OCCASION

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

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

RESTRICTED

DP/ID/SER.A/1351
18 May 1990

ORIGINAL: ENGLISH

18602

28p.
tables
diagrams

TECHNOLOGIES FOR THE FOOD AND AGRO-BASED INDUSTRIES

DP/SRL/86/016

SRI LANKA

Technical report: Essential oil products*

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

Based on the work of W. S. Brud,
consultant on essential oils, fragrances and flavours

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

United Nations Industrial Development Organization
Vienna

53

*This document has not been edited.

V.90-84602 6687T

Mention of the name of firms and commercial products does not imply endorsement by the United Nations Industrial Development Organization (UNIDO).

TABLE OF CONTENTS

I. INTRODUCTION

In 1988 a Project Document DP/SRL/86/016/D/01/37, was signed between Unite Nations Development Programme and Government of Sri Lanka with participation of Executing Agency - Ceylon Institute of Scientific and Industrial Research (CISIR).

Under general title "Technologies for the food and agro-based industries" in Chapter 2 of the project an area "Essential Oil Products" was described (see Annexe 1). During discussions carried out on similar project in Viet Nam by the Consultant and UNIDO staff it was concluded that the project is not specific enough in practical applications of essential oils and their derivatives, and no program has been developed for training of sensory evaluation specialists, perfumers and flavourists who are necessary for practical implementation of research works on the oils and related products. Essential oils i.e. raw materials for fragrance and flavour industry shall not be considered as final stage of the project. Thus more detail program of their transformation into more valuable semiproducts and products should be elaborated. The Consultant was also requested to to consider some aspects of field distillation units for production of crude essential oils in Sri Lanka. It was decided that 1 week initial mission to Colombo, combined with the Consultant trip to Viet Nam will be scheduled for January 1990 with the following objects:
Assessdata gathered by CISIR on local essential oils and advice on:

1. Possibilities of fractional distillation of essential oils to produce aroma chemicals for export.
2. Formulation of fragrance materials for local utilisation
3. Setting up of an organoleptic (sensory evaluation) laboratory
4. Local fabrication and deployment in the field of distillation equipment.

II. SUMMARY

The mission took place between January 8th and 12th 1990. It was unforseen holiday in Sri Lanka on January 10th, what resulted in little more than three full working days in Ceylon Institute of Scientific and Industrial Research including visit to Ministry of Industries (see Annexe 2). There was no time available for travel to fields or plantations, and due to CISIR Management meetings only limited number of Institute staff was available.

The discussions and meetings except of that in the Ministry took pla-

ce on the premises of CISIR including visits to pilot plant area, and equipment, field distillation equipment installed in Institute, control laboratories, library and workshop. Meeting with management representative of PURE BEVERAGES Company was arranged in CISIR. No visits or meetings were possible with LEVER Bros. or any other soap, detergent, or related branches factories were possible.

The mission resulted in range of conclusions and recommendations which within existing framework of the Project can extend training and research program in aim to cover missing links between production of essential oils and their utilisation in fragrances and flavours.

III. FINDINGS AND OBSERVATIONS

Most unfortunately the basic data on range and quantities of essential oils produced and available in Sri Lanka are not available or confusing.

Official data as issued by Government (Customs) cover only total exports of essential oils in tons and rupees. In period of 1976-1988 annual export varied from lowest 248.8 tons in 1977 to highest 3295.4 tons in 1986, being 1276.7 tons in 1987 and 902.5 tons in 1988. The corresponding values in rupees for 1986, 1987 and 1988 were 76.8 milion, 95,4 milion and 135.6 milion which presents more inflation rate than value of the oils (see Annexe 3).

The following data on per year production of essential oils in Sri Lanka were given by Dr. U. M. Senanayake - Head, Natural Products Division CISIR:

Citronella oil	**400**	**tons**
Cinnamon leaf oil	**300**	**tons**
Cinnamon bark oil	**0.5**	**tons**
Lemongrass oil	**0.5**	**tons**
Nutmeg oil	**18.0**	**tons**
Cardamon oil	**0.6**	**tons**

According to gas chromatography analysis main components of the oils are as follows:

1. **Citronella oil**

Geraniol	**15%**
Limonene/Ocimene	**13%**
Methyl iso-eugenol	**9%**
iso-Borneol	**8%**
Geranyl formate	**7%**

Citronellol/Geranyl acetate	7%
Citronellal	5%
Elemeol	3%

The oil contains unusually low amount of citronellal and high contents of methyl iso-eugenol, limonene/ocimene and iso-borneol. As only one chromatogram is available more detail comments will be unjustified.

2. Cinnamon leaf oil

Eugenol	75%
Linalool	4%
Caryophyllene	4%

Relatively low content of eugenol can be increased by fractionation of low boiling components.

3. Cinnamon bark oil

Cinnamic aldehyde	61.0%
Eugenol	8.3%
1,8-Cineol	6.5%
Linalool	3.5%
beta-Caryophyllene	3.2%
p-Cymene	2.7%
limonene	2.3%

According to above contents the oil represents acceptable quality.

4. Lemongrass oil

Citral	79%
Limonene	3%

According to above contents the oil represents acceptable quality.

