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PROCESSING OF MEDICINAL PLANTS CULTIVATED AND COLLECTED IN NEPAL

DU/NEP/87/007

NEPAL

Technical report: Evaluation and recommendations*

Prepared for the Government of Nepal
by the United Nations Industrial Development Organization

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* This document has not been edited.

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Summary :

Herbs Production and Processing Co. Ltd. (HPPCL) has become a successful viable venture; turnover during 1987-1988 was NCRS 10.308 million. Target for 1988-1989 has been programmed at NCRS 20 million with an expected profit of NCRS 2.8 million. Due to some unforseen difficulties, the target might not materialise, nevertheless, the turnover will be far more than achieved during 1987-1988.

Most of the work, as per job description of the consultant was completed. Over and above, some work was carriedout on processing of Centella asiatica(Brahmi), Azadirachta indica (Neem) preparation of absolute & resinoids of jatamansi and valerian, working out parameters for enhanced production of lichen resinoid with the existing equipment and improving economics of its production. Improvement in odour quality of jatamansi oil as per UNIDO telex to suit German market was done.

Work on fixing quality standards for lichen resinoid, jatamansi and valerian products, shilajit extract was initiated. Some data is given in this Report.

One of the dioscorea digestion tank as per discussion with the Consultant & National Project Director was modified by the supplier (without extra charge)to be used for lichen extraction. This unit will free the soxhlet unit for production of jatamansi and calamus oil thus further improving the working capacity and capability of HPPCL. To achieve full utilisation of equipment, factory is running three shifts.

Working of HPPCL is likely to improve further if work done and initiated by the consultant is continued especially on jatamansi, valerian and standardising process for enhanced production of lichen resinoid and reducing of cost of production.

HPPCL has taken adequate steps to produce and procure raw material for processing on ever increasing scale. It was also heartening to note that the staff of HPPCL has not only acquired experience but also gained confidence to improve production on increasing scale and fixing quality standard of the products.

Recommendations : Following recommendations are given for overall improved working of H.P.F.C.L.

i) H.M.G Nepal has banned export of 6 crude drugs i.e. Sugandha kokila, Jatamansi, Valerian, Rauwolfia, Shilajit and Lichens. Work initiated during this Mission on Jatamansi, Valerian and Lichen products of high quality and value need to be persued to create wider market abroad.

ii) Work initiated on improved and modified parameters for enhanced production of lichen resinoid to meet the demand should be brought to satisfactory processing on large scale. This work will not only increase production by about at least 50 percent using existing equipment but is also likely to improve economics of production.

iii) In order to improve further working of HPPCL and also for optimum utilisation of equipment,installation of dust collector for pulverisers, lichen cutter/grinder, alcohol rectification column, marc press, a small vacuum concentrator and centrifuge are considered absolutely necessary.

iv) While broadening the range of products as well as increased production, the sales and marketing wings of HPPCL need strengthening.

v) In due course, the quality control and analytical laboratory will also be well equipped. To cope-up with the increased work of laboratory due to enhanced production of various products, some arrangement will be necessary to house the laboratory in more spacious place than the existing one. This suggestion has been brought to the notice of the HPPCL management.

Introduction : Post investment support for DP/NEP/80/044 "Processing of Medicinal Plants-Cultivated and Collected in Nepal" was followed by way of a project DU/NEP/87/007 from 5 December 1988 for a period of 2.25 months. The follow up mission was required to work specifically on the following :

1. Complete work on pine resin distillation
2. Complete work on development of products in trial production by H.P.P.C.L. as identified in CTA'S terminal report. (pages,2,3 and 5)
3. Evaluate progress of extension work of HPPCL for raw material production.
4. Formulate programme for maximum utilisation of equipment at HPPCL.
5. Evaluate progress of production programme.

Some additional work was also done. Details of work done by the Processing Consultant during the current mission is given in this Report.

1. Pine Resin Distillation :

HPPCL has two types of pine resin distillation units; country still installed in Tamagadhi Farm and a regular modern unit installed in HPPCL factory in Kathmandu. While the former is inexpensive but uses fuel wood for processing, the latter is comparatively expensive and needs steam at pressure for processing. Quality of products obtained in Kathmandu factory is better as compared to those obtained by country still. Pine resin processing units were established near the site of pine resin collection centres to save on transportation expenses.

Pine resin processing unit installed in Kathmandu has started functioning. Pine resin material collected from north of Kathmandu at Dolakha District will be processed here.

Raw material: Average percentage composition of pine resin has been observed to be :

Rosin 75 percent (By weight)
Turpentine oil 16 percent (vol/weight)
Extraneous matter 8-10 percent (By weight)
(Wooden chips, leaves, dust etc.)

Composition of extraneous matter varies from batch to batch. However, strict check is exercised at the collection centres to minimise its content in the resin. The presence of extraneous matter also poses problems during processing.

Processing : The unit is designed to process one ton of resin per eight hour shift. The process in brief is as follows :

Pine resin is brought to processing centre in tins of about 20 kgs. weight. Pine resin being of solid consistency cannot be charged into the still. Top of the tin is cut; tin is put into the melter with open end facing downwards and fixed outo a tube with holes for steam.25 tins are put into the melter. The melter is pre-heated with

steam through the jacket. Steam is also let into the tube (on which tin is kept) intermittently to avoid loss of turpentine oil by evaporation. It takes about 90 minutes for melting the resin which passes through a mesh. Molten resin is first passed through a coarse mesh which retains larger prices of wooden, chips, twigs, leaves etc. The filtered resin is then passed through a fine mesh which retains dust etc.

