

17TH WORKSHOP ON ESSENTIAL OILS



BAD BEVENSEN

SEPTEMBER 28 TO OCTOBER 1, 1986

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ORGANIZATION

PROF. DR. ELISABETH STAHL-BISKUP
UNIVERSITÄT HAMBURG

PROF. DR. KARL-HEINZ KUBECZKA
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KLAUS-DIETER PROTZEN
HAMBURG

The 17th WORKSHOP on ESSENTIAL OILS
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PROGRAMME

SUNDAY, SEPTEMBER 28, 1986

- from 17.00 Arrival and check-in
 Workshop office in the KURZENTRUM of
 Bad Bevensen
- from 18.00 Get-together Party and supper in the
 KURZENTRUM
- 20.30 - 21.00 We invite you to a presentation with
 slides on Bad Bevensen and its unique
 surroundings (in German).

MONDAY, SEPTEMBER 29, 1986

- 9.00 - 10.30 Opening session and opening lecture
 Dr. Dietmar Lamparsky (Dübendorf)
 Essential Oils and Absolutes - Their Role
 as Important Ingredients in the Flavor
 Industry
- 10.30 - 11.00 Coffee break
- 11.00 - 12.20 Lectures (Chairman: Prof. A.Baerheim Svendsen)
- 11.00 L01 Weyerstahl, P., Marschall-Weyerstahl, H.,
 Manteuffel, E., Kaul, V.K. (Techn.Univ.Berlin):
 Constituents of the Essential Oil of
 Strobilanthes auriculatus
- 11.40 L02 Bruns, K., Meiertoberens, M. (Henkel KGaA,
 Düsseldorf)
 Volatile Constituents of Pteronia incana
 (Compositae)
- 12.00 L03 Fischer, N., Nitz, S., Drawert, F. (Techn.Univ.
 München, Freising-Weihenstephan)
 Original Flavour Compounds and Essential Oil
 Composition of Marjoram (M.hortensis Moench)
- 12.20 - 12.40 Instructions for authors concerning the
 publication in "Flavour and Fragrance Journal"

- 13.00 Lunch
- 14.00 - 15.30 Lectures (Chairman: Prof. J.J.C.Scheffer)
- 14.00 L04 Rapp, A., Mandery, H., Güntert, M. (Bundesforschungsanstalt f. Rebenzüchtung, Siebeldingen)
Terpene Compounds in Wine
- 14.30 L05 Katsiotis, S.T. (Aristotelian Univ. Thessaloniki)
Contribution to the Study of the Simultaneous Influence of Three Different Distillation Parameters on the Quality of Aetheroleum Fructus Foeniculi
- 14.50 L06 Tutt, C., Graven, E.H., Gardner, J.B. (Univ. Fort Hare, Ciskei)
Essential Oil Production in Ciskei - the Domestication of Artemisia afra and Salvia stenophylla
- 15.10 L07 Özgülven, M., Binokay, S., Sischka, S. (Univ. of Çukurova, Adana, Turkey)
Composition and Yield of Essential Oil of Thymus vulgaris L., Majorana hortensis Moench and Satureja montana L. grown in Çukurova Region
- 14.50 Dr. Stahl: methods of measurement of radio-activity.
- 15.30 - 16.00 Coffee break
45
- 16.00 - 17.30 Poster session I (Poster 01 - 16)

TUESDAY, SEPTEMBER 30, 1986

- 9.00 - 10.30 Lectures (Chairman: Dr. D.Lamparsky)
- 9.00 L08 Kubeczka, K.-H. (University of Würzburg)
Biology and Chemistry of Conifer Oils
- 9.50 L09 van den Dries, J.M.A., Baerheim Svendsen, A. (University of Leiden, The Netherlands)
Free and Glycosidic bound Monoterpenes in the Needles of Juniperus chinensis var. pfitzeriana
- 10.10 L10 Wichtmann, E.-M., Stahl-Biskup, E. (University of Hamburg)
Composition of the Essential Oil from Caraway Herb and Root

10.30 - 11.00 Coffee break

11.00 - 12.20 Lectures (Chairman: Prof.K.Bruns)

11.00 L11 Stahl-Biskup,E. (University of Hamburg)
Monoterpene Glycosides - State of the Art

11.40 L12 McHale,D., Sheridan,J.B. (Univ. of Reading)
Detection of Adulteration of Cold-pressed
Lemon Oil

13.00 Lunch

14.00 - 15.40 Lectures (Chairman: Prof. P. Weyerstahl)

14.00 L13 Ziegler,E., Kenschake,E. (Aromachemie Aufsess)
On Concentration of Essential Oils with
Pronounced Regard to Citrus Oils

14.20 L14 Joulain,D. (Robertet S.A., Grasse, France)
The Composition of the Headspace from Fragrant
Flowers: Further Results

14.40 L15 Knobloch,K., Weigand,H., Weis,N. (University
of Erlangen)
Effect of Essential Oil Components on Living
Structures

15.20 L16 Aboutabl,E. (University of Cairo, Egypt)
Volatile Constituents of Certain Plants
Growing in Egypt

L 16 Revised

15.40 - 16.00 Coffee break

16.00 - 17.30 Poster session II (Poster P17 - P33)

- 18.30 Departure from KURZENTRUM to the convent
of Medingen
- 19.00 Chamber Concerto
- 20.00 Workshop Dinner, Hotel "Vier Linden-Tannenhof"
in Medingen

WEDNESDAY, OCTOBER 1, 1986

9.00 - 11.00 Lectures (Chairman: Prof. K.-H.Kubeczka)

- 9.00 L17 Lange, G., Schultze, W. (University of
Würzburg)
Analysis of Volatiles by Chemical Ionisation
Mass Spectrometry
- 9.40 L18 Ravid, U., Ikan, R., Weinstein, V., Putievsky, E.
(Newe-Ya'ar and University of Jerusalem)
The Use of a Chiral Lanthanide Shift Reagent
in Determining the Enantiomeric Purity of
Essential Oil Constituents
- 10.00 L19 Bicchi, C., D'Amato, A., Sandra, P., David, F.
(University of Torino)
Direct Capture of Volatiles Emitted by
Living Plants
- 10.20 L20 Günther, W., Schlegelmilch, F. (WGA, Düsseldorf)
Comparison of the Different Sampling
Techniques in Capillary Gas Chromatography
- 11.00 - 11.30 Coffee break
- 11.30 - 12.00 Closing session
- 14.00 Departure from KURZENTRUM to the convent
Lüne and Lüneburg (Sightseeing Tour)

POSTER SESSION I

- P01 Nykänen, J. (Finnish State Alcohol Comp., Helsinki)
The Effect of Cultivation Conditions on the Composition of Basil Oil
- P02 Katsiotis, S. (Aristotelian University, Thessaloniki)
Study of the Influence of the Distillation Conditions on the Essential Oil Percentage yield of Fructus Foeniculi
- P03 De Pooter, H.L., Schamp, N.M. (University of Gent)
The Essential Oil of Mentha x villosa nm alopecuroides. Independence of its Composition on the Collection Site
- P04 Huopalahti, R., Hiltunen, R., Lahtinen, R., Laakso, I. (University of Helsinki)
Studies of Essential Oils of Dill Herb, Anethum graveolens
- P05 Akgül, A., Bayrak, A. (Univ.Erzurum, Univ.Ankara, Turkey)
Essential Oil from Turkish Rosemary
- P06 Carmo, M.M., Frazão, S. (LNETI, Queluz, Portugal)
Laurel Leaves Oil from Portugal
- P07 Adzet, T., Cañigueral, S., Ibañez, C. (Univ. Barcelona)
Essential Oil of Sideritis granatensis (Pau) Rivas-Goday (Labiatae)
- P08 Adzet, T., Vila, R., Ibañez, C., Battlori, X. (Univ.Barcelona)
Essential Oil of Thymus Moroderi Pau ex Martinez (Labiatae)
- P09 Ntezurubanza, L., Scheffer, J.J.C., Baerheim Svendsen, A. (University of Leiden)
Composition of the Essential Oil of Ocimum trichodon grown in Rwanda
- P10 Bos, R., Fischer, F.C., Gijbels, M.J.M. (Univ.Groningen, Univ. Leiden)
Composition of the Volatile Oils from the Roots, Leaves and Fruits of different Taxa of Apium graveolens
- P11 Ramić, S., Grujić-Vasić, J., Murko, D. (University Sarajevo)
Research of Chemical Composition of Essential Oils from Some Sorts of Satureja
- P12 Scheffer, J.J.C., Schoenmakers, M., Schripsema, J., Baerheim Svendsen, A., Posthumus, M.A., Aynehchi, Y. (Univ.Leiden, Univ. Wageningen)
Composition of the Essential Oil of Polyphonium involucreatum
- P13 Motl, O. Ubik, K. (Academy of Science, Prague)
Ayou Essential Oil

- P14 Hanssen,H.P., Abraham,W.R. (Univ.Hamburg,GBF Braunschweig)
Volatile Metabolites from Basidiomycetes
I.Odoriferous Compounds from *Gleophyllum odoratum*
- P15 Hanssen, H.P., Abraham,W.-R. (Univ.Hamburg,GBF Braunschweig)
Volatile Metabolites from Basidiomycetes
II. Sesquiterpenes and other Volatiles from *Lentinellus cochleatus*
- P16 Abraham,W.-R.,Sprecher,E., Hanssen,H.P.(GBF Braunschweig,
University of Hamburg)
Africanols from *Leptographium lundbergii*

POSTER SESSION II

- P17 Pohjola,J., Hiltunen,R. (University of Helsinki)
On Variation and Inheritance of Terpenes in Pine
(*Pinus sylvestris* L.)
- P18 Ntezurubanza,L., Scheffer,J.J.C., Baerheim Svendsen,A.
(University of Leiden)
Prefractionation of Essential Oils Using Silica Gel
"Mini Extraction Columns"
- P19 Scheffer,J.J.C., Looman,A., Baerheim Svendsen, A.,
Hiltunen,R., von Schantz,M. (Univ. Leiden, Univ. Helsinki)
HSGC Analysis of the Volatiles from Fruits of some
Heracleum Species (*H.platytaenium*, *H.paphlagonicum*,
H.carpaticum).
- P20 Kuiper,M.P.J., Bos,R. (University of Groningen)
The Volatile Constituents of *Valeriana wallichii* DC
from Different Origins
- P21 Bos,R., Barrie,F.R. (Univ.Groningen,Univ.Texas)
The Essential Oils from *Valeriana ceratophylla* H.B.K.
and *Valeriana laciniosa* Mort.& Gal.
- P22 Eberhardt,R., Kafka,A. (Akra Intern.,Wiener Neudorf)
Recent Investigations on Preparations of Extracts of
Herbs
- P23 Köpsel,M., Surburg,H.(Haarmann & Reimer, Holzminden)
Two New Naturally Occuring Ketones from the Essential
Oil of Orange Peel
- P24 Naegeli,P., Ambühl,M. (Givaudan Comp. Ltd, Dübendorf)
Synthesis of Fragrant Bicyclic Ketones from Ionones and
Methylionones

