INTERNATIONAL STANDARD

ISO 3515

Third edition
2002-04-15

Oil of lavender (*Lavandula angustifolia* Mill.)

*Huile essentielle de lavande (*Lavandula angustifolia *Mill.)*

Reference number
ISO 3515:2002(E)

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Foreword

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

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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

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

ISO 3515 was prepared by Technical Committee ISO/TC 54, *Essential oils*.

This third edition cancels and replaces the second edition (ISO 3515:1987), which has been technically revised.

Annexes A, B and C of this International Standard are for information only.

Oil of lavender (*Lavandula angustifolia* Mill.)

1 Scope

This International Standard specifies certain characteristics of the oils of spontaneous lavender (population lavender, France) and of clonal lavender (*Lavandula angustifolia* Mill.), from various origins, with a view to facilitate assessment of their quality.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO/TR 210, *Essential oils — General rules for packaging, conditioning and storage*

ISO/TR 211, *Essential oils — General rules for labelling and marking of containers*

ISO 212, *Essential oils — Sampling*

ISO 279, *Essential oils — Determination of relative density at 20 °C — Reference method*

ISO 280, *Essential oils — Determination of refractive index*

ISO 592, *Essential oils — Determination of optical rotation*

ISO 709, *Essential oils — Determination of ester value*

ISO 875, *Essential oils — Evaluation of miscibility in ethanol*

ISO 1242, *Essential oils — Determination of acid value*

ISO 11024-1, *Essential oils — General guidance on chromatographic profiles — Part 1: Preparation of chromatographic profiles for presentation in standards*

ISO 11024-2, *Essential oils — General guidance on chromatographic profiles — Part 2: Utilization of chromatographic profiles of samples of essential oils*

3 Terms and definitions

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

3.1
oil of lavender
oil obtained by steam distillation of the recently cut flowering tops of *Lavandula angustifolia* Mill., spontaneous or cultivated, of the Lamiaceae family

NOTE For information on the CAS number, see ISO/TR 21092.

3.2
spontaneous lavender
population lavender
lavender obtained exclusively from seeds and growing spontaneously or cultivated principally in the south of France

3.3
clonal lavender
cultivated lavender obtained from one individual (plant) by propagation by cuttings

4 Requirements

4.1 Appearance

Clear mobile liquid.

4.2 Colour

Pale yellow.

4.3 Odour

Characteristic, fresh floral, recalling the odour of the flowering tops of the plant.

4.4 Relative density at 20 °C, d_{20}^{20}

Spontaneous lavender		Clonal lavenders (principal origins)									
France		France "Maillette"		Bulgaria		Russian Federation		Australia		Other origins	
min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
%	%	%	%	%	%	%	%	%	%	%	%
0,880 0	0,890 0	0,880 0	0,890 0	0,879 0	0,888 0	0,880 0	0,890 0	0,880 0	0,890 0	0,878 0	0,892 0

4.5 Refractive index at 20 °C

Spontaneous lavender		Clonal lavenders (principal origins)									
France		France "Maillette"		Bulgaria		Russian Federation		Australia		Other origins	
min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
1,458 0	1,464 0	1,455 0	1,460 0	1,459 0	1,463 0	1,460 0	1,466 0	1,457 0	1,464 0	1,460 0	1,466 0

4.6 Optical rotation at 20 °C

Spontaneous lavender	Clonal lavenders (principal origins)				
France	France "Maillette"	Bulgaria	Russian Federation	Australia	Other origins
Between – 11,5° and – 7°	Between – 12,5° and – 9,5°	Between – 10° and – 6,8°	Between – 10,5° and – 7,5°	Between – 11,5° and – 7°	Between – 12° and – 6°

4.7 Miscibility in ethanol at 70 % or 75 % (volume fraction) at 20 °C

To obtain a clear solution with 1 volume of essential oil, it shall not be necessary to use more than

Spontaneous lavender	Clonal lavenders (principal origins)				
France	France "Maillette"	Bulgaria	Russian Federation	Australia	Other origins
2 volumes of ethanol at 75 % (volume fraction)	3 volumes of ethanol at 70 % (volume fraction)[a]	2 volumes of ethanol at 75 % (volume fraction)	2 volumes of ethanol at 75 % (volume fraction)	2 volumes of ethanol at 75 % (volume fraction)	2 volumes of ethanol at 75 % (volume fraction)
[a] Sometimes opalescence is observed on dilution.					

4.8 Acid value

Maximum values:

Spontaneous lavender	Clonal lavenders (principal origins)				
France	France "Maillette"	Bulgaria	Russian Federation	Australia	Other origins
1,0	1,0	1,0	1,2	1,0	1,2

4.9 Ester values

Spontaneous lavender		Clonal lavenders (principal origins)									
France		France "Maillette"		Bulgaria		Russian Federation		Australia		Other origins	
min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
102,5	165	130	160	110	150	90	150	102,5	165	90	160
which corresponds to the following ester contents, expressed as linalyl acetate											
35,8 %	58 %	45,5 %	56 %	38,5 %	52,5 %	31,5 %	52,5 %	35,8 %	58 %	31,5 %	56 %

4.10 Chromatographic profile

Analysis of the essential oil shall be carried out by gas chromatography. In the chromatogram obtained, the representative and characteristic components shown in Table 1 shall be identified. The proportions of these components, indicated by the integrator, shall be as shown in Table 1. This constitutes the chromatographic profile of the essential oil.

4.11 Flashpoint

Information on the flashpoint is given in annex C.

