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**PRODUCTION OF PHARMACEUTICALS FROM MEDICINAL AND AROMATIC PLANTS
PHASE II**

DP/TUR/88/001

TURKEY

Technical report: Second mission of the consultant*

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 M. B. Narasimha, chemical technologist

Backstopping Officer: T. De Silva, Chemical Industries Branch

United Nations Industrial Development Organization
Vienna

* This document has not been edited.

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C O N T E N T S

	Abstract	1
	Introduction	2
I.	Research and Development	4
II.	TRUMAP - 1991	6
III.	Design and Engineering	8
IV.	General Assistance	8
 <u>Annexes</u>		
Annex 1	Job Description DP/TUR/88/001/11-01	11
Annex 2	Report of Visit to Dr. Senel Laboratory, Manisa, Turkey	13
Annex 3	TRUMAP - 1991	24
Annex 4	Backstopping Officer's Technical Comments	29

Abstract

This report is the result of the mission of the Consultants in Chemical Technology of the Project No. DP/TUR/88/001/11-01 titled Industrial Utilization of Medicinal and Aromatic Plant Resources for the production of pharmaceuticals, from 5 Sept. 1991 to 5 Nov. 1991 (one month mission time and another month on leave but served the mission full time).

The following are some of the outputs accomplished:

1. Research and Development
 - 1.1 Extraction of red dye from *Arnebia densiflora*
 - 1.2 Extraction of triterpenic saponins from *scolymus hispanicus*
 - 1.3 Extraction of fixed oils and essential oils from Laurel berries.
 2. Design and Engineering
 - 2.1 Design of a versatile four-stage prototype percolator system (10kg/batch) suitable for studies, of all the above plant materials.
 - 2.2 Fabrication of this unit using parts and accessories salvaged from the air craft maintenance junk yard.
 - 2.3 Fabrication of -
 - 2.3.1. Distillation still of 250 l capacity in stainless steel.
 - 2.3.2. A receiver of 125 l capacity in stainless steel.
- These when assembled with a suitable heat exchanger, would form a distillation unit fit for vacuum operations.
- These items were fabricated from materials salvaged from air craft junk yard.
3. TRUMAP
Participated in TRUMAP -91 as a "Resource Person" conducted at MPRC from 9 Sept. to 28 Sept. 1991.
 4. Preparation of Technology Report
 5. Diagnostic studies of a sick but running manufacturing unit.
 6. Installation of an all glass fractionation column of-
 - 50mm diameter
 - 1000mm height
 - 500ml reboiler
 - knit mesh internals
 - vacuum pump

INTRODUCTION

This report is the result of the mission of the Consultant, Chemical Technologist from 5 September to 5 November, 1991 under Project No. DP/TUR/88/001 (Please see Annex I for job description).

In most of the developing countries, including Turkey, almost all the existing pharmaceutical and plant based drug industries have been established mostly on turn-key basis with foreign collaboration covering technologies, plant and equipment.

It is a common knowledge that the technologies made available are very often obsolete and the machinery out-dated.

With the inputs provided by UNIDO/UNDP and its experts, the medicinal plants research centre is acquiring skills and expertise in the development of technologies for the manufacture of plant based drugs, design and engineering of chemical plants.

Experience and confidence thus gained, MPRC is forging ahead into technologically challenging areas of diagnostics and revival of sick chemical industries.

The best example that can be sited is the revival of Silifke factory (Part I) with the assistance of UNIDO under SIS Project No. SI/TUR/88/803 (March 1989). The author played a prime role in its rehabilitation.

This factory, before its revival was up for sale as scrap, for a sum of TL 100 million. It is understood that the present value of the essential oil factory alone (after rehabilitation) as per the assessment of Çukurova University, Adana is TL 12 billion.

MPRC is venturing out with the offer of help and assistance to the old and uneconomically operated natural products industry in Turkey, to streamline and up-date existing technologies.

The author was involved with MPRC in the detailed diagnostic studies of the following such industries:

- | | | |
|----|--|------|
| 1. | Sistas Liquorice Factory, Siirt | 1989 |
| 2. | Ortas Turpentine Factory, Edremit | 1990 |
| 3. | Eskisehir Alcohol Factory, Eskisehir | 1990 |
| 4. | Dr. Cemil Senel Laboratory
(Tiny Factory), Manisa | 1991 |

It is gratifying to note that several such manufacturers are increasingly seeking the centre's help in solving some of their technical problems, analysis and testing of their products.

With increased tempo of R&D and Pilot Plant activities, a need is felt to increase the working space and facilities.

A three storied building of about 800 M2 working area, adjacent to the centre's pilot plant building is fast coming up and will be ready for occupation by the end of this year.

It will house additional pilot plants, an entire floor is ear-marked for research and development activities in aroma chemicals and perfumery products.

I. RESEARCH AND DEVELOPMENT

A. Extraction of red pigments from Arnebia desiflora root

The hexane extract of roots of Arnebia densiflora yield the red pigment, containing a number of naphthaquinones viz., skikonin and alkannin. These are used as red dye, for cosmetics, food and textiles.

Before the arrival of the Consultant, the time taken at MPRC for the extraction of A. desiflora was 16 hours/batch. As a result of systematic planning and experimentation, it is possible to reduce the time to just 2 hours, without affecting the quantity and quality of the red dye.