Even though thereisa provision for charging warm turpentine oil into the melter to facilitate charging resin into the still, this is not followed in practice as a routine as the molten resin is sufficiently fluid to pass through sieve at higher temperature.

Molten and clear resin is fed into the still through a pre-heated valve.

Empty tins are removed from the melter. Another set of 25 tins of resin is fed into the melter.

Steam at about 2 bar pressure is let in the jacket of the still as also directly in the charge. Stirrer is also started simultaneously. Distillation is continued till the next lot of resin is kept in the melter ready for re-charging. Before charging another 500 kgs. of molten resin in the still, a solution of oxalic acid (800 gm in 5-10 litres of water) is also fed in the unit.

In all, 50 tins of resin corresponding to about 1000 kgs of resin are charged into the still.

After charging 1000 kgs of resin in the still, the steam at the pressure at 3 bars is let into the jacket. Direct steam is also given in the charge simultaneously with the stirrer also working. Injection of direct steam is stopped when about 14-15 percent turpentine oil is recovered (it takes about 4-5 hours to recover this quantity of turpentine oil). Full steam is then given in the jacket which yields balance turpentine oil and also removes any water left in the charge.

Last traces of turpentine oil and moisture are removed by opening the valve into the atmosphere and passing steam for about 15 minutes in the jacket and for 2-5 minutes direct into the charge.

Molten rosin is removed from the bottom valve of the still in tins of 18 kgs. capacity. Rosin sets on cooling.

It takes about 8 hours to complete processing of 1000 kgs. resin.

It has been observed that it would be possible to increase charge size to about 75 tins of resin equivalent to about 1500 kgs. of resin if filteration of molten resin is made more efficient. This being non-tapping season(Dec-Feb) for pine resin, material could not be arranged for this trial. This will, however, be tried as soon as fresh pine resin starts coming from Dolakha district.

Problem :

Due to contamination of pine resin raw material with wood chips, twigs, leaves dust etc. after filteration removal of these from the melter poses some problems. Injection of warm turpentine oil can solve this but extra turpentine oil removal from charge by distillation will need additional steam thus increasing cost of production.

To facilitate removal of extraneous matter, another coarse sieve on top of filters and immediate below the tins has been put. This sieve can be removed periodically and cleaned. This has facilitated removal of extraneous matter and thus save time in charging and cleaning the melter. The modification has been carriedout by the mentainance section of HPPCL during the mission of the consultant.

2. Development of products in trial production :

Developmental work for scaling up the following products was envisaged as per last report (6 August, 1988) by the C.T.A.

i) Belladonna soft extract having 6-7 percent total alkaloid content.
ii) Podophyllum resin for product evaluation and economics of production.
iii) Shilajit extract for market evaluation and economics of production.
iv) Processing of tree moss by cold percolation to produce 200-300 kg. for market evaluation.
v) Pilot scale production of valerian absolute.
vi) Pilot scale production of Jatamansi resinoid.
vii) Production of tree moss absolute from resinoid obtained by hot percolation.

Work done on the above mentioned products is given as under:

i) Belladonna soft extract having 6-7 percent total alkaloids:

Sample prepared for market evaluation was sent to a party interested in the product for plaster. Inspite of reminders there is no response. Scaling up of production has, therefore, been kept in abeyance.

Scaling up upto charge of 10-20 kg. soft extract of 3 percent total alkaloids is under process handled by the staff of HPPCL.

ii) Podophyllum resin: Production of podophyllum resin from a charge of 10½ kg of raw material has been done adopting process worked out in the laboratory.

Coarsly ground podophyllum rhizomes & roots were extracted by alcohol thrice under reflux. In all, 600 litres of alcohol (94%)

was used (250 lit, 200 lit & 150 litres) refluxing for 17 hours (6 hrs, 6 hrs & 5 hrs). Percolate, 423 litres obtained was concentrated to 52 litres in vacuum concentrater.

Podophyllum resin was precipitated by adding 270 litres of ice cold water and 7 kg of conc.hydrochloric acid. The resin was filtered washed with water, and dried in oven at a temperature not exceeding 40°C.

Yield of product was 1.93 percent having 43.83 percent of podophyllotoxin.

The resin was tested as per B.P. It was observed that the material extracted was Podophyllum peltatum as per test given in I.P. & B.P.

Technology for processing Podophyllum has been passed on to the Royal Drug Research Laboratory along with 160 kg of material for processing in Godavari Pilot Plant. Results are awaited.

At this yield level of podophyllum resin sale price has been calculated at NCRS 2000/kg (about US$ 80/kg). Sample has been sent to a party interested in this product.

iii) Shilajit Extract: Shilajit extract is produced basically by water extraction. It was observed in the laboratory that:

a) Coarse powdering of raw material is essential
b) Extraction by hot water gives about 40 percent yield of extract as against 25 percent by cold water.

Shilajit raw material is available at high altitude area with hardly an easy approach.Transportation of raw material to the plains is not only laborious but expensive as the material along with 75-80 percent stone material is

brought by head load. It was, therefore, considered essential to process the material at site and transport only the final extract. (Processing site is about 8 hours walk from Dolpa-altitude 2400 m. while Dolpa is connected by plane only from Nepalganj).