Table 1 — Chromatographic profile

Component	Spontaneous lavender		Clonal lavenders (principal origins)									
	France		France "Maillette"		Bulgaria		Russian Federation		Australia		Other origins	
	min. %	max. %	min. %	max. %	min. %	max. %	min. %	max. %	min. %	max. %	min. %	max. %
Limonene	—	0,5	—	0,3	—	0,6	—	1	—	0,5	—	1
1,8-Cineole [a]	—	1	—	0,5	—	2	—	2,5	—	1	—	3
β-Phellandrene [a]	Traces	0,5	—	0,2	—	0,6	—	1	—	0,5	—	1
cis-β-Ocimene	4	10	—	2,5	3	9	3	8	3	9	1	10
trans-β-Ocimene	1,5	6	—	2	2	5	2	5	0,5	1	0,5	6
3-Octanone	Traces	2	1	2,5	0,2	1,6	—	0,6	2	5	—	3
Camphor	Traces	0,5	—	1,2	—	0,6	—	0,6	—	0,5	—	1,5
Linalol	25	38	30	45	22	34	20	35	25	38	20	43
Linalyl acetate	25	45	33	46	30	42	29	44	25	45	25	47
Lavandulol	0,3	—	—	0,5	0,3	—	0,1	—	0,3	—	—	3
Terpinen-4-ol	2	6	—	1,5	2	5	1,2	5	1,5	6	—	8
Lavandulyl acetate	2	—	—	1,3	2	5	1	3,5	1	—	—	8
α-Terpineol	—	1	0,5	1,5	0,8	2	0,5	2	—	1,0	—	2

NOTE The chromatographic profile is normative, contrary to typical chromatograms given for information in annexes A and B.

[a] 1,8-Cineole and β-phellandrene are often coeluted.

5 Sampling

See ISO 212.

Minimum volume of test sample: 25 ml

NOTE This volume allows each of the tests specified in this International Standard to be carried out at least once.

6 Test methods

6.1 Relative density at 20 °C, d_{20}^{20}

See ISO 279.

6.2 Refractive index at 20 °C

See ISO 280.

6.3 Optical rotation at 20 °C

See ISO 592.

6.4 Miscibility in ethanol at 70 % or 75 % (volume fraction) at 20 °C

See ISO 875.

6.5 Acid value

See ISO 1242.

6.6 Ester value

See ISO 709.

Test portion: 2 g

Saponification time: 30 min.

Molecular mass of linalyl acetate: 196,29

6.7 Chromatographic profile

See ISO 11024-1 and ISO 11024-2.

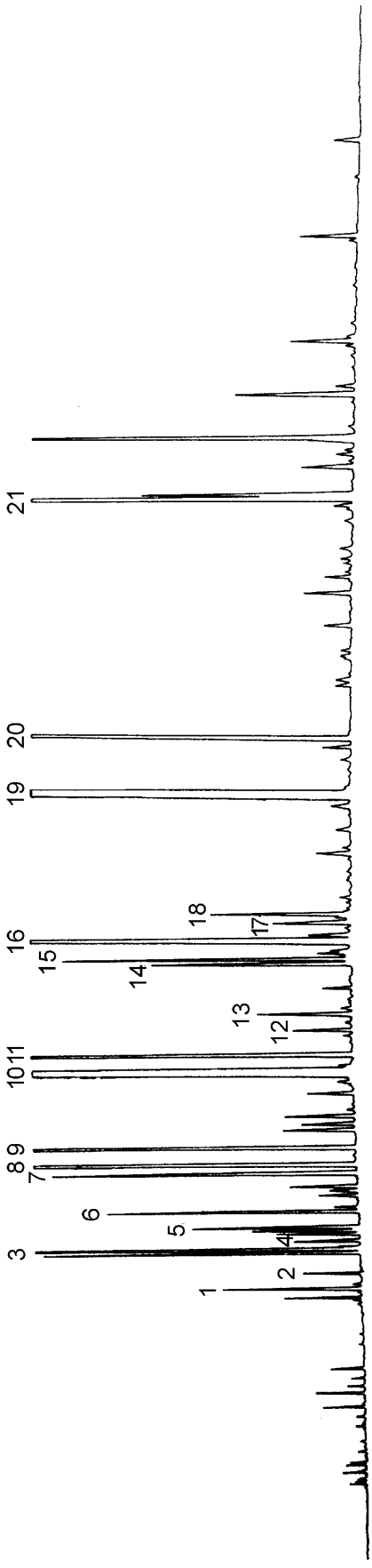
7 Packing, labelling, marking and storage

See ISO/TR 210 and ISO/TC 211.

Annex A
(informative)

Typical chromatograms of the analysis by gas chromatography of the essential oil of spontaneous (population) lavender (*Lavandula angustifolia* Mill.), France

See Figures A.1 and A.2.