5. Nutmeg oil

alpha-Phellandrene	30%
Terpinene-4-01	12%
alpha-Pinene	7%
beta-Pinene	9%
Myristicin	9%
Elemicin	5%
gamma-Terpinene	4%
1,8-Cineol	4%

According to contents the oil represents acceptable quality.

6. Cardamon oil

Cineol	40%
Terpinyl acetate	25%

According to contents the oil represents acceptable quality.

All above oils can be commercialised on world markets.

No data were available on Vetiver oil and spice oils e.g. pepper oil and others which probably are produced in Sri Lanka.

No data were also available on total consumption/imports of fragrance compounds, fragrance raw materials and flavours. There is local production of soaps, detergents toiletries as well as flavoured food products (majority of imported flavours is used for soft drinks). The consumption of fragrances and flavours can be estimated also on the basis of data on production of corresponding market products. These however are also not available. The Consultant prepared kind of questionnaire (see Annexe 4), which if worked out can give necessary information. The questionnaire was handed to CISIR with request that all data available will be mailed a.s.a.p. to the Consultant for further work.

Few samples of fragrance compounds imported from International Flavours and Fragrances were presented to the Consultant as examples of odours used in soaps and detergents by local manufacturer. All of them were of pure, cheap quality, relatively easy to imitate with limited number of raw materials or to replace with compounds prepared with locally available essential oils and some imported raw materials. No data on quantities nor prices of presented compounds were available.

Some informations on flavours were given by Dr. V.U.Ratnayke from PURE BEVERAGES. According to this source total import of soft drink flavours to Sri Lanka is 75 tons per year plus trade mark products (e.g. Coca-Cola, Mirinda, Sprite) which are imported in form of concentrates and bottled locally with addition of water and carbon dioxide. Considering number of local brands of soft drinks as advertised and amounts offered and due to the climate consumed, the import of only 75 tons per year of flavours for that purpose seems underestimated, as local production of the flavours does not exist. It is however possible that part of soft drinks manufactured locally is based on natural fruit juices. But these are also very often flavoured. There is substantial production (exported) of concentrated fruit juices in Sri Lanka. According to information available there is no equipment installed to trap flavour ingredients distilled off with water during concentration process. These ingredients are invaluable components of many flavours. The most modern concentration equipment used by Pure Beverages has also no trapping system. The Company is equipped qith flavour compounding facilities and has flavourist trained by Bush Boake Allen (G.B.), i.e. any flavour compound for soft drinks elaborated in CISIR can be tested and possibly introduced in the Company. Such tentative interest was expressed.

A group of CISIR employees assigned to Essential Oils part of the Project consists of:

3 Ph.D. degree specialists (one on chemical engineering)
3 M.Sc. chemists
1 graduate chemist
2 technicians
1 specialist on chemical synthesis.

The group is fully capable to carry on extended pro-ram of the project with some additional training (see below).

There are no facilities in CISIR for rectification of essential oils to separate isolates, nor for synthesis of aroma chemicals from the isolates. There is also very limited supply of other chemical raw materials for synthesis, due to practical nonexistence of chemical industry, except refineries. There is however enough space in pilot plant area for erection of appropiate equipment and import of basic chemicals should be easy.

Within UNDP project a multipurpose unit has been ordered from L+T LABORTECHNIK (FRG) - purchase order 15-9-1158 - similar in construction to standard TOURNAIRE unit (see scheme Annexe 5). This when erected and commisioned in pilot plant area will allow further development of steam distillation technologies of selected essential oils some extraction processes, fractional distillation of the oils to obtain isolates and possibly some isolates can be converted into more valuable aroma chemicals by very simple processing. The unit has however some limitations due to its compact and interconnected structure which will allow only very few processes to be carried out at the same time. No detail comments on the unit were possible as no design, scheme nor technical data on ordered equipment were available at CISIR except abovementioned nondescribed Tournaire scheme and copy of purchase order.

Analytical equipment and staff available for that purpose as presented and explained to the Consultant can without difficulties cover all instrumental and physico-chemical analytical needs in fractional distillation of essential oils as well as in synthesis of aroma chemicals.

There is however no specialist at all trained in sensory evaluation of essential oils and their derivatives. Odour and taste evaluations are most crucial in production and trade of essential oils and rela-

ted products. Although physico-chemical and analytical parameters according to local and international standards (e.g. ISO) should be always observed the fragrance and/or taste of the product (oil, aroma chemical, isolate, oleoresin, fragrance compound, flavour) are the first quality properties to be tested and usually if olfactory rejected further testing of the product is not performed.

There is enough space within CISIR facilities to set up odour and taste evaluation laboratory with further extension into perfumery and flavour laboratory. Also the production/pilot plant area is sufficient for small scale compounding unit.

Facilities and equipment of CISIR workshop as described to the Consultant are adequate and can handle erection of purchased equipment and manufacture some details (including stainless steel welding). Majority of the equipment (stainless steel and glass lined reactors, columns, coolers, packings etc) should be purchased abroad.