A trained person was deputed from HPPCL for processing shilajit at site using large buckets and pans for extraction and concentration. Process followed was as per laboratory process. The final product obtained in an yield of 40 percent (3 extraction) from a charge of 150 kg was brought to the HPPCL for testing. The product was found to be of satisfactory consistency and free from dust or any water insoluble matter.

In the Ayurveda, there is no set standard for shilajit extract. Work is being done to fix standards such as:

a) Moisture (water content)
b) Acid value
c) Nitrogen percentage
d) Ash content
e) Residue insoluble in water
f) Solubility in water
g) Solubility in various solvents
h) Wt. per ml. of 50% aqueous solution

Large number of samples are being tested for collecting data as given above. The work is progressing satisfactorily.

iv) Processing of tree moss on pilot scale by cold percolation:

As indicated in earlier reports, cold percolation while giving low yield of resinoid, is of better quality (also indicated by higher yield of absolute and benzene extractive). Cold percolation produce of lichen will also be higher priced.

As the position is, HPPCL cannot meet the existing demand for the resinoid under production. Also, considering the limited availability of ethanol, this work could not be undertaken. On the other hand, work

was undertaken to maximise production of resinoid by improving upon parameters. Details of this work are given elsewhere in this report.

v) Pilot scale production of Valerian absolute :

Valerian absolute produced from its resinoid was rated as of good quality with positive market response. Scale up of production on pilot scale was undertaken.

Two trials comprising of 10 kg and 21 kg charge were undertaken. It was observed that 3 extractions with alcohol at room temperature gave optimum yield of absolute.

Filtered extract was concentrated in Jasmine oil concentrater. Final removal of alcohol was achieved in a dryer at 40°C. Absolute was obtained in an yield of 55 to 65 percent.

It may be mentioned here that production of absolute would be facilitated after acquiring a centrefuge (12"-18" basket size) and a vacuum concentrator of about 50 litres capacity. This will not only enable maximum recovery of solvent (thus improving economics of production) but will also give excellent quality product.

vi) Pilot scale production of Jatamansi Resinoid:

Resinoid of jatamansi was produced using ethanol & n.hexane as solvents in an yield of 6.30 and 2.90 percent respectively. It was observed that extraction by soxhlet gives better yield.

Considering the wide variation in oil content of jatamansi, it is considered adviseable to develop other product(s) such as resinoid, absolute which are likely to have better market. This work was, therefore, taken up to get preliminary data on yield and quality of other products as also for market evaluation.

Extraction of jatamansi by ethanol (both hot and cold percolation) was done. Yield of resinoid by soxhlet was 6.3 percent while the same with cold percolation was 4.8 percent.

Yield of jatamansi concrete with n-hexane was 2.90 percent. Quality and appearance of product by n-hexane was superior to the resinoid obtained by ethanol.

Pilot scale extraction of jatamansi (charge size 20 kg) gave resinoid in an yield of 2 percent.

Production of absolute: Absolute was prepared from the resinoids prepared by ethanol and n-hexane. It was observed that resinoid prepared by ethanol was not completely soluble in alcohol. The product was, therefore, reprocessed to make it usable. Data obtained is as under :

Absolute:	Yield from Resinoid/Concrete (%)	Yield on Raw material (%)
1. From resinoid extracted by		
i) hot ethanol	57.7	3.60
ii) cold percolation	93.0	1.80
2. From concrete extracted by benzene	85.8	4.12
3. From concrete extracted by hexane	74.9	1.71

In terms of odour and yield, absolute of benzene concrete was better than absolute from hexane concrete. Larger samples will be prepared for economics of production and market evaluation.

3. Progress of Extension work for raw material production :

Extension work is being undertaken by HPPCL on two aspects :

i) Cultivation by farmers

ii) Procurement of material from various centres mostly natural herbs.

Cultivation : Cultivation of aromatic plants in various places has been taken up to augment production and provide better avenues of employment and income to farmers and land less labour. Total area brought under cultivation under various crops is 97.5 ha. as per details given in annexure I

Procurement of Material from various centres: HPPCL has set up 7 centres wherefrom herbs and crude drugs are purchased for processing and sale as such. Availability of major crude drugs available from these centres is given in Annexure II

Botanical names of crude drugs collected & processed by HPPCL are given in Annexure III H.P.P.C.L. has also set up distillation units and other relevant equipment at sources of availability of cultivated and natural herbs. These centres are :

Place/locality	Material Processed	Materials Proposed for Processing in future
1. Shivalaya (Ramechap)	Wintergreen, Rhododendron	Abies leaves, Juniper, Jatamansi, Artemisea
2. Sundarpur (Sunsari)	Lemongrass, Citronella	Tagetes, Vetiver, Mentha
3. Dolpa	Shilajit	Jatamansi, Juniper, Abies, Calamus, Artemisea

Three more centres are proposed (in view) for processing aromatic raw material as under :

Proposed Centre	Material to be Processed
1. Nepalganj (Bankay)	Mentha, Citronella, Lemongrass, Palmarosa, Vetiver, Calamus, Tagetes

2. Ghorahi (Dang)	Sugandha kokila, Timoor, Calamus, Tejpat, Mentha, Citronella
3. Dadeldhura (under survey)	Jatamansi, Timur, Tejpat, Calamus, Mentha piperita

HPPCL has also embarked upon a programme for planting sugandha kokila in Dang. 12000 plants were planted during 1988 while 50,000 plants are proposed for planting during July-August, 1989.