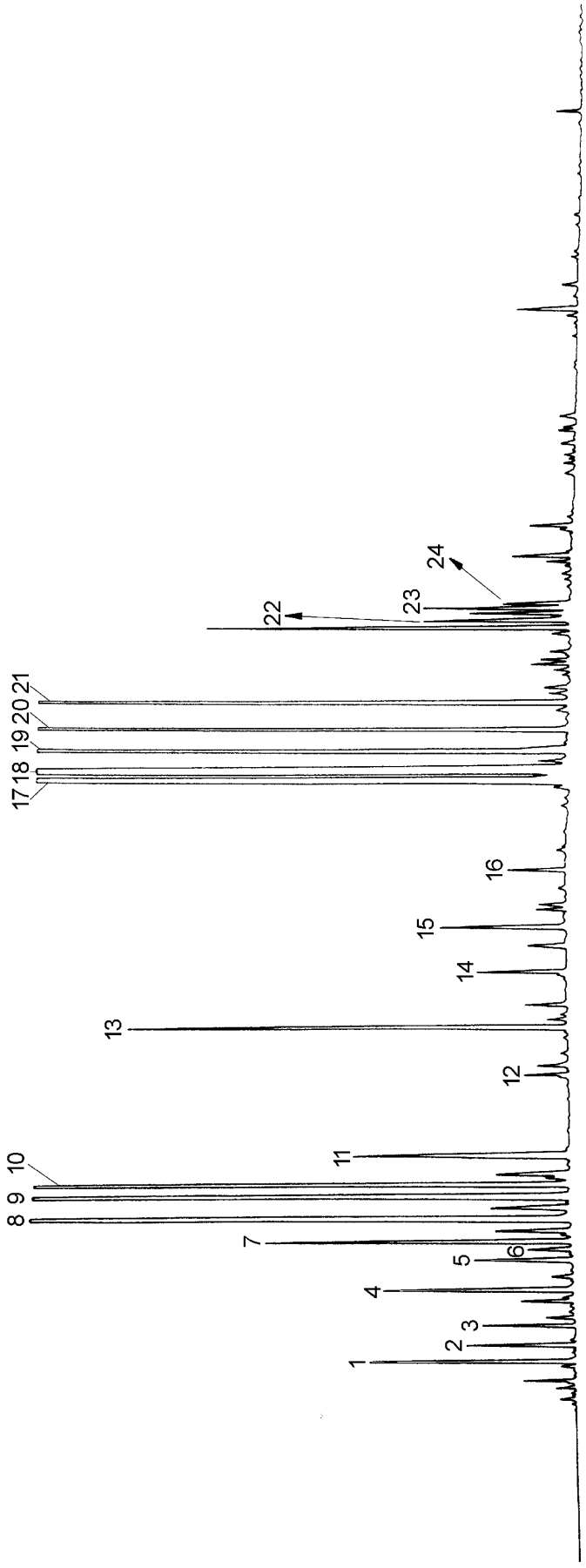
Peak identification

1 α-Pinene
2 Camphene
3 3-Octanone
4 β-Pinene
5 Myrcene
6 Hexyl acetate
7 1,8-Cineole + limonene + β-phellandrene
8 *cis*-β-Ocimene
9 *trans*-β-Ocimene
10 Linalol
11 Oct-1-en-3-yl acetate
12 Hexyl isobutyrate
13 Camphor
14 Borneol
15 Lavandulol
16 Terpinen-4-ol
17 α-Terpineol
18 Hexyl butyrate
19 Linalyl acetate
20 Lavandulyl acetate
21 β-Caryophyllene

Operating conditions

Column: silica capillary; length 50 m; internal diameter 0,27 mm
Stationary phase: polydimethylsiloxane (OV 101®)
Film thickness: 0,25 µm
Oven temperature: temperature programming from 65 °C to 170 °C at a rate of 1,5 °C/min
Injector temperature: 200 °C
Detector temperature: 200 °C
Detector: flame ionization type
Carrier gas: helium
Volume injected: 0,2 µl
Carrier gas flow rate: 0,75 ml/min

Figure A.1 — Typical chromatogram taken on an apolar column



Peak identification

1 α-Pinene + α-thujene
2 Camphene
3 β-Pinene
4 Myrcene
5 Limonene
6 β-Phellandrene
7 1,8-Cineole
8 *cis*-β-Ocimene
9 *trans*-β-Ocimene
10 3-Octanone
11 Hexyl acetate + terpinolene
12 Hexyl isobutyrate
13 Oct-1-en-3-yl acetate
14 Hexyl butyrate
15 1-Octene-3-ol
16 Camphor
17 Linalol
18 Linalyl acetate
19 β-Caryophyllene
20 Terpinen-4-ol
21 Lavandulyl acetate
22 Lavandulol
23 Borneol
24 α-Terpineol

