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INTERNATIONAL CENTRE FOR SCIENCE

AND HIGH TECHNOLOGY

in collaboration with the

Medicinal and Aromatic Plant and Drug Research Centre (TBAM),

Anadolu University, Eskişehir, Turkey

FINAL REPORT

Training Course on

Quality Improvement of Essential Oils

Eskişehir, Turkey

15-19 November 1999

UNIDO

BACKGROUND

Essential oils are products of commerce obtained from aromatic plants. World production of essential oils is estimated at around 120.000-130.000 tons which is valued at over US$ 1 billion. Essential oils are truly natural products and are indispensible ingredients of flavours and fragrances. They are used in food, pharmaceutical, perfumery, cosmetic, toiletries, household goods and personal hygiene industries. Although production of essential oils requires relatively simple technologies, their research, quality control and standardisation procedures require highly sophisticated techniques and expertise. Developing countries are main suppliers of aromatic plants and they are responsible for 65% of the world production of essential oils. However, due to lack or neglect of proper production and quality control measures most essential oils produced in developing countries are generally considered inferior and are undervalued resulting in considerable losses for developing country producers.

JUSTIFICATION

Processing conditions of essential oils can be standardised and analytical improvement measures can be easily implemented if technical personnel responsible for essential oil production are given proper training and appropriate technical guidance.

Anadolu University Medicinal and Aromatic Plant and Drug Research Centre (TBAM) was established in 1982 and strengthened through technical assistance provided by United Nations Industrial Development Organisation (UNIDO) under development projects funded by United Nations Development Programme (UNDP) between 1984 and 1994. Since 1988, TBAM organised ten in-plant group training programmes titled "*Training on the Utilisation of Medicinal and Aromatic Plants in Pharmaceutical and Related Industries (TRUMAP)*" under the auspices and joint sponsorship of the Government of Turkey and UNIDO. These 25-day programmes were aimed at university graduates working in the field of medicinal and aromatic plants in developing countries and each year ten participants carefully selected from among 50-70 nominations had taken up the course. Modern research and development infrastructure, and trained man-power of TBAM coupled with excellent facilities for board and lodging in the Anadolu University campus are favourable for successful implementation of training programmes. Due to its enviable track record, TBAM is regarded as one of the best research and training centres for industrial utilization of medicinal and aromatic plants.

OBJECTIVES

This training course has been designed to enable the participants from developing countries to gain knowledge, improve their skills and interact with specialists in the field for the benefit of their home states. The training course was intended to impart training to the

participants on quality improvement of essential oils. The participants would then be able to improve their existing knowledge on production and quality control of essential oils, and learn about novel techniques applied in modern essential oil research.

OUTPUTS

Twelve selected participants from eight developing countries have been trained. Two candidates who had been invited from China and Tunisia could not attend. The participants acquired knowledge and practical experience on the proper production of essential oils, their standardisation, quality control, olfactory evaluation and new essential oil extraction techniques. Active interaction among the participants have been encouraged to develop productive collaborations among them. The programme addressed the problems of participating developing countries to improve their essential oil processing capacity and capability.

The course consisted of the following five different types of activities:

- Theoretical lectures
- Olfactory evaluation
- Instrumental analysis practicals
- Pilot plant demonstrations
- Round table discussion

PARTICIPANTS

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Mr.Teshome Sisay	Ethiopia
Ms.Maninder Karan	India
Mr.R.K. Thappa	India
Ms.Malgorzata Jankiewicz	Poland
MR.Alvaro Viljoen	S.Africa
Mr.Hisomiddin Nuriddinov	Uzbekistan
Ms.Deniz Tuvay	Turkey
Ms.Eylem Gürel	Turkey
Ms.Özgül Cimbay	Turkey
Mr.Ceng Tüzel	Turkey

RECOMMENDATIONS

This training program should be considered as a crash course. It has enabled the participants to have a general overview of the subject. They have been exposed to all the modern production and analytical techniques. However, in depth evaluation of each technique and instrument has not been possible. The participants, on the other hand, expressed their satisfaction at the planning and implementation of the course program.

As explained in the Background and Justification parts, essential oils are very important for industrial development of developing countries since they are the main sources of aromatic plant materials. Therefore, similar courses should often be repeated to train more scientists from developing countries.

I believe, ICS and TBAM can implement many joint projects in the field of essential oils. The preparation of a Computer Aided Training Kit for Olfactory Evaluation of Essential Oils should be reconsidered. Additionally, a practical manual for the most commonly traded essential oils can be developed.

In addition to training courses, Workshops and Expert Group Meetings can be organised to bring together experts to discuss specific problems often encountered by essential oil producers or analysts.

IMMEDIATE FOLLOW-UP

A roster of essential oil scientists, institutes, traders and producers in developing countries should be compiled. A priority list of most commonly grown and cultivated aromatic plants and commercially produced essential oils should be developed for each developing country. Based on these preparations, a world congress or international consultation meeting on essential oils can be organised by inviting scientists and producers from the developing and the developed world.

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PROGRAMME

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CERTIFICATE

See Annex VII.

08/10/99
KV/GLO/esr

INTERNATIONAL CENTRE FOR SCIENCE AND HIGH TECHNOLOGY

in collaboration with the

Medicinal and Aromatic Plant and Drug Research Centre (TBAM), Anadolu University, Eskisehir, Turkey

AIDE-MEMOIRE

Training Course on Quality Improvement of Essential Oils

Eskisehir, Turkey
15-19 November 1999

INTERNATIONAL CENTRE FOR SCIENCE AND HIGH TECHNOLOGY

Area Science Park, Padriciano, 99 - Building L2, 34012 Trieste, Italy
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BACKGROUND

Essential oils are odoriferous products obtained from aromatic plants. World production of essential oils is estimated at around 120.000-130.000 tons valued over US $ 1 billion. Essential oils are truly natural products and are indispensable components of flavours and fragrances. They are used in food, pharmaceutical, perfumery, cosmetic, toiletries, household goods and personal hygiene industries. Although production of essential oils requires relatively simple technologies, their research, quality control and standardization procedures require highly sophisticated techniques and expertise. Developing countries are main suppliers of aromatic plants to developed countries and are responsible for 65% of the world production of essential oils. However, due to neglect of proper production and quality control measures many essential oils produced in developing countries fail to meet the strict quality standards in the international trade. These are undersold in the market causing considerable losses to the producers in the developing countries.

