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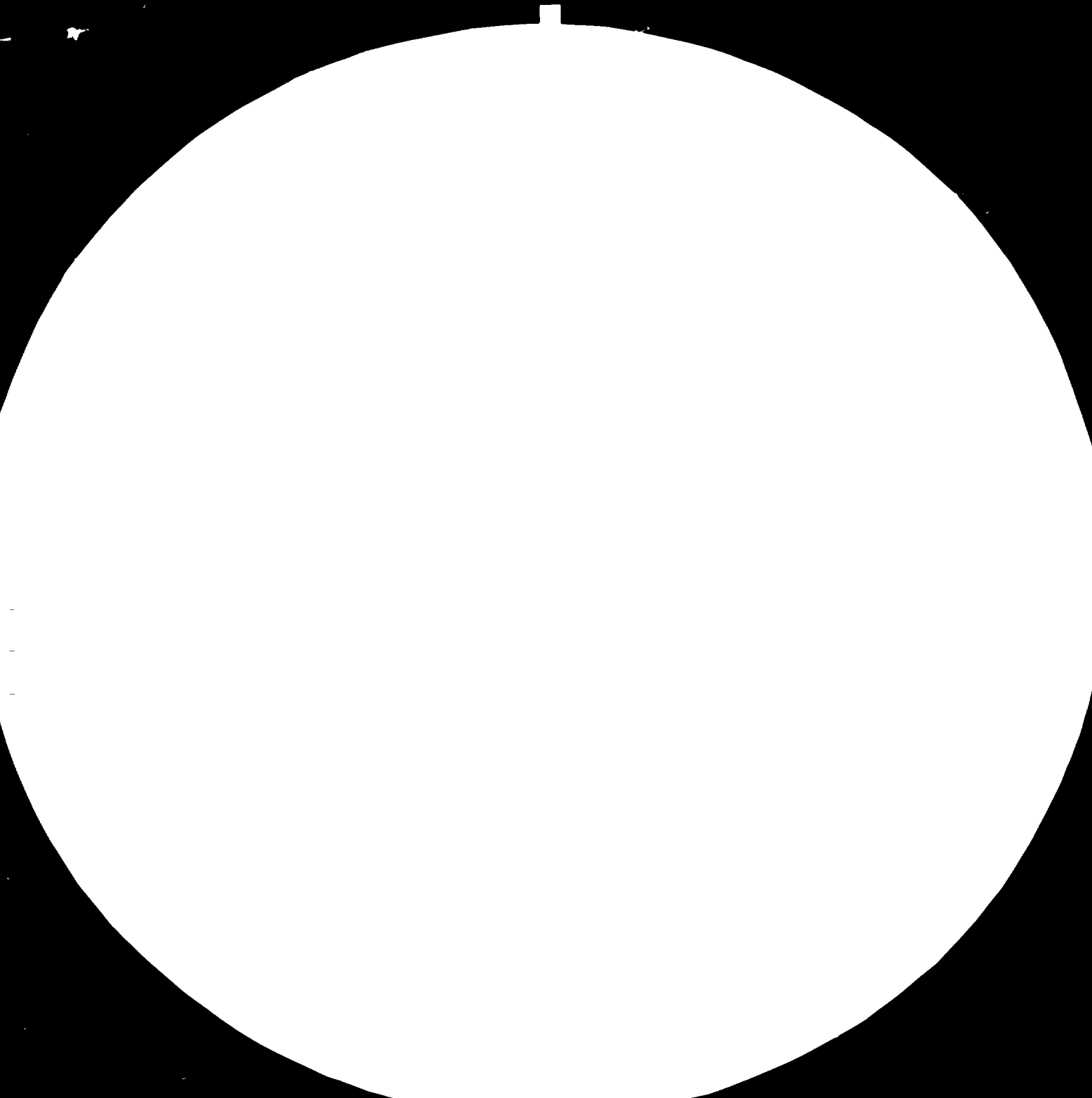
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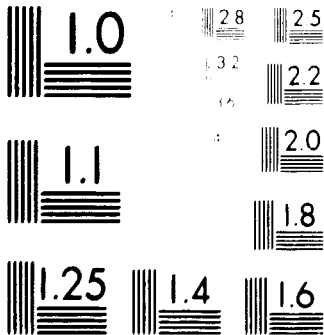
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DP/ID/SER. B/244

7 July 1980

English

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MOBILE UNIT OF PHARMACEUTICAL AND
ESSENTIAL OILS INDUSTRY TO THE
LEAST DEVELOPED COUNTRIES IN AFRICA
4 - 17 FEBRUARY 1980

B O T S W A N A

RP/RAF/79/005

Terminal Report *

Prepared for the Government of the Republic of Botswana

Based on the work of

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Experts of the United Nations Industrial
Development Organization

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Vienna

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S u m m a r y

Within the framework of the UNIDO assistance programme for the industrial valorization of the medicinal plants and their use in medicine in the least developed countries, UNIDO charged the Joint UNIDO/Romania Centre with the task of sending a mobile unit to certain African countries including Botswana.

The main objectives of the mobile unit were to collect data about medicinal and aromatic plants, to carry out chemical determinations on active principles and to examine the prospects of processing them locally in order to be used for the preparation of pharmaceuticals.