Operating conditions

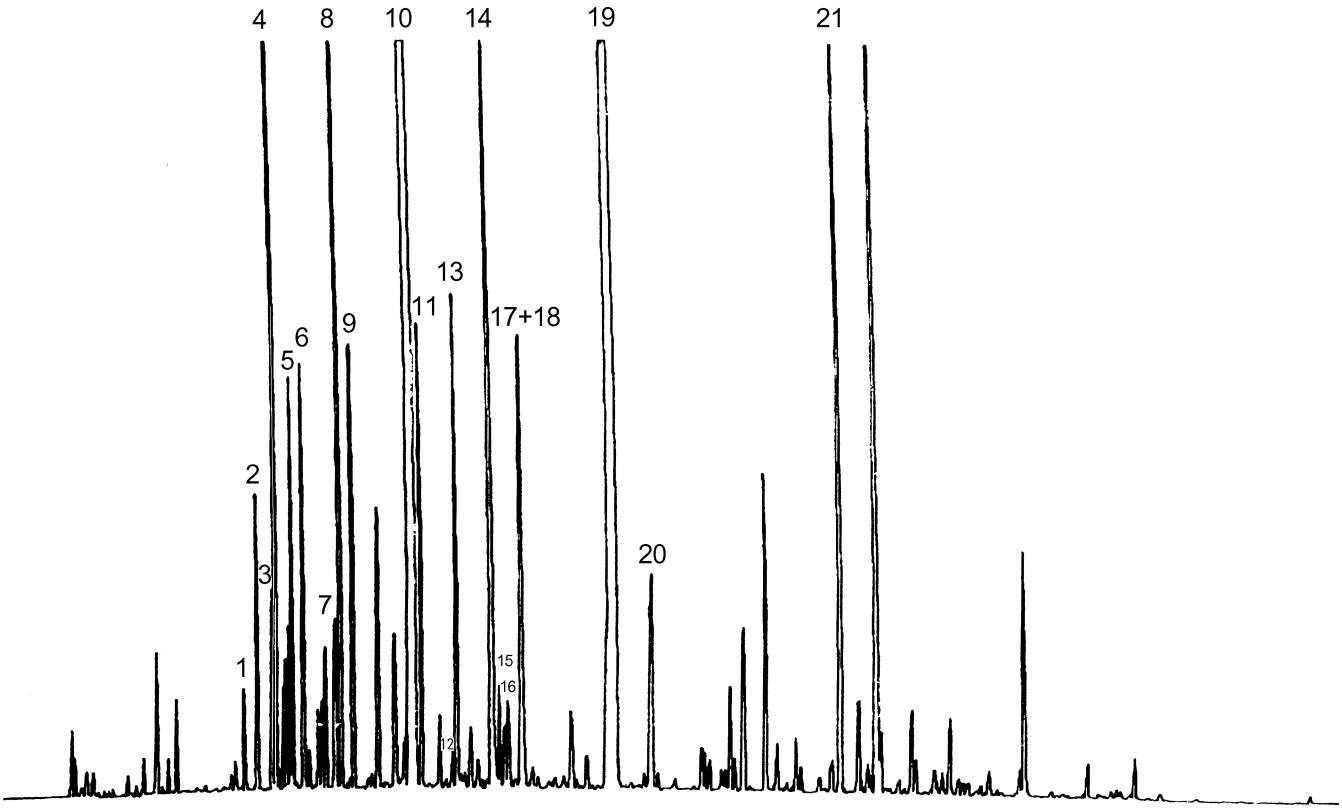
Column: silica capillary; length 50 m; internal diameter 0,27 mm
Stationary phase: poly(ethylene glycol) (Carbowax 20 M®)
Film thickness: about 0,25 µm
Oven temperature: temperature programming from 65 °C to 170 °C at a rate of 1,5 °C/min
Injector temperature: 200 °C
Detector temperature: 200 °C
Detector: flame ionization type
Carrier gas: helium
Volume injected: 0,2 µl
Carrier gas flow rate: 0,75 ml/min

Figure A.2 — Typical chromatogram taken on a polar column

Annex B
(informative)

Typical chromatograms of the analysis by gas chromatography of the essential oil of clonal lavenders (*Lavandula angustifolia* Mill.) from different origins

B.1 Clonal lavender, France "Maillette"



