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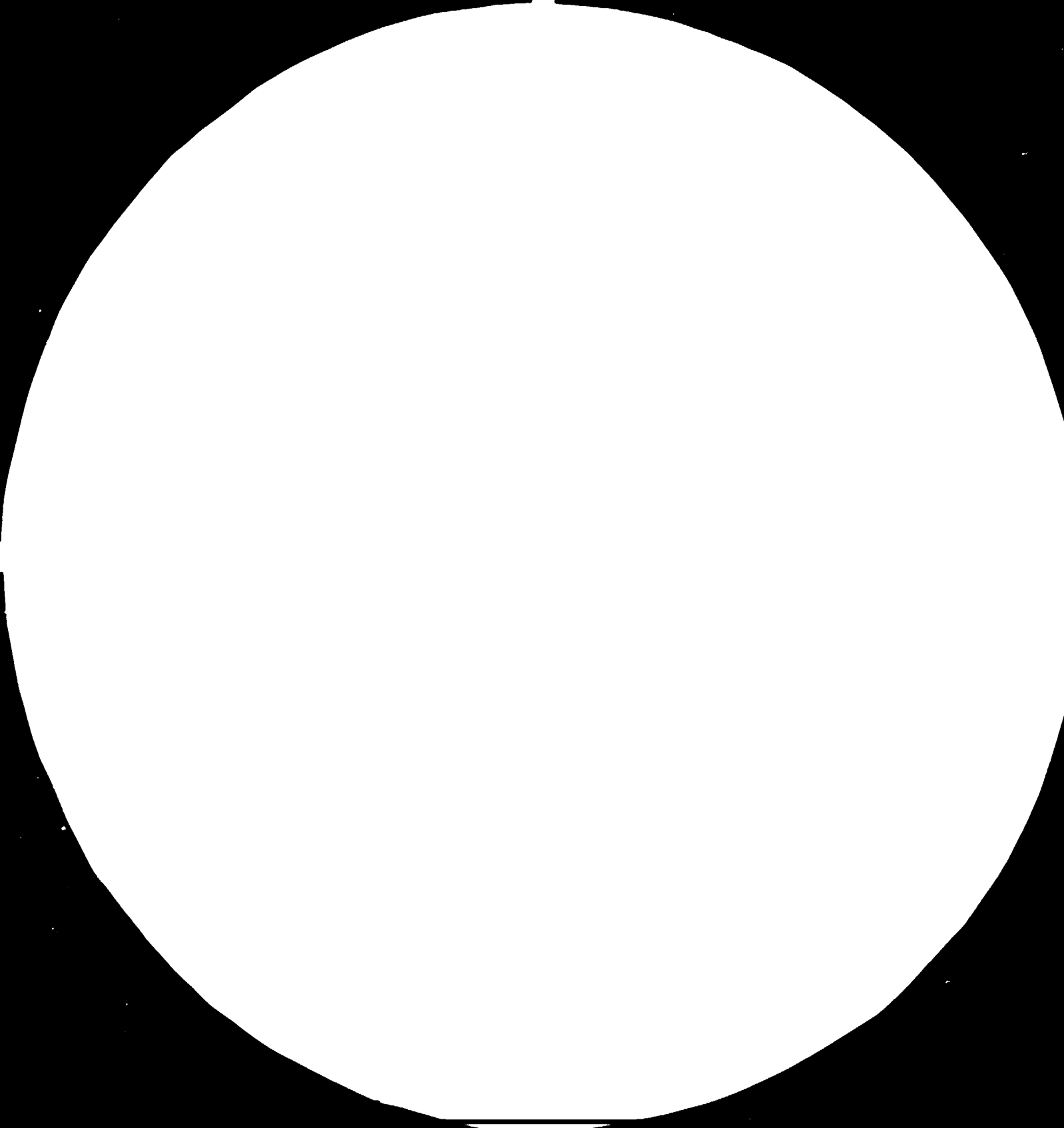

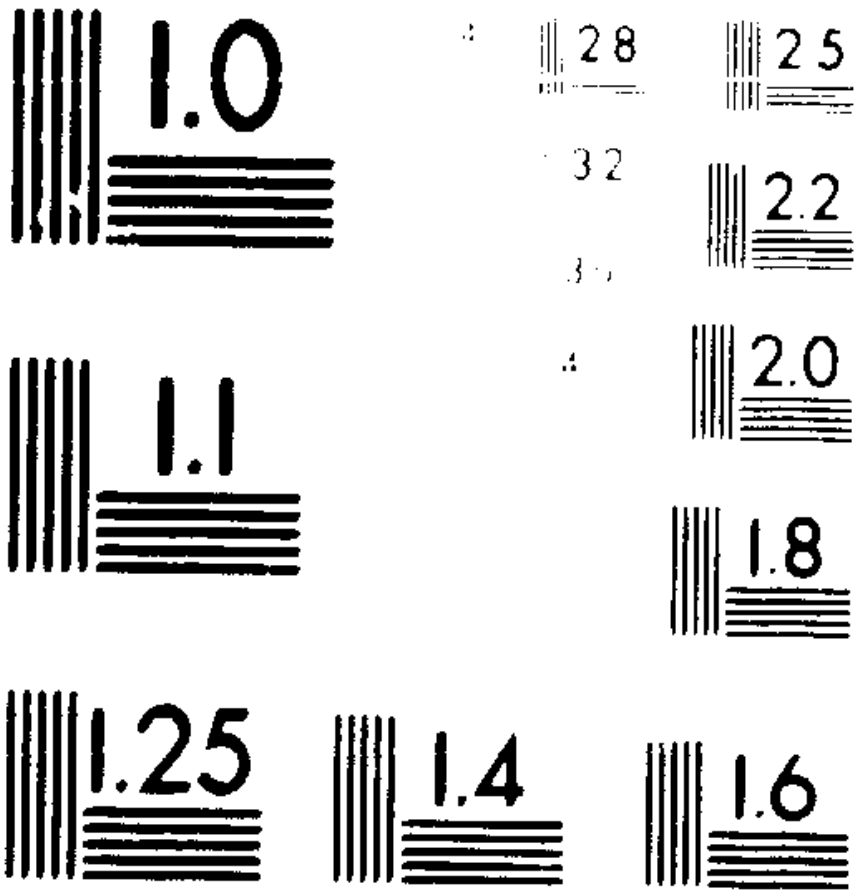

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23 June 1983
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Botswana.

SURVEY OF THE POTENTIAL FOR PLANT - DERIVED PHARMACEUTICALS AND MEAT BY-PRODUCTS .

RP/BOT/82/001

BOTSWANA

Terminal Report *

Prepared for the Government of Botswana
by the United Nations Industrial Development Organisation
acting as executing agency for the United Nations Develo Programme

Based on the work of Dr. A.D.V. de S. Indraratna, Industrial Economist
and Prof.O.Scedrov, Expert in the Production of Opotherapeutic Products

United Nations Industrial Development Organization
Vienna

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A B B R E V I A T I O N S

B D C	=	Botswana Development Corporation
B M C	=	Botswana Meat Commission
C E C	=	Commission of the European Communities
C F T C	=	Commonwealth Fund for Technical Cooperation
E D F	=	European Development Fund
E E C	=	European Economic Community
G B O	=	Government of Botswana
G D P	=	Gross Domestic Product
J P O	=	Junior Programme Officer
M C I	=	Ministry of Commerce & Industry
M F D P	=	Ministry of Finance & Development Planning
N D B	=	National Development Bank
N D P	=	National Development Plan
R S A	=	Republic of South Africa
S A C U	=	South African Customs Union
S A D E C C	=	Southern African Development Coordination Committee
U N D P	=	United Nations Development Programme
U N I D O	=	United Nations Industrial Development Organization

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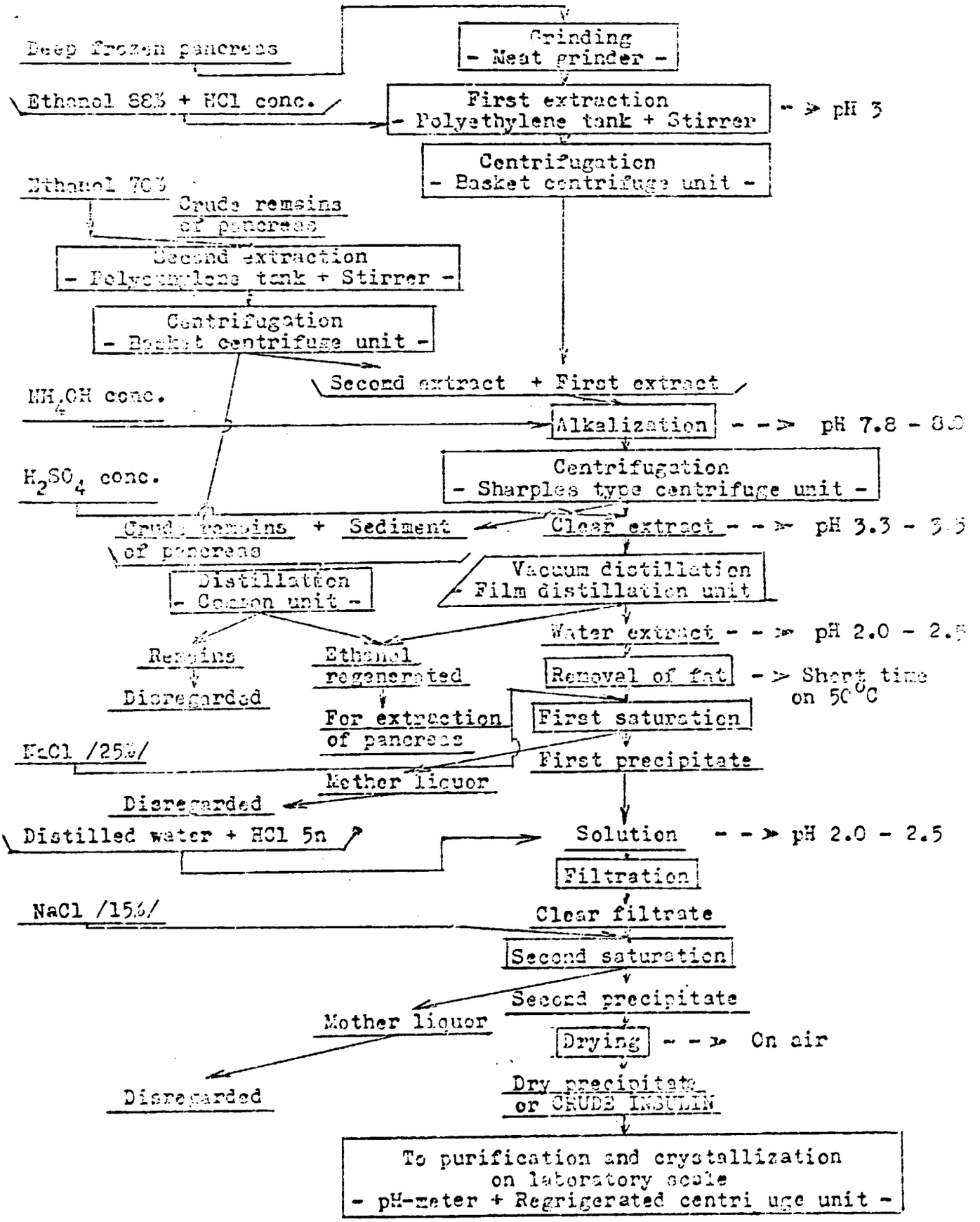
FLOW CHART 1 General review of insulin manufacture



I. INTRODUCTION

I. 1. Background to the Mission

I. 1. 1. The mobile unit of Pharmaceutical and Essential Oils Industry in the Least Developed countries of Africa made an exploratory mission to Botswana during 1 - 6 January 1978 under the Project RP/RAF/77/015. This misssion recommended two main areas of activity namely utilisation of medicinal plants for production of pharmaceuticals and the development of pharmaceutical by-products from the meat industry in conjunction with the Botswana Meat Commission (BMC). The second recommendation later crystalised into a request by the Botswana Government for a technical consultancy to make a techno-economic survey of the production of opotherapeutic products in the country. This request was incorporated in the project proposal of RP/BOT/82/001/11 which had the approval of the Government.

I. 1. 2. The main development objective of the project was to promote the socio-economic development of the country by the optimum utilisation of its natural resources. To this end, the project contained two specific objectives. The first was to field a 4 m/m mission of an economic botanist to assess the possibilities for utilization of the flora for deriving pharmaceutical products the discussion of which is not within the scope of this report. The other was "to field a mission of two experts for a two month's period to make a techno-economic survey and evaluation of the potential for making pharmaceuticals from the by-products of the Botswana Meat Industry" (Vide Annex 7.1).