- P25 Günther,W., Nettersheim,R., Schlegelmilch,F. (WGA, Düsseldorf)
Sample Introduction System HSA for Capillary Gas Chromatography
- P26 Vuorela,H., Holm,Y., Hiltunen,R. (Univ. Helsinki)
Application of Headspace Gas Chromatography in Essential Oil Analysis
VIII. Assay of Matricine and Chamazulene
- P27 Vuorela,H., Pohjola,J., Krause,C., Hiltunen,R. (Univ. Helsinki)
Application of Headspace Gas Chromatography in Essential Oil Analysis
IX. Selective Loss of Terpene Compounds during Hydro-distillation
- P28 Laakso,I., Hiltunen,R., Antila,K., von Schantz,M. (University of Helsinki)
Application of Headspace Gas Chromatography in Essential Oil Analysis
X. Variation in the Terpenes of Juniper Leaves and Berries in some Localities in Finland
- P29 Kivanç,M., Akgül,A. (University of Erzurum, Turkey)
Anti-yeast Activities of Spice Essential Oils
- P30 Janssen, A.M., Scheffer,J.J.C., Baerheim Svendsen,A. (University of Leiden)
Composition and Antimicrobial Activity of Calendula Officinalis Flowers
- P31 Janssen,A.M., Tsai Sioe,W.H.R., Scheffer,J.J.C., Baerheim Svendsen,A. (University of Leiden)
Citronellal and Citronellol, a Case of Antimicrobial Antagonism?
- P32 Nemitz,A., Schilcher,H. (University of Berlin)
Effect of Phosphine on Essential Oils
- P33 Sarer,E. (University of Ankara)
An Endemic Salvia Species from Anatolia
- P34 Wijesekera,R.O.B. (Unido, Wien)
The Essential Oils of Cinnamon (*Cinnamomum zeylanicum* Blum.) Processing and Quality Assessment

CONSTITUENTS OF THE ESSENTIAL OIL OF
STROBILANTHES AURICULATUS

P. WEYERSTAHL, H. MARSCHALL-WEYERSTAHL, E. MANTEUFFEL^{a)}
AND V.K. KAUL^{b)}

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Strobilanthes auriculatus (Acanthaceae family) from the Himalaya region yields an essential oil by steam distillation of the inflorescence part. This not yet investigated oil exhibits a strong pine-wood, earthy-mushroom odor. The composition of the oil was studied using the usual techniques of isolation (fractional distillation, column and gas chromatography) and identification (GC/MS, ^1H , ^{13}C NMR, comparison with authentic samples). Besides some common sesquiterpene alcohols all the interesting constituents derive from isoborneol by further hydroxylation in various positions and subsequent esterification preferably with isobutyric acid.

Volatile Constituents of Pteronia incana (Compositae)

K. Bruns and M. Meiertoberens

Aromatic Chemicals Laboratories

Henkel KGaA, Duesseldorf

Pteronia incana is a heather-like, perennial plant, which has been the subject of cultivation studies with a view to commercial extracting its essential oil. This work has been carried out by Prof. GRAVEN at the University of Fort Hare in Alice, South Africa within the contact of the CENTOIL-Project (Ciskei Essential Oil Projekt) (1,2,3).

GRAVEN and co-workers have studied the composition of the essential oil, also known as "Blue Bush Oil" and have found the following constituents:

α -Pinene, β -Pinene + Sabinene, Myrcene,
1,8-Cineole + Limonene, p-Cymene, Terpinolene

For the purpose of GC/MS-studies the oil was separated by distillation into a monoterpane and a "sesquiterpane" fraction. The monoterpane fraction contains 18 components of which 11 with a total mass of 98,9 % were identified. In the "sesquiterpane" fraction 45 components from approximately 100 components were identified, representing approx. 50 % of the total fraction.

Literature

1. GRAVEN, E. H., BURGER, P. J. and B. GARDENER
IX. International Congress of Essential Oils,
Singapore 13.-17.3.83
Essential Oil Technical Paper Book 1, p. 10-14
2. GRAVEN, E. H., BURGER, P. J. and B. GARDENER
Dragoco Report 1984, Heft 4, 95-102
3. GRAVEN, E. H., GARDENER, J. B. and C. L. C. TUTT
Parfümerie u. Kosmetik 66, Nr. 11, 739 (1985)

Original flavour compounds and essential oil composition
of Marjoram (*Majorana hortensis* Moench)

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The analysis of spice plant flavour compounds usually starts with the so-called essential oil, which is obtained by steam-distillation. Comparative investigations of marjoram flavour extracts, separated using different isolation techniques, showed the great influence of the isolation method on the composition of the resulting flavour extract.

Experiments with triturations of leaf material under liquid nitrogen, extractions with supercritical CO₂ and direct injection of the oil of individual secretory cells demonstrated, that *cis*-sabinene hydrate and its acetate represent the original flavour compounds in the intact leaf. The great number of monoterpenes described in marjoram essential oils therefore appear to be artifacts, arising from a multitude of rearrangement, hydration and deprotonation reactions from *cis*-sabinene hydrate acetate and from an activated precursor form, that possesses the sabinene hydrate skeleton.

The nature of these artifact-forming reactions was investigated by model experiments with synthesized sabinene hydrate and its acetate. The biosynthetic capacity of the marjoram plant with regard to the monoterpenes seems to be confined to the synthesis of the sabinene or sabinene hydrate skeleton.

TERPENE COMPOUNDS IN WINE

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Wine aroma is composed by several hundred components. For the cultivar character, monoterpenes are of outstanding importance.

Besides the widely distributed monoterpene alcohols, ethers or hydrocarbons we managed to identify a number of monoterpene diols in grape must and wine. Those compounds could possibly be formed via-enzymatic reactions within the plant itself:

- enzymatic reactions caused by microorganisms (e.g. *B. cinerea*)
- photooxidation of monoterpene precursors and reduction of the resulting-hydroperoxides
- reactions occurring during wine aging.

During fermentation normally the terpene composition is altered only to a small extent. Bottle aging, however, changes the terpene patterns of several cultivars.

Despite those observations, the amounts of the terpene compounds in wines are significant enough to differentiate between wines of Muscat-, Riesling- or Silvaner-type.

Furthermore we can distinguish between wines of the cultivar Riesling and wines like Welsh-Riesling and Cape Riesling which are not made from grapes of the cultivar White Riesling. With the aid of a statistical computer program based upon several monoterpene compounds, a significant analytical separation of the varieties Riesling, Müller-Thurgau and Silvaner of the same vintage is possible, too.

CONTRIBUTION TO THE STUDY OF THE SIMULTANEOUS INFLUENCE OF
THREE DIFFERENT DISTILLATION PARAMETERS ON THE YIELD AND QUALITY
OF AETHEROLEUM FRUCTUS FOENICULI

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The influence of different parameters applied in the water distillation of a plant material, on the essential oil content determination, suggested by various national Pharmacopoeias, doesn't only interfere on the percentage yield of the oil, but also on each component concentration of it. In the present study using the Latin square method for the experimental program, is investigated the simultaneous influence of the parameters: degree of comminution, distillation time and distillation rate, on the constituents composition of fructus foeniculi. The determination of the percentage composition is carried out by means of gas liquid chromatography. The elaboration of the results suggests: a) the best combination of the distillation conditions for each constituent and b) that the degree of comminution influences the quality of the distilled oil much more than the other two parameters.

ESSENTIAL OIL PRODUCTION IN CISKEI - THE DOMESTICATION OF

ARTEMISIA AFRA AND SALVIA STENOPHYLLA

C L C TUTT, E H GRAVEN AND J B GARDNER

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The production of essential oil from wild Artemisia afra is subject to wide variations in oil quality and availability of processable material. Major factors in this regard are climatic conditions and the locality in which the plant is grown. The development of field management procedures and production techniques used in the domestication of Artemisia afra and Salvia spp indigenous to Ciskei are described.

Artemisia afra has potential as a natural source of thujone and much of the research was directed at the selection and propagation of high thujone clones. The data presented show a variation in the thujone content of individual plants which varied from 2% to 72%. Results of an experiment are presented in which it was shown that the application of judicious cutting schedules adapted to the growth pattern of Artemisia afra can increase the annual oil yield from less than 10kg ha⁻¹ to more than 100kg ha⁻¹ without reducing the longevity of the crop. It was also shown that thujone content of the oil can be influenced by the application of selected cutting treatments.

Certain local Salvia spp appear to have potential as sources of natural bisabolol. Results of field production studies are presented.

COMPOSITION AND YIELD OF ESSENTIAL OIL OF THYMUS VULGARIS L., MAIORANA
HORTENSIS MOENCH AND SATUREJA MONTANA L. GROWN IN ÇUKUROVA REGION

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 University of Çukurova, Adana (Turkey)

** Dept. of Horticulture, Fac. of Agriculture,
 University of Hohenheim, Stuttgart (F.R.G.)

This study was conducted to determine drug herbage yields and content, yield and composition of essential oils of Thymus vulgaris L., Maiorana hortensis Moench and Satureja montana L. grown under Çukurova conditions. The experiment was arranged in randomized block design with four replications. The plants were cut at the beginning of the flowering.

Content of essential oils were determined by steam distillation and essential oil yields were calculated. Components of essential oils obtained by water distillation were determined by Gaschromatography and Mass spectrometry.

Data obtained were statistically analyzed. As a result of this study, it was determined that Maiorana hortensis Moench, among the plants studied gave highest essential oil yield as well as the highest drug herba yield.

In general, essential oil yields obtained in the second year of the plant were higher than the ones in the first year.

