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PRODUCTION OF PHARMACEUTICAL MATERIALS FROM MEDICINAL
AND AROMATIC PLANTS - PHASE II

DP/TUR/88/001

TURKEY

Technical report: Findings and recommendations*

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 Norman G. Bisset, pharmacologist

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

United Nations Industrial Development Organization

Vienna

* This document has not been edited.

SUMMARY OF PRINCIPAL RECOMMENDATIONS

1. The first priority is that the Director of the Anadolu University Medicinal Plants Research Centre, Eskişehir, undertake a course in business management. Together with weekly staff meetings, this will lead to improved planning and organization of the activities of the Centre.
2. Further training for the chemical analysts and pharmacologist is required.
3. Further transfer of expertise in chemical engineering and analytical chemistry is required.
4. The activities of the Centre should be extended to the preparation of pure substances from plant extracts and essential oils, as well as the production of purified solvents by fractionation. Additional equipment will be required.
5. The up-dated Turkish Pharmacopoeia will soon become official. The quality-control laboratory of the Centre should be further equipped so as to be able to carry out the full analysis of pharmaceutical products.
6. The Documentation/Information Section must now begin its work and the library budget must be increased to enable it to acquire up-to-date journals and books relevant to the activities of the Centre.
7. The Centre must continue to make its activities more widely known by advertising and publishing scientific papers in reputable international journals and by the attendance of staff at local and international conferences and symposia.

1. Introduction

The first phase of the UNIDO project DP/TUR/83/003, "Production of pharmaceutical materials from medicinal and aromatic plants", ended in December 1987. The progress achieved up to May 1987 was set out in a report by the writer dated June 1987. Among the recommendations put forward in that report was that the project should be extended for a further 3-year period. Phase II of the project has been delayed by about 5 months because of the late signing of the Project Document and did not begin until May 1988. In accordance with the consultant's job description, the present report contains an assessment of the progress made in the technical aspects of Phase I and an up-dated work plan for the 1988/89 period of Phase II.

During the consultant's visit to Turkey, the in-plant training programme on the Utilization of Medicinal and Aromatic Plants in the Pharmaceutical and Related Industries was held from 12 to 30 September 1988 at the Anadolul University Medicinal Plants Research Centre, Eskişehir. The development of this Centre has been one of the major outputs in Phase I of the original project.

2. Activities and Outputs

The status of the technical activities and outputs of the 1987/88 work plan are set out in Annex I. The following paragraphs discuss briefly various points arising from the work plan.

2.1. Activities

A. The buildings housing the pilot plant, laboratories, and offices, etc. were completed after an initial delay of about a year, in the autumn of 1986. Already it is evident that with the expansion of the activities of the Centre additional pilot-plant and laboratory

space is required. An extension to the pilot-plant building will be constructed during the period of the 1988/89 work plan.

B. The current staff of the Centre is listed in Annex II. It comprises 24 part-time and full-time employees, as follows:

Part-time: 6 Pharmacists (including the Director) and 1 chemical engineer (the Deputy Director)

Full-time: 3 Pharmacists, 2 biologists, 5 chemical engineers, 1 librarian, 3 technicians, 1 secretary, 1 labourer, 1 general help

The first seven names on the list (Annex II) are those of the senior staff of the Centre, including the Director and Deputy Director. All these people have part-time appointments at the Centre; they are also staff members of the Anadolu University Faculty of Pharmacy. It is very unsatisfactory that the entire senior staff of the Centre have only part-time appointments. If the Centre is to function effectively, it is essential that senior staff hold full-time positions so that they can devote all their energy to the development of the Centre.

Three new members of staff, two biologists and a pharmacist, have recently been appointed. One of the newly recruited biologists has been taken on to look after the herbarium and also to carry out some botanical field work. One of the part-time pharmacists will be in charge of the pharmacology laboratory and will be assisted by the second biologist when the laboratory is finally established.

