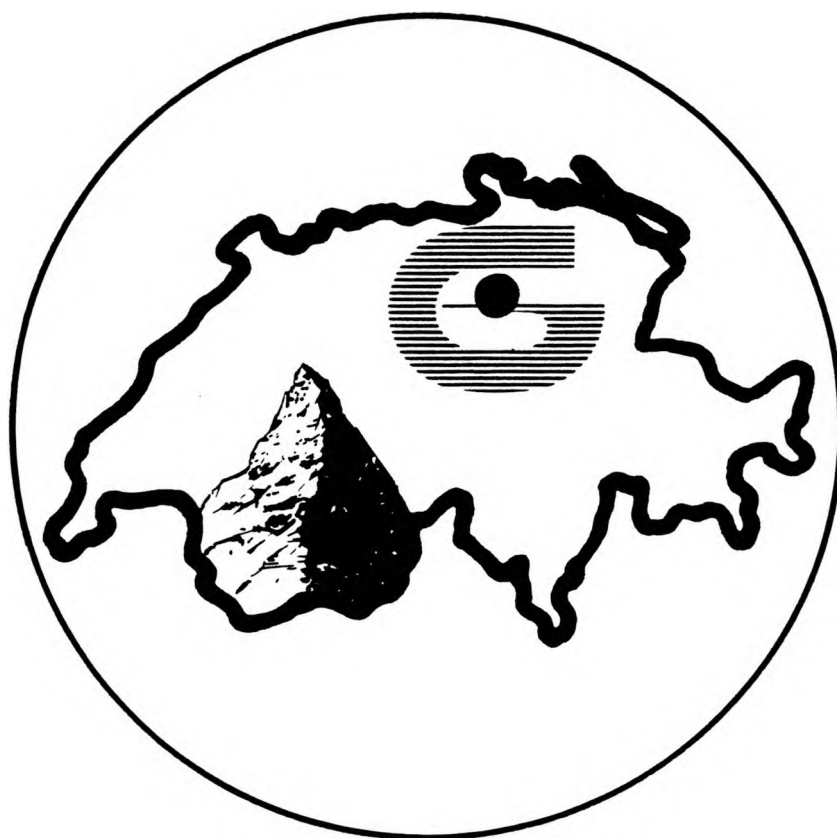


**19 TH INTERNATIONAL SYMPOSIUM ON
ESSENTIAL OILS AND OTHER NATURAL SUBSTRATES**



**SEPTEMBER 7 - 10 , 1988
LANDENBERGHAUS GREIFENSEE**

Abstracts

19TH
INTERNATIONAL SYMPOSIUM ON
ESSENTIAL OILS
AND OTHER NATURAL SUBSTRATES

sponsored by:

GIVAUDAN S.A. Vernier-Genève

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D. Bindschedler, Miss C. Hunziker,
R. Kaiser, G. Peter and Dr. Hp. Schenk
Secretary: Mrs. Dora Klingler

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- A. Program
- B. Abstracts of Lectures
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P R O G R A M

THURSDAY SEPT. 8, 1988

09.00 Opening / Welcome Address (P.M. Müller)

09.15 R. Kaiser, Dubendorf, Switzerland
"Floral Scents"

10.00 Coffee Break

Chairman: D. Lamparsky

10.20 L-1 W. Boland, Karlsruhe, Germany
"Biosynthesis of Vinyl Hydrocarbons in Plants"

L-2 E.-J. Brunke, Holzminden, Germany
"Uncommon Essential Oils with Rare Main Components"

L-3 P. Weyerstahl, Berlin, Germany
"New Constituents from the Essential Oil
of *Artemisia laciniata*"

L-4 I. Wahlberg, Stockholm, Sweden
"New Terpenoids from Tobacco"

L-5 G. Collin, Quebec, Canada
"The Composition of the Essential Oil
of *Ligusticum scoticum* L."

12.30 Lunch

Chairman: K.-H. Kubeczka

14.00 L-6 E. Stahl-Biskup, Hamburg, Germany
"Chemistry of Volatiles in the Genus *Thymus*"

L-7 K.b. Yacoob, Bangi-Selangor, Malaysia
"Novel Essential Oils from Malaysia"

- L-8 O. Ekundayo, Ibadan, Nigeria
"Essential Oils of the *Annonaceae*"
- L-9 S. Katsiotis, Thessaloniki, Greece
Influence of Distillation Conditions on the
Essential Oil of *Juniperus communis* L."
- L-10 R. Steinbrecher, München, Germany
"Emission of Monoterpenes from Needles
of *Picea abies* (L.) Karst. Under Field Conditions"

15.40 Coffee Break

Chairman: R. Hiltunen

- 16.00 L-11 E.H. Graven, Fort Hare, Ciskei
"Influence of Cutting Schedules on the Yield
and Composition of *Artemisia afra* Oil"
- L-12 R. Riccaglia, Bologna, Italy
"Effects of Mineral Fertilizers on the
Composition of *Salvia officinalis* L. Oil"
- L-13 S.A.M. Ghanem, Budapest, Hungary
"Changes of the Root Yield and Essential
Oil Content of *Valeriana officinalis* L.
During the Whole Year"
- L-14 B. Galambosi, Helsinki, Finland
"Cultivation Possibilities of Essential Oil
Containing Plants in South Finland"

17.00 Poster Session

Evening free

Please note the possibility to visit SPECTROSPIN AG (manufacturer of NMR-instruments) in the late afternoon (cf. announcement in folder).

Inscription indispensable (limitation: 40 participants).

- L-8 O. Ekundayo, Ibadan, Nigeria
"Essential Oils of the *Annonaceae*"
- L-9 S. Katsiotis, Thessaloniki, Greece
Influence of Distillation Conditions on the
Essential Oil of *Juniperus communis* L."
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Evening free

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Inscription indispensable (limitation: 40 participants).

FRIDAY SEPT. 9, 1988

Chairman: R. Kaiser

- 08.45 L-15 V. Schurig, Tübingen, Germany
"Separation of Enantiomers by Complexation
Gas Chromatography"
- L-16 W.A. König, Hamburg, Germany
"Modified Cyclodextrins as Chiral Stationary
Phases in Capillary Gas Chromatography"
- L-17 F. Etzweiler, Dubendorf, Switzerland
"Computer-Controlled Micropreparative Isolation
Techniques: Enrichment from Capillary Columns
and Application to Structure Elucidation of
Natural Compounds"
- L-18 K.-H. Kubeczka, Würzburg, Germany
"New Developments in Instrumental Analysis
of Essential Oils"

10.30 Coffee Break

Chairwoman: E. Stahl-Biskup

- 10.50 L-19 T.A. van Beek, Wageningen, The Netherlands
"Preparative Capillary Gas Chromatography -
A Possible Solution to Old Problems ?"
- L-20 C. Bicchi, Torino, Italy
"Direct Capture of Volatiles Emitted by
Living Plants (part III)"

- L-21 H.L. de Pooter, Gent, Belgium
"The Study of the Aroma Formation in Apples
cv. Golden Delicious by Headspace Analysis"
- L-22 H. Grüb, Holzminden, Germany
"Sensory of Essential Oils from *Mentha* Species"
- L-23 W.-R. Abraham, Braunschweig, Germany
"Microbial Hydroxylations of Bi- and
Tricyclic Sesquiterpenoids"

12.30 Lunch

Chairman: E.-J. Brunke

- 14.00 L-24 F. Tateo, Milano, Italy
"Production of Deterpenated Orange Essential Oils
Using Thin Film Evaporator and Analytical Charac-
terization"
- L-25 M.H. Boelens, Sevilla, Spain
"The Chemical Composition of Some Mediterranean Citrus
Oils"
- L-26 D. McHale, Reading, United Kingdom
"The Oxygen Heterocyclic Components of Citrus Peel Oils"
- L-27 G. Ziegler, Aufsess, Germany
"Investigation of the Constituents of Orange Oil"
- L-28 A.F. Thomas, Geneva, Switzerland
"Aspects of the Chemistry of Limonene"
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Chairman: J.J.C. Scheffer

- 16.00 L-29 G. Buchbauer, Vienna, Austria
"Synthesis Within the Bicyclo [3.2.2]-Nonane Series"
- L-30 H. Spreitzer, Vienna, Austria
"Synthesis of Homo- β -Santalol and Homonojigiku Alcohol"
- L-31 P. Rüedi, Zurich, Switzerland
"Structures and Antioxidant Properties of Long-Chain Catechols from *Labiatae*"
- L-32 K. Knobloch, Erlangen, Germany
"New Aspects on the Mode of Antimicrobial Activity of Essential Oils"
- 17.30 Final Remarks
- 18.00 Chamber Concert (S. Ebel, K.-H. Kubeczka, H. Nowak)
- 19.30 Apéro at "Hotel Wallberg"
- 20.00 Symposium Dinner
- ca.23.00-23.30 End of Symposium

POSTER PRESENTATIONS

- P-1: R. Bos, F. Heinzer, R. Bauer
The Volatile Constituents of the Leaves of *Echinacea purpurea*, *E. pallida* and *E. angustifolia*
- P-2: R. Bos, F.C. Fischer, M.J.M. Gijbels
Volatile Components of *Trochiscanthes nodiflora* (Vill.) Koch
- P-3: H.Hendriks, D.J.D. van der Elst, F.M.S. van Putten, R. Bos
The Essential Oil of Dutch Tansy (*Tanacetum vulgare* L.)
- P-4: K.H. Kubeczka, G. Schmaus, W. Schultze
The Essential Root Oils of Selected *Peucedanum* Species
- P-5: K.H. Kubeczka, I. Bohn, W. Schultze
The Essential Oil of *Chaerophyllum hirsutum* L.
- P-6: K.H. Kubeczka, D. Warncke, W. Schultze
The Essential Oil of Different Parts of Parsley (*Petroselinum crispum*)
- P-7: A.M. Janssen, T.J.C. Luijendijk, J.J.C. Scheffer,
A. Baerheim-Svendsen
Antibacterial and Antifungal Activities of Caraway Oil
- P-8: O.A. Onayade, A. Looman, J.J.C. Scheffer, A. Baerheim-Svendsen
Analysis of the Essential Oil from Twigs of *Hemizygia welwitschii* (Lamiaceae)
- P-9: J. Sváb, L. Hornok
The Essential Oil of *Matricaria recutita* Grown on Large Scale in Hungary

