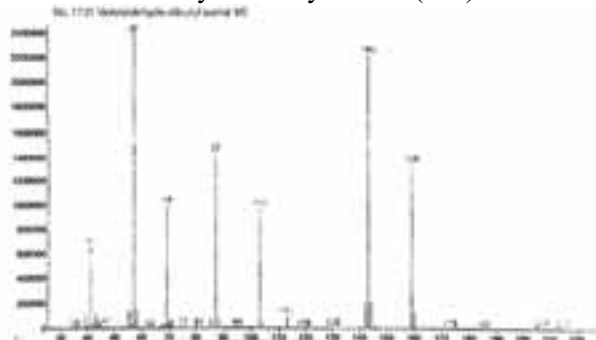
1730 Isovaleraldehyde diethyl acetal (IR)



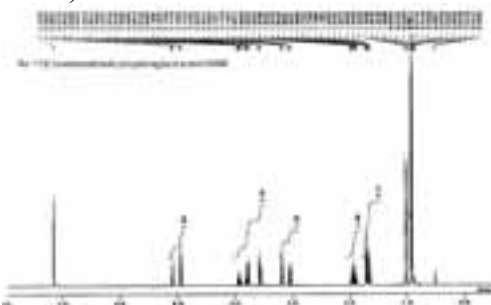
1730 Isovaleraldehyde diethyl acetal (MS)



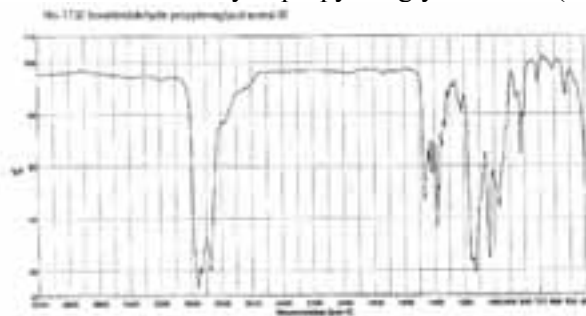
1731 Valeraldehyde dibutyl acetal (MS)



1732 Isovaleraldehyde propyleneglycol acetal (1H-NMR)



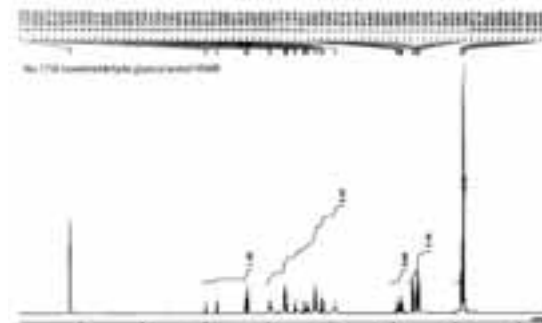
1732 Isovaleraldehyde propyleneglycol acetal (IR)



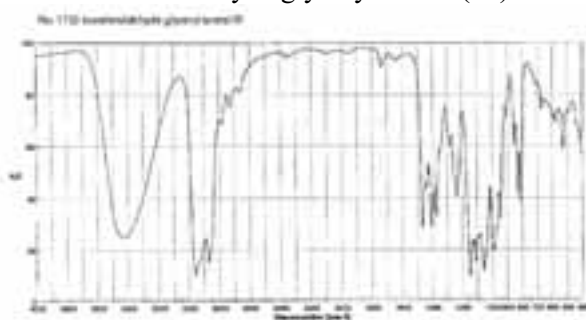
1732 Isovaleraldehyde propyleneglycol acetal (MS)



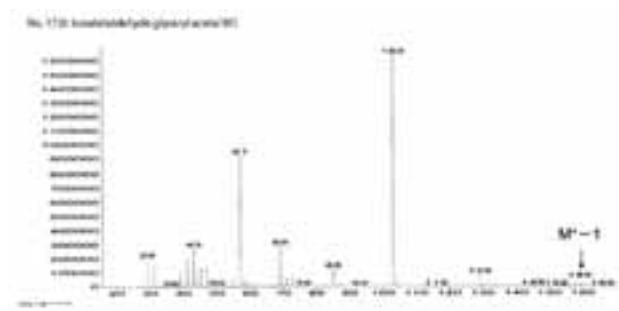
1733 Isovaleraldehyde glyceryl acetal (1H-NMR)



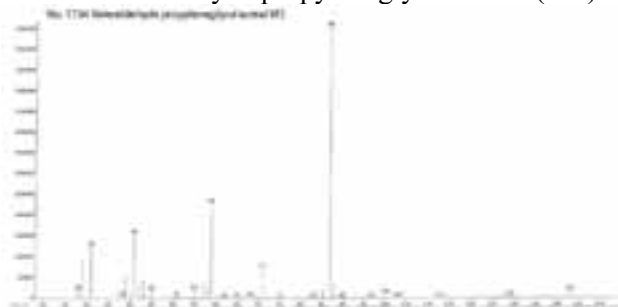
1733 Isovaleraldehyde glyceryl acetal (IR)



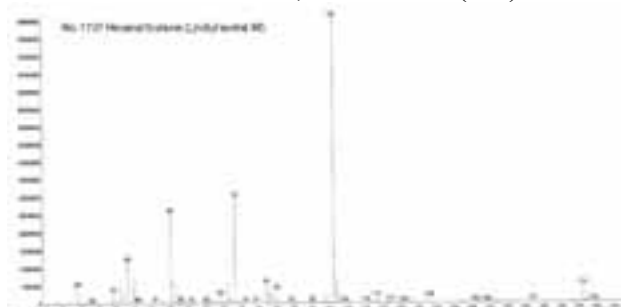
1733 Isovaleraldehyde glyceryl acetal (MS)



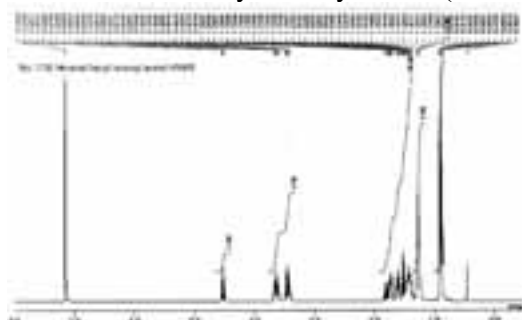
1734 Valeraldehyde propyleneglycol acetal (MS)



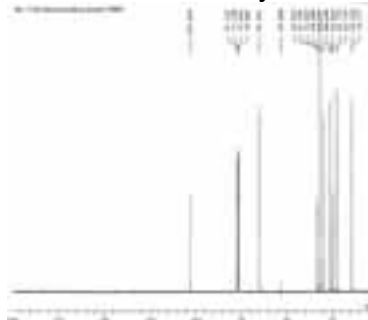
1737 Hexanal butane-2,3-diol acetal (MS)



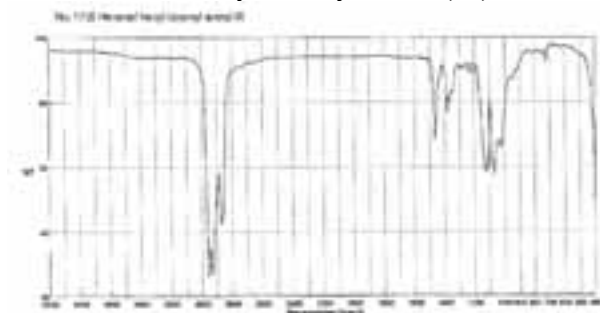
1735 Hexanal hexyl isoamyl acetal (1H-NMR)



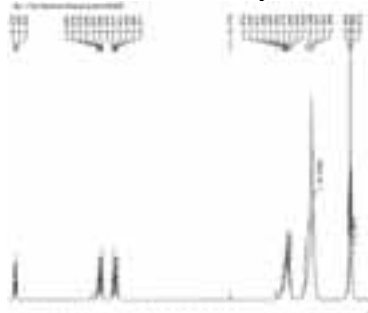
1738 Hexanal dihexyl acetal (13C-NMR)



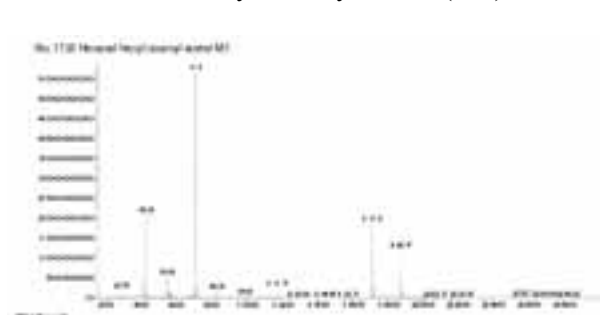
1735 Hexanal hexyl isoamyl acetal (IR)



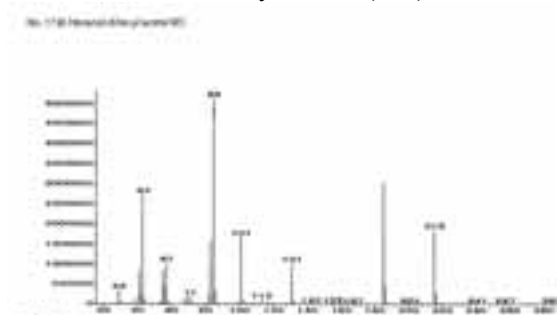
1738 Hexanal dihexyl acetal (1H-NMR)



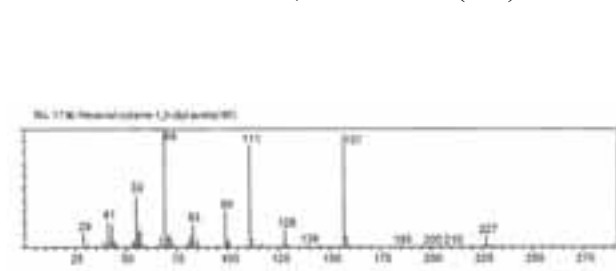
1735 Hexanal hexyl isoamyl acetal (MS)



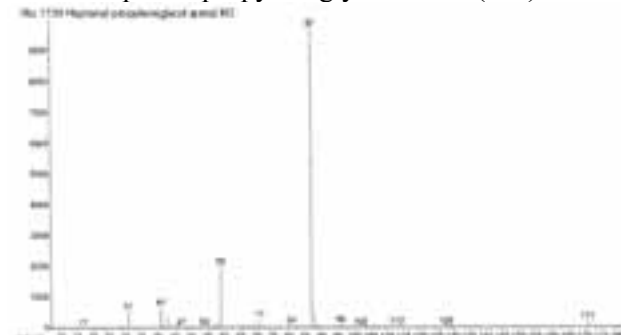
1738 Hexanal dihexyl acetal (MS)



1736 Hexanal octane-1,3-diol acetal (MS)

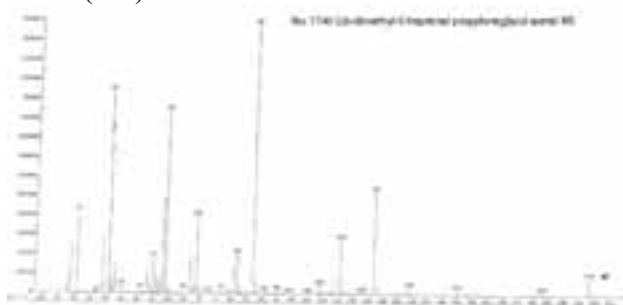


1739 Heptanal propyleneglycol acetal (MS)

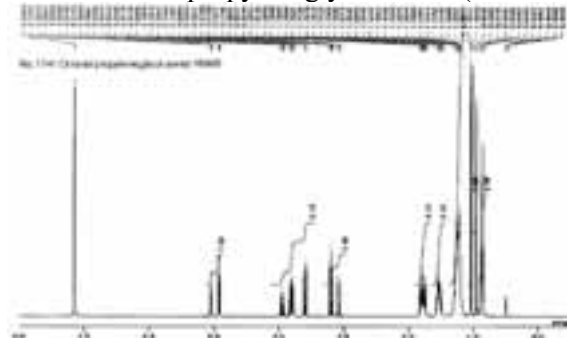




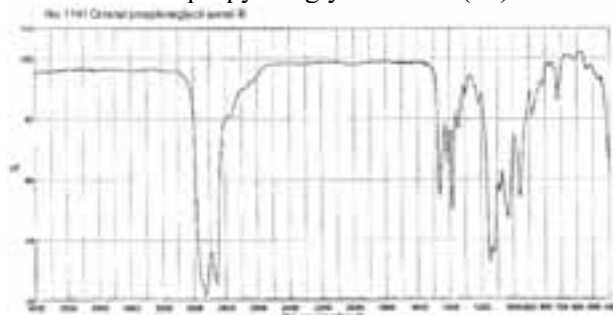
1740 2,6-Dimethyl-5-heptenal propyleneglycol acetal (MS)



1741 Octanal propyleneglycol acetal (1H-NMR)



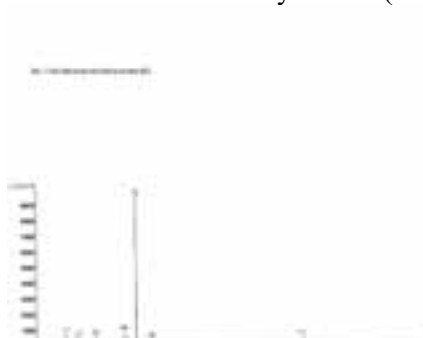
1741 Octanal propyleneglycol acetal (IR)



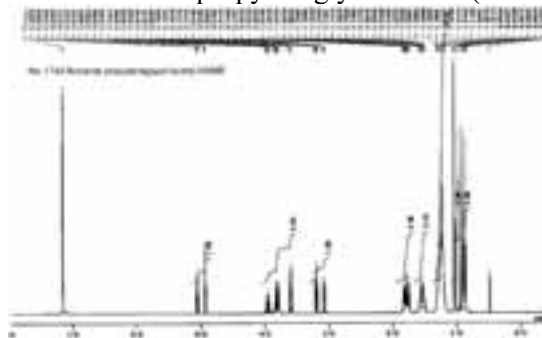
1741 Octanal propyleneglycol acetal (MS)



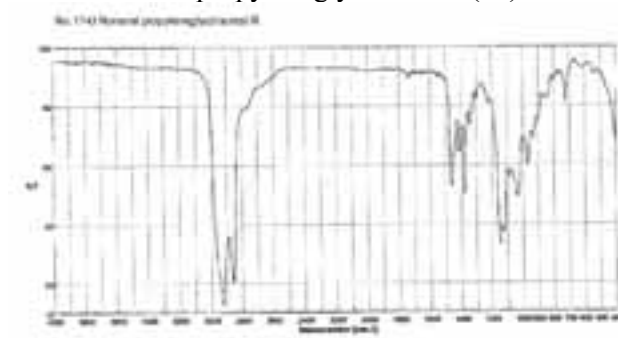
1742 Nonanal dimethyl acetal (MS)