There were 31 components determined in Thymus vulgaris L.. In terms of percentage ratios the dominating ones were p-cymen+limonen, Thymol, Carvacrol, Isopulegol, Cineol, Elemol, Terpinenol-4, γ -Terpinen, 2-Pinen, Sabinen; there were 44 components determined in Maiorana hortensis Moench. In terms of percentage ratios the dominating ones were Linalool+cis-Sabinenhydrat, Terpinenol-4, γ -Terpinen, Sabinen+ β -Pinen, trans-Sabinenhydrat, 2-Terpinen, Geraniol, Limonen, α -Elemen, β -Caryophyllen, 2-Terpinolen, Myrcen, Linalylacetat, trans-p-Menth-2-enol, 2-Thujen; there were 23 components determined in Satureia montana L.. In terms of percentage ratios the dominating ones were Carvacrol, γ -Terpinen, Limonen, Linalool, β -Pinen, 2-Pinen.

Biology and Chemistry of Conifer Oils

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Conifers are widespread through the northern hemisphere and many of their balsams and essential oils have acquired high commercial significance. After a short excurs on conifer taxonomy the location and structures of oil secretory canals within the plant are briefly discussed. Furthermore, some new analytical aspects with regard to conifer oils and balsams are given. With the aid of these methods the compositions of various commercial samples and laboratory distilled oils have been investigated, belonging to the genera *Abies*, *Pseudotsuga*, *Picea*, *Larix* and *Pinus* and the results are given in more detail. The individual compositions are compared with each other and discussed in regard to the systematic grouping of the conifers.

In addition to reviewing the chemistry of conifer oils, the paper will outline the variety of the raw material, especially the relation of needles to twigs and the effect that this variable has on the composition of the essential oil.

Free and glycosidic bound monoterpenes in the needles of Juniperus chinensis var. pfitzeriana.

J.M.A. van den Dries and A. Baerheim Svendsen.

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Although glycosidic bound monoterpenes seem to play an important role in the biosynthesis, transport and accumulation of such compounds, constituting the main part of essential oils, only few investigations on glycosidic bound monoterpenes have appeared so far. Such compounds have been found in Rosa damascena (1), Tanacetum vulgare (2), Thymus vulgaris (3), Melissa officinalis (4) and in cell cultures of Ocimum basilicum (5).

Either the glycosides can be isolated separately and the monoterpenes detected by means of GC after enzymatic hydrolysis, or they can be detected after treatment of an aqueous extract of the fresh plant material, 'stabilized' in boiling water according to Bourquelot (and free from volatile compounds) with β -glucosidase, and subsequent GC of the monoterpenes and other volatile compounds, formed during the enzymatic hydrolysis.

Using the latter procedure for fresh needles of Juniperus chinensis var. pfitzeriana the following oxygen containing compounds were found: geraniol, nerol, linalool, α -terpineol and octen-3-ol.

When using the same procedure for the fresh herb of Melissa officinalis, results were obtained which were in good agreement with those obtained by Mulkens et al. (4), who isolated seven monoterpene glycosides and subsequently splitted them enzymatically to obtain the free oxygen containing monoterpenes. Interesting is that also in M. officinalis octen-3-ol was detected after treatment of a 'stabilized' aqueous extract with β -glucosidase.

In the essential needle oil of Juniperus chinensis var. pfitzeriana a series of alcohols, esters, ketones and phenols was found.

- (1) M.J.O. Francis, C. Allcock, Phytochemistry 8 (1969) 1339
- (2) D.V. Banthorpe, J. Mann, Phytochemistry 11 (1971) 2589
- (3) K. Skopp, H. Hörster, Planta Med., 29 (1976) 208
- (4) A. Mulkens, E. Stephanou, I. Kapetanidis, Pharm. Acta Helv., 60 (1985) 276
- (5) E. Lang, H. Hörster, Planta Med., 31 (1977) 112

Composition of Essential Oils from Caraway Herb and Root

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The chemical composition of the essential oil from the fruits of caraway (*Carum cavi* L., Apiaceae) has often been investigated because of their use as spice and in medicine. Less is known about the composition of the herb and root oils (1), which are the subject of our detailed study.

The plant material was cultivated in summer 1985 and the essential oil was obtained by hydrodistillation of the fresh plants.

By means of GC and GC-MS the herb oil was proved to consist of a couple of sesquiterpene hydrocarbons, mainly germacrene D (72%), germacrene A (12%), and germacrene B (0,5%). Because of their cyclodeca-1,5-diene structure the two last-mentioned rearrange to the corresponding elemene derivatives during GC and MS by a cope-rearrangement.

In addition to these germacrenes β -caryophyllene (8%), γ - and δ -cadinene (2,5%), and humulene (0,5%) were found in the essential oil of the herb.

It is noteworthy that in some individual plants germacrene A was completely missed, but the germacrene D concentration was higher (85%).

In comparison to the herb oil the composition of the root oil differs very much. Aliphatic aldehydes were found to be the characterising compounds of the oil, in detail n-octanal (20%), n-nonanal (7%) and trans-2-decenal (13%). A further aldehyde, not yet completely identified, could be detected (27%), which partly rearranges to cis-4-decenal during GC.

Besides these aliphatic aldehydes germacrene D (6%) and germacrene B (4%) was found; germacrene A was absent.

During the growth of the plants, especially the roots showed a remarkable change concerning the essential oil composition: sesquiterpene hydrocarbons are the main components (73%) in the root oils of the seedlings, whereas the aldehydes only reach a concentration of 14%. Simultaneously to the secondary growth the aldehyde content in the oil increases up to 67% in the first year.

(1) von Schantz, M. and Ek, B.S., *Sci. Pharm.* 39, 82 (1971)

Monoterpene Glycosides - State of the Art

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Before 1969, when Francis and Allcock (1) reported about the occurrence of geranyl, neryl, and citronellyl β -D-glucosides in rose petals, nothing was known about such non-steam distillable forms of monoterpenoids in plant tissue, although the increase of essential oil content during storage and similar phenomena involved the existence of such compounds. To this day, 25 different plants have been investigated and in fact 20 different monoterpene glycosides, mainly glucosides, have been detected.

Geraniol, nerol, linalool, and α -terpineol represent the most often detected monoterpene aglycones, all the four being key intermediates in monoterpene biosynthesis. This fact may indicate a narrow connection between the monoterpene glycosides and the monoterpene biosynthesis.

Banthorpe and coworkers (2) consider monoterpene glucosides as structural equivalents to the carbonium ions in Ruzicka's hypothetical scheme of biosynthetic monoterpene pathway, while Francis (3) postulates geranyl glucoside to be an intermediate in the step from geranyl pyrophosphate to geraniol.

Other results prove the glycosides as a transport form of the free monoterpenes, on the one hand from the site of biosynthesis to the site of accumulation (4,5) and on the other hand in the service of monoterpene turnover (6) and catabolism (7). On account of their hydrophilic properties their role as transport form seems plausible and opens a wide field in future research work.

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DETECTION OF ADULTERATION OF COLD-PRESSED LEMON OIL. D. McHale and J.B. Sheridan, Cadbury Schweppes plc., Group Research, The Lord Zuckerman Research Centre, The University, Whiteknights, Reading RG6 2AL, England.

Adulteration of cold-pressed lemon oil with the lower quality steam-stripped oil still occurs on a major scale. It has been known for many years that substances with ultraviolet absorption characteristics similar to those of the coumarins and psoralens present naturally in cold-pressed lemon oil are added to the oil mixture to mask the adulteration. The detection of these added substances requires the use of chromatography procedures. The present work using high performance liquid chromatography has confirmed that substances such as ethyl p-dimethylaminobenzoate and 7-geranyloxycoumarin (auraptene) are still used to conceal the adulteration of cold-pressed lemon oil. 7-Methoxycoumarin (herniarin) was also identified in some commercial lemon oil samples. This compound is not a natural component of lemon oil and has not been previously associated with its adulteration.

On Concentration of Essential Oils with Pronounced Regard to
Citrus Oils

Erich Ziegler
Ernst Kanschake

Summary

Essential oils are available as condensed products. They are characterized by data determined by different methods.

A method has been presented for discussion which, by means of comparison of analytical data as determination of aldehydes and ketones, alcohols, acids and esters between concentrate and primary product, results in the absolute concentration of the oil tested.

In order to prove the quality of the described concentrating method, a quantitative comparison of some important components by means of gaschromatography may be used. Beside these data obtainable analytically there is also the possibility of sensoric control by rediluting the concentrate with limonene to its specified concentration. As well known, limonene represents the most widespread hydrocarbon in citrus oils. In order to aromatize a final product, the determined dilution degree may be applied to the end product in a similar proportion.

If this contribution could contribute to a standardization of citrus oil concentrates, the market for aroma products would become more transparent.

THE COMPOSITION OF THE HEADSPACE FROM
FRAGRANT FLOWERS : FURTHER RESULTS

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ABSTRACT :

The fragrance given off by certain springtime flowers has been the subject of a previous communication (1). We now present the results from further analysis of flower headspaces from cultivated and wild plants (including trees), which bloom at the end of spring and in summer in the Grasse region : *Sambucus nigra* L. (elder), *Ligustrum ovalifolium* (privet), *Ligustrum vulgare* L. (common-privet), *Ailantus altissima* (Mill.) Swingle, *Magnolia grandiflora* L. and *Trachelospermum jasminoides*. We bring further information about the composition of the headspace from *Philadelphus coronarius* L. flowers (seringat), which had only been briefly reported in our first communication.

We confirm that the odoriferous emissions from flowers contain some chemical substances which are not readily detected in the corresponding extraction or hydrodistillation products. Such constituents include, for example, terpenoids and aliphatic aminoacid derivatives, some of which may be considered as new natural products.

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EFFECT OF ESSENTIAL OIL COMPONENTS ON LIVING STRUCTURES

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Terpenoids are lipid soluble. They dissolve easily in biological membranes. For this reason essential oils may be poisonous to each cell.

Biological membranes catalyze, beside other metabolic functions, the primary energy metabolism which is photosynthesis and respiration. Chloroplasts are sensitive to essential oil as likewise are mitochondria. Bacteria, structurally and functionally similar to both eucaryotic cell organelles, reveal equal sensitivity.

The photosynthetic bacterium *Rhodospseudomonas sphaeroides* develops a respiratory chain related closely to that of the inner mitochondrial membrane. Membranes of this organism were isolated and investigated concerning electron flow systems, proton translocations, phosphorylation reactions, and isolated enzymatic steps. About 40 chemically defined terpenoids were applied in μM and mM conc.s to study their effect on membrane-integrated processes and isolated enzymatic reactions.