- P-10: H. Massoud, Ch. Franz
Quantitative Genetical Aspects of *Chamomilla recutita* (L.)
Rauschert
- P-11: E. Sarer
Comparison of the Volatile Composition of Two Varieties
of *Salvia aucheri* Benth.
- P-12: I. Nykänen, Y. Holm, R. Hiltunen
Composition of the Volatile Oil of Dragonhead (*Dracocephalum
moldavica*)
- P-13: B. Galambosi, Y. Holm, R. Hiltunen
The Effect of Some Agrotechnical Factors on the Herb Yield
and Volatile Oil of *Dracocephalum moldavica*
- P-14: J. Nyárádi-Szabady, M. Lakatos
Effect of PK-Fertilization on the Content and Composition
of Volatile Oil in Dill Seeds (*Anethum graveolens* L.)
- P-15: E. Lemberkovics, G. Petri
Gas Chromatographic Characterization of Frequently Occurring
Aromatic Compounds in Essential Oils
- P-16: G. Tabajdi, F. Kulcsár, A. Háger-Veress
Examination of Flavor Compositions with NIR Technique
- P-17: Jian-Quin Cu, F. Périneau, M. Delmas, A. Gaset
Study on Different Extraction Methods of Aromatic Compounds
of Celery Seeds
- P-18: T. Talou, M. Delmas, A. Gaset
Direct Capture of Volatiles Emitted from Entire Black
Perigord Truffles
- P-19: Jian-Quin Cu, Fan Pu, Zheng-Ju Zhang
The Chemical Composition of the Essential Oil in *Amomum
villosum* Lour. Leaves in Yunnan Province

- P-20: T. Adzet, S. Canigueral, C. Ibanez, R. Vila
Essential Oil of *Sideritis reverchonii*
- P-21: A. Sigrist, F. Valverde, M.H. Boelens
Verbenone in Spanish Rosemary Oil
- P-22: G. Schulz, E. Stahl-Biskup
Glycosidic Bound Volatiles in *Hyssopus officinalis*,
Rosmarinus officinalis and *Origanum vulgare*
- P-23: M.M. Carmo, S. Frazao, F. Venancio
Wild Origanum Growing in Portugal - Chemical Composition
of its Essential Oil
- P-24: A. Proença Cunha, O.R. Roque
Chemical Composition of an Alcoholic Extract and the
Essential Oil of *Juniperus communis* L. var. *nana*
- P-25: H.L. de Pooter, J.R. Vermeesch, L.A. Du Buyck, N.M. Schamp,
A. De Bruyn
The Volatile Fraction of the Ornamental Tree *Chamaecyparis
pisifera* (S. and Z.) Endl. cv. *filifera*. Identification of
the Character Impact Compound
- P-26: T.A. van Beek, R. Kleis, M.A. Posthumus
Investigation of the Essential Oil of *Amyris balsamifera* -
The Oil as a Source of β -Eudesmol
- P-27: W.-R. Abraham, H.-A. Arfmann
Unusual Rearranged Tetrahydrofurans from *Chaetomium cochlioides*
- P-28: M. Ziegler, H. Brandauer
Deterioration of Concentrated Orange Oils Subjected to Aging
Experiments

Abstracts of Lectures



FLORAL SCENTS - CHEMICAL AND OLFACTORY CHARACTERISTICS

R. Kaiser

GIVAUDAN Research Company Ltd.
Ueberlandstr. 138, CH-8600 Dubendorf





BIOSYNTHESIS OF VINYL HYDROCARBONS IN PLANTS

Wilhelm Boland, Institut für Organische Chemie der Universität,
Richard Willstätter-Allee, 75 Karlsruhe 1

The vinyl group is a widespread structural element of many simple and complex natural products like e.g. porphyrins, insect- and plant pheromones, terpenes, homoterpenes or linear olefinic- and acetylenic hydrocarbons. Despite of the extensively studied porphyrins the biosynthesis of the vinyl group in all other classes is largely unexplored. With selected plant producers of algal pheromones (Senecio isatideus, Compositae), linear olefinic hydrocarbons (Carthamus tinctorius) or homoterpenes (Magnolia liliiflora, Hoya carnosa) and appropriately labelled (^2H) precursors some common biosynthetic aspects are observed.

- * the precursors are always oxygenated compounds (carboxylic acids; secondary or tertiary alcohols).
- * the formation of the vinyl group is based on oxidation of the oxygen moiety and fragmentation into an 1-alkene and CO_2 or a carbonyl component (e.g. butenon in the case of homoterpenes).
- * a single hydrogen from the methylene group, β to the C-O moiety is lost during the fragmentation process.
- * hydrogens from other positions, α or β to the C-O moiety are not involved.

SOME UNCOMMON ESSENTIAL OILS WITH UNCOMMON COMPONENTS

E.-J. Brunke, F.-J. Hammerschmidt, and F.-H. Köster

DRAGOCO Gerberding & Co. GmbH, Research Laboratories,
D-3450 Holzminden

The essential seed oil of Laser trilobum L. (Crantz), an Apiaceae rarely growing in Europe and Asia minor, contains as main constituents Perilla aldehyde (15 - 35 %) and Limonene (66 - 54 %). In the group of minor components the occurrence of Bornyl angelate (2 %) is remarkable, which now has been found as natural substance for the second time.

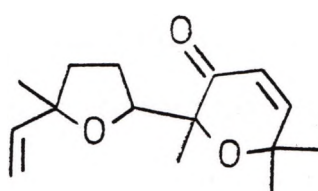
The root bark of the North American Rhus aromatica Ait. gave an essential oil (sample obtained from Professor Schilcher, Freie Universität Berlin), which contains 4 dinor-Diterpene-ketones, 3 dinor-Sesquiterpene-ketones and 1 dinor-Sesquiterpene-alcohol in relatively high concentrations: Farnesyl acetone as main constituent (7.8 %); Δ^7 -, Δ^8 -, and $\Delta^{8(20)}$ -15,16-Dinor-labden-13-ones (4 %); Geranyl acetone (1.5 %), Dihydro- γ -ionone (1.1 %), and α -Ambrinol (0.3 %). α -Ambrinol and Dihydro- γ -ionone are mainly known as constituents of ambergris (from the sperm whale) and have importance as aroma chemicals.

NEW CONSTITUENTS FROM THE ESSENTIAL OIL OF ARTEMISIA LACINIATA

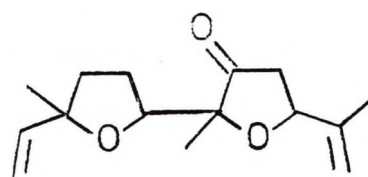
P. Weyerstahl¹, M. Schröder¹, and V. K. Kaul²

Institut für Organische Chemie, Technische Universität Berlin,
Straße des 17. Juni 135, D-1000 Berlin 12¹,
Central Institute of Medicinal and Aromatic Plants,
22 - Rawalpura Colony, Srinagar - 190005, India²

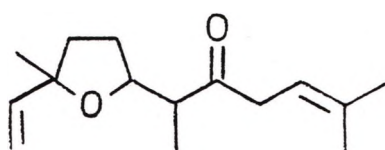
The essential oil of Artemisia laciniata grown near Srinagar, Kashmir, exhibits an interesting odor of fresh, green, herbaceous, woody and animalic notes. In addition to the main constituents (>5%) chrysanthenyl acetate, artemisia ketone, camphor, and eucalyptol, three further compounds in the range of 2 to 4% are typical for this oil. Artedouglasia oxide (1) and the new artelaciniata oxide (2) are products of oxidative cyclization of davanone (3). All four diastereoisomers of 1 could be separated and assigned by comparison of the ¹H NMR spectra. Silphiperfol-5-en-3-ol (4, ~4%) is one of the rare functionalized triquinane compounds. Its spectroscopic properties, degradation reactions, and olfactive evaluation will be presented.



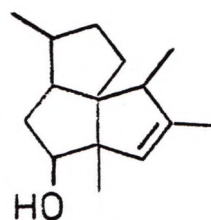
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NEW TERPENOIDS FROM TOBACCO

I. Wahlberg, R. Arndt, I. Forsblom, and C. R. Enzell

Research Department, Swedish Tobacco Company, P. O. Box 17007, S-104 62
Stockholm, Sweden

The cuticular wax of the leaf and flower of most tobacco varieties contains substantial amounts of diterpenoids of the cembrane class. The two 4-epimers of (1S,2E,6R,7E,11E)-2,7,11-cembratriene-4,6-diol are the major components. They are also the principal precursors of the majority of the other tobacco cembranoids to which they are converted by reactions such as oxidations, reductions, dehydrations and acid- and base-induced rearrangements. The metabolism of the tobacco cembranoids also involves ruptures of carbon-carbon bonds with the formation of odoriferous products having less than twenty carbon atoms.

We now report the isolation of three new cembranic diterpenoids from Greek tobacco. They have been identified as (1S,2E,4R,6R,7E,11E,13R)-2,7,11-cembratriene-4,6,13-triol and the two 7-epimers of (1S,2E,4S,6R,11S)-2,8(19),12(20)-cembratriene-4,6,7,11-tetraol by spectral methods and biomimetic syntheses.



THE COMPOSITION OF THE ESSENTIAL OIL OF *Ligusticum scothicum* L.

Guy J. COLLIN and Michel GAGNON

Département des sciences fondamentales, Université du Québec à Chicoutimi,
Chicoutimi, Qué. CANADA G7H 2B1

The essential oil of *Ligusticum scothicum* L. (sea lovage) has been analyzed using both capillary gas chromatography and capillary gas chromatography - mass spectrometry. Among 46 peaks, with reference to authentic compounds, the main identified products are: apiole (dill) (47 - 49 %), myristicin (33 - 34 %), α -pinene (6 - 7 %), apiole (parsley) (2.7 - 4 %), β -pinene (2.1 - 2.5 %), β -caryophyllene (1.2 - 1.4 %), and elemicin (0.9 - 1.4 %). Noticeable differences have also been observed in the composition of the oil extracted from stems, leaves, and seeds: myristicine being more abundant than dill apiole in the leaves but less abundant in the seeds.

Chemistry of Volatiles in the Genus Thymus

E. Stahl-Biskup

Lehrstuhl für Pharmakognosie, Universität Hamburg,
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The genus *Thymus* is of Mediterranean origin, today widespread in the South of France, on the Iberian Peninsula and the Balkan Peninsula including the adjoining Orient. Some species of the serpyllum group grow in the northern part of Europe, even in Iceland and Lapland.

The taxonomy of the genus is complex because of wide variation in shape and form. So it was not surprising that K. Ronniger had described 417 species. Later Jakko Jalas, in his revision of the genus *Thymus* in the *Flora Europaea* estimated the genus to contain 150 species, 75 of them growing in the European region.

The essential oils of about 30 species have been investigated more or less intensively with the identification of about 150 compounds so far. The most important constituents are the terpenoid phenols thymol and carvacrol, followed by the biogenetically related p-cymene and γ -terpinene. Linalol, borneol, 1,8-cineole, α -terpineol, terpineol-4, and some more common monoterpenes as well as some sesquiterpenes have been found in several species, also in addition, some rare trace compounds were detected in oils of the genus *Thymus*.

