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34p.
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YA/RAF/96/X62, BL-043

MISSION REPORT

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OCTOBER 1997

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SUMMARY

In order to select the participants to attend a UNIDO workshop to be held between November, 19-21, 1997 in Harare, Zimbabwe, six African LDCs were visited in October 1997.

Thirty one companies were contacted in Ethiopia, Ghana, Malawi, South Africa, Uganda and Zambia and twelve participants have been recommended to UNIDO for invitation.

The workshop is expected to be beneficial to participants from African LDCs to improve the quality of their aromatic plant products.

1. INTRODUCTION

According to the Terms of Reference (Annex1) the mission required the consultant to visit 2-4 companies which had been identified by UNIDO in six African countries in 20 days in October to prepare company profiles, to render advisory services and to recommend to UNIDO the invitation of two suitable persons from each country for a workshop to be organized by UNIDO between 19-21 November 1997 in Harare, Zimbabwe. The workshop is titled "Workshop on Promotion of Quality Improvement of Aromatic Plant Products in African LDCs".

During the mission, companies and institutions in South Africa, Zambia, Malawi, Uganda, Ethiopia and Ghana were visited between October 6-26, 1997 (Annex 2).

2. ETHIOPIA

2.1. Essential Oils Research Centre

[P.O.Box 5747, Addis Ababa, Ethiopia. Phone: 251-1-611311 (pbx), 182621 (direct). Fax: 611764. Tlx: 21011 alum. Director: Dr.Tadele Worku]

The centre was established in 1987 as an essential oil project of the, then present National Chemical Corporation (NCC). In 1992, its status was changed to a research centre (EORC) under the Ministry of Industry. Until June 1997, EORC had been supported by the capital budget from the Ministry of Finance. Since July this year, the government has been financing it from the re-current budget after realizing the nature and importance of the centre. The centre also receives research grants from the Ethiopian Science and Technology Commission, and SAREC/SIDA (Swedish International Development Agency).

The centre is engaged in applied research into industrial plants including essential oil yielding, medicinal and other plants which are sources of industrial materials such as insecticides, tannins, fixed oils, etc. The activities range from collection of plant materials from wild flora for domestication to introducing foreign plants into cultivation as well as chemical analysis and pilot plant scale distillation. The centre has published an information leaflet on lemon grass for Ethiopian farmers in local language. In the headquarters, the centre has chemical laboratories, administrative offices and a modest library. The facilities include 1) multimedia computers (2 pcs), 2) laserjet printer, 3) printer (Epson LQ-2170), 4) scanner (HP-Scanjet 4C), 5) gas chromatograph (Varian 3700) with integrator (Varian 4290) coupled with hydrogen generator (Packard), and nitrogen and air generators (Nitrox), 6) UV/VIS spectrophotometer (Pye-Unicam SP6-450), 7) polarimeter, 8) Abbe refractometer (both of BS instruments), 9) voltage regulator, 10) rotavapors (J.Bibby and Buchi), 11) Soxtec system (Tecator) with six Soxhlet extractors for fixed oil extraction, 12) fractional distillation units (2): one lab scale with 500 ml flask, and the other smaller unit with 100 ml flask (Normschliff Geratebau-Wertheim), 13) tincture press, 14) grinder (Retsch), 15) analytical balance (Mettler), 16) top-loading balance (2): electronic and mechanical, 17) vacuum pump, 18) flask shaker, 19) pH-meter (Corning), 20) pH-meter+conductimeter (AGB400), 21) fridge, 22) chromatotron, 23) oven (2) (Gallenkamp), 24) incubator (Memmert), 25) different size

Clevenger and Soxhlet apparata, 26) volumetric moisture content apparatus, 27) TLC tanks are used for prespread commercial plates.

The library has about 200 volumes of books in its holding, not all on essential oils, and two journals on essential oils have been received regularly since last year.

A mild steel distillation facility which had been set up by a French company in 1960s, then abandoned for 10 years has been given by the government to the centre in 1990. This facility consisting of two stills with 500 L and 300 L each is installed in the centre's farm in Wondo Genet which is 270 km to the south of Addis Ababa, and has been used for essential oil distillation using materials harvested in the farm. Two boilers fueled by diesel or wood provide steam for both stills. Out of the 80 ha land, 60 ha is under cultivation of *Eucalyptus citriodora* (40 ha), *Cymbopogon citratus* (8 ha), and *C.martini* (3 ha). Up to 5 harvests a year were said to be possible. Annually, a total of ca. 2 tons of oils are produced, including *E. citriodora* oil (1 ton), *C.citratus* oil (0.5 ton) and *C.martini* oil (0.4 ton). The oils are sold to local soap manufacturers.

The centre has a staff strength of 20 in the central laboratories. The number includes research staff consisting of one PhD, one MSc, two BSc and one diploma holders, and 14 support staff. Except for five female personnel consisting of secretaries and workers all the others are male. In the farm, there are ten permanent and twenty contract employees, and 50-60 casual workers.

About 150 medicinal and aromatic plants were said to be under examination. These included experimental cultivation of *Ocimum basilicum, Coriandrum sativum, Boswellia* sp. for olibanum production, *Commiphora* species for myrrha production, and *Opopanax* sp. Ethiopia, reportedly, exports 2000 tons of aromatic gums for a return of US$ 300.000. In addition, 2000 tons of such gums were estimated to be used internally for manufacturing incense. Chamomile (*Matricaria chamomilla*) was also under experimental cultivation. A local firm has recently manufactured tea bags of chamomile produced by the centre.

Advice was given on good quality essential oil production and quality control, as well as on the formulation of UNIDO projects. Mr.Worku informed that a formal request for preparatory assistance was under way.

2.2. Ethiopian Spice Extraction Factory

Address: P.O.Box 5699, Addis Ababa, Ethiopia

Phone: 251-1-653300 or 651829

Fax: 653633

Directors: Mr.Yisak Alemayehu, General Manager, Mr.Desaleng Worku, Production and Technical Manager, Mrs.Nigist Asfaw, Research and Quality Control Manager, Mr.Zeleke Seyum, Administrative Manager, Mr.Getach Ayalew, Commerce Manager and Mr.Aklilu W.Mariam, Financial Manager

This is a public enterprise under the Public Enterprise Supervisory Authority which is directly linked with the Prime Minister's Office. It was started in 1965 as a raw herb processing

works by an American Company (Kalamazoo Spice Co.). In 1970, the paprika processing plant was established. It was nationalized in 1975. Since then, the factory has been functional as a public enterprise. It has 104 employees (82 male and 22 female) comprising 98 workers and six managerial staff including one female. One of the staff members has MSc degree and four staff members have BSc or BA degrees.

The factory processes locally grown paprika and ginger to produce paprika, capsicum and ginger oleoresins. Paprika oleoresin constitutes 95% of the production. Installed capacity of the processing plant is 160 tons of oleoresin a year. however, full capacity cannot be attained due to inconsistent supply or shortage of raw material. 1h 1996, only 95 tons of oleoresin were produced, and this year 100 tons is expected from 2600 tons of paprika. Ginger oleoresin is manufactured on demand when the paprika processing is over. In 1995, 20 tons of ginger oleoresin was produced from 500 tons of ginger. The total production of the factory is exported to Germany and Spain. The organic solvents used in processing such as hexane, acetone and methanol are imported.

Total turn over of the factory is around US$ 4 million from exports of finished products. Seeds and spent powder are sold in local market for a return of *ca.* US$ 500.000 a year. The company's stock situation was as follows during the visit: US$ 350.000 worth of finished product, and US$ 1 million worth of paprika.

ASTA and MSD-10 specifications are followed for the determination of Scoville heat units and colour units. The factory has a research and quality control laboratory where research into essential oil bearing plants of Ethiopia has been carried out by Mr.Nigist Asfaw, apart from the routine quality control work on processed products. The laboratory has modern equipment such as capillary gas chromatograph and high pressure liquid chromatograph.

Problems and constraints spelt out by the management were as follows: Raw material supply is not steady and is easily affected by drought. The company does not have a farm of its own for the cultivation of paprika. Advice was provided on essential oil distillation and analysis.

2.3. Kassk Spices and Herbs Extraction Factory P.L.C.

Address: P.O.Box 120323, Addis Ababa, Ethiopia

Phone: 251-1-341609 and 341610

Fax: 341633

Directors: Mr.Kedir Shemsu, General Manager, Mr.Kemal Said Mishkier, Deputy General Manager, Mr.Belay Dechassa, Technical Manager (Chemical Engineer with MSc degree).