This was the second phase of the UNIDO assistance programme which followed the exploratory mission sent to Botswana in January 1978 under the project RP/RAF/77/015.

The mobile unit consisted of four experts, accompanied by two cars fitted up with laboratory equipment and chemicals.

Due to the travel difficulties towards Botswana, the cars were left in Tanzania and the experts with some limited laboratory glassware and chemicals travelled by plane arriving in Gaborone on the 4th of February 1980 and the mission lasted for two weeks until the 17th of February 1980. After some difficulties the Ministry of Health obtained the permission of the Department of Agricultural Research to allow the UNIDO experts to carry out the chemical analyses in its laboratory. The UNIDO experts carried out 6 qualitative determinations of active principles including some chemical investigations on two plants exported by Botswana, 10 quantitative determinations of essential oils and prepared the tincture of stramonium as a demonstration example of the possibility of obtaining locally some medicines based on medicinal

The present report refers to the activity of the expert and their findings and recommendations concerning the valorization of the medicinal plants growing in the spontaneous flora.

It was a pity that the local authorities didn't succeed in designating an interested counterpart for the UNIDO team to develop further the research and the valorization of the medicinal plants in Botswana.

2. Introduction

The United Nations Industrial Development Organization has a very important assistance programme for the development of a pharmaceutical industry based on the medicinal plants available in certain developing countries. Several programmes have been developed for different developing countries and some of them are already under implementation.

The utilization of medicinal plants has been always known in the developing countries and the largest part of the population make use of extracts or dry herbs for curing many tropical and epidemic diseases. Taking into account the increased demand for medicines in the world and in the developing countries too, a particular attention started to be focussed on the possibility of medicines production on a more economic basis such as the utilization of medicinal plants which many developing countries are rich in.

The spontaneous flora of Botswana is rich in medicinal and aromatic plants and therefore, it is advisable to process them in order to obtain the active principles and the essential oils useful in the pharmaceutical industry.

The expert team was received at the Ministry of Health and the Ministry of Commerce and Industry where the objectives of

the UNIDO assistance programme and the targets of the mission were presented.

The representatives of these ministries showed interest in promoting the valorization of medicinal and aromatic plants growing in the spontaneous flora of Botswana but it was difficult to designate a counterpart for the UNIDO mission.

Finally it was decided that the experts can use the laboratory facilities of the Department of Agricultural Research co-ordinated by the Ministry of Agriculture.

The activity of this Department is focussed on soil fertility research and improvement of plants and cultures for the nourishment of the population and cattle with no preoccupation for medicinal and aromatic plants.

However the management of the Department made available to UNIDO experts its laboratory facilities helping them to fulfil their mission. The persons met by the experts during their activity are indicated in Appendix I.

3. Considerations on the spontaneous flora

Botswana has a large territory, occupied to a large extent by Kalahary desert and a low density of population (approx. 1,25 inhabitants/Km²) concentrated in the Eastern region.

The relief of Botswana, besides the Kalahary desert, which is not entirely deprived of vegetation, consists of large savannah surfaces, forests, hills, table-lands and even delta in the North part of the country.

The flora is rich, a large number of species are growing in the neighbouring zones of the desert where the pedo-climatic and the rain conditions are more favourable for the vegetation.

An important number of species growing in the sponta-

neous flora are medicinal and aromatic species used in the traditional medicine.

In order to collect information and samples of medicinal and aromatic plants the botanist expert made trips towards Lobatse, Francis town regions and in the surroundings of Tshabong in the southern part of Botswana.

Unfortunately the number and the distances of the trips were limited due to the lack of time and adequate transport means.

During these trips, the botanist expert collected numerous samples of medicinal and aromatic plants, some of them recognized by the pharmacopoeia. The majority of the samples were checked in by qualitative determinations concerning the presence of the main groups of active principles as well as the quantitative determinations of the essential oil content.

Unfortunately on his trips, the botanist expert was not accompanied by a local botanist. Therefore he could not demonstrate the method of quantitative evaluation of plants growing in the spontaneous flora and which can be harvested yearly without disturbing the ecological balance. However, the description of the methodology was presented to Miss Pearl Motsepe from the Botswana Agricultural College - Jébele, who showed a particular interest in the study of medicinal and aromatic plants.

The information obtained in the field were completed during the discussions with the specialists of the Ministry of Agriculture (Department of Land Utilization, Department of Agricultural Research - Jébele), University of Botswana (Department of Biology and Chemistry), the Agricultural College - Jébele, Ministry of Health (Nutrition Department), the study of the species existing in the collection of the herbarium belonging to the National Museum and in the collections of the Pharing Nursery - Kanye and

Gaberone Forestry Nursery.

Appendix II presents a list of 7 species of medicinal and aromatic plants identified by the botanist expert which can be used in the preparation of pharmaceuticals. They are also recognized by the international pharmacopoeia. The list of plants is not complete because the botanist expert had not the possibility to explore all the regions of the country.

Appendix III presents 43 species belonging to 21 genus of plants, which have not been tested or they have been little checked from a therapeutical point of view but they are used in the traditional medicine. These species can offer the prospects to identify valuable substances for the pharmaceutical industry following the necessary research works.