In general, essential oils caused damage to a biological membrane due to their lipophilic properties. However, specific functional groups were effective additionally. Among terpenoids, phenolic and non-phenolic alcohols revealed strong inhibitory effects, followed by aldehydes and ketones, whereas pure hydrocarbons were less active at similar mM conc.s. *Thymol* and *carvacrol* were the most powerful components investigated and interfered with all reactions tested. This may be due to the acidity of their OH-group along with their lipophilic character. *Methyleugenol* was less effective than *eugenol*, indicating the importance of a free OH-group. Non-phenolic alcohols, such as *geraniol*, *nerol* or *linalool* were less active than phenolic ones. Esterification of their OH-moiety resulted in a diminished inhibition of phosphorylations and electron flow. However, *linalyl acetate* and *methyleugenol* increased the inhibition on H^+ -translocation. Aldehydes revealed stronger influence than ketones, thereby indicating the participation of the carbonyl function. Hydrocarbons, such as *terpinolene*, *p-cymene*, α - and β -*pinene* were rather poor inhibitors on isolated enzymatic reactions. However, their effect was obvious when membrane-dependent reaction sequences were involved.

VOLATILE CONSTITUENTS OF CERTAIN PLANTS GROWING IN EGYPT

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Abstract is not available!

Analysis of Volatiles by Chemical Ionisation Mass Spectrometry

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Chemical ionization (CI) is discussed as a technique for mass spectrometric analysis of terpenoid compounds.

If suitable reagent gases are employed, the intensity of the "Quasi"-molecular ions can be enhanced and the extent of fragmentation will be reduced. So it is possible to determine the molecular mass of compounds which don't form a molecular ion in EI mode.

Isobutane and ammonia were used as reagent gases. The types of ionization reactions are proton transfer and clustering reactions. The degree of fragmentation is mainly controlled by the exothermicity of the ionization reaction. For example, many esters and their corresponding alcohols show nearly identical isobutane CI spectra. Often the "Quasi"-molecular ion $(M+1)^+$ is not detected while the base peak is represented by the $(MH-\text{acid})^+$ -ion (ester) and by the $(MH-H_2O)^+$ -ion (alcohol), respectively. These ions have the same mass number for corresponding compounds. Thus, these substances cannot be distinguished by isobutane CI.

However, using ammonia as a reagent gas the "Quasi"-molecular cluster ions $(M+18)^+$ and $(M+35)^+$ are formed with high intensity. This enables to determine the molecular mass unequivocally. Increasing reagent gas pressure reduces the extent of fragmentation which is observed especially in ammonia CI. However, rising the source temperature leads to increased fragmentation.

Because of characteristic mass differences in the CI spectra it is often possible, to detect unresolved GC peaks in mixtures of volatiles more easily than in EI mode. This is demonstrated by using mass chromatography in CI mode.

THE USE OF A CHIRAL LANTHANIDE SHIFT REAGENT IN DETERMINING THE ENANTIOMERIC PURITY OF ESSENTIAL OILS CONSTITUENTS.

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Chiral alcohols, acetates and ketones were isolated in high chemical purities from various essential oils. The enantiomeric purities of the chiral oxygenated terpenes were compared with the synthetic racemic terpenes by ¹H-NMR "polarimetry" in the presence of various molar ratios of a chiral lanthanide shift reagent, Eu(hfc)₃. The singlet methyl resonance of the acetate in the ¹H-NMR spectra is more helpful than the other resolved resonances of the alcohols and ketones in determining the enantiomeric purity.

DIRECT CAPTURE OF VOLATILES EMITTED BY LIVING PLANTS

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Both in allelopathy and in the study of plant living cycles, direct capture of the compounds emitted by living plants is a stimulating subject to study.

In this communication the preliminary results of a research project to study this subject are presented.

Direct capture of volatiles has until now been carried out with absorption/heat desorption enrichment techniques, by using porous polymers (e.g. tenax) or active charcoal as trapping agents.

These trapping agents present some difficulties, notably chemical discrimination, memory effects and insufficient chemical inertness; it was thus decided to study the trapping properties of gas chromatographic stationary phases. Traps of different lengths coated with a thick film (15 μ m) of PS 255 coupled with different absorption/heat desorption-gas chromatographic systems were tested.

The results of a series of experiments carried out by multidimensional gas chromatography, short trap/single oven gas chromatography, and independently heated trap/single oven gas chromatography are presented.

Also presented is the capturing system for the living plant volatiles which was designed and developed for this research. It consists of a glass bell to which the trap is connected; the vapour phase is sucked into the cooled trap by a rotative vacuum pump. To avoid pollution of the sample, the air sucked from the bell is replaced by air from an air filled balloon.

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Comparison of the Different Sampling Techniques in Capillary Gas Chromatography

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The disadvantage of Gaschromatography in comparison with HPLC is the necessity of vaporizing of all sample components. Therefore a large scale of sample introducing systems is to be used. Especially in the gaschromatography of essential oils different sampling techniques are to be used depending on their reactivity and volatility. Generally the sample introduction can be done by vaporizing or without vaporizing, that means the direct introduction on to the capillary column. The following sample introduction systems therefore will be discussed.

1. Sample Introduction by Vaporizing
 - 1.1 With Split
 - 1.1.1 With a Hot Injection Needle
 - 1.1.2 With a Cold Injection Needle
 - 1.1.3 Split Technique
 - 1.1.4 Split/Splitless Technique
 - 1.1.4.1 Moving Needle Technique
 - 1.1.4.2 Moving Precolumn Technique
 - 1.1.4.3 Temperature Programmed Split/Splitless Technique by Vogt (PTV, Programmed Temperature Vaporizing)
 - 1.2 Splitless
 - 1.2.1 Splitless/Split by Grob
 - 1.2.2 Static Headspace
 - 1.2.3 Dynamical Headspace
 - 1.2.4 Selective Introduction (Total Transfer)
2. Sample Introduction without Vaporizing
 - 2.1 With Split
 - 2.2 Splitless (On Column by Grob)
3. Sample Introduction by Pyrolysis Techniques

THE EFFECT OF CULTIVATION CONDITIONS ON THE COMPOSITION OF BASIL OIL

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The effects on the composition of the essential oil of basil (Ocimum basilicum L.) of (i) growth district, (ii) nitrogen fertilizer supply and (iii) cultivation under cover vs. open field, were investigated. The compositions of the essential oils were analysed by capillary gas chromatography and mass spectrometry. In all, 54 compounds were identified.

Growth district seemed to affect the composition of basil oil, the four districts studied yielding two chemotypes. The plants grown in the two districts situated in southern and central Finland produced essential oils high in linalool (3-54 %) and estragol (17-77 %), whereas the plants grown in the two districts situated in eastern and northern Finland produced essential oils high in linalool (26-56 %) and eugenol (14-41 %).

Cultivation under cover increased the yield of essential oil (mg/kg of herb) by about 80 %. Depending on the chemotype, this increase was largely reflected in increased production of estragol or eugenol, whereas production of linalool was less affected.

Increasing nitrogen fertilizer supply over the range 0 to 160 kg N/ha first decreased and then increased the essential oil production (mg/kg of herb). The highest essential oil production was found with no nitrogen fertilizer supply and the lowest with 80 kg N/ha. The variation in the essential oil content as a function of the nitrogen fertilizer supply is mainly a result of the variation in estragol production.

Thus, changes in cultivation conditions can increase essential oil production by basil but they also alter the composition of the oil.

STUDY OF THE INFLUENCE OF THE DISTILLATION CONDITIONS ON THE
ESSENTIAL OIL PERCENTAGE YIELD OF FRUCTUS FOENICULI

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The three main distillation parameters a) the degree of comminution, b) the distillation time and c) the distillation rate are investigated in order to draw conclusions on the simultaneous influence of the above distillation conditions, such as those suggested by the various national Pharmacopoeias, on the essential oil percentage content of fructus Foeniculi. The experimental program is designed according to the Latin square method. By the elaboration of the results, the best combination of the distillation conditions is determined, as far as the main significant parameter - distillation time - is pointed out, that influences the most the percentage yield of the obtained essential oil.

THE ESSENTIAL OIL OF MENTHA X VILLOSA NM ALOPECUROIDES.
INDEPENDENCE OF ITS COMPOSITION ON THE COLLECTION SITE.

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Two notomorphs of M x villosa Huds. (M. Spicata x suaveolens) are known. On the one hand nm villosa (Syn. : M x niliaca auct.), the oil of which is characterized by piperitone oxide, and on the other nm alopecuroides (Syn : M x alopecuroides; M x velutina) the oil of which contains carvone as its chief component.

Analysis allowed the identification of 21 substances, 9 of which for the first time in M x villosa nm alopecuroides.

The plant is found infrequently in Belgium, where it is cultivated in gardens, growing wild on the edge of ditches, on the border of pastures and fields and on ruderalised sites. The plant is sterile but is easily multiplied vegetatively. Plant material collected on different locations, or transplanted from a loamy to a sandy soil, or grown on water, always gave the same volatiles, albeit in varying concentrations. This confirms the genetic determination of essential oil formation, and shows the relative unimportance of the soil on the oil composition.

STUDIES ON ESSENTIAL OILS OF DILL HERB, *Anethum graveolens* L.

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The essential oil of freeze dried dill herb was isolated by three different methods and analyzed by GLC-MS. Also headspace gas chromatography (HSGC) was used for analyze flavour compounds of dried dill herb. The aim the present study was to find out a rapid, simple and above all reproducible method for analyzing flavour components of dill herb. The method would be useful for carrying out comparative studies of herbs in order to find out e.g. the most suitable variety or the level of fertilization.

The used isolation methods were: hydrodistillation by Karlsruhe-type apparatus, solvent extraction with the mixture of pentane and diethylether (1:2, v|v) and CO₂-extraction by J&W High Pressure Soxhlet Extractor. The essential oils were analyzed by Hewlet Packard 5890 A gas chromatograph equipped with a flame ionization detector and HP 3393 A integrator (plus HP 9114 Disc Drives). The column used was a fused silica column coated with OV-351 (0.32 mm i.d. x 30 m). The identification of compounds was carried out by VG Analytical 7070E equipment with an energy of 70 eV. The quantitative estimations were performed by using linalool as the internal standard. The headspace analyses were carried out by Carlo Erba gas chromatograph equipped with a headspace sampler Dani HSS 3950. The capillary column used was coated with FFAP (0.32 mm i.d. x 25 m). The identification of components was based on comparison of retention times with those samples identified earlier (see above).