Detailed plan of work has been drawn. Some of the highlights:-

- Choice of solvent
Polar and non-polar
- Whole root, bark and debarked root
- Optimum time
- Storage of the product
- Toxicity
- Product standardization

Preliminary experiments conclusively showed that:

- Optimum extraction time with n-hexane is about 2 hours.

- No difference was noticed with the quality and quantity of the extract using whole root, when compared with bark and debarked root. Thus avoiding debarking operation.
- Optimum particle size is about 3-4mm.

An interesting observation made, during this period was, that the extraction of marc (after extracting the red dye with n-hexane) with methyl alcohol resulted in a blue extract.

Further experimentation particularly identifying the blue compounds was suggested.

B. Scolymus Hispanicus

1. At the instance of the management of Dr. Cemil Şenel Laboratory, Manisa, near Izmir, the manufacturers of "Lityazol Cemil", which is an alcoholic extract of the bark of the plant *Scolymus hispanicus*, bench scale experiments were conducted at MPRC. The results indicate that it is possible to reduce the batch time from 42 days to just 1 or 2 days, effect reduce solvent losses considerably and standardise the quality of the product.
2. Provided designs for a versatile prototype unit of 10kg/ batch.
3. Fabricated this unit in the University's workshop
For details please see "Report of visit to Dr. Cemil Senel Laboratory, Manisa, Turkey" Annex II.

C. Extraction of fixed oil from Laurel berries

Drawn up a detailed plan of work of this project on the following lines :

- Drying of the nuts to optimum moisture level
- De-shelling
- Separation of shells and kernels

- Crushing and steaming of kernels
- flaking of crushed kernels
- Extraction of :
 - Flaked kernels
 - Shells
 - Isolation of essential oils from fixed oils.
 - Splitting of the fixed oil
 - Fractionation of mixed fatty acids to separate lauric acid.

It has been established during earlier studies of MPRC that the fixed oil obtained from the laurel kernels contains about 60% Lauric acid an essential component of the good quality shampoos.

The needs of this component in Turkey is entirely met by imports.

II. TRUMAP-1991

UNIDO in collaboration with the Government of Turkey organised a group training programme on the "Utilization of Medicinal and Aromatic Plants in pharmaceutical and related industries" and conducted by MPRC at Eskisehir from 9 Sept. to 28 Sept. 1991 (Please see Annex III).

The Consultant participated in this programme as a "Resource Person" and delivered lectures on scale-up operations, solid-liquid extraction, fractional distillation, steam distillation of essential oils and reaction kinetics. He also conducted "Hands on" practical training on the above topics on pilot plant scale, jointly with the counterpart engineers.

Prepared the background papers and distributed to all the trainees.

At the request of all the participants a copy of the spinning band high efficiency fractionating column was made available to all of them. This bench scale unit was designed and operated earlier in India by the Consultant.

The Consultant and the Course Director conducted the trainees on study tour to the following factories :

1. Alkaloids factory, the largest running factory.
2. Rose oil distillation factory.
3. Origamum distillation factory.

The following have participated in the TRUMAP-91 programme :

- | | | | |
|-----|-----------------------------------|----|------------|
| 1. | Dr. Mrs. Nawal Ahmed Sansah | .. | Egypt |
| 2. | Mr. James Malumbo Nyangulu | .. | Zambia |
| 3. | Mr. Frederick A. Aboagye | .. | Ghana |
| 4. | Dr. Abdel Karim Mohammed | .. | Sudan |
| 5. | Miss Wannapa Thamasucharit | .. | Thailand |
| 6. | Miss Dima Oscar Shucri Mustafa | .. | Jordhan |
| 7. | Miss Suad Mohammed Meuled Khalifa | .. | Libya |
| 8. | Dr. Mamo Asgedom | .. | Ethiopia |
| 9. | Mrs. Dorothy Chogo | .. | Tanzania |
| 10. | Dr. Wasala Herath M.Wimalasseela | .. | Sri Lanka. |

III. DESIGN & ENGINEERING

With the approval of General-Incharge of Military Air-craft Maintenance Centre, located at Eskişehir, the Consultant with the help of counterpart young engineers, collected quite a lot of parts and accessories from the discarded units.

A. Distillation Still

Using such parts a jacketed distillation still of about 250 l capacity and a receiver of about 125 l capacity in stainless steel were fabricated locally. With the addition of a shell and tube heat exchanger, this would make a perfect distillation unit, fit for vaccum operations.

- Designed a versatile four stage bench scale (10kg/ batch) percolator system. This when installed could be used in the extraction rate studies of most of the medicinal and dye plants.

The components of this unit were fabricated in the workshops of the university, using mostly parts and accessories salvaged from the aircraft maintenance junk yard.

The unit was almost ready for assembly at the time of the departure of the consultant.

IV. GENERAL ASSISTANCE

Assisted NPC during the construction of 800 M², three storied building, to house additional pilot plants, R&D in Aroma Chemicals and perfumery products and appropriate advice on the following :

- General Services

Water
Electricity
Power.

- Drainage facilities
- Overhead trolley
- General layout of laboratories and work benches.

It has been suggested to NPC that the existing pilot plant building should be exclusively reserved for the use of allglass equipment, and other equipment involving the use of volatile solvents as this building is specially fitted with explosion proof wiring and other electrical appliances.