I. 1. 3. As the expert in opotherapeutic production first chosen by UNIDO could not make himself available in December 1982, for which the joint mission was scheduled, the Industrial Economist had to visit Botswana alone and he submitted a preliminary report on his mission to UNIDO. The new expert in opotherapeutic production selected by UNIDO visited Botswana from 4 February - 4 March and submitted a separate technical report. Since the two experts could not undertake the mission

jointly, as was originally envisaged, it was decided that they should meet together in Vienna for ten days to review their findings and submit this joint final report.

I. 2. Field work of the Mission

I. 2. 1. The Industrial Economist was in the field for three weeks while the expert in opotherapeutic production was a little longer for four weeks. Initial discussions were held with the Resident Representative and his Deputy and one of the Junior Programme Officers of the UNDP Office in Gabarone and the Secretary and the Director of Industrial Affairs of MCI and his junior colleagues. Calls were made on the Principal Pharmaceutical Supply Officer, Central Medical Stores, the Chief Medical Officer and the Chief Pharmacist of the Ministry of Health, the Director and the Deputy Director of Veterinary Services, the General Manager, Botswana Vaccine Institute and other Government officials and private entrepreneurs whose operations were considered relevant to the work of the mission. The expert on opotherapeutic production also had the opportunity of discussing the objective of the mission with the WHO expert stationed in Botswana.

I. 2. 2. The Industrial Economist made two visits and the expert in opotherapeutic production one visit to the BMC in Lobatse. They respectively had discussions with Mr. Laker the Marketing Manager and Mr. Harvey, the General Manager. A tour was made of the abbattoir, the tannery and the cannery which are sited not far away from the abbattoir. This gave a very good insight into the entirety of operations of the BMC and the meat and meat by-products produced and marketed by it.

I. 2. 3. Visits were also made to and discussions were held with the relevant parties of the BDC, NDB, Botswana Technology Centre, the University Departments of Economics and Chemistry and National Institute of Development and Cultural Research, Botswana Agricultural College and others who may be connected with provision of supporting finacial and institutional facilities for a potential opotherapeutic industry.

The expert on opotherapeutic production also made a visit to Princess Marina Hospital. Before leaving for Gabarone, meetings were also held in the MCI to "debrief" some of the members of the Ministry of the field work of the mission. The complete lists of institutions visited and persons interviewed are respectively contained in Annexes 7.3 and 7.4.

I. 3. Content of the Report

I. 3. 1. This report contains seven sections. After this Introduction, a summary of the findings and recommendations is given in Section II. The substantive sections containing the findings are respectively entitled the (III) Present Position of the Opotherapeutic Industry, the (IV) Survey of the Production Potential of Opotherapeutic and Related Products, the (V) Constraints on the Establishment of Opotherapeutic Industries and (VI) Follow-up Action including two Project Proposals. The last Section (VII) contains the Annexes.

II. SUMMARY OF FINDINGS AND RECOMMENDATIONS

2.1 The long-term sustained economic development of Botswana must largely depend on its livestock industry. The BMC which handles about 85% of the offtake of cattle cannot be separated from the livestock industry of the country.

2.2 The BMC operates the Abbattoir in Lobatse with a maximum capacity of 1,800 on the slaughter line. Its daily slaughter today averages 1,200 cattle with an annual average of slightly more than 200,000. With the commissioning of the abbattoirs at Maun in February 1983 and the proposed one at Francistown in 1985 or 1986, the capacity is expected to increase by 30% - 40%.

2.3 The BMC in 1981 produced meat and meat products to the value of about P 90.0 million. More than 95% of it was exported, the domestic market being very very small.

2.4 The expansion of the Livestock Industry must take the form of increasing value added to its by-products, viz, the establishment of secondary industries, based on meat by-products of the BMC, which are relatively labour-intensive. This is in accord with the goals of the NDP.

2.5 The BMC exports several by-products which can be further processed and value-added increased before their exportation. Some of them are sources of raw material for pharmaceutical products.

2.6 Raw materials for pharmaceutical products may be derived from some ox organs which are now exported as edible offals and the glands which now go into the making of carcass meal, and blood which go into bloodmeal, which are also exported. Ox testicles which provide the raw materials for hyaluronidase are also exported to USA for making pharmaceuticals.

Hide trimmings inclusive of ears, hooves and horn pith, are other raw materials for pharmaceutical products. Their exports weigh 4,500 tons (rounded off to approximate figures). All these raw materials would increase by 30% - 40% when the other two abbattoirs of Maun and Francistown are in full operation.

2.7 (i) Crystalline Insulin and Pancreatin,
(ii) Haemoglobin and amino acids and albumin
(iii) Gealtin and
(iv) Hyaluronidase, are products which can be respectively turned out from (i) Pancreatic glands (ii) blood (iii) hide trimmings, hooves and horn pith etc. and (iv) ox testicles.

2.8 The establishment of industries to manufacture them is recommended because (i) the technology required for their production would not be highly capital-intensive and also their market prospects seem relatively good (Section V).

2.9 The BMC is in the best position to undertake these secondary industries because it has the raw materials and a certain (already existing) infrastructure and marketing expertise.

2.10 In order to promote the setting-up of these industries, it is recommended that the BMC transfers at least a part of its surplus to an Investment Promotion Fund without redistributing among the cattle producers in the form of higher producer prices and bonuses.

2.11 Either the BMC can utilize this Fund to establish the opotherapeutic industries on its own, or to subsidize the raw materials supplied to other entrepreneurs (2.12 below), willing to undertake them.

2.12 If the BMC is not responsive enough as per 2.11 above, the Government should give approval to reputed Foreign Companies with their own marketing expertise to come over to Botswana and invest in these industries. The BMC should be able to guarantee a regular supply of raw materials to them at prices lower than their f.o.b. prices (vide the case for pancreas in

Section IV).

2.13 With Botswana's liberal foreign exchange and trade policies foreign investors, as is already evident, would not be reluctant to come in and invest in economically viable projects.

2.14 In this context, the MCI and the Goverment should explore the possibility of getting foreign companies, already in possession of the required technology and marketing expertise to set up factories manufacture products on a joint venture or management contract basis.

2.15 It is also recommended that the UNIDO help the MCI to obtain a list of international firms who produce the specific opo-therapeutic products so that they can be approached with a view to promote foreign investment in the production of such products.

2.16 The third alternative is for the BDC to undertake such industries either singly or jointly with local or foreign enterprises. Moves have already been evident in this direction.

2.17 The MCI should seek the assistance of the UNIDO to have a team of two, an Opotherapeutic production specialist and an Industrial Economist to complete detailed feasibility studies in respect of each one of these potential pharmaceutical/opotherapeutic industries.

2.18 The Research and Promotion Unit of the MCI should be expanded in scope to include industrial planning as well and it should have eventually among its core staff a Commercial Engineer and an Industrial Economist and Project/Financial Analyst.

2.19 This Unit should be able to evaluate the feasibility of any project, an application for approval/licensing of which is submitted to it.

2.20 The experience of the development of technology at the vaccine institute may help and may be utilised in the development of technology for the production of pharmaceuticals based on meat-by products.

2.21 For this purpose action should be immediately initiated to set up a research division at the Vaccine Institute.

2.22 Botswana today has not a single bio-technologist, whose services could be utilized in the establishment and running of an opotherapeutic factory. The Botswana Government should accept the assistance of UNIDO for two fellowships to have two local bio-chemists in biotechnology for one year in a country with advanced "opotherapeutic technology".

III. PRESENT POSITION OF THE OPOTHERAPEUTIC INDUSTRY

3.1 The Key Role of Livestock Industry

3. 1. 1. A mainstay of the Botswana Economy, only second to Diamond Mining in recent years, is the livestock industry. While it contributes between 15 - 20% of the GDP of the country, the bulk of the country's population depends on it for their sustenance. The national herd of Botswana comprises of both commercial ranches and small farmer ownerships, the latter accounting for more than half[1]. In 1981, the national herd was estimated at 3 million in comparison with Botswana's human population of less than 1 million (936,000 according to 1981 census). This ratio of less than 1:3 is one of the lowest in the world. The national herd is expected to grow to its optimum size within this decade[2], while some experts on the subject even think that it has already reached it.

3. 1. 2. The importance of the livestock industry from the overall development of the country cannot be overemphasised. The BMC with nearly P 90.0 million annual sales (in 1981) is the largest enterprise in the country and is almost identical with the livestock industry. Until the end of 1982 it handled around 85% of the total offtake of cattle and managed the only abbattoir in the country but the biggest and most up-to-date in Africa, having a maximum capacity of 1,800 on the slaughter line per day. Its daily slaughter averages 1,200 with slightly more than 200,000 (202,000 in 1981) per year.

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[1] Nearly 60% of the cattle slaughtered by the BMC comes from traditional sources, in contrast to commercial ranches. Judged bu this small ownerships must be substantially more than half. GOB and CEC (EDP) -"An Evaluation of Livestock Management + Production in Botswana". Final Report Jan. 1982 Vol. II p.2.26

[2] With 10% offtake with the present rate of growth of the herd, the optimum level of 4.0 million will be reached by 1990. ibid p.2.22.

3. 1. 3. The second abbattoir at Maun was commissioned in February 1983 with a daily capacity of 100 and the third proposed at Francistown with a capacity of 400 is expected to be completed by 1986. Almost all meat[1] and meat by-products of BMC, nearly 95% are exported, contributing nearly one-quarter of the total exports of the country and the BMC employes more than two-fifths of all formal sector manufacturing workers. By about 1986, with all three abbattoirs in full swing, the total capacity of the BMC should increase by about 30% - 40% over its 1982 level and the role it could paly in the industrial development of the country should be correspondingly enhanced.

3.2 Work of the BMC

3. 2. 1. The BMC makes full use of the offtake of cattle which it slaughters. Except perhaps for the stomach contents, nothing goes to waste. Nearly 70% of the carcass (deboned) is exported as vaccum-packed, chilled or forzen beef to the EEC and the RSA. The remainder is semi-processed or even processed and exported except for a few items such as the epithelium of the tongue, ox testicles,gall and gallstones and horns (excluding pith). While the epithelium of the tongue is processed into animal vaccine at the Botswana Vaccine Institute, the latter items are exported in their primary state (in some cases with water extracted - see Table).

3. 2. 2. Hides are processed into "Wet Blues" at the Tannery of the BMC and exported to the RSA and EEC (Italy). Corn-beef is manufactured out of manufactured grade carcasses (not good enough for taking vaccum packed or chilled or frozen beef) and meat trimmings. Pet-food is turned out of meat and lungs, livers and other offal condemned as not fit for human consumption and canned at the BMC cannery. The tannery and cannery are both situated not far away from the abbattoir. Glands such as the Adrenal and the Pituitary and Pancreas and intestines along with horn pith and hooves are

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[1] There is a proposal to increase this to 600 with a corresponding reduction at Lobatse.

processed into carcass meal and is exported. The bone-meal made mainly out of bone is retained as feed for domestic cattle. The blood is processed into blood meal for export to the RSA and other African markets for making animal food. Table I gives a list of BMC meat and meat by-products with their derivation and destinations.

Table I

Name of Product	Derived From	Qty. exported produced in 81	Destinations	End Use
1. Vaccum packed beef	Deboned carcass beef	24,453 (tons)	EEC RSA,EEC	consumption
2. Frozen beef			EEC	consumption
3. Chilled beef				consumption
4. Carcass Meal	mainly condemned meat and offal + glands, horn pith + hooves + intestines*	4,733 (tons)	RSA	making dog biscuits + components for other animal food
5. Hides-"Wet Blues	Raw Hides	4,526 (tons)	RSA,EEC - (Italy)	making leather goods
6. Tallow	Fat	3,698 (tons)	Zimbabwe, Zambia	manufacture of soap
7. Bone Meal	mainly bones	2,456 (tons)	Home Market	Cattle Feed
8. Hide Trimmings	Raw	1,179 (tons)	RSA	manufacture of Gelatin
9. Corned beef (canned)	"manufactured grade" carcass + meat trimmings	2,261 (tons)	EEC(UK)	human consumption
10. Edible offal	liver, kidney heart, tongue etc.	1,600 (tons)	RSA(72%) domestic(24%) other (4%)	consumption
11. Blood meal	Blood	608 (tons)	RSA, Zambia Mozambique Mauritius	Animal food
12. Beef-extract	by-product of corned beef	47 (tons)	EEC (UK)	manuf: Bovr:
13. Horns minus Pith	Raw	85 (tons)	Japan EEC (UK)	manufa re of curios and other decoratives
14. Cattle vaccine	Epithelium of tongue	Not available	Domestic	cattle (dom.)
15. Ox Gall	Raw (water extracted)	7 (tons)	EEC (Germany)	Not available
16. Spinal cord, Gall stones + tendon	Raw (water-extracted)	Not available	Hong Kong	traditional med./consumpt.
17. Testicles	Raw (water-extracted)	Not available	RSA	Pharmaceutical use
18. Foetal blood/ Serum	(Frozen) Raw	Not available	RSA,EEC(France)	Vaccine making
19.(Canned pet food)	condemned meat + condemned organs	Not available	RSA	Pet food

Source: BMC 1981 Annual Report + Interview with BMC Marketing Manager

* Note: Some of it exported as tripe to Zaire and other African countries.

