



**TOGETHER**  
*for a sustainable future*

## OCCASION

This publication has been made available to the public on the occasion of the 50<sup>th</sup> anniversary of the United Nations Industrial Development Organisation.



**TOGETHER**  
*for a sustainable future*

## DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as “developed”, “industrialized” and “developing” are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

## FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

## CONTACT

Please contact [publications@unido.org](mailto:publications@unido.org) for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at [www.unido.org](http://www.unido.org)

RESTRICTED

DP/ID/SER.A/943  
28 December 1987  
English

16591

PRODUCTION OF PHARMACEUTICALS FROM  
MEDICINAL AND AROMATIC PLANTS

DP/TUR/83/003

TURKEY

Technical report: Essential analysis and quality control;  
essential oils and plant extracts\*

Prepared for the Government of Turkey  
by the United Nations Industrial Development Organization,  
acting as executing agency for the United Nations Development Programme

Based on the work of Mr. Jan Karlssen,  
phytochemist/quality control chemist

Backstopping officer: R.O.B. Wijesekera, Chemical Industries Branch

United Nations Industrial Development Organization  
Vienna

---

\* This document has been reproduced without formal editing.

Report

- I Conclusion/Summary.
- II Recommendations.
- III Job description.
- IV Body of the report.
  - 1. General status of the laboratory
  - 2. Analytical equipment
  - 3. Training of the employees
  - 4. Projects and action taken
- V References
- VI Appendices
  - 1. Persons contacted
  - 2. Plant species that can be obtained from Izmir
  - 3. Companies involved in the research center activity
  - 4. Employees of TBAM, Eskişehir
  - 5. On-going projects of TBAM, Eskişehir July 1997
  - 6. Necessary journals for daily consultance
  - 7. Liquidambar orientalis
  - 8. Procedure for the analysis of an essential oil
  - 9. Different chromatograms of Products/fraction =  
produced at TBAM, Eskişehir

## I. Summary

The basis of this report is concerned with the aspects of the instrumental equipment, installation and maintenance, training of personnel, to bring the TBAM (Tibbi Bitkiler Arastirma Merkezi) up to the standards of a modern research laboratory. Secondly a working program consisting of defined projects for the coming year was considered of great importance since this will influence the training and experience gained by the personnel.

The situation in Turkey is favourable for the establishment of a research laboratory like TBAM in connection with the University of Anatolia. However, standard methods for the control of the products must be established and applied. This is especially important for perfumer industry raw materials like essential oils. The export value of raw materials will increase if quality certificates are accompanying the products. I therefore regarded this as an important aspect to stress in the training.

The evaluation of indigenous plant material and products thereof as industrial raw materials is a lengthy process. From the analytical chemists point of view it is therefore the field of quality control/quality assesment which requires most time to acknowledge.

One of the main obstacles for future projects is the establishment of a "library" of industrial standards. For the future marketing of essential oils, aroma products or "cuts" of essential oil, samples for comparison are needed. It should be realized that such samples may not be commercially available and that the procurement of suitable samples may take some time.

This mission was approved as a split mission which proved very successful from the experts point of view. It provided me with the possibility of entering into the planning of the laboratory at an early stage, giving instructions and recommendations (part I), and finally following the completion of the laboratory facilities, recruiting of personnel and installation of equipment (part II).

This gave me a sound background for the initial training of personnel . As the background of recruited personnel is varied and they are young people (preparing for their final university examinations) one must expect that necessary experience in practical analysis will only be gained after several years. However, the energy and enthusiasm they show in their daily work will ensure that the laboratory, even at this premature stage, can provide quality reports. Regular guidance is, however, necessary. It is my opinion that this laboratory has now almost reached a stage where it can function as a selfsupporting unit. Regarding the analytical equipment, some extra instrumentation units are necessary, but more important is that the training of the staff is to be emphasized in the next stage.

II. Recommendations.

1. The Medicinal Plant Research Center (TBAM) of the University of Anatolia has started out well but will need further support to get all the way to international standard.
2. The library is inadequate and needs further strengthening both in books and journals. Several standard textbooks of chromatography is lacking.
3. The laboratory badly needs industrial standards of essential oils. These can also be bought from chemical companies. It is realized that this may take some time to procure. In the meantime some of the most important terpenes should be run as standards.  
More training for the local staff in the use of English
4. is necessary.
5. Top priority for new equipment should be another HPLC with fluorescens detector, and a fluorimeter.
6. The standards, kept at low temperature in the refrigerator, must be controlled regularly.
7. Regular technical reports should be made by means of the IBM PC AT to familiarize the staff with the use of word processing and English.
8. It is highly recommended that 40 - 50 essential oils of Turkey be analyzed by standard methods for their content of main constituents.
9. The above-mentioned results should be published as a product of TBAM for the benefit of potential customers of Turkish essential oils.
10. The making of a brochure to market and inform about the activities of the center.

11. Encourage the staff to have regular meetings and discuss their projects.
12. The director needs to have some training in project management. The change from academic life to a research laboratory requires more effective administrative skills. I would therefore strongly recommend a monthly course in project management.

UNITED NATIONS



UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION  
UNIDO

III. PROJECT IN THE REPUBLIC OF TURKEY

**JOB DESCRIPTION**

DP/TUR/83/003/11-02/32.1.D

INTERNAL

**Post title** Phytochemist/Quality Control Analyst

**Duration** Five months split mission (2 m + 1 m - 2m)

**Date required** March 1987

**Duty station** Eskisehir

**Purpose of project** To develop the industrial utilization of medicinal and aromatic plant resources for the production of pharmaceuticals.

**Duties** The expert will be expected to work in the Medicinal Plants Research Centre, University of Anatolia, and guide and assist the Director and his staff in the analytical quality assessment of plant-derived pharmaceuticals and essential oils. The expert will specifically be required to:

1. Develop rapid phytochemical screening methods based on instrumental analytical techniques such as gas liquid chromatography, high performance liquid chromatography and spectroscopic techniques;
2. Develop methods of quality assessment based on the above, for plant-derived products;
3. Develop methods for the analytical assessment of local essential oils;
4. Train local staff in the methods and practice of instrumental analysis, as applied to plant, natural products.

The expert will also be expected to prepare a final report, setting out the findings of the mission and recommendations to the Government on further action which might be taken. ....

---

Applications and communications regarding this Job Description should be sent to:  
Project Personnel Recruitment Section, Industrial Operations Division  
UNIDO, VIENNA INTERNATIONAL CENTRE, P.O. Box 300, Vienna, Austria



#### IV General status of the laboratory.

The laboratory building was completed in 1986, but small amendments has been carried out until the writing of this report (sept)1987). Laboratory furniture (writing desks, carpets etc.) has been installed lately. Blackboards in the laboratories are still missing, but will come in the near future. Facilities like water and electricity is functioning well with only 2 short cut-offs during my last stay.

Water pressure may give some delay when rotating evaporators are being used for the concentration of water extracts. The dust problem will become less irritant when a lawn has been made all around the laboratory - not only at the front. The construction of the building has been lucky and the temperature can be maintained within reasonable limits as well in the summer as in the winter. This ensures proper functioning of the analytical equipments. A vacuum-cleaner is being used regularly and the instrumental rooms are maintained well. So far I can see there are no malfunctioning of the laboratory.

#### Analytical equipment.

In the first part of my mission I was able to make small amendments to the list of equipment, but the purchase of instruments has been done mainly according to a previous list with no interfering by me. Consequently there are some changes which has to be made and additional equipment to be bought when the "real" need of analytical laboratory is known. In general the equipment purchased will allow the personell, when more training and experience has been gained, to perform quality control analysis which meet international standards. The equipment has been installed and put to work on the ongoing projects of TBAM. Some results are shown in the appendix. Direct analysis on equipments like spectrophotometers, optical rotation, refractive index instruments give few problems. Proper usage and experience with the gas chromatograph and liquid chromatograph requires more skill and training. I found it necessary to concentrate my training on these equipments. Likewise thin layer chromatographic densito-

metry is also a technique that requires skill and experience. Emphasis had therefore to be given to the training on these particular instruments. Initial training were given during my second visit and the results thereof could be controlled during my third visit.

The following equipments has been installed and put to practical use:

1. Gas chromatograph (Shimadzu GC-9A)
2. High performance liquid chromatograph (Shimadzu LC-5A)
3. Infra-red spectrophotometer (Shimadzu IR-435)
4. Ultra-violet spectrophotometer (Shimadzu UV-240)
5. Shimadzu Refractive Index Instrument
6. Automatic optical rotation equipment (Optical activity Ltd. AA-5)
7. Heraeous thermostats
8. High speed thin layer chromatographic scanner (Shimadzu CS 920)
9. Lyovac - freezedryer
10. IBM-PC-AT, computer
11. Hewlett Packard 85B, computer
12. LKB - fraction collector

Some of these equipments still need some extra parts and some new equipments need to be added. My recommendations would be as follows. This is not on priority form:

1. High -pressure Liquid chromatograph including gradient pump, injection system, UV/refractive index/fluorimetric detector, electronic integrator, columns, spares and accessories.
2. HPLC Equipment including applicator, plates, template for densiometric evaluation.
3. Memo titrator with spare parts and accessories
4. Two electronic integrators for chromatographic analysis.
5. IBM PC/printer/turkish word processor for the secretariat of the laboratory.
6. IBM PC/printer/turkish word processor for the library/documentation section.
7. HPLC columns (Silica, -NH<sub>2</sub>) for specific analysis.
8. Spectrofluorimeter

3. Training of the employees.

Most of the employees of the laboratory will get their M.Sc. during 1987. They should then be trained in providing industry with technical reports, and the more fundamental background of quality control.