V. INSTALLATION

An allglass fractionation column, which was procured (locally) and installed with the assistance of the Consultant during 1990 mission, was dismantled as a part of realignment of pilot plants.

This unit has been re-installed in the main pilot plant building using newly procured knitmesh internal packing.

The performance of this unit of 50mm diameter and height of 1 M, reboiler of 500 ml capacity fitted with an electrical heater and a regulator, vacuum pump and an electromagnetic reflux distributor has been tested using Java Citronella oil.

Fractions collected were being analysed at MPRC at the time of departure of the consultant.

VI. TECHNICAL REPORTS

At the request of NPC the Consultant prepared a technical report on essential oils, using the data obtained on pilot plant during his earlier missions.

This report contained the following :

- Availability of raw material
- Quality of raw materials
- Demand and Supply of essential oils
- Optimum conditions of distillation
- Distillation data
- Analysis of oils
- Recommended economical plant size
- Design of unit
- General services.

The report contained the data on the following essential oil bearing plants :

- Salvia triloba
- Origanum
- Bay Leaf
- Storax

The general format of this report is expected to be a model in the preparation of the project reports/profiles in MPRC in future.

VII. MEETINGS ATTENDED

Attended TPR Meeting on 14th Oct'91 to review the project no. DP/TUR/88/001 at UNDP office at Ankara, the following were present at the meeting :

- | | |
|--------------------------|---------------------------|
| - Mr. Khan, Dy. Res.Rep. | - Chairman |
| - Dr. M.K.Hussein | - U.C.D. |
| - Prof. K.H.C.Baser | - N.P.C. |
| - M.B.Narasimha | - UNIDO Consultant |
| - Ms. Meral | - Expert |
| | State Planning Orgn. |
| - Mr. Melih Toreli | - Sr. Programme Assistant |
| | UNIDO Office, |
| | UNDP Ankara. |



UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

JOB DESCRIPTION

DP/TUR/88/001/11-01

Post title Chemical Technologist

Duration 1 month 1.0 w/m

Date required September 1991

Duty station Eskisehir Turkey

Purpose of project Industrial utilization of medicinal and aromatic plant resources for the production of pharmaceuticals

Duties The expert is expected to work in the Medicinal Plants Research Centre, University of Anatolia, and guide and assist the Director and his staff in the pilot-scale processing of pharmaceuticals from Medicinal and Aromatic Plants.

The preparations from medicinal plants are for therapeutic use within the country as well as for export. Essential oils from aromatic plants could also be for export purposes. The expert will be specifically required to accomplish the following:

- a. Initiate the development of suitable process technology for successful products based on work done in Phase I.
- b. Train local counterparts in chemical technology related to the production of plant-derived pharmaceuticals and take part in training programmes by delivery of lectures etc.
- c. Compile a short list of candidate-products for experimental production in the following years, and develop draft process-protocols, and techno-economic parameters.

The expert will also be requested to complete a terminal report, before he arrives for debriefing, in which he is expected to discuss his findings and outline his recommendations as regards the future of the project.

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

DP|TUR|83|003 |11-01

Qualifications

Chemical Engineer with experience in the processing of pharmaceutical products from medicinal plants and essential oils from aromatic plants.

Language

English

Background information

The Turkish government is interested in developing the country's considerable natural resources in medicinal and aromatic plants. Two specialist missions have previously stressed the need to build an industry that could process such plants with pharmaceutical products both for local use as well as for export.

The Medicinal Plants Research Centre is part of the University of Anatolia whose associated facilities are also available to the project. The Government expects the Center to develop as an R and D Centre to serve an industry that will provide the country with plant-derived pharmaceuticals.

The Centre will at first be expected to generate the scientific know-how and process technology on which such an industry may be based.

ANNEX II

Report of visit to Dr.Cemil Şenel Laboratory
Manisa, Turkey

Site visited Dr.Cemil Şenel Laboratory on 25 and 26 Oct.91 in pursuance of a personal request of Mr. Rasit Karaosmanoglu, a partner of the company.

NPC, an Asst. Prof. of Pharmacognosy and a Chemical Engineer accompanied the Consultant during the visit to this unit, located in Manisa, which is about 30 km from Izmir, a major port town in the western part of Turkey.

Dr.Cemil Şenel Laboratory is a tiny scale manufacturing unit, consisting of 15 tin coated copper percolators of about 20 kg/batch. The batch time is 42 days. The product "Lityazol Cemil" is of inconsistent quality. The solvent (ethanol) losses are reported to be heavy. This company is reported to be running under loss.

Only one product viz., "Lityazol Cemil" is produced under Govt. Licence in this laboratory. It is an alcoholic extract of the root bark of the plant scolymus hisponicus. The extract which contains triterpenic saponins and sugars is in good demand for the effective treatment of kidney stones.

Production of "Lityazol Cemil" a herbal medicine based on abundantly available local plant material is incurring heavy financial loss to the management, due to the obsolete methods followed and the use of outdated equipment in its production.

The consultant during his last mission initiated R&D programme on bench scale at MPRC for the development of appropriate technology and provided plant designs for a versatile prototype unit of about 10 kg/batch and helped in its fabrication in the university's workshop. Sketches enclosed.