On the basis of the present results it can be noticed that each method gives a quite different composition for flavour compounds. However, the best retention of flavour components was achieved by HSGC, especially for 3,6-dimethy-2,3,3a,4,5,7a-hexahydrobenzofuran, the most important aroma compound of dill herb.

Poster Presentation(I)

ESSENTIAL OIL FROM TURKISH ROSEMARY

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ABSTRACT

Whereas the rosemary (Rosmarinus officinalis L.) plant from Labiatae family is widespread in all the Mediterranean and Aegean coasts of Turkey and native to Anatolia, the oil production is not at present and although numerous reports appear in the literature on the composition of rosemary oils from different origins, no studies have been reported on turkish rosemary oil. We report our findings on the chemical constituents of the rosemary oil obtained by steam distillation of the fresh leaves for the first time from Turkey.

Plant were collected around Muğla (South-Western Turkey) in June. The fresh leaves gave a yellowish tint oil with yield of 1.16 % (v/w); $d_{20}^{20} = 0.9157$, $n_D^{20} = 1.4687$, $\alpha_D^{20} = + 3^{\circ}53'$. A total of 25 components representing 98 % of the oil were identified by GLC. A terpenoid ether, 1.8-cineole percentage was 43.02 % as the main component. The other important components were camphor 12.62 %, α -pinen 9.61 %, and borneol 8.09 %, respectively. The oil sample was included to the type of rosemary oils with a high eucalyptol - content (Italy, Morocco, Tunisia).

17th WORKSHOP ON ESSENTIAL OILS

Laurel leaves oil from Portugal

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Abstract

We have studied for some years the laurel leaves oil obtained by hydrodistillation and we are trying to obtain the same oil by hydrodiffusion in order to appreciate its differences.

The oil shows a light yellow color and a fine odour.

The physical-chemical characteristics from some oil samples are obtained and we have noticed a density lower than the oils studied by other authors.

The same samples were submitted to different techniques, and the main compounds are identified by gas-liquid chromatography with packed and capillary columns.

The main constituents as sabinene, 1-8-cineole, linalol, methyl eugenol and eugenol have been quantitatively analysed.

ESSENTIAL OIL OF SIDERITIS GRANATENSIS (PAU) RIVAS-GODAY (LABIATAE)

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The genus *Sideritis* is largely represented in Iberian flora. It is constituted by aromatic plants used in folk medicine.

S. granatensis is a southern Spain endemism. The plant material was collected on the surroundings of Nerja caves (Malaga - Spain); it was authenticated by Prof. J. Borja (Madrid) and a voucher specimen was deposited in the BCF herbarium (Botany Department, Faculty of Pharmacy, University of Barcelona) with the n^o 32610.

The air-dried aerial parts of *S. granatensis* yielded 0,27% (v/w) of essential oil (European Pharmacopoeia method).

The essential oil analyzed was obtained by hydrodistillation using petroleum ether as collecting solvent. It was chromatographed through an aluminium oxide column and analyzed by GC and GC-MS, using SE-30 and Carbowax 20M capillary columns. Comparison of Retention Index and MS with literature data and authentic samples were used for identification of essential oil components.

More than 93% of the essential oil has been identified. It contains: α -pinene, camphene, β -pinene, sabinene, myrcene, Δ^3 carene, α -phellandrene, α -terpinene, limonene, β -phellandrene, α -p-dimethylstyrene, γ -terpinene, p-cymene, terpinolene, α -copaene, β -caryophyllene, α -humulene, ar-curcumene, β -curcumene, cuparene, α -cadinene, β -farnesene, α -terpenyl acetate, fenchyl acetate, isobornyl acetate, 1,8-cineol, caryophyllene epoxide, isocaryophyllene epoxide, trans-sabinene hydrate, linalol, fenchol, terpinen-4-ol, trans-pinocarveol, α -terpineol, borneol, carvacrol, α -bisabolol, γ -terpineol, cubenol, 2-nonanone, fenchone, isopinocampone, pinocarvone, 2-undecanone, carvone, cryptone, verbenone, myrtenal, campholenal, perillaldehyde, carvone oxide and methylacetophenone.

The major components were α -pinene (20,2%), fenchol (18,4%), fenchone (9%), fenchyl acetate (7,6%), 1,8-cineol (4,8%) and limonene (4,7%). The percentages were calculated from GC peak areas.

ESSENTIAL OIL OF THYMUS MORODERI PAU EX MARTINEZ (LABIATAE)

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The essential oil of several plants of the genus *Thymus* L. has been studied before in our Laboratory.

Thymus moroderi (Sect. *Pseudothymbra*), an eastern Spain endemism used in liqueur industry and folk medecin, whose flavonoid composition is being investigated by us, was collected in Xixona (Alacant - Spain) in June 1984, and a voucher specimen was deposited in the BCF Herbarium (Botany Department, Faculty of Pharmacy, University of Barcelona) with the nº 31500. The air-dried aerial parts gave an essential oil yield of 1,2% (v/w).

The analysis of its essential oil was carried out by GC and GC-MS (using two stationary phases, SE-30 and Carbowax 20M), as well as column chromatography on aluminium oxide eluted with a gradient of petroleum ether (30-50°) - Et₂O - MeOH. Each component was identified by its MS and its Retention Index in the two stationary phases, comparing with literature data and authentic samples. Its quantification was performed on the basis of their GC peak area.

We have been able to characterize greater than 96% of the essential oil: α -pinene, camphene, β -pinene, sabinene, myrcene, α -terpinene, limonene, δ -terpinene, cis-ocimene, p-cymene, terpinolene, α -copaene, β -caryophyllene, α -humulene, δ -cadinene, γ -cadinene, β -elemol, hedycaryol, τ -cadinol, 10-epicadinol, α -elemol, α -cadinol, ledol, 1,8-cineol, caryophyllene epoxide, isocaryophyllene epoxide, 3-octanol, 1-octen-3-ol, trans-sabinene hydrate, linalol, 1-terpinen-4-ol, α -terpineol, borneol, citronelol, myrtenol, geraniol, thymol, carvacrol, campholenal, trans-pinocarveol, camphor, neryl acetate, bornyl acetate, linalyl acetate, 1-octen-3-yl acetate and geranial.

The major components were: 1,8-cineol (24,5%), camphor (22,8%), camphene (10,6%), α -pinene (6,4%) and borneol (5%).

Composition of the essential oil of Ocimum trichodon grown in Rwanda

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Ocimum trichodon Baker ex Guerke is extensively used in Rwanda in traditional medicine, e.g. to cure cough and headache, and as an analgesic after child-birth. In a previous study the essential oil of O. trichodon showed an activity against some bacteria and a yeast. Since no chemical data on the species could be found, we were interested in analyzing some samples of the essential oil of O. trichodon grown in Rwanda.

Fresh leaves and flowers from seven wild growing plants were subjected to hydrodistillation (oil yield 0.4-0.8% vol/wt). Since one sample differed qualitatively from the other six samples, it was submitted to LSC over silica. The same procedure was carried out with one of the six samples.

The oil samples and the fractions obtained by LSC were analyzed by GC using fused silica columns coated with Durabond-DB 1 and CP-Wax 57cb respectively. When necessary, also GC-MS was performed for identification of the oil components.

All oil samples were dominated by eugenol (44-81%). Elemicin was detected in only one sample, in which it was present in a relatively high amount (5.8%). *cis*- β -Ocimene (2-16%) and *trans*- β -ocimene (1-9%) were the most abundant monoterpene hydrocarbons, while β -caryophyllene (2-9%) and germacrene-D (1-10%) were the main sesquiterpene hydrocarbons. Because of the high content of eugenol in some of the samples, the oil of O. trichodon may serve as a valuable source of that compound, which is used in dentistry.

COMPOSITION OF THE VOLATILE OILS FROM THE ROOTS, LEAVES AND
FRUITS OF DIFFERENT TAXA OF APIUM GRAVEOLENS.

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Continuing our investigations (1) on volatile constituents of Apium graveolens L. (Apiaceae) we investigated light petrol-diethyl ether extracts of roots, leaves and fruits of different taxa/cultivars of A. graveolens.

A. graveolens has been divided in many subspecies/ varieties/cultivars; the most simple classification is the division in three subspecies graveolens, dulce and rapaceum, each comprising many cultivars. It is uncertain whether wild forms are still existing. One of the purposes of this study is looking for a possible correlation between the volatiles, the taxonomic status and the culinary use of some cultivars; another purpose was the search for biologically active components.

The study was done with the aid of GC-MS and quantitative GC analysis. Most of the major compounds were identified by their mass spectra; they were found to be aliphatic alcohols, aldehydes and esters, monoterpenoid hydrocarbons and alcohols, sesquiterpenoid hydrocarbons, alcohols and cyclic ethers (dihydroagarofuran, kessan), phthalides and related compounds (the novel compound 3,3-cis-neocnidilide (2), which exhibited a remarkable reactivity (as does the trans-compound as a "soft" electrophile). The results will be presented in tabulated form.

The leaf- and root-oils from all samples differed much from each other; no single compound or combination of components could be regarded as a characteristic for one of the subspecies. On the other hand the different fruit-oils were very much alike.

The complete removal of the neocnidilides from the extracts by means of sulfhydryl compounds resulted in extracts deprived of their characteristic celery odour.

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RESEARCH OF CHEMICAL COMPOSITION OF ESSENTIAL OILS FROM
SOME SORTS OF SATUREJA

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Satureja hortensis L. is very interesting and wide-spread aromatic plant with high physiological reaction and because of that it went to the pharmacopias of many countries as an official drug.

As *Satureja hortensis* L. and their varieties are inborn and highly wide-spread and because of their characteristic it was very interesting to investigate some of these varieties in connection with quantity and chemical composition of ethereal oils.

We investigate three samples of inborn *Satureja hortensis* L. from the different locality of Bosnia and one sample of *Satureja calamintha* L. in content and chemical composition of ethereal oils.

From the data obtained and presented in table it is clear that all three investigated samples of herba *Satureja hortensis* had the same quantity of ethereal oils (0,95%) but the sample of *Satureja calamintha* L. had smaller quantity of ethereal oils (0,40%), which correspond to the data in papers. Physical constants (density, refraction index) and qualitative reactions had not any big differences at all samples of ethereal oils investigated.