JUSTIFICATION

Quality of essential oil besides being largely dependent upon the traits of the raw material is also influenced to large extent by the method of production and treatment. Although on small scale, skilled and expert personnel can produce essential oils of competitive grade using primitive equipment and technique, but industrial scale production has undergone a sea change in the recent past. The production, which was considered an art in the earlier times is now a mastered high tech science using state-of-the-art equipment to control the quality parameters of the finished products. Analysis report has become matter of routine to ensure the uniform quality. Simple treatments are available to add value to the finished products. The international trade in essential oils has become highly competitive and suppliers are asked to produce certification to the effect of quality. Whereas, the situation in the developed countries, which are the importers is rapidly changing but producers in the developing countries are not well informed of the recent trends in the world market. The preset training course will consolidate for the participants the recent advances in the production, quality control and market trends to update their knowledge and augment their expertise to meet the new challenges of the international market.

OBJECTIVES

The training course will invite participants from the developing countries engaged in the production of essential oils to enable them to gain knowledge, improve their skills and interact with specialists in the field for the benefit of their home states. The training course will impart training to the participants on the recent production technologies, research methodologies and quality improvement measures for essential oils. The training course will update their knowledge on the present world trends in the essential oils.

EXPECTED OUTPUTS

Participants will be trained on the state-of-the-art production technologies, standardization and quality control of essential oils. They will be acquainted with regulatory aspects and marketing of essential oils besides getting practical experience on the research methodologies. Active interaction among the participants will help to develop productive collaborations among them. The programme will address the problems of participating

countries to improve their essential oil processing capacity and capability. The participants are expected to contribute for the benefit of their home state on their return.

STRUCTURE OF THE TRAINING COURSE

The course will consist of five different types of activities:

- Lectures and hand-outs
- Hands-on (individually accessed) laboratory experiments
- Instrumental analysis practicals
- Pilot plant demonstrations
- Round-table discussion

PARTICIPATION

The training course is directed to participants from developing countries, who are working in the area of production and/or research on aromatic plants and essential oils. A maximum of 14 participants will be admitted to the training course representing different parts of the world.

ICS-UNIDO will, in co-operation with the course coordinator, select the participants from the applications received, giving due regard to professional qualifications, experience and other relevant considerations. The course coordinator will select the candidates from the host country.

Each participant will present his/her country status report on aromatic plants based industry at a session reserved for this and it should be elaborative enough to give the panoramic view of the industrial and research status of aromatic plants and essential oils in his/her own country. Participants will submit a set of one hard and soft copy (preferably in word) of their report to the course coordinator at the beginning of the training course.

Participants will attend the whole activity according to the schedule prepared by the host authorities and comply with the rules and regulations laid down for their Training.

TENTATIVE PROGRAMME

13-14 November -weekend		Arrival of participants
15 November Monday	10.00-10.30	Opening ceremony
	10.30-11.00	Tea break
	11.00-12.00	Introduction to the training course
	14.00-17.00	Lectures on essential oils
	19.00-21.00	Welcome reception
16 November Tuesday	09.00-12.00	Lecture on laboratory techniques
	14.00-17.00	Laboratory experiments*

17 November Wednesday	09.00-12.00	Laboratory experiments*
	14.00-17.00	Pilot plant experiments: Distillation
18 November Thursday	09.00-12.00	Pilot plant experiments: Fractional distillation
	14.00-17.00	Analytical practicals: Physicochemical tests and Instrumental analysis (GC and GC/MS)
19 November Friday	09.00-12.00	Olfactory evaluation of essential oils
	14.00-16.00	Round table discussion
	16.00-16.30	Tea break
	16.30-17.00	Closing ceremony
	19.00-22.00	Closing dinner

* Participants will be divided into two groups for hands-on experiments. While Group A is doing distilation, simultaneously Group B will do extraction, and *vice versa.*

Unless indicated otherwise, every day lunch will be served between 12.00-14.00 and tea breaks will be at 10.30-11.00 and 15.30-16.00.

DOCUMENTATION

The documents available for the training course will be:

1. Aide-mémoire of the training course.
2. Programme and list of participants.
3. Lecture notes.

LANGUAGE

The training course will be conducted in English and no translation facilities will be available. It is expected that the participants have a good command of English.

TIME AND VENUE

The course will be held at TBAM of the Anadolu University at Eskisehir, Turkey. Foreign participants will be staying at the **Hotel Anadolu, Anadolu University Campus,** Eskisehir, Turkey.

FINANCIAL ADMINISTRATIVE ARRANGEMENTS FOR UNIDO-ICS FINANCED PARTICIPANTS

For those who will be invited by UNIDO-ICS to participate in the training course, round-trip air-economy transportation from the airport of departure will be arranged and prepaid tickets issued where necessary.

A daily allowance to cover board and lodging will be provided upon arrival to Eskisehir.

The participants will be required to bear the following costs:

All expenses in their home country incidental to travel abroad, including expenditures for passport, visa, and any other miscellaneous items. UNIDO-ICS will not assume responsibility for any of the following costs, which may be incurred by the participant while attending the course:

1. compensation for salary or related allowances during the period of the course;
2. any costs incurred with respect to insurance, medical bills and hospitalization fees;
3. compensation in the event of death, disability or illness;
4. loss or damage to personal property of participants while attending the course.

VISA ARRANGEMENTS

Participants are requested to arrange for their visa as early as possible at the Turkish Embassy in their home country. In case of difficulties, please advise the contact person mentioned below.

CONTACT PERSON

For additional information, please contact:

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TBAM - ICS / UNIDO

MEDICINAL AND AROMATIC PLANT AND DRUG RESEARCH CENTRE (TBAM) ANADOLU UNIVERSITY

INTERNATIONAL CENTRE FOR SCIENCE AND HIGH TECHNOLOGY

Training Course on Quality Improvement of Essential Oils

15-19 November 1999 Eskişehir, Turkey

PROGRAM

15 November Monday	10.00-10.30	Opening Ceremony (TBAM Seminar Hall) Opening Speeches by Prof.Dr.K.H.C.Başer Director of TBAM and Dr.K.Vasisht, ICS Representative
	11.00-12.00	Introduction to the Course Program (K.H.C.Başer)
	14.00-15.30	Essential Oil Extraction from Natural Products: Conventional Methods (K.H.C.Başer)
	16.00-17.30	Essential Oil Extraction from Natural Products: Modern Methods (K.H.C.Başer)
	18.30-20.30	Opening Banquet
16 November Tuesday	09.00-12.00	Essential Oil Distillation Techniques: Bench-scale and Pilot-Plant Scale Productions (M.Kara, N.Azcan)
	14.00-17.00	Rectification of Essential Oils: Theory and Practice (M.Kara, N.Azcan)
17 November Wednesday	09.00-12.00	Standard and Pharmacopoeial Analyses of Essential Oils (E.Sezik)
	14.00-17.00	Headspace, SPME, SFE and Phytosol Techniques (T.Özek, M.Kürkçüoğlu, B.Bozan)
18 November Thursday	09.00-12.00	Olfactory Evaluation of Essential Oils: Theoretical aspects (M.Chmielewska)
	14.00-17.00	Microdistillation, Molecular Distillation, SDE, GC, GC/MS, GC/FTIR and MDGC/MS Techniques (T.Özek, M.Kürkçüoğlu, B.Demirci, F.Demirci, N.Tabanca, İ.Boydağ)
19 November Friday	09.00-12.00	Olfactory Evaluation of Essential Oils: Practical Aspects (M.Chmielewska)
	14.00-16.00	Round Table Discussion
	16.00-16.30	Tea Break
	16.30-17.00	Closing Ceremony and Distribution of Certificates
	19.00-22.00	Closing Dinner