Initial bench-scale experiments indicate, that it is very much possible to reduce the batch time from 42 days to about 1 to 2 days and effect reduce solvent losses considerably and standardise the product.

Recommendations

It is strongly recommended that an appropriate new plant be designed, fabricated locally, installed, commissioned and the technical personnel trained.

It is a fitcase for the UNIDO to extend support to modernise a sick and uneconomically operated herbal drug unit producing a pharmaceutical preparation in good demand based on locally available plant material and indigenously available ethyl alcohol.

Present status:

- Plant and equipment
- Production method
- Product
- Staff

Plant and Equipment

It is a tiny scale manufacturing unit consisting of the following :

- One horsepowerd disintegrator
- 15 tin coated copper conical percolators of 20 kg/ batch capacity with loose fitting top covers.
- 30 tin coated copper buckets of sizes varying from 10 to 20 litres.
- A motorized PVC filter press

- A 2000 l stainless steel storage tank
- A 75 l/batch stainless steel distillation still with goose neck, full length jacket, filled with mineral oil, fitted with an immersion heater and a regulator.
- A coiled condensor made of 6mm dia copper tubing immersed in a water tank.
- A 10 l/batch stainless steel open type evaporator with full length jacket filled with mineral oil and immersion heater with a regulator.

Production method

Peeled and dried bark of the plant *Scolymus hispanicus* procured from the plant collectors is crushed in a mill, the resulting material varying from about -200 mesh to 25mm in the size is stored in bags.

About 20 kg of the coarsly crushed bark is mascerated with 70% ethanol in a bucket for a period of 24 hrs, and then charged into one of the percolators. To this is added, in small lots a total 120 l ethanol of 70% concentration.

The percolate (miscella) is collected, at the rate of about 70 drops per minute in an open bucket. The first 20 l of the percolate is collected separately.

The balance of about 100 l of weak percolate/miscella light yellow in colour is filtered through a thick cloth and stored in the tall stainless steel tank.

The same procedure is independently followed with the rest of the 14 percolators.

Percolation of about 300 kg of coarsly crushed bark in 15 percolators with about 1800 l of 70% ethanol takes about 42 days to produce about 300 l of strong miscella and 1500 l of weak miscella.

With the existing set up, marc containing ethanol cannot be subjected to desolventising operation thus not only allowing valuable solvent to go waste, but polluting surroundings and creating fire hazard situation.

About 75 l of filtered weak miscella is charged into the stainless steel distillation still by gravity from the storage tank, and distilled for about 8 hours, then, retaining the concentrated extract in the still another 75 l of weak miscella is charged into the still and distilled for a further period of 8 hours, collecting about 105 l of ethanol in polythene carboys.

About 40 l of ethanol is lost during this operation alone.

The concentrated extract thus obtained is further concentrated for "days together" in the open evaporator. To this "further concentrated" extract is added 20 l of first percolate/strong miscella, mixed well and manually filtered through cloth, filled about 20 grams in bottles, labelled and marketed.

About 300 kg of extract, ready for pharmaceutical use is obtained from 300 kg of crushed bark in about 42 days.

About 400 l ethanol is all that is recovered for reuse out of 1800 l of ethanol used.

Product

The following physical measurements of the extract are made before packing :

pH	:	5.5	-	6.0 (min. 4.5)
Sp.gr.	:	0.96	-	0.99
Viscosity	:	3.25cp	-	4.25 (min. 2cp)

No other process control or quality measures are applied throughout the production operations.

Despite, seemingly unscientific methods followed in its production, lityazol Cemil according to the management is in great demand in Turkey and in some Europe countries.

Staff

A fulltime Chemical Engineer supported by three semi-skilled workers is looking after the production.

Partners

Mr. Hikmet Toygon

Mr. Raşit Karaosmanoğlu

R&D studies at MPRC

Preliminary results of R&D for the extraction of *Scolymus hispanicus* roots :

Drawn up a broad plan of action for indepth study of extraction of these roots :

- Particle size
- Choice of solvent
- Optimum temperature
- Optimum time

Solvents

De-ionised water

Ethyl alcohol - various concentrations in water.

Rectified spirit

Since *Scolymus hispanicus* root bark contains triterpenic Saponins soluble in ethanol and water, bench scale experiments have been planned and helped in its implementation using various concentrations of ethanol and de-ionised water as solvents at their boiling temperatures.

The extracts obtained were concentrated and tested by TLC. The following is the table of results :

	Hrs.	Ethyl Alcohol			De-ionised water
		96%	70%	50%	
Soxhlet	2	6.4	4.2	6.5	10.1 *
Boiling temp.	2	9.0	23.23	29.5	44.2
Soxhlet	4	13.5	11.0	4.9	9.4
Boiling temp.	4	9.97	23.5	39.3	53.4
Soxhlet	6	12.8	21.8	14.3	24.79
Boiling temp.	6	9.56	21.26	38.14	56.82
Soxhlet	8	15.39	27.58	18.5	41.28
Boiling temp.	8	9.93	28.2	37.18	54.2

*NOTE : These figures are percentage of total solids.

From the above table it is seen that water at its boiling temperature, yields maximum of solids in just 4 hours, However, the extract when compared with "Lityazol Cemil" by TLC method contains more sugars.

Since "Lityazol Cemil" is not produced to any particular standard and is not listed in any pharmacopoeia, it is prudent to evolve and standardise method to produce an extract of, composition comparable to that of factory produced "Lityazol Cemil".