Chemotypes within one species were often encountered and this communication will show the northern *Thymus* species, *T. praecox* ssp. *arcticus*, *T. pulegioides*, *T. serpyllum* ssp. *serpyllum* and *T. serpyllum* ssp. *tanaensis*, as an example of that phenomenon.



Novel Essential Oils From Malaysia.

Karim b Yaacob

Natural Oils Research Laboratories (NOREL)

Department of Chemistry,

Universiti Kebangsaan Malaysia,

43600 Bangi, Selangor.

ABSTRACT

Our extensive study and documentation of local plants and herbs lead to the discovery of a number of essential oils that may prove to be novel products for the flavour and fragrance industry. In this paper, we discuss the chemical composition and possible application of the essential oils of Polygonum minus (Polygonaceae); Phaeomeria speciosa (Zingiberaceae); Melaleuca leucadendron (Myrtaceae) and Aquilaria agallocha. The first and second essential oils are rich in aliphatic aldehydes, with the former containing as high as 75% of decanal and dodecanal; the third oil has pronounced pharmacological properties, while the fourth is a new type of agarwood oil.



ESSENTIAL OILS OF THE ANNONACEAE

Olusegun Ekundayo

Department of Chemistry,
University of Ibadan,
Ibadan. Nigeria.

Annonaceae plant family comprises of a large number of odoriferous and aromatic species. Some of the plants also bear edible fruits of economic importance. Although the volatile oils of most of these Annonaceous plants have not been investigated, an increasing quantity of literature data is now available on the composition of the oils. Typical constituents of the essential oils include benzenoid compounds, mono and sesquiterpenoids which have been found to account for the fragrant and spicy properties of the plants. The occurrence of unusual nitro compounds and prenylindoles in the oils has also been reported. A few of the essential oils exhibit interesting biological activities. Finally, the present review will discuss the available published compositional data in relation to the chemotaxonomy of the family.



INFLUENCE OF DIFFERENT PROCESSING ON THE PLANT
MATERIAL OF fructus JUNIPERUS COMMUNIS ON THE YIELD AND THE
QUALITY OF THE OBTAINED ESSENTIAL OIL

P. CHATZOPOULOU, S. T. KATSIOTIS

Department of Pharmaceutical Technology, Faculty of Pharmacy,
ARISTOTELION University of Thessaloniki, 54006, P.O.B. 19589,
Thessaloniki, GREECE

The spice and the pharmaceutical industries aim to elaborate their products in order to maintain the raw plant material in conditions that offer products of low cost and high quality. A programme of experimental work is being carried out to investigate the effect of drying and comminution conditions on the yield and composition of the essential oil of *Juniperus communis*; being the fruits of *Juniperus communis* one of the most commercial drugs even today, it is important to know with great accuracy the way to handle the plant material, before the distillation procedures to obtain the essential oil. The most important parameters - processes - that influence the yield as far as the quality of the corresponding essential oil are the drying and the comminution methods applied on the plant material. The fruits of *Juniperus* under investigation were comminuted in a ball mill, in a hammer mill and in two different types of cutting mills. The yields of the obtained essential oils present variations from 23 % to 200 %. The most convenient degree of comminution is also suggested. Moreover differences in the quality of the obtained oil are observed too. The single constituents of the oil present variation from 25 % to 1033 %.

EMISSION OF MONOTERPENES FROM NEEDLES OF PICEA ABIES (L.) KARST.
UNDER FIELD CONDITIONS

STEINBRECHER, R., SCHÖNWITZ, R., ZIEGLER, H., Technische
Universität München, Lehrstuhl für Botanik, Arcisstr.21, D-8000
München 2, FRG

Emission rates of terpenes from 1 year old, undisturbed twigs, still attached to the tree, were determined by means of a gas exchange chamber under controlled environmental conditions. Gas exchange parameters, CO₂ assimilation rates (A), transpiration rates (E), leaf conductances (g_s) and internal CO₂ concentrations (c_i) were simultaneously monitored, while the emitted monoterpenes were concentrated on Tenax TA. After separation by capillary gas chromatography six monoterpenes were identified. Four of them (α-pinene, camphene, β-pinene, limonene) are emitted in appreciable amounts.

Total terpene emission rates at standardized conditions (25°C leaf temperature (T_l), 40% rel.humidity (rh)) vary between 30 ng m⁻²s⁻¹ and 2.5 ng m⁻²s⁻¹ in the light (750 μmol PAR m⁻²s⁻¹) and 1.8 ng m⁻²s⁻¹ and 0.6 ng m⁻²s⁻¹ in the dark, depending on needle age and needle position. Therefore it is expected that the complete endogenous terpene pool needs about 20,000 hrs at 25°C T_l and full sunlight for total volatilisation.

During the day, the terpene emission shows a close correlation to light intensity and leaf conductance, under field conditions (ca. 80 years old tree, National Park Bayerischer Wald).

Under laboratory conditions, the influence of light intensity, CO₂, temperature and air humidity on clonal plant material was tested. Preliminary results indicate that terpene emission is not only ruled by leaf conductance and temperature, but also by some other, still unknown factors.

Thus an increase in CO₂ from 69 μbar bar⁻¹ to 320 μbar bar⁻¹ leads to an increase of terpene emission by 25%, despite a decrease in leaf conductance by 10%. These phenomenon needs further investigation.



INFLUENCE OF CUTTING SCHEDULES ON THE YIELD AND COMPOSITION OF
Artemisia afra OIL.

BY

E H GRAVEN, L WEBBER, M VENTER, G DE VILLIERS & B GARDNER

Agricultural and Rural Development Research Institute,
University of Fort Hare, Alice, Ciskei.

Artemisia afra appears to hold considerable promise as a new essential oil crop for Ciskei. Results of a field experiment with different cutting schedules indicate that oil yields and longevity of the crop can be significantly improved by the application of judicious cutting treatments.

EFFECTS OF MINERAL FERTILIZERS ON COMPOSITION OF Salvia officinalis L.OIL

R. Piccaglia, M. Marotti and G.C. Galletti¹

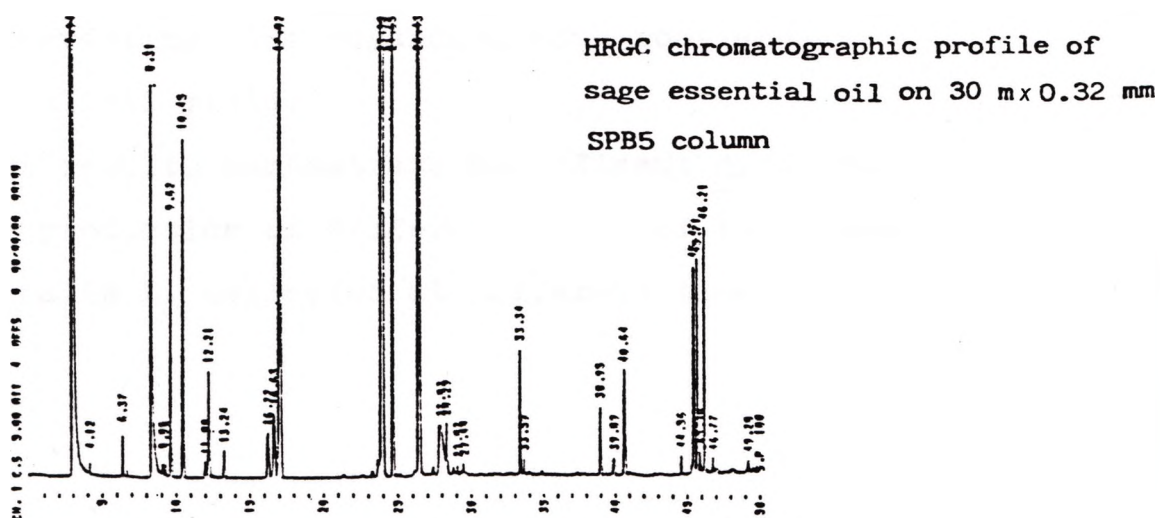
Istituto di Agronomia Generale e Coltivazioni Erbacee - Università di Bologna -
Via F. Re, 8 - 40126 Bologna (Italy), Consiglio Nazionale delle Ricerche -
Via F. Re, 8 - 40126 Bologna (Italy)¹

Sage (*Salvia officinalis*) is widespread in Italy on a small farm scale mainly for a pharmacologic and aromatic utilization,¹ but the expansion of its cultivation on a larger scale is encouraged in order to fulfil demand of the domestic market.

The optimization of the fertilizing treatments are of importance, since mineral fertilizers seem to increase plant and essential oil yields.²

In the present work, we aimed to determine whether three types of mineral fertilizers (N, P, K) distributed in different concentration, may affect the quali- - quantitative composition of sage essential oils.

HRGC was employed to analyse essential oils from sage cultivated in northern Italy. Chromatographic profiles will be presented and data relevant the quantitative composition will be discussed.



REFERENCES:

1. Marzi, V. *Agricoltura Ricerca*, (1986), N°62, pp. 53 - 60.
2. Bezzi, A., Aiello, N. Clementel, F. *Agricoltura Ricerca*, (1986), N°62, pp. 61 - 66.



CHANGES OF THE ROOT YIELD AND ESSENTIAL OIL
CONTENT OF VALERIANA OFFICINALIS L. DURING THE
WHOLE YEAR

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Valerian is one of the most important medicinal plants in Hungary due to its active substances. Its root contains essential oil and valepotriate what is needed for the Pharmaceutical Industry.

In this paper we discuss the changes of root yield and its essential oil content in case of different types of valerian during the seasons.

The aim of our investigations is to find the best harvesting time regarding both root and essential oil yield.

Our results demonstrate significant differences in production of different types of Valeriana officinalis L. collected at different times.



CULTIVATION POSSIBILITIES OF ESSENTIAL OIL CONTAINING PLANTS IN SOUTH-FINLAND

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In 1984, an experimental station in Puumala in south Finland (61°40' N, 28°15' E), was established by the University of Helsinki in order to study the cultivation and production possibilities of herbs in a larger scale for a period of five years.

Experiment plots were established 30 m² sized, for cultivating and observing about 50 different plants. Two years later, on the basis of agrobiological experiments and market studies 25 species, including 20 essential oil containing species were selected for detailed cultivation experiments.

The intention is to show results and experiences of four years cultivation of 16 essential oil containing plants, which are: **basil, chamomile, dill, dragonhead, marjoram, savory, caraway, angelica, hyssop, lemon balm, lovage, peppermint, sage, thyme, yarrow, wild marjoram.**

At this Nordic latitude the limiting factors for plant production are the shortness and the day-degree of the vegetation period. To compensate these factors the grower has to apply all those agrotechnical methods which lengthen the vegetation period and give the plants additional warmth, i.e. planting of strong seedling, plastic house, tunnels, mulching of the soil, covering of the plants, Intensive fertilization has to be used for the plants during the short but rich in light summer period to get a maximal crop.