Spectrophotometry investigations showed that ultraviolet and infrared spectra in three samples of ethereal oils of *Satureja hortensis* L. were identical. On the basis of that it can be concluded: ethereal oils obtained from *Satureja hortensis* L. in qualitative and quantitative composition have not any differences which can be confirmed with results of chromatography determinations.

Working under the regulations of chromatography it was concluded that ethereal oils of *Satureja hortensis* L. as the main components include: Carvacol, 1,8-cineol, α -pinen, β -pinen, Thymol, Menthol, and higher terpenes.

Ethereal oils of *Satureja calamintha* L. as the main components had: Pulegon, Menthon, Limonen, Thymol and higher terpenes and bigger number of substances of not identified structure.

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Composition of the essential oil of Polylophium involucreatum

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Fruits of Polylophium involucreatum (Pall.) Boiss. -synonym: Prangos polyactina Bornm. & Gauba-, Umbelliferae, are used in Iran to flavour food and to soften meat. The odour of the essential oil resembled that of cumin aldehyde, but no chemical data on the oil composition were found. Therefore the oil was analyzed by capillary GC after separation into fractions by LSC. Some components were identified by comparison of retention times on different columns with those of authentic compounds. Some other constituents were identified by comparison of their spectra obtained by GC-MS with literature data and with those of authentic compounds.

The oil was characterized by large amounts of sabinene (12%), gamma-terpinene (26%), p-cymene (9%), geranyl acetate (11%), cumin aldehyde (12%) and an unknown compound (12%). This component was isolated by LSC and subjected to ¹H- and ¹³C-NMR spectroscopy as well as to CI-MS. So the compound was identified as bornyl angelate, which is seldom detected in essential oils.

AYOU ESSENTIAL OIL

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The essential oil ayou obtained from the tree *Nectandra globosa* / Lauraceae /, locally called canella preta or ayou, belongs among the less known Brazilian essential oils.

The composition of the oil has been investigated by a combination of chromatographic and physico-chemical methods, especially by means of GC/MS.

VOLATILE METABOLITES FROM BASIDIOMYCETES

I. Odoriferous compounds from Gloeophyllum odoratum

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The fruit-bodies of the brown-rot fungus Gloeophyllum odoratum (Wulfen ex Fr.) Imazeki (Aphyllphorales; Basidiomycotina) produce a pleasant anise- or fennel-like odour on natural substratum. Strain G. odoratum CBS 444.61 was cultivated on a defined synthetic liquid culture medium for 88 days. Volatiles were obtained several times during this culture period by steam distillation. 6 weeks old cultures emitted a pleasant sweet odour with a mushroom-like note.

GLC analyses revealed that the steam distillates consisted of about 50 components. The major constituents were identified by mass spectral data and ¹H and ¹³C NMR spectroscopy. Predominant compound was the bicyclic sesquiterpene alcohol drimenol (55.8 %). 3,7-Dimethyl-3-hydroxy-6-octenic acid methyl ester (22.5 %), a linalool derivative, is described for the first time as a natural product. High resolution mass spectrometry confirmed our results. The sign of the optical rotation points to a 3R-configuration.

As minor metabolites, several monoterpenes could be identified: linalool (2.2 %), trans-linalool oxide (0.4 %), citronellol (1.2 %), and geraniol (2.2 %). A further metabolite, 1-octen-3-ol (4.3 %), has a mushroom-like flavour and has been shown to be an ubiquitous fungal constituent.

The composition of volatiles differs distinctly from that of an other, previously investigated strain of this species consisting of monoterpene alcohols and several constituents with an aromatic structure (1).

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VOLATILE METABOLITES FROM BASIDIOMYCETES

II. Sesquiterpenes and Other Volatiles from Lentinellus cochleatus

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Lentinellus cochleatus (Pers. ex Fr.) Karst. is a wood-inhabiting basidiomycete mainly found on stumps and roots of various deciduous trees. Frequently, the fruit-bodies of this species produce a characteristic anise-like odour.

Strain L. cochleatus CBS 201.47 was cultivated on a glucose-malt extract-asparagine-mineral salt medium for 12 weeks. The liquid cultures produced a sweet odour with an anise- or cinnamon-like note.

Volatiles were obtained by steam distillation. The steam distillate was analysed by GLC revealing a composition of about 140 components. After fractionation into five fractions of different polarity by dry-CC, the major constituents were found in the apolar fraction I and the more polar fractions IV and V. GC/MS analyses showed that the majority of these compounds were sesquiterpene hydrocarbons and alcohols.

Three predominant constituents were identified by ^1H and ^{13}C NMR spectroscopy: trans-nerolidol (41.4 %) and fokienol (14.8 %) are acyclic sesquiterpene alcohols, the latter being isolated for the first time from a fungus. A further non-terpenoid constituent, 2,2-dimethyl-6-formylchromene (6.1 %), is described as a new natural product.

Besides these, α -copaene (0.3 %), δ -cadinene (1.2 %), calacorene (0.6 %), cubenol (1.2 %), epi-cubenol (1.0 %), and farnesol (1.7 %) could be identified as further terpenoid metabolites.

AFRICANOLS FROM LEPTOGRAPHIUM LUNDBERGII

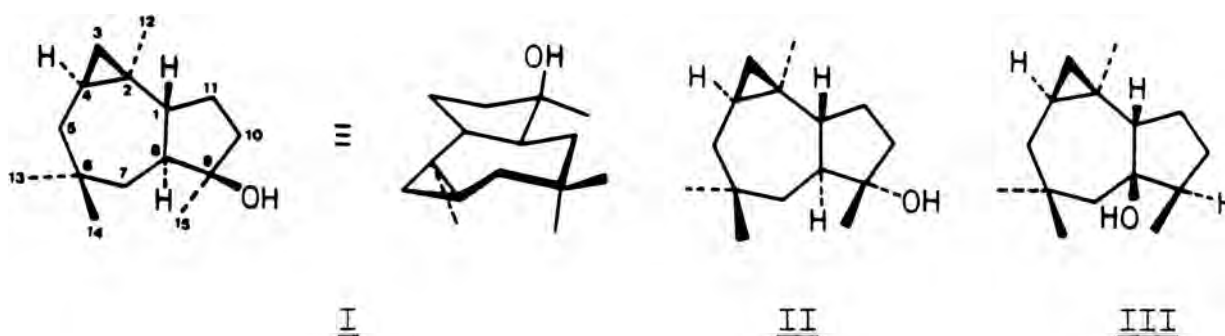
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Leptographium lundbergii Lag. et Mel. is a sapwood staining ascomycete fungus causing a dark, blue discolouration of the infected wood. The fungus is mainly found on pine logs and lumbers in North and West Europe. Spores are distributed by insects or air.

Strain L. lundbergii Ha 2/82 was cultivated for 24 days on a defined synthetic liquid culture medium. Volatiles were obtained several times by steam distillation or extraction with CH₂Cl₂ during the culture period. GC/MS analyses revealed that the distillates and extracts, respectively, consisted mainly of sesquiterpene alcohols and hydrocarbons. Three major constituents, sesquiterpene alcohols, were isolated by column chromatography (Si-60, Merck) using n-hexane-ethyl acetate (97:3) as solvent.

Structures and configurations were elucidated by spectroscopic methods, in particular by nuclear Overhauser enhancement difference ¹H NMR spectra and by two-dimensional ¹H/¹H- and ¹³C/¹H-chemical shift correlation: Leptographiol (I), isoleptographiol (II), and isoaffricanol (III) are tricyclic sesquiterpene alcohols with the hitherto rarely found africanane skeleton. The biosynthetic origin of these compounds which are described for the first time as natural products is briefly discussed.



ON VARIATION AND INHERITANCE OF TERPENES IN PINE (*Pinus silvestris* L.)

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The terpene composition of conifers shows features, which are strongly inherited. As a measure of variation the terpene composition provides useful information when solving forestry problems via studying the modes of inheritance and biosynthesis of terpenes. The quantity and occurrence of some monoterpenes have been shown to be under single gene control and can be used as genetic markers in selecting material for breeding and tracing inheritance through breeding process.

The differences in the components of variation and the relative proportions of terpene compounds in pine needle oil of F_1 -hybrids obtained by control-pollinated crosses and their open-pollinated F_2 -hybrids were determined by headspace gas chromatography (HSGC). More than 600 samples were analysed. The terpenes were identified by GCMS technique with computer matching against library data created on the basis of known mixtures and pure substances and of known retention times.

The HSGC technique showed to be very useful for screening rapidly this kind of a rather large biological material. Under the optimized analytical conditions; bath temperature 120°C, equilibration time 30 min, sample size 50-55 mg of fresh needles, vial 20 ml; it offered the same information as can be obtained by more usual but more inconvenient methods, such as distillating the volatile oil and analysing it by classical GC.

Within both progenies appreciable quantitative variation, which could not be observed between sesquiterpenes, was observed between the monoterpenes of "high"-and "low"-carene chemotypes. Between the two progenies the quantities of both monoterpene chemotypes but also sesquiterpene chemotypes varied greatly.

The frequency distribution diagrams of 3-carene, sabinene and terpinolene in F_1 -progeny and α -pinene, β -pinene, sabinene, 3-carene, myrcene and terpinolene in F_2 -progeny were bimodal suggesting simple inheritance. The rest of the monoterpenes and the sesquiterpenes were almost normally distributed indicating polygenic inheritance of these terpenes.

Prefractionation of essential oils using silica gel "mini extraction columns"

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Essential oils are usually complex mixtures consisting of components from many different classes of organic compounds. Many attempts have been made to facilitate their analysis. Often column chromatography over silica gel has been used either to separate the hydrocarbons and the oxygen-containing compounds of an essential oil or to obtain a further fractionation of the various components present. The study described here was carried out to investigate whether silica gel "mini extraction columns" (1 ml and 3 ml respectively) could be applied for this purpose.

A mixture of limonene and carvone (1:1) was used to determine the capacity of the columns. When 10 μ l and 30 μ l of the mixture were applied on the columns of 1 ml and 3 ml respectively, a total separation of the two components could be achieved by elution with small amounts of pentane and pentane/diethyl ether (1:1).

Many studies have reported on isomerization of essential oil components during column chromatography. Therefore we used two essential oils containing a relatively large amount of sabinene, to study whether changes in the oil composition occurred during the separation procedure by means of the "mini extraction columns".