Note: Tea Breaks: 10.30-11.00 and 15.30-16.00

Lunch Break: 12.00-14.00

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ANADOLU UNIVERSITY

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15-19 November 1999 Eskişehir, Turkey

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INTERNATIONAL CENTRE FOR SCIENCE AND HIGH TECHNOLOGY

Training Course on Quality Improvement of Essential Oils

15-19 November 1999 Eskişehir, Turkey

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INTERNATIONAL CENTRE FOR SCIENCE AND HIGH TECHNOLOGY

Training Course on Quality Improvement of Essential Oils

15-19 November 1999 Eskişehir, Turkey

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UNIDO International Centre for Science and High Technology

CERTIFICATE

This is to certify that

_____

has attended the

TRAINING COURSE ON QUALITY IMPROVEMENT OF ESSENTIAL OILS

Eskisehir, Turkey

15-19 November 1999

held at the

Medicinal and Aromatic Plant and Drug Research Centre (TBAM), Anadolu University, Eskisehir, Turkey

K.H.C. Baser
Director
(TBAM)
Anadolu University

G. Longo
Programme Officer
Earth, Environmental and
Marine Sciences and Technologies
ICS-UNIDO

COUNTRY - STATUS REPORT

STATUS OF RESEARCH AND AROMATIC PLANTS BASED INDUSTRY IN INDIA

Presented by

DR. MANINDER KARAN

UNIVERSITY INSTITUTE OF PHARMACEUTICAL SCIENCES

PANJAB UNIVERSITY

CHANDIGARH-160014

INDIA

At

TBAM-ICS/UNIDO sponsored

'Training Course on Quality Improvement of Essential Oils'

15-19 November, 1999, Eskisehir, Turkey.

Perfume is as old as civilization in itself and India has a perfumery tradition that dates back to over 5,000 years to Indus Valley civilization. Distilling vessels discovered there are very similar to those still used today be traditional perfumers of North India. What distinguishes this art and craft is the simple equipment which can easily be transported from place to place and which can be manufactured and repaired out of readily available materials. Copper, bamboo, clay, and grass are the basic materials required for construction and if a water source is at hand then a distilling operation can be set up even in the most rural settings (as is often done). Perfumes, one time products for the elite coming from essential oils, are presently finding expanding uses in a host of daily use consumer items such as cosmetics, soaps, food, drugs and pharmaceuticals etc. Perfumes are perhaps among the very few consumer commodities that bear a direct and mute link between the grassroot villages with high class societies. Besides perfumery, there are recorded examples of several aromatic plants presently in use for medication.

Essential oils of natural origin enjoy the reputation of raw materials of choice for the manufacture of perfumes. This is because most of the essential oils in demand are unique in constitution, chemistry and composition of a large number of compounds (sometimes more than 200) and are not amenable to synthesis. India has been a traditional supplier of natural perfumery materials while India, Egypt and Persia were amongst the first countries to have conceived the process of distillation for obtaining volatile oils. Rose flowers were distilled in India more than 1000 years B.C. and during Moghul period oriental types of perfumes like "Attars' were developed and exported to other countries.

India possesses a great wealth of aromatic plants the exact details of which, unit recent times, have been little known outside the country. Even at this time very little authentic information about plants such as Kadam (*Anthocephalus cadamba*), Parijat (*Nycanthes arbortris-tis*), Bakul (*Mimopsus elengi*), Lotus

(*Nelumbo necifera*), Water Lily (*Nymphae nouchalii*), Golden Champa (*Michelia champaca*) and Kewds (*Pandaus odoratissimus*) has been available. These exotic scents have played a very important role in Indian culture and have been used in indigenous medicines, perfumes, and cosmetics since ancient times. With the rise of aromatherapy as an important aid in re-establishing physical, mental and emotional equilibrium through the gentle agency of fragrance a new interest in the ways ancient cultures have used their natural aromatic resources has awakened. Today we are entering a phase where countries like Indian can provide a whole new palette of exotic aromatics which, apart from any practical therapeutic they may possess, offer us aesthetic windows in the heart and soul of a people, in a non-verbal intuitive way.

Of late there has been a spurt in the production of essential oils and at present 30 percent of fine chemicals used in perfumes and flavours comes from essential oils. A large number of R & D institutions in government as well as private sector are presently involved in this direction.

RESEARCH, PRODUCTION, MARKETING AND TRADE IN INDIA

(A) RESEARCH AND DEVELOPMENT

The medicinal and aromatic plants at raw material stage are dealt by several R&D organisations in Government of India. In the Ministry of Agriculture, the Department of Agricultural Research and Education (DARE) is responsible for research work on these crops under the aegis of Indian Council of Agricultural Research (ICAR) which has a network of National Research Institutes and State Agricultural Universities. The developmental part is taken care of under Division of Horticulture in the Ministry itself. The Department of Science and Technology (DST) has a similar chain of Research Institutes under the aegis of the Council of Scientific and Industrial Research (CSIR) and a few of these institutes carries out research work on these plants. Broadly speaking all aspects of Agricultural

research fall in the domain of ICAR and technological aspects related to processing, purification and development come in the purview of CSIR. However, this division is not always strictly followed resulting in several areas of research where both have contributed significantly resulting in development of new varieties and improved cultivation practices. Similarly, the Ministry of Health and Family Welfare operate through the Central Council of Research in Ayurveda and Siddha (CCRAS) and Ministry of Environment and Forests through it constituent Research set up *viz.* The Indian council of Forestry Research (ICFR); it has on roll one of the oldest research institute working on first species namely The Forest Research Institute, Dehradun which is also working in this sector. Many important industrial houses like Hindustan Lever Ltd., Richardson Hindustan Ltd., S.H. Kelkar and Co., Camphor Allied Products, Naarden, Bush, Brooke & Allen etc. are actively engaged in development of essential oil industry in this country.