There are no specific regulations and restrictions on use of ingredients in flavours and fragrances. Also no national or international standards are enforced, although in export products international standards for essential oils , due to trading conditions are observed. This however depends (as usual in this trade) on contract conditions. In imported products FDA standards are accepted.

There is no centrally controlled system ofcollection of the oils from field distilleries, blending, quality evaluation and sales. Several trading companies deal with that business. Some of them also import fragrances and flavours. Such disintegration of industry and trade (no association or any other organisation was mentioned) is one of the reasons of lack of informations on quantities of oils, flavours and fragrances produced and traded.

Field/backyard distillation equipment (for cinnamon bark oil) as shown to the Consultant in CISIR premises was not in use and in bad condition. No time nor possibility was found to visit any working unit in fields. It looks as no practical work is carried out in this respect at the moment and it can be assumed that further works will start after delivery and commisioning of abovementioned multipurpose equipment.

A manuscript of Work Plan for UNDP project on essential oils was presented to the Consultant (see Annexe 6), covering 48 months of various

activities. Very general in some areas, gives also some details on research work to be performed. It was understood by the Consultant that major part of this work plan (except perhaps some laboratory experiments) will be started after commisioning of multipurpose equipment, which means in month 12 of the schedule. Some detail comments to this work plan are given in Annexe 7 and in further parts of this report.

Shortage of some books and journals on essential oils, aroma chemicals and perfumery were observed by brief visit to CISIR library. Purchase of some basic books and subscription of some journals were advised on the spot.

Full understanding of the importance of essential oils, fragrance and flavour industry by Government Authorities was found during visit of the Consultant (with UNDP and CISIR representatives - the visit was arranged by UNDP resident Mr. J.Gorski) to Mr.Amarananda S. Jayawaradena - Secretary of Ministry of Industries. Recently released document "A Strategy for Industrialisation in Sri Lanka" was presented by the Secretary. The document and statements by Mr. Jayawaradene convinced the Consultant that full support will be given by Government of Sri Lanka to development of essential oils, fragrances and flavour industry. UNDP and CISIR works and aims were presented as well as the Consultant opinions on the program and approved by the Secretary. Regular reports on progress of UNDP supported R&D works of CISIR will be expected by the Ministry and all necessary assistance will be given.

IV. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

1. Essential oils produced and exported from Sri Lanka are of different and not always controlled quality, thus revenues obtained from the export are not as high as possible. System and technology for upgrading of the oils (improved distillation technology and equipment, blending, deterpenation, standardisation) can and should be introduced. Government controlled standards (e.g. ISO or other internationally recognised standards) will improve position of Sri Lanka oils on competitive international markets. The revenues from production of the oils especially most important of citronella, lemongrass and cinnamon can be increased by introduction of fractional distillation of the oils to obtain isolates i.e. natural fragrance and flavour

chemicals - important components of "back to nature" trend in fragrances and in flavours where in most industrialised countries use of other than natural ingredients is restricted. Detail market study in this respect can be easily prepared.

2. With export of essential oils - basic raw materials for fragrances and flavours - there is at the same time significant import of fragrance and flavour compounds, which obviously can contain the oils from Sri Lanka. As so far the compounds are considered in customs tariff as raw materials there is no pressure and there is also no know-how to start local production of the compounds, which will bring to the country and local companies the profits collected by foreign compounding companies. It is usually a case that such savings on imports are higher in value than profits obtained from export of raw materials (essential oils). Both custom tariff and Government support should create interest of Sri Lanka manufacturers of soaps, detergents, toiletries, household chemical products, flavoured food products, soft drinks etc. in use of locally manufactured fragrance and flavour compounds.

3. The most important issue in essential oils and related products project is selection and training of specialists who will evaluate odour and/or taste quality of all materials and products prepared within the project. This basic part of R&D in fragrance and flavour area was not specified in the project (not in Annexe 1 - project nor in Annexe 6 - work plan) although without this kind of specialists there is no way the project can be successfully completed.

4. There is manpower, technical, qualifications level and space base in CISIR (see Annexe 2B) for set up of:

a. R&D group with laboratory and pilot plant facilities,, which will elaborate extensive, complete program of full utilisation of essential oils, their components and derivatives in aim to achieve maximum added value on the products for export and local use.
(Natural Products Section with cooperation of other Sections i.e. Analytical, Instrument, Pilot Plant, Agro Industries)

b. Odour Evaluation Panel and Perfumery Laboratory for control of odour quality of essential oils and all fragrant products and for creation of fragrance compounds.
(Natural Products Section)

c. Flavour Evaluation and Compounding group for control and

development of food flavours with use of locally available raw materials.
(Food Technology Section)

5. Ther is no equipment in CISIR to introduce UNDP project (Annexe 1) within specified framework on pilot plant and small production scale. The multipurpose unit ordered for this project will be not sufficient to perform all necessary R&D works as described in the project. Additional rectifying (10-20 capacity) glass unit will be necessary for preparation of conditions of fractionation of essential oils on larger stainless steel unit. Multipurpose aroma chemical synthesis unit with stainless steel and glass lined reactors shall be installed in pilot plant area. This can be partially manufactured anddesigned by CISIR. On the same manner small fragrance compounding unit shall be made.