IV. SURVEY OF THE PRODUCTION POTENTIAL OF OPOTHERAPEUTIC AND OTHER RELATED PRODUCTS

4.1 The Need for Opotherapeutic Industries

4. 1. 1. It has been stated in the preceding Section that the long-term sustained growth of Botswana would have to depend to a large extend on the livestock industry. The national herd is nearing it optimum size limited by the carrying capacity of Botswana's range and therefore the expansion of the livestock industry should take the form of maximising the value added to its products, in addition, of course to the better management and increasing the offtake of the existing herd. This necessitates investment in secondary industries to further process the BMC meat by-products before their export, thereby increasing both the GDP and employment.

4. 1. 2. The establishment of secondary industries based on meat by-products in addition to eventually enhancing the prices payable to cattle producers, has better "spread" effects and linkages. This is one of the main ways by which the benefits of the expanding livestock industry can also trickle down to the masses and the present very highly skewed income distribution of the country can somewhat be reduced. It will therefore be quite in accord with the twin objectives of the NDP of 1979-1985 of increasing domestic employment and reducing rural poverty. It also should increase the foreign exchange earnings and stablize the balance of payments by increasing the value added to exports relative to the increase in import content. (Feasibility studies that would be undertaken relating to potential opotherapeutic products should examine this).

4.2 BMC's Pricing Policy

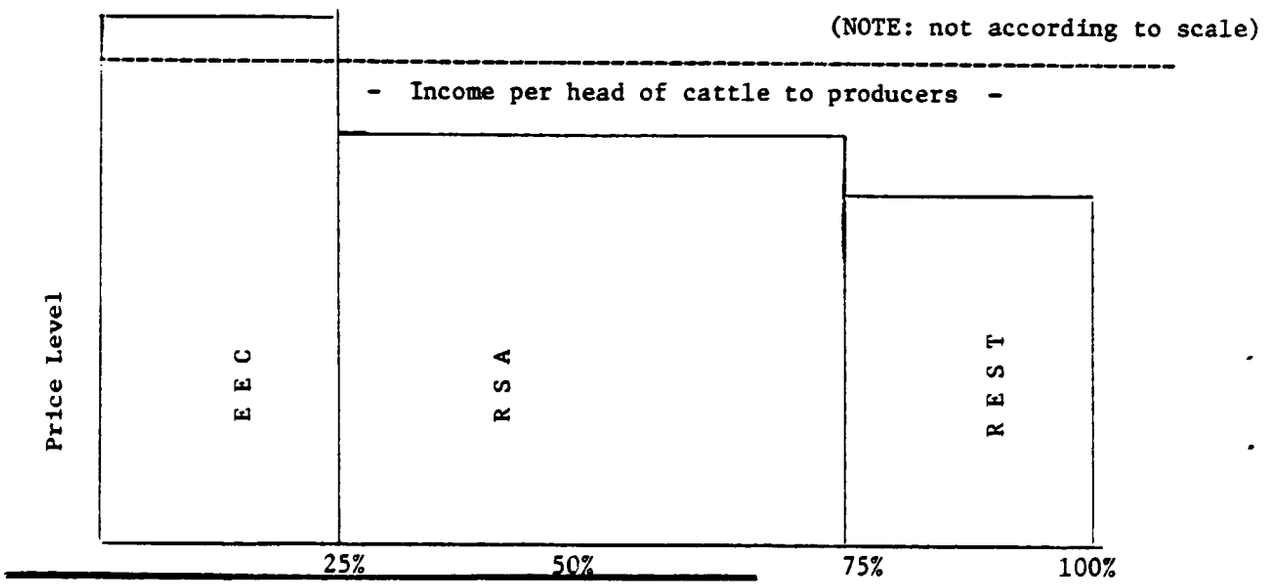
4. 2. 1. The BMC is a "co-operative" of cattle producers. Both is production and pricing policies have, therefore, been guided primarily by their interests. At present its policy is to sell its products to the highest bidder either at home or abroad. However, the quantity which the domestic market can absorb is very very small and the price it can afford relatively low.

4. 2. 2. Botswana, as a signatory to the Lome II Convention has privileged access to the EEC market. It not only receives from the EEC for its meat products prices much higher than what the rest of the world offers but also gets 90% rebate of the export levey on them. Being a member of the SACU, it also receives from the RSA prices higher than world prices. These two markets respectively account for nearly one-quarter and one-half of the BMC products[1]. The remainder is sold to the African and other markets at lower prices. As shown in Diagram I, the actual prices paid to the cattle producers are kept substantially very high by redistributing to them in the form of higher producer (cattle) prices and bonuses, whatever surpluses accrue to the BMC by way of higher export prices and rebate of export levy. For example in 1981 a bonus of 7.6% was paid in addition to an increase of 15% in producer prices and even in 1982 a decision had been taken to increase the producer prices by 10% and to pay a bonus of 15%. Between 1971 and 1980 also prices had been increased by 172%[2].

4.3 Meat by-products of the BMC and their Opotherapeutic Potential

4. 3. 1. In the context described above, there does not seem to have been much inducement for the BMC to consider the establishment of secondary industries based on its by-products.

Diagram I



[1] The respective percentages for boneless beef + edible offal were 21% and 45% in 1981. They are likely to increase to about 25% and 50% respectively when meat by-products are added. Compiled from the data contained in the BMC 1981 Annual Report.

[2] "An Evaluation of Livestock Management and Production in Botswana" op. cit. p. 2.28

4. 3. 2. We have listed in Table I in the last section the meat by-products of the BMC. (i) Carcass meal is mainly processed condemned meat and offal and glands, horn pith and hooves. (ii) Tallow is an intermediate product made out of fat. (iii) Hide trimmings inclusive of ears are exported to RSA for manufacture of Gelatin. (iv) Beef extract, a by-product of corned beef is exported to the United Kingdom for making Bovril and blood is processed into Blood meal and exported to make animal food. Table I also shows that these by-products, except perhaps Beef Extract (only 47 tons in 1981) are obtained in significant volume. After the other two abbattoirs become fully operative their raw materials would correspondingly increase by about 30% - 40%.

4. 3. 4. The availability of local raw material in sufficient quantity is an important criterion of what secondary industries should be set-up in a developing country like Botswana. There are also other equally important ones. The type of technology required and the marketability of the product are two of them. In order to accord with the goals of the NDP, those industries which require less sophisticated and less capital intensive technologies should be preferred. Botswana's domestic market is very small (see below) and will have to always look outward to export markets. Therefore, quality-wise and price-wise, the products it manufactures should be internationally competitive. The location of factories close to places of raw materials is also important, but our view is that (see below) there should be no difficulty in siting the factories in proximity to the abbattoirs as it has been already demonstrated in the case of the BMC tannery and the cannery. All these criteria, in any case, have to be carefully considered in feasibility studies of the respective products.

4. 3. 5. At present secretal glands such as the adrenal and the Pituitary glands, from which basic substances for making Epinephrine (interior of adrenal) and Vasopressin respectively go into carcass meal. The exterior of the adrenal gland and ox organs like the kidney exported as edible offal provede basic substances for steroids and hormones.

4. 3. 6. There are several opotherapeutic products which can be turned out from the meat by-products. A description of these products is given below and which can be justified on the grounds of availability of raw materials, technology required and prospective markets. Today the pancreas which provides the source of material for insulin goes into carcass meal. Botswana, as the experts were informed, can provide about 50 tons of pancreas. Hide trimmings, hcoves and horn pith are exported ad by-products for further processing, weigh 450 tons and can provide the raw material for Gelatin production. Blood, which goes into blood meal, may be more than 2000 tons per year and could provide enough raw material for viable production to Botswana (see section 4.4). The position of these raw materials would improve with the full commissioning of the other two abbattoirs in Maun and Francistown.

4. 3. 7. As long as the increase in value added to the by-products presently exported is more than the increase in import content, they are socially beneficial. As long as industries processing them could use relatively less captial-intensive technology they could create domestic employment as well. If the difference between the increase in added value (say ΔO_n) and the increase in import content $(\Delta M_c)^1$ is greater than the increase in domestic costs (ΔW) it should be even comercially viable on the basis of private profit.

4. 3. 8. All our findings should be subject to detailed feasibility studies of the manufacture of each of these products identified here. (See next Section). We recommend in this context that a team of two comprising an opotherapeutic production specialist and an Industrial Economist be stationed at the MCI for twelve months to complete these feasibility studies. They will have to have due regard not only to the availability of raw materials and consequent input-output calculations and market prospects of their final products but also to the elimination of several other constraints on the economic viability of their production. They also should examine more specifically the possibility of pooling with those of Botswana the respective raw materials of the three other countries of Zimbabwe, Lesotho and Swaziland, free of foot-and-mouth disease, especially for the production of insulin and gelatin. They also should estimate the market potential for these products, if all SADECC countries are taken together as a whole. The discussion of some of these constraints will now be undertaken in the next section.

4.4. Proposed Opotherapeutic Products

4. 4. 1. At first, it would be relevant to clarify what we mean by "opotherapeutic products". This is an old term for a raw extract from animal organs and glands. Current products gained from animal sources and used as pharmaceuticals and drugs are mainly chemically pure substances, like insulin, heparin, hyaluronidase. "Bioactive substances from animal sources" would perhaps have been a better term.

4. 4. 2. Opotherapeutic products in this survey, therefore, would be taken to cover the following wider group of potential products derived from meat by-products:

- Insulin
- Pancreatin
- Albumin and amino acids mixture from blood
- Gelatin and
- Hyaluronidase

Some of them, albumin, amino acids and edible gelatin do not belong to the category of drugs in the strictest sense, but they can be included here as chemically pure substances obtained from animal sources and used in foodstuff industry or as comestics.

4. 4. 3. According to data collected from scientific literature, personal experience and with several specialists in Yugoslavia (Annex 7.3) the insulin hormone is considered as a drug of great importance produced from animal by-products. The only raw material is pancreas of cattle and pigs slaughtered for human consumption. It must have at least 30% dry matter and 70% water. There should not be more than 10% of fat in the pancreas.

4. 4. 4. One can get from 1 kg of pancreas of:

- Cattle to 5 years	2500 units of insulin
- Baby beef/ 18 to 30 months	3500 to 4000 units
- Calves	8000 units and
- Pigs	2500 to 3000 units

About 200 tons of pancreas per annum are needed for economic viability of insulin production (Annex 7.3.1.1, 1.2).
One bovine pancreas weighs about 170 gr and in one kg there

are about six pancreas glands. For 200 tons of pancreas, 1,200,000 head of cattle need to be slaughtered. If there are 250 workdays per year that would be 4,800 cattle per day. On the other hand as one pig pancreas weighs 60 gr, the same calculation gives 16 pancreas glands in one kg. For 200 tons corresponding figures would be 3,200,000 pigs or 12,800 per day.

Today the pig pancreas is preferred (for instance the firm Novo, Denmark) as pig insulin differes from human in only one amino acid. The terminal amino acid in B-chain of pig insulin is Alanine and in human it is Threonine. This can be changed by methods of organic synthesis and human insulin so obtained is called "synthetic insulin". As a matter of fact the major manufacturers of insulin still use bovine pancreas (Annex 7.3) because of lesser fat content, lower price and easier availability of raw material.

4. 4. 5. Today there is a shortage of pancreas in general, but the bovine pancreas has been easier to purchase on the world market than that of pig. The cattle insulin differs from human more than pig insulin. Four amino acids are different. It would be very expensive to change them by organic synthesis. Quite another and new one is insulin made by genetic engineering. This will be human insulin and it will be obtained in unlimited quantities after the large scale production problems are solved. The firm of Lilly in USA has been trying to achieve this. The developing countries prefer to have their own insulin produced locally from pancreas for example, the Caribbean Sub-region, Cuba, Nicaragua and Mexico and previously the Arab Company for Drug Industries and Medical appliances.

4. 4. 6. The standard preparation of crystalline insulin has 24 to 25 international units I.U. per mg, but it will be better to calculate with a purity of 20 units per mg, although many manufacturers obtain 25 to 27 units per mg. Thus with the purity of 20 units per kg of pancreas, and yield of 2,000 units per kg pancreas, it amounts to 400,000,000 units or 20 kg of insulin powder per annum or 1,00,000 vials of insulin of 400 units from 200 tons of bovine pancreas.