A particular attention has to be given to *Solanum* sp. (some of them produce a big quantity of fruits) which can be an important source of solasodine for the preparation of steroid hormones as well as to *Harpagophytum procumbens* sp. which is growing even in the difficult pedo-climatic conditions of the Kafahari desert and which is exported to some companies in Europe.

The species *Tagetes minuta*, *Lippia javanica* and *Ocimum Canum* are growing in big quantities and have a high content of essential oils which can be used in the soap and detergent industry as well as in the preparation of some pharmaceutical products.

During the trips made in the Eastern part of Botswana, it was noted^{that}/favourable conditions exist for the cultivation of some species which are very important to prepare some pharmaceuticals and cosmetics required on the international market. In this respect Appendix IV presents 5 main species.

The UNIDO experts brought along a collection of seeds of 20 species of medicinal and aromatic plants were to be tested locally. These species were handed over to Mr. Frank Taylor

from "Pelegano Village Industries" Gabane, who manifested interest in trying to introduce them in culture and to develop new sources of income for the peasants from this region. Appendix V presents these species as well as the main elements of cultivation.

There is no specialized organization in Botswana to cultivate or to process medicinal and aromatic plants.

The Company "Pelegano Village Industries" in Gabane exports *Notholaena eckloniana* and a juice of an Aloe species and some businessmen export tubercles of *Naragocytum procumbens* from the Tshabong region.

4.- Laboratory activity carried out by the mission and guidelines for the establishment of a pharmaceutical and essential oil industry.

At present all medicines are imported in Botswana through a store administrated by the Ministry of Health.

There is neither a research or control laboratory for medicines nor a project to set up such laboratory in the near future.

After some hesitations and discussions with the Ministry of Health, Ministry of Commerce and Industry and the Ministry of Agriculture it was decided that the UNIDO mission would carry out the quantitative and qualitative determinations. Samples of the medicinal and aromatic plants were collected from the spontaneous flora and they were tested in the laboratory of the Department of Agricultural Research Co-ordinated by the Ministry of Agriculture. This laboratory is specialized to perform soil research and trials on agricultural and industrial plants (maize, sunflower, sorghum, cotton, a.s.o.) and it is well fitted up with glassware but reactives and solvents specific for phytochemical analyses are not so easily available.

In order to carry out these analyses the experts got some solvents from the veterinary laboratory in Gaborone

The UNIDO experts carried out 10 quantitative determinations of essential oils and the results are presented in Appendix VI. At the same time the experts carried out qualitative determinations on 6 samples of medicinal plants in order to identify the main groups of active principles. After further detailed investigations these plants could be used for the preparations of medicines and the results are presented in Appendix VII.

In order to demonstrate the possibility of preparing locally some simple medicines the experts prepared the tincture of Stramonium which can be used for treatment directly in the hospitals (see Appendix VIII).

Such kind of medicines do not require a sophisticated technology or laboratory aparata.

A local pharmacist of the Ministry of Health assisted the UNIDO experts during the chemical analyses and the preparation of tinctures.

The existance of some medicinal plants which are exported, such as Harpagophytum procumbens and Notholaena echloniana, implies a detailed research in order to process them locally up to a certain level (extracts, for instance) and as extracts they can be exported, this may represent a supplementary income for Botswana.

The experts undertook some investigations on the above two mentioned plants but further research should be done under the condition that the necessary laboratory equipment, reagents and solvents can be made available. Samples of these plants were brought to UNIDO-Vienna for further investigations.

5.- Findings

- 5.1. In the spontaneous flora of Botswana are growing a lot of medicinal and aromatic species which are not investigated from a therapeutical point of view. These species can offer the opportunity to identify some active principles useful for the pharmaceutical industry and the essential oils are recommended for the soap, cosmetics and detergent industries.
- 5.2. There are no data available for the quantity and quality of medicinal and aromatic plants which can be yearly harvested without disturbing the ecological system.
- 5.3. Besides some limited preoccupations for harvesting and conditioning of some species to be exported by "Pelegano Village Industries - Gabane" and some private persons, there is not any organization specialized in the exhibition of the spontaneous flora, the introduction in culture or the processing of medicinal plants for pharmaceutical purposes.
- 5.4. The UNIDO mission had difficulties to meet indigenous people specialized in botany or being concerned with the medicinal plants.
- 5.5. There is no laboratory especially organized for the study of medicinal and aromatic plants.

The laboratory equipment, glassware, solvents and reagents recommended by the exploratory mission which visited Botswana in 1978 and ordered by UNIDO for an amount of 29000 had not been delivered until the end of the present UNIDO mission.

As soon as the materials arrive, it is advisable, as a

first step, to set up a research laboratory under the co-ordination of the Ministry of Health.

- 5.5. Taking into account the medicinal and aromatic plants available in Botswana it could be possible to set up a pilot unit to prepare some simple medicines or to obtain by extraction and distillation some active principles or semiproducts for export purposes.
- 5.6. The representatives of the Ministry of Commerce and Industry outlined the interest in turning to account the animal by-products from the slaughter-house of the Botswana Meat Commission (BMC) for the preparation of opotherapeutic medicines. The modern slaughter house can supply enough raw materials for the manufacture on an industrial scale opotherapeutic products to meet the internal requirements and especially to be exported. During 1976 211,987 cattle, 2,990 sheep and 5,137 goats were slaughtered.

