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PREPARATORY TECHNICAL ASSISTANCE FOR UPGRADING AND STRENGTHENING  
THE ARTISANAL INDUSTRIES IN FRANKINCENSE, ROSE WATER AND POTTERY

DP/OMA/89/011/11-51

THE SULTANATE OF OMAN

Technical report: Frankincense\*

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

Based on the work of B. Gulati, expert in frankincense

Backstopping Officer: T. De Silva  
Chemical Industries Branch

United Nations Industrial Development Organization  
Vienna

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\* This document has not been edited.

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Abstract

Dhofar region of Oman was world famous at the time of Christ and very rich due to production of and trade in Frankincense. Quantum of Trade was of the order of 2500-3000 tonnes per annum. The produce was carried to Jeddah by camels. Later on between 1804 - 1829, camel caravans started disappearing due to switching over of the trade to sea. The Golden period of trade was between 1830-1939 due to opening up of Indian Market. Frankincense was shipped to Bombay from Dhofar where from it was exported to other countries. On the return journey, the traders brought gold, cloth, spices, flour, sugar and other products. Bombay market-shifted to Aden after duties were levied by Government of India after 1947.

Boswellia species produce frankincense (loban). In Oman, Boswellia sacra which grows in the state of nature in desert and inhospitable areas, is the main source of frankincense. Work on Omani frankincense and its production has not been done so far while information on frankincense from other species of Boswellia is recorded in literature.

Production and marketing of Omani frankincense has decreased during the last decade, current production is less than 100 tons. Future, as the situation stands today, is not promising. Due to increased avenues of good employment coupled with social security not many people are keen to go to the Boswellia growing areas and gather frankincense. Only Omanis and Somalis used to desert life can do the job of collecting frankincense.

Omani frankincense is of good quality. For local retail sale, grading is done. Storage in humid climate adversely affects the quality. Frankincense gathered during April-October is of good quality, normally Grade I while the same gathered during November-April is of

(ii)

Grade II only. The Public Authority for Marketing of Agriculture Produce is the largest purchaser of frankincense to help traders.

It is considered necessary to start processing frankincense into its essential oil and resinoid of various grades to improve marketing, primarily the export market. Other uses suggested by other sources are preparation of 'Kajal' and incense sticks.

At the present, there is no local processing of frankincense.

(iii)

Abbreviations Used:

MCI	The Ministry of Commerce & Industry
PAMAP	The Public Authority For Marketing Agriculture Produce
AGCC	Gulf Co-operation Council for the Arab States of the Gulf
MAF	The Ministry of Agriculture and Fisheries
RO	Omani Rial
\$	United States Dollar
Rate of Exchange	One US \$ = RQ 0.38

## INTRODUCTION

The Project DP/OMA/89/011 "To upgrade and strengthen local production of Frankincense, Rose Water and Pottery" involved a team of three experts; one in each of the three products. The current report is by the Expert in Frankincense. Job description is given at Annex-1.

During briefing in UNIDO, Vienna, by the backstopping Officer it was suggested to incorporate the follow-up action in terms of a Project Document comprising of work on both Frankincense and Rose Water. Pottery could be dealt with separately.

The Expert was attached with the Ministry of Commerce and Industry of the Government of the Sultanate of Oman. The mission of one month duration started from 28th September, 1992.

The Sultanate of Oman is the second largest state in the Arabian Peninsula covering an area of 300,000 sq.km. and having a population of 2 million. There are three distinct geographical regions:

- Wadi (dry river bed or valley) and desert with an area of 246,000 sq.km.
- Mountain terrain, 45,000 sq.km.
- Coastal Plain, 9,500 sq.km. inhabited by majority of the population.

Oman is well known for Frankincense which is at the present mostly consumed locally.

## I. FRANKINCENSE OF OMAN

Frankincense or Olibanum, a gum-oleo resin, is produced from various species of Boswellia (Family-Burseraceae). A general review is given at Annex.II. Oman has been famous for Frankincense since time immemorial. This product made Southern Arabia fabulously rich from its export in the distant past i.e. upto the first century A.D. Frankincense was the backbone of Dhofar economy. The Dhofaris monopolised its distribution and sale resulting in emergence of several cities and forts to cater to its export: "One of the most famous sites established for this purpose was Sombrum and Hanoum".

The homeland of Frankincense remained a mystery and legend for 1900 years till Dr. H.Carter, a medical doctor, in the mid-19th century, sailing by the southern coast of the Arabian Peninsula, had a chance to undertake some studies in Frankincense. He confirmed that the home of Frankincense was the Arabian Peninsula and that was Dhofar region. Ignorance of the West about the origin of Frankincense during this long stretch of time is perhaps attributed to the policy of the producers to conceal information from the consumers to avoid competition, war and intruders.

### A. Dhofar Region

Boswellia trees grow in Dhofar region. This region is known as "green paradise" bestowed with unique agro-climatic conditions, covering an area of 120,000 sq.km. roughly 1/3rd of Oman. It is bounded by Democratic Republic of Yemen on the West and by Saudi Arabia on the North. Dhofar region is sub-divided into:



- a) Fertile coastal plains along the Arabian sea.
- b) The 231 Km mountain region from the west to the east extending along the northern part of the coastal plain.
- c) The Najd desert area.

Map of Dhofar region (Southern Oman) is given at Annex III. Shaded portions of the Map indicate Boswellia growing areas.

Dhofar is inhabited by about 80,000 people comprising of :

- a) Urban: Occupy coastal plains engaged in agriculture, fishing and trading.
- b) Jabel : Inhabitants raise cattle.
- c) Bedouins: Desert inhabitants, raise camel, goats and sheeps in Najd desert.