*SEPARATION OF ENANTIOMERS BY COMPLEXATION GAS CHROMATOGRAPHY
APPLICATION IN STEREOCHEMICAL ANALYSIS OF PHEROMONES AND FLAVORS*

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The importance of the relationship between chirality and biological activity is now well appreciated in pheromone perception and flavor olfaction. Consequently, the determination of enantiomeric compositions and absolute configurations of biological active compounds is highly important in insect pest control and in food analysis. In addition, the isolation of enantiomerically pure compounds is essential for establishing chirality-activity-relationships in biological and physiological trials.

The quantitative separation of *underivatized* enantiomers by *complexation gas chromatography* on chiral non-racemic metal containing stationary phases constitutes a powerful tool for enantiomer analysis because of speed, simplicity, reproducibility and sensitivity. Thus, racemic ethers, ketones, alcohols, acetals, esters, nitriles as well as racemates of other classes of compounds have been quantitatively separated into enantiomers on high-resolution capillary columns coated with chiral phases such as manganese(II)- or nickel(II)-bis[3-(heptafluorobutanoyl)-(1*R*)-camphorate] dissolved in polysiloxanes. As solute derivatization is generally **not** required in *complexation gas chromatography*, enantiomer analysis is indeed rendered very straightforward and ee up to 99.9% can be determined satisfactorily. Stereochemical investigations of pheromone and flavor molecules in complex biological matrices have also been carried out with ancillary techniques such as GC-MS(SIM)-coupling. Applications are reported by us and others on pheromones such as chalcogran, *exo*- and *endo*-brevicommin, lineatin and manicon, and flavors such as menthol, neo- and isomenthol, menthone, isomenthone and 2-methyl-4-propyl-1,3-oxathiane.

First results have revealed that *complexation gas chromatography* is lending itself also to the semi-preparative separation of enantiomers on analytical packed columns.

Although, in principle, any volatile racemate containing a proper function prone to coordination to metal ions should be subject to efficient enantiomer separation by complexation gas chromatography, some classes of compounds, i.e., lactones and olefins, still present difficulties. To this end, it has been shown that some of these compounds are amenable to gas chromatographic enantiomer separation by enantioselective inclusion into permethylated β -cyclodextrin dissolved in polysiloxanes.

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MODIFIED CYCLODEXTRINS - A NEW GENERATION OF CHIRAL
STATIONARY PHASES FOR CAPILLARY GAS CHROMATOGRAPHY

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Enantiomer separation by capillary gas chromatography is a highly efficient technique to determine the absolute configuration of natural compounds in complex mixtures, to prove optical purity of chiral drugs and retention of configuration during peptide synthesis, and to monitor enantiomeric excess in enantioselective syntheses or enzymatic transformations.

In the past predominantly polysiloxanes with chiral diamide residues¹ or chiral transition metal complexes² were used as stationary phases for enantioselective capillary gas chromatography. Enantiomer separation on chiral polysiloxanes is limited to substrates with donor or acceptor sites for hydrogen bonding interaction (amides, carbamates, oximes and some hydroxy compounds), while complexation gas chromatography can only be applied to highly volatile compounds due to thermal limitations. We have recently introduced hydrophobic cyclodextrin derivatives as chiral stationary phases. These compounds have a wide range of operating temperature (from below room temperature to above 200°C) and exhibit an extraordinary broad enantioselectivity towards chiral substrates. Perpentylated or perhexylated cyclodextrins can be utilized to separate the trifluoroacetylated derivatives of carbohydrates, polyols, triols, diols, alcohols, epoxy alcohols (Sharpless epoxidation products), cyanohydrins, hydroxy acid esters, spiroacetals and even olefins³⁻⁵.



Cyclodextrins acetylated in 3-position and alkylated in 2- and 6-positions of the anhydroglucose residues are suited to separate lactones, trifluoroacetylated amines, amino alcohols, cyclic 1,2- and 1,3-diols, aldols, β -amino acid esters and cyclic carbonates of O-alkylated glycerols and other diols^{6,7}.

In addition to their intrinsic inclusion properties the the different reactivities of the hydroxy groups of cyclodextrins offer the possibility to introduce substituents for specific molecular interaction, i.e. hydrogen bonding, dipole-dipole or charge transfer interaction, thus enabling chiral recognition for a great variety of chiral compounds.

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COMPUTER CONTROLLED MICROPREPARATIVE ISOLATION and ENRICHMENT from
GC CAPILLARY COLUMNS and SUBSEQUENT SAMPLE HANDLING

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The paper describes a computerized system for micropreparative enrichment of components from a mixture being separated on a capillary column. All electronic components are commercially available. Programming was performed in BASIC so that users can easily adapt the program to their special needs.

In order to perform the enrichment reliably, the system searches for reference peaks which can stem from components of the mixture or from deliberately added reference compounds. Optimization is easily performed during a supervised gc run in a semi-automatic mode.

The presented system has been in operation since several years in our laboratory where, in some cases, the mixture had to be injected over 500 times onto the capillary column to obtain the necessary amount of pure component (10-1000 μg) for NMR structure elucidation. Some sesquiterpenoids naturally occurring in amyris oil are cited to illustrate the method. However, to get meaningful spectra of such small amounts special precautions are necessary in sample handling.

This technique can also be applied for sample recovery after analysis by non-destructive elucidation methods or by chemical microreactions without loss.

NEW DEVELOPMENTS IN INSTRUMENTAL ANALYSIS OF ESSENTIAL OILS

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Essential oils represent in general rather complex multi-component mixtures covering a wide range in concentration. Therefore, a detailed analysis of the individual oil components requires the application of modern physico-chemical methods and sophisticated instrumentation. Recent developments in this field are generally dependent on the stage of advancement of instrumentation and the skilful combined application of individual analytical techniques. The procedures to investigate such complex mixtures will be discussed in two sections:

1. Methods by which the mixture to be analyzed is first separated by a chromatographic technique and subsequent identification is performed by spectroscopy. The most commonly employed analytical tool is the on-line coupling of a capillary gas chromatograph to a mass spectrometer. Some examples of advanced techniques in this field will be given to demonstrate the high efficiency and versatility of those techniques (e.g. CI with different reagent gases etc.).

Furthermore, another "hyphenated technique" will be discussed: the coupling of a capillary GC with a Fourier transform spectrometer (HRGC/FTIR) can provide valuable additional information, often being complementary to GC/MS data. This method has proven helpful especially for differentiating stereoisomers, determining functional groups and detecting and analyzing overlapped gc peaks.

2. As an alternative, a completely different approach may be utilized to investigate volatile terpene mixtures: the direct spectroscopic measurement of the entire mixture by ¹³C NMR spectroscopy without previous chromatographic separation. The advantages and perspectives of this method are demonstrated by means of some selected examples.



PREPARATIVE CAPILLARY GAS CHROMATOGRAPHY, A POSSIBLE SOLUTION TO OLD PROBLEMS?

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The identification of volatile trace components in various fields such as essential oil chemistry, food chemistry and info-chemistry is becoming of increasing importance.

Current separation techniques, i.e. preparative TLC, fractional distillation, semi-preparative HPLC or preparative GC suffer from such shortcomings as low resolution, high risk of decomposition, too high capacity or the necessity of an additional work up procedure. Capillary GC has a very high resolution but has a too low sample capacity.

The possibility of using megabore GC columns (i.d. 0.53 mm) with a thick film (2-5 μm) for the purification of trace volatiles has been investigated. Megabore columns almost combine the loadability of old preparative GC columns with the inertness and high resolution of small bore capillary columns. With a 30 m 3 μm megabore column it was possible to separate in one injection 100 μg of two compounds that differed 12 in retention index with a resolution of one. Nowadays it is possible to obtain high resolution $^1\text{H-NMR}$ spectra from such amounts, which can frequently give important clues about the (unknown) structure. The influence of temperatures, injection volume, concentration and type of compounds on the resolution was studied.

The method was successfully tried in the identification of some kairomones for spider mites. Only after separation cold trapping and off-line recording of NMR spectra it was possible to elucidate the structures of these compounds. GC-MS, GC-IR and HPLC-UV alone did not yield enough information.



DIRECT CAPTURE OF VOLATILES EMITTED BY LIVING PLANTS (Part III)

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Wewelgem (B)

The knowledge of the chemical composition of the atmosphere surrounding an odorous plant is of great importance in the study of both allelopathy and living cycles.

Previous papers reported:

- on the development of a sampling assembly,
- on the possibility of open traps (very thick film FSOT columns) and on their coupling to a 220um i.d. FSOT analytical column through a Multiple Switching Intelligent Controller (MUSIC) to obtain an efficient reconcentration and injection
- on the gas chromatographic patterns of the head-space of some odorous mediterranean plants of commercial interest directly captured in the field.

This communication reports on coupling of this multidimensional system to a mass spectrometer to identify the head-space constituents together with studies on the head-space composition of some mediterranean aromatic plants, and on the head-space variation with respect to phytochemical and botanical phenomena

The authors are indebted to NATO for the financial support of this research project (NATO Grant for scientific research 718/83)



The study of the aroma formation in apples cv Golden Delicious by headspace analysis

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Storage of apples for lengthy periods of time according to common practice at low temperature, in controlled atmospheres (high in CO₂, low in O₂) leads to a well-documented loss of aroma and flavour quality, although improving fruit firmness as compared to storage in air, in the cold.

While attempting to track down this decline, intact apples were treated with short-chain carboxylic acids (the latter being the necessary precursors of the aroma esters), and the changes in the composition of the total volatiles were monitored by headspace GC-analysis, and of the volatile aldehydes by HPLC-analysis.

Results show that the reduction in quality after long CA-storage must be attributed to interference of high CO₂-concentrations with alcohol dehydrogenase activity and with fatty acid metabolism in the apples.



SENSORY OF ESSENTIAL OILS FROM MENTHA SPECIES

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Nowadays the term SENSORY means the same as the German SENSORIK. SENSORIK or SENSORY includes sensory analysis, sensory evaluation, etc. and therefore SENSORY is as complex as other disciplines. Furthermore it lies in between or is connected with Quality Assurance and Marketing.

SENSORY ANALYSIS is an important tool for research in the field of essential oils, as well as in the flavor field, perfumery, etc. The main compounds of the oils are well-known. Trace components in the range of 10^{-15} or less become more and more interesting in flavor research as well as in flavor development.

An approach to MENTHA flavor with SENSORY, esp. SENSORY EVALUATION with SSGA (Sensory Statistical and Grafical Analysis), in combination with Marketing will be demonstrated.