This is a private company established in 1991 to produce oleoresins and essential oils. The company started manufacturing in May 1997. It has 95 permanent staff including seven female secretaries and 50 temporary employees (two female).

The processing plant with a capacity to work up 4000 tons of spice raw material (mainly paprika) a year was partly purchased from USA, Europe, South Africa and India, and partly

manufactured locally. Heat exchangers, vessels, boilers, extraction columns, conveyors, hoppers, dryers, gutters and the like were locally manufactured using imported materials. The design, installation and commissioning of the plant was the work of solely Ethiopian engineers without foreign expert participation. It is a counter current continuous solvent extraction plant capable of processing 15-18 tons of paprika per day in three shifts.

The company has since April 1997 produced 32 tons of paprika oleoresin and 8 tons of capsicum oleoresin. The targetted production figure for paprika oleoresin is 115 tons. It is 30 tons for capsicum oleoresin and 5 tons for ginger oleoresin. Annual revenue expected from exports is between US$ 4.5-5.5 millions. Within two months of its operation, the factory has generated over 1 million US dollars. The factory utilizes locally produced paprika and imports all organic solvents. ASTA and MSD-10 specifications are used for Scoville heat units and colour units.

The company also has a locally designed and manufactured 400 L capacity stainless steel steam distillation pilot plant for experimental distillation of essential oils. The company plans to produce 1 ton each of ginger, local thyme and black cummin oils. Advice was provided to the technical manager on practical hints for successful steam distillation of aromatic plants, and on improvements of the design of distillation still.

Ms.Nigist Asfaw of Ethiopian Spice Extraction Factory, and Mr.Belay Dechassa of Kassk Spices and Herbs Extraction Factory were recommended to attend the Harare Workshop.

3. GHANA

3.1. Alafia Bitters Herbal Institute and Clinic Limited

Address: Zongo Junction, Madina, Accra, Ghana

Phone: 233-21-501525

Fax: 500617

Directors: Mr.Ransford Atiako, Managing Director, Mr. Joshua Atiako, Deputy-Director, Mr.Djane Atiako and Ms.Rose Atiako, Board Members.

The company was established in 1967 as a herbal clinic and dispensary of herbal products. There are eight permanent and seven casual employees of which five and three staff members are females, respectively. The company is manufacturing and marketing a number of dosage forms. Manufacturing facilities and conditions are very poor. However, the best seller, Alafia Bitter is not only sold in local market but also is exported. 1996 exports of Alafia Bitters amounted to US$ 5449 according to Ghana Export Promotion Council's report. The company does not produce any aromatic plant product and has no intention to do so.

It was strongly recommended to employ pharmacists and to acquire appropriate machinery for the manufacturing of products under hygienic conditions.

3.2. Panvelley Herbal Products Ltd

Address: P.O.Box 7539, Accra, Ghana

Phone and fax: 233-21-228627 and 222567

Phone: 234833

Mobile: 027554908

Director: Mr.Kobla Boso

The company does not have a manufacturing facility, but markets Ayurvedic medicines imported from India. There is no aromatic product or essential oil bearing medicine in the company's product range. Therefore, no more information will be given about this company.

3.3. Karafi Ltd

Address: P.O.Box 0672, Takoradi, Ghana

Phone: 233-31-23516

Fax: 23516

Director: Mr.Peter Tandoh Mensah

The only product of this company is a liquid preparation titled"Karafi Bitter". It is said to be a mixture of three plant materials. Like the other companies visited in Ghana, this one also does not produce any aromatic plant products and has no intention to go into essential oil business.

3.4. Centre for Scientific Research into Plant Medicine (CSRPM)

The centre is situated in Mampong-Akwapim in Aburi district which is about one hour ride to the north east of Accra at an altitude of about 250 m. Five years ago, I had developed a project for the strengthening of this Centre. I learned that the project was still on the pipeline. The building to house the pilot plant as recommended in the project proposal was now ready and the staff strength of the centre was doubled. The laboratories were equipped with a capillary gas chromatograph (Perkin-Elmer), Fourier-Transform Infra Red (FT-IR) Spectrophotometer (Perkin-Elmer 1600 series), research microscope with camera attachment, analytical and top-loading balances, reciprocating column liquid-liquid extractor (Eyela), fume hood, rotary evaporators (J.Bibby and Buchi), freeze dryers (Edwards-Super Modulyo and Eyela), Ugo-Basile set of pharmacological equipment for Hypocratic screening such as bronchospasm transducer, analgesimeter, hot plate, plethysmometer, tail flick test and blood pressure measurement equipment, activity cage for behavioral studies, rotarod treatmill, respirometer (Fukuda), two-chamber isolated organ bath with two channel recorder, refrigerated centrifuge (Denley), glucose analyzer (Beckman) and biochemical analyzer (Vitalab 31).

The centre has an out-patient clinic, a liquid medicine production unit and a dispensary, as well as phytochemistry and pharmacology laboratories and a herbarium. Most of the plant

materials are grown in the centre's two farms nearby.

Mr.Trausner, JPO in charge of UNIDO in Accra briefed the consultant about the project proposal titled "Processing of Herbal Pharmaceuticals Based on Traditional Ghanaian Therapies" with a total budget of US$ 1.941.600. According to the minutes of a meeting held in July 3, 1997 upon invitation by Mr.D.Tommy, the, then UCD in Accra, UNDP made a commitment to provide seed money (US$ 622.500) provided the expert component was reduced from the proposed $590.000 to $315.000. However, UNDP was not prepared to met the cost of equipment estimated to cost US$ 984.000. For equipment, donor contribution was suggested and likely donors were identified as the Japanese government, USAID, CDF and the World Bank. Cost of the fellowship component was suggested to be met through TCDC and other cooperating agencies. It was strongly recommended in the meeting that the project should be government executed. The director of CSRPM, Prof.F.K.Oppong-Boachie, does not think that government execution is a good idea as there is almost no expertise in the country in the execution of a project of this size and nature. He was enlightened about the benefits of UNIDO execution. At present, it remains to be seen what will happen to the project. Taking into account the interest of donors in Ghana and the increased interest of the government in developing the centre as a focal point in traditional medicine, hence the completion of the pilot plant building, and the seed money promised by UNDP, with a bit of pushing hard, there is no reason why the project should not take off soon. A US-based pharmaceutical company, is interested to be a donor in this project through its subsidiary. This company has recently acquired the GIHOC Pharmaceuticals' modern pharmaceutical manufacturing works, and is willing to enter into a joint venture with the centre. The company's interest to either 1) put in cash, 2) provide the equipment needed, or 3) provide scientific expertise has been communicated to the centre. However, it has not yet come up with a solid proposal.

3.5. Lever Brothers Ghana Ltd

The factory of Lever Brothers Ghana Ltd in Tema, about 40 km to the east of Accra was visited, in order to confirm the validity of information concerning Lever Brothers leasing distillation stills to farmers for essential oil production for the company. The Training Manager who was met very briefly told that a small production of citronella oil was carried out in this manner but declined to give any figures or further information.

The invitation of Prof.Dr.F.K.Oppong-Boachie, Director of CSRPM, was recommended for the Harare workshop from Uganda. Another suitable candidate could not be found, since none of the companies visited had any activity or interest in the field of aromatic plant products or essential oils.

4. MALAWI

4.1. Malawi Industrial Research and Technology Development Centre (MIRTDC)

The Centre was established in 1991 by the Malawi Government as a trust under the Ministry of Trade and Industry to provide sustained efforts towards assisting industries to develop. The Centre started its operations in January 1993. There are four main departments

with several sub-units. (1) Department of Industrial Research comprises (a) Chemical Engineering, (b) Mechanical Engineering, (c) Electrical Engineering and (d) Engineering Drawing units. The other departments are (2) Appropriate Technology, (3) Technology Assessment and Transfer, and (4) Finance and Administration. The centre has interest in establishing facilities and capabilities towards tapping the country's medicinal and aromatic plant resources for industrial development. The staff members of MIRTDC met were as follows: Mr.C.W.Guta, General Manager, Mr.K.J.Gondwe, Senior Research Officer (Mechanical), Ms.D.I.Chanje, Research Officer (Food), and Mr.W.H.Muyila, Research Officer (Chemical Engineering). Mr.Kent Kafatia, Senior Research Officer (Chemical Engineering) could not be met due to his absence from Blantyre due to a workshop in Lilongwe. He was trained at the Medicinal and Aromatic Plant and Drug Research Centre (TBAM) in Turkey during the 9th in plant Group Training Programme on the Utilization of Medicinal and Aromatic Plants in Pharmaceutical and Related Industries (TRUMAP) in 1996 organized under the auspices and joint sponsorship of the Government of Turkey and UNIDO.