Climate and Soil:

Calcareous lime soil accompanied by high relative humidity and high temperature from April to October is conducive to the growth of Boswellia trees. The trees grow along a belt parallel to the coast that gets larger as it runs towards the east till it ends near the bay of Kuria Muria. The trees grow in abundance in the belt.

Frankincense from Dhofar is considered the best; especially the one produced in the north of Samhar mountains. Samhar and Hoger areas are the major producers of Frankincense in the Southern region.

Varieties of Frankincense:

Four varieties of Frankincense are known:

- i) Hogri - the best variety
- ii) Najdi - next to Hogri
- iii) Shazri - produced in western part of Dhofar
- iv) Shalbi - Produced on the coastal plain - the lowest quality.

The quality of Frankincense in general depends on colour and purity. Grading is done after the Frankincense is brought to the market and purchased by PAMAP and other parties.

Boswellia Tree:

Frankincense is reported to be produced from Boswellia sacra Fleuk. It is small tree growing upto 3 meter high, with a papery, peeling bark and exuding resin. Leaves pinnate leaflet with undulate margins. Occurs in dry areas of Dhofar. It is hardy and has great tolerance to the environmental conditions. It is known as Laban in Arabic.

Frankincense trees belong to the respective tribes inhabiting the area in which the trees grow. The ownership of the trees is passed from one tribeman to another in accordance with the tradition and custom of the individual tribe. Women, however, do not inherit the trees and are given cash or cattle in lieu in order to conserve the tribal wealth from passing on to another tribe my marriage.

Boswellia tree leaves are a source of fodder for camels while branches are used as fuel. Both these to an extent are responsible for decrease in their number. The fallen seeds help in natural regeneration of the species.

The tree attains maturity early and can be tapped from 8th to 10th year of age.

Life of Boswellia tree is long and there are reports that some of the trees are being tapped by the fourth generation of a family.

Local people take great care of the trees as these are source for animal fodder, fuel and a cash crop. Legends abound about the tree showing its great importance to the people.

#### Collection of Frankincense

At the beginning of April when hot season sets in, the tree is given several cuts by special implement called Mangaf. The first cut is called Tawqi i.e. scrapping of branches and stem to remove the bark. A sticky secretion starts flowing which is allowed to flow for 2 weeks. Frankincense thus collected is removed. Further cuts are made. Collection of resin is undertaken every 15 days or so. Frankincense is collected in locally made baskets Qafeer.

Tapping of trees is a skilled job which requires experience. Tapping is made for 3 to 4 years consecutively. Tapping goes on from April till October. Tapping and collection of Frankincense is a very difficult

and laborious task. The collectors move from place to place in hot weather and away from places having food and water. Only people who know desert life can stand unfavourable conditions.

The traders send team of workers with adequate supplies of food and daily necessities. Generally, the collection of Frankincense is shared with the worker on 50:50 basis. People of Somalia origin are engaged for this work. Other expatriates such as from India, Pakistan etc. cannot sustain themselves under the conditions prevailing in the inhospitable and difficult to reach areas where Boswellia trees grow.

Average yield of Frankincense is about 0.40 kg. per tree per tapping every 15 days. Total collection from April to October according to a trader in Salalah comes to about 5 Kg. per year.

#### Trade in Frankincense

In the olden times, Southern Arabia by virtue of its location had a flourishing trade in Frankincense. People there became fabulously rich. Trade in Frankincense and other aromatics was conducted both by sea and land.

Frankincense was the backbone of Dhofar economy. The trade was monopolised by the Dhofaris. Anhour Oasis, 40 miles (64 Km.) to the north of Mirbat was famous as a collection centre for the best quality Frankincense. Camel caravans used to transport Frankincense, through what is known as "Frankincense Road" from Dhofar to Jeddah.

Frankincense played a great role in the economy of Southern Arabian countries to the extent that it also affected the political map of that area. Frankincense trade was also the reason behind the connection of Dhofar with Europe and the western world.

During 1804 to 1829, camel caravans started disappearing due to switching over the trade to sea. The golden period of this trade was between 1830 to 1939 due to the opening up of Indian market. Frankincense was shipped to Bombay from Dhofar wherefrom it was exported to other countries. Indian market became the biggest. Frankincense was shipped from Dhofar twice a year in September and March. On the return trip, ships used to bring gold, clothes, spices, flour, sugar and other stuff. India ceased being a big market for Frankincense when duties were levied after 1947. The trade switched over to Aden. The quantum of trade with India was plus 500 tons per annum.

Quantum of trade is reported to have come down in recent times. At the time of Christ, as much as 3000 tons of Frankincense may have been exported annually. However, according to an experienced trader in Salalah, annual collection is now of the order of about 100 tons. Larger quantities can still be collected if demand arises.

Reasons for decline in collection are attributed as:

- Following exploration of oil in the Gulf, many Dhofaris migrated to work there.
- Guerilla war in Dhofar from 1965 - 1975 cut off the port for export.

- Loss of Aden market following military coup and the emergence of PDRY i.e. People's Democratic Republic of Yemen.
- Employment avenues with attractive salaries became available for Omanis after the Renaissance of 1970.
- The social security scheme implemented by the Government induced people to leave the tedious and hard task of collecting Frankincense. Frankincense is no longer a remunerative profession due to sharp rise in the standard of living and increased per capita income coupled with social and health welfare schemes provided by the Government.
- The area rich in Boswellia trees are not easily accessible and normal labour force available cannot withstand the hardships connected with the collection of Frankincense.

Uses of Frankincense:

Frankincense was the traditional item for religious and ceremonial occasions in the past. A large percentage of this is still used for burning and purifying the atmosphere.