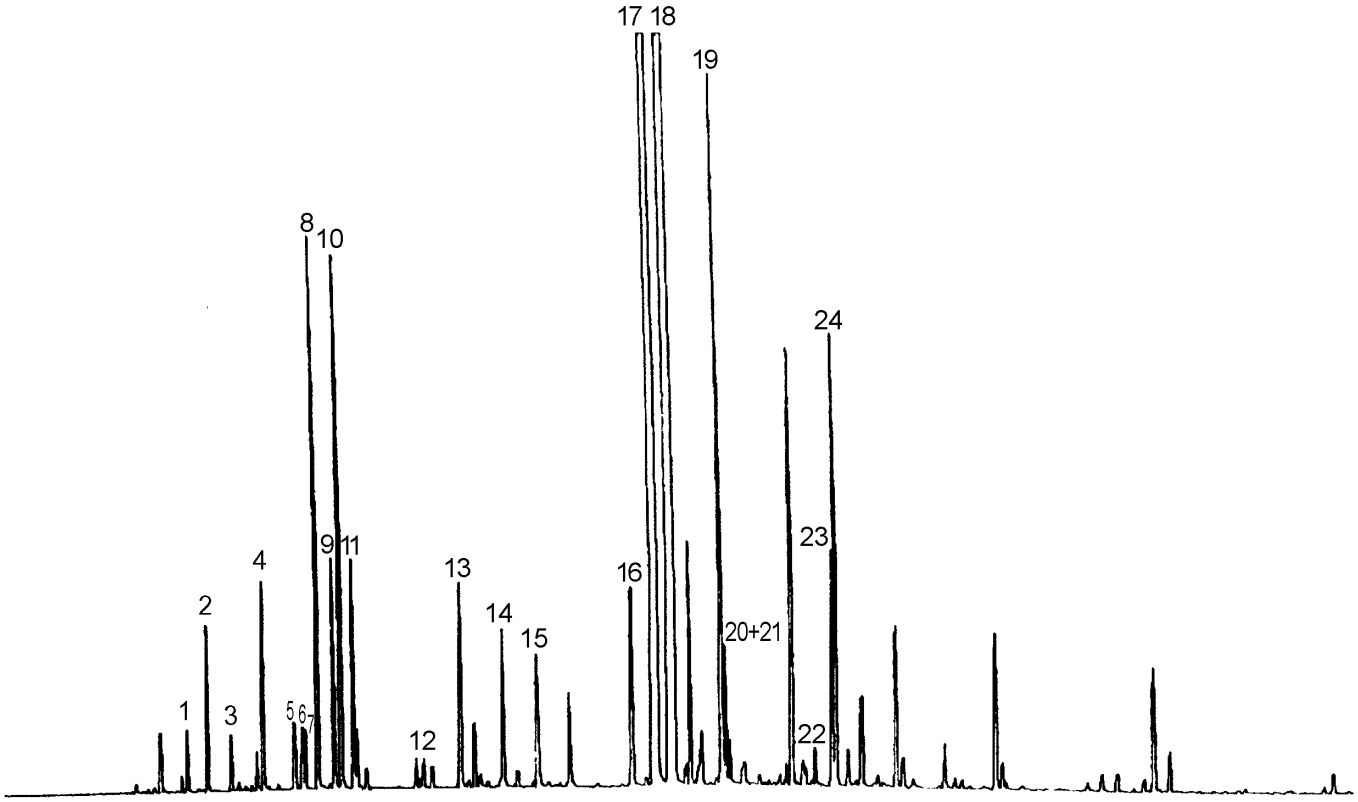
Peak identification

1 α-Pinene
2 Camphene
3 β-Pinene
4 3-Octanone
5 Myrcene
6 Hexyl acetate
7 1,8-Cineole + limonene + β-phellandrene
8 *cis*-β-Ocimene
9 *trans*-β-Ocimene
10 Linalol
11 Oct-1-en-3-yl acetate
12 Hexyl isobutyrate
13 Camphor
14 Borneol
15 Lavandulol
16 Terpinen-4-ol
17 α-Terpineol
18 Hexyl butyrate
19 Linalyl acetate
20 Lavandulyl acetate
21 β-Caryophyllene

Operating conditions

Column: silica capillary; length 50 m; internal diameter 0,2 mm
Stationary phase: polydimethylsiloxane (OV 101®)
Film thickness: 0,25 µm
Oven temperature: temperature programming from 65 °C to 230 °C at a rate of 1 °C/min
Injector temperature: 250 °C
Detector temperature: 250 °C
Detector: flame ionization type
Carrier gas: hydrogen
Volume injected: 0,2 µl
Carrier gas flow rate: 0,75 ml/min

Figure B.1 — Typical chromatogram of clonal lavender, France "Maillette", taken on an apolar column



Peak identification

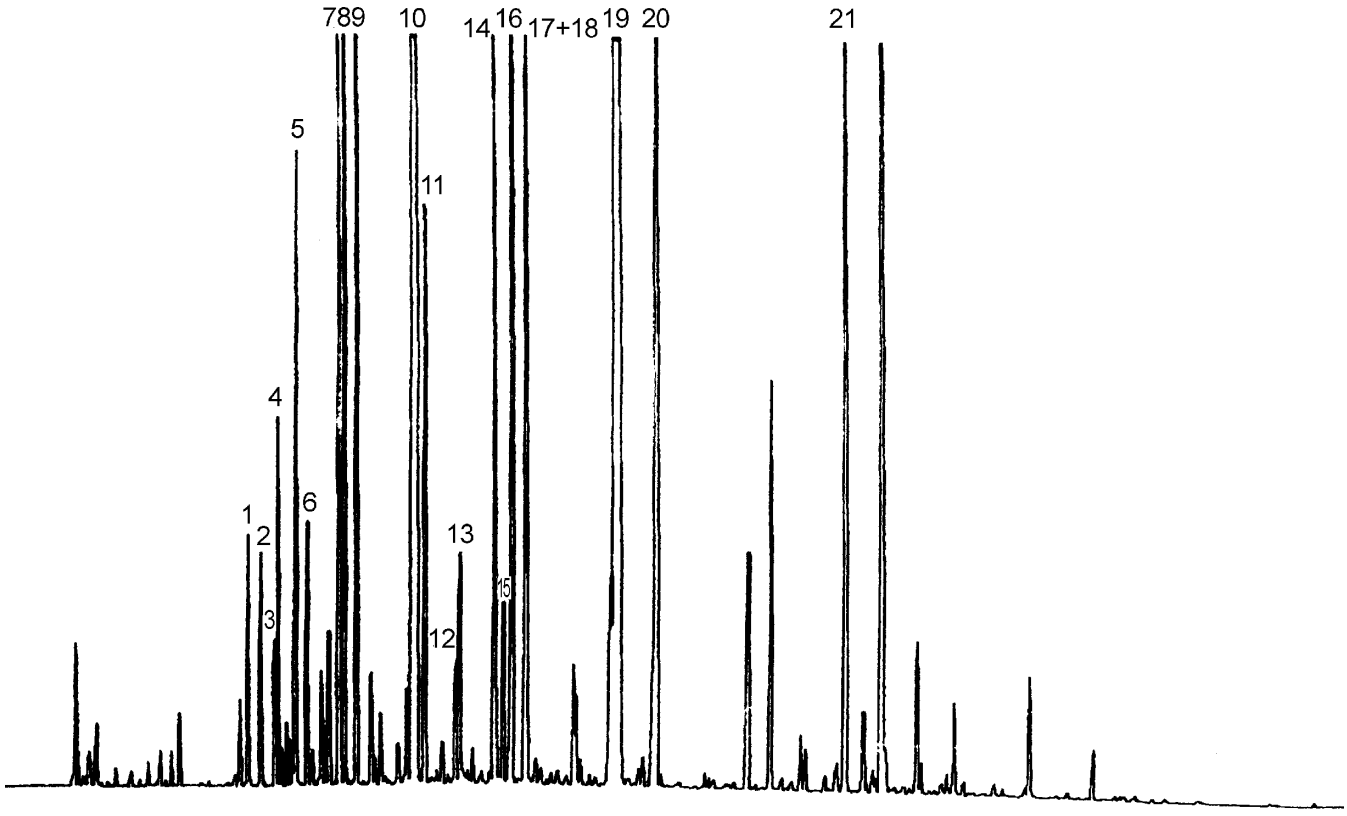
1 α-Pinene + α-thujene
2 Camphene
3 β-Pinene
4 Myrcene
5 Limonene
6 β-Phellandrene
7 1,8-Cineole
8 *cis*-β-Ocimene
9 *trans*-β-Ocimene
10 3-Octanone
11 Hexyl acetate + terpinolene
12 Hexyl isobutyrate
13 Oct-1-en-3-yl acetate
14 Hexyl butyrate
15 1-Octen-3-ol
16 Camphor
17 Linalol
18 Linalyl acetate
19 β-Caryophyllene
20+21 Terpinen-4-ol + lavandulyl acetate
22 Lavandulol
23 α-Terpineol
24 Borneol