6.- Recommendations

- 6.1. The Ministry of Agriculture has to set up a unit specialized in the valorization of medicinal and aromatic plants. The main objectives of this unit have to be the following:
- identification of the valuable species growing in the spontaneous flora of the country;
 - evaluation of the quantities of plants which can be harvested yearly without disturbing the ecological system;
 - organization of a network for the harvest of the useful parts of the plants and their conditioning as well as the transport;

- issue of guides (leaflets) describing the parts of the plants to be harvested, with drawings in the vernacular languages to guide the harvesters;
- organization of medicinal and aromatic plant cultures.

- 6.2. Organization of an experimental station for testing in order to introduce in culture some valuable species which have favourable pedo-climatic conditions in Botswana. This station could be coordinated by the "Department of Agricultural Research".
- 6.3. Organization of a research laboratory for the study of the medicinal plants coordinated by the Ministry of Health. The laboratory equipment and the materials already ordered by UNIDO can represent the first endowment of this laboratory.
- 6.4. Organization of training programmes for the local specialist in the field of medicinal and aromatic plant valorization, to be specialized - through UNIDO - as botanists, analyst (for chemical determinations) and pharmacist (for the preparation of medicines based on medicinal plants). This training should take place in a country with large experience in the valorization of medicinal plants.
- 6.5. Assistance of an international expert specialized in botany and in the culture of medicinal plants, to assist the Ministry of Agriculture to organize the setting up of the unit mentioned at the para.6.1. Period : 6 months (November-April).
- 6.6. Assistance of an international expert as analyst to organize the research laboratory (see para.6.3.) and to train locally the skilled personnel to carry out chemical determinations of active principles. Period : 6 months with his last 3 month mission to be overlapped on the last 3 months of the botanist's mission.

6.7. Pending on the positive results of the chemical determinations of active principles in the medicinal and aromatic plants growing in Botswana, the setting-up of an extraction and distillation pilot unit to process the plants for the preparation of pharmaceutical products.

In the Appendix IX is indicated the necessary equipment for the extraction and distillation pilot unit.

6.8. Assistance of an international expert as technologist for a period of 6 months to supervise the erection, mounting and installation of the pilot unit mentioned at the para.6.3. and to prepare medicines based on medicinal plants.

6.9. Assistance of an international expert specialized in the production of opotherpic products to evaluate the possibility of setting up a production unit in Botswana - duration of the mission : 3 months.

x

x

x

During the mission the experts drew up a project proposal concerning the further assistance to Botswana as mentioned above. The draft of project proposal is presented in Appendix X and the assistance is estimated at US\$138,000.-

List

of persons met by the UNIDO experts

1. Mr. Manzur Zaidi -
UNDP resident representative
2. Mr. Teshome - deputy of the resident representative
3. Mrs. Amina Dirie - programme officer
4. Mr. Rudolf B. Brandeis - E.E.C. Trade adviser
5. Mr. Selugea - director - Ministry of Commerce and Industry
6. Mr. Klaus Eder - Senior Industrial Officer - Ministry of
Commerce and Industry
7. Mr. Philip Saunders - Ministry of Commerce and Industry
8. Mr. prof. Uland - director of the Department of Agricultural
Research
9. Mr. Herbert - - " -
10. Dr. M.Gration - chief pharmacist - Ministry of Health
11. Mr. Cambel - director of the National Museum.
12. Mr. Seitzhiro - Ministry of Agriculture - Division of
Land Utilisation
13. Mr. Johnatan Timberlake - - " -
14. Mr. Frank W. Taylor - Managing director of "Pelegano
Village Industries - Gabane"
15. Miss Pearl Motsepe - Botswana Agricultural College
16. Miss Vera Makhema - pharmacy technician - Central
Medical stores

Plants which are used in sufficient quantities in the preparation of codex and recognized by international pharmacopoeia

No.	Botanical name	Part of the plant used	Content (from literature)	Therapeutic effect
1.	Achillea millefolium	flores	essential oil 0.1-0.5% (chamazulenes 50%)	stomachal hemostatic antiinflam- matory
2.	Chenopodium ambrosioides	herba	essential oil 1% (Ascaridol 60-80%)	antihelmin- thic
3.	Datura innoxia	folia	alcaloids 0.2-0.4% (scopolamine 45-55%)	nervous depressant antispas- modic, anti- parkinson
4.	Datura stramonium	folia	alcaloids 0.2-0.4% (Atropin, hyoscyamine scopolamine)	nervous depressant antispasmo- dic, anti- parkinson
5.	Ocimum canum	herba	essential oil 0.2 - 0.5% (camphor 40-50%)	cardiac rubefacient revulsive
6.	Ricinus communis	semen	fat oil 40-50%	purgative
7.	Strophanthus kombe	semen	heterosides cardiotonics (strophanthin 8%)	cardio- tonic

List

of medicinal and aromatic plants which are growing in the spontaneous flora and which have to be tested from a therapeutical point of view