The essential oil of Frankincense has an odour which is strongly diffusive, fresh terpeny, almost green lemon like or reminiscent of green unripe apples but most terebenthinate. It gives good effect in citrus colognes where it modifies the sweetness of begamot and orange oils. It find use in variety of perfumes blends especially of oriental type.

Frankincense resinoid has much greater fixative properties and is one of the best fixatives employed in perfume work. Its odour is soft, reminiscent of Frankincense.

Some of the famous modern perfumes include Frankincense in their formulation. A few, as an example, are Replique by Colonia, Mel by Frances Denney, Mennen Millionaire by Mennen, Sculptura and Gambler by Jovan, etc.

Sweet bitter and hot' the Frankincense is used for treatment of sore throat, cough, bronchites, mouth sores, fevers, convulsions, diabetes, asthma, jaundice, chronic ulcers, diseased bones, trouble of testis, menstrual and urinary disorders, gonorrhoea and syphilis. In the form of an oily solution, it has beneficial effect on the growth of hair. Alcoholic extract of the defatted gum - oleoresin, shows antiarthritic activity.

## II. PRODUCTION OF FRANKINCENSE IN OMAN. - Latest position.

Frankincense in Oman is produced from Boswellia sacra growing widely in the state of nature. According to the Forestry Department at Salalah, the main areas of its occurrence are:

- i) Coastal plain in the wadi side in unconsolidated coarse alluvial gravelly soil.
- ii) Steep valley and minor hill sides in lithosols, colluvial rock slopes, minimal soil development.

In general, Boswellia trees grow in difficult terrain, difficult to reach and inhospitable conditions.

The quality of Frankincense is different from various regions. Quality wise following classification is made:

- Hojri
- Najdi
- Shazri and
- Jerbeel (Coastal plains)

According to the Forestry Department *Boswellia* trees are declining primarily due to the following:

- Rehabilitation projects
- Due to settlements in the area, overgrazing by animals
- Change in land use pattern.
- Termite problems; in some places, the problem is serious.

Solution to the problems are limited due to :

- Very low rainfall
- Steep topography and restricted human and livestock access.
- Minimal soil development, very poor rangeland.

Natural regeneration is scanty due to low rainfall and soil type.

As mentioned elsewhere in this Report, life of *Boswellia sacra* tree is very long; some trees are being tapped by 3rd and 4th generation. Tapping starts from 6th to 8th year.



However, according to some experienced traders involved in this trade from generations, there are still plenty of trees which can produce large quantities, upto even 500 tons if some of the current problems are taken care of such as:

- Solving transportation problem to reach the areas and bringing back the produce.
- To find market for Frankincense.

The Forestry Department in Salalah has taken steps to rehabilitate Boswellia along with other tree species. Boswellia is being raised from seeds (and cuttings but seeds give better results). Within the next 5 years about 15,000 plants will be planted in the forest areas.

Tapping of Trees:

Tapping of Boswellia trees is a skilful job; the skill is passed on from one generation to the next. More than that only very few people can withstand and work under the most difficult conditions. Tapping season starts from April and lasts till October. The trees are given cut at an interval of 2 weeks or so. Each collection comes to about 400 gm. In all 12 collections are made during the six months. Frankincense collected during this period is supposed to be of Grade I. The Frankincense which flows down the tree is scrapped once a year. According to trade sources, Frankincense collected during November to March is of Grade II.

Method employed for collection of Frankincense is the same<sup>as</sup> followed in the past:

Marketing:

All the Frankincense produced is purchased and or gathered by the private traders. Considering the difficulty encountered by the traders, PAMAP started purchasing Frankincense from the market about 5 years back. However, all the Frankincense that comes to the market is not purchased by the PAMAP.

Frankincense is purchased by the PAMAP Centre in Salalah. Purchase during the last few years is as under:

Year	Quantity Purchased
1987	40 tons
1988	12 tons
1989	36 tons
1990	37 tons
1991	Nil
1992 (till Sept.)	15 tons

Source : PAMAP Salalah

Frankincense purchased is brought to Nizwa and graded. Sale price of various grades is as given under:

Grade	Sale Price/Kg.
Hojari	RO 4,000
Grade I	RO 2,500
Grade II	RO 1,600
Naam	RO 1,000
Powder	RO 0.800

Source: PAMAP Muscat.

Above prices are for retail sale and in small boxes. Hojari is packed in 100 gm., 200 gm, and 400 gm. packing while other cheaper grades are packed in 500 gm and 1.0 kg. plastic bags.

PAMAP exported about 5 tons Frankincense this year, 1992.

Processing:

Frankincense is not processed further in Oman at the present. However, steps were taken to use this in some product. Production of Kajal is one of the products envisaged. The National Industrial Development Corporation Limited of the Government of India has prepared a Project Report for the production of incense sticks using Frankincense. This has not been implemented so far.

PAMAP has also made attempts to produce essential oil. No data is available. A perfumery company in Oman has produced for trial use in their formulation resinoid from Frankincense. Here also, trials for complete extraction were inconclusive. Essential oil has also been produced on a small scale. Data was not available.

III. THE PUBLIC AUTHORITY FOR MARKETING  
AGRICULTURAL PRODUCE (PAMAP)

PAMAP, a Government Organisation was established to achieve the following objectives:

- to provide a link between the farmers and the trade through the establishment of a well organised marketing network;

- to provide Omani farmers with a market outlet and to encourage them to grow high quality products;
- to improve the present market situation for Omani products in terms of quantity, quality and availability.