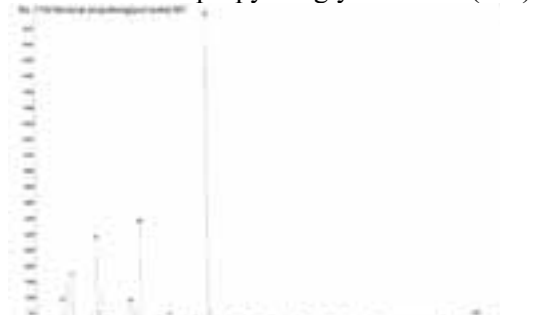
1743 Nonanal propyleneglycol acetal (1H-NMR)



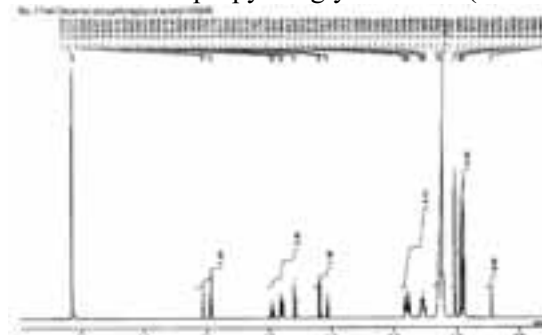
1743 Nonanal propyleneglycol acetal (IR)



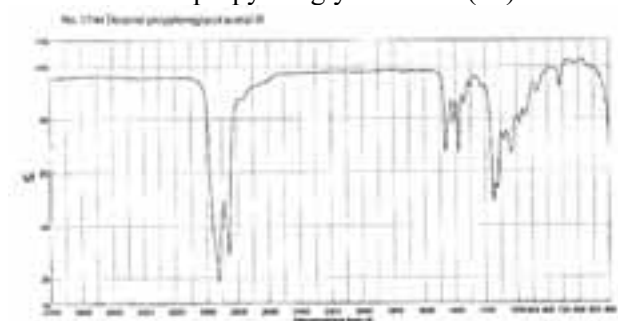
1743 Nonanal propyleneglycol acetal (MS)



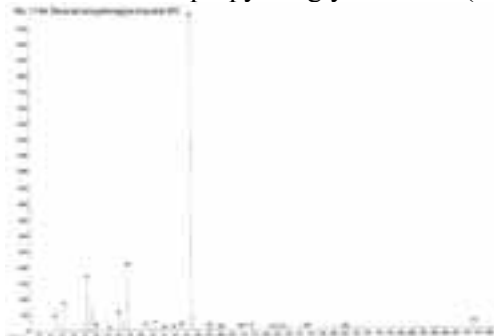
1744 Decanal propyleneglycol acetal (1H-NMR)



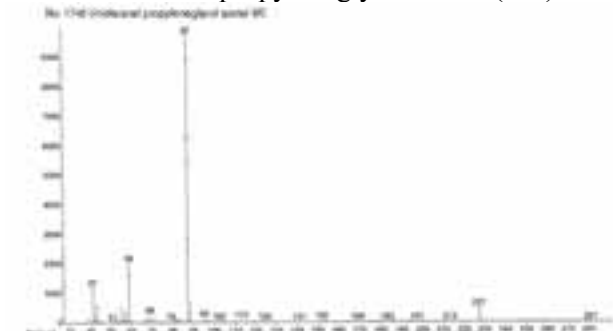
1744 Decanal propyleneglycol acetal (IR)



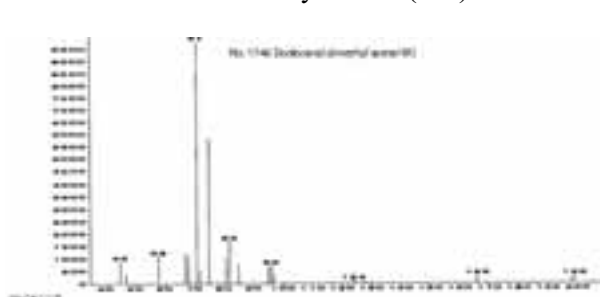
1744 Decanal propyleneglycol acetal (MS)



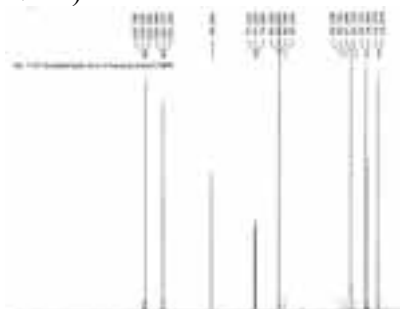
1745 Undecanal propyleneglycol acetal (MS)



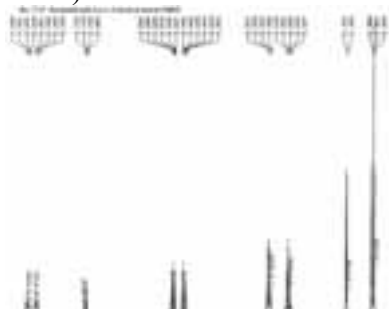
1746 Dodecanal dimethyl acetal (MS)



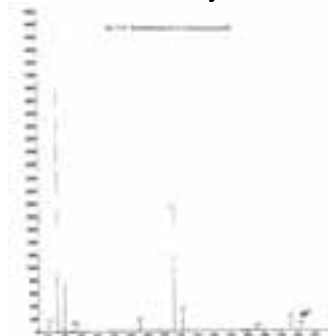
1747 Acetaldehyde di-cis-3-hexenyl acetal (13C-NMR)



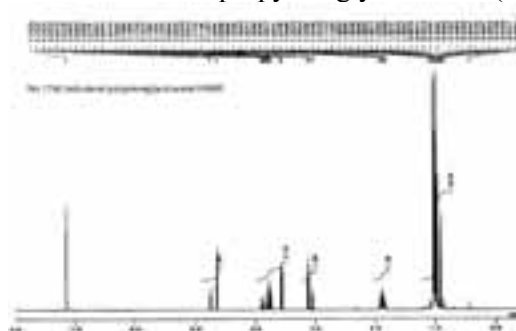
1747 Acetaldehyde di-cis-3-hexenyl acetal (1H-NMR)



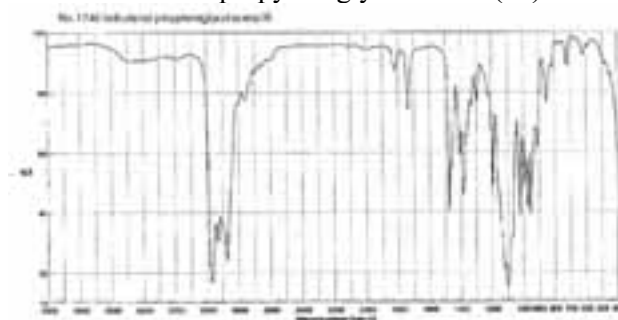
1747 Acetaldehyde di-cis-3-hexenyl acetal (MS)



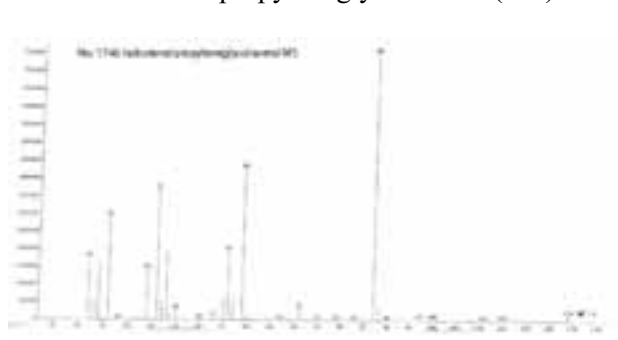
1748 Isobutanal propyleneglycol acetal (1H-NMR)



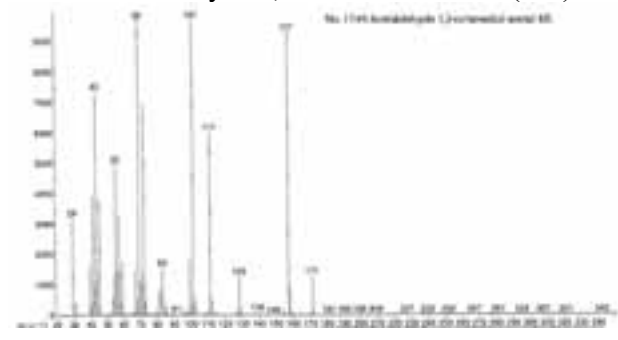
1748 Isobutanal propyleneglycol acetal (IR)



1748 Isobutanal propyleneglycol acetal (MS)



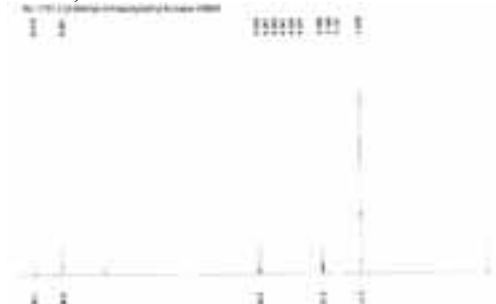
1749 Acetaldehyde 1,3-octanediol acetal (MS)



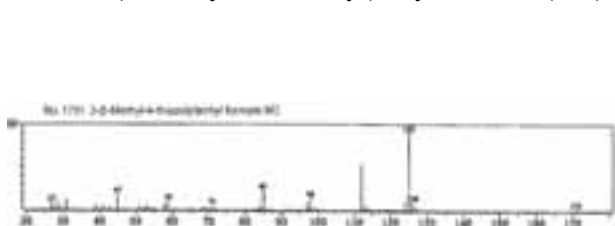
1750 1-(3-Hydroxy-5-methyl-2-thienyl)ethanone (1H-NMR)



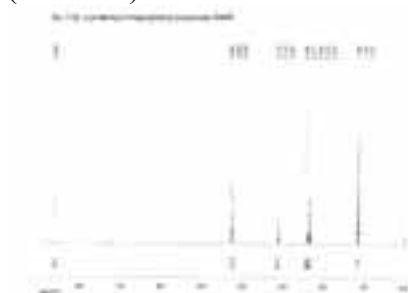
1751 2-(5-Methyl-4-thiazolyl)ethyl formate (1H-NMR)



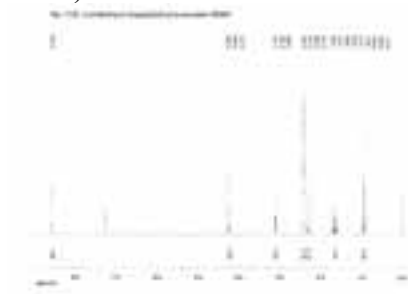
1751 2-(5-Methyl-4-thiazolyl)ethyl formate (MS)



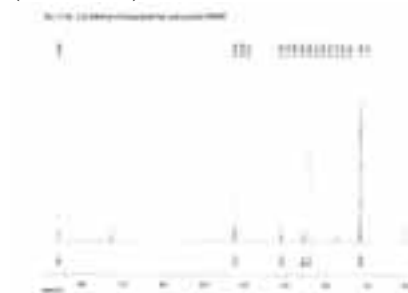
1752 2-(4-Methyl-5-thiazolyl)ethyl propionate (1H-NMR)



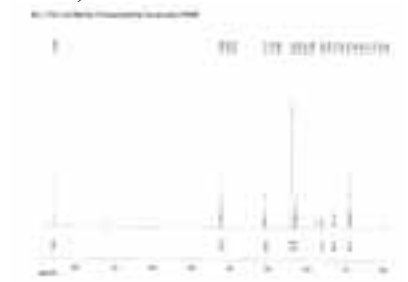
1753 2-(4-Methyl-5-thiazolyl)ethyl butanoate (1H-NMR)



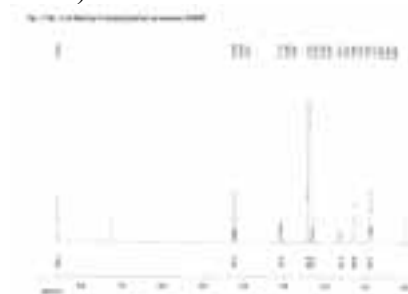
1754 2-(4-Methyl-5-thiazolyl)ethyl isobutyrate (1H-NMR)



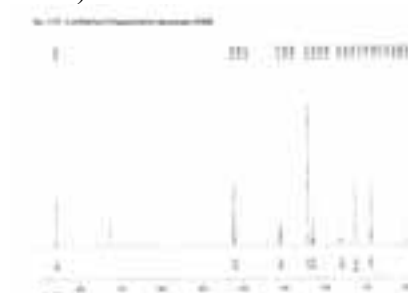
1755 2-(4-Methyl-5-thiazolyl)ethyl hexanoate (1H-NMR)



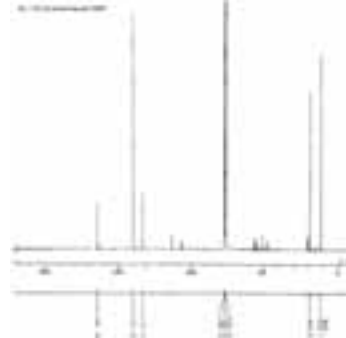
1756 2-(4-Methyl-5-thiazolyl)ethyl octanoate (1H-NMR)



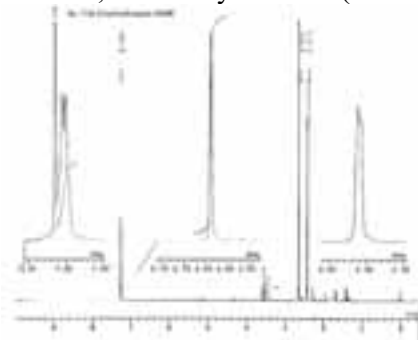
1757 2-(4-Methyl-5-thiazolyl)ethyl decanoate (1H-NMR)



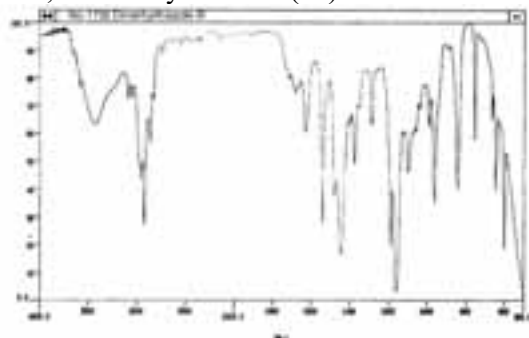
1758 2,5-Dimethylthiazole (13C-NMR)



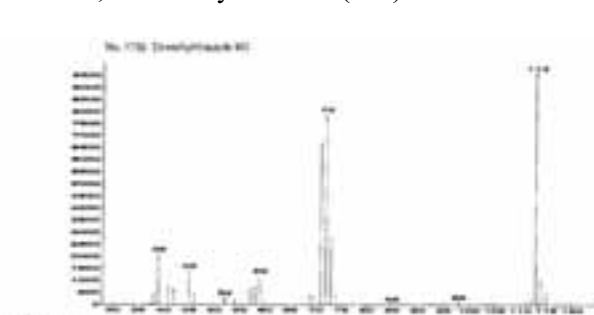
1758 2,5-Dimethylthiazole (1H-NMR)