Regular discussions must be continued. Lack of language skills is still an obstacle for smooth functioning of the laboratory. The fundamentals of chromatography has been provided through daily discussions. According to my experience another year of varied training on the different instruments will do good for their practical experience. A number of projects has been discussed and the practical solving of their analytical problems likewise. Instruments are run on routine basis regarding the on-going projects. The basics of instruments maintenance is also understood and the handling of the instruments between my 2. and 3. visit clearly showed that this part of the training was well absorbed.

The people working in the analytical laboratory now know more about the choice of analytical instrument to solve a specific analytical problem which eventually should lead to better use of the instruments.

The following analysis were discussed and evaluated (These analyses are applied routinely at the time of my leaving Eskicel).

1. General essential oil analysis (GC-column chrom.)
2. Setting up a program for the screening of essential oils for comparison with GC-MS analysis at the University of Oslo
3. HPLC-anal. of Ruscus extracts/ruscogenin
4. TLC - " -
5. HPLC-anal. of Capsicum oleoresin
6. HPLC-anal. of capsaicin
7. TLC-anal. (qual.quant.) of capsaicin
8. HPLC-anal. of Liquorice extracts
9. HPLC-anal. of glycyrrhizin
10. TLC-anal. of  $\beta$ -glycyrrhetic acid
11. TLC-anal. of saponins from Gypsophila spp.
12. TLC-anal. of saponinins - " -
13. TLC-anal. of carotenoids from Capsicum species.
14. HPLC anal. of aescin from Aescitus hippocastaneum
15. TLC-anal. of aescin - " -

4. Projects and actions to be taken

The most important action to be taken during 1987/1988 will be the establishing of regular contact with local industry. There has already been made substantial progress in that direction. I feel, however, that the making of purified solvents for analytical laboratories will be the most easily realizable goal. Establishing good standards and quality of usual solvents should be a natural spin-off of the laboratory. This could also help marketing the services of the TBAM.

Another project concerns the mapping of essential oils of Turkey. By collecting plant material, distilling essential oils, running GC-analyses etc. - and given a GC-MS control by my laboratory in Oslo, a book on the essential oils of Turkey could be realized, in manuscript, by August 1988. This would be a necessary and valuable exercise in systematic analysis. The period 1987-1988 should also be spent in marketing the services of TBAM, establishing the center as an analytical laboratory. This would necessarily lead to the training of the director in project management.

I would also consider the production of an annual report as necessary for the marketing. The laboratory must also establish a board of directors where Turkish, chemical industry is represented.

TBAM has, at the moment, some very interesting plans for industrial cooperation (i.e. rose oil production in Isparta and alkaloid production in ) which I would like to see in normal industrial reports by 1988. TBAM has been established now as a well-equipped laboratory (although more equipment will be needed) that can take on industrial projects of a greater variety. However, regular contacts on the proper use of analytical equipment is necessary and training in basic statistics, technical English and the making of technical reports is necessary. In my view the prospects of the future for the IBAM looks promising. Enthusiasm and energy among the employees is a valuable asset. There are, of course, a constant need for support which ought to be given as a result of formal contacts with local industry. Starting-up and finalizing projects with local industry is very beneficial to the staff of TBAM.

V References

1. A. Tcheknavorian-Asenbauer & R.O.B.Wijesekera  
Medicinal and Aromatic Plants for Industrial Development  
UNIDO/ 10.505 3.June 1982
2. T.Baytop  
Turkiyenin Tibbi ve Seherli Bitkilirli  
Istanbul 1963
3. J.T.Brown  
Long Term Development Chemical Industry  
Turkey, Pharmaceutical Sector  
DP/TUR/79/003/A/01/37/june 1980
4. M.Tanker & N.Tanker  
Farmakognozi  
Ankara 1985
5. J.W.Purseglove, E.G.Brown, C.L. Green & S.R.J. Robbins  
Spices Vol. I  
Longmans London 1981
- 6 N.G. Bisset  
Terminal Report DP/TUR/83/003 10 June 1983
7. K.H.C. Baser  
Unpublished work on Turkish Medicinal Plant Tradition

Appendix 1

Persons contacted

Doc. Dr. Erden Guler  
Eczaclik Teknolojisi Bolumu  
Anadolu Universitesi  
Eskisehir

Pro. Dr. Kemal Husnu Can Baser  
Eczaclik Fakultesi  
Anadolu Universitesi  
Eskisehir

Doc.Dr. Mustafa Kara  
Eczaclik Fakultesi  
Eskisehir

Doc. Dr. Serap Kara  
Eczaclik Fakultesi  
Anadolu Universitesi  
Eskisehir

Prof. Dr. Ekrem Sezik  
Eczaclik Fakultesi  
Hacettepe University  
Ankara

Prof. Dr. Mekin Tanker  
Eczaclik Fakultesi  
Anakara University  
Ankara

Appendix 1.

Prof. Dr. Nevin Tanker  
Eczacilik Fakultesi  
Ankara University  
Ankara

Prof. Dr. Turhan Baytop  
Istanbul University  
Istanbul

Prof. Dr. Kasim Cemal Given  
Istanbul University  
Istanbul

Doc. Dr. Gunay Sariyar  
Istanbul University  
Istanbul

Prof. Dr. Sevil Atasoy  
Council of Forensic Medicine  
Istanbul

Mr. Iskender Efe, director  
Incekaralar Cp.  
I.M.C.1 Block 1425  
Unkapani Istanbul

Mr. Serdar Oztunaoglu  
Incekaralar Cp.  
I.M.C.1 Block 1425  
Unkapani Istanbul

Dr. Hisashi Ishizawa, general manager  
Shimadzu Mid. East Consulting Office  
Cairo

Mr. Hideki Ohnishi  
Shimadzu Mid. East Consulting Office  
Cairo



APPENDIX 2

Plant species that can be obtained from Izmir

1. *Atropa belladonna*
2. *Datura stramonii*
3. *Withania somnifera*
4. *Mentha species*
5. *Salvia officinalis*
6. *Salvia triloba*
7. *Origanum türkesei*
8. *Lavandulae officinalis*
9. *Thymus vulgaris*
10. *Digitalis turkesi*
11. *Pyrethrum cinerarifolium*

Appendix 3

The following companies are involved in the activities of the research center through requesting consultancy:

1. Kurtsa<sup>®</sup> İlaçları A.S. - Istanbul
  - Formulation of Storax soap
  - Evaluation of Storax Balsam
  - Literature survey of skin effects of Storax balsam
2. Koska Helvacisi A.S. - Istanbul
  - Use of Gypsophila saponin as neutral emulsifying agents in helva production.
3. Sistaç A.S. - Istanbul, Siirt
  - Purification, production of Liquourice extract.
  - Production of monoammoniumglycyrrhizinate
4. OT-KOOP A.S. - Pazaryeri, Bilecik
  - Production of Rose oil
5. Gülbirlik A/S - Isparta
  - Evaluation of pilot-plant rose oil distillation
  - Analytical control and issuing of quality control certificate

## Employees at TBAM, Eskişehir

1. Prof.Dr. Kemal Hüsnü Can BAŞER	Pharmacist	Director
2. Doç.Dr. Mustafa KARA	Chemical Engineer	Deputy Director
3. Doç.Dr. Muzaffer TUNCEL	Pharmacist	Analytical Lab.
4. Doç.Dr. Erden GÖLER	Pharmacist	Formulation and Pharmaceutical Technol Lab.
5. Dr. Yusuf ÖZTÖRK	Pharmacist	Pharmacology
6. Dr. Neşe KIRIMER	Pharmacist	Phytochemistry Lab.
7. Mr. Yusuf İ. AKYOL	"	" "
8. Miss. Mine ERSOY	Chemical Engineer	Analytical Lab.
9. Miss. Berrin BOZAN	" "	" "
10. Miss. Samiye FİÇİCİOĞLU	" "	" "
11. Mr. Sedat Hakkı BEİŞ	" "	Pilot plant
12. Mr. Temel ÖZEK	" "	" "
13. Mrs. Aytac BERHAYAT	Pharmacist	Phytochemistry Lab.
14. Miss. Hülya TOMSUK	"	" "
15. Mrs. Mühedde VATANSEVER	Technician	
16. Miss. Beyhan ACAR	"	
17. Mr. Hamdi ÖZKALAY	"	
18. Mrs. Güler PEKDEMİR	Secretary	
19. Mr. Hüsnü USLU	Librarian	
20. Mr. Mehmet SAĞIR	Laborer	
21. Mrs. Servet BAYDAR	Laborer	

## On-going projects at TBAM, Eskişehir July 1987

- |                      |   |
|----------------------|---|
| 1. Neşe Kırimer      | - Arnebia                               |
| 2. Yusuf İ. Akyol    | - Ruscogenin                            |
| 3. Mine Ersoy        | - Essential Oils<br>Mint, Rose, Cyperus |
| 4. Berrin Bozan      | - Liquorice                             |
| 5. Samiye Fıçıcıoğlu | - Storax and Hovenia                    |
| 6. Sedat Hakkı Beis  | - Capsicum oleoresin                    |
| 7. Temel Özek        | - Gypsophila saponins                   |
| 8. Aytaç Berhayat    | - Humulus                               |
| 9. Hülya Tomsuk      | - Thalictrum                            |

## Joint Projects:

- |                      |   |                             |
|----------------------|---|-----------------------------|
| 1. Salvia            | } | Sedat H. Beis               |
| 2. Laurus            |   | Temel Özek                  |
| 3. Origanum          |   | Mine Ersoy                  |
| 4. Aesculus (aescin) |   | Berrin Bozan<br>Mete Koçkar |