Further staff is required in both the pilot plant and the laboratories (Annex III), but it is questionable whether the University

will fund the necessary appointments.

The international project personnel have completed their Phase I assignments and are currently (September 1988) carrying out their first duties in Phase II of the project - for the chemical engineer some 8 months later than originally envisaged.

Only one of the fellowships listed in the previous report has been taken up and the part-time pharmacist/pharmacologist is at present undergoing 3 months initial training abroad in screening techniques - this is a hold-over from Phase I.

D/E. Under the guidance of the consultant chemical engineer additional pilot-plant equipment has been fabricated, mostly from locally available materials:

150 L Fractionation assembly

2000 L Essential-oil distillation unit

Battery of 3 percolators (aqueous), each having a capacity of 2000 L

80 L stainless-steel filtration unit

In addition, a tray drier and a basket centrifuge, both of local manufacture, have been purchased.

All this equipment has been paid for by the Turkish Government.

F. The library and documentation unit is still not able to play its assigned role and the person appointed as librarian has not yet received appropriate training.

G. Collaboration with the Köy Hizmetleri Eskişehir Araştırma Enstitüsü (Eskişehir Rural Services Research Institute), part of the former Topraksu, continues and is expected to expand during the period of the present work plan.

H. Economic mapping of the medicinal-plant flora is not now considered essential to the development of the project.

I. The pilot-plant products obtained up to September 1988 are listed in Annex IV.

2.2. Outputs

1/2. The adaptation and development of technology to meet local industrial needs in the field of aromatic and medicinal plants is continuing and some of the problems dealt with are set out in Annex V. In some cases, progress in resolving the problems is very slow since contact with the firms concerned is at best intermittent; moreover, it also depends on the willingness of the firms to try out the improved technologies put forward by the Centre. It is for this reason that most of the activities given in Annex IV of last year's report are still included in Annex V of the present one.

3. This output is no longer seen as essential to the project at this stage. It is only quite recently that a biologist able to undertake field work has been appointed to the staff of the Centre. The major effort so far has been in familiarizing the staff of the pilot plant and laboratories with the operation and use of their equipment and instruments.

4. No progress has been made in developing the work of the library and documentation unit.

5. So far, it has not been possible to promote enough interest among local industrial firms to make it worthwhile organizing a local in-plant training programme. However, efforts in this direction are being continued.

A very successful international in-plant training course, with 9 participants, has recently (September 1988) been completed.

3. Work Plan 1988/89

Owing to the late start of Phase II of the project, the outputs given in section II.F of the project document must all be rephased.

The current work plan has been drawn up in consultation with the Director of the Centre and the appointed international experts. The expected activities are listed in Annex VI. In some cases it is not possible to give any further detail, since, although a number of firms have been in contact with the Centre, neither has the nature of the problems requiring investigation yet been established nor has agreement to undertake the work required been reached.

4. Recommendations

4.1. The Director of the Centre has not yet undertaken a suitable course in business management. The lack of this training is evident in the rather chaotic organization of the activities of the Centre. It is therefore of the utmost priority that the Director attends a suitable course as soon as possible. This will not only help the organization of the Centre's activities but it will also be of considerable help in the negotiations with industry and commerce.

At the same time, it is important that the Director hold regular weekly meetings with his staff, so that the work of the Centre can be properly planned and executed.

4.2. The training programme has not yet been completed and the following fellowships are still required:

Chemical analysts	2 x 1 m/m (Note 1)
Pharmacologist	1 x 6 m/m

Note 1. For the proper organization of the quality control work in the Centre, it is important that the analysts in charge be given further training particularly in record keeping (including computerized systems) and product documentation and certification.

4.3. Further transfer of expertise is still required and appointment of the following international experts/consultants is recommended:

Chemical engineer	1 x 8 m/m (Note 1)
Analytical chemist	1 x 3 m/m (Note 2)
Short-term consultant	1 x 1 m/m

Note 1. To be divided as follows: 3, 3, and 2 m/m at yearly intervals.