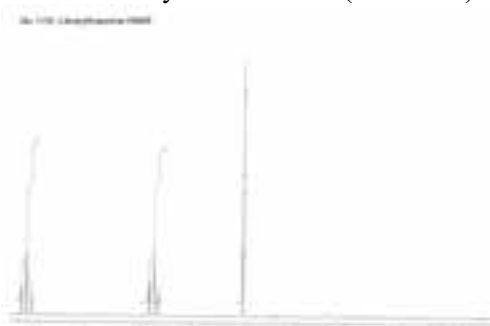
1758 2,5-Dimethylthiazole (IR)



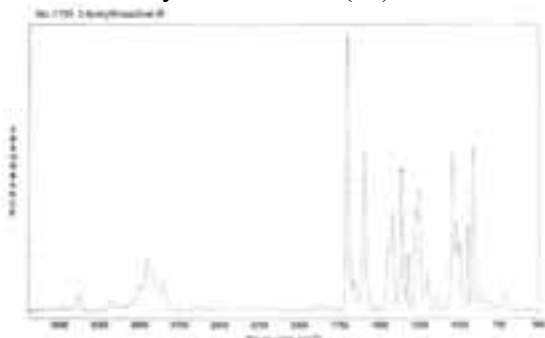
1758 2,5-Dimethylthiazole (MS)



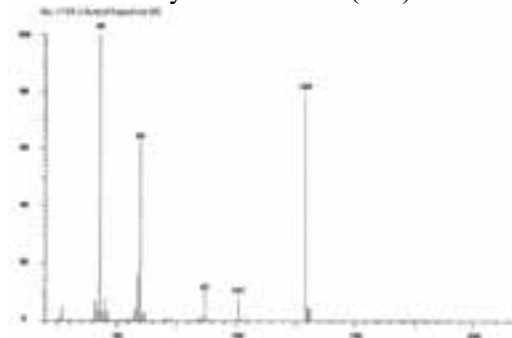
1759 2-Acetyl-2-thiazoline (1H-NMR)



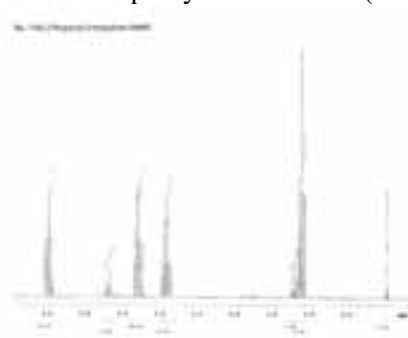
1759 2-Acetyl-2-thiazoline (IR)



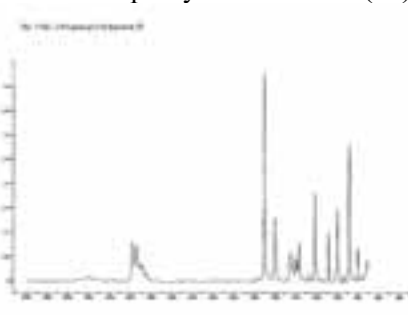
1759 2-Acetyl-2-thiazoline (MS)



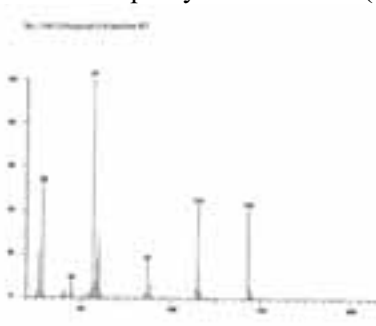
1760 2-Propionyl-2-thiazoline (1H-NMR)



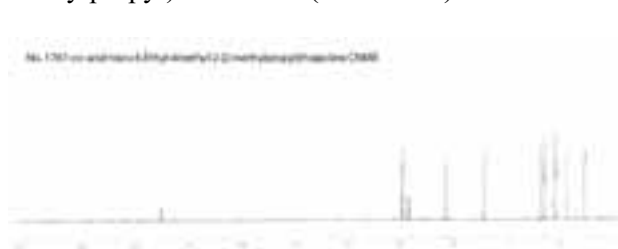
1760 2-Propionyl-2-thiazoline (IR)



1760 2-Propionyl-2-thiazoline (MS)



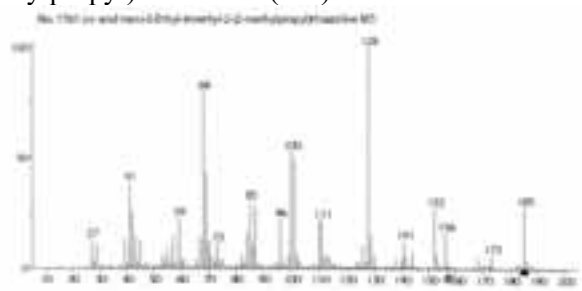
1761 cis- and trans-5-Ethyl-4-methyl-2-(2-methylpropyl)-thiazoline (13C-NMR)



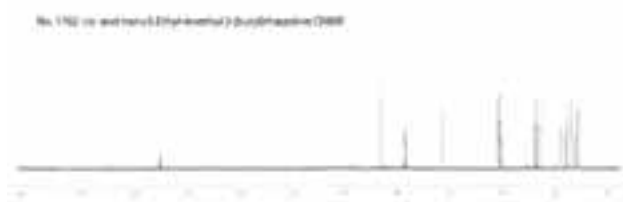
1761 cis- and trans-5-Ethyl-4-methyl-2-(2-methylpropyl)-thiazoline (1H-NMR)



1761 cis- and trans-5-Ethyl-4-methyl-2-(2-methylpropyl)-thiazoline (MS)



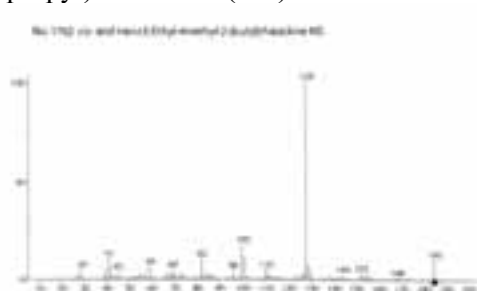
1762 cis- and trans-5-Ethyl-4-methyl-2-(1-methylpropyl)-thiazoline (13C-NMR)



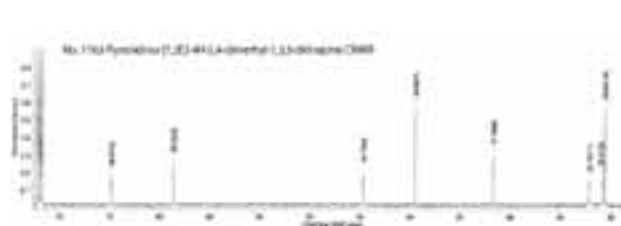
1762 cis- and trans-5-Ethyl-4-methyl-2-(1-methylpropyl)-thiazoline (1H-NMR)



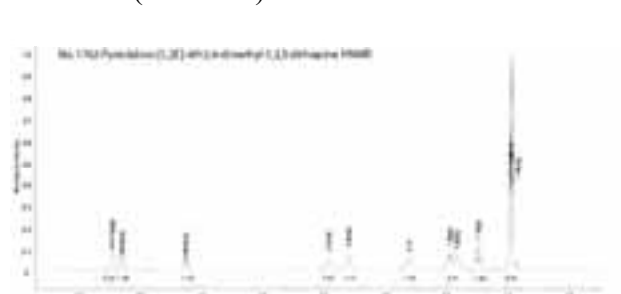
1762 cis- and trans-5-Ethyl-4-methyl-2-(1-methylpropyl)-thiazoline (MS)



1763 Pyrrolidino-[1,2e]-4H-2,4-dimethyl-1,3,5-dithiazine (13C-NMR)



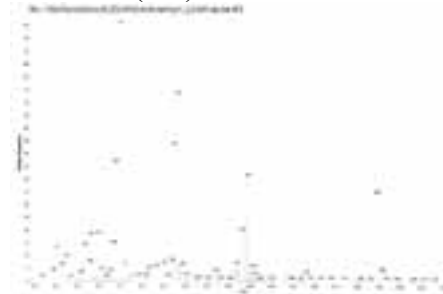
1763 Pyrrolidino-[1,2e]-4H-2,4-dimethyl-1,3,5-dithiazine (1H-NMR)



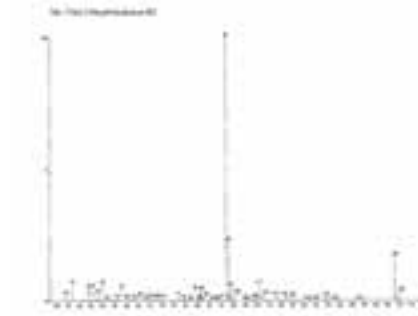
1763 Pyrrolidino-[1,2e]-4H-2,4-dimethyl-1,3,5-dithiazine (IR)



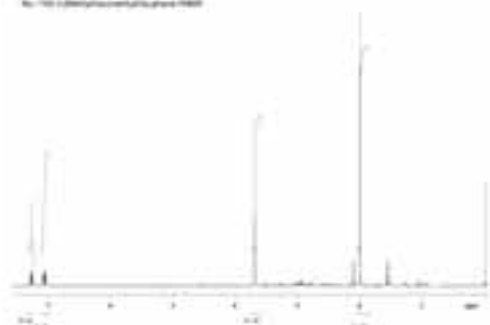
1763 Pyrrolidino-[1,2e]-4H-2,4-dimethyl-1,3,5-dithiazine (MS)



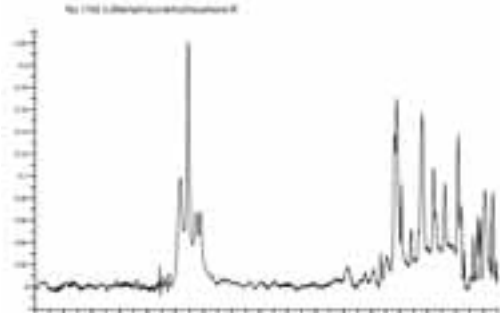
1764 2-Hexylthiophene (MS)



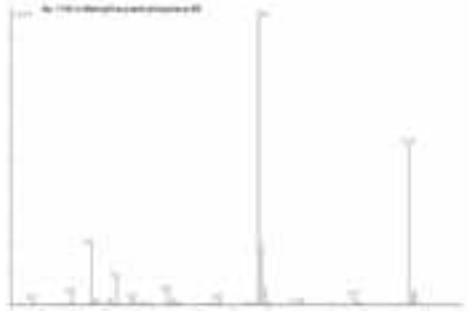
1765 3-(Methylthio)methylthiophene (1H-NMR)



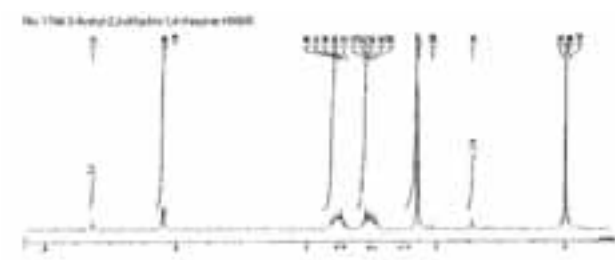
1765 3-(Methylthio)methylthiophene (IR)



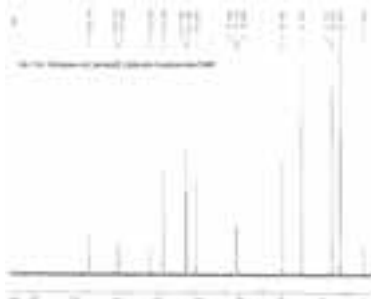
1765 3-(Methylthio)methylthiophene (MS)



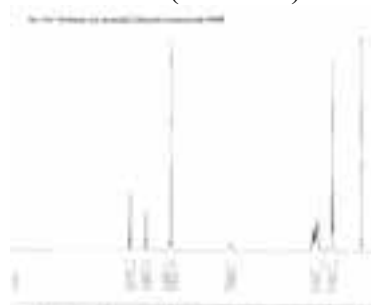
1766 5-Acetyl-2,3-dihydro-1,4-thiazine (1H-NMR)



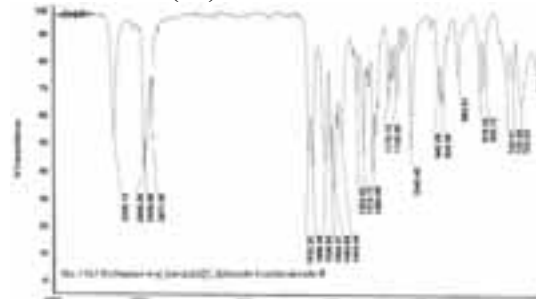
1767 N-Heptan-4-yl)benzo[d][1,3]dioxole-5-carboxamide (13C-NMR)



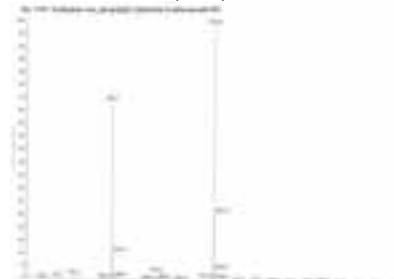
1767 N-Heptan-4-yl)benzo[d][1,3]dioxole-5-carboxamide (1H-NMR)



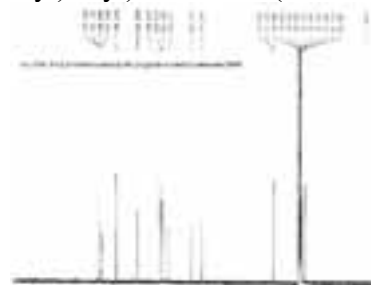
1767 N-Heptan-4-yl)benzo[d][1,3]dioxole-5-carboxamide (IR)



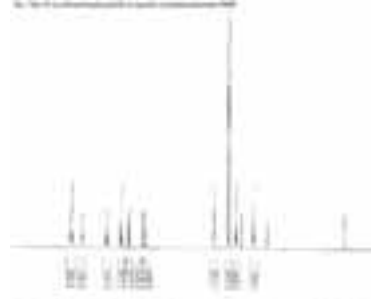
1767 N-Heptan-4-yl)benzo[d][1,3]dioxole-5-carboxamide (MS)



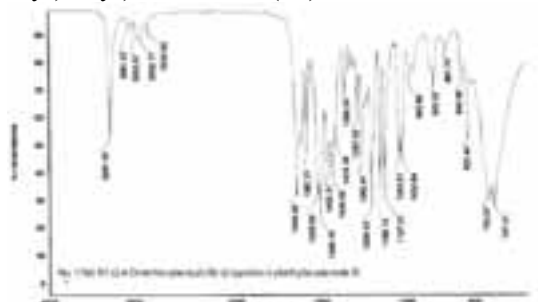
1768 N1-(2,4-Dimethoxybenzyl)-N2-(2-(pyridin-2-yl)ethyl)oxalamide (13C-NMR)