No.	Botanical name	Substitute of the species	Active principles	Therapeutical effects
1.	Aloe roburulutea	aloe ferox		tonic, stomachal
	" saponaris	" vera	aloe-emodol	laxative
	" zebrina	" perryi	aloine	purgative
2.	Balanites aegyptiaca	Solanum laciniatum	solasodine	
		Dioscorea polystachya		
		Dioscorea giraldii	diosgenine	
		Dioscorea guingueloba		
3.	Cassia abrus			
	" abbreviata	Cassia	emodins	
	" biensis	angustifolia	resin	laxative
	" falcinella		senosid a	purgative
	" kirkii	acutifolia	" b	
" obovata				
4.	Chenopodium bonte	-	essential oil	-
5.	Conyza stricta	-	flavones, sterols, antracianosides	-
6.	Croton gratissimus	-	essential oil	-
7.	Cymbopogon plurinoides	cymbopogon	essential oil	carminative
		citratius		antispasmodic
8.	Dioscorea dumetorum Dioscorea sylvatica	solanum laciniatum	solasodine	
		dioscorea polystachya		
		giraldii	diosgenine	
		guingueloba		
9.	Euphorbia candelabrum			
	" heterophylla	euphorbia	euphorbon	nervous and cardiac stimulant.
	" ingens	resinifera		
" tirucalli				
10.	Gomphocarpus fruticosus (=Asclepias fruticosa)	digitalis sp.	glycosides	cardiotonic

No.	Botanical name	Substitute of the species	Active principles	Therapeutical effects
11.	Harpagophytum peglerae	-	-	antirheumatic
	Harpagophytum procumbens	-	-	antitumorous
12.	Lantana rugosa	-	sterols tanins	-
13.	Lippia Javanica	-	essential oil	-
14.	Lobelia erinus	lobelia	alkaloids (lobeline)	stimulate breathing
	" minutidentata	inflata		Antiastringent
15.	Notholaena eckloniana	-	essential oil sterols tanins flavonosides	-
16.	Rhus lancea			
	" leptodictya			
	" quartiniana	Rhus	tanins	
	" pyroides	aromatica		
	" undulata			
17.	Solanum kwebense	Solanum laciniatum	Solasodine	
	" incanum	Dioscorea polystachya		
	" nigrum	Dioscorea giraldii	diosgenine	
	" panduraeforme	quinqueloba		
18.	Strychnos cocculoides			
	" potatorum	strychnos	alkaloids	bitter tonic
	" pungens	nux-vomica	(strichnine, brucine)	depressant
19.	Tagetes minuta	-	essential oil	-
20.	Tarhonanthus	-	flavones	-
	camphoratus	-	tanins	-
21.	Urginea altissima	urginea maritima	heterosides cardiotomics	cardiotonic
	" sanguinea	(=scilla maritima)	scillaren A scillaren B	diuretic

Medicinal and aromatic plants which can find
favourable pedo-climatic conditions in the
Eastern part of Botswana to be introduced
in cultures

No.	Botanical name	Part of used plant	Content (from literature)	Therapeutical effect
1.	Catharantus roseus (=Vinca rosea)	Herba	Indolic alkaloides (vincalencoblastin)	antileu- chaemia
2.	Cymbopogon citratus	Herba	Essential oil (Geraniol, citronelal)	Stomachal carminative antispasmo- dic in cosmetics
3.	Cynara scolymus	Folia	Cinarin Poliphenols flavones	Coleretic colagog
4.	Pelargonium roseum	Herba	The same content as Rosa damascena	In cosme- tics
5.	Rosmarinus officinalis	Sumita- tes	Essential oil (Borneol, cineol, camphor)	Antirheu- matic colagog coleretic

APPENDIX V

List

of medicinal and aromatic plant species recommended to be introduced in culture.
The seeds of these species were brought by the UNIDO experts from Romania.
The main elements of cultivation technology.

No.	Botanical name	Previous culture	Fertilisers				Soil works		Sowing			Maintenance works	Harvest		Production			
			P ₂ O ₅ kg/ha	K ₂ O a.s.	N	Ploughing depth cm	Before sowing	Month	Quantity kg/ha	Dis-tance cm	Depth cm		Period	Manner of harvesting	Drying	Part used	kg/ha	
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.	Atropa bella-donna	-vegetables -cereal -pot after solanaceae	20-30	70-80	45-55	90	28-30	-disk -harrow -roller	XI	4-6	60 x 15	1.5-2	-hoed -weeded -thinned	-leaves -roots in 2nd year.	manual 1-2 harvests	at shad ^o t ^o max. 50-60 ^o C	dried leaves (6-7:1) dried roots (4-5:1) (1)	500-600 700-1000
2.	Colendula officinalis	-plants with annual hoeing	-	60-80	-	40-50	20-25	-disk -harrow	III	6-7	30	2-3	-hoed -weeded	-flowers	manual	at shad ^o t ^o max. 40-50 ^o C	dried flowers (8:1)	1000-2000
3.	Carum carvi	-plants with annual hoeing -cereal	-	40-50	60-70	45-50	28-30	-disk -harrow -roller	III	10-12	50	1.5-3	- " -	when 35-40% of fruits are yellow	- " -	dry- ing and se- lec- tion	fruits	700-1000