In 1996, Mr.M.K.Raina, UNIDO Consultant prepared a UNIDO report ISED/R.73 (9 December 1996) titled "Fact-finding and Preparatory Assistance to Assess the Potential and Prepare a Plan of Action for the Industrial Utilization of Medicinal and Aromatic Plants in Malawi". In this report, he recommended the establishment of a pilot plant for processing medicinal and aromatic plants at the Centre and the coordination of project activities by MIRTDC. He shortlisted the following aromatic plants for industrial development: Ninde (*Aeolanthus gamwelliae*), lemongrass, geranium, Java citronella and mints. According to his findings, Forestry Department was experimenting cultivation of *Eucalyptus citriodora*, lemongrass and geranium in Northern Malawian forests. Successful cultivation trials were achieved for cinnamon, cardamom and cloves. In Viphya forest resources in Northern Malawi, VIPCOR (Viphya Corporation) was tapping *Pinus elliottii* and *P.kessiya* trees for oleoresin (turpentine) production.

With these information at hand, several companies which were shortlisted by the MIRTDC staff were visited. Telephone conversations with several pharmaceutical companies in the UNIDO's list such as **Pharmanova Ltd** and **Import and Export Ltd** in Blantyre and **Malawi Pharmacies Ltd** in Limbe rendered a visit to them unnecessary since they had no present or future interest in producing locally or using essential oils or aromatic plants.

4.2. Universal Industries Ltd

Address: P.O.Box 507, Blantyre, Malawi

Phone: 265-670055

Fax: 677408 and 671404

Directors: Mr.D.K.Amin, Managing Director, Mr.T.Mugunthan, Technical Manager, Mr.H.C.Mvula, Operations Manager, Mr.B.Panchal, National Sales Manager, Mr.C.Twist, Fleet Manager, Mr.S.D.Mehta, Financial Controller.

This company, established in 1957, manufactures bisquits, confectioneries, snacks and bubble gums and is an end-user of aromatic plant products including essential oils. The product

range of the company comprises 140 products under four brand names: Universal, Zokoma, Kamba and Sun Valley. The work force of the company is 700 including 34 females. Three of the staff have MSc degrees and six staff members are university graduates. The company imports all the food flavours. Their annual requirement for aromatic plant products which are imported from South Africa include ginger extract (1 ton), ginger powder (0.5 ton), peppermint oil (0.2 ton), orange oil (1.5 tons), lemon oil (0.5 ton). The company sees great scope for development in domestic clove and cardamom.

Products of Universal are generally consumed in the domestic market. However, bisquits and sweets are also exported. Annual turnover is around US$ 12 million. It has a stock of US$ 3 million worth of raw materials and US$ 1 million worth of finished products. 30% of the raw materials such as sugar, maize, vegetable oil, bran and potato are acquired locally, and 70% of the raw materials are imported.

The company complains about the low quality of services in the country such as water, power, telecommunication all having to do with poor infrastructure. Therefore productivity is low. Financial opportunities are almost nil and interest rates on loans are high. Coupled with high customs duties and heavy bureaucracy competition becomes very difficult. Furthermore, due to lack of good roads and low population density marketing distribution of products within the country pose problems.

The company was urged to initiate aromatic plant cultivation through the mobilization of small holder farmers and to set up a distillation plant to meet essential oil requirements of the company. The management complained about the lack of technological information to set up one. They indicated their willingness to start such activities if proper advice was provided. The company management was briefed about the technological requirements for establishing an essential oil distillation plant.

4.3. Naming'omba Tea Estates Ltd

A visit to this company was arranged by the Centre due to information that it had a steam distillation facility. It is situated about 30 km to the east of Blantyre in Thyolo district in the heart of the tea production region of Malawi. According to the information provided by Mr.Stephen Mullan, General Manager, the company has never produced essential oils or any other aromatic plant products, and was only manufacturing black tea, Macadamia nuts and second grade of which were expressed to produce 20 tons of Macadamia (fixed) oil per annum. So far, the company had produced 50 tons of oil. The sale of good quality nuts was to the tune of 120 tons per annum. Tea was cultivated in 1250 ha to harvest 13 million kg of green tea which were processed to yield 3000 tons of black tea, all of which were exported. The total turn over of the company was to the tune of US$ 5 million annually. The company had a work force of 6000. Mr.Mullan remembered that in early '90s a Frenchman used to produce *Eucalyptus* oil next to its estate. However, he was not sure whether he was still producing it. In his farm, *Eucalyptus grandis* was planted in 4000 ha for use as fuel wood. *E.europhylla* and *E.citriodora* were also cultivated in smaller acreage.

4.4. Viphya Corporation Ltd (VIPCOR)

Address: P.O.Box 1252, Blantyre, Malawi

Phone: 265-620600

Fax: 633097

Director: Mr.Cedric Makunganya, Projects Manager

The company was established in 1973 as a public enterprise to turn non-timber forest products into commercial benefit. With no field stations, the company employs 13 people including 5 women, all working in the headquarters. VIPCOR is exploiting the Viphya forest resources in Northern Malawi. Out of a total area of 114.000 ha, about 53.000 ha were under pine cultivation. Although suffered forest fires since last year, there were about over 1 million pine trees of *Pinus elliottii* (3128 ha), *P.kesiya* (6380 ha) and *P.patula* (40.000 ha). Except for the latter, the other two species were tapped for oleoresin (turpentine) production. One tree reportedly yields 2.2 kg of oleoresin. The company used to sell turpentine to Royale Chemical Enterprises Ltd, but has stopped selling now. Over the last six years, the company has tapped 1 ton of oleoresin ready for processing in the planned pilot plant which will be set up by a Kenyan processing company. The project cost is estimated to be US$ 1 million for plant and machinery to process 1000 tons of oleoresin per annum. At present, VIPCOR has no processing facility. Apart from pine, in the same forest, *Eucalyptus saligna* is said to be cultivated in 2000 ha and cypress in 923 ha with no immediate plan to exploit them. Forestry Department has reportedly been cultivating lemongrass, *E.citriodora* and geranium in the area without any obvious reason.

The manager was reminded of the benefits of having a separate distillation plant for the production of essential oils from aromatic plant products. He complained about the lack of expertise, technical knowledge and information on distillation techniques and technologies. It was explained to him that under proper guidance by an expert, a commercial size distillation plant could easily be manufactured locally at a cheaper cost than imported.

4.5. Royale Chemical Enterprises Ltd

Address: P.O.Box 51048, Limbe, Malawi

Phone: 265-641299 or 641782

Fax: 643813

Directors: Mr.I.A.G.Panjwani, Managing Director, Mr.G.G.Balsara, Production Manager

Established in 1982, the company is a manufacturer of household and industrial cleaners, polishes, soaps, detergents, disinfectants, insecticides and petroleum jelly. The company has a staff strength of 45, all male and two female secretaries. Two staff members are university graduates. Except for dolomite, all the other raw materials are imported. Natural fragrance materials imported include musk, jasmine, red rose fragrances, citronella oil, lemon oil and pine oleoresin. The company is interested in setting up of a distillation plant but lack

of raw materials for distillation was implied. They were advised to give incentives to farmers to grow lemon grass and citronella grass with buy-back guarantees, and even to lease them small distillation units. The feasibility of such an initiative was explained.

4.6. Bvumbwe Agricultural Research Station

The station in Limbe was visited in order to obtain information on the availability of cultivated aromatic plants in Malawi. According to Mr.Noel Nsanjama, Officer-in-Charge, there was simply no project in the station to cultivate aromatic plants. When asked about the ninde plant. He said its cultivation was stopped in early '70s and all the stockhad to be destroyed due to a nematode problem. Some information was derived from a research bulletin published by the Department of Agriculture on ninde plant. It is *Aeolanthus gamwelliae* (Labiatae), an aromatic shrub indigenous to Northern Zambia and neighbouring areas in Malawi and Tanzania. Calices are harvested when most petals are fallen and dried in shade. When distilled for up to four hours, flowers yield 2% oil of the fresh weight. Percentage of the oil on dry weight basis reaches 11.7% in petals, 11.1% in calices, 2% in leaves and trace amounts in stems. The oil contains over 70% geraniol. Production of the oil had taken place between 1949 on 1963 but never exceeded 25 kg a year in Zambia. The plant was introduced into cultivation in Malawi, which went on till 1970s when it was stopped suddenly. Main buyer of the oil was UK. With such a high oil yield and high percentage of geraniol , if steady production is achieved, there is no reason why this oil should not find place again in world markets. Since it has a history of use in Europe in living memory, this oil needs careful reconsideration for commercial exploitation in near future.