A summarized list of the organizations involved in all aspects of education, research, extension in agriculture sector and development of technological skills etc. is listed below:

(1) The Indian Council of Agricultural Research

- *Teaching in Medicinal and Aromatic crops at Agricultural Universities*
- *All India Co-ordinated Research Project on Medicinal and Aromatic Plants (AICRP - M&AP)*
- *Central Agricultural Institutes*
  - *National Bureau of Plant Genetic Resources, Delhi*
  - *Indian Institute of Horticultural Research, Bangalore*
- *State Agricultural Universities*
  - *The Gujarat Agriculture University, Anand (Gujarat)*
  - *Dr.Y.S. Parmar University of Horticulture and Forestry, Solan (HP)*
  - *Jawaharlal Nehru Krishi Vishwa Vidhyalaya, Indore (M.P.)*
  - *Jawaharlal Nehru Krishi Vishwa Vidhyalaya, Regional Research Station, Mandsaur (M.P.)*
  - *Rejasthan Agriculture University, RCA, Udaipur (Rajasthan)*

- *Acharya Narender Dev University of Agriculture and Technology, Faizabad (U.P.)*
- *Kerala Agricultural University, Trichur (Kerala)*
- *Tamil Nadu Agricultural University, Horticulture Research Station, Kodaikanal (T.N.)*
- *Punjabrao Krishi Vishwa Vidhyalaya, Akola (Maharashtra)*
- *Haryana Agricultural University, Hissar (Haryana)*
- *Panjab Agricultural University, Ludhiana (Punjab)*
- *G.B. Pant University of Agriculture and Technology, Pantnagar*
- *The Andhra Pradesh Agricultural University, Hyderabad*
- *National Research Centre (NRC), Anand*

(2) Department of Agriculture and Co-operation, Delhi

(3) Department of Biotechnology (DBT), Delhi

(4) The Council of Scientific and Industrial Research (CSIR)

- *The Central Institute of Medicinal and Aromatic Plants (CIMAP), Lucknow*
- *Regional Research Laboratory, Jammu (J&K)*
- *Regional Research Laboratory, Jorhat (Assam)*
- *Regional Research Laboratory, Bhubaneshwar (Orissa)*

(5) Central Council of Research in Indian Systems of Medicine (CCRAS)

(B) AREA AND PRODUCTION

Market surveillance and analysis in this sector has not received regular update institutional support, as a result, there is little published data on the exact details of area, production and consumption of different aromatic plants. Table-1 lists approximate area under cultivation of major aromatic plants in India.

In India, the estimated production of perfumery raw material is around 5000 tonnes per annum valued at more than Rs.400 crores and the total consumption of perfumery and flavouring material is about 3,800 tonnes valued at Rs.100 crores.

Table 1: Area under cultivation of major Aromatic Plants in India (after Gupta, 1993).

S.No.	Crops	Estimated Area	Major states where cultivated
1.	Japanese mint	10,000 ha	U.P. and Punjab
2.	Lemongrass	20,000 ha	Kerala
3.	Palmarosa oil grass	2,000 ha	U.P., Karnataka, Andhra Pradesh, Maharashtra, Madhya Pradesh, Tamil Nadu
4.	Sandalwood oil	-	Karnataka and Tamil Nadu
5.	Celery	3,000-5,000 ha	Punjab and Western U.P.
6.	Basil	500 ha	U.P.
7.	Vetiver	Scattered in small acreage	Kerala, Tamil, Nadu & Karnataka
8.	Jasmine	2,000 ha	Tamil Nadu, Karnataka and Andhra Pradesh
9.	Damisk Rose	3,000 ha	U.P.
10.	Rose Geranium	2,000 ha	Tamil Nadu and Karnataka
11.	Saffron	3,000 ha	Jammu & Kashmir
12.	Hops	800-1,000 ha	Kashmir & Himachal Pradesh
13.	Davana	500 ha	Karnataka and Andhra Pradesh

There are about 400 blenders in India. They buy natural essential oils from distillers and prepare industrial perfumes and aromatic chemicals by either mixing one variety with the other or blending the essential oils with fine chemicals. According to an estimate 90 percent of the present requirement of essential oils in the country is met by the indigenous production and 10 percent from imports. Peppermint, spearmint and other mint oils constitute approximately 68 percent of the total volume of the production of essential oils in the country. Other important varieties which constitute 28 percent are : Basil oil, Citronella, Eucalyptus, Lemongrass, Plamarosa, Sandalwood and Vetiver oils.

The Association of Essential Oil Manufacturers in India estimated growth in export value from Rs.50 crore in 1991-92 to Rs.125 crore in 1995-96. Many developing countries including India produce most of the spices like coriander,

cumin seed, clove, cardamom, cinnamon, nutmeg and ginger and essential oils/oleoresins from these are exported in crude form to the developed countries for further processing. A large number of R & D institutions in government as well as private sector are presently involved in developing latest technologies to process essential oils and oleoresins from spices for exporting these in finished form.

(C) MARKETING AND WORLD TRADE

INDIAN AROMA CHEMICAL INDUSTRY - A PERSPECTIVE

The Indian aroma chemical industry is comparatively very young and was developed largely due the efforts of a few Indian enterpreneurs/fragrance manufactures between the year of 1950 and 1960. In order to control the outflow of the precious foreign exchange and avoid an adverse balance of payment situation, the Government of India imposed a ban on the import of finished perfumes and selected aroma chemicals. The policy which continued for almost two decades provided the local aroma chemical manufacturers a definite assured market and at the same time catalysed the development and R&D of new perfume ingredients from locally available raw materials. The few major products developed during this period were based on natural essential oils like Ionones and Methyl Ionone from Lemon grass oil, Geranoil from Palmarosa oil, besides Amyl acetate and Amyl salicylate from Amyl alcohol isolated from fused oil, a by product of the sugar industry. The scale of manufacturing activity during this period was mainly on a small scale with the quality of materials produced showing considerable fluctuations. However, during the sixties as a result of heavy investment made in research and development activity several new perfumery products were produced on a viable commercial scale with emphasis on quality. Some of the products during this period were : i. Eugenol Methyl Eugenol from clove leaf oil; ii. Citronellol, hydrocitronellol from, Jaya citronellol oil; iii. Linalool