MICROBIAL HYDROXYLATIONS OF BI- AND TRICYCLIC SESQUITERPENOIDS

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A number of sesquiterpenoids possess biological activities. Syntheses of bi- and tricyclic sesquiterpenalcohols are often difficult because of many steps, low yields and insufficient selectivity, so we choose the biotransformation to produce some of them from cheaper and readily available precursors.

The fungi *Diplodia gossypina*, *Chaetomium cochlioides*, and *Corynespora cassicola* and the bacterium *Mycobacterium smegmatis* were selected from a screen for biotransformations in preparative scales.

Humulene and caryophyllene were epoxidized at the 4,5-double bond and then hydroxylated at one of the geminal methyl groups. The stereochemistry of this hydroxylation depends on the microorganism used. Calarene, ledrene, and globulol were mainly hydroxylated at one of the geminal methyl groups at the cyclopropyl ring. Depending on the substrate and the strain used the yields were more than 50% of one hydroxylation product.

The comparison of the biotransformation products from the different strains revealed pronounced differences in the regio- and enantioselectivity of the enzymes involved in the reactions.



PRODUCTION OF DETERPENATED ORANGE ESSENTIAL OILS USING THIN FILM
EVAPORATOR AND ANALYTICAL CHARACTERIZATION

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Summary

Among various processes for the production of deterpenated essential oils, the one based on distillation is the most common, but also the most controversial one.

This is due to the influence of temperature on the characteristics of final product.

The use of thin film evaporator may be conveniently considered, first for the possibility of continuous production offered by this kind of equipment and further because different essential oil fractions characterized by so different deterpenation degree can be produced.

The paper describes the use criteria of the plant and gives GC-MS composition data of deterpenated orange essential oils obtained with different operative parameters.



THE CHEMICAL COMPOSITION OF SOME MEDITERRANEAN CITRUS OILS

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There exists seasonal and regional variation in the quantitative composition of cold-pressed lemon oil from California and Arizona¹.

We wondered whether these variations also exist in Citrus Oils from Mediterranean countries.

Therefore the chemical composition was studied of the following Citrus Oils from Italy (Sicily) and Spain (Andalucia):

- Sweet Orange Oil (*Citrus sinensis* L.)
- Bitter Orange Oil (*C. aurantium* L. ssp. Amarga)
- Lemon Oil (*C. limon* Burm.)
- Mandarin Oil (*C. reticulata* Blanco)

50 main constituents were identified and quantified in the oils.

No significant differences were found in the concentrations of the constituents of sweet orange oils from both countries.

The following variations were found in the chemical compositions of Bitter Orange-, Lemon- and Mandarin oils:

Italian oils contain more alpha- and beta- pinene, aliphatic aldehydes and monoterpenoid-O-derivatives than Spanish oils. Spanish oils contain more limonene, sesquiterpenoids and benzenoid-derivatives than Italian oils.

Climatological differences between Italy-Sicily (coastal) and Spain-Andalucia (desert) are presumed to be most responsible for the compositional differences observed.

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THE OXYGEN HETEROCYCLIC COMPONENTS OF CITRUS PEEL OILS

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The occurrence of oxygen heterocyclic compounds in the peel oils from different Citrus species has been investigated by high performance liquid chromatography. The use of a photodiode array detector has facilitated the identification and quantification of the individual coumarins, psoralens and polymethoxyflavones present. Certain oxygen heterocyclic compounds are unique to a particular species but the majority occur widely in the peel oils. Nevertheless, the patterns of occurrence are sufficiently diverse to permit the detection of peel oil from one species in that from another. 7-Methoxycoumarin (herniarin) has been identified as a natural component of both Persian and Key lime oil. The presence of herniarin in commercial samples of lemon oil is now attributed to the addition of lime oil to these oils. Other compounds identified in the present study and reported for the first time as components of citrus peel oils include isomeranzin (bitter orange and grapefruit), 8-(2',3'-epoxyisopentyloxy)psoralen and 8-methoxy-5-(2',3'-epoxyisopentyloxy)psoralen (lime).

INVESTIGATION OF THE CONSTITUENTS OF ORANGE OILGünter Ziegler, Gerhard Spiteller

It was the scope of the present work to investigate orange oil and the fruit of *Citrus Sinensis* Osbeck L. in regard to non-volatile components.

The orange oil was distilled under high vacuum, subjected to preparative column chromatography over silica gel and investigated with GC/MS and the presence of the following components in orange oil was confirmed.

Osthol, which so far had not been found in sweet orange oil, was identified in the coumarin class.

Moreover, a labdan diterpene, which so far has only been mentioned as a by-product of synthesis in the literature, but was not yet found in nature, could be identified in orange oil. The structure was confirmed by synthesis.

After lipid extraction and hydrolysis, the orange fruit was examined with regard to fatty acids. Derivatization to picolinylesters was used to facilitate the mass spectral interpretation of unsaturated and branched fatty acids.

A furan-fatty acid was identified and quantified in orange oil for the first time.

ASPECTS OF THE CHEMISTRY OF LIMONENE

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(+)-Limonene is one of the largest volume chiral products, about 50,000 tonnes of more or less pure material being available annually from orange oil.

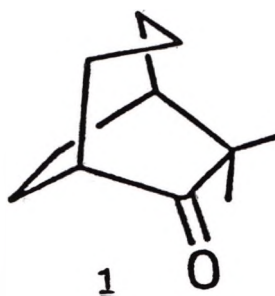
Formation of bridged bi- and tricyclic compounds from limonene is not a very common reaction, and routes to such systems, particularly those containing a bicyclo[3.2.1]octane skeleton will be discussed. A new route, involving treatment of limonene-8,9-epoxide with an acid ion exchange resin leads to 2,6-dimethylbicyclo[3.2.1]oct-2-en-7-endo-ol, in which the 6-methyl group is mainly exo, but which contains a trace of the 6-exo-methyl isomer. The racemate of the major isomer has already been described, having been prepared in poor yield from geranyl acetate.

SYNTHESES WITHIN THE BICYCLO[3.2.2]NONANE SERIES

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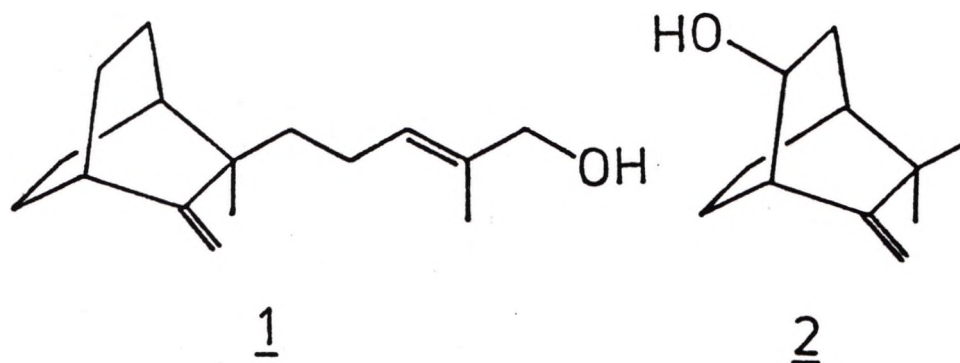
In continuation of our syntheses of bridge-modified norbornanes we were interested in developing a new and short access to derivatives with the bicyclo[3.2.2]nonane skeleton, also known as bishomo-norbornanes. This group of compounds differ from the regular norbornane system by an extension of the methylene bridge to a bridging three-carbon-unit. The key substance -bis-homocamphenilone (1)- has been prepared by Diels-Alder reaction of acrylonitril and cycloheptadiene-1,3 via the corresponding bicyclonitril which upon geminal chlorination and alkaline oxidation furnished the corresponding dehydro-bishomo-norbornan-6-one. Hydrogenation of this unsaturated ketone and finally twofold methylation yielded 1. The bicyclic ketone 1 serves as a starting substance for the synthesis of bishomo-camphene and bishomo-camphenilanic acid and their derivatives. The configuration of all the new compounds has been ascertained and their olfactive properties have been discussed.



SYNTHESES OF HOMO- β -SANTALOL AND HOMONOJIGIKUALCOHOLH.SPREITZER, G.BUCHBAUER AND H.KIENZL

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In continuation of studying structure-activity relationship of bicyclic odorants we focused our interest on Homo- β -santalol (1) and Homonojigikualcohol (2). These artificial products differ from the natural model by extension of the methylene bridge to a bridging two-carbon-unit. The synthesis of 1 started from bicyclo[2.2.2]octanone by introducing the side chain, methylation and subsequent methylenation of the keto group. Finally the allylic hydroxyl group was established by SeO_2 -oxidation. Homonojigikualcohol (2) was prepared by Diels-Alder-reaction of 6,6-dimethylcyclohexadienone with vinyl acetate. Hydrogenation, protection of the hydroxyl group and methylenation leads to Homonojigikualcohol (2). The olfactive properties have been discussed.



STRUCTURES AND ANTIOXIDANT PROPERTIES OF LONG-CHAIN
CATECHOLS FROM *LABIATAE*

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A fraction isolated from *Plectranthus albidus* (*Labiatae*) showing *in vitro* significant antioxidant activity yielded several novel long-chain phenols and catechols. Their structures have been established as derivatives of 1-phenyl-(C₁₀ - C₁₈)-5-ones by spectroscopy and syntheses.

(*E,E*)-1-(3,4-dihydroxyphenyl)deca-1,3-diene-5-one is the main compound, and its inhibitory concentration is comparable to that of BHA and BHT in the linoleic acid test system.

Analytical and synthetic aspects of the title compounds are discussed.

NEW ASPECTS ON THE MODE OF ANTIMICROBIAL ACTIVITY OF ESSENTIAL OILS

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Essential oils are active antiseptically (1,2,3). Especially terpenic compounds related to phenolic alcohols or aldehydes reveal antimicrobial effects. This is due to gram-positive and gram-negative bacteria as well as to several fungi tested.

The biochemical mechanism has to be seen in the interference of specific essential oil components which inhibit the primary energy metabolism catalyzed by bacterial membranes or cell organelles, respectively. Partly due to their lipophilic properties, terpenoids inhibit membrane-catalyzed electron flow, proton translocation, and phosphorylation reactions.

The antimicrobial activity likewise is related to the potency of terpenoids to penetrate the rather differently composed cell walls of microorganisms.

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Abstracts of Posters

THE VOLATILE CONSTITUENTS OF THE LEAVES OF
ECHINACEA PURPUREA, E. PALLIDA AND E. ANGUSTIFOLIA

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Within the scope of investigations on the constituents of Echi-
nacea species, the essential oil of the roots of Echinacea an-
gustifolia, E. pallida and E. purpurea has been examined (1). We
now present the results of the examination of the leaf oils.
Steam distillation of the leaves yielded essential oils in
quantities of less than 0,1% (E. purpurea and E. pallida: 0,04%
each). The oils were analysed by GC-MS and the constituents
identified by their Kovats indices and MS.