6. Apart from R&D works on distillation and extraction of plant materials with use of the multipurpose unit field/backyard hydro-distillation units should be purchased, or fabricated locally on the basis of purchased or own design and tested in field conditions. Results of experiments on multipurpose unit can be used as source of know-how for such design but in this case time factor should be considered.

B. RECOMMENDATIONS

Considering limited time and data available the recommendations which follow may not cover all problems which will arise during development of the project or may specify actions which are already undertaken, of which the Consultant was not aware.

1. Immediate action should be started in aim to select and educate Odour Evaluation Panel within CISIR. This action should be included in UNDP project (Annexe 1) as its integral part although it was not explicite specified in the text of the project. The full program of such selection and training elaborated by the Consultant is presented in Annexe 8.

2. CISIR should be assisted by UNDP consultant in reconsideration of details of Work Plan (see Annexes 6 and 7) in aim to extend its scope, increase number of products to be obtained, and elaborate more specific program of preparation of fragrance compounds, their application and marketing. 2m/m including preparative study. Aroma chemicals and

fragrance chemist with Ph.D. in organic chemistry and technology.

3. CISIR should be assisted by UNDP consultant in selection, designing and manufacturing of multipurpose pilot plant aroma chemicals synthesis unit and small compounding unit. 2x1m/m Aroma chemicals and fragrance compound chemist with chemical engineering degree,

4. CISIR should be advised by UNDP consultant in selection and/or designing of field/backyard simple and inexpensive hydrodistillation unit for use by small farmers/distillers (mainly for cinnamon oil), and mobile field unit (for citronella, lemongrass oils). 1 m/m Essential oils distillation specialists with engineering experience.

5. UNDP/UNIDO will be requested to purchase vacuum fractional distillation glass unit with appropriate control system (e.g. L+T Labortechnik unit as purchased for DP/VIE/84/010/88 project in Hanoi).

6. UNDP/UNIDO will be requested to purchase necessary parts of the pilot plant equipment (stainless steel and glass lined reactors, control systems etc.) for aroma chemicals synthesis unit and small fragrance compounding unit as designed by CISIR and UNDP consultant according to above Recommendation 3.

7. UNDP/UNIDO will be requested to purchase laboratory equipment and materials for setting up Sensory Evaluation Laboratory (see Recommendation 1 and Annexe 5)

8. UNDP/UNIDO may be requested to purchase model field hydro-distillation unit as described in Recommendation 4.

9. UNDP/UNIDO will be requested to provide fellowship for 3 months training of CISIR organic chemist with M.Sc. degree in organisation, chemistry and specific aspects (odour quality) of synthesis of aroma chemicals (2 months in research centre, 1 month in manufacturing company)

10. CISIR should be advised by UNDP consultant on marketing of essential oils, isolates, aroma chemicals and fragrance compoundsproduced and to be manufactured under this project on international and local markets. This can be done after completion of data specified in Annexe 4 by CISIR with or without assistance of consultant. 2 weeks to 1 m/m according to data available from CISIR. Marketing specialist

in area of fragrance and flavours raw materials and products with international background.

11. New Custom Tariff in Sri Lanka should include fragrance compounds, food flavours, fragrance and flavour specialities and mixtures with unidentified chemical contents as well as reconstituted essential oils under heading "Chemicals and their mixtures required as inputs for manufacture". Single identified aroma chemicals and natural essential oils should be considered as intermediate or raw materials.

REMARK: Recommendations 3, 5, 6, 9 should be considered necessary if aim of the project is to develop production and use of essential oils and their derivatives up to technology and production scale. Other recommendations with special emphasize of pos. 1 are crucial for succesful completion of the project in any scale. Recommendation 11 is considered as protection of Sri Lanka manufacturers of flavours and fragrances once such production is started.

Annex 1

EXCERPT FROM PROJECT DOCUMENT
"TECHNOLOGIES FOR THE FOOD AND AGRO-BASED INDUSTRIES"

2. Essential oil products

2.1 Modern pilot scale distillation and extraction plant and processing technology for distilling and fractionating of essential oils from spices and extraction of oleoresins from essential oils; practical experience in operating the multipurpose unit gained from field tests.

2.2 High geraniol fraction from indigenous citronella oil and flavour components: test batches of soap with these flavour components produced in the local soap industry.

2.3 Spice Oleoresins extracted from local raw materials for interested parties on a cost or fee basis: the extracted material to enable the industry and exporting trade to test the export potential.

2.4 Transfer of operating know-how by enabling industry to use multipurpose unit or a cost or fee basis.

2.5 Design and construction of a prototype small scale still for distilling cinnamon bark and other fine spices with attributes such as, reasonably low cost of construction, while providing improved yield of high quality oil where oxidation and polymerisation of sensitive compounds are minimised. This will be based on experience with multipurpose unit and previous CISIR work; practical operating experience with prototype still from field tests, improved unit to be based on results of field tests.

2.6 Quality standards for 4 products of added value derived from essential oils

2.7 Two scientific staff and one technician trained in essential oil distillation and extraction technology

2.8 Freely available publications of the processes, product formulas, quality standards and estimated production costs in the forms of brochures.