from Bois de rose oil; iv. Yara-Yara and Nerolin Bromelia from Beta-Naphthol; v. Santalol from Sandalwood oil; vi. Vetiveryl acetate from Vetivert oil; vii. Amyl cinnamic aldehyde; viii. Various esters such as acetate, formates, butyrates, propionates, benzoates, salicylates, phenyl acetates etc. of various alcohols such as Methanol, Ethanol; Isobutanol, Amyl alcohol. During the period, the locally produced aroma chemicals had to complete with imported materials both in price and quality. The emerging perfume/flavour industry automatically adopted the international standards for purity and odour as a basic requirement of the manufacturing activity. This international competition also enabled the local manufacturers to gain a good perspective of the perfumery industry related to the proper material balance, economic scale of operations, investments in proper equipment for manufacturing and quality control operations. Perfumery chemical from Turpentine (Alpha & Beta Pinenes, carene, longifolene e.g. Acetyl arene, Acetyl longifolene, Camphor, Isoborneol, Isobornyl acetate, Isobornyl (methoxy cyclohexanol) are now available in the country. Currently over 300 different aroma chemicals are locally made in the country for perfumery and flavour applications. During the eighties the country has witnessed considerable development and increase in the production of essential oils especially, Citronella (Java), Mint oils such as Peppermint, arvensis mint, spearmint, basil oil, Jammu Lemongrass oil, Mentha citrata. Also the all-round development of the chemical industry has rendered infrastructural facilities available for isolation and synthesis of aroma chemicals. Thus in recent years, different products such as Menthol, different grades of processed dementholised arvensis oil, methyl chavicol, anethole, linalool, linalyl acetate, cypriol, mint terpenes are produced and these are available for fragrance and flavours.

Today, Indian Cosmetic Industry can match the challenge of high standards in quality, price and offer variety of items for export. India is geared up to meet the increasing demand from countries all over the world. From the snow clad

Himalayas down to Kanyakumari in the South, India is a veritable emporium of oils and medicinal plants. These are as essential to life as pharmaceuticals, engineering or chemical products.

Top Home ESSENTIAL OILS they have use in aromatherapy, cosmetics, as disinfectants and insect repellents. India has rich biodiversity and geoclimatic conditions for essential oil bearing crops. The industry has enormous scope for growth and to provide employment opportunities for rural poor and to provide foreign exchange. The share of the industry is hardly 2.5% of the international market which is around 25,000 crores.

Amongst the oils exported, Sandalwood still holds the most enviable position as the 'queen of essential oils' and is a virtual monopoly of India. The tree grows to a height of 30 feet, has a girth of one metre, takes 60 years to grow and gives out fragrance for over 80 years. Out of the total world production of 400 mts of Sandalwood oil, 200 mts is produced in India. India is also the second largest producer and exporter of Jasmine and Tube-rose concrete to the world market. Besides very high unit price fetched by the produce the advantage lies in the fact, that it is not amenable to synthesis/reconstitution of their fragrances because of complex aroma which is made of a very large number of compounds (approx. 275 in oil of rose). Such plantation crops have remote chances of losing market through introduction of synthetics in the near future. While the above are some of the aromatic plants of Indian origin, a plethora of exotic aromatic plants have found their way into India, some as a result of enormous research and some through the enthusiastic nature lovers of the days of British rule. A few of these exotic plants are Japanese Mint, Peppermint, Java, Citronella, Lavender Geranium, Eucalyptus, Patchouli, etc. and interestingly 68 percent of the total volume of the production of essential oils comes from these exotic plants and 28 percent comes from the indigenous plants. The position of Mint oils - Arvensis, Piperita, Citrata and Spicata has put India on the world map and we are major

exporters of Menthol and Mentha Piperita. Mint oils occupy highest place in terms of quantity and value.

The growth in demand of the perfumery raw material is very fast in the world trade. The modern fragrance industry developed in India around the early twentieth century was entirely based on the locally available natural products/perfumery ingredients. Many perfumery/consumer products developed by the local manufactures were successful and fitting to the local taste/liking than the imported fragrance compounds available in the market. Presently, there are more than 400 Indian companies developing and marketing fragrances for use in toilet soaps, laundry soaps, detergents, agarbathis (incense sticks), cosmetics and toiletries, aerosols, sprays, personal perfumes (Attar). To promote Indian fragrances and perfumery ingredients to foreign market and earn foreign exchange, Indian manufacturers have also started 100% export-oriented units. This activity has been found promising and encouraging as evidenced by the results in the export of fragrance and ingredients to the various end-product industries of the developing country. Presently, the consumption of fragrances in India is rapidly growing due to the expanding mass-based consumers product markets evidenced in recent years. To meet this situation the local fragrance industry in recent years has developed the necessary skills, capability and expertise for creating fragrances suitable for the product formulations produced by the local consumer product industries. Resinoids like Benzoin, Olibanum, Labdnaum & Oakmoss, which were imported in earlier year for fragrance are new being locally manufactured in India in collaboration with foreign perfumery houses meeting the requirements and expectations of the fragrance manufacturers in terms of product specification and odour profiles.

Flavour is the deciding factor for the acceptability of an food product by the consumer, and flavour industry plays a vital role in the growth of food and beverage industries all over the world. The even expanding beverage and

convenience food industry and also the manufacturer of nutritional food production depend totally on flavour houses for the cost made flavours to build the image of their products. Flavour is a mixture of odoriferous substances like aroma chemicals, essential oils of natural ingredients with a composition similar to fragrances. The difference exists in the ingredients used for the production of flavour. The ingredients of flavours are governed by the flavour legislation. Organisations like EEC (Europe), FDA (US), FEMA (Flavour Extractor Manufacturer's Association) IOFI (International Organisation of Flavour Industry, Geneve). These organisations continuously screen the ingredients and ban the use of those ingredients which are found to be harmful. The growth of the flavour industry in India has also closely alligned with the growth of the end user industries (Estimated annual total flavour Rs. 1500 Million) such as soft drinks and beverages, biscuits, confectionery, syrups, ice creams and other milk-based products, hard beverages (liquors etc.), pharmaceuticals, bottled and canned products, dry flavour concentrates, mouth fresheners, chewing tobacco and pan masala. The expansion of the food industries producing processed food products such extruded products, snacks and fast foods, has created new vistas for the country's growing flavour industry. The salient features of the Indian flavour industry are :- (i) The flavours presently manufactured in the country are of liquid, paste, supported, spray-dried or encapsulated types. (ii) Modern techniques of manufacture incorporating Good Manufacturing Practices with strict quality control procedures are followed. (iii) The manufacture of flavours in India for all application conform to Government regulations such as the pFA act and its amendments. (iv) The level of expertise in the flavour area is also high and highly experienced technocrats with a good knowledge of the conditions of the end user industries and the necessary expertise/experience of making quality flavour ingredients and flavours are engaged in flavour Manufacturing Industries. Although the Indian flavour industry started with imported flavours the present

progress of the country's flavour industry using locally produced ingredients and blends is so encouraging, that the coming years will definitely witness the country making a debut and strong impact in the world market as one of the major and viable suppliers of natural flavour raw materials and finished flavour blends based entirely on locally produced natural products.