The main constituents of the leaf oil of Echinacea pallida
were: 8- pentadecene -2- one, bornyl acetate, caryophyllene
oxide, humuladienone, mono- and sesquiterpene hydrocarbons,
oxygenated compounds, palmitic acid, and ketoalkenes as already
found in the root oil (1).

The main constituents of the E. purpurea leaf oil were: germa-
crene D, nerolidol, caryophyllene oxide, humuladienone,
palmitic acid and small amounts of the ketoalkenes.

The identification of the constituents of E. angustifolia leaf
oil will also be presented.

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(No.4)

VOLATILE COMPONENTS OF *Trochiscanthes nodiflora* (Vill.) KochR. Bos¹, F.C. Fischer² and M.J.M. Gijbels³

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Trochiscanthes nodiflora (Vill.) Koch (*Ligusticum nodiflorum* Vill.)

is an Umbelliferous plant endemic in the French Alps, Italy (South Tirol, Apennines) and a small part of Switzerland (Rhone valley). It grows in beech, sweet chestnut and larch woods on hills and lower parts of mountains. As far as we know nothing has been published on components of the plant. Its systematic position in the Umbelliferae makes it a candidate for containing phthalides (M.J.M. Gijbels, Ph.D. Thesis, Leiden (Netherlands) 1983). We found one reference to the use of *T. nodiflora*, which pointed also to the possible presence of phthalides: Dragendorff mentions its use as emmenagogum and carminativum.

Plants were collected in the French Alps, in the neighbourhood of Gap. Roots, leaves and fruits were extracted with n-pentane, extracts were investigated with GC-MS. Results:

- (Z)-ligustilide comprised 90% of the volatile compounds from the roots; small amounts of (E)-ligustilide, (Z)-butylidenephthalide, palmitic acid and some other fatty acids were present. Traces were found of myrcene, α -phellandrene, p-cymene, limonene, cis- β -ocimene, γ -terpinene, δ -elemene, β -elemene, germacrene-D, β -selinene, γ -elemene, tr. α -bergamottene, β -bisabolene, ψ -cadinene, T-cadinol and some straight-chain aliphatic compounds.

The essential oil of Dutch Tansy(Tanacetum vulgare L.)

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An investigation of the composition of the essential oil of tansy(Tanacetum vulgare L.) occurring in Finland revealed different chemotypes(1).


The first results of a GC-MS study on the essential oils, distilled from 14 different tansy populations, naturally occurring in the Netherlands, also show considerable qualitative differences in the composition of the oils.

Because the composition of the essential oil of individual plants has not been investigated until now, it is not possible to categorize our samples in "well defined" chemotypes. Two samples, however, contained more than 60% of artemisia ketone and in a number of other samples the presence of a relatively high amount of chrysanthenyl acetate(up to 40%) could be demonstrated.

All samples contained β -caryophyllene, germacrene-D and bicycloelemene in minor quantities(< 10%).

Vulgarone A and B were found in five samples in nearly equal amounts, whereas the essential oil of the separated flower heads of the same plants contained a relatively high amount of vulgarone B(up to 17.5%) and vulgarone A in trace amounts only.

The sesquiterpene diketone cis-longipinane-2,7-dione also found in Bulgarian tansy(2) could be detected in only two samples.

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- The main component in leaves is tr. α -bergamottene, with smaller amounts of myrcene, β -caryophyllene, tr. β -farnesene, germacrene-D and some high boiling aliphatic compounds. Phthalides were present in trace amounts.
- β -Pinene is the main component in the fruits, followed by (Z)-ligustilide and β -bisabolene. Trace amounts were found of α -pinene, myrcene, p-cymene, limonene, γ -terpinene, β -caryophyllene, β -humulene, tr. β -farnesene, germacrene-D, β -selinene, tr. α -bergamottene, another farnesene, (E)-ligustilide and palmitic acid.

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THE ESSENTIAL ROOT OILS OF SELECTED PEUCEDANUM SPECIES.

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In course of our chemosystematic investigations of volatiles within the apiaceae plant family 5 European Peucedanum species have been investigated by means of capillary gas chromatography and spectroscopic methods. The essential root oils of *Peucedanum officinale* L. and *Peucedanum cervaria* (L.) Lapeyr. are characterized by a high percentage of monoterpene hydrocarbons (93.1 and 98.1%, respectively). The main constituent in *P.officinale* is limonene (89.5%) while it is α -pinene (89.6%) in *P.cervaria*.

In contrast to these two oils the essential root oils of *P.austriacum* (Jacq.) Koch and *P. verticillare* (L.) Koch ex DC., which have a rather similar make up, contain only traces of monoterpene hydrocarbons. They consist predominantly of C-13 polyacetylenes (78.6% and 74.4%, resp.). Main constituent of this type of components is aethusin with about 50%. In addition, lower amounts of isomyristicin have been detected (7.7% and 1.1%).

The essential root oil of *P.oreoselinum* (L.) Moench differs from the above mentioned oils by the occurrence of several sesquiterpene hydrocarbons. Furthermore, numerous ubiquitous monoterpene hydrocarbons (total 58%) and the phenylpropanoids myristicin and isomyristicin (5.3%) have been found.

THE ESSENTIAL OIL OF CHAEROPHYLLUM HIRSUTUM L. (APIACEAE)

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The *Chaerophyllum hirsutum* group is a complex and heterogeneous taxonomic aggregate which is difficult to delimitate and subdivide by conventional morphological characters. However, chemical constituents of these plants may be of taxonomic value, thus we studied the volatile oils of plants belonging to the *Chaerophyllum* genus. This report deals with the essential oil composition of different parts of *Ch.hirsutum* L., which is one of the three species of the *Ch. hirsutum* group according to the *Flora Europaea*.

Ch.hirsutum is a perennial plant growing at wet meadows, swampy places and along brooks in mountainous regions of South and Middle Europe. The essential oils of the fresh roots, herbs and fruits of *Ch. hirsutum*, collected from the Rhön mountains near Wildflecken (FRG) were analyzed by chromatographic (LC,HRGC) and spectroscopic (IR,MS,1H-,13C-NMR) methods.

Main constituents of all volatile oils are terpenoids with common monoterpene hydrocarbons dominating (up to 90% in the roots). Concerning these monoterpenes the composition of the oils from different plant parts is very similar, however, considerable differences can be observed with regard to the proportion of particular components.

Major monoterpenes of the fruit oil are β -pinene ($\approx 20\%$), γ -terpinene ($\approx 20\%$), besides myrcene, α -pinene and sabinene (each about 5 to 7%) whereas the herb oil is dominated by high amounts of sabinene (up to 50%). Main constituents of the root oil are β -pinene ($\approx 25\%$), α -pinene ($\approx 13\%$), β -phellandrene ($\approx 18\%$) and α -phellandrene ($\approx 15\%$). In addition, smaller amounts of sesquiterpene hydrocarbons (up to 6% in fruits and roots and 28% in the herb) could also be detected in all essential oils investigated. Furthermore, some oxygenated members of these compound classes occur in these oils. In particular, the fruit oil contains appreciable quantities of monoterpene esters, e.g. fenchyl acetate (about 10%), and sesquiterpenoids like acorenone ($\approx 5\%$).

Investigations of the essential oils of several *Ch.hirsutum* plants from different locations in Middle Europe showed, that two chemotypes exist, which can be distinguished by means of differences in their essential oil compositions.

THE ESSENTIAL OIL OF DIFFERENT PARTS OF PARSLEY (PETROSELINUM CRISPUM)

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Parsley is a biennial plant, which is native to the mediterranean region and cultivated in temperate countries throughout the world. Its herb is widely used as a condiment, whereas the fruits and roots mainly are used in medicine as diuretic drugs. Among other things, this is due to the different oil content and oil composition in the individual parts of the plant. We have, therefore, investigated the essential oils of the herb, the fruits and above all of the roots, whose make up is scarcely known.

The essential root oil of leaved parsley affords 28% terpinolene, 26% apiole and 25% myristicin, besides 12.3% of ubiquitous monoterpene hydrocarbons and lower concentrations of different sesquiterpenes. In comparison with the root oil composition of turnip-rooted parsley (content of terpinolene \leq 0.5%), the significantly higher percentage of terpinolene is noticeable.

The herb oil is characterized by the occurrence of p-mentha-1,3,8-triene (13%) and p-cymene (4%), besides several monoterpene hydrocarbons (40%) such as β -phellandrene, myrcene, terpinolene, limonene etc. The amount of phenylpropanoids is very variable in the investigated samples ranging from 0.1 to 22% in the case of myristicin and from 0 to 9% for apiole, respectively.

The major constituents of the fruit oil are phenylpropanoids. However, the individual composition of this type of compounds exhibits an infraspecific variability which can be attributed to 3 chemotypes (1). The fruit oil of the investigated leaved parsley contains higher amounts of 1,2,3,4-tetra-methoxy-5-(2-propenyl)-benzene (14.6%), myristicin (35.2%) and apiole (29.5%), besides 5.3% elemicin and lesser proportions of several monoterpene hydrocarbons (total 14%).

Comparison of the fruit oils from leaved, curled and turnip-rooted parsley exhibited no correlation between the individual oil compositions and the different types of parsley.

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ANTIBACTERIAL AND ANTIFUNGAL ACTIVITIES OF CARAWAY OIL

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Caraway is a crop of some economic importance in the north-eastern part of The Netherlands. The essential oil isolated from caraway fruits is highly appreciated and widely used as flavouring agent. Because of a growing interest to extend the use of this oil, we studied whether the oil possessed anti-microbial activities.

Maximum inhibitory dilution (MID) values were determined for a number of bacteria and fungi. Special attention was paid to the possible application of the oil to retard the growth of fungi on the surface of cheese. The oil showed some activity in the experiments concerned.

Although caraway oil was not very active against a sterigmatocystin-producing strain of Aspergillus versicolor - a fungus occurring on cheese- it inhibited the formation of the mycotoxin that is known to be carcinogenic after activation by liver cells.

Results of some experiments on the conversions of (-)-carvone and (+)-carvone by some micro-organisms will also be presented. A certain degree of stereospecificity was observed in these conversions.

ANALYSIS OF THE ESSENTIAL OIL FROM TWIGS OF HEMIZYGIA
WELWITSCHII (LAMIACEAE)

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Twigs of Hemizygia welwitschii (Rolfe) M. Ashby are used in
Nigeria in baths and in decoctions for treatment of skin
diseases. Reports on biological activities or chemical con-
stituents of H. welwitschii and H. bracteosa (Benth.) Briq. -
the two species of the genus which have been described to
occur in West Tropical Africa- could not be found.