APPENDIX V

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
4.	<i>Coriandrum sativum</i>	-plants with annual hoeing -cereal	-	40-50	30-35	60-70	20-25	-disk -harrow	III	15-18	50- or 25	4-5	-hoed -weeded	when 50-70% of fruits are yellow	mecha- rical means	drying and selection	fruits	1000-1500
5.	<i>Cynara scolymus</i>	-plants with annual hoeing	-	60-70	50-65	70-80	28-30	-disk -harrow	V	4-5	70	3-5	-"	green leaves	manu- al	at shadow	dried leaves	1500-3000
6.	<i>Datura innoxia</i>	-plants with annual hoeing with manure; -not after solanaceae	-	60	60	120	28-30	-"	IV	10-12	50	4-5	-"	herbs when appears first fruit	manual	at shadow	dried herbs	2500-3000
7.	<i>Digitalis lanata</i>	-plants with annual hoeing	-	40-80	-	45-50	20-25	-disk -harrow -roller before and after sowing	III	3-4	50	1-1.5	-"	when the leaves have 3 months	manual	at shadow	dried leaves	1000-2000
8.	<i>Foeniculum officinale</i>	-cereal not to be sowed in fields with <i>Cuscuta</i> sp.	-	40-50	-	60-70	28-30	-disk -harrow	III	8-10	60	2-3	-"	when the fruits are yellow-brown	manual or with mechanical means	drying selection.	fruits	600-1000

APPENDIX V

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
9.	Lavandula angustifolia	It will be planted besides crop-rotation	40-50 at the beginning.	45-70 each year	150-200	85-100	45-60	level-lining-disk-harrow	shoot XI-XII plantation X-XI	-	100 x 50	-	-hoed-weeded	when 50% of flow-ers are open	manual flow-ers with 12 cm stem	by dis-tillat-ion	green-in-res-cence	3000-6000
10.	Matricaria chamomilla	plants with very short vegetation period	-	40-50	45-50	40-50	15-20	level-lining-disk-harrow-roller	VIII-IX	4-5	25	0.3-0.5	-weed-ed	when ma-jority of flow-ers are hori-zontal	ma-nual sha-dow t. max. 30-35°	at dis-tillat-ion	dried-in-res-cence (5:1)	600-800
11.	Ocimum basilicum	plants with annual hoeing/very clean	-	40-50	30-40	50-70	20-25	-disk-harrow-roller	IV	4-6	50	1.5-2	-hoed-weed-ed	at com-plete bloom-ing of main in-flo-res-cence	with sick-le	at sha-dow t. max. 30-35°	dried herbs (5:1)	1500-2000
12.	Pimpinella anisum	plants with annual hoeing very clean	-	50-60	-	70-80	20-25	-disk-harrow	III	10-12	50	2-3	-hoed-weed-ed	when 50% of fruits are yellow-gray	with sick-le	dry-ing so-lect-ion	fruits its	500-700

APPENDIX V

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
13.	<i>Plantago lanceolata</i>	plants with annual hoeing besides crop-rotation.	-	50-60	30-40	60-80	20-25	-disk -harrow -roller	XI	5-6	50	0.5-1	-hoed -weeded	when the leaves have 12-14 cm	with the sickle	at shaft height max. 40-50°C	dried leaves (6:1)	1500-2000
14.	<i>Salvia officinalis</i>	plants with annual hoeing cereal besides crop-rotation	-	50-60	40-50	60-70	28-30	-disk -harrow	XI	6-8	70	3-4	-hoed -weeded	leaves during blooming	manual	at shaft height max. 30-35°C	dried leaves (4:1)	600-800
15.	<i>Saponaria officinalis</i>	plants with annual hoeing cereal	-	50-60	30-40	40-50	28-30	-disk -harrow	III	8-10	50	2-3	"	roots	"	at sun	roots (4:1)	800-1200
16.	<i>Sinapis alba</i>	plants with annual hoeing	-	50-60	-	60-80	20-25	-disk -harrow	III	10-12	25	2-3	-weeded	when the plants are yellow	with the sickle	dry- ing selection	seeds	1000-1500
17.	<i>Solanum laciniatum</i>	plants with hoeing cereal	-	40	30	80-90	28-30	-disk -harrow -roller	III	4	60	3-4	-hoed -weeded	when the fruit appears on stem	with the sickle first at 20 cm height	at shaft height max. 70-80°C	dried herbs (7-8:1)	2000-2500
18.	<i>Tagetes patula</i>	plants with hoeing clean	-	50-60	-	70-80	20-25	-disk -harrow -roller	III	4-8 manual,	50	1-15	-hoed -weeded	when the flowers are completely open	manual	at shaft height max. 35-40°C	dried ligule (7:1)	250-350

APPENDIX V

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
19.	Thymus vulgaris	- plants with hoeing - cereal besides crop-rotation.	- 60- 80	- 80- 100	28- 30	-disk -harrow -harrow	shoot III plan- tation: X	0.4 Kg/2 100m	20 50 x 20 with 2-3 shoot	0.5- 1	-weeded -water- ed -hoed -weeded	at the ope- ning of first flow- ers.	manu- al with sickle	at sha- dow t max 30- 35°C	at dryed herbs (4:1)	2000- 2500		
20.	Valeriana officinalis	- plants with hoeing - cereal - very clean	- 60- 70	50- 60	35- 40	28- 30	-disk -harrow -roller	X-XI 4-6	50	0.5- 1	-hoed -weeded	at the end of vege- ta- tion	manu- al with sickle	at sha- dow t max 35- 40°C	at dryed roots (4-5: 1)	1200- 1500		