Towards this objective, samples of "Lityazol Cemil" produced during the past 10-15 years were collected for assay at the centre (Saponins, Sugars, Free ethanol and any other compounds).

Bench scale experiments indicate the following optimum conditions :

- 50% ethanol as solvent at its boiling temperature
- 4 hours time of extraction

Design of Prototype pilot unit

To scale up the results of bench scale, a battery of four stage percolator (10 kg/batch) system has been designed.

This unit has four miscella tanks attached to the four percolators, fitted with preheating coils (steam heated) and four circulating pumps.

Pipes and fittings have been devised in such a way that:

- One to four percolators can be used at any time to determine optimum number of stages required for a given raw material at set conditions.
- Miscella from any percolator can be re-cycled into any one of the remaining percolators.
- Suitable to study solid-liquid extraction parameters.
- Polar and non-polar solvents at various temperatures can be used.
- Variable percolation time.

Percolators and Miscella tanks were fabricated in the university's workshop.

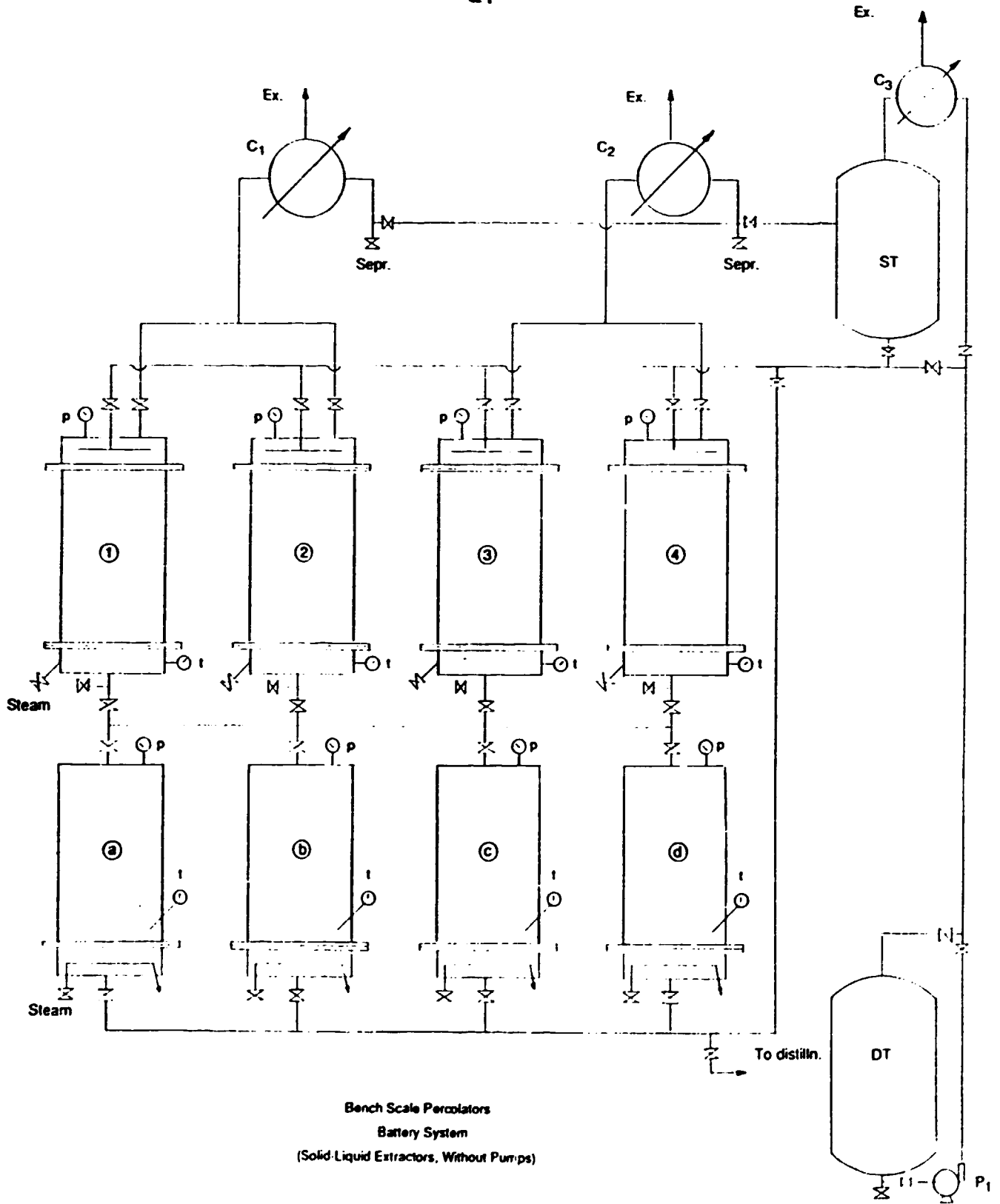
It is interesting to note that a distillation still 250l/ batch (steam heated) a receiver of 125l capacity, a shell and tube condenser of 1 M² cooling surface were made in stainless steel from parts salvaged from the Air Force junk yard in Eskisehir.

All these units were ready for installation at the end of the consultant's last mission (early Nov'91).