Operating conditions

Column: silica capillary; length 50 m; internal diameter 0,2 mm
Stationary phase: poly(ethylene glycol) (TPA treated) (INNOWAX®)
Film thickness: 0,25 µm
Oven temperature: temperature programming from 65 °C to 250 °C at a rate of 2 °C/min
Injector temperature: 250 °C
Detector temperature: 250 °C
Detector: flame ionization type
Carrier gas: hydrogen
Volume injected: 0,2 µl
Carrier gas flow rate: 0,75 ml/min

Figure B.2 — Typical chromatogram of clonal lavender, France "Maillette", taken on a polar column

B.2 Clonal lavender, Bulgaria



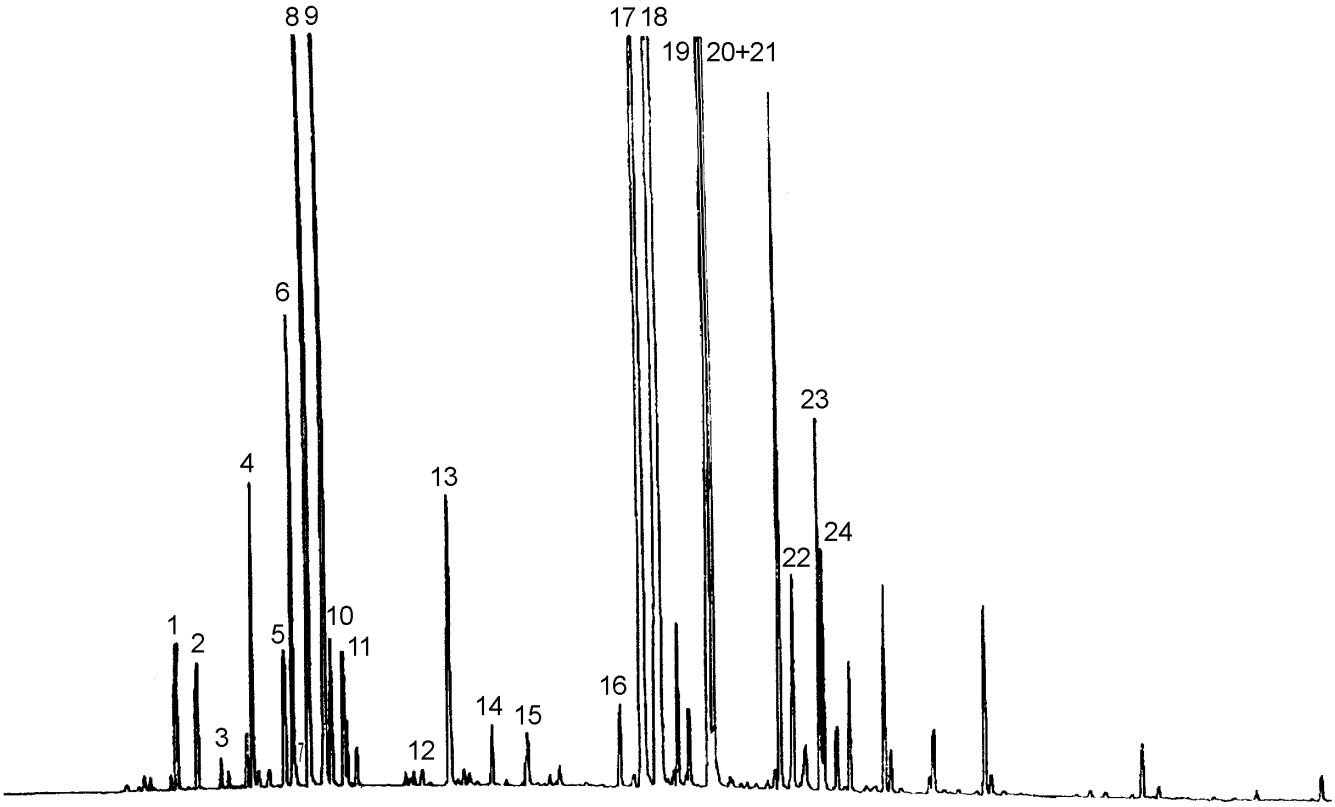
Peak identification

1 α-Pinene
2 Camphene
3 β-Pinene
4 3-Octanone
5 Myrcene
6 Hexyl acetate
7 1,8-Cineole + limonene + b-phellandrene
8 *cis*-β-Ocimene
9 *trans*-β-Ocimene
10 Linalol
11 Oct-1-en-3-yl acetate
12 Hexyl isobutyrate
13 Camphor
14 Borneol
15 Lavandulol
16 Terpinen-4-ol
17 α-Terpineol
18 Hexyl butyrate
19 Linalyl acetate
20 Lavandulyl acetate
21 β-Caryophyllene

Operating conditions

Column: capillary, silica, length 50 m, internal diameter 0,2 mm
Stationary phase: polydimethylsiloxane (OV 101®)
Film thickness: 0,25 µm
Oven temperature : temperature programming from 65 °C to 230 °C at a rate of 1 °C/min
Injection temperature: 250 °C
Detection temperature: 250 °C
Detector: flame ionization type
Carrier gas: hydrogen
Volume injected: 0,2 µl
Carrier gas flow rate: 0,75 ml/min