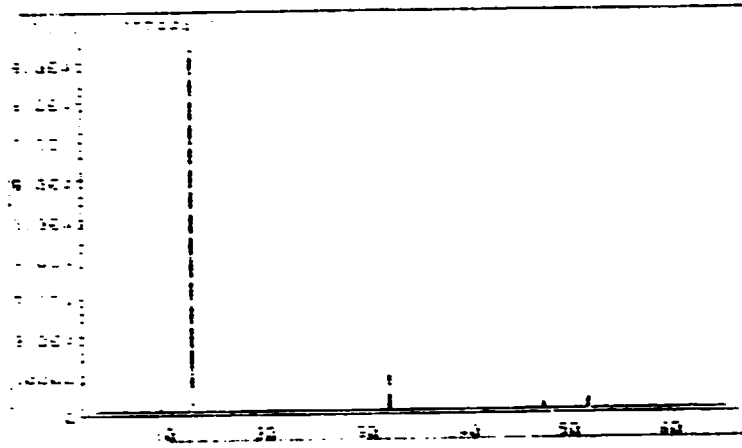
**Necessary journal for daily consultance**

1. **Phytochemistry**
2. **Planta Medica**
3. **Journal of Natural Products**
4. **Natural Products Reports**
5. **Plantes Medicinales et Phytotherapie**
6. **Fette, Seifen und Anstrichmittel**
7. **Perfumery and Cosmetics**
8. **Dragoco Report**
3. **The Chemical Manufacturer**
10. **Soap, Perfumery and Cosmetics**
11. **Flavour and Fragrance Journal**

**The above journals will be placed permanently in the Library of TBAM**

Appendix 7

Mass spectrometric analysis of the essential oil obtained from *Liquidambar orientalis*. Material was collected in the Marmaris region on the south coast of Turkey.



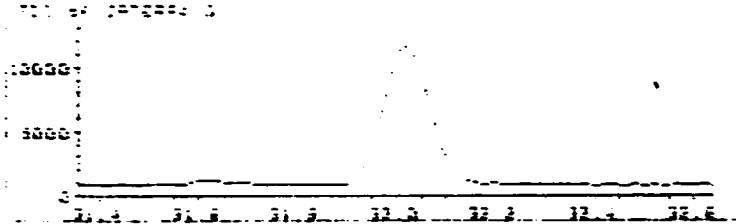
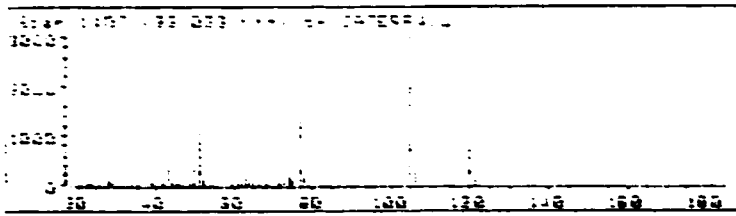




Scan 1407

Scan 1407

Scan 1407 (10.145 min) of 1

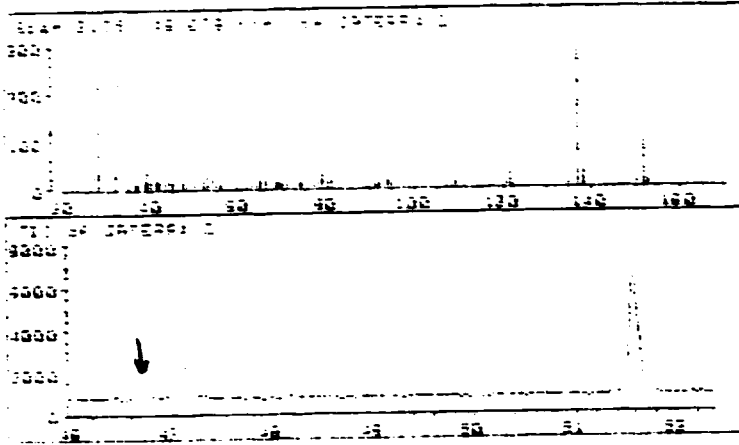


Scan 1407 10.145 min 14.070701.D

TABLE

m/z	abund.	m/z	abund.	m/z	abund.	m/z	abund.
39.00	1	45.00	15	55.00	3	79.00	3
41.00	1	47.00	1	61.00	1	89.00	1
55.00	2	59.00	1	65.00	2	91.00	2
73.00	1	83.00	15	73.00	1	105.00	39
81.00	1	91.00	33	74.00	5	106.00	7
91.00	1	97.00	7	74.00	1	120.00	30
99.00	5	101.00	1	77.00	87	121.00	2
101.00	1	101.00	1				

Scan 492 12.445 min of  
Scan 1407 32.023 min of



Scan 2125 46.679 min of INTERP4.D  
TABLE 1

m/z	abund.	m/z	abund.	m/z	abund.	m/z	abund.
37.00	0	41.00	4	81.00	14	99.00	11
41.00	1	43.00	4	84.00	3	91.00	10
43.00	1	44.00	3	88.00	3	92.00	4
44.00	4	45.00	4	89.00	5	94.00	3
45.00	3	47.00	4	93.00	11	95.00	3
47.00	3	48.00	1	98.00	11	106.00	3
48.00	1	50.00	3	99.00	11	109.00	11
50.00	1	51.00	3	101.00	11	109.00	11
51.00	1	52.00	3	103.00	11	113.00	3
52.00	1	53.00	3	104.00	11	120.00	2
53.00	4	55.00	3	107.00	6	129.00	4
55.00	1	56.00	3	110.00	4	131.00	13
56.00	1	58.00	3	111.00	7	131.70	2
58.00	1	59.00	3	112.00	2	132.00	2
59.00	1	67.00	3	113.00	5	133.10	1
67.00	1	69.00	2	114.00	1	134.00	2
69.00	3	81.00	11	137.00	1	137.00	100

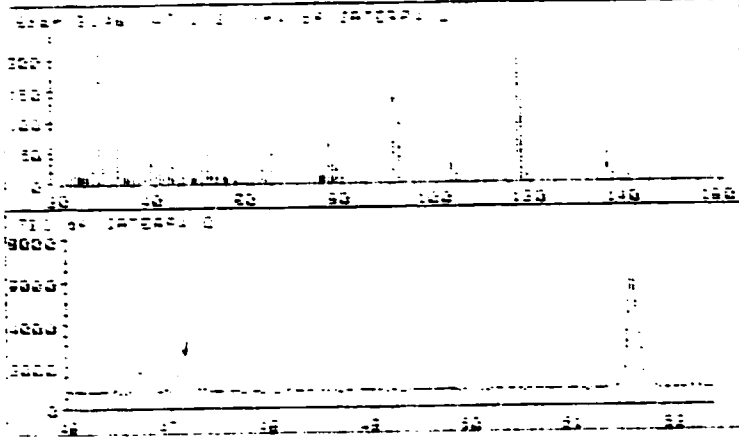
TABLE 2E  
(MS1)

Scan 2125 46.679 min of INTERP4.D  
TABLE 1

m/z	abund.	m/z	abund.	m/z	abund.	m/z	abund.
109.10	3	162.00	35	162.90	4	167.10	1
162.00	1						

Y: Scan 1407 (32.023 min) of  
Y: Scan 2125 (46.679 min) of

Scan 207 (32.223 min) of  
Scan 2125 (46.579 min) of



Scan 2148 (47.113 min) of INTERP4.D  
TABLE1

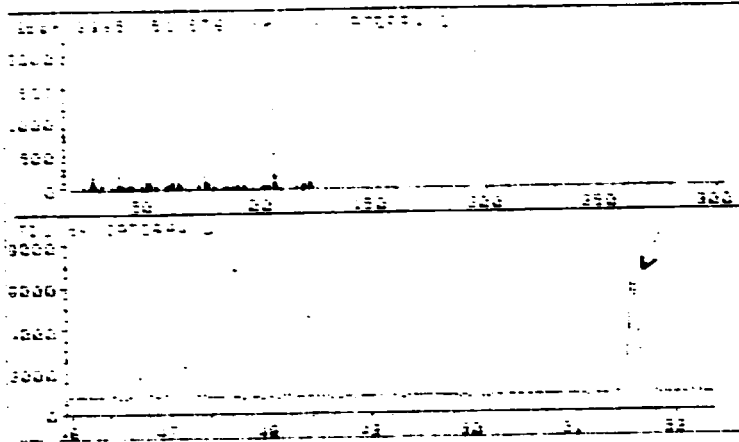
m/z	abund.	m/z	abund.	m/z	abund.	m/z	abund.
27.00	0	31.00	0	85.00	0	93.10	0
31.00	0	33.00	19	87.00	1	97.00	0
33.00	0	40.10	4	89.00	0	98.00	0
37.00	4	41.00	0	91.10	0	91.00	0
41.00	4	43.00	0	93.10	10	92.10	41
43.00	0	44.00	0	94.00	0	92.00	4
45.00	0	44.00	0	94.00	0	92.10	1
47.00	120	45.10	0	94.00	0	102.10	1
49.00	100	45.10	0	95.00	0	104.10	0
51.00	15	47.10	0	97.00	0	105.00	10
53.00	18	49.00	0	99.00	0	105.00	0
55.00	77	49.00	0	99.00	0	106.10	1
57.00	0	50.00	0	99.00	0	114.00	0
59.00	0	51.10	10	99.00	0	117.00	0
61.00	0	53.00	0	99.00	0	119.10	0
63.00	0	55.00	0	99.00	0	119.00	0
65.00	0	57.00	0	99.00	0	134.10	0
67.00	0	59.00	0	99.00	0	135.10	0