Note 2. Two of the missions to be phased before and after the chemical analysts have received their fellowship training abroad.

4.4. The appointment of national consultants has not so far been very successful. However, bearing in mind some of the problems to be solved, it is recommended that, for example, certain younger academics with appropriate qualifications in the universities at Izmir and Van be approached with offers of a local consultancy.

4.5. As indicated in the previous report, the activities of the Centre should be extended to the isolation of pure substances from plant extracts and isolates from essential oils. The additional equipment required is listed in Annex VII. With the extension of the pilot-plant building in the coming year, it will be possible to set up the fractionating column that has been constructed with the help of the chemical-engineer expert. Production of purified solvents for pharmaceutical, cosmetic, and industrial use will then be possible.

4.6. The up-dated Turkish Pharmacopoeia will soon become official. The Centre should therefore equip itself to undertake the full range of prescribed tests (cf. Annex VII). This will extend the capabilities of the quality-control laboratory and enable it to carry out the analysis of pharmaceutical products, and thus allow the Centre to develop closer contacts with the indigenous pharmaceutical industry.

4.7. The Centre should establish from available statistics the most important essential oils used within the country and also the most important oils that are exported. This will help the Centre to orientate its activities more effectively.

4.8. The Documentation/Information Section of the Centre must now begin to develop its activities and this means that the librarian in charge must receive training in the appropriate technology. It also means that the library of the Centre must receive up-to-date journals and books relevant to its activities (Annex VII); and the budget of this section of the Centre must be increased correspondingly.

4.9. The Advisory Board has not yet been appointed. It is suggested that it be constituted as a Consultative Board and that the Rector of Anadolu University be asked to help in nominating suitable members.

4.10. Report writing is not yet at an appropriate level and ongoing training by the project's international experts is still required.

4.11. Publicizing the activities of the Centre has been partially implemented. But the Centre should also advertise in local technical journals in order to make its activities more widely known. A suitable brochure should be prepared for distribution at the 1989 International Symposium of Fragrances and Flavours which is to be held in New Delhi. The Director should attend this Symposium and present several posters or communications on the essential-oil work that has been carried out at the Centre.

ASSESSMENT OF THE PROGRESS MADE IN PHASE I OF THE PROJECT DP/TUR/83/003, BASED ON THE ELEMENTS SET OUT IN THE ORIGINAL PROJECT DOCUMENT.

Project Elements	Success Criteria	Verifiers	Progress Made	Factors Delaying Progress
<p><u>A. Development Objective</u> Industrial development and utilization of the indigenous plant resources of the country</p>	<p>Development of the capability of producing plant-derived drugs and other preparations and essential oils for local use and export</p>	<p>Availability of products for local use and for export</p>	<p>Products available to local firms</p>	<p>Senior staff only part-time; limited experience of junior staff; managerial organization and authority too concentrated centrally</p>
<p><u>B. Immediate Objectives</u> Setting up of a pilot plant and analytical facility at Anadolu University Medicinal Plants Research Centre as focal point in developing and helping industry to produce medicinal-plant preparations and essential oils</p>	<p>See below</p>		<p>Largely accomplished</p>	<p>Inexperience in developing industrial contacts</p>
<p><u>C. Outputs</u> Adaptation and development of technologies for the production of pharmaceutical materials from selected plant species and of essential oils for use in pharmaceutical and cosmetic preparations</p>	<p>Making available technologies to industrial users</p>	<p>Testing of procedures and products developed in the Centre by industrial users</p>	<p>See outputs 1987/88 work plan, below</p>	<p>Limited pilot-plant and quality-control facilities; slow uptake of technologies by local industries</p>