Due to no visible essential oil production in Malawi, it was found extremely difficult to select two persons to attend the Harare workshop. Finally, Mr.Kent Kafatia of MIRTDC who had been a TRUMAP trainee and currently the person-in-charge of developing a UNDP/UNIDO project for implementation in Malawi on medicinal and aromatic plants was recommended. After some consultation, it was decided to recommend Mr.I.A.G.Panjwani of Royale Chemical Enterprises Ltd as the second possible candidate due to his interest, enthusiasm and plans to set up a steam distillation facility in Malawi.

5. SOUTH AFRICA

Among was visited list of companies provided by UNIDO, **Aromatherapy Oils of South Africa**, and made telephone contacts with **Aromatic Essential Oils CC** and **Clive Teubes (Pty) Ltd.** were made. The latter two companies were not included in the list, however, could be contacted after personal inquiry.

During the visit, Mrs.Sheila Resnick, the owner of Aromatherapy Oils of South Africa, was met briefly. She said she was importing all the oils for her business and as far as she could know there was no producer of essential oils in South Africa. It was hard to believe it but the other companies also said the same thing.

None of the companies were producer of essential oils or any other aromatic plant products. They all import essential oils from abroad and either sell them as such or blend them

into mixtures for aromatherapy use or as flavours and fragrances. None of them use locally produced oils.

According to the information obtained from Clive Teubes (Pty) Ltd, there were only small producers of *Eucalyptus* oil, however, none of them were near Johannesburg, and the name and address of none of them could be obtained since Mr.Clive Teubes was abroad and no one was authorized in the company to give information.

Therefore, no company profile could be prepared but Mr.Clive Teubes was identified from South Africa for the Harare Workshop.

The companies contacted are as follows:

1 Aromatherapy Oils of South Africa, 62 Cavendish St., Wendywood, Sandton, Box 651874, Benmore, South Africa. Phone: 27-11-7840032, 7840033. Fax: 7840122

2 Aromatic Essential Oils CC, Killarney Mall, 60 Riviera Rd., Lillarney, (Johannesburg), South Africa.Phone: 4861773.

3 Clive Teubes (Pty) Ltd., 75 Wallis Ave., Strijdom Park, Randburg, Box 4919, Randburg (Johannesburg), South Africa. Phone: 7924451, 7924452, 7931207. Fax: 7921110.

6. UGANDA

6.1. Uvan Limited

Address: P.O.Box 8813, Kampala, Uganda

Phone: 256-41-243490 and 243687

Fax: 243682

Tlx: 61322 agase

Directors: Mr.Aga Sekelala, Managing Director, Mr.A.Sekelala, Jr., Deputy Director

The farm of Uvan Ltd is 25 km away from Kampala in Majija district. The company is a producer of cured vanilla pods which are chopped, steamed and dried after harvesting, and exported to McCormick company in USA. Uvan limited has 15 permanent staff including six women. 50 more workers including 30 females are employed by the company during the vanilla season.Three of the staff have university degrees. *Vanilla planifolia* (Orchidaceae) is a parasitic (epiphytic) plant which grows on *Jatropha* or *Gracidia* trees. After processing vanilla acquires the characteristic vanilla flavour due to generation of vanillin, which is widely used in flavour and fragrance industries. Cured vanilla production constitutes the main activity of the company.

Other activities of the company are the cultivation of a number of aromatic plants and distillation of essential oils. Citronella grass is cultivated in 8 acres (1ha=2.5 acres) and geranium in 250 sq.m. The following *Eucalyptus* species are also grown: *E.viridis, E.olida, E.Macarthurii, E.radiata, E.smithii, E.stangerania, E.citriodora, E.goniocalyx and E.globulus*.

All the planting materials were imported from South Africa. Experimental distillations were carried out on all, but citronella oil was produced in commercial quantities (300 L) and sold to a local soap manufacturer, and mutete oil (30 kg) was produced with 0.06-0.4% yield from *Cymbopogon afronardus* (Graminae) for Mukono Ltd. The latter oil obtained by distilling the freshly cut grass harvested from the wild is said to be used in the formulation of a locally manufactured toothpaste by Kato Aromatics Ltd. 3 kg of lemon grass oil was also produced with 0.1-0.14% yield. The yields of other oils were as follows: *Eucalyptus citriodora* (0.6% with over 86% citronellal), *E.globulus* (0.7% with ca. 70% 1,8-cineole), *E.goniocalyx* (0.7%). The geranium oil produced did not appeal to likely buyers who rated it as African geranium oil, not as good as Bourbon or Chinese which have a ready market. The company has recently imported good quality importing material from South Africa, and early experimental results suggested it to be of a better quality.

In 1996, Uvan Ltd's net earnings was US$ 685.000. The company has 30 tons of cured vanilla in stock and is planning to market candles scented with citronella oil as mosquito repellent.

The processing facilities of Uvan Ltd includes 2 x 2500 L capacity mild steel wood-fired water and steam distillation stills, both connected to a single condenser. No Florentine flask exists for the separation of oil and the distillate collects in a metal container from which oil is scooped resulting in significant loss of oil. There is no cohobation facility. Recently, NRI of UK has donated a used stainless steel steam distillation plant of 25 gallon capacity to Uvan Ltd through USAID and IDEA (Uganda's Investment in Developing Export Agriculture). This donation was realized upon recommendation by Mr.Clinton Greene who had visited Uvan Ltd in 1996. The plant is planned to be installed and commissioned in November 1997. The company also has two glass Clevenger apparata for experimental distillations.

One of the main problems identified was the contamination of oils with those oils distilled immediately before. Proper cleaning of the still before distilling another plant material was stressed and planned distillation was recommended. It was explained that otherwise, changing the type of plant materials to be distilled every so often would definitely cause contamination which would render the oils valueless. Advice was given to Mr.Baxton Kiviri, distillation technician, on how to store essential oils. The company has no facility for the quality control of essential oils. As a gesture from my side, I promised Mr.Sekalala to analyze a number of his clean oils free of charge if sent by DHL. He was also advised on production, storage, quality control and marketing of good quality essential oils.

Mr.Sekalala mentioned about another company cultivating geranium. The owner of the **Buiga Farm Industries Ltd** company, Mr.Mugenwa, was contacted by phone. He said a pilot size steam distillation plant had been donated to him by NCI would soon be installed in his farm.

6.2. Natural Chemotherapeutics Research Laboratories (NCRL)

The laboratory was established in 1965 by the Ministry of Health with specific objectives of undertaking systematic scientific evaluation of traditional medicines being practiced by herbalists and traditional healers in Uganda. The laboratories have been equipped to undertake research into botanical, chemical, toxicological and pharmacological aspects of

medicinal and aromatic plants (see Annex 3). However, library, herbarium and information technology facilities need improvement.

Although the laboratories are well equipped with pilot scale processing, analytical and pharmacological facilities, due to lack of professional staff and qualified technicians the facilities have not been and are not being used to produce any useful results. Of the two people trained in Eskisehir, Turkey in 1989 (Mr.Joseph Bogere Mutyaba) and 1994 (Mr.Busingye Charles Nicholas), the latter had passed away three years ago and the former had retired to start his own oil mill to produce vegetable oils. The other TRUMAP trainees, Ms.Sarah Christine Nyanzi (1988) of Uganda Pharmaceuticals Ltd was in USA for training and Mr.Gabriel Kayanja Kaddu (1993) was working as inspector in National Drug Authority. According to the information given by Mr.N.K.Mubiru, Director, a National Health Research Organization was being created by the government and NCRL would be given an institute status. NCRL has at present a mere five staff members including the director, comprising three chemists and two botanists. The laboratory has been compiling information on traditional healers and their remedies for the last 20 years and has produced 27 reports after interviewing healers in 27 districts. The healers interviewed have been catalogued and their practices and cures have been documented. Plant materials used by them have been scientifically identified. The present Medical Practitioners Act allows traditional healers to practice only in their community and the new amendment to the act which is before the parliamentis expected to order the establishment of a Council of Traditional Healers in order to make them liable to prosecution for their malpractices and the Council will be responsible for assuring lawful practices of its members as a form of autocontrol.