TABULATE  
TABLE1  
Scan 2148 (47.113 min) of INTERP4.D  
TABLE1

Y: Scan 2125 (46.579 min) of  
X: Scan 2148 (47.113 min) of

m/z	abund.	m/z	abund.	m/z	abund.	m/z	abund.
137.00	0	142.70	1	151.50	1	157.00	2

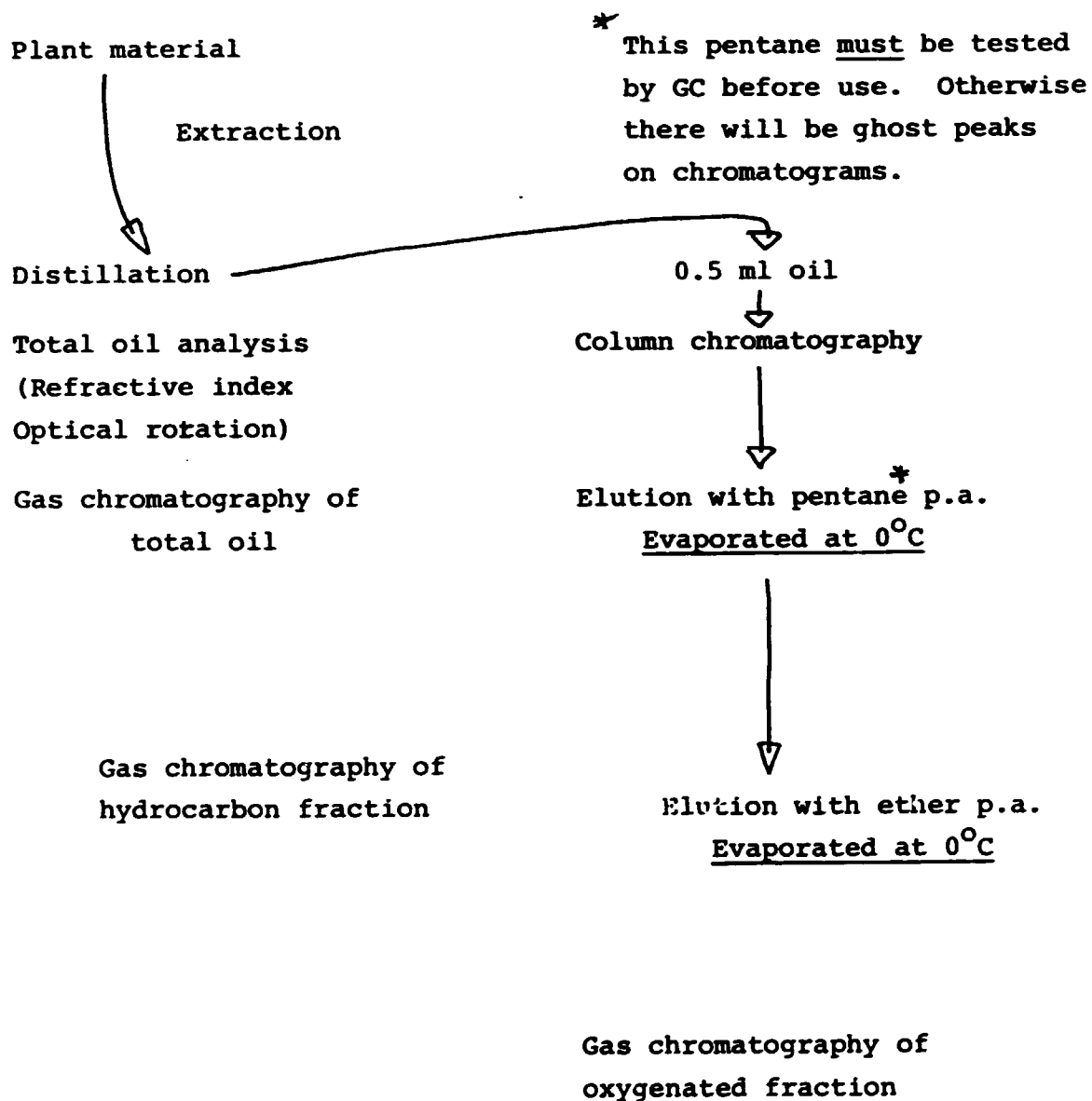
1000 1000 1000 1000 1000 1000  
 1000 1000 1000 1000 1000 1000



1000 1000 1000 1000 1000 1000  
 1000 1000 1000 1000 1000 1000

Wavelength	Abundance	Wavelength	Abundance	Wavelength	Abundance	Wavelength	Abundance
25.10	1	37.20	1	54.10	1	91.00	1
27.20	2	39.30	1	56.20	2	103.00	1
29.30	1	41.40	1	58.30	1	125.00	1
31.40	1	43.50	1	60.40	1	137.00	100
33.50	1	45.60	1	62.50	10	159.00	1
35.60	1	47.70	1	64.60	1	171.00	1
37.70	1	49.80	1	66.70	1	183.00	1
39.80	1	51.90	1	68.80	1	195.00	1
41.90	1	54.00	1	70.90	1	207.00	1
44.00	1	56.10	1	73.00	1	219.00	1
46.10	1	58.20	1	75.10	1	231.00	1
48.20	1	60.30	1	77.20	1	243.00	1
50.30	1	62.40	1	79.30	1	255.00	1
52.40	1	64.50	1	81.40	1	267.00	1
54.50	1	66.60	1	83.50	1	279.00	1
56.60	1	68.70	1	85.60	1	291.00	1
58.70	1	70.80	1	87.70	1	303.00	1
60.80	1	72.90	1	89.80	1	315.00	1
62.90	1	75.00	1	91.90	1	327.00	1
65.00	1	77.10	1	94.00	1	339.00	1
67.10	1	79.20	1	96.10	1	351.00	1
69.20	1	81.30	1	98.20	1	363.00	1
71.30	1	83.40	1	100.30	1	375.00	1
73.40	1	85.50	1	102.40	1	387.00	1
75.50	1	87.60	1	104.50	1	399.00	1
77.60	1	89.70	1	106.60	1	411.00	1
79.70	1	91.80	1	108.70	1	423.00	1
81.80	1	93.90	1	110.80	1	435.00	1
83.90	1	96.00	1	112.90	1	447.00	1
86.00	1	98.10	1	115.00	1	459.00	1
88.10	1	100.20	1	117.10	1	471.00	1
90.20	1	102.30	1	119.20	1	483.00	1
92.30	1	104.40	1	121.30	1	495.00	1
94.40	1	106.50	1	123.40	1	507.00	1
96.50	1	108.60	1	125.50	1	519.00	1
98.60	1	110.70	1	127.60	1	531.00	1
100.70	1	112.80	1	129.70	1	543.00	1

## Procedure for the analysis of an essential oil.



Every essential oil must be tested like this before a GC/MS is carried out to identify the main constituents.

## Essential oil certificate

1. Gas chromatogram of total oil and indication of the main constituents (qualitative-quantitative analysis)
- (2. Refractive index and optical rotation.)

Different chromatograms of products/fraction = produced at TBAM

TLC SYSTEMS FOR SAPONINS

S.1: n-BuOH/EtOH/H<sub>2</sub>O (7:2:5)

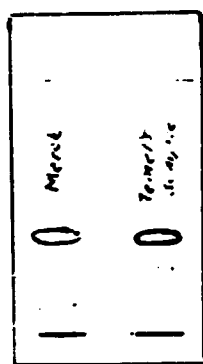
Spray: 10% H<sub>2</sub>SO<sub>4</sub> and heating at 110°C for 10 min.

S.2: EtOAc/gIAcOH/H<sub>2</sub>O/n-BuOH (4:2:3:4)

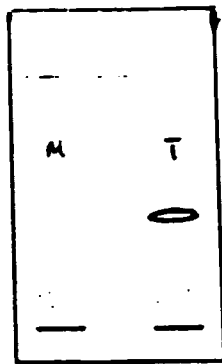
Spray: 30% H<sub>2</sub>SO<sub>4</sub> and heating at 110°C for 10 min.

S.3: EtOAc/gIAcOH/H<sub>2</sub>O/n-BuOH (4:2:3:4)

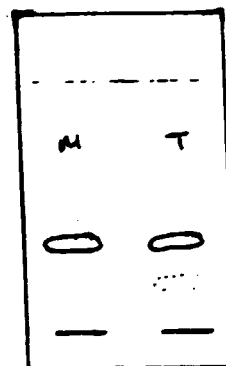
Spray: Anisaldehyde and heating at 110°C for 10 min.