The same percolator battery can be used for extraction studies of the following on-going projects of MPRC :

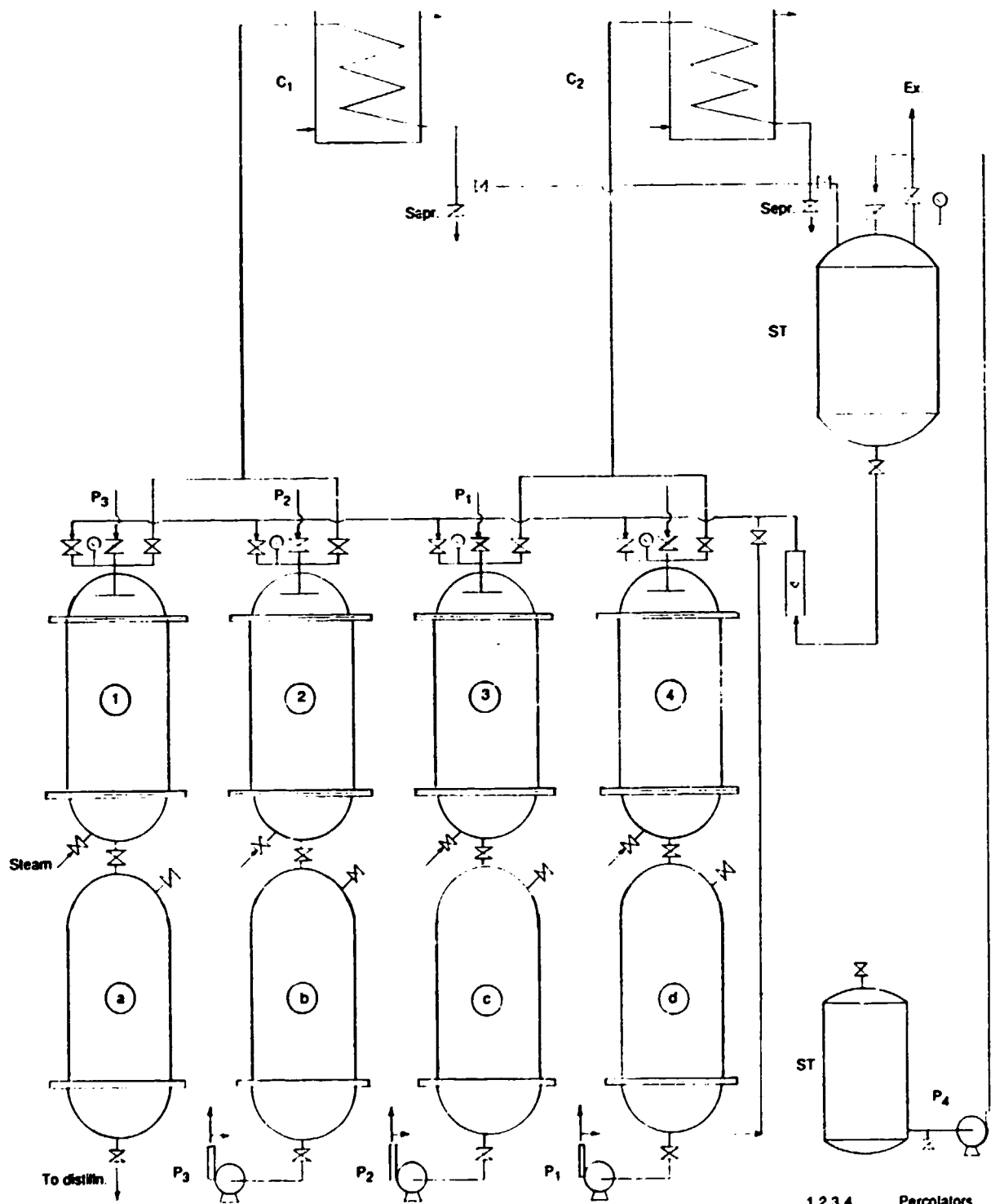
- Arnebia - for red dye
- Laurel berries - for fixed oil
- Scolimus hisponicus - for pharmaceutical preparation.

M.B. NARASIMHA



- | | | | |
|--|-------------------|----|----------------------|
| 1,2,3,4 | .. Perculators | t | .. Thermometer |
| a,b,c,d | .. Miscella tanks | p | .. Pressure gauge |
| C ₁ ,C ₂ ,C ₃ | .. Condensers | DT | .. Distillation Tank |
| P ₁ | .. Solvent pump | ST | .. Solvent tank |