Quantitative determinations of essential oils

No.	Botanical name	Part used	Aspect	% essential oil
1.	<i>Lippia Javanica</i>	Herba	semidried	1.5
2.	<i>Notholaena eckloniana</i>	Somitate	dried	0.2
3.	<i>Lantana rugosa</i>	Herba	green	0.05
4.	<i>Tagetes minuta</i>	Herba	green	0.4
5.	<i>Croton gratissimum</i>	Leaves	semidried	0.75
6.	<i>Chenopodium bontel</i>	Herba	"-	0.2
7.	<i>Rosmarinus officinalis</i>	Somitate	"-	0.6
8.	<i>Cymbopogon plurinoides</i>	Herba	dried	1.0
9.	<i>Ocimum sp.</i>	Herba	green	0.3
10.	<i>Ocimum camum</i>	Herba	dried	0.4

Qualitative determinations of the main groups of active principles ~~found~~ identified in the plants growing in the spontaneous flora

Botanical name	lan-taha rugosa	Not-ho-lae-na eck-loni-ana	Cony-za stri-cta	Tarcho-lantus campho-ratus	Gompho-carpus fructi-cosus	Ehus lepto-dictya
Part used	Herba	Sumi-ta-tes	Sumi-ta-tes	Sumita-tes	Herba	Herba
<u>Active principles</u>						
essential oil	+	++		++		
alkaloids bases						
fat acids			++	+++		
Coumarins derivates						
flavone aglicones			+++	++++		
emodins			++++	+		
carotenoides	+++					
sterols	+++	+++	+++		+++	+++
triterpenes				++++		
gallic tannin						
catecholic tannin	+++	++++	++	++++	++++	
reducing compounds	+++	+++	++	+++	+++	++
alkaloids salts						
anthraceno-sides			+++		+	
coumarins						
steroidal heterosides	+++	++	+++		++	++
triterpen-heterosides						
flavonosides	+	+++	++	+++		
antocianocides	++					
polyuronides	++				++	
polyose saponosides		+++	+++	++	+++	++

STANDARD USAGE

Contains :

- COLIUM STEROMONII 100 gr.
- Sodium hydrochloride 10 ml.
- Alcohol ethylicus 70° q.s. ad. - 1000 ml.

Therapeutic effects : The product is antispasmodic and light laxative, diminishes intestinal secretions and peristalsis, reduces the spasms of the smooth muscles and especially of the bronchial muscles.

Indications : to be used for the treatment of smooth muscles spasms, biliary distensions, colic, asthma and emphysema.

Contraindications : Costiveness, atrial fibrillation, stenosis, prostate

Dose : Adults : 1 ml. once, 3 ml. in 24 hours

- Children : 1-5 years : 2 drops once, 4 drops in 24 hours
- 3-5 years + 3 drops once, 10 drops in 24 hours
- 6-10 years : 5 drops once, 20 drops in 24 hours
- 11-15 years : 10 drops once, 20 drops in 24 hours

List

of equipment for the extraction and distillation
pilot unit

No.	Denomination	Quantity pieces
1.	Percolater Capacity: 30 l Material : stainless steel	1
2.	Manual press for waste plants Capacity: 25 Kg	1
3.	Concentrater (Rotavapeur type) with vacuum pump and electrical heating Capacity : 10 l Material : glass	1
4.	Receiver and sedimentation vessel for vegetal extracts Capacity : 50 l Material : stainless steel	2
5.	Distillator of essential oils with refrigerator, florentin vessel and electrical heating Capacity : 100 l	1
6.	Vessel for the preparation of syrups with heating jacket and stirring system Capacity : 300 l Material : stainless steel	1
7.	Press filter - frame 20/20 cm	1
8.	Balance 5-100 Kg	
8.	Pump - H = 4 m, stainless steel Pipes, fitting and taps	1

Total estimated cost including 10%
for transport :

\$45,000.-

United Nations Industrial Development Organization

Project proposal

Part A - Basic data

Country: Republic of Botswana	Project title : Assistance
Project no :	programme for the
Scheduled start: May 1980	valorization of
Scheduled completion : 1981	medicinal and
Origin and date of	aromatic plants
official request:	in order to pre-
	pare medicines.
Government counter -	UNIDO contribution:
part agency:	Government contribution:
Proposal submitted by:	Currency required:
Date of submission :	For UNIDO input: \$138,000.-
	Convertible : \$138,000.-
	Other
	UNIDO substantive
	backtopping section: Chemical
	Industries
	Programme component Section
	Code

x

x

x

Part B - Narrative

1.- Background and justification

The development of traditional medicine based on available medicinal plants in developing countries is one of the very important programme of UNIDO. Several programmes for different developing countries have been designed and some of them are already under implementation. The utilization of medicinal plants has always been known and the majority of the population

of the developing countries are using extracts or dry herbs for accuring many tropical and epidemic diseases. Due to the increase of medicines demand in the world and in the developing countries, it merits attention to explore the possibility of manufacturing pharmaceutical products on a more economical basis, based on medicinal and aromatic plants.