1768 N1-(2,4-Dimethoxybenzyl)-N2-(2-(pyridin-2-yl)ethyl)oxalamide (1H-NMR)



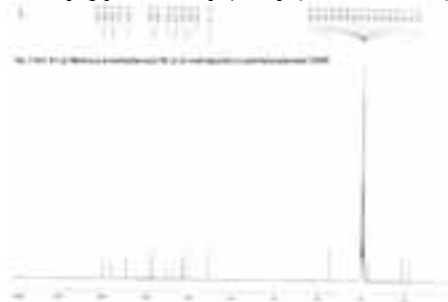
1768 N1-(2,4-Dimethoxybenzyl)-N2-(2-(pyridin-2-yl)ethyl)oxalamide (IR)



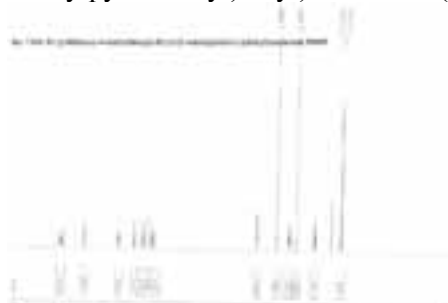
1768 N1-(2,4-Dimethoxybenzyl)-N2-(2-(pyridin-2-yl)ethyl)oxalamide (MS)



1769 N1-(2-Methoxy-4-methylbenzyl)-N2-(2-(5-methylpyridin-2-yl)ethyl)oxalamide (13C-NMR)



1769 N1-(2-Methoxy-4-methylbenzyl)-N2-(2-(5-methylpyridin-2-yl)ethyl)oxalamide (1H-NMR)



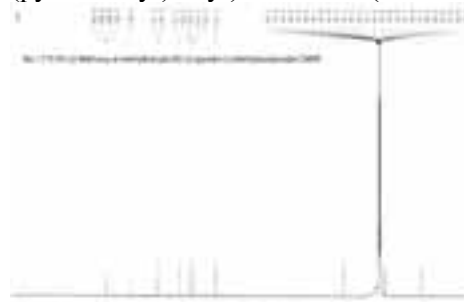
1769 N1-(2-Methoxy-4-methylbenzyl)-N2-(2-(5-methylpyridin-2-yl)ethyl)oxalamide (IR)



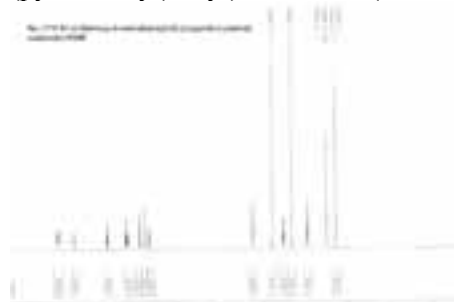
1769 N1-(2-Methoxy-4-methylbenzyl)-N2-(2-(5-methylpyridin-2-yl)ethyl)oxalamide (MS)



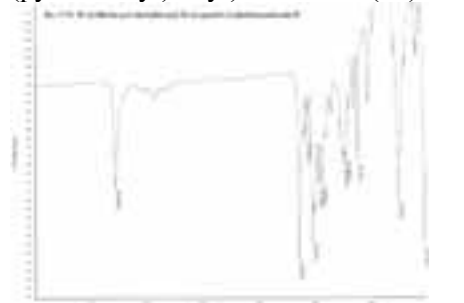
1770 N1-(2-Methoxy-4-methylbenzyl)-N2-(2-(pyridin-2-yl)ethyl)oxalamide (13C-NMR)



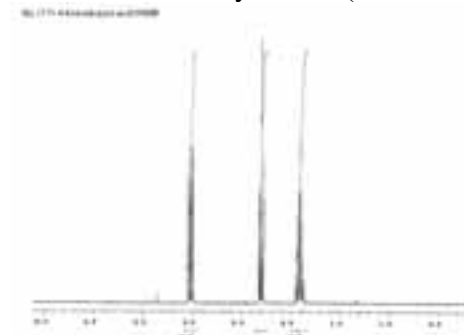
1770 N1-(2-Methoxy-4-methylbenzyl)-N2-(2-(pyridin-2-yl)ethyl)oxalamide (1H-NMR)



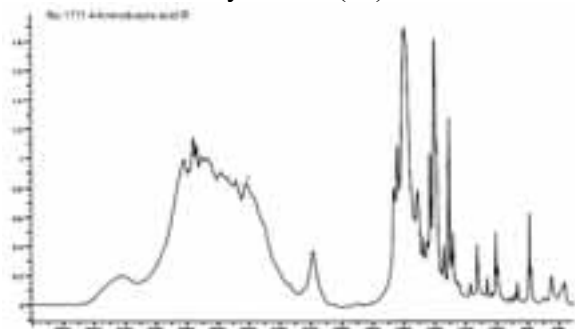
1770 N1-(2-Methoxy-4-methylbenzyl)-N2-(2-(pyridin-2-yl)ethyl)oxalamide (IR)



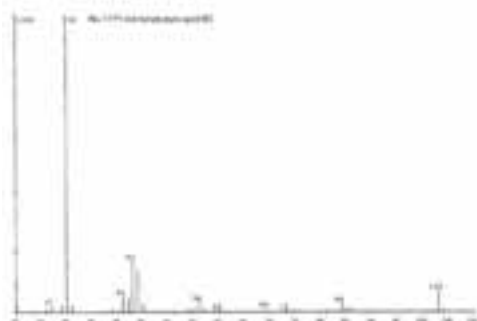
1771 4-Aminobutyric acid (1H-NMR)



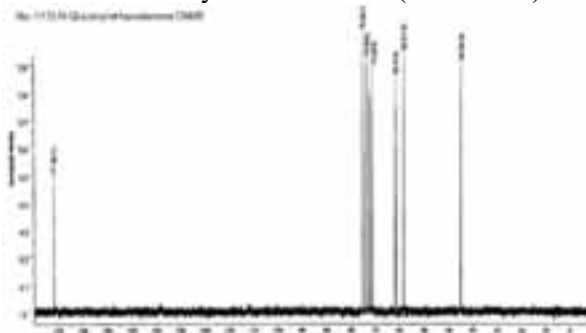
1771 4-Aminobutyric acid (IR)



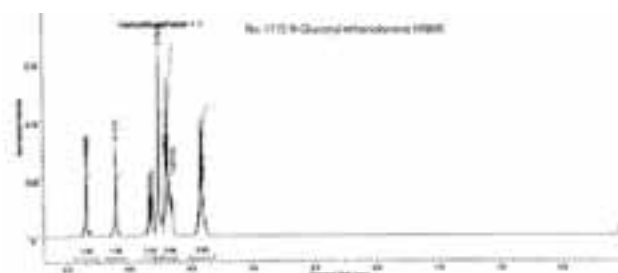
1771 4-Aminobutyric acid (MS)



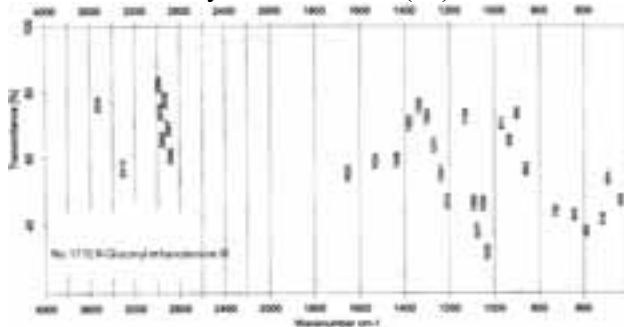
1772 N-Gluconyl ethanolamine (13C-NMR)



1772 N-Gluconyl ethanolamine (1H-NMR)



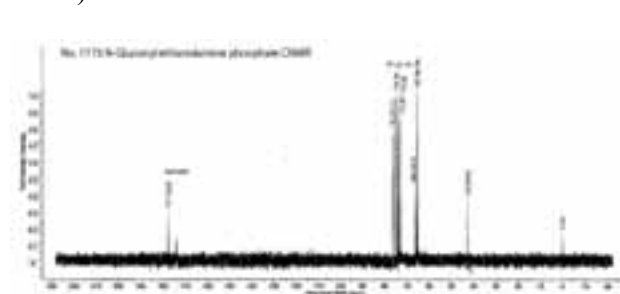
1772 N-Gluconyl ethanolamine (IR)



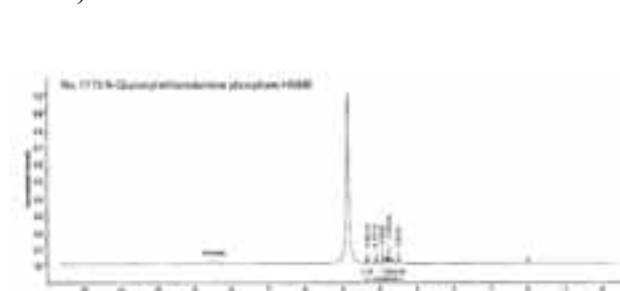
1772 N-Gluconyl ethanolamine (MS)



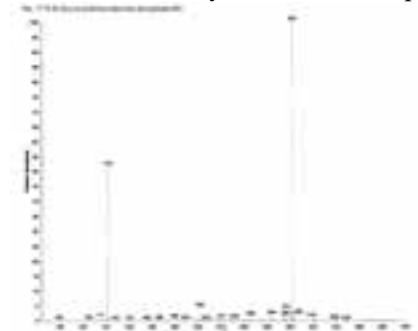
1773 N-Gluconyl ethanolamine phosphate (13C-NMR)



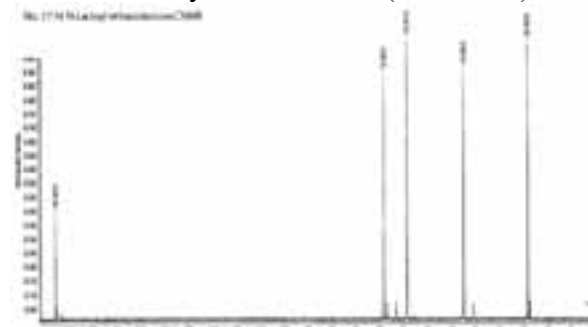
1773 N-Gluconyl ethanolamine phosphate (1H-NMR)



1773 N-Gluconyl ethanolamine phosphate (MS)

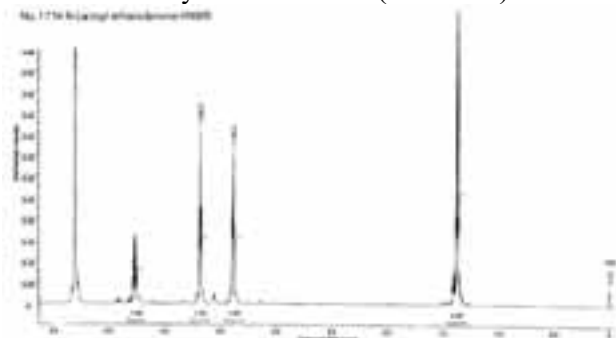


1774 N-Lactoyl ethanolamine (13C-NMR)

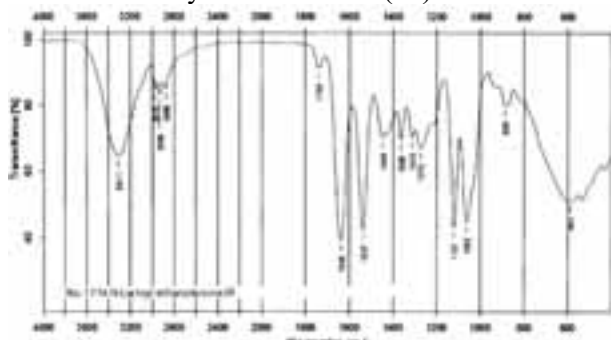




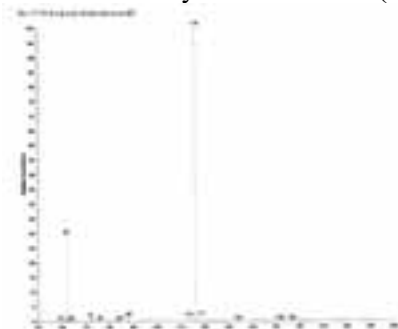
1774 N-Lactoyl ethanolamine (1H-NMR)



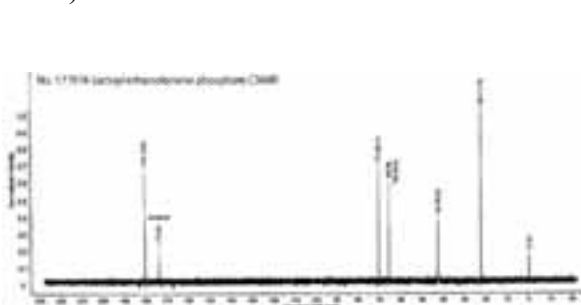
1774 N-Lactoyl ethanolamine (IR)



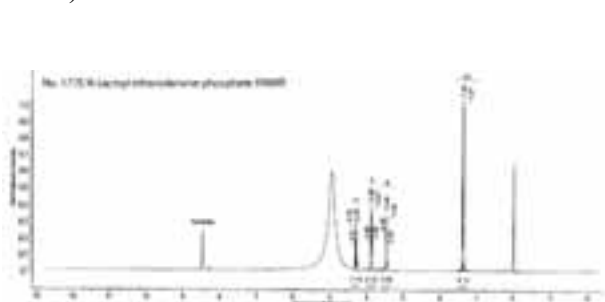
1774 N-Lactoyl ethanolamine (MS)



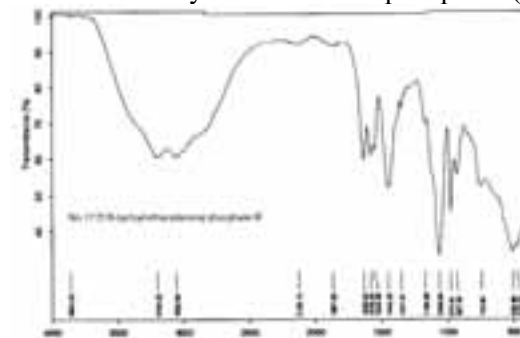
1775 N-Lactoyl ethanolamine phosphate (13C-NMR)



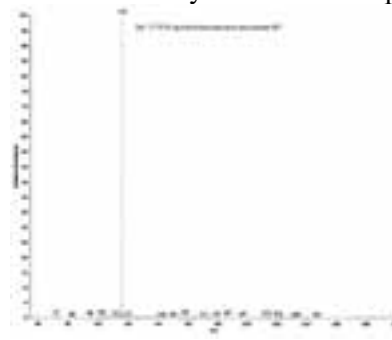
1775 N-Lactoyl ethanolamine phosphate (1H-NMR)



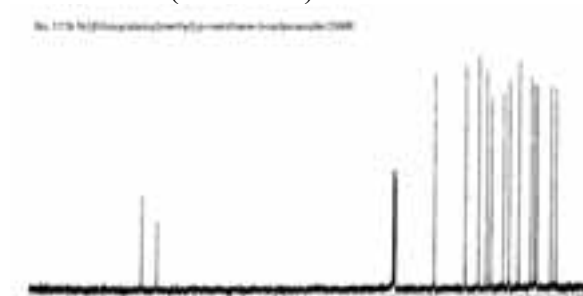
1775 N-Lactoyl ethanolamine phosphate (IR)