It will be seen that HPPCL has taken adequate steps for procuring raw material for sale & processing.

4. Programme for maximum utilisation of Equipment at HPPCL.

With the passage of time and with the experience acquired in production and sale, it is seen that based on quality and price, demand for certain items is more than estimated earlier. Items such as tree moss products, calamus oil, jatamansi oil, valerian resinoid and absolute, citronella and lemongrass oils, tagetes oil, wintergreen oil are to be produced in larger quantities. Though there will be certain constraints in increasing production of some items immediately either for want of equipment capacity (resinoids & absolutes) or time lag in initiating cultivation and achieving increased level of production (citronella, lemongrass and tagetes) steps can be taken now to achieve higher production.

With the enhanced processing capacity for pine resin, efforts have been made by HPPCL to procure additional quantity of resin. In due course, production of both rosin and turpentine will be increased to meet local demand and export. It seems possible to process 500 tons or more of pine resin now if raw material becomes available.

Sudden stoppage of demand for sugandh kokila oil in France, gave HPPCL a set-back. Concerted efforts for alternate market have started giving results. It is expected that about 2000 kg. of oil will be sold now this year thus bringing back stability in this oil. Production of this oil is continuing making full use of the distillation capacity.

There has been increased demand for some other essential oils such as calamus and jatamansi, which will require utilisation of distillation units at full capacity. It is also seen that it will not be possible to produce sufficient quantity of oils to meet demand from the distillation units available in HPPCL (There is one regualr distillation unit only, soxhlet unit is also used for distilling aromatic material as also for extraction of lichen resinoid).

Basic equipment like extraction and distillation units are in contineous use. Auxillary equipment especially solvent recovery units are also being used regularly. An idea about the utilisation of various equipments is given as under:

1. Distillation unit: One : capacity - 500 kg (in terms of Sugandh kokila)

The unit is ideal for sugandh kokila and light materials, like leaves, herbs etc. but not for roots and plants giving oil having high boiling constituents. At the present, the unit is engaged for distillation of sugandha kokila throughout the year.

In terms of sugandh kokila, 75 tons of material can be distilled in a year. At present its capacity utilisation can be put at about 70 percent.

2. Soxhelet unit : One : Capacity 3000 litres : (300 kg in terms of Lichen or 350 kg jatamansi)

The unit was installed primarily for contineous extraction of dioscorea hydrolysate. As dioscorea processing has not been taken up, the unit is being put to use for lichen extraction and distillation of jatamansi and calamus. Prior to installation of distillation unit, sugandh kokila was also distilled regularly.

Capacity utilisation of soxhelet unit is nearly 100 percent.

3. Pine Resin Unit : One : Capacity 1 ton/batch.

The unit was installed recently. This being non-tapping season for pine resin, is not being put to regular use. Full capacity utilisation will depend on availability of pine resin; the unit can process upto 450 tonnes per annum. 300 ton of resin is expected this year.

4. Extraction units : There are two types of extraction units; extraction in hot solvent by reflux and for cold percolation.

i) Extraction in hot solvent : Two : Capacity - 150 kg of lichen each.

These two units, having steam jacket, are regularly used for extraction of lichen. Both these units can extract 32 tons of lichen per annum; capacity utilisation is 85 percent.

ii) Cold Percolators : Two : Capcity : 500 kg in terms of belladonna & vasaka leaves.

These units are not put to full use for want of demand for belladonna and vasaka leaves extract. Capacity utilisation is, therefore, low at 10 percent.

Capacity utilisation can be increased to about 100 percent if lichen is extracted in these units. This is not being done as solvent cannot be recovered for want of a marc press.

5. Digestion Tanks (FRP) : Two : Capacity 200 litres each.

Due to shelving of dioscorea processing, these units are not being used for the purpose meant for. However, one tank is being used for upgrading quality of turpentine oil as and when required. The other tank is being modified (by the supplier at no additional cost) to serve as an extraction unit. Lichen extraction will be done in this modified unit. Once modified the unit will be used regularly freeing the soxhlet unit for distillation of aromatic raw materials.

6. Belladonna Extract
Processing unit : One : Capacity 400 litres.

The unit was being used for hydrolysis of dioscorea which is now stopped. The unit is meant for processing belladonna extract for production of belladonna alkaloids. The unit will be put to use once demand for belladonna soft extract of 6-7 percent materialises. (Sample of the latter produced have been sent for approval of the buyer. Response is awaited)

7. Pulverisers : Two : Capacity 25 kg & 50 kg/hours

Jaw Crusher : One : Capacity 25 kg/hour

These units are being used regularly. As the units are not equipped with dust collectors, working is not convenient. Installation of dust collectors is necessary.

8. Deep Freeze : Two : Capacity 400 litres each.

These units are used occasionally for processing mentha oil for menthol only. Capacity utilisation is, therefore, low at about 10 percent. Once mentha oil production increase with simultaneous demand for menthol, capacity utilisation will increase automatically.

These units will also be used for producing absolutes of valerian and jatamansi. (Samples of absolutes have been prepared for market response)

9. Vacuum Concentrators :

i) with stirres : Two : Capacity 300 lot & 800 litres respectively
ii) without stirrer : One : Capacity 2000 litres

Working of these units is linked with processing of lichen , belladonna & vasaka. Capacity utilisation on an average of the above is 80 percent.