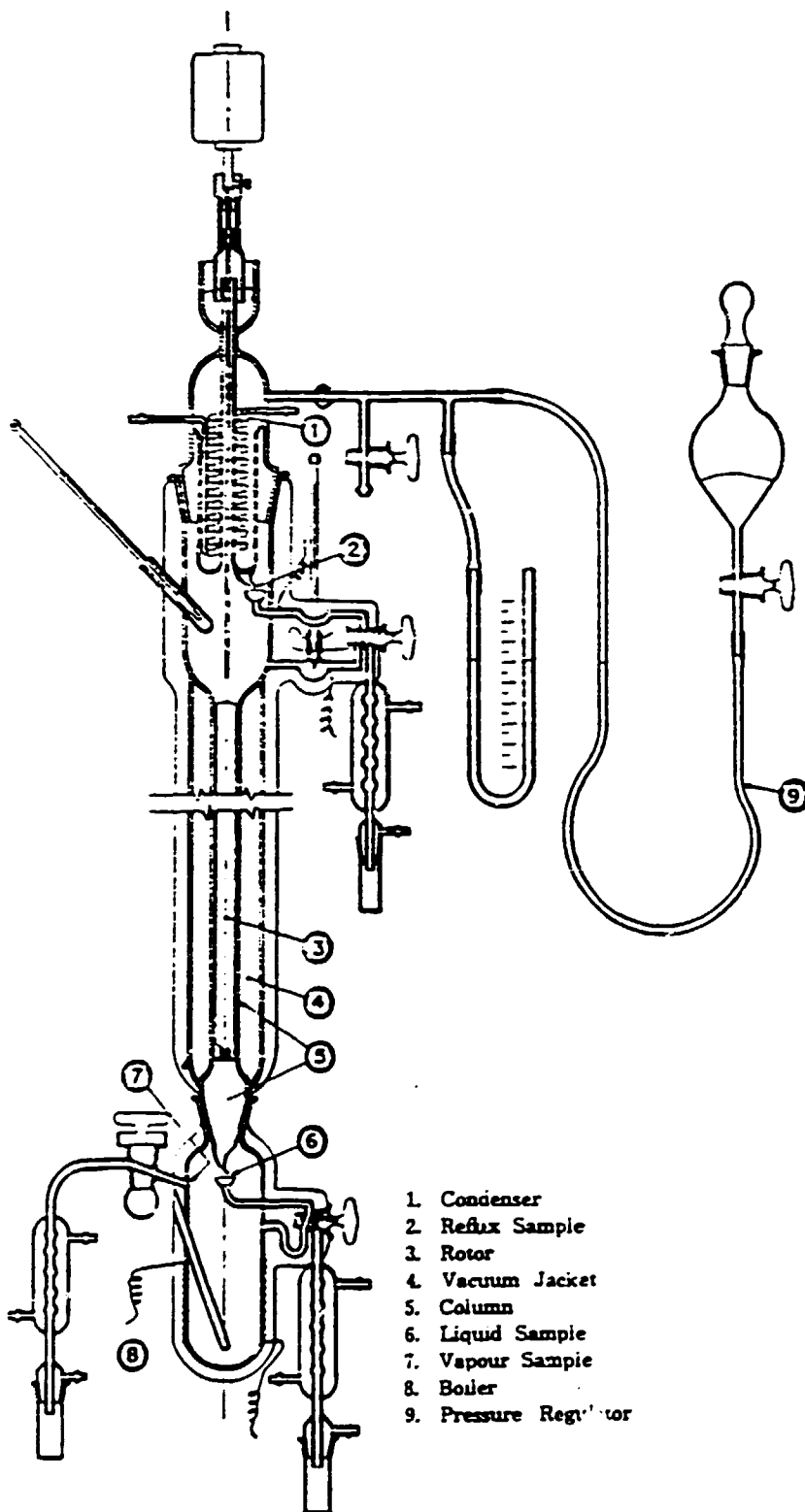
Designed by: M. B. NARASIMHA, S. H. BEIS
 Anzolu University Medicinal Plants
 Research Centre, Eskişehir, October 1991



Bench Scale Perculators
Battery System
(Solid-Liquid Extractors)

- 1,2,3,4 .. Percolators
- a,b,c,d .. Miscella tanks
- P₁,P₂,P₃ .. Miscella pumps
- P₄ .. Solvent pump
- C₁,C₂ .. Condensers
- ST .. Solvent tank

Designed by: M. B. NARASIMHA, S. H. BEIS
Anadolu University Medicinal Plants
Research Centre, Eskişehir, October 1991



1. Condenser
2. Reflux Sample
3. Rotor
4. Vacuum Jacket
5. Column
6. Liquid Sample
7. Vapour Sample
8. Boiler
9. Pressure Regulator

Spinning Band Column

DESIGNED BY	DRAWN BY	CHECKED BY	DATE
M. B.
MATERIAL	SPINNING BAND COLUMN		
GLASS	COLUMN		
SS.		

24

ANNEX III

TRUMAP

Training Programme
on the Utilization of Medicinal and Aromatic Plants in
Pharmaceutical and Related Industries

9-28 September 1991
Eskisehir, Turkey

9 September Monday

- 9.30 - 10.30 OPENING CEREMONY
- Prof.Dr.K.H.C.Baser, Programme Director
 - Prof.Dr.M.K.Hussein, UNIDO Country Director
 - Prof.Dr.Semih Buker, Deputy Rector,
Anadolu University.
- 10.00 - 10.30 TEA BREAK
- 11.00 - 12.00 - Introduction to the Training Programme
Prof.Dr. K.H.C.Baser
- 13.00 - 14.00 LUNCH
- 14.00 - 15.00 - From plants to products - An overview
Prof.Dr. K.H.C.Baser
- 15.00 - 15.30 TEA BREAK
- 15.30 - 18.00 Visit to the University Campus
- 19.00 - 21.00 RECEPTION

10 September Tuesday

- 8.30 - 9.00 - A brief lecture on laboratory techniques
Prof.Dr. K.H.C.Baser
- 9.00 - 18.00 - Laboratory experiments
Prof. Dr. K.H.C.Baser,
Assist.Prof. Dr. N.Kinmer,
Assist.Prof. Dr. M.Ogutveren,
Assist.Prof. Dr. A.Ertan.