The PAMAP is the only Organisation that buys Frankincense in large quantities upto 50 tons or so from the producers. Some firms are also involved in this purchase and marketing but on a smaller scale. At the present PAMAP could be considered the major supplier of Frankincense. The local market absorbs bulk of the Frankincense. Small quantities, about 5 tons is also exported primarily to the AGCC countries like Bahrain, Saudi Arabia and the U.A.E.

The aim of PAMAP is to regulate the Frankincense trade and encourage the producers. It also co-operates with the firms involved in this trade both locally and internationally.

Processing of Frankincense at the PAMAP Centre in Nizwa is a 3-step process, i.e.

a) Sorting and Cleaning:

Frankincense purchased from the producers is cleaned by removing bark residue and stones, sifted to remove powder which is normally produced in the bags due to handling and transportation.

b) Grading:

Clean and sifted Frankincense is graded according to the colour and refinement (Colour depends on the weather conditions during collection. Resin collected during summer and monsoon is of whitish colour, supposed to be the best quality. Humidity tends to lower the quality; the colour of the product turns yellowish-brown).

Grade I of the resin is thus of whitish colour, homogeneous in size and free of bark pieces. Grade II yellowish brown while Grade III comprises of brownish blackish in colour. Grade III comprises of big lumps and difficult to remove bark pieces.

c) Packing:

After grading packing is done as:

Grade I & II	:	200 gm boxes
Grade III	:	500 gm - 1.0 Kg. bags.

Processing Centre of PAMAP is located in Nizwa, about 800 Km from Dhofar as weather in Nizwa is less humid which does not adversely affect the quality (colour) of the resin.

The PAMAP centre in Muscat has a Post Harvest Quality Control Laboratory established in 1988. It is primarily concerned with agricultural produce. Its scope and functions are given in Annex. IV.

#### IV. MODERNISATION OF MANUFACTURING TECHNOLOGY

Frankincense of Oman origin is considered the best by PAMAP for burning as compared to the one from Sudan and Somalia. Yemeni Frankincense is not used for this purpose.

For use in the fragrance industry, following products can be produced.

- i) Essential oil
- ii) Resinoid pure (it is not pourable)
- iii) Resinoid Crystalline form
- iv) Resinoid pourable (using diluent)
- v) Absolute & resin absolute.

Essential oil is produced by steam distillation while other products (ii to v) are obtained by extraction with solvent either in cold or by soxhlet. Absolute is produced by reextraction of resinoid pure by ethanol and removal of ethanol under vacuum.

Extraction of Frankincense in cold gives better quality products while soxhlet extraction gives better and maximum yield of the final product.

To obtain products of good acceptable quality from Frankincense selection of the raw material is of prime importance.

Dust and sifting, by virtue of their price would be economical for processing. However, essential oil in dust or sifting is likely to resinify, especially after long storage. Such a material will give less yield of

essential oil and that too of poor quality. Yield of resinoid is, however, not likely to suffer much. In any case, odour evaluation helps in selecting the proper quality raw material. In the beginning, estimating yield and evaluating quality of the essential oil gives fairly accurate idea about the raw material. Later on experience and skill acquired in selecting proper raw material would help.

Storage changes the shape and colour of the material. Long storage results in agglutination of pale yellow and pale amber coloured tear-shaped, egg shaped or round and larger lumps of deeper colour material. (In India, we process such a material also which gives various products, described earlier that are accepted in the industry). In general, reddish orange coloured tears or lumps are poorer starting material for perfumery use than those of yellowish or whitish lumps.

Choice of solvent is another parameter in the extraction technology of the material. Following solvent can be used:

Benzene, toluene, petroleum ether, acetone, methylene di-chloride, ethanol.

Benzene is the solvent of choice, it gives good yield of resinoid of readily acceptable quality. However, the colour of these products is darker (dark amber to dark orange or reddish brown) almost solid but somewhat plastic mass of nonpourable soft extract consistency. Petroleum ether gives less yield of a light coloured product of excellent olfactory value. Ethanol also gives better extraction and good quality product.

Resinoid produced with the above solvents pose problem for use in blends being non-pourable. To overcome this problem, resinoids are mixed with odour-less diluents such as di-ethyl phthalate. The practice is acceptable by the industry.

(The expert has developed Technology for the production of Frankincense resinoid crystals, 100 per cent pure, which can be used directly in perfume blending without the use of diluents. Being 100 % pure it gives excellent results at lower level of use).

At the present, there is no information about the yield and quality of products from Omani Frankincense which could help in starting a manufacturing unit. It would be essential to gather this information, in the first instance, and to get various products required by the industry.

Frankincense gum oleo-resin yields following products:

Essential oil, resinoid pure, resinoid pourable, resinoid crystals (solid), resin absolute and absolute.

As more than one product can be produced from Frankincense, the market demand for a particular product or products will enable to suggest the technology, equipment and size of production. It is, therefore, necessary to have market study after trial production of various products.

Quality Control Procedures:

Quality control procedures for processing Frankincense pertain to the following:



- i) Raw Material
- ii) Essential Oil
- iii) Resinoid - various products.

Details are given hereunder:

Raw Material:

Quality Control aspects of the raw material have been indicated earlier. Visual appearance, essential oil content, olfactory value, size of the material, admixture with extraneous matter such as bark, wood pieces and sand have to be examined carefully prior to processing of Frankincense.

Essential Oil:

Essential oil content indicates, in general, age and the purity of the material. Quality of the essential oil depends not only on the *Boswellia* species but also, to an extent, age of the material. Also, content of essential oil even in fresh material varies considerably and can range between 5 to 9 per cent. Composition of the essential oil, however, is specific for frankincense derived from a particular *Boswellia* species.