10. Driers :

i) Vacuum : One : Capac ty 25 kg batch size
ii) Tray : One - do -

The driers are being used upto 80 percent of the capacity utilisation.

11. Boilers :

i) One : One ton Steam/hour
ii) One : 500 kg " / "

Boiler of 1 ton capacity is being used at full capacity while the one with 500 kg steam per hour is meant as stand bye and is being used for night shift when requirement of steam is low.

Programme for 1988-89 for production and sale has been put at about NCRS 20 million, while the same for 1989-1990 will be more than NCRS 20 million. Capacity utilisation of equipment will improve further especially with the availability of modified FRP digestion tank & freeing soxhlet unit for distillation of jatamansi and calamus.

HPPCL will need following items of equipment in order to further enhance the capacity utilisation.These items of equipment are :

1. Alcohol rectification unit of capacity 1000 litres per day (8 hours shift)
2. Marc Press : This will enable using cold percolators to full capacity(hydraulic &
3. Cutter/grinder for lichen. This will enable increasing charge capacity automatic) of extractors by at least 70 percent more.
4. Vacuum. concentrater : 50 litre capacity.
5. Centrifuge: 18" basket diameter.

The programme of work of processing will be upgraded once the above equipment is procured.

5. Progress of Production Programme :

Sales of material worth NCRS 10.308 million were achieved during 1987-1988 as against the same at NCRS 8.041 million during 1986-1987. Figures for earlier years have already been given in terminal report of 6 Aug; 1988. Projected sales for 1988-1989 are at about NCRS 20 million with expected profit of NCRS 2.882 million (Annexure IV). This a commendable effort and achievement considering the inherent difficulties due to non availability of certain inputs of solvents in time and regularly. For example, ethanol was not available for 3 months in this year which affected the production programme.

Considering availability of herbs giving products in economic yields and their marketability, HPPCL has acquired competence in producing :

a) Essential oils
b) Extracts & resinoids

In certain cases, demand has out stripped production which cannot be increased either for want of quality raw material or due to inadequate capacity/lack of equipment.

Optimum capacity of available equipment has been looked into cerefully. Recently steps have also been taken to process certain materials at site (to save on transportation of material to Central Processing Facility at Kathmandu) such as wintergreen, rhododendron, shilajit. This has augmented production to some extent.

While considering the product mix, priority has been given to products with regular demand and reasonable margin of profit. Such items are known and production is organised accordingly.

6. Additional work : Some work was done besides required under job description. Details are given hereunder :

Resinoid of Centella asiatica : (Brahmi) : Basic odour of brahmi resinoid is sweet, earthy mossy. Such products are in demand. An attempt was therefore, made to process brahmi to examine possibility of its production.

(Brahmi is a weed growing widely in state of nature. It is highly valued in Ayurvedic system of medicine and is traded in large scale)

As a result of various trials, it was observed that acetone and benzene extract of alcoholic (ethanol and methanol extracted) resinoid, gave a product in an yield of 5.6 and 4.63 percent respectively. While yield of resinoid with ethanol was high 15.85 percent, water soluble gum was the main component which could be easily removed by reprocessing. Products will be evaluated for their utilisation in the industry.

Resinoid of Azadirachta indica (Neem) leaves : As in case of Centella asiatica, resinoid of neem leaves was also prepared considering abundant availability of the raw material. It was observed that benzene extract of resinoid (prepared by using ethanol) gave highest yield at 4.06 percent of a product which had agreeable odour. The product will be evaluated for use in the industry.

Improvement in odour quality of jatamansi oil :

UNIDO, Vienna conveyed comments of GTZ-HK German Enterprise on oil of jatamansi as having valerian odour. The consultant was asked to check if valerian odour was as a result of admixture/contamination or due to some other reasons of processing.

The problem was looked into. It was observed that top note of jatmansi oil did suggest valerian odour. As there was no possibility of contamination with valerian, jatamansi sample was examined for solving this problem. By treatment of oil, it was possible to isolate the component contributing valerian type odour. The resultant oil was free from this particular top note. Fresh sample was prepared & sent to GTZ/Protrade. Comments are awaited.

The process of improvement in odour has been passed to HPPCL. Large batch size treatment of the oil was not undertaken as the oil (without treatment) has been very well received by the consumers in India who have placed bulk orders.

In case oil sample is approved by GTZ/Protrade, larger quantities of this odour improved oil can now be produced.

Carum Spp. Carum from wild growing plants was distilled. Oil yield was 3.5 percent but having only 8 percent carvone.

Juniper berry oil : Some work was also done on production of juniper berry oil. Sample of 'blue-berries' (mature berries) was distilled. It was observed that to get optimum yield of oil, it is obsolutely essential to distil only crushed berries. Yield of oil from whole berries was 0.4 percent while yield from crushed berries was 0.8 percent. (berries had 40 percent moisture content).

Quality standards for Tree moss Resinoid :

Broadly speaking, tree moss resinoid is composed of two types of components:

a) Components contributing to the characteristic odour and value
b) Components that get extracted but do not contribute to odour and value.