Annex 2

A. PERSONS AND INSTITUTIONS CONTACTED:

1. MINISTRY OF INDUSTRIES

Mr. Amaranda S. Jayawaradena	Secretary

2. CEYLON INSTITUTE OF SCIENTIFIC & INDUSTRIAL RESEARCH (CISIR)

Dr. E.R. Jansz	Director
Dr. P.M. Jayatissa	Deputy Director
Dr. U.M. Senanayake	Head, Natural Products Sections
Dr. T. Habarakada	Officer-in-Charge, Pilot Pland & Design
Miss N. T. Amarasinghe	Research Officer
Mr. P.M. Muthukuda	Research Officer

3. UNIDO

Mr. J.B. Gorski	UNIDO Country Director

B. ESSENTIAL OILS AND RELATED PRODUCTS IN CISIR ORGANISATION SYSTEM

Production and processing of essential oils and related products are or should be included in research programs of the following sections of CISIR:

1. Natural Products Section

Distillation of oils from plants, extraction, fractionation, chemical transformation of isolates, blending, compounding of fragrances, odour evaluation, standardisation.

2. Analytical Chemistry Section and Instrument Centre

Physico-chemical analysis of essential oils, their derivatives and related products.

3. Pilot Plant & Design Section

Development of field/backyard essential oils hydro-distillation units comissioning and/or designing synthesis, blending, fractionaction and compounding equipment.

4. Agro Industries Section

Application of fragrance compounds elaborated in Natural Products Section in soaps and detergents.

5. Food Technology Section

Development and preparation of food flavours based on raw materials prepared by Natural Products Section

Annex 3

VOLUME AND VALUE OF EXPORTS OF ESSENTIAL OILS, 1976-1988

Year	Volume (Thousand kg)	Value (Million SLRs)
1976	363.0	10.5
1977	248.8	11.7
1978	253.7	25.4
1979	734.6	25.5
1980	281.9	29.2
1981	253.3	36.5
1982	354.4	40.2
1983	2,199.4	68.6
1984	346.6	49.1
1985	291.3	45.8
1986 (a) (b)	3,295.4	76.8
1st Qtr.	563.0	20.5
2nd Qtr.	2,074.6	28.1
3rd Qtr.	556.3	15.0
4th Qtr.	101.5	13.2
1987 (a) (b)	1,246.7	95.4
1st Qtr.	569.9	21.7
2nd Qtr.	377.8	23.8
3rd Qtr.	113.3	22.3
4th Qtr.	185.6	27.6
1988 (a) (b)	902.5	135.6
1st Qtr.	74.7	26.2
2nd Qtr.	147.1	38.4
3rd Qtr.	79.5	24.8
4th Qtr.	601.1	46.3
1987 January	15.4	6.4
February	522.3	10.1
March	32.1	5.2
April	117.5	6.4
May	107.4	8.3
June	152.9	9.2
July	35.5	7.9
August	36.4	4.8
September	41.4	9.6
October	116.2	9.3
November	26.2	6.0
December	43.3	12.3
1988 January	15.9	5.5
February	35.4	9.2
March	23.3	11.5
April	66.7	16.1
May	15.7	7.6
June	34.7	14.0
July	49.7	12.8
August	23.6	8.4
September	6.3	3.5
October	380.3	22.0
November	95.2	10.7
December	125.6	13.5

Annex 4

DATA TO BE GATHERED BY CISIR FOR EVALUATION OF MARKET POTENTIAL IN FRAGRANCE COMPOUNDS AND FOOD FLAVOURS AND AVAILABILITY OF RAW MATERIALS.

A. Essential Oils

1. Commercial and botanical names of all essential oils produced for commercial use.
2. Quantities of each oil produced, exported and used locally.
3. Prices achieved in exports and on local market.
4. For what purpose are the oils used locally?

B. Fragrances

1. Local production (in metric tons or pieces) of:
   - Soaps: Laundry
     Toilet
   - Detergents: Washing powders
     Washing liquids
     Household and other cleansing agents
   - Toiletries: Shampoos
     Bath products
     Others
   - Cosmetics
   - Perfumes and toilet waters
2. What is main source of fragrance compounds used for above products?
   Imports..... Where from..... Local production.....
3. Is there any production of aroma chemicals?
4. Is there any working installation for production scale fractionation and/or deterpenation of essential oils?
5. Government policy (if specific) on imports of fragrances, aroma chemicals, essential oils. Custom duties.
6. Which brand of market products listed above under 1 is most popular? What kind of fragrance is most common?
7. Is there any local production of organic chemicals which can be used as semiproducts in fragrance chemistry (e.g. benzaldehyde, acetic anhydride)?