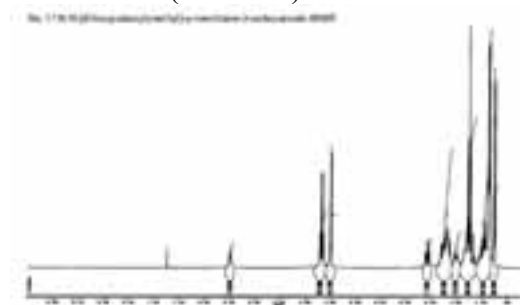
1775 N-Lactoyl ethanolamine phosphate (MS)



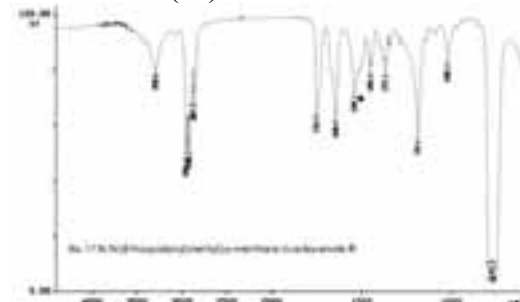
1776 N-[(Ethoxycarbonyl)methyl]-p-menthane-3-carboxamide (13C-NMR)



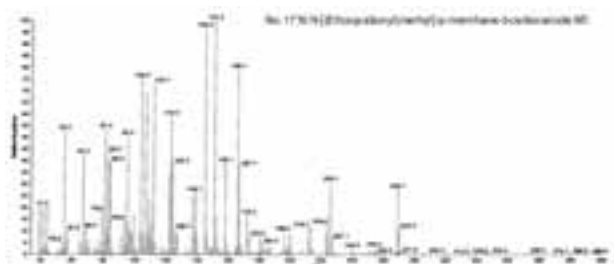
1776 N-[(Ethoxycarbonyl)methyl]-p-menthane-3-carboxamide (1H-NMR)



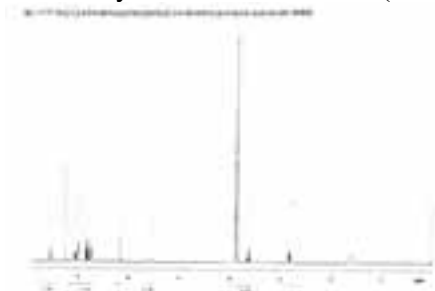
1776 N-[(Ethoxycarbonyl)methyl]-p-menthane-3-carboxamide (IR)



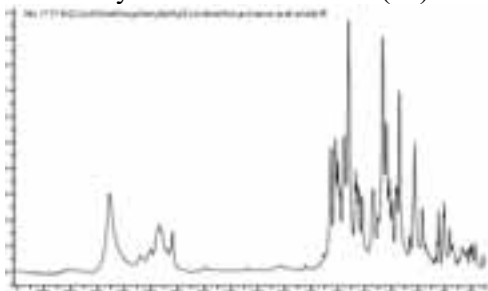
1776 N-[(Ethoxycarbonyl)methyl]-p-menthane-3-carboxamide (MS)



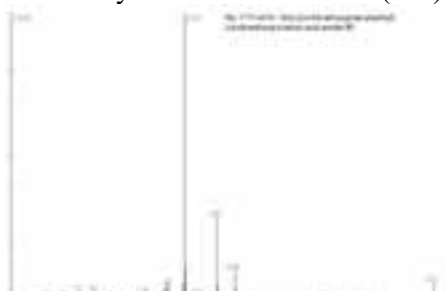
1777 N-[2-(3,4-Dimethoxyphenyl)ethyl]-3,4-dimethoxycinnamic acid amide (1H-NMR)



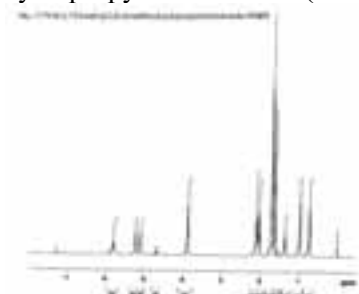
1777 N-[2-(3,4-Dimethoxyphenyl)ethyl]-3,4-dimethoxycinnamic acid amide (IR)



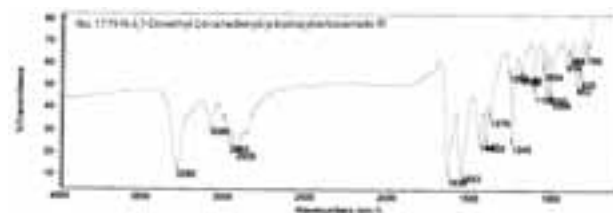
1777 N-[2-(3,4-Dimethoxyphenyl)ethyl]-3,4-dimethoxycinnamic acid amide (MS)



1779 N-3,7-Dimethyl-2,6-octadienyl cyclopropylcarboxamide (1H-NMR)



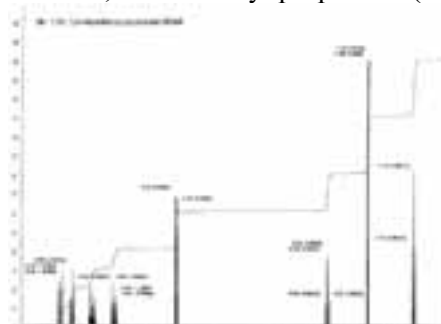
1779 N-3,7-Dimethyl-2,6-octadienyl cyclopropylcarboxamide (IR)



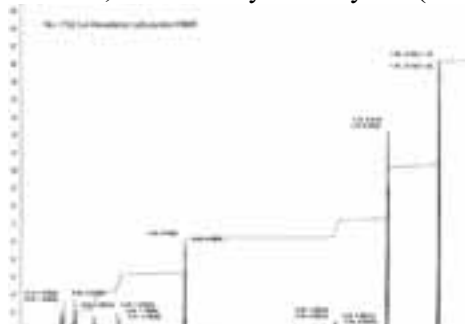
1780 2,4-Hexadienyl acetate (1H-NMR)



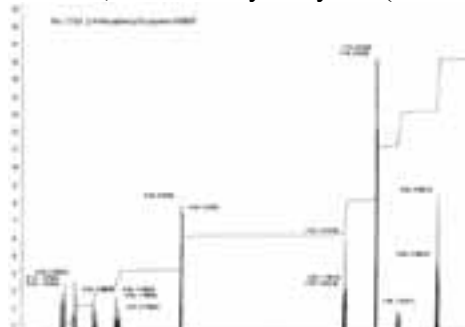
1781 2,4-Hexadienyl propionate (1H-NMR)



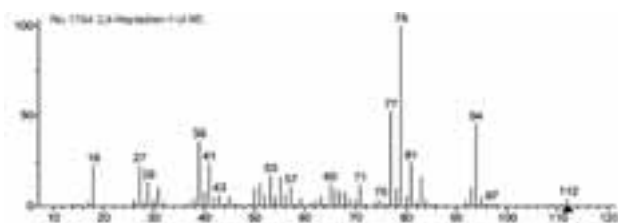
1782 2,4-Hexadienyl isobutyrate (1H-NMR)



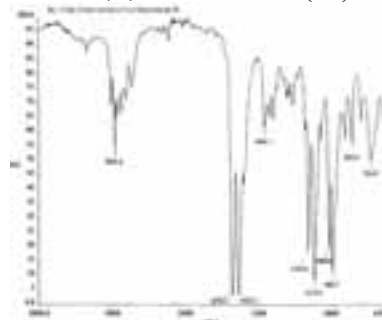
1783 2,4-Hexadienyl butyrate (1H-NMR)



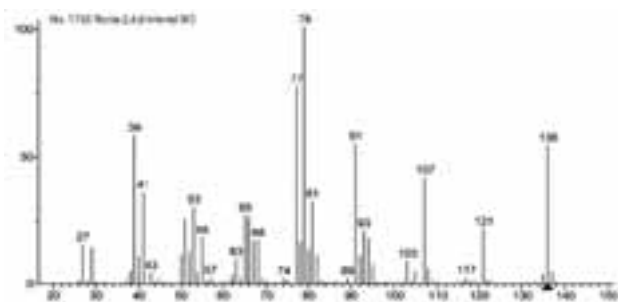
1784 2,4-Heptadien-1-ol (MS)



1786 2,4,7-Decatrienal (IR)



1785 Nona-2,4,6-trienal (MS)



## Index: Specifications of certain flavouring agents

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Acetaldehyde cyclic propylene acetal	92	1,1-Dimethoxydodecane	95	Ethyl 2-hydroxy-2-methylbutyrate	84
Acetaldehyde di-cis-3-hexenyl acetal	95	1,1-Dimethoxy-trans-2-hexene	93	Ethyl 2-hydroxy-3-methylpentanoate	84
Acetaldehyde diisoamyl acetal	93	1,1-Dimethoxyhex-2(E)-ene	93	Ethyl 2-hydroxy-3-methylvalerate	84
Acetaldehyde hexyl isoamyl acetal	93	1,1-Dimethoxynonane	95	Ethyl maltol	79
Acetaldehyde 1,3-octanediol acetal	95	N-[(2,4-Dimethoxyphenyl)methyl]-N'-[2-(pyridinyl)ethyl]ethanediamide	98	Ethyl mercaptan	85
6-Acetoxydihydrotheaspirane	84	N-[2-(3,4-Dimethoxyphenyl)ethyl]-3,4-dimethoxycinnamic acid amide	100	Ethyl methyl disulfide	89
1-Acetoxy-1ethoxyethane	93	Dimethyl benzyl carbonyl acetate	85	Ethyl 3-octenoate	82
5-Acetoxyhexanoic acid methyl ester	93	Dimethyl benzyl carbonyl butyrate	86	Ethyl oct-3-enoate	82
3-Acetoxy-2-methyl butyric acid ethyl ester	92	Dimethyl benzyl carbonyl formate	85	Ethyl 4-pentenoate	80
Acetyl thiazoline-2	97	Dimethyl p-tolyl carbinol	85	Ethyl propyl disulfide	90
5-Acetyl-2,3-dihydro-1,4-thiazine	98	2,5-Dimethyl-3-acetylfuran	79	Ethyl propyl trisulfide	90
2-Acetyl-4,5-dihydrothiazole	97	2,4-Dimethyl-1-aza-3,5-dithiabicyclo[4.3.0]nonane	98	5-Ethyl-2,5-dihydro-4-methyl-2-(1-methylpropyl)-thiazole	97
3-Acetyl-2,5-dimethylfuran	79	alpha, alpha-Dimethylbenzyl isobutyrate	85	5-Ethyl-2,5-dihydro-4-methyl-2-(2-methylpropyl)-thiazole	97
N-Acetylglycin-thioethyl ester	88	alpha, alpha-Dimethylbenzyl 2-methylpropanoate	85	1-Ethyl disulfanyl-butane	90
2-Acetyl-2-thiazoline	97	2,4-Dimethyl-1,3-dioxolane	92	1-Ethyl disulfanyl-propane	90
N-Acetylthioglycine, S-Ethyl ester	88	2,6-Dimethyl-5-heptenal propyleneglycol acetal	94	2-Ethyl-3-hydroxy-4H-pyran-4-one	79
Allyl butanethioate	88	2-(1,5-Dimethyl-4-hexenyl)-4-methyl-1,3-dioxolane	94	2-Ethyl-3-hydroxy-4-pyrone	79
Allyl propyl disulfide	90	N-3,7-Dimethyl-2,6-octadienyl cyclopropylcarboxamide	100	cis- and trans-5-Ethyl-4-methyl-2-(1-methylpropyl)-thiazoline	97
Allyl thiohexanoate	88	N-[(2E)-3,7-Dimethyl-2,6-octadienyl]-cyclopropanecarboxamide	100	cis- and trans-5-Ethyl-4-methyl-2-(2-methylpropyl)-thiazoline	97
Allylacetic acid methyl ester	80	4,5-Dimethyl-2-pentyl-1,3-dioxolane	94	2-Ethylpyromeconic acid	79
S-Allylcysteine	92	alpha, alpha-Dimethylphenethanol	84	3-(Ethylthio)butanol	91
S-Allyl-L-cysteine	92	alpha, alpha-Dimethylphenethyl acetate	85	N-Gluconyl ethanolamine	99
2-(Allylsulfanyl)-1-heptene hydrate	88	1,1-Dimethyl-2-phenetyl acetate	85	N-Gluconyl ethanolamine phosphate	99
(2R)-3-(Allylthio)-2-aminopropanoic acid	92	alpha, alpha-Dimethylphenethyl alcohol	84	2,4-Heptadien-1-ol	100
(R)-Allylthio-2-aminopropanoic acid	92	alpha, alpha-Dimethylphenethyl butyrate	85	Hepta-2,4-dien-1-ol	100
(2R)-2-Amino-3-(prop-2-en-1-ylsulfanyl)propanoic acid	92	alpha, alpha-Dimethylphenethyl formate	85	Heptanal, 2,3-butanediol acetal	92
4-Aminobutyric acid	99	2,4-Dimethyl(4H)pyrrolidino[1,2e]-1,3,5-dithiazine	98	Heptanal, cyclic propylene acetal	94
Amyl hydrosulfide	86	Dimethylpyruvic acid	78	Heptanal propyleneglycol acetal	94
Amyl mercaptan	86	2,4-Dimethyltetrahydropyrrolo[2,1-d][1,3,5]-dithiazine	98	2-Heptanethiol	86
Amyl methyl disulfide	90	2,5-Dimethylthiazole	97	Heptane-1-thiol	86
Amyl sulphydrate	86	Dimethyl p-tolyl carbinol	84	Heptane-2-thiol	86
Benzenepropanoic acid, alpha-oxo, sodium salt	78	2,4-Dipentyl-1,3-dioxane	94	3-Heptanethiol, 1-methoxy-	88
Benzyl dimethyl carbinol	84	3,4-Dithiaheptane	90	1-Heptanol, 3-mercapto-, 1-acetate	93
Benzyl dimethyl carbinol butyrate	86	2,5-Dithiahexane	91	N-Heptan-4-yl)benzo[d][1,3]dioxole-5-carboxamide	98
Benzyl dimethyl carbonyl acetate	85	3,4-Dithiahexane	90	2-Heptene-1-carboxylic acid	81
Benzyl dimethyl carbonyl formate	85	2,3-Dithiaoctane	90	1-Heptene, 2-(2-propenylthio)-monohydrate	89
2-Benzyl-2-propanol	84	3,4-Dithiaoctane	90	Heptyl mercaptan	86
2-Benzyl-2-propyl acetate	85	4,5-Dithia-1-octene	90	2-Heptyl-4-methyl-1,3-dioxolane	95
2-Benzyl-2-propyl butyrate	86	2,3-Dithiapentane	89	2,4-Hexadienyl acetate	100
2-Benzyl-2-propyl formate	85	Dodecanal dimethyl acetal	95	2,4-Hexadienyl butyrate	100
Butanoic acid, 3-methyl-2-oxo	78	Dodecane, 1,1-dimethoxy-	98	2,4-Hexadienyl isobutyrate	100
Butanoic acid, 3-methyl-2-oxo, sodium salt	78	4-Dodecenal, (4Z)-	82	2,4-Hexadienyl propionate	100
1-Butanol-2-one	92	cis-Dodec-4-en-1-al	82	Hexanal butane-2,3-diol acetal	94
Butyl ethyl disulfide	90	11-Dodecenoic acid	82	Hexanal dihexyl acetal	94
2-Butyl-4-methyl-1,3-dioxolane	94	Elialdehyde	83	Hexanal hexyl isoamyl acetal	94
p-Cymen-8-ol	84	2,8-Epithio-cis-p-menthane	88	Hexanal octane-1,3-diol acetal	94
Decanal propyleneglycol acetal	95	2,8-Epithio-p-menthane	88	4-Hexenal trans	80
2,4,7-Decatrienal	100	1,1-Ethanedithiol	86	E-4-Hexenal	80
Deca-2,4,7-trienal	100	Ethane-1,1-dithiol	85	Hex-4-enal	80
4-Decen-1-ol, (4Z)-	82	Ethanethioic acid	87	trans-4-Hexenal	80
cis-4-Decenol	82	Ethanethiol	85	trans-Hex-4-enal	80
2-Decyl-4-methyl-1,3-dioxolane	95	4-Ethoxycarbonylbut-1-ene	80	trans-2-Hexenal dimethyl acetal	93
1,1-Dibutoxypentane	93	N-[(Ethoxycarbonyl)methyl]-p-menthane-3-carboxamide	99	5-Hexene-1-ol	81
1,1-Diethoxyisopentane	93	Ethoxyethyl acetate	93	3-Hexenoic acid, ethyl ester, (3Z)-	81
1,1-Diethoxy-3-methylbutane	93	Ethyl 3-acetoxy-2-methylbutyrate	92	3-Hexenoic acid, methyl ester	81
Diethyl disulfide	90	S-Ethyl 2-acetyl amino ethanethioate	88	1-Hexen-6-ol	81
Diethyl trisulfide	90	S-Ethyl 2-acetyl amino ethanethiolate	88	3-Hexen-1-ol, (3E)-	80
3,6-Diethyl-1,2,4,5-tetrathiane, mixture with	89	cis- and trans-Ethyl 2,4-dimethyl-1,3-dioxolane-2-acetate	92	5-Hexen-1-ol	81
3,5-diethyl-1,2,4-trithiolane	89	Ethyl disulfide	90	5-Hexenol	81
3,5-Diethyl-1,2,4-trithiolane	89	Ethyl (Z)-3-hexenoate	81	beta-gamma-hexenol	80
1-(4,5-Dihydro-1,3-thiazol-2-yl)-1-propanone	97	Ethyl cis-3-hexenoate	81	trans-3-Hexenol	80
Dihydroxyacetone dimer	92	Ethyl hydroxymethyl ketone	92	trans-3-Hexen-1-ol	80
2,5-Dihydroxy-1,4-dioxane-2,5-dimethanol	92			1,1-bis[3(Z)-Hexenyloxy]propane	95
Diisoamyl thiomalate	87			Hexyl 3-mercaptopbutanoate	91
Diisopentyl thiomalate	87			Hexyl 3-mercaptopbutyrate	91
1,1-Diisopentyl oxyethane	93			2-Hexyl-4,5-dimethyl-1,3-dioxolane	92
Diisopropyl methyl carbinol	83			2-Hexyl-4-methyl-1,3-dioxolane	94
Dimercaptomethane	86			1,1-bis(Hexyloxy)hexane	94
1,1-Di(3-methylbutoxy)ethane	93			1-Hexyloxy-1-(3-methylbutyl)oxyhexane	94
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N1-(2,4-Dimethoxybenzyl)-N2-(2-(pyridin-2-yl)ethyl)oxalamide	98				