Figure B.3 — Typical chromatogram of clonal lavender, Bulgaria, taken on an apolar column



Peak identification

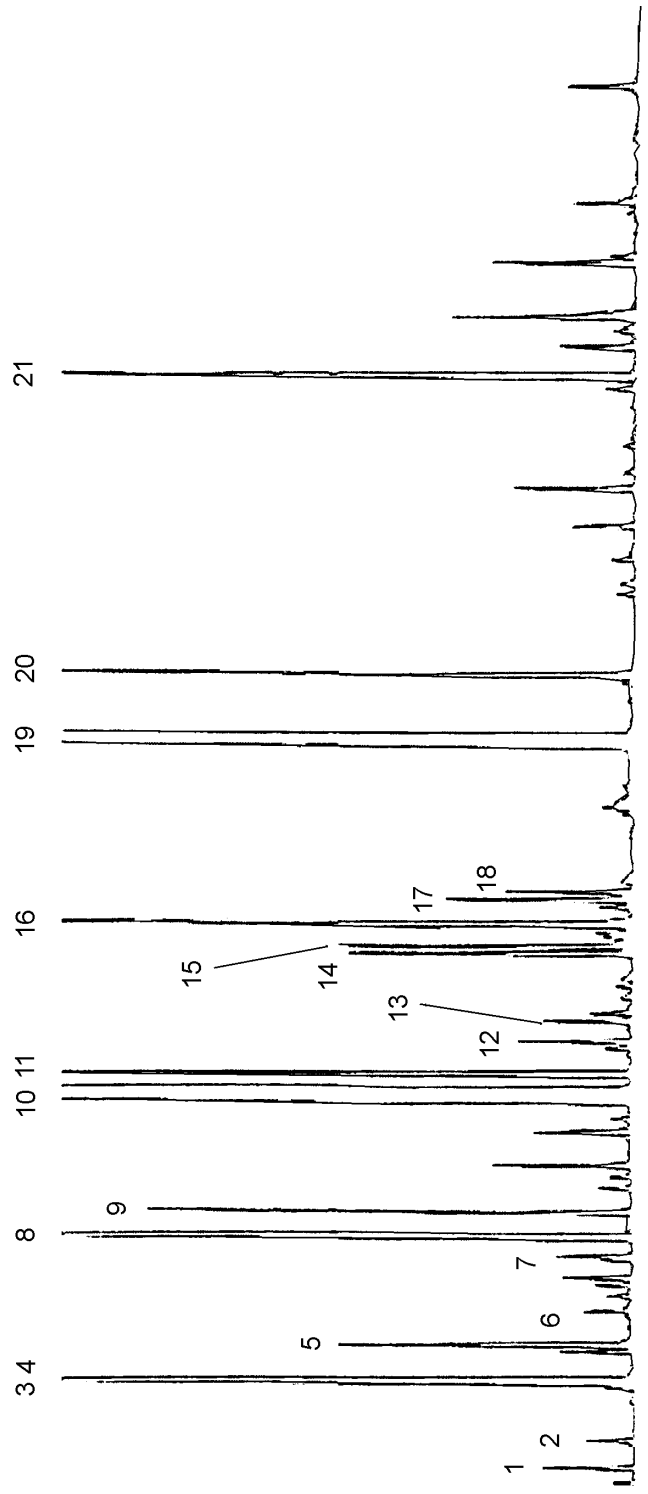
1 α-Pinene + α-thujene
2 Camphene
3 β-Pinene
4 Myrcene
5 Limonene
6 β-Phellandrene
7 1,8-Cineole
8 *cis*-β-Ocimene
9 *trans*-β-Ocimene
10 3-Octanone
11 Hexyl acetate + terpinolene
12 Hexyl isobutyrate
13 Oct-1-en-3-yl acetate
14 Hexyl butyrate
15 1-Octen-3-ol
16 Camphor
17 Linalol
18 Linalyl acetate
19 β-Caryophyllene
20 + 21 Terpinen-4-ol + lavandulyl acetate
22 Lavandulol
23 α-Terpineol
24 Borneol

Operating conditions

Column: silica capillary; length 50 m; internal diameter 0,2 mm
Stationary phase: poly(ethylene glycol) (TPA treated) (INNOWAX®)
Film thickness: 0,25 µm
Oven temperature: temperature programming from 65 °C to 250 °C at a rate of 2 °C/min
Injector temperature: 250 °C
Detector temperature: 250 °C
Detector: flame ionization type
Carrier gas: hydrogen
Volume injected: 0,2 µl
Carrier gas flow rate: 0,75 ml/min

Figure B.4 — Typical chromatogram of clonal lavender, Bulgaria, taken on a polar column

B.3 Clonal lavender, Australia



Peak identification

1 α-Pinene
2 Camphene
3 3-Octanone
4 β-Pinene
5 Myrcene
6 Hexyl acetate
7 1,8-Cineole + limonene + β-phellandrene
8 *cis*-β-Ocimene
9 *trans*-β-Ocimene
10 Linalol
11 Oct-1-en-3-yl acetate
12 Hexyl isobutyrate
13 Camphor
14 Borneol
15 Lavandulol
16 Terpinen-4-ol
17 α-Terpineol
18 Hexyl butyrate
19 Linalyl acetate
20 Lavandulyl acetate
21 β-Caryophyllene