OLEORESINS & SPICE OILS Oleoresins are active ingredients of Spices obtained by solved extraction and possess all the characteristics like taste and colour. Curcumin of Turmeric, Carotenoid pigments of Paprica, Capsicum and chlorophyll of black pepper give colour to the Oleoresin. The taste and colour are the important features of Oleoresins. The position of this segment of this industry is indeed enviable. India exported about 2.5 lakh tons of spices in crude form worth 750 crores which is about 40% of the world trade. India produced oleoresins from capsicum, black pepper, cardamom, coriander, cumin, chilly, tumeric, celery, ginger, fennel and fenugreek. These have considerable use in food processing and flavour industry. Use of oleoresins have advantage of consistency, shelf life, ease of storing and safety from microbiological contamination. The world demand for oleoresins is about 3000 M.T and our capacity of spice oleoresins is about 4500 M.T. Persistent quality assurance as regards olfactory aspect and other physical constant is necessary.

SPICE ESSENTIAL OILS The concerned spice is well ground, soaked and subjected to steam distillation in a S.S. container to avoid colouration. They are suitably mixed with Propylene Glycol to avoid evaporation of the low volatiles. Spice oil free of terpenes and sesquiterpenes are produced by counter current extraction, with polar and non polar solvents. The installed capacity is 500 M.T. against an export performance of 300 M.T. (1995-96) @ 60%. The spice oils give aroma to the food. To utilise the surplus capacity we have to explore the new market, get to know the trends and needs. We have to improve technology for

consistent quality, competitive pricing, and schedule for supplies. The days ahead have positively a promising and happy note.

Though a few traditional essential oils were exported from India before 1970, there was no major essential oil or spice oil/oleoresin industry in our country. Today, however, India has more than enough capacity to produce the world requirements of a few essential oils as well as spice oils and oleoresins.

India traditionally known as the land of spices contributes significantly to the world production and consumption of land (20 lakh tonnes per annum of value exceeding Rs. 42 billions). Out of this only a small quantity is exported as the bulk of the produce is consumed in the country itself. The real boost to the spice export from India comes from black pepper and chillies which hold the key to the world market. The exports shot up from 892 tonnes in 1990-91 to 1,132 tonnes in 1992-93. Another area where India has performed well is spice oils and oleoresins. The spice oils, oleoresins and citurs oils are the major flavourings used in the food industry. The production and export of spice oils and oleoresins from India have increased steadily since 1970. The export of spice oils and oleoresins now ranks high, next to chilli and black pepper. The total European market for flavour and fragrances was estimated around 1,00,000 t in 1991, of which flavour accounted for 40% and the rest going to fragrances. In this context, CHEMEXIL (Bombay) has reported India to have a total perfume market valued at Rs.456 crore, which is just less than 2.0% of the total world market in perfumery products during 1994-95.

The decade of nineties will go down in the Indian history for heralding liberalisation in farm based economy. The post-GATT scenario has brought liberalisation in imports, reduction in duties and connected the hither-to protected national economy (both demand and prices of local farm produce) with the global market economy by developing strong linkages. This is going to influence markets for several traditionally grown crops in India. For example, during 1993-

94, the price of oil of Lemon grass, Citronella and Eucalyptus has gone down significantly due to competition with imported oils and their derived aroma chemicals. The Citronella oil provides example where the price soared to an all time high of Rs.380 per kg in 1993 but declined in 1994 to Rs.270 per kg and even at this price the manufacturing units of aroma-chemicals find imported isolates to be more competitive. This developing situation demands higher investment by user industries in research and development programmes in this sector. It also calls for more efficient management of inputs by growers to maintain competitive value of the native farm produce to survive competition from imported materials. The overall picture for future developments in the sector is bright considering the existing strong research base in this sector and the high technological skill which may allow India to emerge as a provider of technological services in the plantation sector in the post GATT years. These advantages may also open up strong possibilities of collaborations coming to India with market leaders from industrial countries to protect against wide fluctuation in the raw material price and competition with established outside selling organisations.

INDIAN SCENARIO

By R.K. THAPPA

A. Cultivated Herbaceous Plants

(a). Mint Oils

1. Cornmint (*Mentha arvensis)*	16,000 Tons/annum	Indian Perfumer, (1997) **41**(3), III.
2. Peppermint *(M. piperita*)	300 Tons/annum	Indian Perfumer, (1997) **41**(3), III.
3. Spearmint *(M. spicata*)	150 Tons/annum	Indian Perfumer, (1997) **41**(3), III.
4. Bergamot *(M.citrata*)		

(b). Basil Oils or "Tulsa-oils"

5. Indian basil oil (*Ocimum basilicum* , methylchavicol type) 700 tons/annum
6. *Ocimum canum* oil (linalool type)
7. *Ocimum canum* oil (methyl cinnamate type)
8. Clocimum oil (*O. gratissimum*, eugenol type)

(c). Cymbopogon species

9. Lemongrass oil
   (*Cymbopogon citratus,* West Indian and *Cymbopogon flexuosus*, East Indian)
   and recently introduced North Indian or Jammu lemongrass (RRL-16, *Cymbopogon pendulus*) and improved strain CKP-25 (*C. khasianus* X *C. pendulus*)
10. Java Citronella (*Cymbopogon winterianus*)
11. Palmrosa (*Cymbopogon martinii* var. motia) wild & cultivated
12. Ginger grass (*Cymbopogon martinii* var. sofia) wild & cultivated
13. Jamrosa oil (RRL-14, *Cymbopogon khasianus*) for geraniol
    and (RRL-82, *Cymbopogon jawarancusa* X *C. nardus)*
14. Cymbopogon species α-bisalolol type (RRL-Cf-100, *Cymbopogon flexuosus*)

(d). Others

Lavender oil (*Lavendula angustifolia* subsp. *angustifolia* syn. *L. officinalis* Chaix, *L. vera* DC.)
Geranium oil (*Pelargoniun graveolens* L.)
Patchouli oil (*Pogostemon cablin*)
Rosemary oil (*Rosamarinus officinalis*)
Davana oil (*Artemisia pallens*)

Clary-sage (*Salvia scalarea*)

(e). Flower oils

Rose oil & water (*Rosa damascena*)
Jasmine concrete & absolute (*Jasminum grandiflorum*)
Tuberose concrete & absolute (*Polyanthes tuberosa*)
Matricaria oil (*Matricaria chamomila*) wild & cultivated