C. Flavours

1. Which daily use food flavourings are most commonly used - ready made seasonings, powdered spices, sauces, herbs etc.?
2. Volume of local production of:
   Preserved food
   Ready made sauces
   Food in tins

Soft drinks

Flavoured alcoholic drinks

Candies

Flavoured pastries

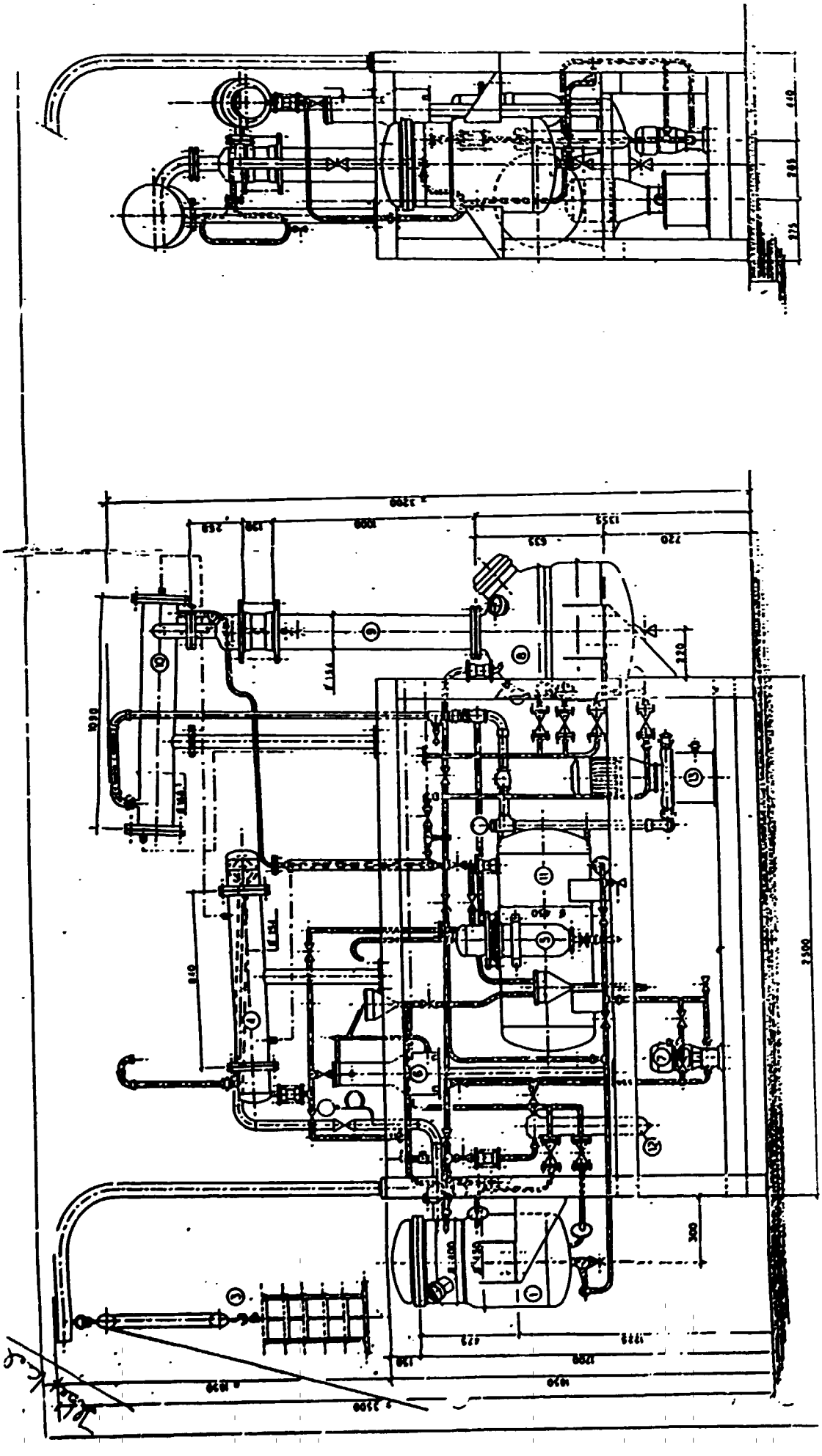
Pet food

3. What kind of flavours are produced locally - oleoresins, extracts, spray dried powders, alcoholic solutions, emulsions?

4. Are there any Government regulations existing or in preparation on use in food of natural, nature identical, and synthetic flavouring ingredients?

Annex 5

SCHEME OF PILOT MULTI-PURPOSE UNIT PROPOSED BY UNIDO



Annex 6

WORK PLAN, "ESSENTIAL OILS AND OLEORESIN" PREPARED BY CISIR

1. Local selection of staff for training , selection of fields of training and location (tentative) for training .—— 1 a/
2. Literature survey on extraction & fractionation of essential oils and preparation of oleoresin 2 - 5
3. Ordering of Pilot Plant Equipment ——— 5
4. Shipment of equipment —— 8
5. Send staff for training at centres abroad ——
   target date 01 Sept - Mid Dec.
   2. Graduates
   2. Technicals
   1. Engineering technician
6. Arrival of equipment —— 10
7. Cleaning of goods from post , installation and commission of equipment — 12
8. Ordering of raw materials
   (i) Leaf type essential oils for fractionation — 10-12
   (ii) Spices for trial distillation of essential oils 10-12
9. Trial operationsof essential oil
   Distilling unit ——— 12-16
   Distilling the following : Nutmeg , clove end , clove stem , pepper , Cinnamom bark , Ginger
10. Trial operations with oleoresin extraction unit by extractionating Ginger , pepper , chillie , tarmeoil
11. Quality control methodology for assessment of above productions 13-16
12. Determining chemical parameters of products that could be used in feed back to change operational conditions ——— 14-18
13. Fractionation of Essential oils Order of fractionation .
    eg Cinnamon leaf to obtain .
    (i) Eugenol (technical grade)
        - iso eugenol (reaction)
            - iso eugenol esters (reaction)
            - high pure iso-eugenol
        - High purity eugenol
    (ii) Non-eugenol fractions
        Develop Application ——— 18-22

---

a/ Number of month(s) from commencement.