NCRL was visited last year by a UNIDO expert who drafted a project proposal titled "Industrial Utilization of Medicinal and Aromatic Plants in Uganda". This three-year project had a budget of US$ 735.175. The objectives included production of standardizer traditional medicines to supply the public with affordable and reliable medicines from indigenous plants cultivated in rural areas by small holder farmers. Increased employment of women, increased availability of locally produced raw materials and increased agro-industrial production were envisaged. Outputs included cultivation of selected medicinal and aromatic plants, setting up of a multipurpose pilot plant for the production of extracts and essential oils with consistent and acceptable quality, establishment of a product development laboratory for the formulation of raw materials into dosage forms. The project included 21 w/m of experts, 8 w/m of fellowships, 3 w/m of study tours, and in-service training and workshops amounting to 53.15% of the total budget. The equipment budget comprised 46.85% of the total. The project is expected to be executed by UNIDO and is hoped to be financed from UNDP funds next year, since the subject has been identified by the government as a priority area and is expected to be announced in the country's development plan due next year. The other staff members of NCRL are as follows: Ms.Apio Sophia Kerwesi (Botanist), Ms.Grace Nambatya (Medicinal Chemist), Mr.Corn Alele Aruai (Chemist) and Mr.Ben Adrian Kakooko (Botanist).

Mr.Mubiru was advised on strategies for successful implementation of UNDP/UNIDO projects.

6.3. Mukono Vanilla and Horticultural Cooperative Society Limited

Address: P.O.Box 8475, Kampala, Uganda

Phone: 256-41-230125, 230127 and 285987

Mobile phone: 075730125

Fax: 230142

Directors: Mr.Ismail Tamale, Chairman, Mr.Hammad Musoke Tamale and Mr.Ahmed Tamale, Board Members.

Vanilla curing facilities of the company are in Makindi area which is 4 km to the southwest of Kampala. The company was established in 1986 and has been engaged mainly in the curing of vanilla pods. The product called "cured aromatic vanilla" is exported mainly to Canada, Germany, France and Egypt, since there is no local market for it. The company permanently employs 25 people including 20 women. During the vanilla season 100 casual workers are employed of which only 20 are male. Three of the permanent staff have university degrees. The product complies with customer specifications and with the specifications of the Uganda National Bureau of Standards. It has a vanillin content of 2-3% and a moisture content of 25-30%. Vanilla pods are cured by the traditional technique which takes about three months.

1997 produce of the company was 10 tons. Annual turn over is between US$ 120.00 to 200.000. The company has 10 tons of cured vanilla in stock. The manager complained about the difficulties experienced in financing the purchase of green beans from farmers, and mentioned that curing was a labour intensive expensive business.

Mukono Ltd has some association with Kato Aromatics of Egypt and has been supplying Kato with mutete oil distilled by Uvan Ltd from plants supplied by them. So far, 30 kg of mutete oil has been produced.

Mukono Ltd expressed interest in setting up of a mobile distillation plant. A plant being constructed at a metal workshop in Kampala was shown. It is a crude, mild steel structure of ca. 2000 L capacity with numerous design faults. Critism was voiced to the person who designed it and to Mr. Tamale. They were cautioned about the danger of designing an imaginative still and were recommended to consult UNIDO for the correct design drawings of commercial size distillation stills. They appreciated it but reiterated their wish to continue with its construction. Then, some recommendations were made on improvements of the existing design. It is a rectangular shaped box with a cylindrical boiler at the bottom. Over it, there is a water tank which will be boiled to generate steam to penetrate into plant material packed loosely above the grill. Plant material will be loaded through a man-hole on the top. The distillate will then be let through a pipe to a coil type condenser, and then to a separating funnel. The need to have a Florentine flask was stressed and a drawing of it was provided.

The participation of Mr.A.Sekalala and Mr.I.Tamale from Uganda were recommended for the Harare workshop.

7. ZAMBIA

7.1. White Rose Farms Ltd

Address: Church House, Cairo Rd., P.O.Box 33805, Lusaka, Zambia.

Phone and Fax: 260-1-236348

Owner and Managing Director: Mrs.Katongo Maine

The company was established in 1979 as a textile company and in the address indicated there is a shop selling textiles. The company has in recent years decided to go to farming business, and cultivation of herbs was taking place in own fields for the last few years. The company is planning to set up a small distillation facility for essential oil production. Upon recommendation of a South African expert (Mr.Hoek), two different sizes of steam distillation plants had been ordered. The one which would process 100 kg of herbs (presumably of 500 L capacity) would be set up in November 1997 in the company's farm. Two of each 1000 L capacity steam distillation plants would be installed and commissioned by a South African firm next March.

Mrs.Maine mentioned that Mr.H.Kaplan, a consultant who had been commissioned by International Executive Services Corporation (USA), after analysing the aromatic plant materials produced by the company, had recommended them to go into essential oil business.

The company employs twelve people including two female workers. Two of the staff, both male, are university graduates. During the peak season, about 40 female casual workers are employed.

The following herbs are currently under cultivation: Lemongrass (3 hectares, to be expanded to 50 ha next year), marjoram and *Origanum vulgare* (1 ha each, to be expanded to 20 ha). The company also runs a nursery to provide contact farmers with planting material. The company has imported 3000 seedlings of Geranium Bourbon from Reunion and 2000 seedlings of Citronella grass from Zimbabwe for cultivation in Zambia.

The company has the following stocks of dried herbs: Oregano (250 kg), marjoram (80 kg), peppermint (60 kg). Last year, 1.5 tons of paprika were produced. This year, paprika was cultivated in 40 ha and an additional 10 ha was cultivated for seed production. Peppermint was cultivated only in 1 ha for local consumption as herbal tea with no immediate plants to expand its cultivation.

The turn over of the company in 1996 was US$ 50.000. The company is also a member of the Zambia Association of High Value Crops (ZAHVAC). This is a commercial association with several essential oil producers as its members. More information about this association will be given further ahead.

Advice was given to Mrs.Maine about commercial size distillation plants, distillation of essential oils and their quality considerations.

7.2. Eden Herbal Gardens

Address: P.O.Box 33974, Lusaka, Zambia.

Phone: 274805. No fax.

Owner and Director: Mrs.Rose Zulu

The company was established in 1996 for the cultivation and sale of medicinal and aromatic plants for use in therapy. Ms.Zulu affirmed that she had no essential oil distillation facility and had no future plants to have one. She grows a wide variety of herbs in small plots of land for retail sale. She owns 50 acres of land for cultivation and has five male employees. A list of plants propagated by her is as follows: Rosemary, spearmint, peppermint, variegated mint, pennyroyal, celery, marjoram, oregano, thyme, yarrow, valerian, vervaine, chives, garlic, comfrey, cotton lavender (*Santolina chamaecyparissus*), English lavender, plantain, dill, fennel, basil, borage, calendula, caraway, chamomile, chervil, feverfew, chicory, columbine (*Aquilegia vulgaris*), coriander, yellow dock (*Rumex obtustifolia*), elder, evening primrose, fenugreek, lemon balm, lovage, parsley, *Pelargonium graveolens*, summer savory (*Satureja montana*), rue, salad burnet (*Sanguisorba officinalis*), sorrel (*Rumex acetosa*), soapwort, sour fig (*Carpobrotus edulis*), southernwood (*Artemisia abrotanum*), St.John's wort, tansy, tarragon, blue violet, watercress, wormwood (*Artemisia absinthium*), goldenrod (*Solidago virgaurea*), Periwinkle, *Aloe vera*, bulbinella (*Bulbine frutescens*), Asparagus, Hyssop, *Alcea rosea*, poplar, *Ajuga*, purslane.

Advice was given to her on the correct identification of several herbs.

7.3. Bimzi Limited

The company is engaged in three different type of activities: leather goods, cut flowers and oleoresin production. The latter activity is dealt with a separate company titled ***Enviro Oils and Colorants Ltd.***

Address: P.O.Box 50514, Lusaka, Zambia.

Phone: 260-1-247353, 242990

Fax: 245558

Directors: Mrs. T. Mwanamwambwa and Mr.J.S.Mueller

The company, established in 1994, is a manufacturer of paprika oleoresin from home grown paprika (*Capsicum annuum*). It has 85 employees including 15 females. Two of the staff members are university graduates and six with technical college diplomas. The company owns 5000 ha land of which 200 ha is reserved for paprika cultivation. A mild-steel continuous extraction plant with 15 ton per hour paprika processing capacity is used to produce 600 tons of oleoresin from 6000 tons of dried paprika fruits. The product is shipped in 60 L or 210 L PVC drums. All the produce is exported to Japan. The company is planning to cultivate geranium, citronella and lemongrass next year, and tagetes and tuberose in following years for oleoresin production.