The list of raw material and chemicals necessary for 1,000 I.U. of crystalline insulin is given below:

Item	Quantity	Cost
Pancreas	0.50kg	1.00
Ethanol 95%	0.25kg)	
HCl conc.p.	0.012kg)	
NH_4OH conc.p.	0.007kg)	
H_2SO_4 conc.p.	0.0002kg)	1.00 approx.
NaCl p.	0.04kg)	
Acetone p.a.	0.001kg)	
Acetic acid glac.	0.0005kg)	
Zn-acetate p.a.	0.0002kg)	
Distilled water	)	

4. 4. 7. The price of bovine pancreas in the world market is US$ 1.00 to US$ 1.20 per kg (see Annex 7.3). The Botswana Meat Commission, Lobatse, would not be in a position to offer less than US$ 2.00 per kg. Assuming that the price of 1 kg of pancreas will not be more than US$ 2.00 the cost of materials used of 1000 I.U. of crystalline insulin would be US$ 2.00 as follows:

0.5 kg of pancreas	$1.00
All chemicals required	$1.00
	$2.00

4. 4. 8. While all chemicals required for the manufacture of insulin are readily available in the world market, pancreas are not so easily available as the world manufacturers of insulin have already cornered the market for them. This is an added reason for the collection of pancreas in Botswana and utilizing them for manufacture of bovine insulin.

4. 4. 9. It must however be pointed out that Botswana would not be able to slaughter more than 1600 heads of cattle per day even after all the three abbattoirs mentioned earlier are in full operation. In a viable production of insulin a daily slaughter of about 4,800 cattle, as indicated earlier, is required. We are of the view that if the three countries of Zimbabwe, Lesotho and Swaziland, the only ones in the SADECC region free of foot-and-mouth disease

can slaughter 3,200 cattle per day, the balance pancreas required could be collected for this viable investment. During the one month mission, we have regrettably not been able to visit these countries to ascertain the exact position. It should be one of the tasks of the team of two experts which has been recommended in this report for a detailed feasibility study of this industry.

4. 4. 10. In economical production of insulin, the cost of materials used should not exceed 30% of the cost of sales of the final product. Since on the world market price of 1000 units of insulin today is between $6.00 and $6.50, this condition may be met. But we believe that the Botswana Meat Commission can sell its pancreas cheaper, if it is prepared to subsidize the selling price of its raw materials to the local entrepreneurs. If as we have recommended in a preceding section of this report, the BMC creates an Investment Promotion Fund from part of the surplus accruing to it without distributing it among the cattle producers in the form of higher prices and bonuses, this can be easily achieved. Consequently the cost of manufacture of insulin would be correspondingly less and price-wise the locally manufactured insulin would be internationaly competitive.

4. 4. 11. Literature for crystalline insulin production is very extensive. Two processes can be selected, the so-called classical, published by R.G. Romans, D.A. Scott and A.M. Fischer/Ind. Eng. Chem. 1940 32, 908-910/ and the other published by E. Jorpes, V. Mutt and S. Rastgeldi/Acta Chem. Scand. 1960, 14 1777-1780. Other processes, including patents, are mostly their modifications. The technology applied depends on production capacity. In any case pancreas must be transported to the production plant deep-frozen. The first step is always the extraction with acidified alcohol followed by short alcalization for removal of protein hydrolysates. After repeated acidification the extract is vacuum-distilled, or insulin is adsorved from alcoholic extract, for instance, on alfinic acid. Further steps are usually the removal of fat and precipitation with sodium chloride. The dry crude insulin is then gained. It has to be purified and finally crystallized on laboratory scale.

The general review of the sequence of the production line of insulin with vacuum distillation is in the Flowchart No.1.

4. 4. 12. The necessary equipment for crude insulin production are:

- Meat grinder
- Polyethylene tanks
- Stirrers
- Basket centrifuge unit for separation of pancreas tissue
- Sharples type centrifuge unit, or sedimentation type centrifuge, for removal of the alkaline precipitate.
- Vacuum distillation unit, film distillation if possible
- Common distillation unit for regeneration of ethanol.

For purification and crystallization of insulin on a larger laboratory scale, the common biochemical laboratory apparatus will be needed, among others a good pH meter and a refrigerated centrifuge unit. It can be said that the most important and at the same time the most expensive, equipment will be two different centrifuge units and the vacuum distillation unit.

4. 4. 13. The expected cost for the whole investment would be about US$2,500,000 made up as follows:

- Equipment	$ 937,500
- Installing	$ 575,000
- Electrical works	$ 62,500
- Construction of a 600 m^2 building	$ 600,000
- Deep freezer of about 60 m^3	$ 75,000
- Laboratory equipment an appartus	$ 125,000
- Instrumentation	$ 125,000
Total:	$2,500,000

More precise data can be had from specialized firms, Alfa Laval AB, Tumba, Sweden or Westfalia, W. Germany who would be able to give a complete know-how.

4. 4. 14. For a capacity of about 200 tons of pancreas per annum the following personnel may be required:

- One biochemical or chemical technologist
- Two technicians
- Two laboratory workers
- Four skilled workers
- Two manual workers

Estimates of requirements and yield given above are on a modest scale and should improve with time with the experience gained in the working of the new plant.

4. 4. 15. In the preceding paragraphs the production of crystalline insulin and not insulin injections was discussed. Obtaining the insulin in powder form from pancreas' as a chemical substance, comprises a well rounded process. There is no economical reason to have a special injection department for preparing only insulin in vials. It is understood that they are to be made in an ordinary injection department of any drug factory.

4. 4. 16. Quality control is the biggest problem in insulin production and has to be done in two different laboratories. It includes control of sterility and biological assay of insulin activity. Sterility control is easy and well known. But the activity test of insulin on rabbits or mice is an expensive and rather difficult method. It requires a specially trained person. Besides that another laboratory for insulin assay, independent of the manufacturer, is required, where the final products, insulin powder and insulin in vials, will be tested once more[1].

4. 4. 17. One vial of insulin of 400 units is market-priced differently in different countries, for example, in USA or West Europe about $2.50, in India $1.00 in Yugoslavia $0.80 -1.70 and in Botswana $4.00 - 5.00. (For the respective sources refer to Annex 7.3 7.3.1.1, 7.3.1.9., 7.3.2.16 and 7.3.2.28). The production of 1,000,000 vials of 400 units of insulin made from 20 kg of crystalline insulin thus would be worth around $2,500,000 - in the world market, on an average of $1,200,000 - in Yugoslavia

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1 Insulin is the only medicine for more serious cases of Diabetes mellitus Diabetics need it to survive. Insulin cannot cure Diabetes but only maintain the well-being of patients.

but $4,000,000 to $5,000,000 in Botswana. Therefore on the basis of this estimate alone, the investment in insulin in Botswana is a worthwhile undertaking.

4. 4. 18. However, the market for insulin in Botswana is extremely small and amounts to about 11,000,000 I.U. per annum (see Annex 7.4.1). At present, Botswana procures its insulin from the South African Republic.

4. 4. 19. The production of 400,000,000 units of insulin, as descrived above, requires a market of nearly 40 million people, on the assumption that the consumption per head is as in Botswana. Although Botswana has only about one million people, the SADECC countries together have a population of nearly 70 million [1]. It is our view that an export-oriented insulin industry to cater to the needs of SADECC countries is quite viable.

4. 4. 20. If after further investigation by a future mission it is found that sufficient raw materials for a viable production of crystalline insulin cannot be collected from the four countries, Botswana, Zimbabwe, Lesotho and Swaziland, at least the production of Pancreatin must be attempted.

4. 4. 21. Pancreatin is a drug with pancreatic enzymes. The method of preparation is easy. Sheeps pancreas is a common raw material, but cattle pancreas can be used too. It is obtained by extraction in 20% methanol, removing tissue and spray-drying the extract. A smaller production unit can be viable too. Pancreatin is needed for patients who lack pancreatic enzymes.

4. 4. 22. The utilization of blood should be one of the first considerations in slaughterhouse policy. Very often the blood is simply disregarded and this pollutes the human environment. The small slaughterhouse units can utilize the blood, after very simple processing, as an additive for poultry and pig feed. For some slaughterhouses, of not too big a capacity, it will be useful to process blood

into blood meal. In bigger slaughterhouses, processing of blood into spray dried plasma and haemoglobin would be the better choice. For obtaining albumin in several grades of purity, fibrin, and immunoglobulins from dried plasma, and hydrolysis of dry haemoglobin to amino acids mixture, further processing has to be done.

4. 4. 23. After slaughter about 10 kg of blood can be collected per head of cattle. The easiest way of utilisation is of course by evaporating the water from whole blood at 180°C by 3 atm. The blood meal thus obtained with 12% of moisture is used for animal feed or fertiliser. During such processing however, the most valuable ingredients of blood are destroyed. A better and more up-to-date process is spray-drying the blood to dry plasma and haemoglobin.
For viable production, about 2,000 tons of blood per annum is needed. As 10 kg of blood can be collected from one animal, it will need about 20,000 cattle per year. The BMC slaughterhouse along has this capacity today.

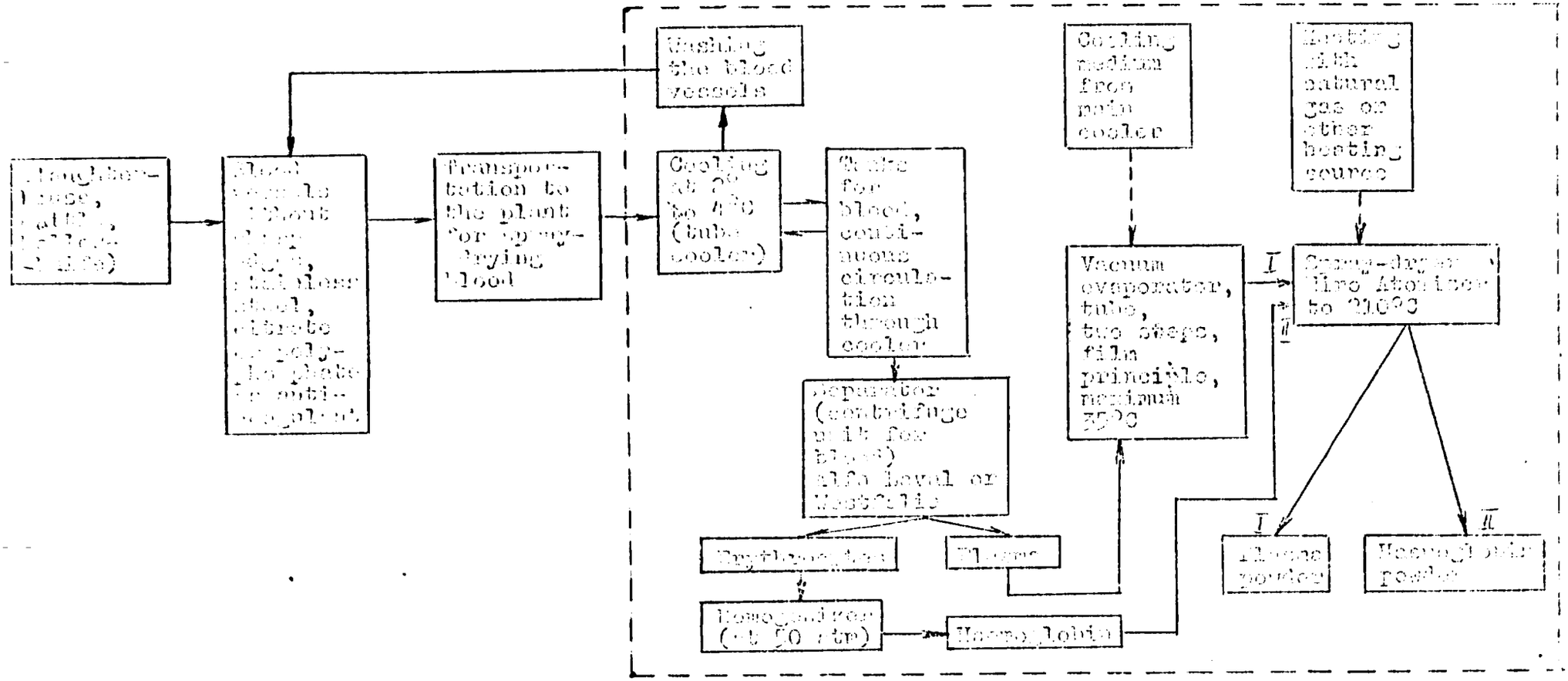
4. 4. 24. Spray drying of blood is also not a too complicated process except that measures have to be taken against contamination. after collecting the blood of animals freshly killed with the hollow knife, an anticoagulant should be added. For blood centrifugation in a special-type centrifuge is easy and effective. It may be possible to use a centrifuge unit form the firm Alfa Laval or Westfalia. After treatment of the erythrocytes in homogenizer to extract haemoglobin and a separate evaporation of plasma and haemoglobin, the two products have to be spray dried, using maybe Niro Atomizer apparatus.
The general sequence of the production operations is given in Flowchart 2.