Citronalla oil fractionation

(i) Low boiling point fractionation

Terpene hydrocarbons

consent to value added product .

(ii) Citronella , Barneol-Linalool fraction

(iii) Citronellol-Geraniol & terpene ester fraction —— 22-24

(ii) +(iii) used for , blending into

soap fragrances

convert into esters using Formic Acetic , Coconut fatty acid — 24-25

(IV) Attempt to separate the ester mixture into pure substance — 25-26

(V) High boiling point fractions

Phenolic/sessniterpinic : to be evaluated for use in washing soaps, deesterants , and as fixativer —— 26-28

Lemon Grass oil

(i) Low boiling point fraction

└→consent to value added product

(ii) citral (a+b) fraction

└→consent to Ionones (α & β)

Iones (Methyl ionones)

(iii) High boiling point fraction ———— 28-30

Pinus Turpentine

(i) α + β Pinene

└→Chemical conversion to α - terpineol-pure

└→Pine oil -(Technical)

(ii) other terpene hydrocarbons

└→value added product by chemical conversion

(iii) Middle fraction

(iV) High boiling point fraction —— 31-35

2.1 Field test the varions Pilot Plant units for distillation, fractionation, oleoresin extraction and chemical consersion . Evaluate performances —— 35-40

2.2 Provide services tc Producers/Exporters for manufacture of oleoresins to evaluate local & export market —— 38-45

Produce appropriate amounts of perfume components & suitable bends of perfumes (Eg. inexpensive Eau de colognes) —— 35- onwards

Design and construct based on expenence during the presions 2yrs a prototype still for distilling of fine spices —— 35-onwards

conduct field trials on above still —— 42 ——→

Compute results of development work & make available tested still ——— 48

Annex 7

COMMENTS ON "ESSENTIAL OILS AND OLEORESINS" WORK PLAN PRESENTED BY CISIR

1. Although some some works are planned for chemical transformations of isolates obtained by fractional distillation of essential oils no literature survey of selected chemical reactions has been forseen (see p.2 of the plan). It was gathered by the Consultant from discussion with few junior staff members, that some attempts to try new chemical routes are planned without full knowledge of works already published. Limited literature sources on chemistry and technology of aroma chemicals (specialised literature) are one of the reasons but as Chemical Abstracts are available, time consuming, but detail literature study of the problem should be made before any laboratory or larger scale study of synthetic methods will be started.

2. No training of the perfumers nor odour and taste evaluation specialists has been forseen in the work plan. Such goals as use of essential oils fractions in soap fragrances (see p.13 under "Citronella oil fractionation") or "Produce appropiate amounts of perfume components and suitable blends of perfumes (e.g. inexpensive eau de cologne)" in p.2.2. page 3 can not be achieved without skilled creative perfumer. Futhermore any product obtained from this work plan - oil, isolate, chemical, fraction, blend etc., should be first of all evaluated as an odorifeous component i.e. its odour should be described.

3. The range of chemicals which are selected as derivatives of isolates obtained from the oils is rather limited and should be extended by all possible products which can be prepared by simple synthesis. E.g. methylisoeugenol, hydroxycitronellal, terpineol esters, Schiff bases of aldehydes, geranitryle, and few others can be easily synthesized from materials obtained by oils fractionation. Formic acid esters are not very common in perfumery, acetates and higher acid esters shouldbe the first target.

4. Except one reactor (which should also serve as extractor and steam distillation unit) in multipurpose unit ordered with this project there is no equipment in CISIR which can be used for reactions listed in the work plan on scale larger than laboratory one. Also one fractionation column in the multipurpose unit will be not enough for the program and time planned.

Annex 8

PROGRAM OF TRAINING OF ODOUR QUALITY EVALUATION PANELISTS AND CREATIVE PERFUMERS a/

Step 1. At the location of trainees

On the basis of preliminary selection test as described in paper "Simple method of odour quality evaluation of essential oils and other fragrant substances" by Dr. W.S.Brud published in Perfumer and Flavourist Vol.8, August/September 1983 p.47 (copy enclosed test marked) group of 10-20 people should be selected. The test should be performed by trainees management, without participation of outside specialist. If necessary more detail description of the test and samples can be provided by the Consultant. Candidates selected in preliminary test will be then tested again and selected for training as described in step 2.