Since paprika oleoresin is used as a natural dyestuff, its colour value is important for quality assessment. ASTA (American Spice Trade Association) colour values are taken as standard. Colour measurements are said to be carried out in own laboratories according to ASTA specifications.

The company made a turn over of US$ 3 million last year, and at present, there is no stock of product. Although the plant was installed and commissioned last year, due to rusting of some parts, the factory is at present shut down for maintenance and repairs. It will be operational next February when the new crop is ready for processing.

Discussion was held with Ms.Mwanamwambwa on the company's future plans and the training of technical personnel was recommended on processing and quality control techniques. Advice was also provided on how to formulate requests for UNIDO's assistance and on the feasibility of cultivating some essential oil crops in Zambia.

Upon strong recommendation of Mrs.Mwanamwambwa, a meeting was arranged with Arulussa Ltd.

7.4. Arulussa Ltd.

Address: P.O.Box 31653, Lusaka, Zambia.

Phone and fax: 260-1-611064

E-mail: arulussa@zamnet.zm *or* paagaard@zamnet.zm

Directors: Mr.Peter Aagaard, Chairman; Mr.Vincent Hodson, Managing Director, Mr.George Allison, Active Director

Arulussa farm is *ca.* 45 km to the north of Lusaka. It is a 154 ha farm with 23 ha cleared and 10 ha under irrigation. The company was established in 1993 to cultivate aromatic crops for essential oil and concrete production. The company employs 20 permanent (30% female) and 45 casual workers. During the peak harvesting period 100 more casual workers are employed. Of the permanent staff, two are with university degrees, one with college diploma and three with certificates. Harvesting and processing take place continuously between end-August and mid-May. During winter months (June-July) of the southern hemisphere only maintenance work is carried out. Harvested materials are dried using a solar dryer.

The company has a 2 x 200 L capacity Phytol extraction plant. It uses a liquified gas extraction technique at minus temperatures. The liquified gas used is 1,1,1,2-tetrafluoroethane, a refrigerant gas with resolving power similar to that of hexane. Since it extracts non-polar compounds, it is suitable for essential oil extraction. The technique has the approval of European Union and the FDA for the production of food grade products. The oils so produced may contain non-volatile matter as well, therefore, phytol-extracted oils are not considered as true essential oils, but rather as concretes. They enjoy market opportunities especially in aromatherapy trade. The company is planning to construct 2 x 300 L extraction tanks to increase the capacity to 2 x 500 L.

Arulussa cultivates three varieties of fragrant garden roses in 10 ha and *Melissa officinalis* in 4 ha. Ndruma variety of rose consists of 70% of the cultivated roses with Princess

of Nassau and Isaac Perrier variety of 15% each. Each plant yields 1 kg of fresh flowers and 10.000 plants exist in a hectare. Yield of Phytol extract of roses is 0.1%.

50 tons of dried Melissa leaves are harvested annually with three cuttings. The strain which had been cultivated for the last few years has afforded a yield of 0.015% Phytol extract which has not been appreciated by the buyers. Therefore, the company has imported seeds of a high-yielding cultivar of Melissa from Germany. The plants are thriving well and the old stock will soon be replaced by this cultivar by next year. 3-4 cuttings are planned and between 0.05 to 0.15% yield of Phytol-extracted oil is expected. Melissa oil sells for 4000 pounds sterling in the UK market.

Jasminum grandiflorum is now being experimented in 0.75 ha. Next year, the cultivation is planned to be extended to 5 ha. Tuberose is grown in nursery now, to be planted next year in 4 ha. Frangipan (*Plumeria* sp.) is in the long term processing plan of the company. The tree grows abundantly in Zambia and there is no shortage of raw material for extraction.

The company has so far reportedly sold only small quantities of Melissa oil and Rose oil production will start from next month on. A turn over of US$ 15.000 is predicted for 1997 and US$ 125.000 in 1998.

There are no R&D and QC facilities, and no standards to follow since phytol-extracted oils have, at present, no set standards. Gas chromatographic/mass spectrometric analyses of the oils are presently carried out in France.

The company is importing the Phytol solvent from South Africa. Since the solvent is recycled, annual demand is low. Major constraints of the company were expressed as difficulties in marketing the products. Technology is new and the company has to perform numerous experiments to optimize processing conditions as well as agrotechnology since paucity of written information was said to be a stumbling block. Plans are under way to increase the capacity of the processing plant and to improve the quality of products by obtaining quality certificates for each of them. Apart from the existing UK market, an Australian buyer was said to be interested in Arulussa products and the company has plans to approach the south African aromatherapy market.

The company was advised to set up a separate steam distillation facility for the production of distilled oils. Due to availability of vast irrigated land with perfect soil conditions, cultivation of lemon grass and citronella grass was recommended to meet the demand of local soap and household products industries. The possibility of producing soap in the farm for the domestic market was also discussed. Training opportunities offered by UNIDO for technical people in the industrial utilization of medicinal and aromatic plants were briefly mentioned. In order to initiate lab-scale R&D work, the purchase of a Clevenger-type water distillation apparatus and a volumetric moisture content determination apparatus was recommended. Mr.Vincent Hodson was selected to participate in the UNIDO workshop to be held in Harare, Zimbabwe in November. Mr.Hodson was asked to bring along their products for exhibition in Harare.

7.5. SDK Essential Oils Ltd

About the other essential oil producers in Zambia, SDK Essential Oils Ltd and Quien Sabe Ltd, both ZAHVAC members, were mentioned. All efforts failed to arrange meetings with the officials of these companies during the mission time. According to the information provided, SDK Essential Oils Ltd is situated in Kitwe and owned by Mr.S.D.Kabaso. He reportedly has two 100 L capacity stainless steel distillation stills with aluminium condensers but without Florentine flasks. Steam is generated by a separate steam boiler. The company is said to draw raw material from the National Research Council's Experimental Farm on a small plot of lemon grass (0.25 ha). *Eucalyptus citriodora* leaves are obtained from the Forestry Department.

7.6. Quien Sabe Ltd

Quien Sabe Ltd was reported to have a 200 L mild steel steam distillation still and was said to be cultivating lemon grass in 1 ha with a plan to expand it to 5 ha in near future. 1 ha of other crops such as anise, coriander and english lavender were under observation trials. Based on the testimonies obtained during the interviews with the above mentioned persons, Mr.S.D.Kabaso of SDK Essential Oils Ltd was selected as the second participant from Zambia to attend the Harare workshop. Mrs.K.Mulenga-Maine was listed as a stand-by.

7.7. A Short note on ZAHVAC

ZAHVAC (Zambia Association of High Value Crops) was established in February 1997 to represent the interests of existing out growers associations involved in the production of paprika and paprika oleoresins, essential oils, herbs and spices. Since its inception ZAHVAC has approved the membership of 20 core members and seven associate members. The criteria for joining the association as a core member include (1) an asset base sufficient to secure necessary seasonal and medium term loan finance to cover production requirements, (2) at least 12 months experience in the production of paprika, essential oils and herbs/spices, (3) proven market demand for processed products, and (4) ability to provide security of up to US$ 100.000 before being eligible to access credit.

ZAHVAC was registered as a limited company in May 1997 and the constitution and rules of the association were finalized on August 5, 1997 at the first Annual General Meeting. Since September 1997, ZAHVAC is a member of the Zambia Export Development Programme (EDP).

With the necessary structure in place, core members would be in a position to access supplementary finance and technical support on approval of the Association's Steering Committee to promote and expand their production through the development of outgrower schemes based on small-holder production. Small-holders would be provided with seasonal loans, technical extension services and a guaranteed market for the crops produced.

Associate members would have the following requirements: (1) Affiliation to a ZAHVAC big sister company (core member), (2) payment of an associated member fee of 250.000 Kwacha (1US$=K 1330). Associated members would only have access to funding facilities or technical assistance through the core member they are associated with. Associated

members would have an option to become a core member.

Four companies, all ZAHVAC core members, have been involved in the R&D of essential oils in Zambia for the last three years. These are Arulussa Ltd, Quien Sabe Ltd, Chishawasha Ltd and SDK Essential Oils Ltd. In addition, White Rose Farms, also a ZAHVAC core member, will install a small distillation facility (500 L cap.) in November 1997.

ZAHVAC has recently received two consultants assigned by Landell Mills Ltd (London) through the Seventh European Development Fund. The consultants (Mr.J.W.Hoek and Mr.Clinton Greene), after spending 10 days each in July and August 1997, and studying the situation as regards "high value crops in Zambia" have produced reports recommending that priority should be given to essential oils as the most promising crops, and oleoresin production should only be given the second priority.