(f). Seed oils

Muskdana oil

B. Woody Perennials

Turpentine oil
Sandalwood oil (*Santalum album)*
Himalayan Cedarwood oil (*Cedrus deodara)*
Eucalyptus oils
- *Eucalyptus globulus* oil
- *Eucalyptus tereticornis* oil (Eucalyptus hybrid)
- *Eucalyptus citriodora* oil

Juniper oils
- Juniper berry oil (*Juniperus communis*)
- Juniper leaf oil (*Juniperus communis*)
- *Juniperus semiglobosa* leaf oil

Litsea cubeba,

Other Forest Products
Vetiver (*Vetiveria zizanioides* root oil)
Ferula oil (*Ferula jaeschkeana* root oil)
Iris butter
Angelica root oil (*Archangelica officinalis* syn. *Angelica archangelica*)
Choora root oil (*Angelica glauca*)
Spike nard oil
Nagarmotha oil (*Cyperus rotundus & Cyperus sacriasus*)
Jatamansi oil (*Nardostachyus jatamansi*)
Valerian oil
Calamus root oil (*Acorus calamus*)

Costus root oil (*Sassurea lappa*)
Sughand kokila oil
Sughand mantri oil
Kewda oil
Kapoor-kachiri oil
Kalungi oil
Galinga oil
Cade oil
Tagetes oil *(Tagetes minuta* oil) wild & cultivated
Tree moss resinoid
Skimmia leaf oil
Artemisia vestita oil
Tomar seed oil (Zanthoxylum oil)
Carrot seed oil

Spices, Spices oils and Spice-oleoresins
(Spices export during 1996-97, Rs. 1200 crore or $ 350 million, Indian Perf., (1997) **41**(2), I)
Ajowan oil
Caraway oil
Coriander oil
Coriander oil
Anise (Fennel) oil
Dill seed oil
Cumin seed oil
Celery seed oil
Anethi oil
Clove
Cinnamon bark oil (Cinnamomum)
Cinnamon leaf oil
Nutmeg oil
Mace oil
Cassia oil
Black pepper oil
Cardamon oil
Large cardamon oil
Nukachoor oil
Turmeric oil

Ginger oil
Cajupet oil
Hops

Citrus species
Orange oil
Lemon oil
Lime oil
Petitgrain oils

REGIONAL RESEARCH LABORATORY, JAMMU :
IN THE SERVICE OF NATION FOR THE LAST FOUR DECADES

01. Agrotechnology packages of the following genetically upgraded cultivars developed and standardised :

Anethum graveolens , *Apium graveolens* , Lemongrass (RRL - 16 , CPK - 25*)* , *Jamrosa* (RRL - 82 , RRL - 14 ,RRL - CN - 5 *)*, *Cymbopogon flexuosus* RRL-Cf-100 (α- bisabolol rich*)* *Eucalyptus citriodora* , *Humulus lupulus* , *Matricaria chamomilla* , *Mentha arvensis* ,*M. citrata* , *M. piperita* ,*M. spicata* , *Ocimum canum* RRL - Oc - 11- Linalool rich and RRL-Oc-12 - Methyl cinnamate rich) , *O. gratissimum* RRL-Og-14(Eugenol rich) *O. viride* (Thymol rich).

02. Micropropagation Protocols standardised for the mass-production of the following disease free plants:

Bunium persicum , *Crocus sativus* , *Cymbopogon nardus* , *Eucalyptus citridora,Mentha arvensis* , *M. piperita* , *M. spicata* , *Ocimum viride* ,*O.gratissimum.*

03. Pilot Plant /Turn-Key Processes of proven technologies

Bolder crystals of Menthol from *Mentha arvensis* oil ; Terpineols and terpenyl acetate from α-β pinenes; Pine oil from turpentine oil ; Rosin and turpentine oil from pine-oleoresin ; Disproporsionated resin / Hydrogenated resin & metal resinates ; Citronellol ; citronellal and geraniol esters from *Java citronella* and *Eucalyptus citrodora* oils ; Separation of citral from Lemongrass & *Litsea cubeba* oils; Trans-anethole from Methyl chavicol; Production of citronellol from citronellal.

04. Bench Scale Processes developed for the following industrially important Aroma chemicals.

Production of value added products from dementholised oil such as limonene, octanol, menthone, isomenthone menthyl acetate ; Separation of Linalool and Methyl chavicol from *Ocimum* oils; Menthone - Isomenthone into liquid Menthol ; Menthone-isomenthone into Thymol ; Trans-anethole from Methyl chavicol ; Fractionation of Turpentine oil for the production of high quality , Pinenes, delta-3-carene, longifolene ; Longifolene to isolongifolene ; Production of citronellyl isopropyl ketone, citronellyl methyl ether and rose oxide from Citronellol.

05. Analytical and Testing facility available for conducting the following analytical tests/ evaluations .

Identification and authentication of aromatic plants and Essential oils.

06. Pilot Plant / Workshop facilities available for:

Optimisation of chemical processes on pilotscales and Design drawing,fabrication, installation and commissioning of pilot plants on turn-key basis.

FURTHER INFORMATION CAN BE HAD FROM :