Duration of preliminary test: 1-2 days

Time: any as decided by interested party

Step 2. At the location of trainees

Testing of preliminary selected people for their abilities to recognize, differentiate and percept and associate odours. This testing should be organised and results evaluated by the Consultant and/or Consultant Perfumer indicated by the Consultant according to testing and training method elaborated and used in POLLENA-AROMA Warsaw in their Perfumery School. The full test will select trainees who will be capable to be trained as odour quality evaluation panelists and also select people who will be potentially creative perfumers. The Consultant or Consultant Perfumer will bring all necessary samples forms etc. to organize the test. Few small rooms will be necessary to perform the test. (Candidates are tested individually).

Duration of the test for 10-20 candidates: 10 working days with appropriate preparations made on location i.e. traineesppreliminary selected, free rooms ready, all people to be tested present during all test.

Time:to be agreed with the Consultant.

REMARK 1: The test as described under Step 2 should select:

- Odour quality evaluation panelist with ability to run daily works of Odour Evaluation Panel (OEP Chief)
- Odour quality evaluation panelists to work in the Panel
- Candidates for training as Creative perfumers (fluent knowledge of English obligatory)

---

a/ See also W. S. Brud "Simple methods of odor quality evaluation of

Step 3. At the location of trainees

Introduction training for all trainees in form of lectures on theory of odour, methods of quality evaluation, basic differences of odour quality of the products and sources of differences with presentations, trial testing, discussions, seminars etc. This training is necessary for all trainees selected in step 2. The introduction will also provide the candidates with adequate knowledge of their future duties. This should allow them to decide if they are interested in their future work. This especially important for OEP Chief and potential Creative Perfumers. Considering certain psychological abilities needed the candidates should freely decide to carry on with training and further work. This training will also allow to gather better knowledge about the candidates. The introduction training can be given by the Consultant and Consultant Perfumer.

Duration of the introduction training: 6-10 working days. If combined with step 2 and both steps performed together by both the Consultant and Consultant Perfumer these two steps can be performed within three calender weeks with 6 days week.

Time: best immediately after Step 2.

REMARK 2: Further steps are different for groups of candidates as specified in remark 1. For Odour Quality Evaluation Panelists Introduction training will be enough and their further work will be organised by OEP Chief after his Step 4.

Odour Evaluation Panel Chief (Secretary)

Step 4. At the location of the Consultant.

Training on practical methods ofpreparation and organisation of routine work of Odour Evaluation Panel.

Duration of training: Minimum 1 month, preferably 2 months.

Time: a.s.a.p. after Step 3.

Step 5. At various locations.

Training visits to leading compounding Companies (1 week each) in Europe or USA or India to learn and compare various methods used by potential customers and suppliers in evaluation of quality of raw materials and products.

Duration of training: 4 - 6 weeks.

Time: after ca 1 year work as OEP Chief.

Creative Perfumer Candidate

Step 4. At the location of the Consultant

Basic training and testing of candidate's abilities in creative work. This training may result in rejection of the candidate. When accepted after basic training the individual program willbe prepared by the Consultant for next step of training at the location of the candidate.

Duration of Step 4: 3 months

Time: a.s.a.p. after Step 3, according to agreement with the Consultant.

Step 5. At the location of candidate.

Individual work according to program obtained from the Consultant.

Organisation of fragrance compounding laboratory.

Duration of Step 5: 6-9 months.

Time: immediately after Step 4.

REMARK 2: During Step 5. at third or fourth month of its duration visit of Consultant Perfumer at the location of candidate is necessary to assist in arrangement of perfumery laboratory and preparation of further work.

Step 6. At the location of the Consultant.

After examination of work performed during Step 5 second degree of training in creation of fragrances, practical work on basic compounding of fragrances. Preparation of program for further individual work at home.

Duration of step 6: 3 months

Time: a.s.a.p. after step 5 according to agreement with the Consultant.

Step 7. At the location of candidate.

Individual work according to program prepared by the Consultant.

Duration of step 7: 9-12 months

Time: immediately after step 6.

Step 8. At the location of the Consultant.

After examination of work performed during Step 7 third degree of training on creation of fragrance compounds, application tests, fragrance usage in market products and introduction to marketing and customer service.

Duration of step 8: 3-4 months

Time: a.s.a.p. after step 7 according to agreement with the Consultant.

Step 9. At the location of the candidate.

Individual work according to program prepared by the Consultant

and local needs. Study of advanced literature on fragrance theory, markets, history, top class perfumery etc. Direct contact with customers.

Duration of step 9: 9-12 months.

Time: immediately after step 8.

REMARK 3. At the end of step 9 a visit of Consultant Perfumer at the location of candidate will be necessary to evaluate final results and work out further methods and procedures of candidate - now independent perfumer - according to local situation. System of training junior perfumers in the company will be also elaborated.

Duration of visit: 2 weeks.

Step 10. At various locations.

Training-study visits of the trainee-perfumer to leading Fragrance Compounding Companies in aim to familiarise with new products used in compounding, methods of testing of fragrances in market products, new trends in perfumery etc.

Duration of step 10: 4-6 weeks (2-3 companies)

Time: and after step 9.

REMARK 4: If more than 2 Creative Perfumers will be trained it is advisable to change location of step 6 and possibly also step 7 from the Consultant place to the location of the candidates. This however will depend on availability of Consultant Perfumer.