S.1



S.2



S.3

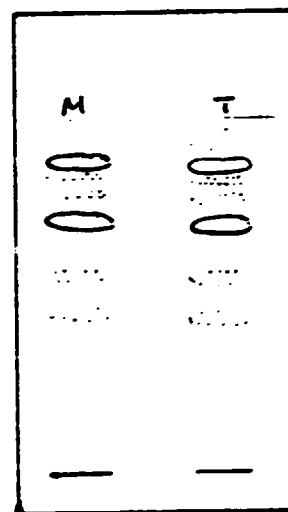
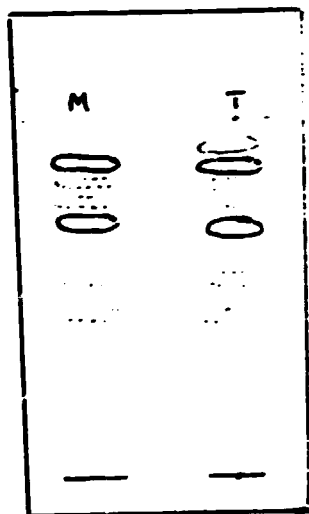
TLC SYSTEMS FOR SAPOGENINS

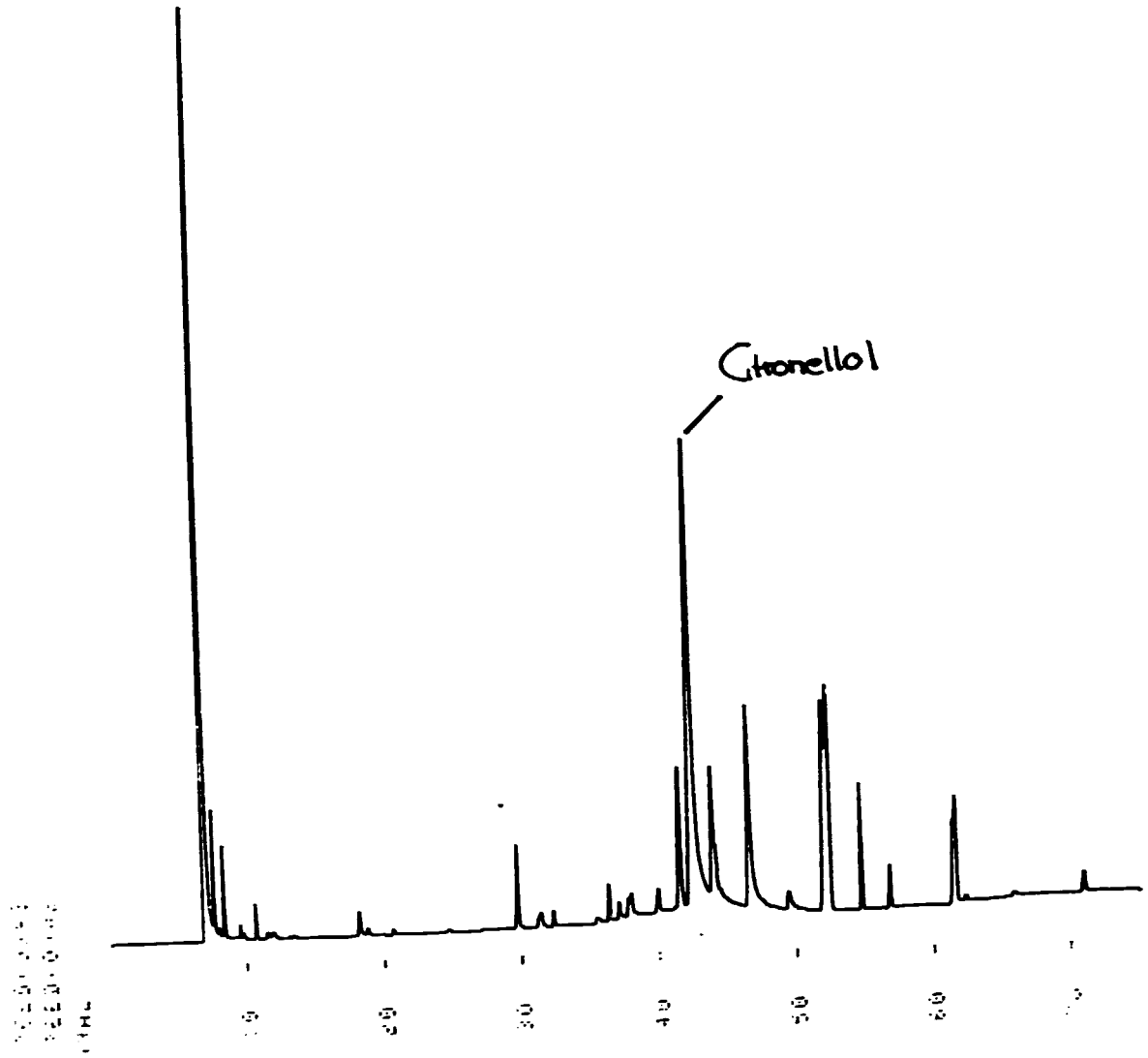
S.1:  $\text{CHCl}_3/\text{EtOH}$  (25:1)

Spray: 10%  $\text{H}_2\text{SO}_4$  and heating at  $110^\circ\text{C}$  for 10 min.

S.2:  $\text{CHCl}_3/\text{EtOH}$  (25:5)

Spray: 10%  $\text{H}_2\text{SO}_4$  and heating at  $110^\circ\text{C}$  for 10 min.

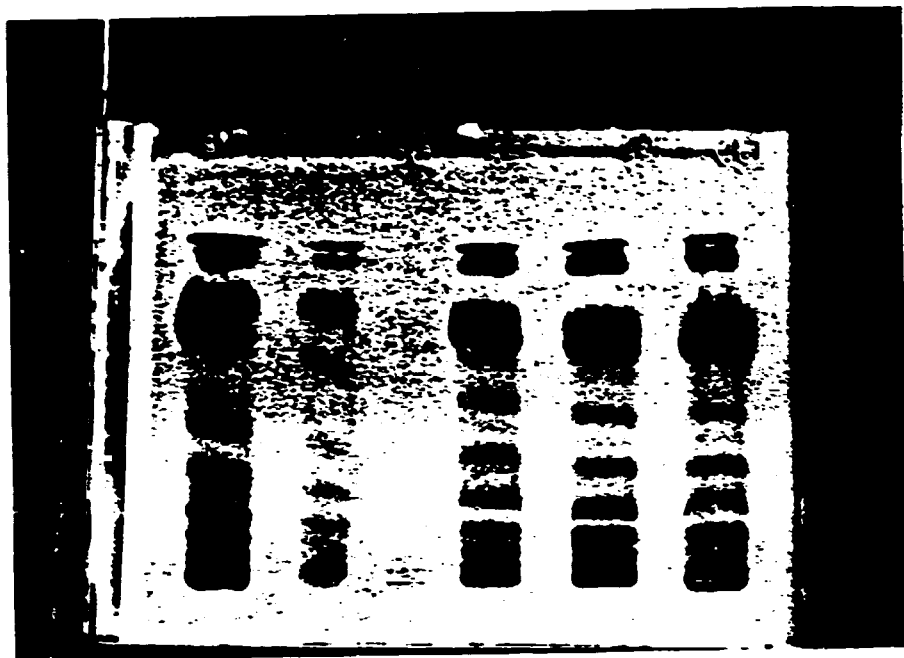




ROSA DAMASCENA ESSENTIAL OIL:

TOTAL OIL



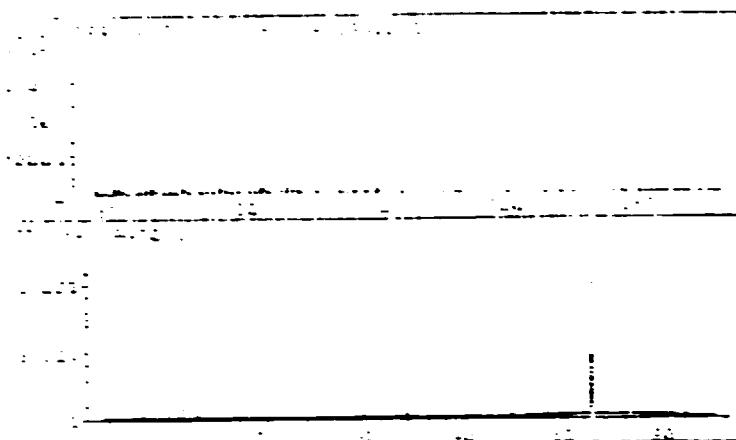


Carotenoid extract from *Capsicum* sp.

Ethanol extr. (oleoresin) dissolved in acetone to give standard solution.

TLC standard  $\text{SiO}_2$ -Merck

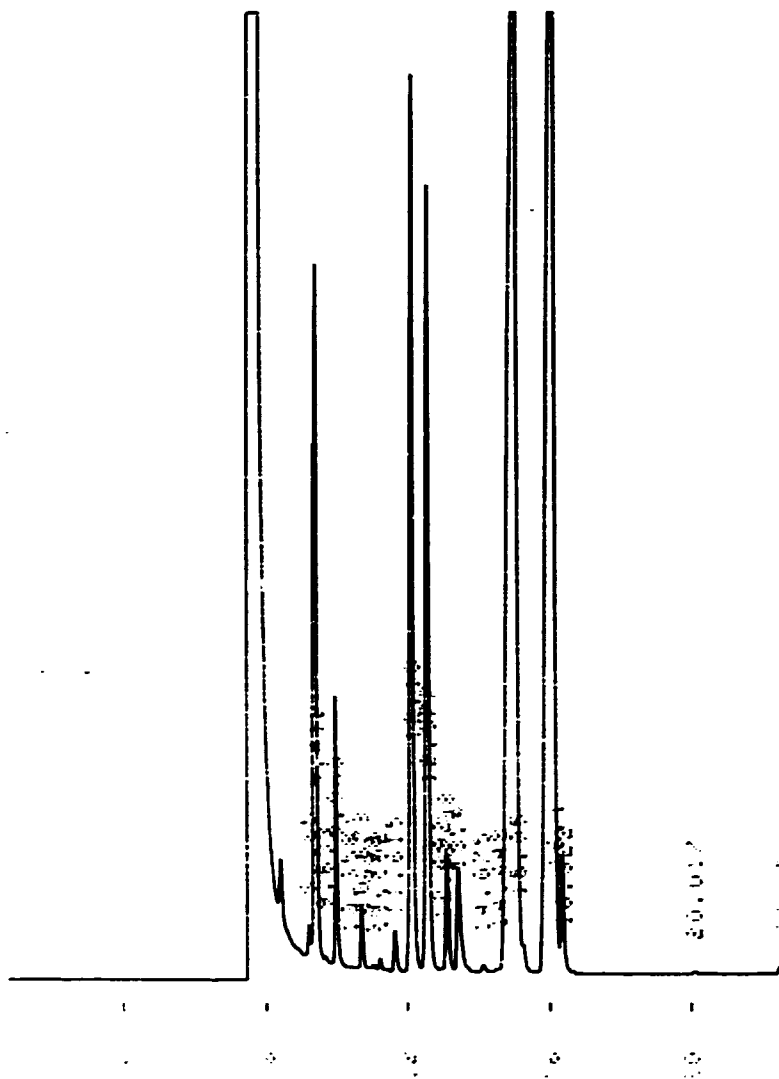
Mobile phase: Petr. ether/Benzene 50:50 + 2 ml acetone