Name	Page	Name	Page	Name	Page
1-Hexyloxy-1-(3-methylbutyl)oxypropane	93	Methyldisulfanyl-ethane	89	Mixture of 3,6-Diethyl-1,2,4,5-tetrathiane and	89
2-Hexylthiophene	98	1-Methyldisulfanyl-pentane	90	3,5-diethyl-1,2,4-trithiolane	
1-Hydroxy-2-butanone	92	Methyl (Z)-3-hexenoate	81	Nerolidol	83
1-Hydroxybutan-2-one	92	Methyl cis-3-hexenoate	81	3,7-Nonadien-2-ol, 2,4,8-trimethyl-	84
6-Hydroxydihydrotheaspirane	84	Methyl isopentyl disulfide	90	Nonanal dimethyl acetal	95
N-(2-Hydroxyethyl)galactonamide	99	Methyl 3-mercaptoputanoate	87	Nonanal propyleneglycol acetal	95
6-Hydroxy-1-hexene	81	Methyl 3-methylbutyl disulfide	90	Nonane, 1,1-dimethoxy-	97
2-Hydroxy-N-(2-hydroxyethyl)propanamide	99	[1R-(1 $\alpha$ ,2 $\beta$ ,5 $\alpha$ )]-N-[5-Methyl-2-(1-methylethyl)cyclohexyl]carbonyl glycine ethyl ester	99	Nona-2,4,6-trienal	100
4-Hydroxymethyl-2-(2-methylpropyl)-1,3-dioxolane and 5-Hydroxy-2-(methylpropyl)-1,3-dioxane	94	Methyl (methylthio)acetate	89	trans-4-Nonenal	83
2-Hydroxy-2-methyl-1-phenylpropane	84	Methyl 2-(methylthio)acetate	89	2-Nonyl-4-methyl-1,3-dioxolane	95
5-Hydroxy-2-(2-methylpropyl)-1,3-dioxane	96	Methyl 3-(methylthio)butanoate	89	9-Octadecenal	83
3-Hydroxy-2-methyl-4-pyrone	79	Methyl 5(Z)-octenoate	81	9-cis-Octadecenol	82
1-(3-Hydroxy-5-methyl-2-thienyl)ethanone	96	Methyl (Z)-5-octenoate	81	cis-9-Octadecen-1-ol	82
2-Hydroxy-N-[2-(phosphonoxy)ethyl]propanamide	99	Methyl 4-pentenoate	80	cis-9-Octadecenol	82
6-Hydroxy-2,6,10,10-tetramethyl-1-oxaspiro[4.5]decane	84	2-Methyl-4-pentyl-1,3-dioxane	97	cis-9-Octadecen-1-yl acetate	82
INS No. 636	79	S-Methyl propanethioate	89	cis-9-Octadecenyl acetate	82
INS No. 637	79	Methyl 10-undecenoate	83	cis-9-Octadecenyl alcohol	82
Isobutanol propyleneglycol acetal	95	Methyl vinyl homogeranyl carbinol	83	Octadecenyl aldehyde	83
Isobutyl 3-methylthiobutyrate	87	3-Methylbutanal diethyl acetal	95	Octanal propyleneglycol acetal	95
Isobutyl 3-(methylthio)butyrate	87	2-Methylbut-2-en-1-ol	80	3-Octenoic acid	81
Isobutyl 10-undecenoate	82	Methyldisulfanyl-ethane	89	4(E)-Octenoic acid	81
2-Isobutyl-4-methyl-1,3-dioxolane	93	1-Methyldisulfanyl-pentane	90	4-Octenoic acid, (E)-	81
2-Isobutyl-4-methyl-5-ethylthiazoline	97	1,2-bis(Methylmercapto)ethane	91	5(Z)-Octenoic acid	82
3-Isopropenylpentanedioic acid	80	3-Methyl-1-[1-(3-methyl-butoxy)-ethoxy]-butane	93	cis-5-Octenoic acid	82
S-Isopropyl 3-methylbut-2-enethioate	88	4-Methyl-2-(1-methylethyl)-1,3-dioxolane	95	delta-3-Octenoic acid	81
2-Isopropyl-4-methyl-1,3-dioxolane	95	4-Methyl-2-(2-methylpropyl)-1,3-dioxolane	93	trans-4-Octenoic acid	81
S-isopropyl 3-methylthiocrotonate	88	2-Methyl-1-methylthio-2-butene	88	(Z)-4-Octen-1-ol	81
S-Isopropyl thiosenecioate	88	4-Methyl-2-nonyl-1,3-dioxolane	95	cis-4-Octenol	81
Isovaleraldehyde diethyl acetal	93	4-Methyl-2-octyl-1,3-dioxolane	95	(Z)-3-Octenyl propanoate	81
Isovaleraldehyde glyceryl acetal	94	3-Methyl-2-oxobutanoic acid	78	2-Octyl-4-methyl-1,3-dioxolane	95
Isovaleraldehyde propyleneglycol acetal	93	3-Methyl-2-oxobutanoic acid, sodium salt	78	Olealdehyde	83
N-Lactoyl ethanolamine	99	3-Methyl-2-oxobutyric acid	78	Oleic aldehyde	83
N-Lactoyl ethanolamine phosphate	99	3-Methyl-2-oxopentanoic acid	78	Oleyl acetate	82
Larixinic acid	79	4-Methyl-2-oxopentanoic acid	78	1-Oxaspiro[4.5]-decan-6-ol, 2,6,10,10-tetramethyl-, acetate, (2R,5S,6S)-rel-	84
Lauryl aldehyde dimethyl acetal	95	3-Methyl-2-oxopentanoic acid, sodium salt	78	1-Oxaspiro[4.5]-decan-6-ol, 2,6,10,10-tetramethyl-, [2S-[2 $\alpha$ ,5 $\alpha$ alpa-(R)]]-	
Leaf alcohol	80	4-Methyl-2-oxopentanoic acid, sodium salt	78	2-Oxo-1-butanol	92
Maltol	79	2-Methyl-4-oxo-4H-pyran-3-yl isobutyrate	79	2-Oxoisovaleric acid	78
Maltol isobutyrate	79	3-Methyl-2-oxovaleric acid	78	Oxopentanoate, 4-methyl-2-oxo, sodium salt	78
Maltol 2-methylpropanoate	79	4-Methyl-2-oxovaleric acid	78	2-Oxo-3-phenylpropionic acid, sodium salt	78
2-Mercaptoanisole	86	2-Methyl-4-pentyl-1,3-dioxane	95	Pelargonaldehyde dimethyl acetal	95
3-Mercaptobutanoic acid hexyl ester	91	1-Methyl-1-(2-phenylethyl) isobutyrate	85	Pelargonic aldehyde dimethyl acetal	95
3-Mercaptoethyl acetate	91	2-(4-Methylphenyl)-2-propanol	84	Pentane-1-thiol	86
3-Mercapto-1-butyl acetate	91	2-Methyl-1-phenylpropan-2-ol	84	1-Pentanethiol	86
3-Mercaptoheptyl acetate	91	2-Methyl-1-phenyl-2-propyl acetate	85	Pentanoic acid, 3-methyl-2-oxo, sodium salt	78
cis- and trans-Mercapto-p-menthan-3-one	87	2-Methyl-1-phenyl-2-propyl butyrate	86	4-Pentenal	80
1-Mercapto-p-menthane-3-one	87	2-Nethyl-1-phenyl-2-propyl formate	85	Pentyl mercaptan	86
3-Mercapto-3-methylbutyl acetate	91	2-Methyl-1-phenyl-2-propyl isobutyrate	85	Phenyl dimethyl carbinyl isobutyrate	85
3-Mercapto-3-methyl-1-butyl acetate	91	S-Methyl propanethioate	88	1-Phenylethanethiol	86
4-Mercapto-4-methyl-2-pentanol	86	2-Methylpropyl 3-(methylthio) butanoate	87	1-Phenylethylmercaptan	86
4-Mercapto-2-pentanone	87	2-Methylpropyl 3-(methylthio) butyrate	89	Phenylethyl methyl ethyl carbinol	84
4-Mercapto-2-pentan-2-one	87	2-Methyl-4H-pyran-4-one-3-yl 2-methylpropanoate	79	1-Phenylethylthiol	86
bis(1-Mercaptopropyl)sulfide	91	2-Methylpyrromeconic acid	79	1-Phenyl-3-methyl-3-pentanol	84
Methane, thiobis(methylthio)-	89	2-Methyl-4-pyran-3-yl 2-methylpropanoate	79	2-Phenylpropan-2-yl isobutyrate	85
Methanedithiol	86	3-Methyl-3-sulfanylbutyl acetate	91	N-[2-(Phosphonoxy)ethyl]galactonamide	99
Methanethiol, (methylthio)-	88	3-Methylsulfanyl-butyric acid methyl ester	89	2-Propenamide, 3-(3,4-dimethoxyphenyl)-N-[2-(3,4-dimethoxyphenyl)ethyl]-	100
Methionyl butyrate	86	2-(4-Methyl-5-thiazolyl)ethyl butanoate	96	S-2-Propenylcysteine	92
o-Methoxythiophenol	86	2-(4-Methyl-5-thiazolyl)ethyl decanoate	97	Propionyl carbinol	92
o-Methoxybenzenethiol	86	2-(5-Methyl-4-thiazolyl)ethyl formate	96	2-Propionyl-2-thiazoline	97
2-Methoxybenzene-1-thiol	86	2-(4-Methyl-5-thiazolyl)ethyl hexanoate	96	Propyl allyl disulfide	90
1,1'-bis(Methoxy)dodecane	95	2-(4-Methyl-5-thiazolyl)ethyl isobutyrate	96	N-(1-Propylbutyl)-1,3-benzodioxole-5-carboxamide	98
N1-(2-Methoxy-4-methylbenzyl)-N2-(2-(5-methylpyridin-2-yl)ethyl)oxalamide	98	2-(4-Methyl-5-thiazolyl)ethyl octanoate	96	Propyl 2-mercaptopropionate	86
N1-(2-Methoxy-4-methylbenzyl)-N2-(2-(pyridin-2-yl)ethyl)oxalamide	99	2-(4-Methyl-5-thiazolyl)ethyl propionate	96	Propyl propane thiosulfonate	91
N-(2-Methoxy-4-methylphenyl)methyl]-N'-[2-(5-methyl-2-pyridinyl)ethyl]ethanediamide	98	(Methylthio)acetic acid methyl ester	89	Propylene acetal	92
N-[(2-Methoxy-4-methylphenyl)methyl]-N'-[2-(pyridinyl)ethyl]ethanediamide	99	3-(Methylthio) butyric acid methyl ester	89	Pyroolidino-[1,2e]-4H-2,4-dimethyl-1,3,5-dithiazine	98
1-Methoxy-3-heptanethiol	87	3-(Methylthio)-2-butanone	90	Rubenamin	100
2-Methoxythiophenol	86	1,2-bis(Methylthio)ethane	91	Sodium alpha-ketoisovalerate	78
Methyl 5-acetoxyhexanoate	93	3-(Methylthio)heptanal	89	Sodium 4-methyl-2-ketopentanoate	78
Methyl allylacetate	80	(Methylthio)methanethiol	87	Sodium 4-methyl-2-oxo-pentanoate	78
bis(3-Methylbutyl)mercaptosuccinate	87	Methylthiomethylmercaptan	87	Sodium 3-methyl-2-oxovalerate	78
		3-(Methylthio)methylthiophene	98	Sodium 4-methyl-2-oxovalerate	78
		4-(Methylthio)-2-pentanone	89		
		3-(Methylthio)propyl butyrate	86		