4. 4. 25. The most important equipment required are given below:

- Centrifuge unit for blood
- Homogenizer for erythrocytes
- Vacuum evaporator
- Spray dryer

FLOWCHART 2

Spray-dried blood production, small series
(7 000 litres of blood per day)



One batch processing lasts two shifts from 6 a.m. to 10 p.m.
Night shift washes and disinfects the whole equipment of the plant.

4. 4. 26. A plant for processing blood as discussed above, has to be close to the slaughterhouse, as any transportation of blood is difficult and prohibitively costly and also because of the infrastructure facilities needed such as steam, cooling facilities, electricity and water supply. The entire investment, including equipment, installation, electricial works, construction of the building, instrumentation and laboratory equipment and apparatus for processing of 2,000 - 3,000 tons of blood per annum would total approximately $2,000,000. More precise data and complete know-how could be obtained from the firm of Niro Atomizer, Soeborg, Copenhagen, Denmark or Phylaxia, Budapest, Hungary.

The investment would need the following personnel:

- One biochemical technologist or veterinarian
- Three technicians
- Six skilled workers

From 2,000 tons of blood per annum the following outputs can be obtained:

- Dry plasma with 5% of moisture - 100 tons
- Dry haemoglobin with 5% of moisture - 260 tons

At a price of $3.00 per 1kg of dry plasma and $1.00 per 1kg of dry haemoglobin, respectively, the value of this output would be $560,000.

Dry plasma is widely used in food processing industry for soups canned preparations etc. Dry haemoglobin serves for animal feed with much higher nutritional value than blood meal and a lesser quantity for sausages too.

4. 4. 27. Further processing of dry plasma requires defibrination with more anticoagulant and calcium salt and the second centrifugation. After spray drying, pure 98% albumin is obtained. For this production, a further investment of about $500,000 is required bringing the cost of total investment to $2,500,000.

4. 4. 28. From dry plasma 40% of albumin, 98% pure can be extracted with the capacity of production considered here 100 tons of dry plasma per year, would yield 40 tons of 98% albumin. The price of albumin would be about ten times higher than that of dry plasma and accordingly the value of output of albumin would

be several times higher than that of dry plasma. There should be a good market for albumin as it is widely used for cosmetics medical diagnostics and special analytical determinations.

4. 4. 29. Although with further purification of plasma, the isolation of high purity albumin, fibrin, and immunoglobulins for veterinary medicine is possible, such production is not recommended, as the processing is not easy and is very costly. On the other hand, as the spray dried haemoglobin can be hydrolysed into many valuable amino acids, by fairly easy and not too costly technology, the feasibility of its production must be examined. Amino acids should have a good market, as they can be used as additional nutrition in human diseases accompanied by loss of body proteins and in foodstuff industry, especially as meat extracts.

4. 4. 30. Generally smaller slaughterhouses disregard the blood. This blood however, can be processed very easily to provide as a special additive to poultry or pig feed. Only a refrigerator unit at $4^{o}C$ and a common meat grinder are needed[1].

4. 4. 31. Gelatin is another product which can be derived from meat by-products. It is obtained by partial hydrolysis of collagen. Raw materials are hide-trimmings, ears, cartilage, connective tissue, horn pith and bones. At present BMC's supply of hide-trimmings, ears, horn pith and hooves amount to about 4000 tons annually and should be sufficient for a viable gelatin industry.

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[1] The method of preparation as given in Annex 7.5 was handed over to the Veterinarian in Gaborone Slaughterhouse.

4. 4. 32. There are Type A gelatin produced by acid treatment, and Type B gelatin gained by an alkaline process. A variety of products with desirable properties are available and special processing is required in each case. The steps in manufacture involve isolation and refinement of the insoluble collagen, followed by its hydrolytic conversion to soluble gelatin. The product is further processed by chemical adjustment, filtration for clarification and then dried to yield a gelatin of some predeterminated quality. A vacuum ecaporation is required, because after hydrolysis the solution has only 3% to 8% of gelatin. With further drying the product with 10% of moisture is obtained. Gelatin is used in food industry, photographic industry and for capsule in the pharmaceutical industry.
There exists a special method for preparation of pharmaceutical gelatin. There are only a few such manufacturers in the world as this process is very sophisticated and very costly.
The edible gelatin production seems to be the most feasible. The product obtained has to be free of microbiological contamination.

4. 3. 33. If we have the spray dried blood production, several pieces of equipment used there can be used for gelatin production as well, such as evaporator and spray-dryer and as enough raw material is available in Botswana, the setting up of an industry for gelatin manufacture is recommended. Edible gelatin is usually used and therefore should have a market not only in Botswana but in the whole of the SADECC countries.

4. 4. 34. Hyaluronidase, an enzyme which splits the linkages in acid mucopolysaccharides, like hysluronic acid, several chondroitinsulphates, is a product which can be turned out of testicles. Deep frozen testicles are ground and extracted with water or a slightly acid solution. After fractional precipitation with ammonium sulphate, dialysis, and lyophilization the raw enzyme is obtained. Many purfication methods are described and some of them are patented. All in all, obtaining the pure, pharmaceutical grade, hyaluronidase is not a complicated and over costly process. Hyaluronidase preparations serve as a medicine for easier absorption of various fluids, accumulations in organism. It is used for instance, for quicker subcutaneous infusions, in pediatrics, small surgery, dentistry, urology and as a cure for some allergies.

V. CONSTRAINTS ON THE ESTABLISHMENT OF OPOTHERAPEUTIC INDUSTRIES

5.1 Size of the Market

5. 1. 1. One of the first constraints facing the establishment of any secondary industry in Botswana has been its small domestic market. Botswana has a population of less than 1 million people with a per capita real income of around P400 (approximately $365) but with a highly skewed income distribution. Therefore, the domestic market is very small[1] and an opotherapeutic industry as an import-substituting one would be hardly economically viable. We agree that an assured doemstic market is always a good starting point. However, the lack of it should not deter countries from being "outward-looking" and going in for export promoting industries, instead of the import substituting ones. The livestock industry in Botswana has always been export-oriented with nearly 95% of its output being exported. Any secondary industry based on meat by-products has to be equally export-oriented.

5. 1. 2. With the establishment of the SACU and the more recent arrangement of SADECC comprising Angola, Botswana, Lesotho, Malawi, Mozambique, Swaziland, Tanzania, Zambia and Zimbabwe the market for Botswana products may be enlarged. Following[2] the UK entiv into the EEC and the signing of the Lome II Convention, Botswana has also been granted 90% rebate of export levy on her products to the EEC. We hope it will be possible to negotiate similar concessions for her potential opotherapeutic products.

5. 1. 3. The EEC provides substantial assistance to SADECC with Botswana as the co-ordinator of all its activities. Botswana has also been able to penetrate into a highly sophisticated

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[1] The expenditure on all pharmaceutical imports in 1980 and 1981 was respectively P.4.9 and 6.4 million, less than 1% of total imports into the country. The size of the domestic market for any one particulat pharmaceutical product would not make production for only the domestic market economically viable.

[2] The population of SADECC countries about 69 million (mid 1980). The World Bank Report 1982 and the Demographic Year Book 1981 op.cit.

market like Japan (with her horns). The development of the Port of Beira in Mozambique and access to it from Francistown via Zimbabwe also should serve as another outlet for Botswana's products by sea.

5. 1. 4. It is therefore our conclusion that the small size of Botswana's domestic market should no longer be held as a constraint for her industrial development. The establishment of the Botswana Vaccine Institute is a good example for this. The government established the Botswana Vaccine Institute solely to manufacture vaccine for domestic cattle to protect them from the Foot and Mouth disease. With the last severe outbreak of this disease, the locally manufactured vaccine was found not effective enough. Then French expertise was obtained on a ten-year management contract basis. The vaccine now manufactured with this French technology is so good that 5 1/2 million doses of trivalent vaccine[1] are being exported to SADECC countries, Zimbabwe, Zambia, Mozambique, Swaziland and Tanzania, Nambia and RSA. This vaccine has been abel to bring under control the foot and mouth disease not only in Botswana but also in the neighbouring country of Zimbabwe.

5. 1. 5. In any case, the feasibility study has to consider the prespective demand in the context of the existing and potential markets and marketing constraints. Any fear in this direction can also be allayed by inviting to, or joining up with, a foreign firm who already has the ncessary marketing expertise (see next paragraph) to set up secondary industry. In this context we recommend that the trade promotion section of the MCI, obtains from UNIDO or any other source, a list of international firms already manufacturing the specific opotherapeutic products and the list of countries to which the respective products are exported.

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[1] The Vaccine Institute now employs one French Vetinarian and 5 French technicians as against 18 Botswana personnel, four of whom are technicians in France.

5.2 Technology and Technical Skill

5. 2. 1. Another problem facing Botswana is the absence of indigenous technology and technical skill. We do not agree that this is an insurmountable difficulty. Even Botswana's most sophisticated abbattoir was started off with foreign technology and expertise. So was its tannery and the cannery. Even today, the BMC has in its abbattoir around 40 expatriates at higher executive and managerial level to around 1,800 Botswana regular hands. The position is similar with 2:50 in the tannery and 5:100 in the cannery. It is learnt that there are local counterparts at each of the top executive/managerial posts who will take over from the expatriates. The possibility of establishment of local factories with imported technology has also been amply demonstrated by the Vaccine Institute whose experience has been already quoted in the preceding paragraph. We do not see any reason why similar arrangements cannot be made with respect to secondary industries based on meat by-products of the BMC.

5. 2. 2. In the course of our interviews with several private entrepreneurs and Government officials such as the General Manager of the Vaccine Institute, we have found several possibilities of enhancing technology capability of Botswana for the production of opotherapeutics. One of them is to invite foreign companies who already possess the technological know-how and who are interested in investing in pharmaceutical production in Botswana and also asking to train local counter-part personnel. We recommend that the MCI and the Government should explore this possibility. Another possibility which they should explore is the establishment of pharmaceutical factories and a joint venture on management contact basis as was done in the case of the Vaccine Institute. The list of selected foreign firms who manufacture respective opotherapeutic products made also available to the GOB (para 5.1.4) should also enable the GOB to approach them with a view to seek their assistance to set up factories to produce these products locally.

5. 2. 3. A foreign company with its marketing expertise may be able to compete with a company like Davis Gelatin of South Africa to whom BMC is today sending its hide trimmings and ears. The Government should also explore the alternative possibility of a joint venture where the BDC joins up with a foreign or local collaborator. In this regard, it may be helpful to report that a local entrepreneur has laready evinced interest in setting up a pharmaceutical industry and has approached the BDC for funds. The BDC, we have been informed, would support the project if it were satisfied with the financial viability of the project.

5. 2. 4. In the course of our interviews, we gathered that there is not a single biotechnologist in Botswana today and that the Government should initiate action to train a few local chemists in biotechnology with the assistance of UNIDO.

5. 3. Infrastructure

5. 3. 1. Whatever industries are set up, they should be in conformity with the NDP of 1979-85. The two major objectives of the NDP are employment creation and reduction of poverty. There must be the institutional set-up to ensure that the industries set-up within the country help to achieve these objectives.

5. 3. 2. The MCI should have within its Industrial Division (see Section VI), capability to study all proposals for new industries in Botswana to ascertain their employment creating an income distributing effect. The MFDP to which all Government proposals are also referred would ensure that they are in keeping with the goals and objectives of the NDP. The MFDP can seek the advice of the Commerce/ Industrial Divison of the BDC with its Project Development Department in this regard.

5. 3. 3. It is not only the institutional infrastructure that is necessary for the establishment of industries but also a basic physical infrastructure. Although Botswana started with a great handicap in this regard at the time of gaining

Independence, lacking in modern transport and communications the position is different today. The most habitable part of the country is well-served with a system of good roads. There is a railway traversing through this part from South West to North East. Although the country is land-locked it has access to the sea through the RAS under the SACU and Mozambique under the SADECC arrangements. At present Beira is not easily accessible by road or rail. It is expected that Botswana acting as co-ordinator of SADECC will take action to link Francistown with Beira by road and rail. Botswana's present international airport is very small. However, the construction of a new international airport is under way with a capital of P35 million with all modern facilities including handling of heavy cargo.