Twigs of H. welwitschii growing wild at the Campus of the
University at Ile-Ife (Nigeria) were collected in August
1987. Samples of the plant material were subjected to hydro-
distillation and to distillation-extraction respectively.
The essential oils were analysed by GLC using capillary
columns of different polarities, and by GC-MS. Due to the
complexity of the oils, LSC over silica gel using disposable
solid phase extraction columns was also applied.

Leaving diterpenes (30-40% of the total oil) out of consider-
ation, the oils consisted mainly of sesquiterpene hydrocar-
bons, β -caryophyllene (35%) being the major one, oxygen-
containing sesquiterpenes (19%) and monoterpene hydrocarbons
(17%).

THE ESSENTIAL OIL OF MATRICARIA RECUTITA GROWN
OF LARGE SCALE IN HUNGARY

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German chamomile is the most important medicinal and essential oil plant in Hungary. It is cultivated on more hundred hectars in our cooperative. The essential oil production is significant. In sake of producing the best quality we examine regularly the essential oil composition of the same and also of the different varieties of *Matricaria recutita* cultivated on varies sites.

In this paper we report the technology of large scale production and essential oil extraction, besides the composition of some german chamomile oils.

Quantitative Genetical Aspects of
Chamomilla recutita (L.) Rauschert

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From earlier experiments it was known that the yield characters of camomile are fairly influenced by the environment whilst the qualitative composition of the essential oil depends on few genes only (1,2).

In order to evaluate additionally the quantitative genetical parts of the essential oil and its main compounds, crossing progenies of 10 different parent plants were investigated beyond several environmental conditions. In that manner we were able to estimate the heritability of the characteristics, i.e. the genetical part of the total phenotypical variance. The heritability values ranged from 72% for the essent. oil content in the flower drug up to 85% for the content of pro-chamazulene and (-)- α -bisabolol (in mg/100g dry flowers). As to the high heritability coefficients of the essential oil compounds progress in breeding of high value cultivars may be expected.

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Comparison of the Volatile Composition
of Two Varieties of *Salvia aucheri* Bentham

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Salvia aucheri Bentham var. *aucheri* and *Salvia aucheri* Bentham var. *canescens* Boiss. & Heldr. are two endemic plants growing in southern Anatolia (1). Both plants are used as popular medicine in this region. The aim of the present study was to compare the volatile composition of two varieties of *S.aucheri*.

The flowering parts of the plants were subjected to hydrodistillation. And the obtained oils were investigated by means of LSC and GLC (2).

The oil content of the samples was 0.61 % (*S.aucheri* var. *aucheri*) and 1.00 % (*S.aucheri* var. *canescens*). The essential oils of both varieties showed a similar composition of their monoterpene hydrocarbons with α -pinene, camphene and β -pinene as the main constituents.

The GLC analysis of oxygen-containing compound fraction of the oil of *S.aucheri* var. *aucheri* showed that the composition of this fraction differed generally in a quantitative regard from that of the *S.aucheri* var. *canescens*. But, the fraction of the first variety contained a sesquiterpene compound in addition.

Further results will be given during the presentation.

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COMPOSITION OF THE VOLATILE OIL OF DRAGONHEAD (DRACOCEPHALUM MOLDAVICA)

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Dragonhead, Dracocephalum moldavica L., is an annual, volatile oil containing plant native to south Siberia and the Himalaya area. It contains 0.1 to 0.9 % volatile oil, which mainly consists of geranial, neral, geranyl acetate and geraniol. In the present study the composition of dragonhead oil was studied in more detail by capillary gas chromatography-mass spectrometry. The oil was isolated by hydrodistillation, dried and stored at 6°C until analysed. In preliminary gas chromatographic analyses the oil was found to contain only traces of monoterpene hydrocarbons and was therefore separated in a polar and non polar fraction using a SEP-PAK silica cartridge (Waters Ass., USA). The non polar fraction was analysed by GC-MS using the selected-ion-monitoring method (SIM) and 9 monoterpene hydrocarbons were detected accounting for 0.2 % of the oil. Altogether 58 compounds in dragonhead oil were identified by GC-MS analyses. The identification was based on mass spectra of reference substances, and published mass spectra, as well as gas chromatographic retention indices obtained on two phases of different polarity (OV-351 and OV-101). Ten compounds, which could not be identified, were also detected. Of these compounds five were oxygenated monoterpenes, two oxygenated sesquiterpenes, one hydrocarbon and two completely unidentified.

**THE EFFECT OF SOME AGROTECHNICAL FACTORS ON THE HERB YIELD AND
VOLATILE OIL OF DRAGOCEPHALUM MOLDAVICA**

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Dragonhead (*Dragocephalum moldavica* L.) is an annual, volatile oil containing plant originating from south Siberia and the Himalaya area. It has a flavour quite similar to that of lemon balm (*Melissa officinalis* L.), which comes from the Mediterranean region and requires a warm climate. Lemon balm is not suitable for cultivation under Finnish conditions and dragonhead has been studied in Puumala, Finland during the years 1984 - 1987. The effect of different sowing and planting times, the effect of mulching of the soil and the effect of fertilization on the herb yield and volatile oil was studied. The propagation time did not have any effect on the herb yield, but the sowed plants gave a yield twice as high as the yield obtained by planting. Mulching of the soil did not improve the herb yield, which was expected because dragonhead is adapted to a cold climate. Nitrogen fertilization increased the yield. None of these treatments had any effect on the content or composition of the volatile oil. The variation in the volatile oil content was followed during the vegetation period as well as the plant weight. The volatile oil content reaches its maximum at the flowering stage, while the plant weight increases until the post flowering stage. Thus the optimum harvest time is during the budding and flowering stage.

Effect of PK-fertilization on the content and composition of
volatile oil in dill seeds (*Anethum graveolens* L.)

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The nutrient element demand of dill plants, as well as the relationship between nutrient supply and the amount and composition of volatile oil in dill seeds were studied in a long-term small-plot experiment. The experiment was set up on a calcareous chernozem soil supplied to a medium degree with available P and K. In the experiment the single plots received increasing P and K fertilizer doses and equal N-fertilizer doses.

The results can be summarized as follows:

The N-fertilizer - without PK-fertilization - did not affect the amount of volatile oil in seeds, but the composition of the oil was changed by it: the ratio of D-limonen rose from 32% to 43%, while the one of D-carvon diminished from 63% to 44%.

The volatile oil content of the seeds increased from 1,7% to 2,7% as a result of the higher P-doses. K-fertilization had no effect on the amount of volatile oil.

The composition of the volatile oil was significantly influenced by the higher P and K doses: the ratio of D-limonen in the oil decreased from 43% to 28-34%, while that of D-carvon increased from 44% to 53-57%.

In our paper we briefly deal with the influence of PK-fertilization on the seed-, volatile oil-, D-limonen-, and D-carvon-yields, as well.

GAS CHROMATOGRAPHIC CHARACTERIZATION OF FREQUENTLY
OCCURRING AROMATIC COMPOUNDS IN ESSENTIAL OILS

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As part of our continuous work reporting the mono- and sesquiterpenes /1, 2/ in this paper we give a collection prepared from the relative retention factors of aromatic compounds frequently occurring in essential oils of plants.

Our aim was to facilitate the identification of these common phenyl propane derivatives in essential oils and the selection of a suitable stationary phase for their analysis.

We built different standard series consisted of 15-20 components prepared from 25 aromatic compounds and we investigated the separation of their components on two stationary phases of two different polarity /OV-17 and Sp-2250+ Sp-2401/. We determined the retention factors related to selected "reference standards" and for assuring of reproducibility we established the factors of "reference standards" referred to n-alkane series, too.

To examine the reliability of our collection, the data of aromatic standard series were compared with those of the corresponding aromatic components of different essential oils - such as fennel, clove, pimenta, parsley, propolis, cinnamon, serpylli, thyme oils and some Hungarian spice mixtures: Salad, White meat, Game, Bouillon and Fruit - examined under identical conditions. The retention data obtained showed fair agreement.

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EXAMINATION OF FLAVOUR COMPOSITIONS WITH
NIR TECHNIQUE

/G. Tabajdi, F. Kulcsár, Á. Háger-Veress/

The NIR technique is a rapid non-destructive method, which was applied to examination of many food components successfully. In this work the NIR spectrums were used for testing of different flavour compositions.

The composition of standard samples was changed slightly, as if it were the error of the production. All samples and standards were evaluated with visual and mathematical methods. The result of NIR technique were compared to that of organoleptic test. The NIR method was considered suitable for detection slight differences in the composition of lever.

NIR= Near Infra Red

STUDY ON DIFFERENT EXTRACTION METHODS OF AROMATIC COMPOUNDS OF CELERY SEEDS**Jian Quin CU, Francis PERINEAU, Michel DELMAS, Antoine GASET****Laboratoire de Chimie des Agroressources, Ecole Nationale Supérieure de Chimie (INPT)****118 route de Narbonne 31077 TOULOUSE Cédex - FRANCE**

A dry raw material of celery (*Apium graveolens* L.) seed is extracted by different solvents such as ethanol, dichloromethane and 1.1.2 trichloro 1.2.2 trifluoroethane (Forane 113 R).

The procedure is as follows. First, the celery seed is extracted by one of these solvents, then the concrete obtained is subjected to steam distillation in order to separate volatil and non volatil compounds. Yields obtained by extraction are better than those obtained by steam distillation, both for concretes and for essential oils.

In order to analyse these essential oils, first it is necessary for good identification to separate some major compounds such as limonene. So, total oil was separated by silica gel column chromatography. Each fraction obtained by eluting with petroleum ether, hexane, and ether respectively, was subjected to analysis by GC/FTIR and GC/MS.

Results show that this processing of extraction is better in both yield and quality of the essential oil of celery seed compared to traditional hydrodistillation.

DIRECT CAPTURE OF VOLATILES EMITTED FROM ENTIRE BLACK PERIGORD TRUFFLES.

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Black Perigord Truffles (*Tuber Melanosporum*) are underground mushrooms that grow in symbiosis with certain trees, especially oaks. One finds them in several regions of Europe, particularly in Spain, Italy and France. Black Truffles are very much appreciated by gourmets for its typical aroma. A dynamic headspace procedure is developed for isolating volatiles from freshly unburied entire Black Perigord Truffles. The method used a modified gas chromatographic device D.C.I. System (Desorption - Concentration - GC Introduction), based on flushing with an inert gas a glass flask containing an entire truffle, a cryogenic adsorption of the volatiles on a Tenax GC trap followed by a thermal desorption. The analysis is carried out by combined D.C.I. System - capillary gas chromatography - mass spectrometry. The contribution of the major identified compounds to the final aroma impression is evaluated. The formulation of a Nature-Identical aromatizer is discussed.