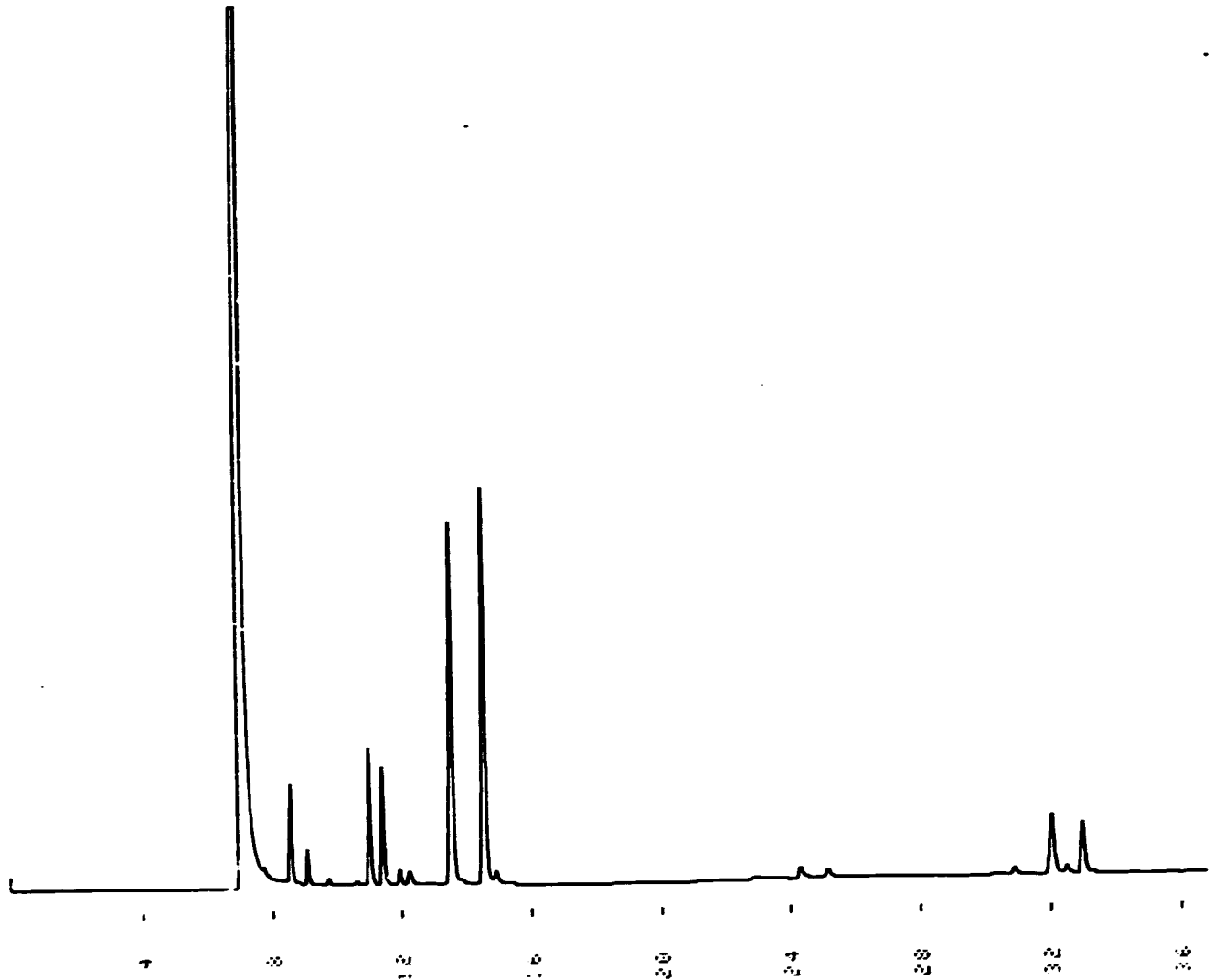
m/z	Relative Intensity	Reference
93	100	Carvacrol
135	15	Carvacrol
151	10	Carvacrol
167	10	Carvacrol
183	10	Carvacrol
199	10	Carvacrol
215	10	Carvacrol
231	10	Carvacrol
247	10	Carvacrol
263	10	Carvacrol
279	10	Carvacrol
295	10	Carvacrol
311	10	Carvacrol
327	10	Carvacrol
343	10	Carvacrol
359	10	Carvacrol
375	10	Carvacrol
391	10	Carvacrol
407	10	Carvacrol
423	10	Carvacrol
439	10	Carvacrol
455	10	Carvacrol
471	10	Carvacrol
487	10	Carvacrol
503	10	Carvacrol
519	10	Carvacrol
535	10	Carvacrol
551	10	Carvacrol
567	10	Carvacrol
583	10	Carvacrol
599	10	Carvacrol
615	10	Carvacrol
631	10	Carvacrol
647	10	Carvacrol
663	10	Carvacrol
679	10	Carvacrol
695	10	Carvacrol
711	10	Carvacrol
727	10	Carvacrol
743	10	Carvacrol
759	10	Carvacrol
775	10	Carvacrol
791	10	Carvacrol
807	10	Carvacrol
823	10	Carvacrol
839	10	Carvacrol
855	10	Carvacrol
871	10	Carvacrol
887	10	Carvacrol
903	10	Carvacrol
919	10	Carvacrol
935	10	Carvacrol
951	10	Carvacrol
967	10	Carvacrol
983	10	Carvacrol
999	10	Carvacrol

MS of main constituent of

Origanum onites  
: Carvacrol

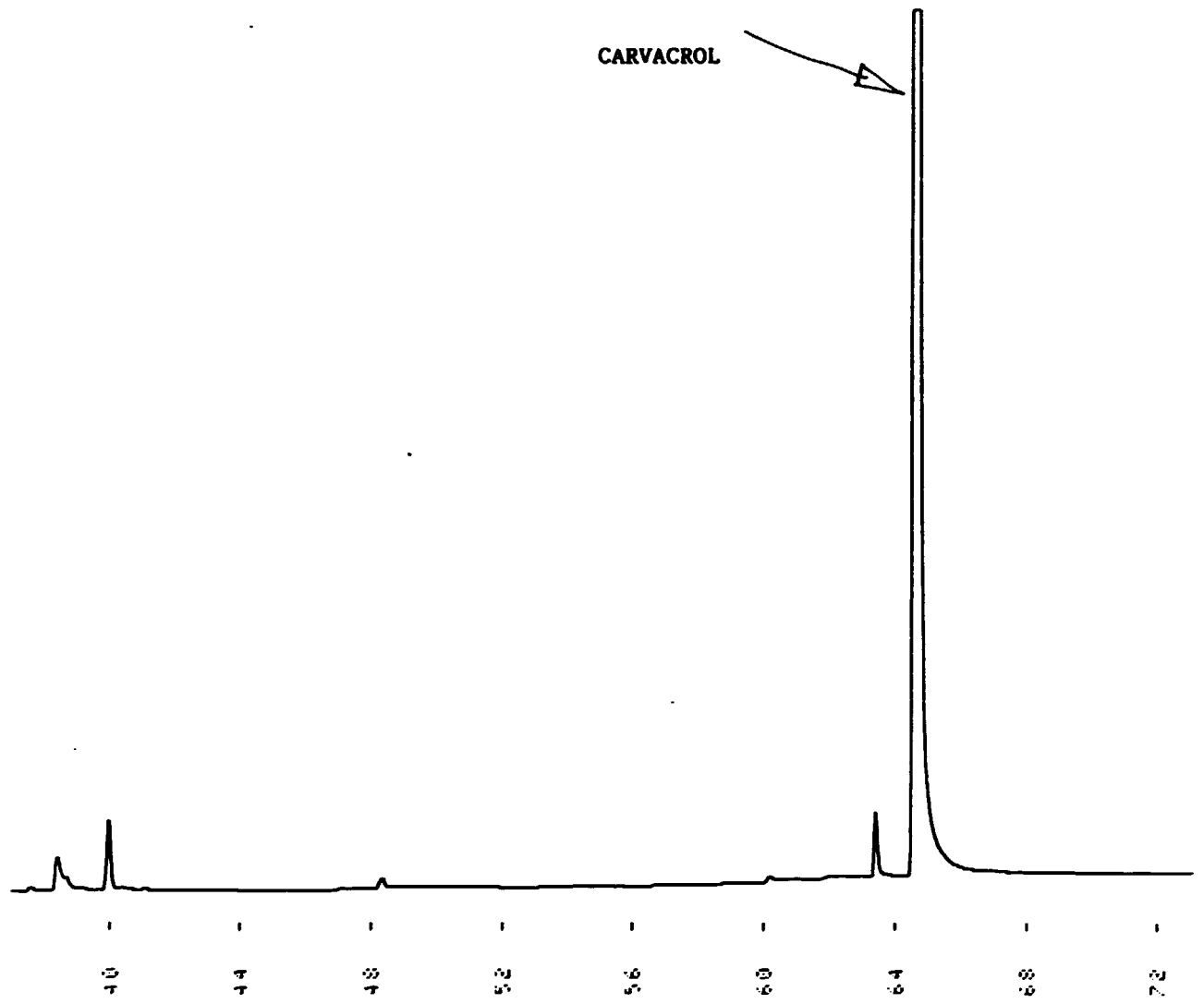


Origanum orites essential oil:  
Hydrocarbon fraction



Origanum onites essential oil:

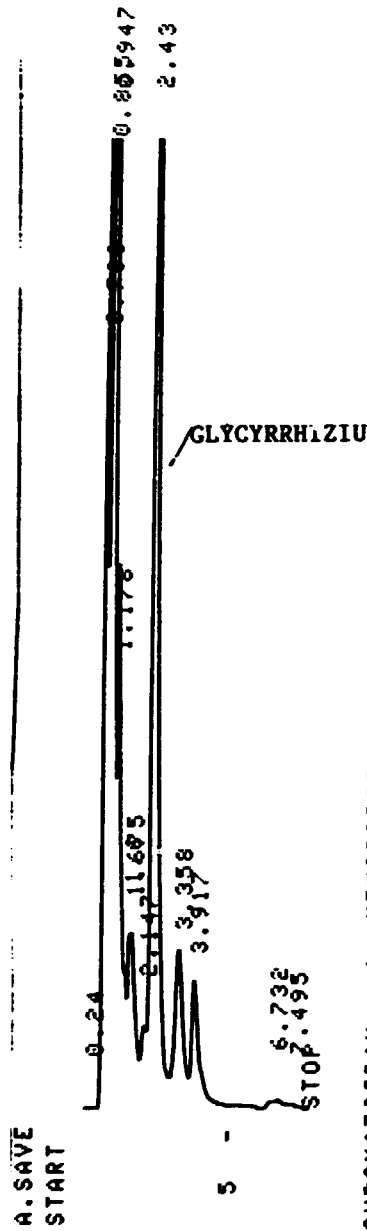
Total oil I



Origanum onites essential oil:

Total oil II

Shimadzu



CHROMATOGRAM 1 MEMORIZED

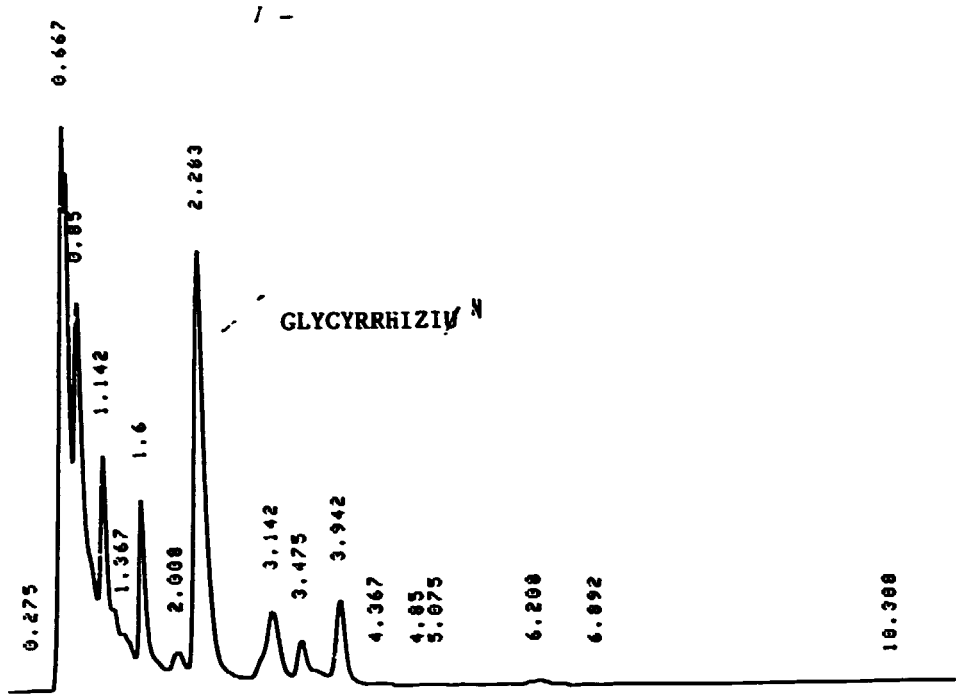
CHROMATOPAC	C-R3A	FILE	1
SAMPLE NO	0	METHOD	3441
REPORT NO	196		

Precipitate in Liquorice extract

Reversed phase C<sub>18</sub> - H<sub>2</sub>O/HOAc/CH<sub>3</sub>CN-  
61/1/38

254 nm/ 2ml/min.

ATTEN(1)=4  
ANAL DATES  
#ERROR# 4:TYPE MISMATCH  
ANAL 1

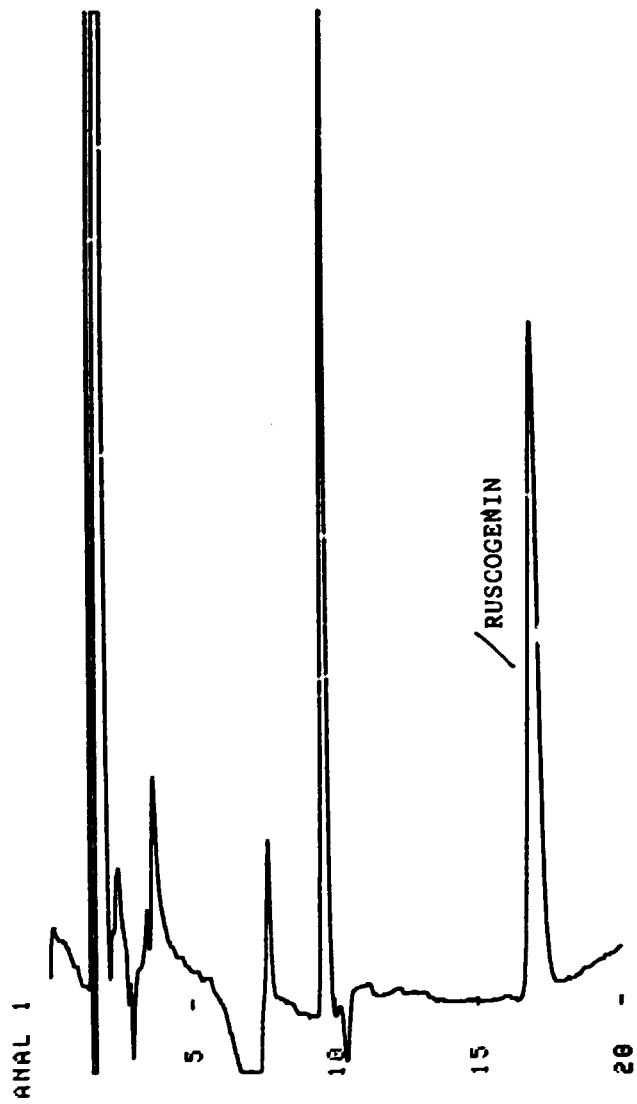


Glycyrrhiza glabra extract:

Reversed phase, C<sub>18</sub>

H<sub>2</sub>O/HOAc/CH<sub>3</sub>CN 61/1/38

1 ml/min



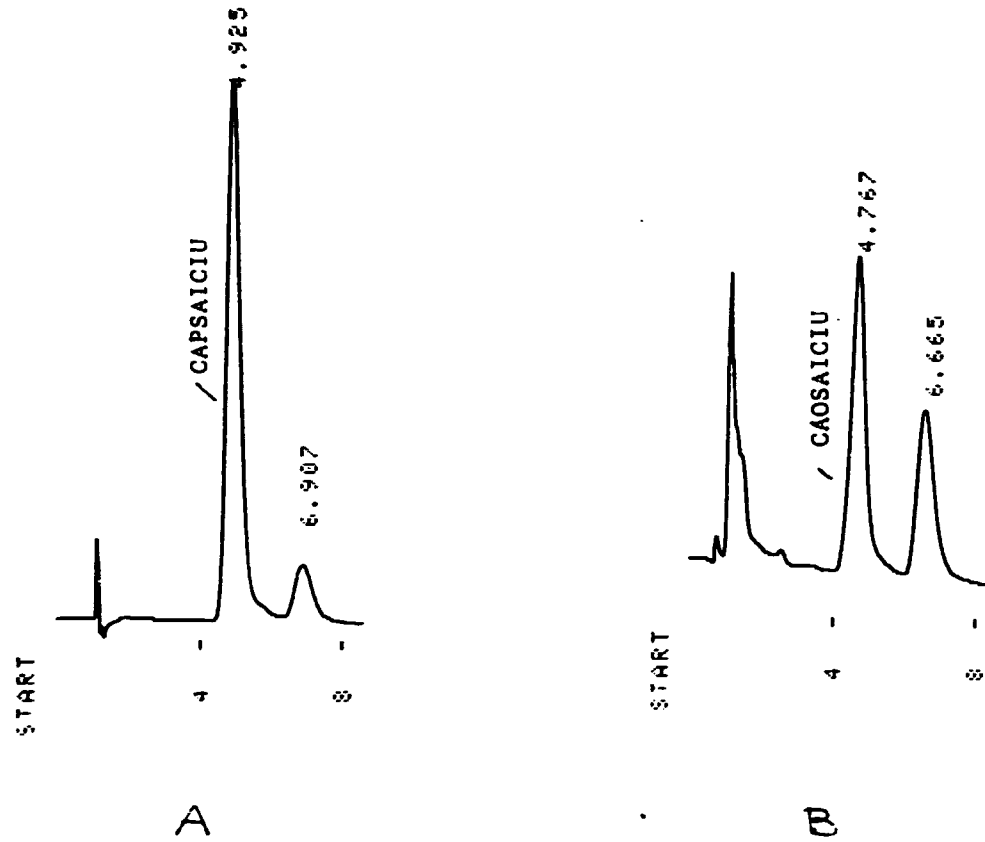
Ruscogenin standard analysis

Reversed phase C<sub>18</sub>

CH<sub>3</sub>CN/H<sub>2</sub>O 6/4

200 nm





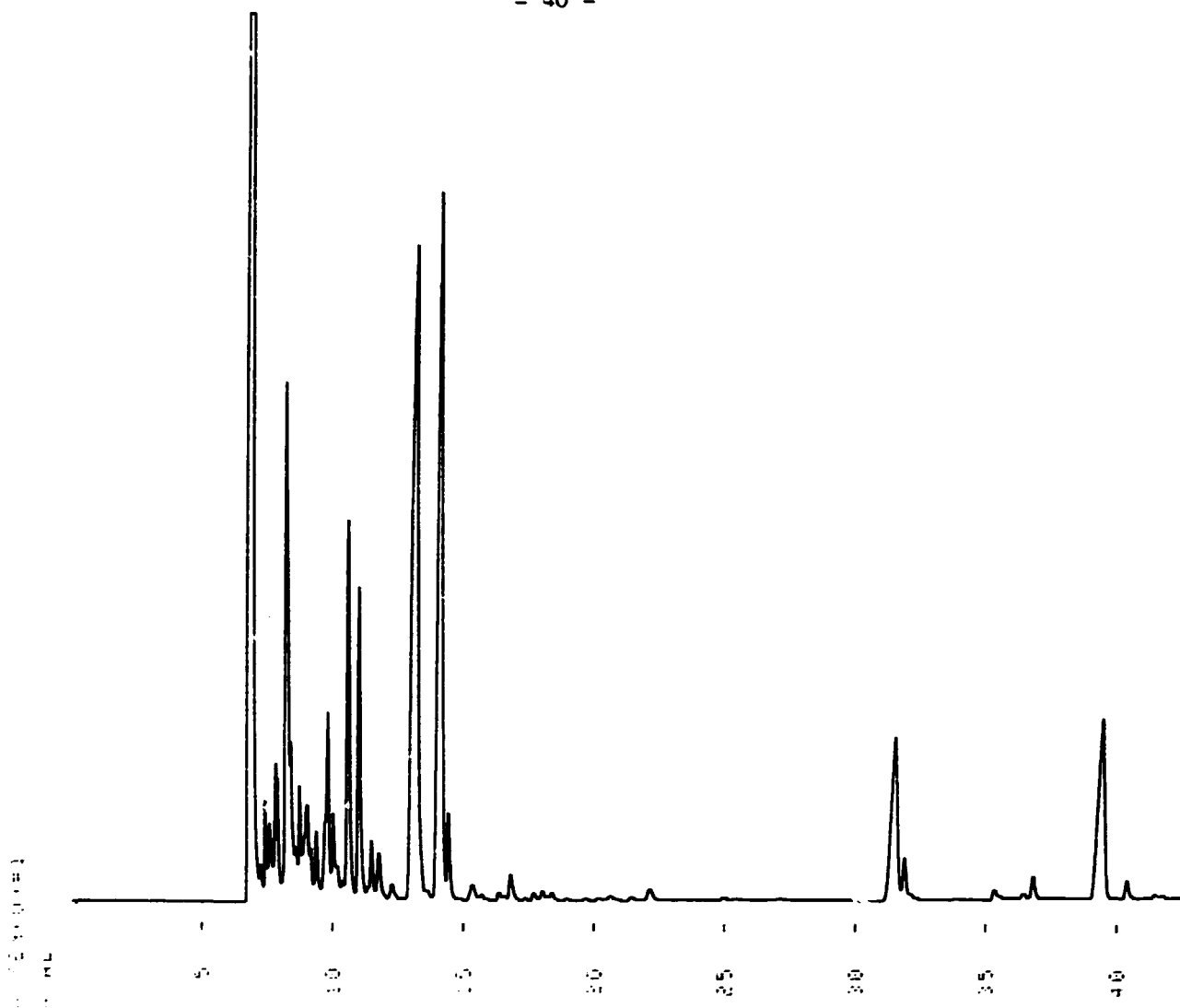
A: Capsaicin standard

B: Capsicum ethanol extract

Reversed phase C<sub>18</sub>

264 nm MeOH/H<sub>2</sub>O/HOAc

85/34/1



Oreganum onites essential oil:

Hydrocarbon fraction

Teutative work plan for 1986/1987 (12 months)  
second phase project DP/TUR/83/003

Activity	Technical report expected	Remarks
Essential oil screening	July 1988	30-40 oils to be studied to build up an essential oil library for future de- velopment. This work has to be coupled to selective literature search. On-going
Liquorice extract:		
Block, powder, yellow	December 1987	Pilot plant investigation
Monoammonium glycyrrhizinate	July 1988	Terminal report On-going
Essential oils of:		Pilot plant production
Laurus nobilis		
Salvia triloba	August 1987	Terminal report
Origanum sp.	(interim rep)	
Carvacrol pro- duction	December 1987	On-going
Aescin	July 1988	Pilot plant investigation
Styrax	(interim rep) December 1987	On-going
Capsicum		
Laboratory scale screening for cap- saicin		Technical report expected Combination of laboratory and pilot plant report
Capsaicin enrich- ment.	July 1988	
Pilot plant extrac- tion of capsaicin- rich variety		

**Gypsophila**

Characterization

Screening of other December 1987

G.species for saponin  
contentCommercial evaluation under  
way  
Closer study of the saponins  
Laboratory and a pilot plant  
report.**Hops**

Oleoresin

Essential oil December 1987

Laboratory investigation and  
report.Medicinal plants of  
Turkey

December 1987

Literature report by  
T.Baytop

Ruscogenin

July 1988

Laboratory investigation  
Terminal report

Solvent purification

July 1988

Technical reports on each  
solvent.Modifications to  
existing pilot plant  
facilities

To be completed by Dec.1987

Design and fabrication  
of a fractional distil-  
lation unit

- " -

Quality control of Rose oil July 1988

Terminal report

UNIVERSITY OF ANATOLIA  
MEDICINAL PLANTS RESEARCH CENTRE  
ESKISEHIR  
TURKEY

TRAINING COURSE  
IN  
THE UTILIZATION OF MEDICINAL AND AROMATIC  
PLANTS IN THE PHARMACEUTICAL AND RELATED INDUSTRIES  
(TRUMAP)

May 1988  
Eskisehir, Turkey

Under the auspices of:

United Nations Industrial Development Organization  
(UNIDO) Industrial Training Branch-Department of Industrial  
Operations  
PO.BOX 300  
A-1400 Vienna, Austria

- M.T. 9.15-10.00**      **Analytical Techniques**  
**Pharmacopeial Methods-Examples. Demonstrations**  
- Identification reactions  
- Limit test  
- Thin-layer chromatography  
- UV and IR spectroscopy  
- Optical rotation  
- Refractive index  
- Essential oil determination
- M.T. 10.15-11.00**      **Analytical Techniques**  
**Pharmacopeial Methods-Examples. Demonstrations**  
- Chromatographic techniques (other than Thin-layer chromatography)  
Limitations and advantages
- M.B.N.11.15-12.00**      **Pilot Plant Operations**  
Theory and practice of essential oil distillation
- 14.00**                      **Practical sessions**  
Group B: Pilot Plant Groups A and C: Analytical Laboratories
- M.K. 10.15-11.00**      **Pilot Plant Operations**  
Scaling up
- H.B. 11.15-12.00**      **University of Anatolia Medicinal Plant Research Centre**
- M.T. 9.15-10.00**      **Analytical Techniques**  
Application of spectrophotometric methods

- 14.00                      Practical Sessions  
Group C: Pilot Plant      Groups A and B: Analytical Laboratories
- J.K. 9.15-10.00            Analytical Problems concerning Essential Oils  
- Selection of appropriate analytical method  
- Total analysis  
- Hydrocarbon-fraction analysis  
- Oxygenated-fraction analysis  
- Requirements of Industries utilizing essential oils  
- Evaluation of analytical results  
- Analysis of mixed products
- J.K. 11.15-12.00           Pilot Plant Observation
- J.K. 14.00                   Practical Sessions  
Group A: Pilot Plant      Group B and C: Analytical Laboratories
- N.B. 9.15-10.00            From Plant Material to Product II.  
Important plant materials in current use:  
- Plant material as such  
- Extracted natural products  
- Natural products for hemisynthesis
- R.O.B. 10.15-12.00        Essential Oils
- 14.00                      Practical Sessions  
Group B: Pilot Plant      Groups A and C: Analytical Laboratories
- E.S. 9.15-10.00            Essential Oil Plants in Turkey

- N.B. 10.15-11.00 Post-harvest Treatment of Plant Material I.  
Collection methods:  
    Wild  
    Cultivated  
  
Cleaning  
Drying  
Deterioration  
    Enzymatic  
    Chemical  
    Biological
- R.O.B. 11.15-12.00 Post-harvest Treatment of Plant Material II.  
Essential Oils
- 14.00 Practical Sessions  
Group A and B: Analytical Laboratories  
Group C: Pilot Plant
- E.G. 9.15-11.00 Formulation of Products for Industry and Consumer.  
    Pharmaceutical Industry  
    Cosmetic Industry  
    Natural products as active ingredients or  
        as formulating aids.  
    Special equipment for drug formulation  
    Requirements for natural products used in  
        drug formulation  
    Encapsulation process  
    Natural products in cosmetics  
    Natural products as stabilizers for formula  
        ted drugs  
    Spices.



J.K. - N.B. 11.15-12.00

Economic Aspects of plant products

Areas of application

Economic viability

Market research:

local

regional

foreign

Quality control implications

Management of R+D

Natural molecules as templates

14.00

Summing-up

Round-table Discussions

Additional Practical Sessions