5. 3. 4. Another constraint on successful running of factory industries is the shortage, or exhorbitant cost of energy. Botswana is less unfortunate in this regard than many other developing countries. The view of experts is that Botswana has got enough coal reserved to generate whatever electric power it needs for industrial and household purposes. The Botswana Technology Centre has been managing the GOB/USAID Renewable Energy Technology Project. It has already obtained, as we have been informed, adequate funds to implement this energy programme. According to the Director of the Centre, it is expected to demonstrate after about 3 1/2 years the availability of cheap coal for all botswana's requirements.

5.4 Capital

5. 4. 1. The last, but not the least important problem facing the setting up of domestic industries in Botswana is the shortage of capital, in particular in the form of foreign exchange, to import the ncessary plant and machinery and the technical expertise. Botswana has been running a deficit in its merchandise account over the years but this has been offset by the inflow of short and long-term capital resulting in an overall surplus in the balance of payments, except in 1981.
This position has to be, no doubt, carefully watched in the future.

5. 4. 2. The country has liberal foreign exchange regulations and there is no restriction on merchandise trade at all. Repatriation of profits is not restricted, and although there is a equirement to bring into the country all export proceeds, the importers can retain accounts abroad with the Bank of Botswana approval with established limits depending on merits of each case.

5. 4. 3. Non-resident companies can borrow locally, provided that loan capital over and above P100,000 should be matched with 1:1 in foreign exchange. Similarly locally registered companies can borrow abroad with Bank of Botswana approval.

5. 4. 4. In this setting the capital for starting an opotherapeutic industry can come in several ways: (i) local capital combined with foreign capital in the form of joint ventures. If local entrepreneurs cannot bring in adequate capital, the BDC can assist them; (ii) established foreign companies with their own marketing expertise can be allowed to come in with their technology and expertise to manufacture opotherapeutics with an assured supply of raw materials by the BMC; (iii) the BMC itself can pioneer the setting up of certain opotherapeutic industries as it has already done in the case of the tannery and the cannery.
The BMC can in fact play the major role in providing the necessary capital for setting up of opotherapeutic industries in the country. As mentioned earlier, the entire surplus accruing to the BMC is now distributed among the cattle producers.

5. 4. 5. We recommend that, if not the whole surplus, at least the amount equal to the export-levy rebate should be retained in an Investment Promotion Fund for reinvestment in secondary industries based on BMC meat by-products. This can be done in two ways: (i) As mentioned earlier, one is by the BMC itself using this Fund to finance certain opotherapeutic industries on its own. The BMC is in the best position to do so. It has the raw materials and it has a certain infrastructure. The BMC has already demonstrated its capability in this direction by its successful running of the tannery and the cannery.

5. 4. 6. The other is the BMC making its raw materials available to other entrepreneurs at subsidized prices. The BMC should use the Investment Fund to subsidize the prices of raw materials at least in the "infant industry" stage so that the locally produced opotherapeutics can be internationally competitive. We have been informed, for example, that the BMC would not sell 1kg of pancrease for less than US$2.00. However the world price is between US$1.00 and 1.20. If, as is proposed here, a Fund is instituted, it would be possible for the BMC to subsidize the price of pancreas to would-be-manufacturers bringing it closer to the world market price.

VI. FOLLOW-UP ACTION

6.1 Background

6. 1. 1. In Section IV, we have identified the opotherapeutic products which may be produced in Botswana. On the basis of available raw materials, the appropriate technology which may be used and the infrastructure of institutional, physical and financial facilities and the prospect of marketability, we have recognised that the production of Insulin, Albumin, Amino Acids, Edible Gelatin and Hyaluronidase would be the most suitable in the context of Botswana's socio-economic development.

6. 1. 2. However, before the establishment of industries to produce them, certain follow-up action on the basis of this report would be necessary.

6.2 Feasibility Studies

6. 2. 1. A feasibility study in respect of each of these products must be undertaken. Such study, among others, must look into the input costs on the basis of prices which the BMC would be prepared to subsidize to entrepreneurs in Botswana. It also must estimate the output values on the basis of prospective markets. The level of output which could be targeted on the basis of raw materials which the BMC could regularly supply is another factor to be reckoned.

6. 2. 2. Further the employment creating capacity of such industries in particular, the employment of Botswana must be evaluated, on the basis of required technology. The increase in value added to the export product vis-a-vis the increase in import content must be also estimated.

6.3 The Role of MCI and Botswana Government

6. 3. 1. The MCI has a critical role to play in the establishment of opotherapeutic industries in Botswana. Its task constitutes the different stages of (i) Identification; (ii) Evaluation; (iii) Monitoring and; (iv) Follow-up. In the context of this Report it should be concerned with evaluation.

6. 3. 2. In this context, we recommend that the MCI should take early action to institute feasibility studies in respect of opotherapeutic products identified in the present survey. To this end, it should request UNIDO or any other International Agency to station a team of two, an Industrial Economist and an Opotherapeutic production specialist for 12 months to complete these feasibility studies. This team could work in collaboration with any local institute specialised in related technology, such as the Vaccine Institute. The Government should also request UNIDO's assistance in training two local chemists in biotechnology for one year in a country with such advanced technology. A project proposal containing these recommendations is contained in Annex 7.7.

6. 3. 3. At present the MCI has a Research and Promotion Unit. We recommend that the scope of this Unit should be enlarged to include industrial planning and project evaluation. This unit should eventually have as its core personnel an Industrial Economist, Chemical Engineer and Project Financial Analyst. The UNIDO team recommended under 6.3.2. above could have one or two Botswana as local counterparts.

6.4 Research

6.4.1. At present there is no research or facilities for research into opotherapeutic technology in any of the institutions which we visited in Botswana. The only scope for research in this direction is at present, in the Vaccine Institute. We recommend that this Institute should set up a special unit to promote research in opotheraputic technology.

6.5 The Work of UNIDO

6. 5. 1. We have stated in Section IV that for a very viable Insulin plant. raw materials have to be collected from countries such as Zimbabwe, Lesotho and Swaziland. In this connection it is our view that UNIDO should extend the present project to cover these countries.

6. 5. 2. UNIDO should initiate action to send to each one of the above-mentioned countries a biotechnologist and an Industrial Economist to survey the possibility of pooling of raw materials for the establishment of viable opotherapeutic industries in Botswana or any one of the other three to meet the needs of SADECC countries and then outside. Arrangements have been made to establish industries on such a regional scale in the Caribbean Sub-region. A Project proposal for this is given in Annex 7.7

VII. A N N E X E S

Annexe 7.1

TERMS OF REFERENCE

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

PROJECT PROPOSAL

PART A - BASIC DATA

COUNTRY: Botswana
PROJECT NUMBER:

PROJECT TITLE: Survey of the potential for plant derived pharmaceuticals, and meat by-products in Botswana

SCHEDULED START: January 1982

SCHEDULED COMPLETION: September 1982

UNIDO CONTRIBUTION: 61,200 US$
GOVT CONTRIBUTION : 10,000 US$

ORIGIN AND DATE
OF OFFICIAL REQUEST : 24 April 1981
(Received at UNIDO 12th May 81;
Annex III attached;
Letter No. PRO/300/UNIDO Req.
from Resident Representative)

CURRENCY REQUIRED:
FOR UNIDO INPUT : 61,200 US$
CONVERTIBLE :
OTHER :

GOVERNMENT COUNTERPART
AGENCY: Ministry of Commerce and Industry, Govt. Botswana

UNIDO SUBSTANTIVE
BACKSTOPPING SECTION: Chemical Industries Branch/Pharmaceutical Industries Unit
PROGRAMME COMPONENT CODE: 32.1.D

PROPOSAL SUBMITTED BY:

A.O.B. Mijesekera

DATE OF SUBMISSION : 16 June 1981

PART B - NARRATIVE

1. BACKGROUND AND JUSTIFICATION

1.1. The project derives from the Exploratory Mission of the Mobile Unit for Pharmaceutical and Essential Oils Industry in the Least Developed Countries of Africa under the sponsorship of UNIDO (RP/RAF/77/015). This mission took place during 1 - 6 January 1978, and the report of the mission,*1 recommended development of two main areas of activity viz:

(i) Utilization of medicinal herbs for production of pharmaceuticals; introduction for cultivation of selected medicinal and aromatic plants; development of a laboratory for medicinal and aromatic plants at the experimental farm of the Agricultural Research Department, near Gaborone.

(ii) Development of pharmaceutical by-products from the meat industry in conjunction with the Botswana Meat Commission.

1.2 In December 1980 the Resident Representative conveyed to UNIDO the Government of Botswana's considered views on the recommendations made by the Exploratory Mission of the Mobile Unit. There appeared to be some apprehension in regard to the potential of both types of activities represented by (i) and (ii) above. The Government while reiterating its desire and interest in establishing a pharmaceutical industry in Botswana, felt that a botanical survey of the flora, and cultivation possibilities should precede initiation of activity on (i) and that a techno-economic feasibility study should be undertaken on (ii). The Government has now accepted a UNIDO porposal to field a botanist specialising in economic botany for a four month period, and has also requested a consultancy for a technical and commercial viability study for production of pharmaceuticals as by-products of the meat industry.

The present project is the result of these recommendations and are in accordance with the desires of the Government.

1* Report of the Mission: 24 January 1979: UNIDO/10/379

2. SPECIAL CONSIDERATIONS

The utilization of medicinal and aromatic herbs for the production of plant-derived pharmaceuticals, employs technologies that are dependent on rural sector participation in the cultivation, and pre-processing preparative requirements of the raw material.

The project is a very necessary prelude to a wider project which will enable the profitable and systematic use of two of Botswana's natural resources. The project will need to utilise facilities available in the country already from projects sponsored by other agencies like FAO, UNDP etc. eg. Transport facilities, Farms, Farm Equipment and Facilities.

3. OBJECTIVES

The primary development objective is the utilization of existing natural resources for the production of pharmaceuticals; this activity would serve the dual interest of aiding the government's present health-care efforts as well as generating local industrial involvement. The specific immediate objectives of the projects are as follows:

(a) to field a 4 m/m mission of an economic botanist, to assess the possibilities for utilization of the existing flora, cultivating suitable plant species, enhancing present laboratory capabilities, for the studies on plants with the object, at some later stage, of setting up pilot scale facilities for the production of plant-derived pharmaceuticals.

(b) to field a mission of two experts for a two months period to make a techno-economic survey and evaluation of the potential for making pharmaceuticals from the by-products of the Botswana Meat Industry.

The objectives when accomplished will enable decisions to be taken as regards future development of the pharmaceutical industry in Botswana.

4. PROJECT OUTPUTS

The project outputs will be <u>two</u> Technical Reports embodying the above objectives (a) and (b) as follows:

Technical Report (A) : Potential for the Production of Plant-derived Pharmaceutical in Botswana

Technical Report (B) : The Techno-economic Feasibility of the Production of Pharmaceuticals based on By-products of the Meat Industry, in Botswana.

5. PROJECT ACTIVITIES

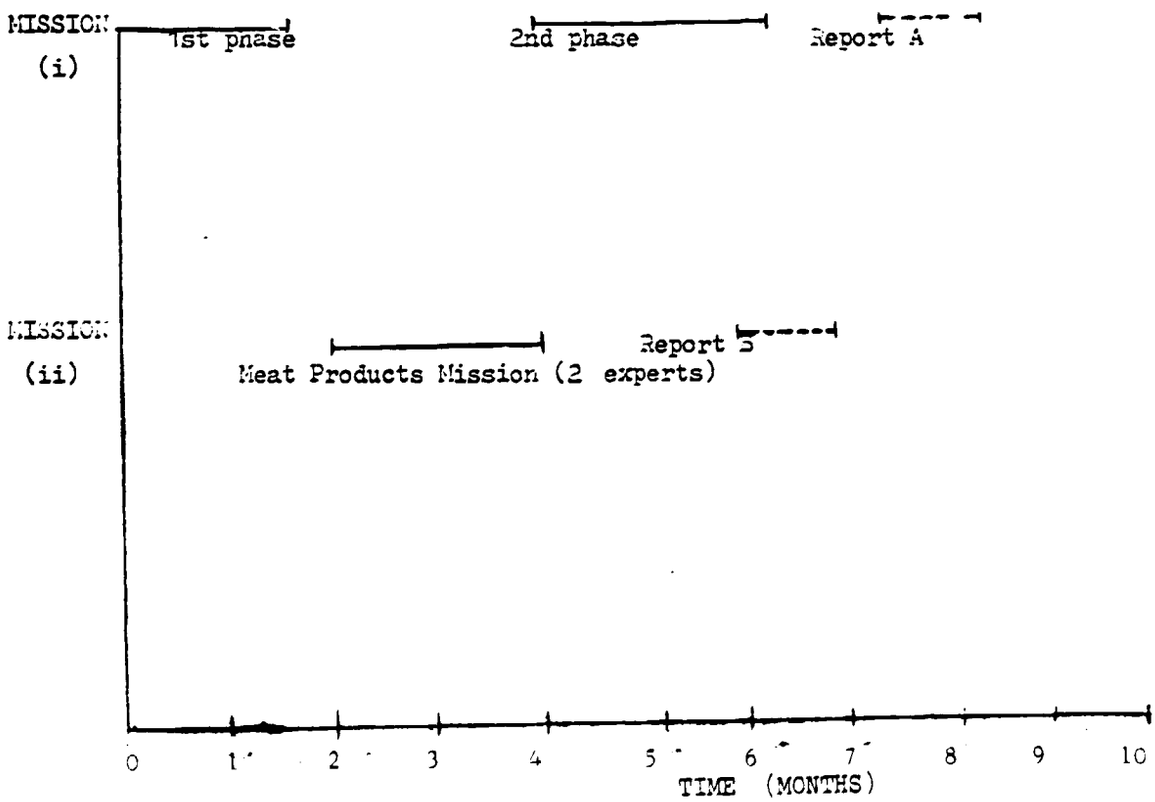
The activities for the project would be, the fielding of two missions constituted as follows:

(i) Expert in Field Botany/Economic Botany with special experience in medicinal and aromatic plants; 4 m/m mission (split) commencing January 1982.