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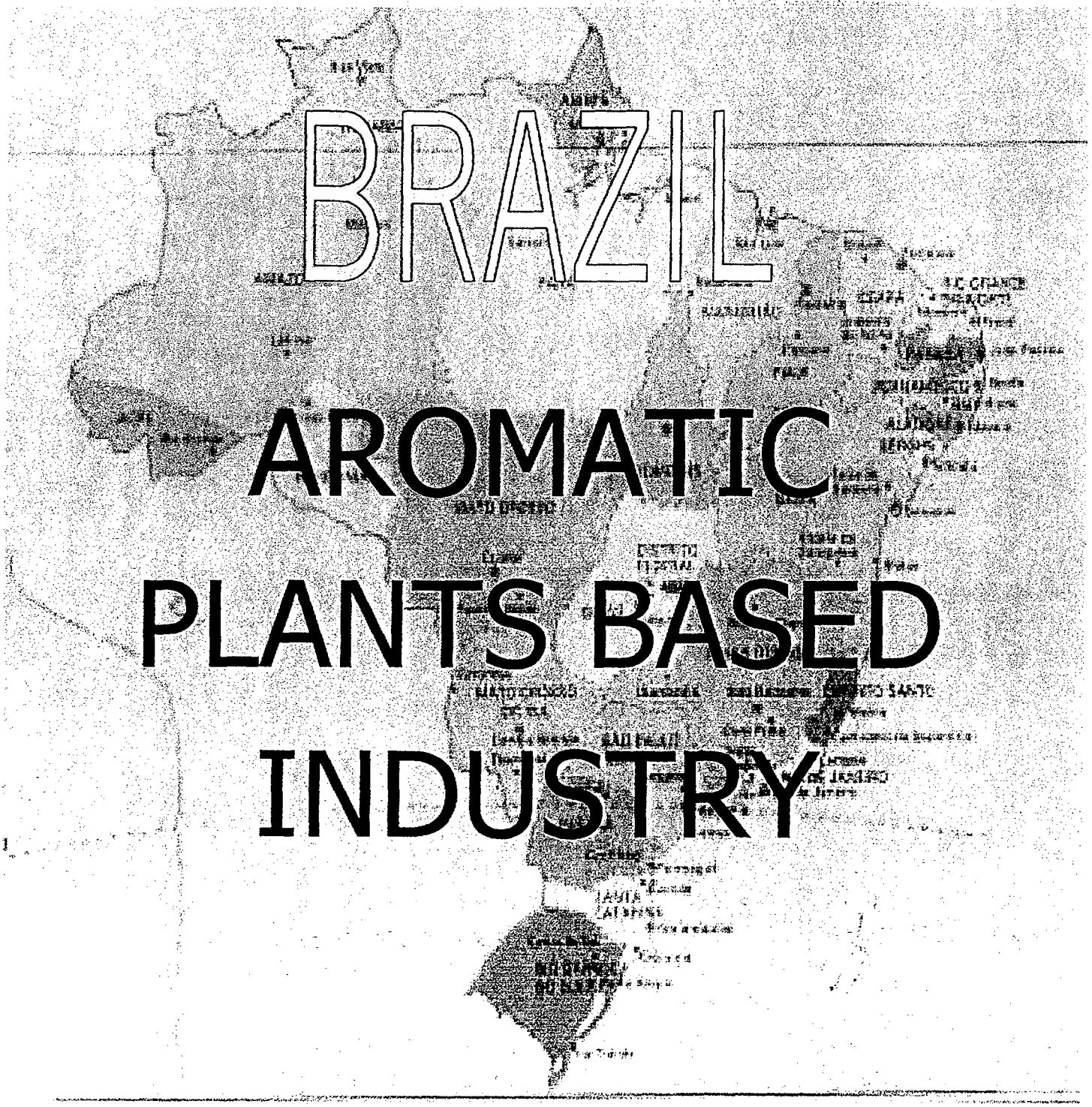

BRAZIL AROMATIC PLANTS BASED INDUSTRY

Oil from cultivated plants

Cymbopogon flexuosus Stapf - "Lemongrass East Indian oil"

Cymbopogon citratus Stapf - "Lemongrass West Indian oil"

(75 - 85% citral)

1 há ⇒ leaves 60 - 90 ton ⇒ 220 kg oil (0,26%)

Cymbopogon martini Stapf - 120 Kg oil/há. Geraniol 90 - 93%.

Cymbopogon nardus Rendle / *Cymbopogon winterianus* Jowitt - Citronella's oil - 180 - 200 kg oil/há

Oils from cultivated plants

Pelargonium graveolens / P. radula / P. terebinthinum / P. capitatum - Fonte de geraniol - Perfumery

Vetiveria zizanioides Stapf - dried roots ⇒ 2% oil vetiverol

Mentha arvensis: oil ⇒ 70% menthol

Pogostemon patchouli - Perfumery

Eucalyptus globulus / E. citriodora / E. staigeriana - cineol / citronelol / geraniol

Citrus limon, Citrus sinensis, Citrus aurantium - food / perfumery

Essential oils from native plants

- *Aniba rosaeodora* Ducke - Pau-rosa (rosewood) - Amazônia - 80 - 90% linalol - perfumery.
- *Ocotea cymbarum* / *O. pretiosa* - Brazilian sassafrás oil - 90% safrol
- *Copaifera reticulata*
- *Myrocarpus frondosus* - farnesol

MINISTRY OF TRADE AND INDUSTRY
ESSENTIAL OILS RESEARH CENTER

REPORT ON CURRENT STATUS OF RESEARCH AND DEVELOPMENT WORK IN ETHIOPIA

TESHOME SISAY
NOVEMBER 1999
ADDIS ABABA
ETHIOPIA

INTRODUCTION

Ethiopia is rich in flora and the variation in wide range of agro climate in the country makes it possible to introduce and grow plants not ingenious to the country even.

Plant derived chemicals production establishes a strong link between agriculture and industry. The agriculture part of the process involves systematic cultivate of aromatic plants that need specific cultural practices and agronomcal requirements and further processing of the material produced that is distillation and extraction.

AROMATIC AND MEDICINAL PLANT OF ETHIOPIA

Essential oils research center is a state owned organization. It has agricultural research site covering 80 ha of irrigable land which is located at about 267 km south of Addis Ababa. It has collected over 200 indiginous as well as exotic plant species. The collected plant species are aromatic, medicinal, insecticidal, and other chemical bearing plants.

Currently four types of oils namely Eucalyptus citrodora, Eucalyptus glublos, Cymbopogon citratus and cymbopogon martinii have been promoted to pilot scale production and these were used in soap factory. Except this, there is no other industrial product of essential oils in the country. Since very recently, government policy towards development of private - Companies involved in processing of biological resources, including spice extracts, essential oils and extracts of medicinal plants appears to be among one of the encouragement.

MAJOR TASKS OF ESSENTIAL OIL RESEARCH CENTER

- Collecting and maintaining planting material of essential oil bearing plants on the field as well as in the store.

- Developing pilot scale production on selected plants

- Under take agronomic and cultural practices studies

- Yield studies of some essential oils for their oil contents.

THE RESEARCH & DEVELOPMENT ACTIVITY

A number of research activities being done in various institution which need to be organized and be in harmony.

The chemistry Department of Addis Ababa University analyzing chemical constitutes of essential oil bearing plant, the Biology Department identifying and collection of medicinal and aromatic plant, the school of pharmacy and medicinal faculty, having curried out a number of biological and pharmacological studies and Essential Oils Research Center Collecting and Growing Various Plant Species used as a field gene bank conservation.

INDUSTRIAL PRODUCTION OF ESSENTIAL OILS AND OLEORESINS

The essential oil research center has produce four types of oils in pilot scale from. Eucalyptus citriodora, Cymbopogon citratus, Cymbopogon martinii and Eucalyptus globuls.

There is a spice extraction factories engaged in the production of chilies oleoresin and parariku oleoresin except the oleoresin from capsicum and ginger (started recently) there is no export of essential oils. However, aromatic gum is exported annually.