The flora of Botswana is very rich in medicinal and aromatic plants and therefore it is worth to process these plants in order to get extracts and essential oils.

In January 1978 UNIDO organized an exploratory mission in Botswana under the project EP/RAF/77/05 to collect information and data on the available facilities for the setting up of a pharmaceutical industry.

Following this mission a team of UNIDO experts was sent to Botswana in January 1980 to collect samples of medicinal and aromatic plants for quantitative and qualitative determinations of active principles as well as ~~for~~ to ^{demonstration of} perform the possibility of preparing locally pharmaceutical products based on these active principles, in co-operation with the local specialists.

The UNIDO team activity has been carried out in the laboratory of the "Agricultural research station" Gqberone belonging to the Ministry of Agriculture. The pharmaceutical preparations and the results which have been got during the investigations in the field and the laboratory activity had to favourable conclusions concerning the establishment of a small scale production of pharmaceutical preparations based on the raw materials available in Botswana under the condition of a further assistance programme.

2. Objectives

2.1. Development objectives

The programme will lead to the establishment of an extraction and distillation pilot unit for plants which are available locally. Furthermore, the extracts of plants will be used to formulate pharmaceutical preparations which will be incorporated in the health programme of the country.

The establishment of such unit will lead to economic benefit and to the creation of a labour intensive industry which will benefit the farmers since these plants are not currently exploited.

2.2. Immediate objectives

- a) Training of the local personnel in the valorization of medicinal plants.
- b) Development of methods to prepare medicines based on medicinal and aromatic plants.

3. Project outputs

- Government policy on the development of a pharmaceutical industry based on medicinal and aromatic plants available locally.
- A survey on the quantity and quality of the natural resources in this field.
- Development of the research work on the medicinal plants and their use in the pharmaceutical industry.

4. Project activities

The main activities of the project are the following :

- 4.1. Training of the local personnel in the field of culture and processing of medicinal and aromatic plants in order to get medicines. UNIDO will organize a training course

in a country with a large experience in the processing of medicinal plants and their use in the pharmaceutical industry during 1980 (approx. 6 weeks). It is advisable to designate 3 fellowship holders (botanist, analyst and pharmacist).

4.2. International experts to train locally the Botswana specialists to evaluate the quality and the quantity of medicinal and aromatic plants available in Botswana as well as to develop the research and production activity in the field of manufacturing pharmaceutical products based on medicinal plants.

Period : 1980-1981 (See Annex I).

4.2.1. - one botanist to evaluate the quantity of medicinal plants especially in Ngamiland and Kgalegadi districts - Period : 6 months. (November - April)

4.2.2. - one analyst to carry out quantitative and qualitative determinations of active principles. Period: 6 months

N.B. The arrival of analyst in Botswana has to be conditioned by the supplying of laboratory equipment already ordered by UNIDO, following the proposal of the exploratory mission which visited Botswana in January 1978. The first 3 months of his mission has to be overlaped with the last 3 months of the botanist's mission.

4.2.3. - one technologist to develop the adequate technologies to process the medicinal plants selected by the analyst as valuable ones from therapeutical point of view. Period: 6 months.

N.B. The first 3 months of his mission has to be overlaped with the last 3 months of the analyst's mission.

Before the arrival of the technologist in Botswana, he has to be informed about the

results of the analyst's activity.

His arrival in Botswana has to be also conditioned by the supplying of the equipment of the extraction and distillation pilot unit - see paragraph 4.3. The technologist has to supervise the assemblage of the pilot unit equipment.

4.3. Supplying of the equipment for an extraction and distillation unit to process medicinal and aromatic plants. - See Annex IX.

5. Project inputs

5.1. The UNIDO contribution will be the following:

	<u>Estimated budget in \$</u>
5.1.1. Fellowships for the local personnel to be trained in the frame of the training course which will be organized by UNIDO during 1980 (approx. 6 weeks)	
- 3 fellowship holders x 4000 \$	12,000.-
5.1.2. International experts	
Period : 1980 - 1981	
- 3 experts x 6 months = 18 m/m	
18 m/m x 4500 \$/m	81,000.-
5.1.3. Supplying of the pilot unit equipment for extraction and distillation of medicinal and aromatic plants (See Annex IX)	45,000.-
	<hr/>
Estimated assistance cost :	\$138,000.-

5.2. The Government of Botswana will make available :

- Necessary space (room) for the setting up a pilot unit (5 m x 5 m) including the assemblage of the equipment
- National personnel for the laboratory works and the operation of the pilot unit.
- Raw materials (medicinal and aromatic plants) and ingredients for the preparation of pharmaceutical products based on medicinal plants.

Programme of main activities

0 1.5 3 4.5 6 7.5 9 10.5 12 13.5 15 months

6 weeks

Training of local personnel (para.4.1.)

Botanist - 6 months (para.4.2.1.)

Supplying of lab. equipment (para.4.2.2.)

Analyst - 6 months (para.4.2.2.)

Supplying of pilot unit equipment (para.4.2.3.)

Technologist - 6 months (para.4.2.3.)