THE CHEMICAL COMPOSITION STUDIES OF THE ESSENTIAL OIL
IN *Amomum villosum* Lour. LEAVES IN YUNNAN PROVINCE

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Four fractions were obtained by rectification of the essential oil of *Amomum villosum* Lour leaves in Yunnan province. Every fraction was respectively subjected to GC/MS and GC/FTIR analysis. Through rectification, some components unidentified before being fractionated are identified positively. A total of twenty-nine components were identified in the essential oil. Major components are α -pinene, β -pinene etc.

"ESSENTIAL OIL OF SIDERITIS REVERCHONII"

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Following our work on essential oils of Iberian South-eastern Labiatae endemisms we have now studied the volatile constituents of Sideritis reverchonii Willk. collected near Málaga.

Its air-dried aerial parts yielded by hydrodistillation a 0.40% (v/w) of essential oil. It was analyzed by GC and GC-MS using capillary columns of two different stationary phases: carbowax 20M and methyl-silicone SE-30. The identification of the constituents was performed on the basis of their retention indices and MS, comparing with literature data and authentic samples.

The results obtained in the quantitative analysis show that the main components are δ -cadinene, sabinene, α -bisabolol, α -pinene, 1,8-cineol, limonene and carvacrol.

VERBENONE IN SPANISH ROSEMARY OIL

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Verbenone is a characteristic constituent of rosemary oil. Its concentration varies a lot, depending especially on the geographic origin of the plant and the conditions of the extraction.

Therefore rosemary leaves (whole and milled) from Andalucía were hydrodistilled with recycling of the water. The monoterpenoids of the oil were studied quantitatively, with emphasis on the verbenone content.

Spanish rosemary oil from Andalucía, especially if prepared from milled leaves, contains more verbenone (6.2%) than published up to now (2-3%)¹.

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Glycosidic Bound Volatiles in Hyssopus officinalis, Rosmarinus officinalis, and Origanum vulgare

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It has been shown that monoterpene glycosides evidently are involved in formation, transport, and accumulation of essential oils in plants (1, 2). Now three further species of the Lamiaceae family have been investigated in detail concerning the composition of their glycosidic fractions. In each species 15 to 20 different compounds could be detected and identified by means of GC and GC-MS after enzymatic hydrolysis of the glycosides using β -glucosidase and Pectinol C.

It was conspicuous that some of the identified compounds could be found in all three of the species, namely 3-octanol, linalol, α -terpineol, nerol, geraniol, benzyl alcohol, phenylethyl alcohol, and β -ionone. Eugenol, o-vanillin, trans-hexen-1-ol, and cis-nerolidol were to detect in H. officinalis and R. officinalis.

Moreover, every species had its characteristic "fingerprint" meaning that further compounds were found, whose skeletons showed a connection to main components of the essential oils, e.g. myrtenol and verbenol in H. officinalis, terpinen-4-ol and borneol in R. officinalis, and carvacrol in O. vulgare.

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* Part of the thesis of G.S.

WILD ORIGANUM GROWING IN PORTUGAL - CHEMICAL COMPOSITION OF ITS ESSENTIAL OIL.

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There is some oils commonly named origanum oils in the international trade which are from the thymus species, generally rich in phenols.

The Origanum vulgare L., widely spread in the wet fields and calcareous lands of portugal, is an aromatic, spicy herb, frequently applied as condiment.

We have distilled these plants from May to July in a modified clevenger-type apparatus, and in a field still.

The ultrastructure and development of the oil secretores glands were observed.

The essential oil obtained was studied by classical and chromatographic methods, mainly G.L.C. More than 25 compounds were identified and the chromatogrammes are shown.

The essential oil contains mainly mono and sesquiterpen hydrocarbons, linalol, and weak quantities of phenols (about 25%).

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CHEMICAL COMPOSITION OF AN ALCOHOLIC EXTRACT AND THE ESSENTIAL OIL OF JUNIPERUS COMMUNIS L. VAR. NANA

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The chemical composition of essential oil of Juniper berry (*Juniperus communis* L. var. *nana*) of Portugal (Serra da Estrela) and an aroma prepared by percolating with an alcohol-water mixture (50/50) from Juniper berry was investigated by means of gas chromatography.

The qualitative composition of the essential oil and the alcoholic extract are most similar. Both of them are constituted by high percentages of hydrocarbons (monoterpenes and sesquiterpenes); the main components were α -pinene, myrcene, limonene, β -caryophyllene, α -humulene and germacrene-D. In relation to oxygenated compounds, the terpineol-4 is the most abundant component. In the alcoholic extract there are one enrichment of the sesquiterpenes compounds.

The volatile fraction of the ornamental tree Chamaecyparis pisifera (S. and Z.) Endl cv Filifera. Identification of the character impact compound.

H.L. De Pooter, J.R. Vermeesch, L.A. De Buyck and N.M. Schamp

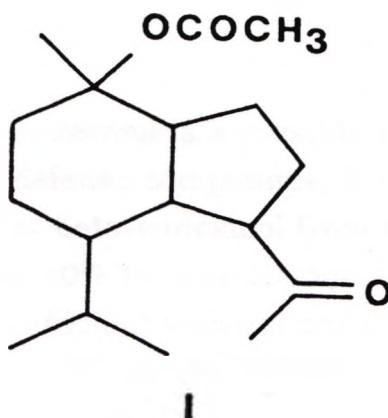
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The ornamental trees Chamaecyparis pisifera cv Filifera (Cupressaceae), originating from Japan, are extensively grown in gardens as wind-breakers or as tall hedges. On trimming and crushing of the leaves and fruitlets, a characteristic, sour, green, resinous odour is evolved.

The essential oil, prepared by exhaustive treatment of leaves, fruitlets and twigs with dry steam, was composed mainly of limonene, which may account for the sour note of the aroma. After distillation, the substance which is responsible for the characteristic smell of the plant material was isolated from the residue. It was identified by ^1H , ^{13}C -NMR and mass spectrometry as 2-acetoxy-7-acetyl-2-methyl-5-(methylethyl)-bicyclo[4.3.0]nonane (I).



INVESTIGATION OF THE ESSENTIAL OIL OF *AMYRIS BALSAMIFERA*

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The essential oil of *Amyris balsamifera* has been investigated once before. Then six compounds were identified, five of which were sesquiterpene alcohols.

In connection with the preparative isolation of β -eudesmol (10% of oil) from *Amyris* oil (see other poster) we have reinvestigated the essential oil.

With GC and GC-MS 48 major and minor components, all sesquiterpenes, could be distinguished. The hydrocarbons constituted ca. 25% of the oil. Major hydrocarbons were α -zingiberene, β -sesquiphellandrene, *ar*-curcumene and an unknown one, the structure elucidation of which is still in progress.

All the major sesquiterpene alcohols were obtained in pure form after fractional vacuum distillation and repeated normal and reversed phase MPLC. The structures were identified by GC-MS, $^1\text{H-NMR}$ and $^{13}\text{C-NMR}$.

In order of increasing retention time on carbowax they were: elemol, 10-epi- γ -eudesmol, γ -eudesmol, valerianol, α -eudesmol, 7-epi- α -eudesmol and β -eudesmol.

Valerianol was the main component. 7-Epi- α -eudesmol has been synthesized before but has never been isolated from a plant. Several other rare C15 compounds were identified as minor components.

AMYRIS BALSAMIFERA OIL AS A SOURCE OF BETA-EUDES MOL

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Optically pure (+)-beta-eudesmol is a possible starting material for the synthesis of several termite defense compounds. A two step procedure for isolation of gram quantities of beta-eudesmol from commercially available *Amyris balsamifera* (contains 10% beta-eudesmol) oil was developed.

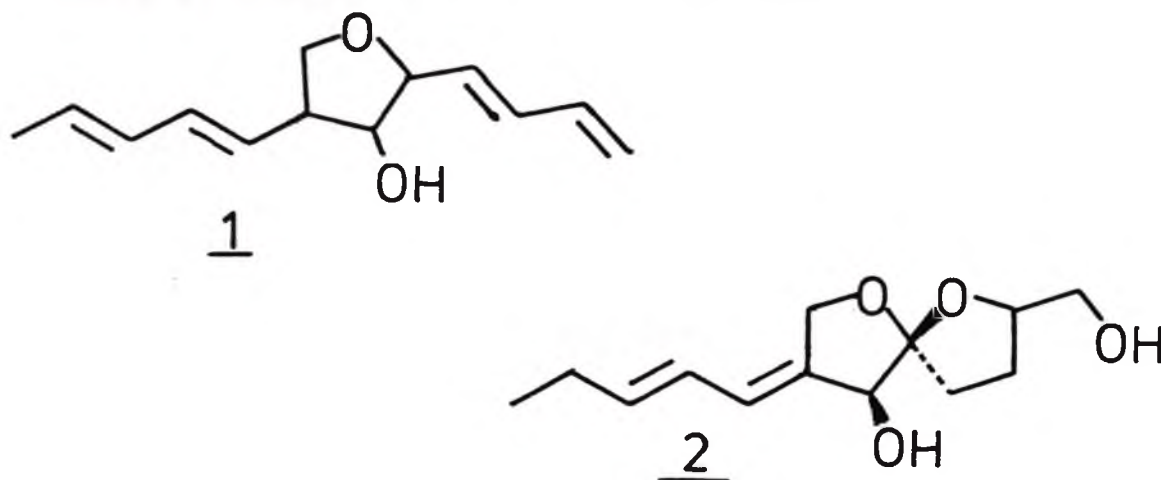
Step one consisted of an efficient vacuum distillation of the total oil. Step two was an MPLC separation with silicagel/AgNO₃ stationary phase. Many other procedures failed due to the presence of many closely related sesquiterpene alcohols (ca. 75% of the oil).

UNUSUAL REARRANGED TETRAHYDROFURANS FROM CHAETOMIUM COCHLIOIDES

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From the fungi *Chaetomium cochlioides* DSM 63353 and
Chaetomium coarctatum ATCC 14530 we isolated the metabolite 1.



Extensive NOE studies were only in agreement with a syn configuration of the carbon chains and a trans configuration of the hydroxy group at the ether ring. The same substance was found in 1967 by Burrows in *Chaetomium coarctatum* and Mason and Vane determined the configuration of the side chains to be anti.

In 1979 Bohlmann and Ziesche isolated the same compound from the plant *Helichrysum aureo-nitens* and named it aureonitol. In contrast to Mason and Vane and also in contrast to our results they concluded from ¹H NMR data that the relative configuration of this substance is all cis.

In addition we isolated the spiro-ketal 2 biogenetically related to 1 from *Chaetomium cochlioides* in low yields.

DETERIORATION OF CONCENTRATED ORANGE OILS
SUBJECTED TO AGING EXPERIMENTS

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Abstract not available

CHEMOTAXONOMIC STUDIES ON THE *Lamiaceae* FAMILY

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Abstract not available

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