No information is available on the essential oil from the Frankincense from *Boswellia sacra*. Data on essential oil from *Boswellia* of some regions is as under:

Essential Oil of Frankincense/Origin

Characteristics	Indian	Somalian	
		Grade I	Grade II
Specific gravity	0.8358-0.8475 (30°C)	0.876-0.880	0.883
Refractive index	1.4535-1.4613 (30°C)	1.476-1.480	1.479
Optical Rotation	+24.0° to +34.35°	-10.5 to -20°4	-9°4
Alpha Pinene (%)	--	37.2 - 41.7	33.4
Acid Value	0.76	-	-
Saponification Value	4.1 - 8.5	-	-
S.V. after acetylation	26.4-42.8	-	-

Specification for essential oil from Boswellia carterii Birdw including oil from other Boswellia species have been given by the Essential Oil Association of U.S.A. (EOA No. 68) in details. This is given at Annex. V.

However, it will be necessary to study a few samples of the essential oil from Boswellia sacra which is the predominant species in Oman, before specifications are suggested.

Major difference in essential oil of Frankincense from different regions (and species) is in the content of major component as given below:

Essential Oil Origin	Major Component
Aden	Alpha Pinene 43.0%
Eritrean	Octyl Acetate 52.0%
Indian	Alpha Thujene 61.36 %

Resinoid of Frankincense:

Quality and yield of resinoid (pure) from Frankincense depends on quality of the starting material, solvent used and the technouque employed for extraction. The main criteria of the resinoid is its odour and solubility in perfumery blends. Colour of resinoid is dark yellow to reddish brown which is acceptable.

One of the criteria for good quality resinoid is its content of essential oil. However, no standard specification for Frankincense resinoid has been laid down.

V. Interaction with the Government <sup>of</sup> Oman  
Officials and UNIDO Consultant

Information on Frankincense produced in Oman was gathered from both official and trade sources. Site visits to areas dealing in Frankincense gave additional insight into this product. During the fielding of

expert in Rose Water, visit to the rose growing and rose water producing area was also undertaken jointly with him. This enabled the expert to prepare a report on the status of frankincense (and rose water) industry in Oman. This in turn lead to the formulation of a Project to rehabilitate, both the frankincense and rose water industry.

The details of the proposed project were discussed in a meeting held on 21 October, 1992, attended by the UNDP and the official of the Ministry of Commerce and Industry. The latter expressed their keenness to start work at an early date. Prior to the departure of the expert, a meeting was arranged with the Director General of the Ministry of Commerce and Industry. Details of the proposed project were presented. The Director General realising the importance of such a project, arranged a meeting with the Minister of Agriculture and Fisheries. It was stressed by His Excellency, the Minister of Agriculture and Fisheries to finalize the project and to ensure its implementation as early as possible.

The project Document for the proposed project also includes work on production of rose water and improvement in rose cultivation to produce products meeting international standards.

## VI. Conclusion

Products from Boswellia gum oleo-resin are important for the fragrance industry. While the essential oil is used for modifying and enhancing topnote, resinoids are excellent fixatives. Synthetic substitutes are not reported.

While user countries occasionally prefer to process Frankincense in their own processing units to suit their specific requirements, processing of Frankincense in the countries of production is also a common practice. Processing of frankincense in Oman can be undertaken to produce products for export. However, to achieve this objective, Research and Development work needs to be undertaken. Initially pilot plant scale trials can give an idea about the products from Frankincense that will have export market.

In order to rehabilitate and strengthen the Frankincense industry in Oman, it is considered essential to process it into various products. Establishment of a multipurpose pilot plant and an analytical cum quality control laboratory is required. A project has been proposed for which, a Draft Project Document (including work on Rose water production) has been prepared and submitted for consideration.

Draft Project Document was discussed with the government of Oman concerned officials and the UNDP Muscat who agreed, in principle, with the project proposal.

#### VII. Recommendations

Following recommendations are given to rehabilitate the Omani Frankincense industry:

- 1) Frankincense produced in Oman is graded, primarily in respect of colour and shape, for retail sale in small packings. Lumps and resinous mass considered low grade for retail sale can be useful material for processing into value added products such as essential oil and resinoids.

- 2) All the value added products need to be produced first on laboratory scale and then on pilot scale. Samples to be market evaluated before selecting the value added products for large scale production.
- 3) Suitable facilities for laboratory and pilot plant studies should be created. Immediate large market is not visualized; it will increase gradually thus creating better market for Omani Frankincense.
- 4) Simultaneously, utilization of Frankincense in incense sticks industry and 'Kajal' should be explored.

Persons Met

Ministry of Commerce & Industry

Mr. Khamis Al Kiyumi	Director General of Industry
Dr. Faisal Mohamed Elamir	Technical Adviser
Mr. Abdullah Nasser Al-Ghassani	Director General, Salalah
Mr. Abdullah Rashid Al-Aremi	Inspector of Industries
Mr. Hamed Seif Al-Habsy	Inspector of Industries
Mr. Hafeez Salem Mazable	Inspector of Industries, Salalah.

Ministry of Agriculture & Fisheries

H.E. Shaik Mohammad Abdullah Al-Hinai	Minister of Agriculture and Fisheries.
Mr. Mohammed Ahmed Mahfood Al-Sheikh	Deputy Director General, Salalah
Mr. Ahmed Mohd Mustakiel	Specialist, Forestry, Rangeland, Salalah
Mr. Elttag Bukheil Ahmed	Team Leader, Project OMA/87/013
Mr. Salah Al-Deen-Al Mohammed	U.N.V. Project OMA/87/013

Public Authority for Marketing of Agriculture Produce, Muscat.

Mr. Hamoud bin Salem Al-Abry,,	Manager, Production Department.
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Mr. Moncef Cherif	Food Technologist
Ms. Felinda S. Macasaet	Laboratory Chief
Mr. Khalid Abdoon	Supervisor, Salalah.