Group A

Extraction of a medicinal plant

Group BEssential oils
- Distillation
- Concrete extraction

11 September Wednesday

9.00 - 18.00 Experiments for Groups (A) and (B)
will be interchanged

12 September Thursday

8.30 - 9.00 - A brief lecture on analytical techniques
Prof. Dr. M. Tuncel

9.00 - 18.00 - Laboratory experiments
Prof. Dr. M. Tuncel, Assist. Prof. Dr. N. Kinmer

- Refractometry
- Polarimetry
- Gas Liquid Chromatography
- TLC-densitometry
- Gas Chromatography -
Mass Spectrometry (GC-MS)

13 September Friday

9.00 - 18.00 - Laboratory experiments
Prof. Dr. M. Tuncel, Assist. Prof. Dr. N. Kinmer

- High Pressure Liquid Chromatography
(HPLC)
- UV spectrophotometry
- IR spectrophotometry
- Potentiometry
- Polarography

15 September Sunday Sightseeing visit to Bursa

16 September Monday

9.00 - 18.00 - Pilot plant experiments
Extraction of a medicinal plant
Theory and practice
Chem. Engr. M. B. Narasimha,
Assoc. Prof. Dr. M. Kara.

Facilities have been provided for conducting experiments
individually.

Lunch break 13.00 - 14.00.
Tea breaks 10.00 - 10.30 and 15.30 - 16.00

17 September Tuesday

9.00 - 18.00

- Pilot plant experiments
- Fractional distillation
- Theory and practice
- Chem.Engr. M.B.Narasimha,
Assoc.Prof. Dr.M.Kara.

18 September Wednesday

9.00 - 13.00

- Pilot plant experiments
- Distillation of essential oil
- Theory and practice
- Chem.Engr. M.B.Narasimha,
Assoc.Prof. Dr. M.Kara.

14.00 - 18.00

- Pilot plant experiments
- Rectification of dilute ethanol
- Chem.Engr. M.B.Narasimha,
Assoc.Prof. Dr. M.Kara.

19 September Thursday

9.00 - 18.00

- Pilot experiments
- Chemical reaction
- Theory and practice
- Chem.Engr. M.B.Narasimha,
Assoc.Prof. Dr. M.Kara

20 September Friday

- Visit to an Alkaloids Factory in Bolvadin/Afyon
- Visit to Rose Oil Distilleries in ISPARTA
- Stay in Antalya

21 September Saturday

- Sightseeing in Antalya

22 September Sunday

- Back to Eskisehir

23 September Tuesday

9.00 - 18.00.

- Cosmetic formulations
- Theory and practice
- M.Muderrisoglu, Assist.Prof.Dr.Y.Yazan.

24 September Monday

- 9.00 - 10.00 - Rose oil production in Turkey
Mr. Z.Konur
- 10.00 - 10.30 TEA BREAK
- 10.30 - 12.00 - Essential oil bearing plants of Turkey
Prof. Dr. E.Sezik
- 12.00 - 13.30 LUNCH
- 13.30 - 15.00 - Assays on essential oils
Prof. Dr. E.Sezik
TEA BREAK
- 15.30 - 17.00 - Industrial Production of Herbal Preparations,
D.Kurtebe
- 17.00 - 18.00 - Rehabilitation of Silikfke Laurel Oil Factory
Technical Film and Discussion

25 September Wednesday

- 9.00 - 18.00 - Pharmaceutical formulations - Theory and practice
Prof. Dr.E.Guler, Assist.Prof.Dr.Y.Yazen
Assist.Prof. Dr.H.Bilac,
Assist Prof. Dr.Zeki Uskan

26 September Thursday

- 9.00 - 17.00 Lectures by invited lecturers

27 September Friday

- 9.00 - 12.00 Round Table Discussion
- 12.00 - 14.00 LUNCH
- 14.00 - 16.00 Evaluation meeting
- 16.00 - CLOSING CEREMONY.

De Silva/jbg
2 July 1992

**Backstopping Officer's Technical comments based on
the work of M.B. Narasimha, DP/TUR/88/001/11-01**

The report shows that the consultant has continued his good work as in earlier missions. The services being delivered to industry by MPRC has been enhanced by the consultant as seen by his report on the visit to Dr. Senel Laboratory. The consultant has designed and fabricated equipment for improving the efficiency of a factory presently running at a loss. Every time MPRC assists in improving a rehabilitation of an industry, it makes a positive contribution to the economic and industrial development of the country.

Parameters have been developed for the extraction of Laurel berries and colourants. In the process, the counterpart staff at MPRC have received very good training and enhanced their self reliance.

The consultant has also strengthened the design and fabrication abilities of MPRC so much so that discarded air craft parts have been used to fabricate usable extractors and percolators. In addition a distillation still has been improved.

Though the mission of the consultant was for one month, he continued work up to two months at the request of the MPRC. The outputs achieved during the mission could not have been possible during one month as the consultant also actively participated in the three week UNIDO training course on the industrial utilization of medicinal plants. The evaluation of the training course showed that the consultant made a very useful contribution.

The consultant has accomplished all his duties and more during this mission.