(ii) Two experts (i) one Economist and (ii) Technologist with experience in the utilization of meat by-products for production of pharmaceuticals 2 m/m.

The envisaged time-frame for activities is as follows:

Plant pharmaceuticals mission (1 expert)



6. PROJECT INPUTS

(i) Government inputs

The following would be the envisaged inputs from the Government:

Office accommodation, secretariat and administrative arrangements and travel facilities for work of experts:

Estimated: US$ 10,000

(ii) UNIDO inputs

Mission (i) One expert 4 m/m split mission	... 25,600 US$
Mission (ii) Two experts 2 m/m	... 25,600 US$
Contingencies, literature survey by computer data Bank, seed procurement, basic testing Equipment for experts etc. and reports	... 10,000 US$
T O T A L	... 61,200 US$

7. EVALUATION PLANS

The project will be evaluated in the approved fashion for UNIDO projects after the presentation of the reports by, selected government officials together with the Special Technical Advisor of UNIDO substantive section and a consultant.

8. FOLLOW-UP ACTION

Consequent to the evaluation of the Technical Reports and the detailed study of the technical reports by appropriate Government Agencies, a project for follow-up action will be formulated.

Annexe 7.2

INSTITUTIONS AND PERSONS VISITED

1. UNDP

E. P. M'cleod, Deputy Representative (R.R. a.i.)

Renata Von Hovel, JPO

2. Ministry of Commerce and Industry

M. Mbaakanyi - Director of Industrial Affairs (Acting Secretary)

K. E. Eder - Senior Industrial Officer

K. Sarpong - Industrial Officer

J. Collins - Senior Trade Promotion Advisor (EEC/ACP Project Coordinator)

3. Ministry of Finance and Development Planning

M. Afeta - Principal Planning Officer

M. Ngidi - Planning Officer

4. Ministry of Agriculture

J. F. Machacha - Chief. Animal Production Officer

M. M. Mannathoko- Director, Department of Veterinary Services

5. Ministry of Health

Dr. J.S. Moeti - Chief Medical Officer

George Gundersen - Chief Pharmacist

6. Bank of Botswana

E. Y. Ablo - Deputy Director of Research

7. Botswana Development Corporation

Mohammed Talha - Senior Project Officer

M. Mmopi - Project Officer

8. National Development Bank

O. P. Mmopi - Assistant General Manager

D. T. Maindan- Financial Manager

9. The University of Botswana

Prof. M. A. Omen	-	Professor of Economics
Prof. Robins	-	Professor of Chemistry
Prof. L. Ngcongco	-	Director, National Institute of Development & Cultural Research

10. Central Statistics Office

F. Modise	-	Govt. Statistician

11. Botswana Meat Commission

J. K. Laker	-	Marketing Manager

12. Botswana Vaccine Institute

Dr. Jack Falconer P.H.	-	General Manager

13. Central Medical Stores

Harold Skei	-	Principal Pharmaceutical Supply Officer

14. Botswana Technology Centre

D. Medford	-	Managing Director

15. Botswana Enterprise Development Unit, MCI
Pilane Industrial Estate

S. E. M. Tshoe	-	Estate Manager
L. A. Dalhbarg	-	Swedish Advisor

16. Private Entrepreneurs

Trevor Courtenay	-	RET Courtenay (Pty) Ltd.
B. Egner	-	Economic Consultancies
E. A. N. Mtui	-	Managing Director, Zambesi Enterprises (Pty) Ltd.

IN SRI LANKA

17. The Superintendent of Government Medical Stores
18. The Head, Department of Pharmacology, Faculty of Medicine University of Sri Lanka.
19. Dr. Visidagama, former Chief Veterinary Surgeon, Colombo Municipal Council

IN UNIDO

20. R.O.B. Wijesekera, Special Technical Adviser, Pharmaceutical Industries Unit, Chemical Industries Branch, Division of Industrial Operations.

Annex 7.3

Meetings and Discussions ~~Had~~ with Various Specialists and Other Persons had by the expert on opotherapeutic productions.

1 Before and After my Mission

1.1 D. Veble, M.Sc., Technical Counsellor, "Pliva" Pharmaceutical Works, Zagreb, Yugoslavia, 27 Jan., 11, 17 and 21 Mar. 1983, and telephone call from Gaborone, Botswana, 25 Feb.

1.2 Professor S. Djokić, Director of Research Institute, "Pliva" Pharmaceutical Works, Zagreb, Yugoslavia, 27 Jan., 12 and 15 Mar. 1983.

1.3 Z. Petrović, Director of Research Institute, "Podravka" Foodstuff Industry, Koprivnica, Yugoslavia, 24 Jan. and 14 Mar. 1983.

1.4 F. Pipić, Director of Development Section, "Podravka" Foodstuff Industry, Koprivnica, Yugoslavia, 24 Jan. and 16 Mar. 1983.

1.5 Dr. Z. Mašansker, Veterinarian Counsellor, "Podravka" Foodstuff Industry, Koprivnica, Yugoslavia, 14 and 22 Mar. 1983.

1.6 Professor V. Johanides, Faculty of Biotechnology, University of Zagreb, Zagreb, Yugoslavia, 20 Jan. and 22 Mar. 1983.

1.7 Professor F. Mildner, Faculty of Biotechnology, University of Zagreb, Zagreb, Yugoslavia, 21 Jan. and 23 Mar. 1983.

1.8 Assist. Prof. B. Zamola, Faculty of Technology, University of Zagreb, Zagreb, Yugoslavia, 31 Jan. 1983.

1.9 Professor Z. Škrabalo, Director of Institute for Diabetes, Faculty of Medicine, University of Zagreb, Zagreb, Yugoslavia, 28 Jan., 15 and 23 Mar. 1983.

1.10 Assist. Prof. M. Granić, Institute for Diabetes, Faculty of Medicine, University of Zagreb, Zagreb, Yugoslavia, 31 Jan., 15, 23 and 24 Mar. 1983.

1.11 Dr. G. Katona, Institute for Diabetes, Faculty of Medicine, University of Zagreb, Zagreb, Yugoslavia, 31 Jan. and 11 Mar. 1983.

1.12 I. Buković, Member of the Federation Council, Zagreb, Yugoslavia, 24 Mar. 1983.

2 During my Mission

2.1 Dr. A. Tcheknavorian, Chief of Pharmaceutical Industries Unit, UNIDO, Vienna, Austria, 8 and 9 Mar. 1983.

1.2 Dr. R. O. B. Wijesekera, Pharmaceutical Industries Unit, UNIDO, Vienna, Austria, 2 and 3 Feb., and 7 to 9 Mar. 1983.

2.3 M. Zaidi, Resident Representative, UNDP, Gaborone, Botswana, 14 Feb. and 1 to 4 Mar. 1983.

2.4 H. P. M'cleod, Deputy Resident Representative, UNDP, Gaborone, Botswana, 4 Feb. to 4 Mar. 1983.

2.5 R. von Hoevel, Programme Officer, UNDP, Gaborone, Botswana, 4 Feb. and 21 Feb. to 4 Mar. 1983.

2.6 W. Mascarenhas, Administrative Officer, UNDP, Gaborone, Botswana, 4 Feb. to 4 Mar. 1983.

2.7 Dr. P. Rojas, WHO Expert, UNDP, Gaborone, Botswana, 7 Feb. to 3 Mar. 1983.

2.8 P. Matsetse, Permanent Secretary, Ministry of Commerce and Industry, Gaborone, Botswana, 9 and 14 Feb., and 3 Mar. 1983.

2.9 M. Mbaakanyi, Director of Industrial Affairs, Ministry of Commerce and Industry, Gaborone, Botswana, 14 Feb. 1983.

2.10 D. I. Tibone, Principal Industrial Officer, Ministry of Commerce and Industry, Gaborone, Botswana, 7, 18, and 25 Feb. 1983.

2.11 K. S. Sarpong, Industrial Officer, Ministry of Commerce and Industry, Gaborone, Botswana, 7 Feb. to 4 Mar. 1983.

2.12 J. Collins, Senior Trade Promotion Advisor, Ministry of Commerce and Industry, Gaborone, Botswana, 11 and 14 Feb. 1983.

2.13 K. E. Eder, Senior Industrial Officer, Ministry of Commerce and Industry, Gaborone, Botswana, 3 Mar. 1983.

2.14 Dr. Moeti, Chief Medical Officer, Ministry of Health, Gaborone, Botswana, 7 Feb. 1983.

2.15 G. Gundersen, Chief Pharmacist, Ministry of Health, Gaborone, Botswana, 7 Feb. and 3 Mar. 1983.

2.16 H. Skei, Principal Pharmaceutical Supply Officer, Ministry of Health, Gaborone, Botswana, 14 Feb., and 1 and 3 Mar. 1983.

2.17 A. Blumeris, Representative of SADCC Group of Countries, Gaborone, Botswana, 23 Feb. 1983.

2.18 J. E. Bradley, Deputy Director of Veterinary Services, Ministry of Agriculture, Gaborone, Botswana, 9 Feb. 1983.

2.19 Dr. R. S. Windsor, Director of the Veterinary Diagnostic and Research Laboratory, Gaborone, Botswana, 9 Feb. 1983.

2.20 W. T. Harvey, General Manager/Technical, Botswana Meat Commision, Lobatse, Botswana, 8 Feb., and telephone call 2 and 3 Mar. 1983.

2.21 M. R. Dinku, Botswana Meat Commision, Lobatse, Botswana, 8 Feb. 1983.

2.22 D. Bolaaive, Cannery Manager, Botswana Meat Commision, Lobatse, Botswana, 8 Feb. 1983.

2.23 A. Esplin, Senior Tannery Technician, Botswana Meat Commision, Lobatse, Botswana, 8 Feb. 1983.

2.24 S. G. Sithole, Veterinarian, Gaborone Slaughterhouse, Gaborone, Botswana, 9 and 10 Feb. 1983.

2.25 Dr. A. H. Merriweather, Senior Surgeon, Princess Marina Hospital, Gaborone, Botswana, 10 Feb. 1983.

2.26 Dr. Moffat, Physician, Princess Marina Hospital, Gaborone, Botswana, 10 Feb. 1983.

2.27 Dr. K. C. Mohapatra, Forensic Pathologist, Princess Marina Hospital, Gaborone, Botswana, 9 and 10 Feb. 1983.

2.28 H. Flatberg, Pharmacist, Princess Marina Hospital, Gaborone, Botswana, 10 Feb., and 3 Mar. 1983.

2.29 M. B. Rayamah, UNDP, Medical Statistics, Ministry of Health, Gaborone, Botswana, 14 Feb. 1983.

2.30 Professor P. A. Robins, Dept. of Chemistry, Faculty of Science, University of Botswana, Gaborone, Botswana, 7, 9, and 14 Feb. 1983.

2.31 Dr. Jefford, Dept. of Biology, Faculty of Science, University of Botswana, Gaborone, Botswana, 14 Feb. 1983.

2.32 R. C. B. Hartland-Rowe, Dean of the Faculty of Science, University of Botswana Gaborone, Botswana, 14 and 28 Feb. 1983.