Ministry of Social Welfare, Muscat

Ms. Huda Abdullah Al-Ghazali	Adviser
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Ministry of Interior

Mr. Seif Salim Al- Zayeed	Deputy (Wally)
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UNDP Muscat

Ms. Barka S. Al-Bakry	Programme Officer
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Mr. Jihad Al-Zaaby	Finance Assistant
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Mr. Nasib Al-Raise	
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Mr. Patricio Castro Boisier	Consultant, Industrial Master Plan, UNIDO
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Others

Mr. Giles W.M. Ellerton	Admn. Manager, Oman Perfumery LLC, Muscat.
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Mr. K.P. Mathur	Manager, R&D, National Gift and Arab Perfume Centre, Muscat.
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Mr. J.S. Dedwal	Factory Manager, National Gift and Arab Perfume Centre, Muscat.
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Mr. Shak Sakum Bin Bekheit Bin Said- Khalket	Al Sanad Sesame Oil Loban Co. Salalah.
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Mr. Salim Khalfan Rashid Al-Shikeli	-do-
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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

Project of the Government of  
The Sultanate of Oman

JOB DESCRIPTION

DP/OMA/89/011/11-51

- Post Title: Expert in Frankincense  
Duration: One month 1.0 m/m  
Date Required: ASAP  
Duty Station: Muscat, with travel in the country.
- Purpose of Project: To upgrade and strengthen local production of Frankincense, rose water and pottery.
- Duties: The expert will be a member of a team of three experts in Frankincense, rose water and pottery respectively who, in close co-operation with local specialists will assess the potential for up-grading these three industries. Specifically, he will be expected to :
- 1) Carry out a first hand study of the existing local manufacture of Frankincense from *Boswellia* spp. and of the technologies used for the production of various qualities of incense.
  - 2) Make recommendations as to the improvement and further modernization of the manufacturing technology and the related quality control procedures and requirements, storage and marketing policies.

- 3) Elaborate a plan for further UNIDO assistance in this field for discussion with Government officials and UNIDO Headquarters.
- 4) Prepare draft Project Document for further UNIDO Technical Assistance.

Submit a Report containing final recommendations.

ANNEX - II

Frankincense : A General Review

The word, Frankincense is derived from the Old French "francencense, meaning "pure essence" or literally "free lighting". The Arabic word for Frankincense is Luban, derived from the semetic root denoting whiteness and inferring purity. The Hebrew name is Lebona, the Greek Libanes, and the Latin Tus. The ancient Egyptian word was neter sent.

Frankincense is obtained from species of the genus Boswellia (Fam: Burseraceae). The Frankincense of antiquity is reported to be from Boswellia papyrefera (Del) Hochst, found in Ethiopia, Sudan and East Africa. The Arabian Frankincense came from B. Sacra Fluckiger (B. thurifera sensue Carter). In Somalia, Frankincense is collected from the mohar madun tree, B. carterii Birdwood, the so called Bible incense or olibanum, and the jigaar tree (B. frereana Birdwood, the African elemi or elemi Frankincense. Indian Frankincense (Indian Olibanum) is derived from B. serrata Roxb. ex Colebr. (variety glabra and serrata). Boswellia bhau - dajiana Birdwood may also pass as Frankincense.

The principle sources of Frankincense are :

- B. carteri - Iran, Iraq and Somalia
- B. sacra : Oman (Dhofar region)
- B. carterai and B. frereana : East Africa
- B. serrata : India

Boswellia species are small trees, 3-6 meters high which grow on rough and inhospitable arid mountaineous

regions at an altitude of 1000 - 1800 meters, the favourite areas being Northeast Africa and Southern Arabian Peninsula.

The *Boswellia* tree contains physiological schizogenous gumoleoresin pockets on the bark. When the bark is incised, a white emulsion exudes which dries into globular, pear or club shaped pears. Depending on the size of the tree, it may be tapped in more than one place. Usually only the exudate which settles on the wood is gathered at regular intervals what flows down the stem accumulates and is scrapped off only annually.

Olibanum or Frankincense from Arabia and Somaliland is brought to Aden. The commercial brands, Aden and Ereteria are usually regarded as derived from *Boswellia carterii* and *B. frereana* respectively. Sudan supplies Frankincense directly from the country and is reported to be produced from *B. papyrefera*.

In the world market, Olibanum is available as:

- Grade I : Tears and most carefully selected white or white-yellow colour.
- Upgraded : A mixture of white-yellow and reddish angulated masses with particles of bark.
- Dust and Sifting
- Unassorted Olibanum as it comes from the producing region.

Frankincense or Olibanum from various regions of the world is reported to contain :

- Southern Arabia and North-east Africa.

Contents of a)	essential oil	3 - 8 per cent
b)	resin	60 - 70 per cent
c)	gum	27 - 35 per cent

- Indian Olibanum

Contents of a)	essential oil	6 - 10 per cent
b)	resin	53 - 64 per cent
c)	gum	24 - 28 per cent

Quality of essential oil from Olibanum from Southern Arabia and N.E. Africa is considered better.

The Essential Oil :

Quality of the essential oil depends on the type of Frankincense used and is thus a suitable criteria to identify the origin of the material. Content of essential oil depends on the grade of Frankincense and, therefore, can not be a criteria of the source material. Frankincense oil from Aden, Eriterian and Indian material have different chemical composition and olfactory properties. The essential oil from the Aden brand has strong balasamic odour with a pronounced terpenic note. On the other hand, a dry, woody and strongly balsamic note characterises the oil from Eritrean brands, the odour is also slightly lighter than the oil from the Aden variety. Indian olibanum oil possesses pleasant ethereal smell, sweet and agreeable. Gas Chromatographic study clearly brings out the differentiation.