A great deal of work was done in HPPCL under the Project DP/NEP/80/044 on the physico-chemical properties of various lichen resinoid samples. However, it was not possible to fix quality standards based only on physico-chemical characteristics. Some further work was, therefore, done during this Mission about the quality standards for lichen resinoid & for other products there from.

Two parameters played a vital role in evaluating quality of lichen resinoid.

i) Content of alcohol soluble matter in the resinoid

ii) Benzene extractive content of the resinoid.

A few samples of resinoids were evaluated for the above 2 aspects. Data on these samples is given hereunder :

Analysis of Lichen Resinoid Samples

Sample		Percentage content of	
		Benzene Extractive	Absolute
1. Resinoid (Dry)		32.00	60.00
2. Absolute of No I		36.00	-
3. Resinoid Commercial		25.00	-
4. Resinoid from powdered lichens		31.37	71.50
5. Resinoid scrapped from vac. concentrator	i)	31.50	40.00
	ii)	22.75 (Cold percolation)	-
6. Resinoid by cold percolation with alcohol		33.83	86.41
7. Resinoid extracted with benzene		-	92.04
8. Resinoid extracted with hexane		-	15.00

Note : Resinoid dry is free from ethanol

Resinoid commercial contains about 40 % ethanol.

Valerian & Jatamansi Resinoids & Absolutes :

So far resinoid type of products from valerian and jatamansi were evaluated by odour only. To fix some physico-chemical standards, acid and ester value are considered important as these contribute to some extent to the olfactory value. Data obtained on few samples are given hunder.

Data on Jatamansi Product

Product (Yield)	Acid value	Ester value	Colour & Consistency
1. Resinoid by alcohol (6.3 %)	60.05	214.45	Soft dark brown with greenish hue
2. Resinoid extracted with benzene (4.8 %)	48.39	43.70	Greenish brown thick waxy mass
3. Benzene extract of No. 1 (3.88 %)	40.23	183.94	Greenish brown waxy mass
4. Cold percolation with benzene of No.1 (2.05%)	37.71	128.69	Reddish brown thick mass
5. Hexane extractive of No.1 (2.61 %)	28.95	191.73	Brownish green smooth soft mobile liquid
6. Concrete extracted with hexane (2.28 %)	22.02	112.83	Light brown thick soft mass
7. Absolute of No. 6 (1.71 %)	35.85	113.58	Dark orange brown thick mobile liquid
8. Absolute of No. 2 (4.12 %)	19.76	34.37	Golden brown thick smooth liquid
9. Alcohol extractive of No.1 (3.60 %)	56.73	214.45	Greenish brown thick smooth liquid
10. Residual matter after producing absolute of No.2	22.48	23.94	Greenish yellow solid

Data on Valerian products is given at Annexure V.

Yield data on jatamansi and valerian products is given at Annexure VI and VII.

Improved Production & Economy in Cost of Production of Lichen Resinoid :

It has already been mentioned in various reports submitted so far that lichen resinoid has been very well received by the Industry. In view of this all available equipment was put to use for extraction of tree moss.

It was observed during the present mission that inspite of best efforts, production of tree moss resinoid was less than the demand. It was also observed that yield of resinoid was low as compared to earlier work Attention was therefore, paid to the following.

i) Reasons for low yield of resinoid
ii) To increase production of resinoid with the existing equipment.

Reasons for low yield of resinoid : Three reasons could be attributed for low yield of resinoid

a) Low quality material of tree moss
b) Extraction with ethanol of low percentage
c) Incomplete extraction.

The raw material was checked for quality. Extraction of material using alcohol of similar percentage used in large scale extraction was done in the laboratory. Yield of resinoid was satisfactory. Reason for low yield was, therefore, attributed to incomplete extraction. Yield is now again increasing by giving proper care at the extraction stage.

ii) To increase production of resinoid with the existing equipment :

To recapitulate earlier work done in the laboratory, it was observed that high yield of resinoid is obtained by using large volume of alcohol; ratio of raw material : ethanol at 1:10 gave consistently higher yield. However, it was also observed that higher the yield lower the quality due to extraction of matter which does not contribute to the odour (quality). Three extractions were seen to be necessary; the third extract was used for extraction of next batch of lichen.

For large scale extraction, in order to get optimum yield of resinoid having good odour value, the alcohol raw material ration was reduced to 1:6.5.

During the present mission, while working out reasons for low recovery of resinoid, it was observed that it would be worthwhile working out parameters which might improve production as also reduce cost of production :

To increase charge size, lichen was reduced to coarse powder. This step enabled us to increase batch size of 160 kg to a maximum of 275 kg in large scale extraction i.e. increase of about 70 percent.

Laboratory data indicated from a few trials that for powdered lichen ratio of raw material to ethanol at 1:5.6 gave an yield of 13.57 percent of resinoid of acceptable quality. However, in large scale extraction, the ration of raw material to ethanol at 1:4 (3 extraction) gave yield of 10.53 percent. Fourth extraction was also done to see if yield could be improved further. Further work on this very important aspect of lichen resinoid extraction could not be done for want of time.

In terms of saving in ethanol in this improved method, 4000 litres are used for extraction as against 6500 litres for 1000 kg of lichen extracted for resinoid which resulted in saving of 40 percent ethanol for every 1000 kg of lichen.

Also, production of lichen resinoid by cold percolation, as indicated from laboratory work, would increase the overall production by about 700 kgs per annum. (value NCRS Seven hundred thousands). This is also a promising line of work, but could not be undertaken for want of time.