Operating conditions

Column: silica capillary; length 30 m; internal diameter 0,27 mm
Stationary phase: polydimethylsiloxane BP 1®)
Film thickness: 0,25 µm
Oven temperature: temperature programming from 40 °C to 240 °C at a rate of 10 °C/min
Injector temperature: 200 °C
Detector temperature: 300 °C
Detector: flame ionization type
Carrier gas: hydrogen
Volume injected: 0,2 µl
Carrier gas flow rate: 1 ml/min

Figure B.5 — Typical chromatogram of clonal lavender, Australia, taken on an apolar column

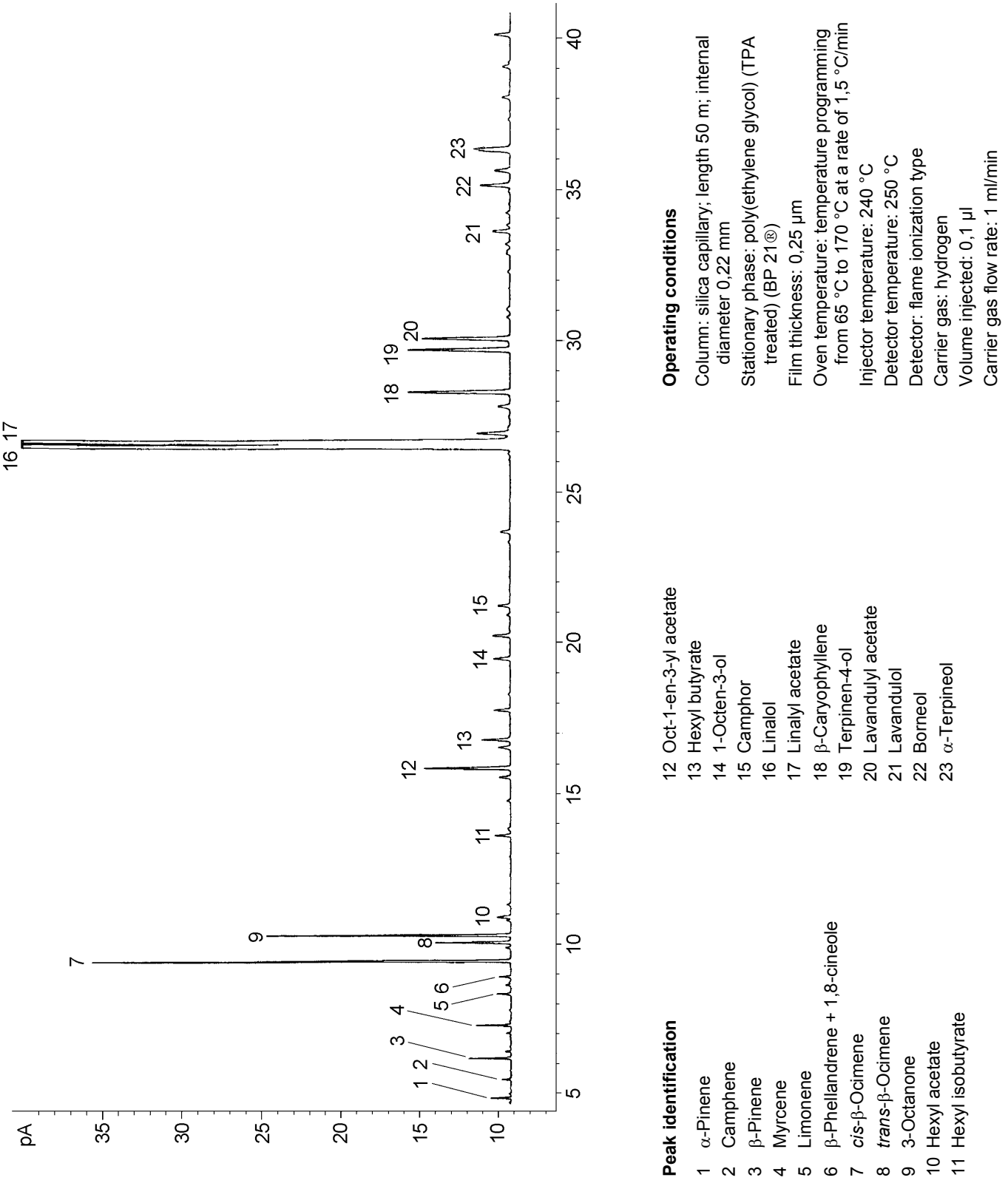


Figure B.6 — Typical chromatogram of clonal lavender, Australia, taken on a polar column

Annex C
(informative)

Flashpoint

C.1 General information

For safety reasons, transport companies, insurance companies, and people in charge of safety services require information on the flashpoints of essential oils, which in most cases are flammable products.

A comparative study on the relevant methods of analysis (see ISO/TR 11018) concluded that it was difficult to recommend a single apparatus for standardization purposes, given that:

— there is wide variation in the chemical composition of essential oils;

— the volume of the sample needed for certain requirements would be too costly for high-priced essential oils;

— as there are several different types of equipment which can be used for the determination, users cannot be expected to use one specified type only.

Consequently, it was decided to give a mean value for the flashpoint in an informative annex in each International Standard, for information, in order to meet the requirements of the interested parties.

The equipment with which this value was obtained should be specified.

For further information see ISO/TR 11018.

C.2 Flashpoint of the essential oil of lavender, all origins

The mean value is $+71\ ^{\circ}C$.

NOTE Obtained with “Luchaire” equipment.

Bibliography

[1] ISO/TR 11018:1997, *Essential oils — General guidance on the determination of flashpoint*

[2] ISO/TR 21092:—[1)], *Essential oils — Characterization*

1) To be published.

ICS 71.100.60

Price based on 16 pages