Name	Page	Name	Page	Name	Page
Sorbyl acetate	100	Thioguaiacol	86	Trisulfide, diethyl	92
Sorbyl butyrate	100	2-p-Tolyl-2-propanol	84	Trisulfide, ethyl propyl	91
Sorbyl isobutyrate	100	p-alpha,alpha-Trimethylbenzyl alcohol	84	2,4,6-Trithiaheptane	88
Sorbyl propionate	100	2,4,5-Trimethyl-2,5-dihydrooxazole	79	3,4,5-Trithiaheptane	90
Tangerinal	82	3,7-11-Trimethyl-1,6-10-dodecatrien-3-ol	83	3,4,5-Trithianonane	90
8-Tetradecenal, (Z)-	83	2,4,5-Trimethyl-delta-oxazoline	79	Undecanal propyleneglycol acetal	95
Tetrahydro-2,4-dimethyl-4H-pyrrolo[2,1-d]-1,3,5-dithiazine	100	Trimethyl-delta-oxazoline	79	Valeraldehyde dibutyl acetal	93
6-Thiabicyclo[3.2.1]octane, 4,7,7-trimethyl-	90	(E)- and (Z)-2,4,8-Trimethyl-3,7-nonadien-2-ol	83	Valeraldehyde propyleneglycol acetal	94
Thioacetic acid	87	2,3,4-Trimethyl-3-pentanol	83	Valeric acid, 3-methyl-2-oxo, sodium salt	78
3-Thiobutyl acetate	91	4,7,7-Trimethyl-6-thiabicyclo[3.2.1]octane	88	Valeric acid, 4-methyl-2-oxo, sodium salt	78

## Annex 1: Summary of recommendations from the 68<sup>th</sup> JECFA and further information required

### Toxicological recommendations and information on specifications

#### 1. Food additives and ingredients evaluated toxicologically or assessed for dietary exposure

Food additive	Specifications <sup>a</sup>	Acceptable daily intake (ADI) and other toxicological recommendations
Acidified sodium chlorite (ASC)		<p>The available toxicological data were sufficient to assess the safety of ASC by setting ADIs for chlorite and chlorate.</p> <p>Chlorite: ADI of 0.03 mg/kg bw per day</p> <p>Chlorate: ADI of 0.01 mg/kg bw per day.</p> <p>New specifications were prepared for sodium chlorite and one of the acids used in the preparation of ASC, sodium hydrogen sulfate.</p>
Asparaginase from <i>Aspergillus oryzae</i> expressed in <i>Aspergillus oryzae</i>	N	ADI “not specified” <sup>b</sup> when used in the applications specified and in accordance with good manufacturing practice.
Carrageenan and	R	<p>The group ADI “not specified”<sup>b</sup> for the sum of carrageenan and processed eucheuma seaweed was maintained for food additive uses in foods other than infant formula.</p> <p>The Committee was of the view that based on the information available, it is inadvisable to use carrageenan or processed eucheuma seaweed in infant formulas.</p>
Processed Eucheuma Seaweed	R	
Cyclotetraglucose and cyclotetraglucose syrup (listed on draft agenda as cyclotetraose)	N N,T	<p>A temporary ADI “not specified”<sup>b</sup> was allocated for cyclotetraglucose and cyclotetraglucose syrup pending submission of data on the identity of the bacterial strain used to produce the 6-GT/IMT enzyme preparation and evidence of its lack of pathogenicity and toxigenicity. The specifications for cyclotetraglucose syrup were made tentative pending information on the total saccharide content, the unidentified fraction and test methods.</p>
Isoamylase from <i>Pseudomonas amyloclavata</i>	N	ADI “not specified” <sup>b</sup> when used in the applications specified and in accordance with good manufacturing practice.
Magnesium sulfate	R	ADI “not specified” <sup>b</sup>
Phospholipase A1 from <i>Fusarium venetatum</i> produced by <i>Aspergillus oryzae</i>	S	ADI “not specified” <sup>b</sup> when used in the applications specified and in accordance with good manufacturing practice.
Sodium iron(III) ethylenediaminetetraacetic acid (EDTA)	S	<p>Sodium iron EDTA is suitable for use as a source of iron for food fortification to fulfil nutritional iron requirements, provided that the total intake of iron from all food sources including contaminants does not exceed the PMTDI of 0.8 mg/kg bw. Total intake of EDTA should not exceed acceptable levels, also taking into account the intake of EDTA from the food additive use of other EDTA compounds. An ADI of 0-2.5 mg/kg bw was previously established for the calcium disodium and disodium salts of EDTA, equivalent to up to 1.9 mg/kg bw EDTA.</p>

Food additive	Specifications <sup>a</sup>	Acceptable daily intake (ADI) and other toxicological recommendations
Steviol glycosides	R	The temporary ADI of 0–2 mg/kg bw for steviol glycosides, expressed as steviol was extended until 2008, pending submission of the results of the ongoing studies. The Committee considered that the newly available data did not raise additional concerns regarding the safety of steviol glycosides, but that the results of ongoing clinical studies, which more closely address the requirements specified at the sixty-third meeting, would be essential to its evaluation. The specifications were revised and the tentative assignment was removed. The method of assay includes a minimum requirement of 95% of the total of 7 steviol glycosides.

<sup>a</sup> N: new specifications prepared; R: existing specifications revised; S: existing specifications maintained; T: tentative specifications.

<sup>b</sup> ADI 'not specified' is used to refer to a food substance of very low toxicity which, on the basis of the available data (chemical, biochemical, toxicological and other) and the total dietary intake of the substance arising from its use at the levels necessary to achieve the desired effects and from its acceptable background levels in food, does not, in the opinion of the Committee, represent a hazard to health. For that reason, and for the reasons stated in the individual evaluations, the establishment of an ADI expressed in numerical form is not deemed necessary. An additive meeting this criterion must be used within the bounds of good manufacturing practice, i.e. it should be technologically efficacious and should be used at the lowest level necessary to achieve this effect, it should not conceal food of inferior quality or adulterated food, and it should not create a nutritional imbalance.

## 2. Food additives, including flavouring agents, considered for specifications only

Food Additive	Specifications <sup>a</sup>	
Anisyl acetone	W	
Furfural	W	
Ethyl maltol	R	
Maltol	R	
Nisin preparation	R	
Pectins	R	
Polyvinyl alcohol	R	
Sucrose esters of fatty acids	R	
Zeaxanthin-rich extract from <i>Tagetes erecta</i>	W	

Flavouring agents	JECFA No.	Specifications <sup>a</sup>
3-Acetyl-2,5,-dimethylfuran	1506	R
Ethyl maltol	1481	R
Maltol	1480	R
Maltol isobutyrate	1482	R
3-Methyl-2-oxobutanoic acid	631	R
3-Methyl-2-oxopentanoic acid	632	R
4-Methyl-2-oxopentanoic acid	633	R
Sodium 3-Methyl-2-oxobutanoate	631.1	R
Sodium 3-Methyl-2-oxopentanoate	632.1	R
Sodium 4-Methyl-2-oxopentanoate	633.1	R
Sodium 2-oxo-3-phenylpropionate	1479	R
2,4,5-Trimethyl-delta-oxazolin	1559	R

<sup>a</sup>R: existing specifications revised; W: existing specifications withdrawn.



### 3. Food contaminants evaluated toxicologically or assessed for dietary exposure

Food Contaminant	Tolerable intakes and other toxicological recommendations
<p>Aflatoxins</p> <p>(Intake assessment from pistachios, hazelnuts, almonds, Brazil nuts and dried figs, impact of various Maximum Levels, MLs)</p>	<p>The Committee decided to base the assessment of the impact of different MLs for aflatoxin (AFL) exposure on data provided by producing countries, noting that these better represent the materials in commerce and result in a robust estimate of AFL dietary exposure from the tree nuts.</p> <p>Consumption of almonds, Brazil nuts, hazelnuts, pistachios, and dried figs contributes greater than 5% of the total AFL dietary exposure in only five of the 13 GEMS/Food cluster diets (Clusters B, C, D, E and M). If fully enforced, an ML at 20 µg/kg in hazelnuts, almonds, pistachios, Brazil nuts, and dried figs would only have an impact on the relative contribution to AFL dietary exposure in these clusters, including high-level consumers of tree nuts. This contribution is due solely to the elevated AFL level in pistachios. For tree nuts other than pistachios, the presence of an ML has no effect on AFL dietary exposure. Moreover, the Committee concluded that enforcing an ML of 15, 10, 8, or 4 µg/kg, would have little further impact on the overall dietary exposure to AFL in all five of the highest exposed population groups compared to setting an ML of 20 µg/kg.</p> <p>Regarding dried figs, the Committee concluded that whatever the hypothetical ML scenario applied (no ML, 4, 8, 10, 15, or 20 µg/kg) there would be no impact on the overall dietary exposure to AFL.</p> <p>The Committee noted that the reduction of AFL dietary exposure is an important public health goal; particularly in populations who consume high levels of any potentially AFL contaminated food.</p>
<p>Ochratoxin A (OTA)</p>	<p>The previous PTWI of 100 ng/kg bw was retained.</p> <p>The new data, including data on mode of action of OTA in the kidney, do not indicate any reason to modify the previous risk assessment approach taken by JECFA.</p> <p>The current estimate of overall dietary exposure to ochratoxin A from cereals, based mainly on European data, is about 8–17 ng/kg bw per week, based on processed cereals, compared with 25 ng/kg bw per week in the previous evaluation, based on raw cereals. The current estimates are well below the PTWI.</p> <p>Contamination levels in the majority of raw cereal samples were below 5 µg/kg. Due to the very small number of samples contaminated above the highest proposed limit of 20 µg/kg, such an ML would have very limited impact compared with no ML. The Committee concluded that the use of an ML of 5 or 20 µg/kg would be unlikely to have an impact on dietary exposure to ochratoxin A. The Committee was unable to reach a conclusion regarding the situation in developing countries, due to the lack of adequate data to consider.</p>

#### 4. Flavouring agents evaluated using the Procedure for the Safety Evaluation of Flavouring Agents

##### A. Linear and branched-chain aliphatic, unsaturated, unconjugated alcohols, aldehydes, acids and related esters

Flavouring agent	JECFA No.	Specifications <sup>a</sup>	Conclusions based on current estimated intake
Ethyl-2-methyl-3,4-pentadienoate	353	S	No safety concern
Methyl 4-pentenoate	1616	N	No safety concern
2-Methylbut-2-en-1-ol	1617	N	No safety concern
Ethyl 4-pentenoate	1618	N	No safety concern
4-Pentenal	1619	N	No safety concern
3-Isopropenylpentanedioic acid	1620	N	No safety concern
<i>trans</i> -3-Hexenol	1621	N	No safety concern
<i>trans</i> -4-Hexenal	1622	N	No safety concern
5-Hexenol	1623	N	No safety concern
Methyl (Z)-3-hexenoate	1624	N	No safety concern
<i>cis</i> -4-Octenol	1625	N	No safety concern
Ethyl (Z)-3-hexenoate	1626	N	No safety concern
3-Octenoic acid	1627	N	No safety concern
(Z)-3-Octenyl propionate	1628	N	No safety concern
<i>trans</i> -4-Octenoic acid	1629	N	No safety concern
Methyl (Z)-5-octenoate	1630	N	No safety concern
<i>cis</i> -5-Octenoic acid	1631	N	No safety concern
Ethyl 3-octenoate	1632	N	No safety concern
<i>cis</i> -4-Decenol	1633	N	No safety concern
Isobutyl 10-undecenoate	1634	N	No safety concern
11-Dodecenoic acid	1635	N	No safety concern
(Z)-4-Dodecenal	1636	N	No safety concern
<i>cis</i> -9-Octadecenol	1637	N	No safety concern
<i>cis</i> -9-Octadecenyl acetate	1638	N	No safety concern
Methyl 10-undecenoate	1639	N	No safety concern
(Z)-8-Tetradecenal	1640	N	No safety concern
9-Octadecenal	1641	N	No safety concern
(E)-4-Nonenal	1642	N	No safety concern

<sup>a</sup>N: new specifications prepared; S: Specifications maintained.

##### B. Aliphatic acyclic and alicyclic terpenoid tertiary alcohols and structurally related substances

Flavouring agent	JECFA No.	Specifications <sup>a</sup>	Conclusions based on current estimated intake
<b>Structural Class I</b>			
2,3,4-Trimethyl-3-pentanol	1643	N	No safety concern
(+/-)-2,4,8-Trimethyl-7-nonen-2-ol	1644	N	No safety concern
(E)- and (Z)-2,4,8-Trimethyl-3,7-nonadien-2-ol	1645	N	No safety concern
Nerolidol	1646	N	No safety concern
1-Phenyl-3-methyl-3-pentanol	1649	N	No safety concern
<i>p</i> - <i>alpha</i> , <i>alpha</i> -Trimethylbenzyl alcohol	1650	N	No safety concern
(+/-)-Ethyl 2-hydroxy-2-methylbutyrate	1651	N	No safety concern
(+/-)-Ethyl 2-hydroxy-3-methylvalerate	1652	N	No safety concern
<i>alpha</i> , <i>alpha</i> -Dimethylphenethyl alcohol	1653	N	No safety concern
<i>alpha</i> , <i>alpha</i> -Dimethylphenethyl formate	1654	N	No safety concern
<i>alpha</i> , <i>alpha</i> -Dimethylphenethyl acetate	1655	N	No safety concern
<i>alpha</i> , <i>alpha</i> -Dimethylphenethyl butyrate	1656	N	No safety concern
<i>alpha</i> , <i>alpha</i> -Dimethylbenzyl isobutyrate	1657	N	No safety concern
<b>Structural Class II</b>			
6-Acetoxydihydrotheaspirane	1647	N	No safety concern
6-Hydroxydihydrotheaspirane	1648	N	No safety concern

<sup>a</sup>N: new specifications prepared.