A mixture of oxygen-containing compounds (4 alcohols, 3 aldehydes, 1 cyclic ether, 3 esters, 3 ketones) was used to determine whether a fractionation could be obtained. By elution with a stepwise gradient of diethyl ether in pentane a satisfactory fractionation of the mixture was achieved.

As conclusion it can be stated that by means of "mini extraction columns" a satisfactory fractionation of essential oils can be obtained, which is simple, rapid, and suited for very small amounts of sample, while also small amounts of solvent are needed.

HSGC analysis of the volatiles from fruits of some *Heracleum* species
(*H. platytaenium*, *H. paphlagonicum*, *H. carpaticum*)

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In a previous study (1) we used fruits of some *Heracleum* species as well as the essential oils isolated from the fruits in order to compare the results obtained by 'classical' GC and by headspace GC (HSGC). Also the results obtained in two laboratories were compared. It was shown that the differences between the HSGC analyses of the fruits and the 'classical' GC analyses of the isolated oils were small. The differences in the results of the HSGC analyses carried out in the two laboratories were at the same level as the biological variations observed in intralaboratory analyses.

In the present study we analyzed the fruits of three *Heracleum* species (*H. platytaenium*, *H. paphlagonicum*, *H. carpaticum*) by HSGC using the apparatuses and applying the optimum parameters as described before (1). The samples of the first and the second species were collected in Turkey, whereas the fruits of the third species were collected in Romania. To verify the identity of the components detected by HSGC the essential oils isolated from the fruits were also analyzed by GC-MS. The results of the analyses will be presented.

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THE VOLATILE CONSTITUENTS OF VALERIANA WALLICHII DC FROM DIFFERENT ORIGINS.

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Within the scope of our investigations on *Valeriana* species we investigated the volatile constituents of *Valeriana wallichii* DC.

This species comes from the Indian and Pakistani regions of the Himalayas, where locals use its essential oil as a perfume. The principal constituent is patchouli alcohol. This is an important substance in the perfume world, and the possibility of using *V. wallichii* DC as a source of it would be worth considering. Other substances described are α -, β - and γ -patchoulene (decomposition products from patchouli alcohol after hydrodistillation?).

We examined fresh plant material from different origin as well as dried roots for commercial use. By means of quantitative GC- and GC/MS analysis we have identified most of the volatile components.

Variations in the relative amounts of patchouli alcohol and qualitative differences in composition of the essential oils were found. Probably chemotypes occur within the species *V. wallichii* DC too.

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THE ESSENTIAL OILS FROM VALERIANA CERATOPHYLLA H.B.K. AND
VALERIANA LACINIOSA MORT. & GAL.

+
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Within the scope of our investigations on *Valeriana* species we would like to present the results of our examinations on the essential oils from two *Valeriana* species from Mexican origin.

Valeriana ceratophylla H.B.K.

Collected on 6 August 1984; HIDALGO: 9 km North of Pachuca on the road to Mineral del Monte, municipio of Mineral del Monte. Population of 10-15 plants. Flowers rose-purple.

Valeriana laciniosa Mart. & Gal.

Collected on 5 August 1984; HIDALGO: 9 km South of Jacala on the road to Zimapan, municipio of Jacala. Elevation 2000 m. All plants past flowering.

By means of GC-(retention indices) and GC/MS analysis we have identified most of the volatile components. The main components in both oils are δ -elemene and a sesquiterpene alcohol.

The mass-spectral data of this alcohol are in agreement with the fragmentation pattern of cadinenol-isomers, but on the moment the right structure and configuration are not yet known.

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 Hendriks, H., Bos, R., (1984) Dragoco Report 1, 3-17
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RECENT INVESTIGATIONS ON PREPARATION OF EXTRACTS OF HERBS

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When choosing the conditions for the extraction of a particular herb, it is essential first to analyse the components as completely as possible. For the identification of the volatile flavour components the optimum method is GC-MS analysis of different laboratory extracts with different solvents.

According to the Austrian Pharmacopoeia fluid extracts are manufactured by extraction of the herbs followed by evaporation of the extracts. The dried herbs are ground and then extracted by percolation. By evaporation (if possible under reduced pressure) extracta fluida or extracta sicca are then obtained. This general method is only applicable, however, if the desired active substances are not or only slightly volatile, are well soluble in the chosen solvent (i.e. generally ethanol or water) and are not steam volatile during the evaporation procedure.

Adaption of well known laboratory methods to industrial large scale production:

Step I: Simultaneous steam distillation-extraction using pentane as solvent (extract I)

Step II: The distillation residue is filtered and the filtrate is evaporated to the desired concentration (extractum fluidum or siccum, extract II). During this step no loss in flavour occurs, all of the flavour being in extract I.

Step III: The residue of the distillation from step I is percolated with alcohol or acetone. In this step the polar, not or only slightly soluble and not steam volatile compounds are extracted. The solvent is removed to give extract III.

The combined extracts I, II and III give an extract which contains the maximum possible concentration of flavour substances. Trial runs have shown that this method which was developed in the laboratory can easily be adapted to actual large scale productions. Thus improved extracts are obtained.

Extracts of the following herbs have been prepared:

elder flower, sage, mallow, ribwort, coltsfoot, yarrow, thyme and camomila.

Two New Naturally Occuring Ketones from the Essential
Oil of Orange Peel

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Abstract :

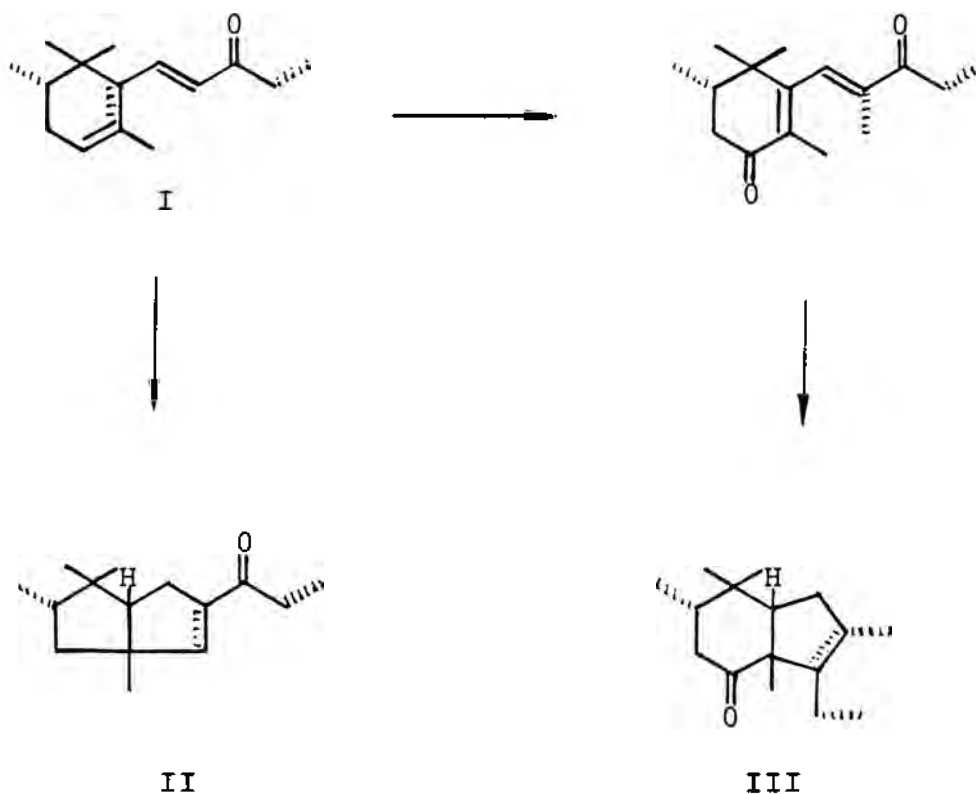
During an investigation of minor constituents of the essential oil of orange peel two new naturally occuring bicyclic ketones were isolated. Their constitution was elucidated by spectroscopic means and confirmed by synthesis.

SYNTHESIS OF FRAGRANT BICYCLIC KETONES
FROM IONONES AND METHYLIONONES

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A series of new bicyclic derivatives II and III have been synthesized for perfumery evaluation starting with the commercial ionones or methylionones I.



Sample Introduction System HSA for Capillary Gas Chromatography

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FH Niederrhein, Krefeld

Gaschromatography, especially capillary gas chromatography, is a modern and effective technique for separating, analyzing and determining components in technical chemistry, biochemistry, environmental chemistry as well as in the chemistry of essential oils. This method consists of injecting the sample on to the capillary column of a gas chromatograph.

This method of the DHA system enables the analysis of not only gaseous and liquid samples but also of solids. A stream of nitrogen, acting as a carrier, passes through the solid or liquid samples at a high temperature and extracts in this way the components which are then concentrated in an adsorbent which is cooled at the same time. Next, the oven is heated up quickly, thereby causing desorption of the components which are carried by the carrier gas into the gas chromatograph.

This sample introduction system comprises the sample, an oven, a cooling system, two heaters, and connections to the carrier gas and the capillary column.

Application of Headspace Gas Chromatography in Essential Oil Analysis

VIII. Assay of matricine and chamazulene

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Chamazulene, unlike its precursor matricine, can be detected by headspace gas chromatography-technique (HSGC) and some observations have been done that the chamazulene content is quite low when compared to the results obtained by the conventional hydrodistillation-GC method. The aim of the study was to optimize the assay conditions of HSGC for chamazulene and for the rough estimation of the matricine content on the basis of the formed chamazulene.

HSGC-technique was used as reported elsewhere (1). Samples: flowerheads of Matricaria recutita L. (10 mg); the same material was also extracted with n-pentane and diaethylaether (1:1) to serve as a blank matrix. Pure chamazulene and matricine (Degussa, Homburg) were used as standards.

In order to optimize the bath temperature in HSGC chamazulene, in the sample vial only, was studied at the temperatures 60, 90, 120 and 150°C. The increase of the peak area was linear but at 120-150°C the increase was only 10%. At the presence of pure matrix chamazulene behaved similarly. Matricine had a low response at 120°C and therefore 150°C proved to be the optimum; matricine was measured as chamazulene formed in HSGC.