Project Elements	Success Criteria	Verifiers	Progress Made	Factors Delaying Progress
Building up of R & D services (pilot plant and quality control facilities) for the local pharmaceutical and cosmetic industries to reduce imports and create export potential	Availability of these services at the Centre	Pilot plant and laboratories now established at the Centre		
Economic mapping of the country's spontaneous medicinal and aromatic plants				Not now considered essential to the project
Library and documentation unit for the acquisition and dissemination of information on plant-based pharmaceuticals and essential oils	Availability of the appropriate staff and facilities		Inadequate	Lack of sufficient relevant literature. Lack of trained staff. Inadequate budget resources
Chemical technologists trained in pilot-plant and quality-control work for the future development of the pharmaceutical industry	Training courses run by the Centre for appropriate personnel from local industry		Inadequate	Training of the Centre's staff not yet completed. Poor response from local industry
Cultivation of selected medicinal and aromatic plants as crops	Fields of appropriate plants as raw materials for processing	Availability of plant materials for processing	Satisfactory. Agreement with other institutions and Government facilities about the plants to be studied by the Centre	
<u>D. Activities</u> Construction of buildings and cultivation areas		Buildings completed	Accomplished	Ground for cultivation not yet in use

Project Elements	Success Criteria	Verifiers	Progress Made	Factors Delaying Progress
Selection and recruitment of national and international project personnel		International and national personnel appointed or in post	International project personnel functioning	Biologist/field botanist only recently appointed
Selection of trainees and execution of training programmes		Pilot plant and laboratories operating with the locally recruited staff	Ongoing	
Finalization of initial equipment needs	Accomplished			
Acquisition and installation of equipment	Accomplished	Pilot plant and laboratories in operation		Certain modifications still to be carried by the supplier of the pilot plant
Establishment of library and documentation unit	Accomplished		Inadequate	Shortage of books and journals owing to inadequate budget allocation. Staff member lacks the appropriate training
Experimental cultivation trials		Some materials available for processing	Slow	Agreement with other institutions only recently reached
Economic mapping of indigenous medicinal and aromatic plants				Not considered essential at this stage of the project

Project Elements	Success Criteria	Verifiers	Progress Made	Factors Delaying Progress
Pilot plant production of selected materials in accordance with report DP/TUR/83/003 -				
Essential oils from: <u>Laurus nobilis</u> <u>Salvia triloba</u> <u>Salvia sclarea</u> <u>Origanum</u> species, etc.	-----Products available----- See Annex IV		Accomplished	
Oleoresin from capsaicin-rich variety of <u>Capsicum</u>			Limited	Insufficient raw material available
<u>Gypsophila bicolor</u> saponins	Extract currently being evaluated commercially		Adequate	
Extract of <u>Glycyrrhiza glabra</u> Monoammonium glycyrrhizinate	-----Products available----- See Annex IV		Limited	Commercial firm interested, but has not yet requested a more detailed study
Design and fabrication of 2000 L mild-steel/stainless-steel essential-oil distillation unit	Operational		Accomplished	
Design and fabrication of 50 L stainless-steel Buchner-type vacuum filter	Operational		Accomplished	

Project Elements	Success Criteria	Verifiers	Progress Made	Factors Delaying Progress
Design and fabrication of a fractional distillation unit	Partly operational		Accomplished	Unit requires a taller building; construction to be carried out during the period of the present work plan
Industrial solvent purification			None	Fractionation column not yet fully installed; see previous entry
Feasibility study for a rose-oil distillation plant			Ongoing	
Laboratory studies -				
<u>Gypsophila</u> Characterization of saponin(s) Screening of various species for their saponin content			None	To be restarted Discontinued; work has been done elsewhere
Preparation of hops extract		Report available		Discontinued because of lack of interest
Storax extraction and purification	Product available (Annex IV); analytical methods developed	Report available	Accomplished	
Extraction of ruscogenin from <u>Ruscus aculeatus</u>		Report available		Discontinued through lack of interest