(Content of alpha pinene, octyl acetate and alpha thujene characterise the oils from Aden, Eriterean and Indian brand respectively).

Olibanum oils being very volatile contribute to the top note of a perfume while the resinoid from the gum-oleo resin is an excellent fixative. While the essential oils are produced by water or steam distillation, resinoids are produced by extraction of the given oleo-resin by a suitable solvent, such as benzene, toluene, hexane, ethanol, methanol, acetone, ethyl acetate and methylene di-chloride.

Colour of the essential oil is light yellow while that of the resinoid is dark red/orange/reddish brown, fairly solid plastic non-pourable mass. Dark colour of the resinoid is accepted in the industry.

Resinoid from the Aden brand has "warm balsamic odour with a characteristic incense and somewhat woodynote". The resinoid from the Eriterean brand has a woody, dry flowery and somewhat metallic odour, a distinct balsamic note develops at the dry out stage. Thin layer chromatographic examination of these resinoids clearly brings out the differentiation.

Production:

Production of Frankincense in various countries of the world is not known with certainty. Following figures of production can be taken as approximately correct estimates.

- Oman : Earlier, many centuries back, the production touched nearly 3000 tons per year. By fifties of this century production estimates were plus 500 tons. During the recent few years it is about 100 tons and not more.

- East Africa, Iran, Iraq and Somalia : No information available on production.
- Indian : Production estimates are between 1000 to 1200 tons per year.

Uses :

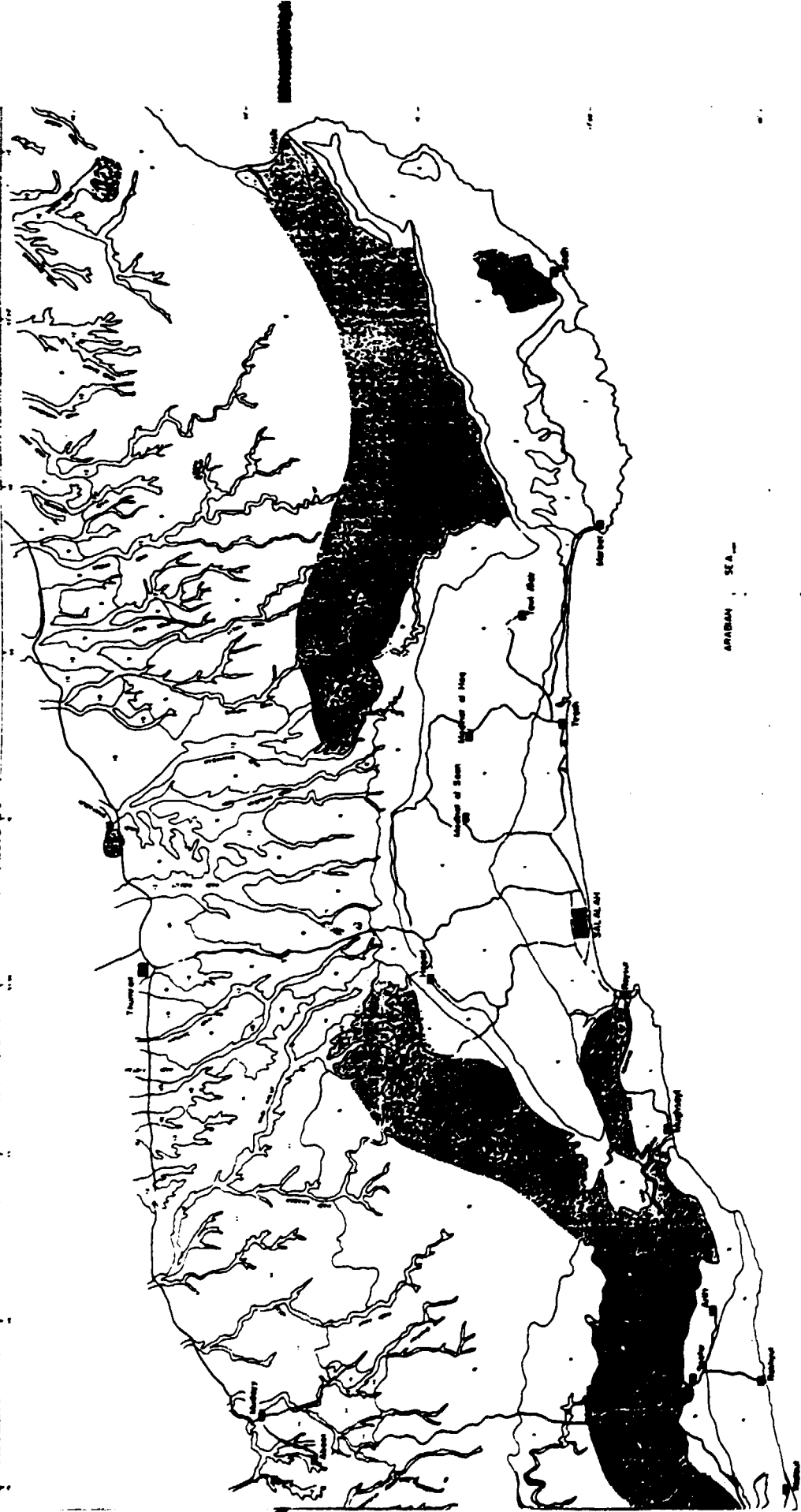
The use of Frankincense was already ancient and even today Frankincense is the incense in some medicines. Yet it cannot be said with certainty that the Frankincense of today is the same of the time of Christ. The Kohl, or black powder, used by the ancient Egyptian women as an eye cosmetic was powdered galena often mixed with Frankincense. Today, an acceptable incense in Roman Catholic Churches is composed of 1/35 styrax, 4/15 Benzoin and 10/15 Frankincense.