8. CONCLUSIONS AND RECOMMENDATIONS

In the course of this mission, 28 companies and institutions were contacted and company profiles were prepared for the related ones. In addition, information was gathered on three companies in Zambia. The countries and the number of companies visited are as follows: South Africa (3), Zambia (4+3), Malawi (6), Uganda (4), Ethiopia (3) and Ghana (5) (Annex 4). Altogether, ten persons have been recommended to UNIDO for invitation to the Harare workshop (Annex 5). Two persons were recommended as stand-by. If enough funds are available it is advisable to invite them as well.

This mission has clearly shown that there is hardly any activity or production in the field of essential oils in all the countries visited. In Zambia, ZAHVAC Ltd has been established to join the efforts of essential oil producers and to promote essential oil production in the country. Within the short duration of the visit it was not possible to obtain information on the essential oil producers in South Africa. The companies contacted stated that there was no essential oil production in the country. Only Clive Teubes company mentioned about small scale production by some farmers, but no further information was available.

In Malawi, Uganda and Ghana, UNIDO has conducted fact-finding and preparatory assistance missions in the field of medicinal and aromatic plants, but project proposals await approval. In Ethiopia, a formal request for UNIDO's assistance is under way.

All the countries visited have vast fertile land and suitable climate for the cultivation of many medicinal and aromatic plants. Aromatic floras of these countries have not been exploited as sources of new essential oils and aromatic materials. If proper research is conducted several aromatic plants can be introduced into this countries for the production of essential oils with ready markets and indigenous aromatic plants with development potential can be domesticated for further development. Although it is not easy to introduce a new essential oil into the market, but there is a great potential for essential oils rich in a particular aroma chemical in demand.

Indigenous aromatic plants such as ninde (*Aeolanthus gamwelliae*) in Zambia and Malawi, and mutete (*Cymbopogon afronardus*) in Uganda may have development potential for

new essential oils.

All the companies complained about the lack of technological know-how and information on commercial scale distillation of essential oils with acceptable quality and on their marketing or formulation into products.

Although distillation is a simple process, but wrongly designed stills not only may result in lower yields and poor quality essential oils but may also bring about danger to life and property.

Quality control of essential oils is essential and has to be conducted by well equipped and experienced laboratories. Standards on most commercial essential oils are available.

Post-harvest treatment of aromatic plants for essential oil distillation and storage of essential oils are important considerations for producers. Cultivation of aromatic plants with development potential should be initiated if commercial exploitation is envisaged.

Governments should take necessary steps to encourage the cultivation and processing of aromatic plants. Aromatic plant products are low volume-high value commodities which if produced in quality in commercial quantities can easily become foreign currency earners for the producer countries. Many of the persons interviewed were critical of the lack of interest of their governments towards the development of this sector. This lack of interest was put down to the lack of appreciation by government officials on the importance of this field. Small incentives and concessions can easily turn potential countries like Zambia, Malawi, Ethiopia, Uganda and Ghana into essential oil producers.

UNIDO can play a very important role in the promotion of essential oil industries in these countries through technology transfer, technology adaptation and training.

Annex 1

TERMS OF REFERENCE FOR CONSULTANT

(YA/RAF/96/X62, BL-043)

1. Background

A good number of medicinal plant-based products and essential oils are produced in African countries. Some of the essential oils are exported at prices lower than those of the world market for want of quality and refinement. Many of the medicinal products are for local use only although a market could be found in countries of the region and abroad.

Indeed, it is generally recognized that the lack of know-how in quality, packaging requirements as well as facilities for the application of quality control measures to upgrade the standard of products in essential-oil manufacturing companies is often hindering exports of these products, and thus their expansion and intended contribution to the economic development process.

The importance of quality improvement was particularly stressed at the UNIDO-GTZ/Protrade Seminar in Germany, where products of 14 companies from 6 African countries were exhibited at a trade fair. The Seminar focussed on requirements for quality, packaging and import regulations of the European Union. Many of the entrepreneurs who attended the Seminar recommended that priority should be given the projects with emphasis on quality management. For this reason and others, the Department of Pharmacy of the University of Zimbabwe and the Southern African Federation of Herbs, Spices and Essential Oils (SAFHSO), an organization which promotes propagation, production and marketing of aromatic plants in the COMESA member states have requested UNIDO to hold a Workshop on quality improvement to support companies' efforts to meet the acceptable standard of aromatic plant products of Africa, and to increase agri-business in the region as well.

It is in response to this request that UNIDO will organize this Workshop to contribute to transferring the latest information on quality, packaging and other export requirements particularly of the Eutopean Union and the United States of America. It will also offer opportunities for industrial partnership arrangements among selected African countries as well as between the latter and partners from industrialized countries.

II. Issues to be Addressed

The study will provide a brief appraisal of the macro-and-micro environment and policy framework for industrial development prevailing in selected African countries, with a view to assisting governments and private companies in identifying and overcoming structural and institutional constraints including policy, technological and professional skills to the industrial development process.

Specifically, the study will analyse the structure and performance of selected companies producing medicinal plant-based products and essential oils in terms of production, employment, productivity, profitability, exports, imports and competitiveness. The assessment will include key products providing an in-depth analysis of retrospects and prospects, and focusing in particular on the resource base, market penetration, investment opportunities and promising product areas. The analysis will be reveal crucial areas requiring technical assistance for products quality improvement.

III. Intended Use of Findings

The study will provide national governments, private companies, professional associations, research institutes and other industrial partners with a basis for:

(i) specific topics on problems and constraints for discussions at the workshop

(ii) developing technical cooperation programmes/projects

(iii) undertaking technical cooperation assessment and project formulation activities

(iv) stimulating industrial partnership arrangements in areas such as investment, technology transfer, information and training, especially among African countries as well as with private sector in developed and advanced developing countries.

IV. Methodology and Approach

The study will be carried out through:

A. Meetings/discussions/interaction with:

- Ministries concerned (i.e.Industry, Health) and other identified local companies dealing with aromatic plant industry in selected African countries.
- Representatives from financial institutions

B. Desk research of available published literature comprising of:

- Country profiles
- Published data/information
- Policies and procedures

V. Description of Duties

1. The consultant will visit 2 or 4 companies identified before hand in the selected countries-Ethiopia, Malawi, South Africa, Uganda, Zambia and Ghana and with the assistance from the UNIDO offices in these countries to collect information on raw material procurement and storage, processing methods, quality assurance system, validation and quality control method, packaging and marketing in order to identify products that need improvement to be competitive. Products with a potential for regional and global use should be given preference.

2. The consultant should also advise the company counterpart staff about the improvements, if any, that could be made including quality control procedures. Besides

identifying the products and companies, the consultant should select at least two companies from each country who could participate in the exhibition of products and the workshop. He also should prepare company profiles of the selected companies. The consultant should submit a report with a diskette in Word Perfect 5.1/5.2 to include his findings, problems and constraints faced by the companies specifically on quality improvement and make recommendations on how the companies could be assisted through the Workshop and subsequent technical cooperation projects. The consultant should also participate as a resource person presenting his findings and giving other lectures at the Workshop to be held from 19-21, November 1997 in Harare, Zimbabwe.

Annex 2

TRAVEL ITINERARY

Date	*Destination*	*Airline*	*Dep.*	*Arr.*	*Duration*
6/10 Monday	**Ankara**-Istanbul	Turkish Airlines TK147	21.00	22.00	1:00
	Istanbul-Johannesburg	Turkish Airlines TK590	23.55	08.15*	9:20
9/10 Thursday	**Johannesburg**-Lusaka	S.African Airways SA64	10.00	12.00	2:00
12/10 Sunday	**Lusaka**-Lilongwe	Air Malawi Ltd QM182	12.00	13.40	1:40
	Lilongwe-Blantyre	Air Malawi Ltd QM013	16.00	16.30	0:30
15/10 Wednesday	**Blantyre**-Lilongwe	Air Malawi Ltd QM004	08.00	08.30	0:30
	Lilongwe-Nairobi	Kenya Airways KQ421/420	12.40	18.25	4:45
16/10 Thursday	**Nairobi**-Entebbe	Uganda Airlines UA541	11.00	12.05	1:05
19/10 Sunday	**Entebbe**-Addis Ababa	Ethiopian Airlines ET870	09.35	11.25	1:50
22/10 Wednesday	**Addis Ababa**-Accra	Ethiopian Airlines ET931	12.45	19.15	9:30
24/10 Friday	**Accra**-Johannesburg	S.African Airways SA56	15.15	23.05	5:50
25/10 Saturday	**Johannesburg**-Istanbul	Turkish Airlines TK591	20.00	06.10*	10:10
26/10 Sunday	**Istanbul**-Ankara	Turkish Airlines TK106	07.30	08.30	1:00

* Arrival next day.