Project Elements	Success Criteria	Verifiers	Progress Made	Factors Delaying Progress
Aescin from <u>Aesculus hippocastanum</u>	Extraction and analytical methods developed	Report available	Ongoing	Commercial interest in the process being developed still has to be stimulated
Essential oil screening	Products available	Analytical data	Limited	Work being repeated with a new more efficient glc column
Cervacrol production			None	Discontinued
<u>Capsicum</u> Screening for capsaicin Capsaicin enrichment		Technical report	None	Lack of appropriate raw material
Medicinal plants of Turkey Literature survey			None	No report produced by the national consultant

CURRENT STAFFING OF THE ANADOLU UNIVERSITY
MEDICINAL PLANTS RESEARCH CENTRE, ESKIŞEHİR

*Prof. Dr. K. H. C. BAŞER	Pharmacist	Director
*Doç. Dr. M. KARA	Chemical Engineer	Deputy Director
*Doç. Dr. M. TUNCEL	Pharmacist	Analytical Lab.
*Doç. E. GÜLER	Pharmacist	Pharm. Tech. Lab.
*Doç. Y. ÖZTÜRK	Pharmacist	[Pharmacology Lab.]
*Doç. N. KIRIMER	Pharmacist	Phytochem. Lab.
*Mr. Y. I. AKYOL	Pharmacist	Phytochem. Lab.
Mrs. M. KÜRKCÜOĞLU	Chemical Engineer	Analytical Lab.
Miss B. BOZAN	Chemical Engineer	Analytical Lab.
Miss S. FIÇICIOĞLU	Chemical Engineer	Analytical Lab.
Mr. S. H. BEİS	Chemical Engineer	Pilot Plant
Mr. T. ÖZEK	Chemical Engineer	Pilot Plant
Mrs. A. BERHAYAT	Pharmacist	Phytochem. Lab.
Mrs. H. TANRIVERDİ	Pharmacist	Phytochem. Lab.
Mr. S. AYDIN ¹	Biologist	[Pharmacology Lab.]
Miss A. KAYA ¹	Biologist	Botany
Miss N. KURTAR ²	Pharmacist	
Mr. H. USLU	Librarian	
Mrs. M. VATANSEVER	Technician	
Miss B. ACAR	Technician	
Mr. H. ÖZKALAY	Technician	
Miss G. PEKDEMİR	Secretary	
Mr. M. SAĞIR	Labourer	
Mrs. S. BAYDAR	General Help	

* Part-time staff ¹ Very recent appointment ² Recent Appointment

PROJECTED ADDITIONAL STAFFING REQUIREMENTS

Laboratories

- 1 Phytochemist
- 1 Pharmaceutical Analyst
- 1 Taxonomist
- 1 Computer Program Specialist
- 1 Documentalist

Pilot Plant

- 2 Chemical Engineers
- 2 Technicians
- 1 Labourer

PRODUCTS FROM THE PILOT PLANT, UP TO SEPTEMBER 1988

<u>Material</u>	<u>Amount</u>	<u>Product</u>
<u>Gypsophila bicolor</u> roots	95 kg	Ca. 18 L saponin extract
<u>Salvia cryptantha</u> leaves	40 kg	6 mL essential oil
<u>Salvia sclarea</u> leaves	138 kg	260.5 mL essential oil
<u>Origanum onites</u> leaves	380 kg	5.01 L essential oil
<u>Origanum</u> powder	1090 kg	6 L essential oil
<u>Mentha spicata</u> leaves	1307.5 kg	1.93 L essential oil
<u>Mentha piperata</u> leaves	53 kg	2.35.5 mL essential oil
<u>Capsicum</u> fruit	194 kg	42 kg extract
Storax	248.2 kg	157.5 kg purified storax
Lemon leaf	27 kg	40.5 mL essential oil
<u>Melissa officinalis</u> leaves	64 kg	18 mL essential oil
Chamomile flowers	18.6 kg	20 mL essential oil
<u>Laurus nobilis</u> leaves	31 kg	338 mL essential oil

LIST OF COMMERCIAL FIRMS FOR WHOM WORK IS CURRENTLY BEING UNDERTAKEN BY
THE ANADOLU UNIVERSITY MEDICINAL PLANTS RESEARCH CENTRE

1. Kurtsan İlaçları A.Ş., İstanbul

July 1987: Analysed eucamenthol lozenges.