Oil of Jatamansi (Nardostachys jatamansi)

Oil of jatamansi is not a regular item of production in the essential oil industry; its production was small and confined mostly to India. It is only recently that this oil has caught attention of consumers in abroad and on increasing scale in India. So far standard (physico-chemical characteristics) for this oil was not fixed. It is non felt that standard for quality jatamansi oil should be set steps have now been taken during this Mission to analyse oil samples in HPPCL due to regular production.

Batch wise samples will be analysed for a year or two to collect data. Analysis of a lot of oil is as under :

Odour : Typical	
Colour : Light clear blue	
Refractive index ($17^{o}C$)	1.5078
Specific gravity ($17^{o}C$)	0.9649
Acid value	2.16
Ester value	17.36
E.V. after acetylation	32.58
Carbonyl value	82.39
Solubility in 90 % alcohol ($17^{o}C$)	1:0.15;soluble upto 10 vol.

Oil is also soluble in 90 % alcohol but at $30^{o}C$.

7. Miscellaneous :

H.M.G. Nepal has taken a decision to encourage processing of herbs instead of selling/exporting in crude form. To begin with 6 items have been identified for processing and export of products there from. These items are:

Sugandha kokila
Jatamansi
Valerian
Rauwolfia serpentina
Shilajit
Lichens

While this decision has encouraged processing of herbs in Nepal, it has also created certain problems. It is known that end use of various herbs is not for their products As such processing of herbs will not serve the purpose for using these. In certain cases, for example sugandh kokila, even processed material i.e. after distillation, can be very well utilised in the industry. In such specific cases, the processed material, where shape of material is not changed, be allowed to be exported. This will not only permit production of value added products in Nepal at competitive price but will also meet the demand of users of such raw material in abroad (particularly India) as also in local market. While a broad decision is not possible covering all the items, each item may be considered as the case may be.

Annexure I

Extension Programme by Cultivation:
(1988-1989)

	Place	Crops under Cultivation	Area (ha)
1.	Tamagadhi (Bara & Rautahat)	i) Palmarosa	52.0
		ii) Citronella	0.5
		iii) Lemongrass	0.5
2.	Sundarpur & Biratnagar (Morang)	i) Lemongrass	3.0
		ii) Citronella	0.5
3.	Sanischaray (Jhapa)	i) Citronella	12.0
4.	Butwal (Rupandehi)	i) Palmarosa	3.0
		ii) Citronella	2.0
5.	Kohalpur (Bankay)	i) Mentha arvensis	7.0
6.	Dang	i) Sugandha kokila	15.0 (12000 plants)
7.	Khopasi (Kavrepalanchok)	i) Belladonna	2.0
	Total area		97.5 ha

Estimated Production of oils :

1.	Citronella	500 kgs.
2.	Palmarosa	3000-3500 kgs.
3.	Lemongrass	300 kgs.
4.	Mentha arvensis	500 kgs.
5.	Belladonna leaf	1500-2000 kgs.

Annexure II

Centres for Purchase of Crude Drugs

	Centre	District	Availability of Important herbs
1.	Dhankuta	Dhankuta	Chiraita, Kutki, Padamchal, Bikh, Sunpati, Jatamansi, Sugandhwal, Panchaunlay, Dioscorea, Laghupatra.
2.	Shivalaya	Ramechhap	Chiraita, Kutki, Indrayani, Jatamansi, Wintergreen, Shilajit, Bojho, Majitho, Sunpati, Lichen.
3.	Kathmandu	Kathmandu	Chiraita, Padamchal, Kutki, Jatamansi, Sugandhwal, Panchaunlay, Bikh, Indrayani, Dioscorea, Laghupatra, Lichen, Satuwa, Belladonna (Cultivated), Vasaka.
4.	Gorkha	Gorkha	Chiraita, Indrayani, Satawari, Kutki, Majitho, Bojho, Shilajit, Jatamansi, Sugandhawal, Lichen, Podamchal, Satuwa, Atis, Panchaunle, Timur.
5.	Ghorahi	Dang	Sugandh kokila, Timur, Pakhanved, Satawari, Bojho, Dioscorea, Kutki, Sugandhwal, Jatamansi, Atis, Satuwa, Panchaunlay, Lichen, Dalchini.
6.	Nepalganj	Bankay	Jatamansi, Shilajit, Sugandhwal, Timur, Lichen, Panchaunlay, Satawari, Haro, Baro, Dioscorea, Pakhanved, Laghupatra, Dalchini.
7.	Nijgadh	Bara	Haro, Baro, Jivanti, Satawari, Rauwolfia, Vasaka, Tejpat.