The optimal equilibrium period for chamazulene was achieved already after 10 minutes both at 120 and at 150°C. Matricine, in the sample vial only, gave the largest peak area after the equilibrium period of 10-20 minutes at 150°C. However the presence of pure matrix at 150°C showed to increase the equilibrium period needed: the optimum was 90 minutes. The same tendency was also found in the analysis of chamazulene on chamomile flowerheads.

Under the optimal HSGC conditions for matricine it could be calculated that about 50% of matricine could be converted into chamazulene. Adding 0,1 N NaOH or 0,1 N HCl had no measurable influence on the formation of chamazulene from matricine. The content of chamazulene in the volatile oil of Matricaria recutita L. was 10,5% when the conventional hydrodistillation-GC-technique was used, whereas HSGC under optimal conditions gave 9,5%. Percentage normalisation, calibration with external standard and the multiple headspace extraction (MHE) suited well for the quantitative determination of chamazulene.

HSGC is suitable for indirect qualitative determinations of matricine. The optimized HSGC-method can be used for quantitative determinations of chamazulene and the results are well comparable to those obtained by the conventional hydrodistillation-GC-method.

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Application of Headspace Gas Chromatography in Essential Oil Analysis

IX. Selective loss of terpene compounds during hydrodistillation

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Compounds in volatile oils can be lost during the hydrodistillation of plant material and indeed small differences in the composition of volatile oils have been detected when analysed by headspace gas chromatography (HSGC) and conventional hydrodistillation-GC-techniques. The aim of the study was to determine quantitatively the compounds lost selectively during hydrodistillation.

HSGC analyses were carried out as described earlier (1). The volumetric determinations were done using a Karlsruher distillation apparatus and the obtained volatile oil was further analysed by GC. In order to determine the loss of terpenes during the hydrodistillation 3 adsorption tubes containing each 500 mg of Tenax^R 80/100 mesh were connected in series. The gas near the pressure balancing outlet of the distillation apparatus was sucked by a Sipin sampler pump (pumped volume 3 1/2 h). The desorption was made thermally by HSGC at 120°C. As plant material served chopped needles of Pinus silvestris L. (high 3-carene chemotype).

HSGC and GC-techniques gave same results for 20 monoterpene compounds in the hydrodistilled volatile oil of Pinus silvestris L. ($r = 0,9995$). HSGC of the needles compared to HSGC of the hydrodistilled oil showed a small change in the composition ($r = 0,9974$, $n = 20$). Some compounds had a slightly higher concentration in HSGC of the needles than HSGC of the volatile oil: tricyclene (2,12 → 1,76%), α -pinene (46,47 → 45,77%) and camphene (9,50 → 8,18%). However the content of 3-carene was lower in HSGC of the needles than in HSGC of the volatile oil (26,29 → 29,15%).

Tenax^R tubes contained mainly the following monoterpenes:

tricyclene (4,90%), α -pinene (81,01%) and camphene (8,66%).

The 3-carene content was only 0,36%. The total loss of volatile oil compounds during hydrodistillation when analysed in Tenax^R tubes was $1,27 \pm 0,76 \mu\text{l}$ ($x \pm \text{s.d.}$, $n = 6$). This loss was 0,25% of the oil content obtained by volumetric determination.

A small amount of terpene compounds is selectively lost during hydrodistillation. HSGC is therefore more quantitative for easily volatile compounds in the analysis of aromatic plants than the conventional hydrodistillation-GC-technique.

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Application of Headspace Gas Chromatography in Essential Oil Analysis.
X. Variation in the Terpenes of Juniper Leaves and Berries in some Localities in Finland

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Local variation in the terpenes of juniper leaves and berries were investigated by headspace gas chromatography (HSGC). Samples (N=8-10) were collected at 17 localities in southern and middle parts of Finland.

The HSGC conditions were as described earlier (1). For identification the DANI 3950 HS sampler was connected to an HP 5970A quadrupole MS coupled to an HP 5890 GC. The GCMS system was used under the control of an HP 9825B Desktop Computer with an HP 9134 Disc Memory for data storage. The HSGCMS conditions were as follows: scan rate 690amu/sec, ion source 70eV, electron multiplier energy 1600V, vacuum 1.1×10^{-5} torr, column OV-351 vitreous silica (25m, 0.20mm i.d.). Helium was used as the carrier gas (15kPa) and auxiliary gas for pressurization the HS sample vial.

The mean precision of the HSGC analyses (N=6) performed on the same leaf material was 4.8% (C.V.) for 17 terpene compounds. α -Pinene was found to be the main monoterpene in the leaf oil (~70%). Other major compounds (>10%) included sabinene and Δ^3 -carene, however, such a level was detected only in 10% of all the samples. The content of α -pinene varied significantly between localities whereas in the case of limonene and Δ^3 -carene tentative differences were found. Sabinene, α - and β -phellandrene were positively correlated with each other to a highly significant degree as also was the case between α - and γ -terpinene and terpinolene and Δ^3 -carene. In berries, on the other hand, α -pinene was accompanied with myrcene rather than with sabinene or Δ^3 -carene.

1. Laakso et al., Farm.Tijdschr.Belg.61(3), 371 (1984).

ANTI-YEAST ACTIVITIES OF SPICE ESSENTIAL OILS

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ABSTRACT

Six strains of yeasts (Candida tropicalis, Hansenula anomala, Kloeckera apiculata, Pichia membranaefaciens, Rhodotorula glutinis, and Saccharomyces cerevisiae) were examined for sensitivity to twelve essential oils of turkish spices (anise, basil, cumin, dill, fennel, laurel, oregano, parsley, sage, savory, tarragon, and thyme).

The tested essential oils varied in their anti-yeast activities. Oregano, savory and thyme essential oils inhibited completely the growth of all yeasts, using the agar diffusion method. The lowest effect were obtained with anise and parsley oils. The most sensitive yeast was K. apiculata, while the most resistant yeasts were C. tropicalis and S. cerevisiae respectively.

The results showed that the biostatic data obtained by the agar diffusion (inhibition zone) and serial dilution (minimum inhibitory concentration) methods were not always parallel. This fact was particularly observed in S. cerevisiae and, tarragon and thyme essential oils.

In most cases minimum biocidal concentrations were lower than minimum biostatic ones. However anise, basil, and tarragon oils gave the similar values for MIC and MBC, in general.

In a conclusion, all essential oils were active on all yeasts, but through to variable extent. The tested oils were important sources as biostatic rather than as biocidal, except for oregano essential oil.

Composition and antimicrobial activity of the essential oil of
Calendula officinalis flowers

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Calendula officinalis is increasingly popular in phytotherapy, especially in the treatment of wounds. In order to investigate the possible role of the essential oil of marigold flowers, its composition was analyzed by GC, GC-MS, and NMR spectroscopy. The oil was abundant in sesquiterpenes, both hydrocarbons and oxygen-containing compounds, α -cadinol being the main component.

The antimicrobial spectrum of the oil showed weak activities against bacteria and moderate activities against dermatophytes. It was concluded that the antimicrobial properties of the essential oil are probably not important for the possible effect of marigold in the therapy of wounds.

Citronellal and citronellol, a case of antimicrobial antagonism?

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Because essential oils are complex mixtures, the question is often raised whether some kind of interaction as to their antimicrobial activities takes place. Experimental work concerning this subject is rather scarce.

In agar overlay assays with citronellal and citronellol, some evidence was obtained for an antagonistic effect of citronellol on the activity of citronellal against Bacillus subtilis. To verify this effect some experiments were performed which could not substantiate the first observation. It was concluded that agar overlay assays should be interpreted with care, because transport phenomena may also play an important role.

THE INFLUENCE OF PHOSPHINE ON ESSENTIAL OILS

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The aim of this work is to test the feasibility of using phosphine as a pesticide on medicinal plants and spices as an alternative to the disinfestation with ethylen oxide and methyl bromide.

After years of investigation and experience a lot of foodstuff (for example grain, cereal products, nuts) and luxury foods such as coffee and cocoa are successfully disinfested with phosphine without harmful effects on these goods.

Though it is permitted to disinfest tea and spices with phosphine, no specific investigations on herbs have been made so far, for example on appearance of chemical reactions between herb constituents and phosphine or phosphine residues in herbs.

Procedures:

Phosphine was used on

- a) essential oil-herbs,
- b) essential oils and
- c) chemical constituents of herbs, that may react with phosphine (aldehydes, ketones, olefinic compounds).

Until now 12 herbs and their essential oils have been analysed. About 20 compounds were investigated. Only citral and citronellal showed chemical reactions, which were detected by TLC.

AN ENDEMIC SALVIA SPECIES FROM ANATOLIA

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Abstract is not available!

THE ESSENTIAL OILS OF CINNAMON (*Cinnamomum zeylanicum* Blum)
PROCESSING AND QUALITY ASSESSMENT

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The volatile chemical constituents of cinnamon leaf, bark and root oils have relatively recently been re-examined using modern analytical techniques, mainly gas-liquid chromatography and infra-red spectroscopy. The oils are prepared by water or steam distillation of the material. The root oil is not produced on a commercial scale and the analyses are on laboratory distilled samples. After drying, they are subjected to gas-liquid chromatographic analyses, and their various chemical constituents identified. The most striking feature in the chemistry of cinnamon oil is that the volatile oil from leaf, stem bark and root bark differ markedly one from another in chemical composition. Each oil contains a different major constituent. The leaf oil is rich in eugenol (about 80%); the bark oil has cinnamic aldehyde as the major component (about 60%); and the root oil contains camphor (about 60%) as the major constituent. The other important components of the cinnamon leaf oil are linalool, caryophyllene, cinnamic aldehyde and benzylbenzoate. The bark oil also contains these compounds and in addition about 4% cinnamyl acetate. The cinnamon root oil on the other hand contains a comparatively high percentage of monoterpene hydrocarbons and eucalyptol (1:8 cineole). The main chemical differences as revealed in the recent studies of these oils are outlined in Table A.

A knowledge of the chemistry of the volatiles of cinnamon has afforded a sound basis for reliable methodology for quality assessment of these oils to be evolved. Modern instrumental techniques such as GLC and IR have afforded a way of delving deep into the biosynthetic mechanisms for the formation of the constituent compounds of cinnamon and the biochemical variations can therefore be particularly well monitored.

GLC and IR methods are now routinely employed in the quality assessment of commercially distilled oils. The methodology that has been developed in Sri Lanka has recently been employed in developing technology and quality assessment of oils produced in the Seychelles which is the next major producer.

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