February 1988: Asked to develop (anticancer) formulations for Nerium oleander.

May 1988: Analyses of Sen-Ben (for halitosis), developing method for the analysis of thymol/menthol.

2. Koska Helvacısı, İstanbul

Evaluation of Gypsophila saponin extract prepared by the Centre still underway.

3. Sistaş A.Ş., İstanbul; Factory in Siirt

The Centre prepared a 13-page report on the uses and good and bad effects of liquorice; it has been sent to the Ministry of Health.

The firm sent 2 engineers with HPLC problems which were solved by the staff of the Centre; the firm is now using the method developed by the Centre. The Centre will undertake further training of personnel in HPLC techniques.

4. Ot-Kocp, Bilecik

A feasibility report on the establishment of a rose-oil factory is still being prepared by the Centre. Some rose oil has been distilled for the Co-operative in the pilot plant of the Centre.

5. Gülbirlik (Union of Agricultural Co-operatives for Rose, Rose-Oil and Oily Seeds), Isparta

May 1987: Help was requested to improve the production of rose oil obtained by distillation. A visit was paid by staff of the Centre to the distillery and after studying the process modifications were proposed and successfully introduced. The Centre continues to carry out analyses of the rose oil produced by the Co-operative.

June 1988: Formulation of a rose cream requested.

6. Orköy Merkezi Silifke, S. S. Orman Köylerini Kalkındırma Koop, Silifke (Silifke Forest Villages Development Co-operative)

January 1988: Technical assistance requested for the rehabilitation of the more-or-less derelict bay-leaf oil distillation plant. Via the Turkish Government, the Centre has approached UNIDO and a SIS project has been accepted in which the chemical engineer expert and staff from the pilot plant of the Centre will help in the rehabilitation work.

7. Zeki Konur (and Robert), nr. Isparta

Analyses of rose oil and rose concrete requested. Help of the Centre in organizing an international symposium on essential oils also requested.

8. Ortaş Co., Edremit

August 1988: Request for analyses of their products - light and heavy pine oil, rosin, (pine) tar from pine stumps - and for technical advice and research. The firm has sent 500 kg of crude pine oil to determine the best conditions for fractionation. Some preliminary work has been done. An agreement to carry out the research will soon be arranged.

9. Kalikimiya, Istanbul

The managing director of this company which compounds perfumes, etc. has visited the Centre. No further contact has yet been made.

10. Yağmur Ltd., Eskişehir

Rose-oil analyses for this local export company have been carried out by the Centre.

11. Böke A.Ş., Izmir

Summer 1987: > 1 tonne of finely powdered Origanum (sweepings) was sent to the Centre for distillation of the oil.

September 1988: 380 kg of coarser Origanum was distilled during the in-plant training course.

WORK PLAN FOR THE PERIOD ENDING DECEMBER 1989 - ACTIVITIES

Activities	Completion date	Remarks
<u>ANALYTICAL LABORATORY</u>		
1. Analyses of at least a further 15 essential oils, including those in the most commonly used aromatic products in Turkey and 6 commercial seed products	September 1989	Data sheets to be prepared for each oil
2. Installation of and familiarization with the new HPLC equipment (cf. Annex V)		
3. Development of a (new) HPLC analytical method for <u>Gypsophila</u> saponins	December 1988	
4. Development of a HPLC/TLC analytical method for the constituents of <u>Arnebia</u> extract; isolation and identification of the 3 main components	December 1989	
5. Routine analyses of products from existing and future projects	Ongoing	Includes: Bay leaf and berry oils (from <u>Laurus nobilis</u>), oils from <u>Origanum</u> species, cineole-rich fractions, pine oil, fusel oil (--> amyl & isoamyl acetates), aescin, liquorice, rose oils
6. Extraction and analysis of the carotenoids and natural colouring compounds from <u>Capsicum</u> for possible use in foodstuffs	December 1989	To be integrated with studies on the concentration of capsaicin; possible demand to be established
7. Analytical gas chromatograms of pilot-plant and laboratory solvents	Ongoing	Data sheets to be prepared for each solvent