Annexure III

Botanical name of crude drugs Collected & Processed by HPPCL

Local Name	Botanical name
Sunpati	Rhododendron anthopogon
Chirata	Swertia chirata
Indrayani	Trichosanthes palmata
Majitho	Rubia cordifolia
Bojho	Acorus calamus
Jivanti	Desmotrichum fimbriatum Bl.
Timur	Xanthoxyllum alatum
Kutki	Picrorhiza kurroa
Bhyakur	Dioscorea deltoidea
Laghupatra	Podophyllum peltatum
Pakhanved	Bergenia ligulata
Asuro	Adhatoda vasica
Belladonna	Atropa belladonna
Satawar	Asparagus racemosus
Harro	Terminalia chebula
Barro	Terminalia belerica
Wintergreen	Gaultheria fragrantissima
Sugandha kokila	Cinnamomum ceciododaphne
Jhyau	Lichens sps.
Shilajit	-
Sugandhwal	Valeriana wallichii
Jatamansi	Nardostachys jatamansi
Satuwa	Paris polyphylla
Panchaunle	Orchis incarnata
Padamchal	Rheum emodi
Atis	Delphinium denudatusu
Dalchine/Tejpat	Cinnamomum tamala

Annexure IV **Production - Sale Programme 1988 - 1989**

	Product	Quantity (Tons)	Sale Price (NCRS) (Ex-factory)
A.	Crude Herbs	112.00	46,19,460
B.	Resinoids/Oils	202.02	1,23,47,393
	1. Rosin	165.00	40,50,750
	2. Turpentine oil	30.00	5,29,200
	3. Lichen Products	3.50	35,19,355
	4. Valerian Products	0.30	2,02,500
	5. Sugandha kokila oil	2.00	16,19,640
	6. Jatamansi oil	0.30	16,52,120
	7. Wintergreen oil	0.30	2,30,010
	8. Calamus oil	0.60	4,69,926
	9. Juniper berry oil	0.02	73,892
		Total A + B =	1,69,66,853
C.	Farm - Cultivated Crops Products	7.72	33,80,820
	1. Citronella oil	1.00	1,84,200
	2. Palmarosa oil	5.50	28,33,600
	3. Lemongrass oil	0.70	1,83,920
	4. Mentha oil	0.50	1,45,000
	5. Tagetes oil	0.02	33,600
		Grand Total A + B + C =	2,03,47,673

Annexure - V

Data on Valerian Products

Product (Yield)	Acid value	Ester value	Colour & Consistency
1. Resinoid by alcohol (16 - 18 %)	48.88	290.76	Dark brownish green waxy mass
2. Absolute of No 1 (10.24, 11.52 %)	58.47 53.47	325.71 270.77	Dark brownish green smooth thick but mobile mass
3. Concrete extracted by hexane (2.39%)	58.09	363.97	Greenish yellow, thick soft mass
4. Absolute of No. 3 (2.11 %)	43.89	484.36	Yellowish brownish with green tinge thick liquid
5. Concrete extracted by benzene (2.71%)	27.24	467.46	Greenish brown thick liquid
6. Absolute of No. 5 (2.09 %)			Greenish brown thick liquid
7. Residual matter after preparing absolute from No. 1	47.0	223.35	Black granules
8. Valerian absolute from alcoholic resinoid (Lab. sample)	116.3	275.0	Dark brownish green smooth thick mobile mass.

Note : Sample No. 8 was an old sample.

Annexure VI

Yield Data of Products from Jatamansi

	Product	Yield (%)	Extractive (%age)	Yield on raw material (%)
1.	Essential oil	0.40 - 1.7	-	-
2.	Resinoid by ethanol			
	a) Hot reflux	6.3	-	-
	b) Cold percolation	2.0	-	-
3.	Absolute from No. 2 (a)	-	57.7	3.60
	" " No. 2 (b)	-	93.0	1.86
4.	Benzene extractive of :			
	No. 2 (a)	-	60.7	3.88
	No. 2 (b)	-	85.2	1.74
5.	Hexane extractive of No. 2(a)		40.8	2.61
	" " " No. 2(b)		34.7	0.70
6.	Concrete by benzene	4.80	-	-
7.	Concrete by hexane	2.28	-	-
8.	Absolute of No. 6	-	85.8	4.12
9.	Absolute of No. 7	-	74.9	1.71
10.	Essential oil content of No. 2 (a)	10.66	-	1.02

Annexure VII

Yield Data of Products from Valerian:

	Product	Yield (%)	Extractive (%)	Yield on raw material(%)
1.	Resinoid by ethanol	16-18	-	-
2.	Absolute of No. 1	-	67.0	10.24 - 11.52
3.	Benzene extractive of No. 1		18.50	3.14
4.	Hexane extractive of No. 1		10.40	1.77
5.	Benzene concrete	2.71	-	-
6.	Hexane concrete	2.39	-	-
7.	Absolute of No. 5	-	77.16	2.09
8.	Absolute of No. 6	-	91.32	2.11
9.	Essential oil	0.10	-	-

Annexure VIII

Samples taken by Processin[illegible]nsultant for Evaluation

1. Jatamansi oil
2. Calamus oil (Low asarone content)
3. Jatamansi absolute via alcohol
4. Jatamansi absolute of hexane concrete
5. Jatamansi absolute of benzene concrete
6. Jatamansi benzene extractive of alc. resinoid
7. Jatamansi " " " " " (C.P.)
8. Jatamansi hexane extractive of alc. resinoid
9. Jatamansi benzene concrete
10. Jatamansi hexane concrete
11. Brahmi benzene extractive of methanol resinoid
12. Brahmi acetone " " " "
13. Neem acetone extractive of alc. resinoid
14. Neem acetone extract
15. Lichen resinoid benzene extractive
16. Lichen benzene extractive of resinoid (C.P.)
17. Valerian hexane concrete
18. Valerian absolute of No. 17
19. Valerian benzene concrete
20. Valerian absolute of No. 19
21. Valerian hexane extractive of resinoid (alc.)
22. Valerian benzene extractive of resinoid (alc.)