Uses :

While in the countries of production large quantities of Frankincense are used for burning, the same is not the case in the other countries importing Frankincense. It is processed into its ingredients, i.e. essential oil and various grades of resinoids, both pure and pourable. India processes large quantities of Frankincense (locally produced) into the above mentioned products used widely into the fragrance industry.

While Frankincense is reported to be an effective medicine for a number of ailments, its use as a medicine is not very popular.

DISTRIBUTION OF OLIBANUM IN SOUTHERN OMAN





Post Harvest Quality Control Laboratory of PAMAP

The Laboratory was established on 1st September 1988 through the Administration Resolution No. 79/1900 issued on 21st June, 1990 and charged with the following functions:

In accordance with the exigence of Public interest, it has been decided that the Post harvest Quality Control Laboratory shall assume the following tasks:

- 1) Conduct checmical, sensory, and microbiological analysis and evaluation of fresh and processed fruits and vegetables, as well as other food products, in accordance with Oman and other international food standards.
- 2) Inspect and monitor quality of fresh produce during arrival, storage and distribution to Centres.
- 3) Make recommendations to the Sales and Marketing Department as to proper disposition of fresh produce.
- 4) Develop quality standards and handling guidelines for fresh horticultural produce.
- 5) Conduct experiments and researches on post-harvest technologies, designed to prolong shelflife of produce and reduce losses.
- 6) Perform in-line quality control and finished product inspection in food manufacturing operations, as vegetables pickles processing, jam processing, etc.

- 7) Establish quality control systems and good manufacturing practices (GMP) in food manufacturing operations.
- 8) Develop fruit and vegetables products and processes for commercial-scale production, in cooperation with the Food Processing Unit.
- 9) Conduct seminars, workshops and individualized trainings on postharvest handling and technology, food processing and quality control, and other related areas in cooperation with the Training Unit.
- 10) Give consultancy services on matters requiring technical inputs or research on food handling processing, technology, and related areas.

The laboratory is well equipped both with respect to equipment and trained staff for conducting chemical, sensory and microbiological analysis as also evaluation of food products.

OLIBANUM

Other names	Frankincense
Botanical source	<u>Boswellia carterii</u> Birdw. and other <u>Boswellia</u> species.
Botanical family	Burseraceae
Foreign names	Encens oliban (Fr.) Weihrauch, olibanum (Ger.) Olibano (Sp.), Olibano (It.)
Description	Olibanum is a gum resin secreted by several <u>Boswellia</u> species that grow extensively from South Arabia to Somaliland. The small trees or shrubs yield an exudate after incisions are made on the bark; it consists of a milky liquid that hardens into small, yellowish droplets commercially known as incense tears. The tears are sorted; the most valuable quality (white tears) is sold as burning incense, while the less valuable qualities (powder and fragments) are used in flavors and perfumes because of their more reasonable cost.
Parts of plant used	Gum resin exudate

Physical-chemical  
characteristics  
Essential oil

The oil, obtained by steam distillation of the gum resin, is an almost colorless to pale-yellow liquid with a balsamic, slightly citrine odor. Physical-constants of the oil follow:

Specific gravity at 25°/25° C	0.869-0.889 <sup>2</sup>
Refractive index 20°C	1.4685-1.4820 <sup>2</sup>
Optical rotation	15° to + 35° <sup>2</sup>
Acid value	4.0 <sup>2</sup>
Ester value	4-30 <sup>2</sup>
Solubility	1:6 in 90 % alcohol <sup>2</sup>

Derivatives

Resin Absolute. Resinoid, Absolute.

Since the gum resin is upto 75 % soluble in alcohol, a resin absolute is prepared by filtration and vacuum concentration of the alcoholic solution. The resin absolute is a plastic mass of light-amber colour and balsamic odor. The resinoid is obtained by solvent extraction of the resin. Sometimes heat is employed to increase the yields, but this method yields products with a slightly different odor than the cold-extracted resinoid. An absolute also can be prepared by alcoholic extraction of the resinoid.

Uses

The use of resin in the formulation of pomades and ointments is approved by the Swiss Pharmacopoeia. The oil, the resinoid, and the resin absolute find application in perfumery as fixatives in the so-called Oriental notes. Olibanum oil and sometimes its derivatives find a limited use in flavour formulations only to confer a nuance. Olibanum oil (FEMA No. 2816) has been reported used in the following:<sup>3</sup>

non-alcoholic beverages	0.60 ppm
ice cream, ices etc.	1.2 ppm
candy	3.3 ppm
baked goods	3.7 ppm

Regulatory  
status

FDA § 121.1163

T. De Silva <sup>sk</sup>  
17 November 1992

**Backstopping Officer's Technical Comments**  
**based on the work of Mr. B. Gulati**  
**DP/OMA/89/011/11-51**

The report describes the work done by the expert during the preparatory assistance mission. Mr. Gulati has assessed the current status of the production of frankincense and related products and recommended the requirements for a technical assistance project. A draft project document was submitted by him which is being processed.

He has discussed the recommendations with both the UNDP and Government authorities who have expressed the willingness to initiate action through a UNDP/UNIDO project. Mr. Gulati, who has worked in close collaboration with the expert on rose water has included this aspect in the draft project document. The consultant has outlined the new products that could be developed from frankincense and even given some initial processing methods. Mr. Gulati has discharged his duties very well. BSO hopes that a technical assistance project to follow up his recommendations would be a reality soon.