Activities	Completion date	Remarks
8. See <u>Pilot Plant 1.</u>		
9. Routine analytical method for <u>Datura</u> alkaloids to be developed	December 1985 and ongoing (2-year project)	At least 100 samples to be analysed on behalf of Köy Hizmetleri Eskişehir Araştırma Enstitüsü
<u>Pilot Plant</u>		
1. Rehabilitation of the Silifke essential-oil distillation unit	November 1988 - May 1989	A SIS project being undertaken by the chemical engineer expert and the staff of the Centre's pilot plant
2. Distillation of <u>Origanum</u> oil for BÜke A.Ş., Izmir		30 tonnes to be processed
3. Distillation and fractionation of crude pine oil for Ortaç, Edremit	December 1989	0.5 Tonne crude oil supplied; technical problems not yet identified
4. Fractionation of fusel oil and acetylation of the amyl/isoamyl alcohol fraction	December 1989	
5. <u>Laurus nobilis</u> - fractionation of cineole and cineole-rich fractions = Support for the Silifke SIS project; see 1, above		
6. Integrated system for the purification and refining of storax		Processing material on behalf of Kurtan İlaçları A.Ş.
7. Liquorice extraction, scaling up	Ongoing	Industrial collaboration with Sistaş A.Ş.
8. <u>Gypsophila</u> extraction, scaling up	Ongoing	Integrated system (concentrators required) for Koska Helvacısı

Activities	Completion date	Remarks
9. Aescin extraction, scaling up	Ongoing	Also purification and formulation
10. Service to industry - rose oil production	Ongoing	Various firms involved, e.g. Ot-Koop, Bilecik, and Zeki Konur, nr. Isparta

ANNEX VII

ADDITIONAL EQUIPMENT REQUIREMENTS (subject to budget)

In order of priority:

Analytical Laboratory

HPLC equipment with automatic injection system

Sotax 6-channel dissolution tester

Disintegration tester for tablets

Combined gas chromatograph/mass spectrometer

Pilot Plant

Niro atomizer spray drier

Liquid-liquid extractor

Additional steam-generating capacity (1 ton/h)

Water-cooling tower and chilling unit

RECOMMENDED LIBRARY ACQUISITIONS

Subscriptions to at least some of the following journals will help to keep the Centre up-to-date with what is going on in the field of essential oils:

Soap, Perfumery & Cosmetics
Perfumery & Flavorist
Parfums, Cosmetiques et Savons
Soap, Perfumery . Cosmetics
Perfumery & Cosmetics
Dragoco Report
Chemical Manufacturer
Flavour & Fragrance Journal
Parfums, Cosmetiques et Arômes

The following publications are also recommended:

1. B. M. Lawrence, Essential Oils 1976-1978, Allured Publishing Corporation, P. O. Box 318, Wheaton, Ill. 60187
2. VIIIth International Congress of Essential Oils, October 1980.
Technical Data, Cannes - Grasse, Perfumes and Flavours Symphony of Nature, 1982, Fedarom, 7 Rue Gazan, 06130 Grasse, France
3. IXth International Congress of Essential Oils, March 1983,
Singapore
4. Xth International Congress of Essential Oils, 1986, Washington,
to be published

A range of reference books covering mass spectra, gas chromatography, terpenoids, phytochemistry, etc. should also be acquired. A list will be provided by the phytochemist/analytical chemist expert.