Equipment List of Natural Chemotherapeutics Laboratory in Kampala, Uganda

Chemistry Laboratory

1) TLC spreader and accessories (J.Bibby) [1], **2**) Chromatography tanks for 20x20 cm plates-large [8] and narrow [10], **3**) Plate racks [12], **4**) Glass desiccators - large [9] and small [4], **5**) Top-loading electronic balance - large (Mettler) [1], **6**) Grinder - Hammer type - with screens (Christy Hunt) [1], **7**) Heating mantle - different sizes (Electrothermal) [20], those needing repair [15], **8**) Distilled water still - all glass, 8 L/h cap. (Gallenkamp) [1], **9**) Hot plates - large (Clifton) [2], small (Juniper) [4], **10**) Soxhlet aparatus - different sizes [5], **11**) Heating mantles for 20 L flasks (Electrothermal) [2], **12**) Autoclave (Express) [1], **13**) Centrifuge [1], **14**) Vacuum bag sealer (Salton) [1], **15**) Blender (Waring) [1], **16**) Labelling machine (Brother) [1], **17**) Vacuum oven (National) [1], **18**) Drying oven (Gallenkamp) [1], **19**) Dryer (Leec) [1], **20**) Rotavapor (J.Bibby) [2], **21**) Vacuum pump (Fisons) [1], **22**) Water bath - 20 L (Clifton) [1], **23**) Water bath - 5 L (Clifton) [10], **24**) Water bath - 10 L with 12 lids [1], **25**) Double hot plate [4], **26**) Cooled incubator (Gallenkamp) [1], **27**) Fridge (Lec) [2], **28**) Glassware dryer [1], **29**) Cube ice maker (Lec) [1], **30**) UV lamps [2], **31**) Blow dryer [1], **32**) Craig Counter Current Chromatography Equipment (Quckfit) [1], **33**) Press for IR discs (Grace-Spelab) [1], **34**) Lamp for drying discs [1], **35**) FT-IR spectrophotometer (ATI Mattson Genesis Series) + Dell computer + Canon printer [1], **36**) HPLC - isocratic, UV detector (Cecil 1100 series) + Samtron computer + Epson printer [1], and HPLC grade solvents + HPLC columns (Hichrom) [4], *HPLC and FT-IR are in an air conditioned room with voltage regulators*, **37**) Fraction collector (Jaytee) [1], **38**) Ultrasonic bath (Grant) [3], **39**) Electronic top loading balance (Mettler) [1], **40**) Gas chromatograph (Fisons-GC-8000 series) with FID, NPD, FPD and ECD (ordered) detectors + split/splitless injector [1], **41**) CO_2 production unit (Peak Scientific) [1], **42**) Freeze dryer (Edwards) [1].

Pharmacology Laboratory

1) Rotarod (Ugo Basile) [1], **2**) Bronchospasm trasducer (Ugo Basile) [1], **3**) Rodent ventilator (Ugo Basile) [1], **4**) Plethysmometer (Ugo Basile) [1], **5**) Storage pressuremeter (Letica) [1], **6**) Single chamber isolated organ bath (Ugo Basile) [2], **7**) Four-channel recorder (Ugo Basile) [1], **8**) Hot plate analgesimeter (Socrel) [2]. *As there is no pharmacologist. The laboratory is idle.*

Pilot Plant

1) Distillation plant with ca. 40 L flask (Quickfit) [1], **2**) Extraction pilot plant with ca. 40 L cylindrical flask (Quickfit) [1], **3**) Glass percolators with reservoir - different size and diameter columns (2 m long) [3]. *This can also be used for column chromatography.* **4**) Lots and lots of technical and analytical grade solvents.

Herbarium

The herbarium has 1750 mounted specimens. **1**) Drying oven (Gallenkamp) [1], **2**) Microtome [1], **3**) Deep freeze (Sanyo) [1], **4**) Research microscope [1], **5**) Colony counter for microbiology [1]. *There is no stereomicroscope.*

Annex 4

The Countries and Companies Contacted or Visited

Country	*Company / Institution*
South Africa	1) Aromatherapy Oils of SA 2) Aromatic Essential Oils CC 3) Clive Teubes (Pty) Ltd
Zambia	1) White Rose Farms Ltd 2) Eden Herbal Gardens Ltd 3) Bimzi Ltd (Enviro Oils and Colorants Ltd) 4) Arulussa Ltd *Information gathered on:* 1) Quien Sabe Ltd 2) S.D.K.Essential Oils Ltd 3) ZAHVAC
Malawi	1) Malawi Industrial Research and Technology Development Centre (MIRTDC) 2) Universal Industries Ltd 3) Naming'omba Tea Estates Ltd 4) Viphya Corporation Ltd (VIPCOR) 5) Royale Chemical Enterprises Ltd 6) Bvumbwe Agricultural Research Station *Companies contacted briefly:* 1) Pharmanova Ltd 2) Malawi Pharmacies Ltd 3) Import and Export Ltd

Uganda	1) Uvan Ltd 2) Buiga Farm Industries Ltd 3) Mukono Vanilla and Horticultural Cooperative Society Ltd 4) Natural Chemotherapeutics Research Laboratories (NCRL)
Ethiopia	1) Essential Oils Research Centre (EORC) 2) Ethiopian Spice Extraction Factory 3) Kassk Spices and Herbs Extraction Factory PLC
Ghana	1) Alafia Bitters Herbal Institute and Clinic Ltd 2) Karafi Ltd 3) Panvelley Herbal Products Ltd 4) Centre for Scientific Research Into Plant Medicine (CSRPM) 5) Lever Brothers Ghana Ltd

Persons Selected for the Harare Workshop

Country	*Name, Address*
South Africa	Mr.Clive Teubes *Clive Teubes (Pty) Ltd., 75 Wallis Ave., Strijdom Park, Randburg, Box 4919, Randburg (Johannesburg),* *South Africa. Phone: 7924451, 7924452, 7931207. Fax: 7921110.*
Zambia	Mr.Vincent Hodson *Arulussa Ltd, P.O.Box 31653, Lusaka, Zambia. Phone/Fax: 260-1-611064. E-mail: arulussa@zamnet.zm* Mr.S.D.Kabaso *SDK Essential Oils Ltd, P.O.Box 21933, Kitwe, Zambia* Standby: Ms.K.Mulenga-Maine *White Rose Farms Ltd, P.O.Box 33805, Lusaka, Zambia. Phone: 260-1-236348. Fax: 236350*
Malawi	Mr.Kent Kafatia *Malawi Industrial Research and Technology Development Centre (MIRTDC), P.O.Box 357, Blantyre, Malawi. Phone: 265-623805. Fax: 623831* Mr.I.A.G.Panjwani *Royale Chemical Enterprises Ltd, P.O.Box 51048, Limbe, Malawi. Phone: 265-641299 or 641782. Fax: 643813. Tlx: 44706 panjwani mi*
Uganda	Mr.A.Sekalala *Uvan Ltd, P.O.Box 8813, Kampala, Uganda. Phone: 256-41-243490 or 243687. Fax: 243682. Tlx: 61322 agase* Mr.Ismail Tamale *Mukono Vanilla and Horticultural Cooperative Society Ltd, P.O.Box 8475, Kampala, Uganda. Phone: 256-41-230125, 230127, 285987. Mobile phone: 075-730125. Fax: 230142*

Ethiopia	Ms.Nigist Asfaw *Ethiopian Spice Extraction Factory, P.O.Box 5699, Addis Ababa, Ethiopia. Phone: 251-1-653300. Fax: 653633*
	Mr.Belay Dechassa *Kassk Spices and Herbs Extraction Factory PLC, P.O.Box 120323, Addis Ababa, Ethiopia. Phone: 251-1-341609 or 341610. Fax: 341633*
	Standby:
	Mr.Yisak Alemayehu *Ethiopian Spice Extraction Factory, P.O.Box 5699, Addis Ababa, Ethiopia. Phone: 251-1-653300. Fax: 653633*
Ghana	Prof.F.K.Oppong-Boachie *Director, Centre for Scientific Research into Plant Medicine (CSRPM), P.O.Box 73, Mampong-Akwapim, Ghana. Phone: 233-872-22041. Fax: 22087*