**C. Simple aliphatic and aromatic sulfides and thiols**

Flavouring agent	No.	Specifications <sup>a</sup>	Conclusions based on current estimated intake
<b>Simple sulfides</b>			
<b>Structural Class I</b>			
2-Methyl-1-methylthio-2-butene	1683	N	No safety concern
2,4,6-Trithiaheptane	1684	N	No safety concern
2,5-Dithiahexane	1707	N	No safety concern
<b>Acyclic sulfides with oxidized and thiol side-chains</b>			
<b>Structural Class I</b>			
Methionyl butyrate	1668	N	No safety concern
Methylthiomethylmercaptan	1675	N	No safety concern
(+/-)-Isobutyl 3-methylthiobutyrate	1677	N	No safety concern
3-(Methylthio)-2-butanone	1688	N	No safety concern
4-(Methylthio)-2-pentanone	1689	N	No safety concern
Methyl 3-(methylthio)butanoate	1690	N	No safety concern
Methyl (methylthio)acetate	1691	N	No safety concern
(+/-)-3-(Methylthio)heptanal	1692	N	No safety concern
(+/-)-3-(Ethylthio)butanol	1703	N	No safety concern
S-Allyl-L-cysteine	1710	N	No safety concern
<b>Heterocyclic sulfides – Structural Class I</b>			
(+/-)-2,8-Epithio- <i>cis-p</i> -menthane	1685	N	No safety concern
<b>Simple thiols</b>			
<b>Structural Class I</b>			
Ethanethiol	1659	N	No safety concern
1-Pentanethiol	1662	N	No safety concern
Heptane-1-thiol	1663	N	No safety concern
2-Heptanethiol	1664	N	No safety concern
<b>Structural Class II</b>			
(+/-)-1-Phenylethylmercaptan	1665	N	No safety concern
<b>Thiols with oxidized side-chains</b>			
<b>Structural Class I</b>			
Propyl 2-mercaptopropionate	1667	N	No safety concern
(+/-)-4-Mercapto-4-methyl-2-pentanol	1669	N	No safety concern
4-Mercapto-2-pentanone	1670	N	No safety concern
(S)-1-Methoxy-3-heptanethiol	1671	N	No safety concern
Methyl 3-mercaptoputanoate	1674	N	No safety concern
Hexyl 3-mercaptoputanoate	1704	N	No safety concern
(+/-)-3-Mercapto-1-butyl acetate	1705	N	No safety concern
3-Mercapto-3-methyl-1-butyl acetate	1706	N	No safety concern
3-Mercaptoheptyl acetate	1708	N	No safety concern
<b>Structural Class II</b>			
<i>cis</i> - and <i>trans</i> -Mercapto- <i>p</i> -menthan-3-one	1673	N	No safety concern
<b>Structural Class III</b>			
2-Mercaptoanisole	1666	N	No safety concern
Diisopentyl thiomalate	1672	N	No safety concern
<b>Dithiols – Structural Class I</b>			
Ethane-1,1-dithiol	1660	N	No safety concern
Dimercaptomethane	1661	N	No safety concern
<i>bis</i> (1-Mercaptopropyl)sulfide	1709	N	No safety concern
<b>Simple disulfides</b>			
<b>Structural Class I</b>			
Ethyl methyl disulfide	1693	N	No safety concern
Ethyl propyl disulfide	1694	N	No safety concern
Methyl isopentyl disulfide	1696	N	No safety concern

Flavouring agent	No.	Specifications <sup>a</sup>	Conclusions based on current estimated intake
Amyl methyl disulfide	1697	N	No safety concern
Butyl ethyl disulfide	1698	N	No safety concern
Diethyl disulfide	1699	N	No safety concern
<b>Structural Class II</b>			
Allyl propyl disulfide	1700	N	No safety concern
<b>Trisulfides – Structural Class I</b>			
Ethyl propyl trisulfide	1695	N	No safety concern
Diethyl trisulfide	1701	N	No safety concern
<b>Heterocyclic disulfides – Structural Class II</b>			
(+/-)-3,5-Diethyl-1,2,4-trithiolane	1686	N	No safety concern
Mixture of 3,6-diethyl-1,2,4,5-tetrathiane (approx. 55%) and 3,5-diethyl-1,2,4-trithiolane (approx. 45%)	1687	N	No safety concern
<b>Thioesters and acids</b>			
<b>Structural Class I</b>			
Thioacetic acid	1676	N	No safety concern
(S)-Methyl propanethioate	1678	N	No safety concern
(S)-Isopropyl 3-methylbut-2-enethioate	1679	N	No safety concern
<b>Structural Class II</b>			
Allyl thiohexanoate	1681	N	No safety concern
<b>Structural Class III</b>			
(S)-Ethyl 2-acetylaminooethanethioate	1680	N	No safety concern
Propyl propane thiosulfonate	1702	N	No safety concern

<sup>a</sup>N: new specifications prepared.

**D. Aliphatic acyclic diols, triols, and related substances**

Flavouring agent	No.	Specifications <sup>a</sup>	Conclusions based on current intake
<b>Structural Class I</b>			
Dihydroxyacetone dimer	1716	N	No safety concern
1-Hydroxy-2-butanone	1717	N	No safety concern
Ethyl 3-acetoxy-2-methylbutyrate	1718	N	No safety concern
Methyl 5-acetoxyhexanoate	1719	N	No safety concern
<b>Structural Class III</b>			
2,4-Dimethyl-1,3-dioxolane	1711	N	No safety concern
2-Hexyl-4,5-dimethyl-1,3-dioxolane	1712	N	No safety concern
<i>cis</i> - and <i>trans</i> -Ethyl 2,4-dimethyl-1,3-dioxolane-2-acetate	1715	N	No safety concern

<sup>a</sup>N: new specifications prepared.

Five substances in this group (listed as Nos. 1720, 1721 and 1723–1725 in the Call for data; they are various fatty acid esters of glycerol and propylene glycol) had been previously evaluated by the Committee as emulsifying agents. These substances have food additive specifications and have been allocated ADIs. Although the use of these substances as flavouring agents would not be anticipated to cause a safety concern, the Committee questioned whether these substances have flavouring properties and did not evaluate them according to the Procedure for the Safety Evaluation of Flavouring Agents. In addition, the Committee questioned the flavouring function of lactylated fatty acid esters of glycerol and propylene glycol (listed as No. 1722), for which an ADI and specifications are not available, and decided not to evaluate this substance as a flavouring agent using the Procedure.

**E. Aliphatic acetals**

Flavouring agent	No.	Specifications <sup>a</sup>	Conclusions based on current estimated intake
<b>Structural Class I</b>			
(+/-) 1-Acetoxy-1-ethoxyethane	1726	N	No safety concern
Acetaldehyde hexyl isoamyl acetal	1727	N	No safety concern
1,1-Dimethoxy-trans-2-hexene	1728	N	No safety concern
Acetaldehyde diisoamyl acetal	1729	N	No safety concern
Isovaleraldehyde diethyl acetal	1730	N	No safety concern
Valeraldehyde dibutyl acetal	1731	N	No safety concern
Hexanal hexyl isoamyl acetal	1735	N	No safety concern
Hexanal dihexyl acetal	1738	N	No safety concern
Nonanal dimethyl acetal	1742	N	No safety concern
Dodecanal dimethyl acetal	1746	N	No safety concern
Acetaldehyde di- <i>cis</i> -3-hexenyl acetal	1747	N	No safety concern
<b>Structural Class III</b>			
Isovaleraldehyde propyleneglycol acetal	1732	N	No safety concern
Isovaleraldehyde glyceryl acetal	1733	N	No safety concern
Valeraldehyde propyleneglycol acetal	1734	N	No safety concern
Hexanal octane-1,3-diol acetal	1736	N	No safety concern
Hexanal butane-2,3-diol acetal	1737	N	No safety concern
Heptanal propyleneglycol acetal	1739	N	No safety concern
2,6-Dimethyl-5-heptenal propyleneglycol acetal	1740	N	No safety concern
Octanal propyleneglycol acetal	1741	N	No safety concern
Nonanal propyleneglycol acetal	1743	N	No safety concern
Decanal propyleneglycol acetal	1744	N	No safety concern
Undecanal propyleneglycol acetal	1745	N	No safety concern
Isobutanal propyleneglycol acetal	1748	N	No safety concern
Acetaldehyde 1,3-octanediol acetal	1749	N	No safety concern

<sup>a</sup>N: new specifications prepared**F. Sulfur-containing heterocyclic compounds**

Flavouring agent	No.	Specifications <sup>a</sup>	Conclusions based on current estimated intake
<b>Structural Class II</b>			
1-(3-Hydroxy-5-methyl-2-thienyl)ethanone	1750	N	No safety concern
2-(4-Methyl-5-thiazolyl)ethyl formate	1751	N	No safety concern
2-(4-Methyl-5-thiazolyl)ethyl propionate	1752	N	No safety concern
2-(4-Methyl-5-thiazolyl)ethyl butanoate	1753	N	No safety concern
2-(4-Methyl-5-thiazolyl)ethyl isobutyrate	1754	N	No safety concern
2-(4-Methyl-5-thiazolyl)ethyl hexanoate	1755	N	No safety concern
2-(4-Methyl-5-thiazolyl)ethyl octanoate	1756	N	No safety concern
2-(4-Methyl-5-thiazolyl)ethyl decanoate	1757	N	No safety concern
2,5-Dimethylthiazole	1758	N	No safety concern
5-Acetyl-2,3-dihydro-1,4-thiazine	1766	N	No safety concern
<b>Structural Class III</b>			
2-Acetyl-2-thiazoline	1759	N	No safety concern
2-Propionyl-2-thiazoline	1760	N	No safety concern
<i>cis</i> - and <i>trans</i> -5-Ethyl-4-methyl-2-(2-methylpropyl)thiazoline	1761	N	No safety concern
<i>cis</i> - and <i>trans</i> -5-Ethyl-4-methyl-2-(1-methylpropyl)thiazoline	1762	N	No safety concern
Pyrrolidino-[1,2e]-4H-2,4-dimethyl-1,3,5-dithiazine	1763	N	No safety concern
2-Hexylthiophene	1764	N	No safety concern
3-(Methylthio)-methylthiophene	1765	N	No safety concern

<sup>a</sup>N: new specifications prepared

**G. Aliphatic and aromatic amines and amides**

Flavouring agent	No.	Specifications <sup>a</sup>	Conclusions based on current estimated intake
<b>Structural Class I</b>			
4-Aminobutyric acid	1771	N	No safety concern
N-Gluconyl ethanolamine	1772	N	No safety concern
N-Gluconyl ethanolamine phosphate	1773	N	No safety concern
N-Lactoyl ethanolamine	1774	N	No safety concern
N-Lactoyl ethanolamine phosphate	1775	N	No safety concern
<b>Structural Class III</b>			
N-(Heptan-4-yl)benzo[d][1,3]dioxole-5-carboxamide	1767	N	No safety concern
N1-(2,4-Dimethoxybenzyl)-N2-(2-(pyridin-2-yl)ethyl)oxalamide	1768	N	No safety concern
N1-(2-Methoxy-4-methylbenzyl)-N2-(2-(5-methylpyridin-2-yl)ethyl)oxalamide	1769	N	No safety concern
N1-(2-Methoxy-4-methylbenzyl)-N2-(2-(pyridin-2-yl)ethyl)oxalamide	1770	N	No safety concern
N-[(Ethoxycarbonyl)methyl]-p-menthane-3-carboxamide	1776	N	No safety concern
N-[2-(3,4-Dimethoxyphenyl)ethyl]-3,4-dimethoxycinnamic acid amide	1777	N	No safety concern
N-3,7-Dimethyl-2,6-octadienyl cyclopropylcarboxamide	1779	N	No safety concern

<sup>a</sup>N: new specifications prepared.**H. Aliphatic alicyclic linear  $\alpha,\beta$ -unsaturated di- and trienals and related alcohols, acids and esters**

Flavouring agent	No.	Specifications <sup>a</sup>	Conclusions based on current estimated intake
<b>Structural Class I</b>			
2,4-Hexadienyl acetate	1780	N	No safety concern
2,4-Hexadienyl propionate	1781	N	No safety concern
2,4-Hexadienyl isobutyrate	1782	N	No safety concern
2,4-Hexadienyl butyrate	1783	N	No safety concern
2,4-Heptadien-1-ol	1784	N	No safety concern
Nona-2,4,6-trienal	1785	N	No safety concern
2,4,7-Decatrienal	1786	N	No safety concern

<sup>a</sup>N: new specifications prepared.

***Recommendations and further information required*****Carrageenan**

The Committee noted that the previous dietary exposure estimate for carrageenan was made solely using production poundage and may be outdated. The Committee therefore recommended that a new dietary exposure evaluation, employing specific food type and use level information, be undertaken, ensuring that new uses are adequately taken into consideration.

**Cyclotetraglucose and cyclotetraglucose syrup**

Data on the identity of the bacterial strain used to produce the 6-GT/IMT enzyme preparation and evidence of its lack of pathogenicity and toxigenicity. For cyclotetraglucose syrup, information on total saccharide content, the unidentified fraction and test methods.

**Steviol glucosides**

Submission of the results of the ongoing toxicological and clinical studies, in particular studies addressing pharmacological effects.

**CORRIGENDUM****COMPENDIUM OF FOOD ADDITIVE SPECIFICATIONS  
FAO FOOD AND NUTRITION PAPER 52, Addendum 8, ROME, 2000.**

Page 150, last entry *o*-(*Methylthio*)phenol, the synonym Thioguaiacol is deleted as this substance is not a synonym to *o*-(*Methylthio*)phenol.

**COMPENDIUM OF FOOD ADDITIVE SPECIFICATIONS  
FAO FOOD AND NUTRITION PAPER 52, Volume 2, ROME, 1992.  
COMBINED COMPENDIUM OF FOOD ADDITIVE SPECIFICATIONS  
FAO JECFA MONOGRAPHS 1, Volume 3, ROME 3, 2005.*****Sodium Carboxy Methyl Cellulose***

Page 1326, Under Identification tests C in FNP 52, Volume 2, the 4<sup>th</sup> line from the bottom of the page, the sentence 'No precipitate appears.' is changed to 'A precipitate appears.'

Page 316, Under Identification, Precipitate formation, in FAO JECFA Monographs 1, Volume 3, line 6, the sentence 'No precipitate appears.' is changed to 'A precipitate appears.'

The original specification for Sodium Carboxy Methyl Cellulose, published in FAO Food and Nutrition Paper 31/2, Rome, 1984, the text of the identification test on precipitate formation was correctly worded as follows: To 5 ml of an 0.5% solution of the sample add 5 ml of a solution 5% solution of copper sulfate or aluminium sulfate. A precipitate appears.



## FAO TECHNICAL PAPERS

### FAO JECFA MONOGRAPHS

- 1 Combined compendium of food additive specifications – JECFA specifications monographs from 1<sup>st</sup> to 65<sup>th</sup> meeting. (E)  
Vol. 1 Food additives A – D  
Vol. 2 Food additives E – O  
Vol. 3 Food additives P – Z  
Vol. 4 Analytical methods, test procedures and laboratory solutions
- 2 Residue evaluation of certain veterinary drugs  
Joint FAO/WHO Expert Committee on Food Additives  
66<sup>th</sup> meeting 2006 (E)
- 3 Compendium of food additive specifications -  
Joint FAO/WHO Expert Committee on Food Additives  
67<sup>th</sup> meeting 2006 (E)

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# COMPENDIUM OF FOOD ADDITIVE SPECIFICATIONS

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## **Joint FAO/WHO Expert Committee on Food Additives**

68th meeting 2007

This document contains food additive specifications monographs, analytical methods and other information, prepared at the sixty-eighth meeting of the Joint FAO/WHO Expert Committee on Food Additives (JECFA), which was held in Geneva, Switzerland, from 19 to 28 June 2007. The specifications monographs provide information on the identity and purity of food additives used directly in foods or in food production. The main three objectives of these specifications are to identify the food additive that has been subjected to testing for safety, to ensure that the additive is of the quality required for use in food or in processing, and to reflect and encourage good manufacturing practice. This publication and other documents produced by JECFA contain information that is useful to all those who work with or are interested in food additives and their safe use in food.