2.33 Dr. D. Everret, Chief of Party, Botswana Agricultural College, Gaborone, Botswana, 21 Feb. 1983.

2.34 B.Memsley, Admissions Officer, Botswana Agricultural College, Gaborone, Botswana, 15 Feb. 1983.

2.35 P. Cline, Microbiologist, Botswana Agricultural College, Gaborone, Botswana, 15 and 21 Feb. 1983.

2.36 Dr. K. Cland, Director of Agricultural Research, Gaborone, Botswana, 15 Feb. 1983.

2.37 D. Medford, Managing Director, The Botswana Technology Centre, Gaborone, Botswana, 15 Feb. 1983.

2.38 K. Kuiper, General Manager, Botswana Development Corp. Ltd., Gaborone, Botswana, 17 Feb. 1983.

2.39 Dr. M. Marković, Surgeon, Gaborone, Botswana, 19, 22, 24, and 26 Feb. 1983.

2.40 B. I. Gasennelwe, General Manager, National Development Bank, Gaborone, Botswana, 22 Feb. 1983.

2.41 Dr. J. Falconer, Veterinarian, General Manager, Botswana Vaccine Institute, Gaborone, Botswana, 24 Feb. and 1 Mar. 1983.

2.42 Dr. J. J. Guinet, Veterinarian, Botswana Vaccine Institute and Iffa-Mérieux Institute, Gaborone, Botswana, 24 Feb. 1983.

2.43 W. G. Shaw, Secretary, Botswana Vaccine Institute, Gaborone, Botswana, 9 Feb. 1983.

Annex 7.4

PREPARATION OF ADDITIVE POULTRY FOOD FROM BLOOD

Blood of helahty animals was,after slaughter, collected in milk cans . It was set immediately in a refrigerator at 0^{o} to 4^{o}C during 4 to 5 days . Then, blood clots were ground in a meat grinder, serawere added to it (liquid remainder of blood) and then added the same weight of water . It was left for one hour,and then the mixture was slowly boiled for another hour. The whole preparation (homogenous) is now ready to use. If itis not used up in the same day, 10% NaCl should be added for preservation.

This preparation is given to the chicken in their feed twice a day , mornings and evenings, for three months.Every animal should receive 1 or 2 ml of the preparation daily, depending on its body weight.

Those chickens who get this prepartion in their feed would be on the average 30% heavier, after three months, than chicken that had been given the same feed but without this preparation from blood.

Annex 7.5

RAW MATERIALS FOR INSULIN

Number 4 (1982)

British Medical Association
and
The Pharmaceutical Society of Great Britain

[illegible] 80 units/ml, price 10-ml vial = E; 80 [illegible] price 10-ml vial = G

GLOBIN ZINC INSULIN INJECTION

[illegible]

Indications: diabetes mellitus

Cautions; Side effects; Dose: see under Insulin Injection (section 6.1.1.1); globin may cause [illegible] reactions

Globin Zinc Insulin Injection, 80 units/ml. Price [illegible] = I

INSULIN ZINC SUSPENSION (AMORPHOUS)

(Amorph. I.Z.S.)

Indications: diabetes mellitus

Cautions; Side effects; Dose: see under Insulin Injection (section 6.1.1.1)

Insulin Zinc Suspension (Amorphous), Semilente, [illegible] units/ml, price 10-ml vial = E; 80 [illegible] 10-ml vial = F

Semitard MC (Novo)

[illegible] insulin zinc suspension (amorphous) [illegible] highly purified) 40 units/ml, price [illegible] E; 80 units/ml, price 10-ml vial = G

ISOPHANE INSULIN INJECTION

(Isophane Protamine Insulin Injection)

Indications: diabetes mellitus

Cautions; Side effects; Dose: see under Insulin Injection (section 6.1.1.1); protamine may cause allergic reactions

Isophane Insulin Injection (NPH), 40 units/ml, [illegible]; 80 units/ml, price 10-ml vial [illegible]

Hypurin Isophane (Weddel)

[illegible] isophane insulin (bovine, highly purified) 40 units/ml, price 10-ml vial = E; 80 units/ml, price 10-ml vial = F

[illegible] (Novo)

[illegible] highly purified [illegible] highly purified [illegible] price 10-ml vial = E; 80 [illegible] price 10-ml vial = G

Insulatard (Nordisk)

[illegible] isophane (porcine, highly purified) [illegible] price 10-ml vial = E; 80 [illegible] price 10-ml vial = G

[illegible] (Nordisk)

[illegible] (porcine, highly purified) [illegible] highly purified) [illegible] units/ml, price 10-ml vial = E; 80 [illegible] price 10-ml vial = G

Neuphane (Boots, Wellcome)

[illegible] (bovine, highly purified) [illegible] price 10-ml vial = E; 80 [illegible] price 10-ml vial = F

6.1.1.3 LONG-ACTING INSULIN PREPARATIONS

[illegible] of Insulin Zinc Suspension

[illegible]

(Semilente) has an intermediate action and the crystalline form (Ultralente) has a slow action. When the two preparations are mixed in different proportions, a wide range of action can be obtained. The aim in using a mixture of the suspensions is to control the diabetic condition with a single daily injection. A mixture containing 3 parts of amorphous and 7 parts of crystalline suspension is known as Insulin Zinc Suspension, Insulin Zinc Suspension (Mixed), or Lente insulin. Its peak activity occurs about 6 hours after injection and its action lasts up to 24 hours. Its main use is in moderately insulin-deficient patients who cannot be controlled adequately on diet and oral hypoglycaemic drugs. It is of only limited use in those with severe insulin deficiency.

If requirements for insulin zinc suspension exceed 30 units per day, diabetic control is usually easier on twice daily insulin. It should not be used at doses greater than 60 units per day. Neutral Insulin Injection, but not Insulin Injection (pH 3), can be mixed with insulin zinc suspension to add a shorter acting component.

Protamine Zinc Insulin, unlike Isophane Insulin, contains an excess of protamine and should not be mixed with soluble insulin as this leads to the formation of more protamine zinc insulin in the syringe and subcutaneous depot.

INSULIN ZINC SUSPENSION

(Insulin Zinc Suspension, Mixed. I.Z.S.)

Indications: diabetes mellitus

Cautions; Side effects; Dose: see under Insulin Injection (section 6.1.1.1)

Insulin Zinc Suspension, Lente, 40 units/ml, price 10-ml vial = E; 80 units/ml, price 10-ml vial = F

Hypurin Lente (Weddel)

Injection, insulin zinc suspension (bovine, highly purified) 40 units/ml, price 10-ml vial = E; 80 units/ml, price 10-ml vial = F

Lentard MC (Novo)

Injection, insulin zinc suspension (bovine and porcine, highly purified) 40 units/ml, price 10-ml vial = E; 80 units/ml, price 10-ml vial = G

Monotard MC (Novo)

Injection, insulin zinc suspension (porcine, highly purified) 40 units/ml, price 10-ml vial = E; 80 units/ml, price 10-ml vial = G

Neulente (Boots, Wellcome)

Injection, insulin zinc suspension (bovine, highly purified) 40 units/ml, price 10-ml vial = E; 80 units/ml, price 10-ml vial = G

INSULIN ZINC SUSPENSION (CRYSTALLINE)

(Cryst. I.Z.S.)

Indications: diabetes mellitus

Cautions; Side effects; Dose: see under Insulin Injection (section 6.1.1.1)

Insulin Zinc Suspension (Crystalline), Ultralente, 40 units/ml, price 10-ml vial = E; 80 units/ml, price 10-ml vial = F

Ultratard MC (Novo)

Injection, insulin zinc suspension, crystalline (bovine, highly purified) 40 units/ml, price 10-ml vial = E; 80 units/ml, price 10-ml vial = G

PROTAMINE ZINC INSULIN INJECTION

Indications: diabetes mellitus

Cautions; Side effects; Dose: see under Insulin Injection (section 6.1.1.1); protamine may cause allergic reactions; see also notes above

Protamine Zinc Insulin Injection, 40 units/ml, price 10-ml vial = E; 80 units/ml, price 10-ml vial = F

Hypurin Protamine Zinc (Weddel)

Injection, protamine zinc insulin (bovine, highly purified) 40 units/ml, price 10-ml vial = E; 80 units/ml, price 10-ml vial = F

6.1.2 Oral hypoglycaemic drugs

6.1.2.1 Sulphonylureas

6.1.2.2 Biguanides

Oral hypoglycaemic drugs should not be used until patients have been shown not to respond adequately to a period of at least one month's restriction of energy and carbohydrate intake. They should be used to augment the effect of diet, and not to replace it.

6.1.2.1 SULPHONYLUREAS AND RELATED DRUGS

The sulphonylureas act mainly by augmenting insulin secretion and consequently are effective only when some residual pancreatic beta-cell activity is present.

Tolbutamide (Pramidex, Rastinon) has a short duration of action and is usually given twice daily; the total daily dose should not exceed 2 g. **Chlorpropamide** (Diabinese, Melitase) has a more prolonged action and need only be given once daily; the maximum effective dose is 500 mg daily. Glibenclamide (Daonil, Euglucon) has a duration of action [illegible] tolbutamide and chlorpropamide, but is usually given once daily within the dose range 2.5 to 15 mg.

Other sulphonylureas and related drugs include acetohexamide (Dimelor), glibornuride (Glutril), gliclazide (Diamicron), glipizide (Glibenese, Minodiab), gliquidone (Glurenorm), glymidine (Gondafon), and tolazamide (Tolanase).

Adverse hypoglycaemic [illegible] after [illegible] this is usually [illegible] of overdosage. Chlorpropamide may cause prolonged hypoglycaemia, particularly in the elderly and in those with renal disease; tolbutamide is preferable in the elderly. Chlorpropamide and tolbutamide may cause facial flushing after drinking alcohol; this effect is uncommon with glibenclamide. Sulphonylureas must be used with caution in patients with renal insufficiency.

Sulphonylureas are best avoided in obese

patients unless their symptoms and ketoacidosis [illegible] have not improved despite weight loss to within 15% of their ideal body weight.

ACETOHEXAMIDE

Indications: diabetes mellitus

Cautions; Contra-indications; Side effects: see under Chlorpropamide

Dose: [illegible] daily up to [illegible] given as a single daily dose [illegible]

PoM Dimelor (Lilly)

Tablets, yellow, scored, acetohexamide 500 mg. Price 20 tabs = C

CHLORPROPAMIDE

Indications: diabetes mellitus; diabetes insipidus, see section 6.5.2

Cautions: see notes above; also breast-feeding. Drug interactions: see Appendix 1

Contra-indications: impaired adrenal, hepatic, renal, or thyroid function; pregnancy; diabetes complicated by surgery, severe infection, or trauma

Side-effects: anorexia, nausea, vomiting, epigastric discomfort, weakness, paraesthesia; sensitivity reactions including fever, rashes, jaundice, agranulocytosis; flushing with alcohol

Dose: up to 500 mg once daily, with breakfast; elderly patients [illegible]

PoM Chlorpropamide Tablets, chlorpropamide 100 mg, price 20 tabs = B; 250 mg, price 20 tabs = B

PoM Diabinese (Pfizer)

Tablets, scored, chlorpropamide 100 mg. Price 20 tabs = C

Tablets, scored, chlorpropamide 250 mg. Price 20 tabs = D

PoM Glymese (DDSA)

Tablets, scored, chlorpropamide 250 mg. Price 20 tabs = B

PoM Melitase (Berk)

Tablets, scored, chlorpropamide 100 mg. Price 20 tabs = B

Tablets, scored, chlorpropamide 250 mg. Price 20 tabs = C

GLIBENCLAMIDE

Indications: diabetes mellitus

Cautions; Contra-indications: see under Chlorpropamide

Side effects: see under Chlorpropamide (except [illegible])

Dose: initially [illegible] mg daily; dose range 2.5–15 mg daily

PoM Glibenclamide Tablets, glibenclamide 2.5 mg, price 20 tabs = D; 5 mg, price 20 tabs = E

PoM Daonil (Hoechst)

Tablets, scored, glibenclamide 5 mg. Price 20 tabs = I

PoM Semi-Daonil (Hoechst)

Tablets, scored, glibenclamide 2.5 mg. Price 20 tabs = D

6: Drugs used in the treatment of disorders of the

ENDOCRINE SYSTEM

[illegible]

6.1 Drugs used in diabetes

[illegible]

6.1.1 Insulin

[illegible]

of mixtures of neutral pork insulin or monocomponent insulin.

About 25% of diabetics require insulin treatment; apart from those presenting in coma or precoma, insulin is needed by most of those who are underweight and ketotic at presentation. The majority of those who are of normal weight or obese can be managed by restriction of carbohydrate or energy intake alone or with the subsequent administration of oral hypoglycaemic drugs. Most children require insulin from the outset.

Since insulin secretion fluctuates from minute to minute in normal subjects, it is impossible to maintain normoglycaemia in the majority of diabetics by insulin injections once, twice, or even three times daily. Symptoms are relieved rapidly as glycosuria is controlled. The aim of treatment is to achieve the best possible control of blood glucose, and close co-operation is needed between the patient and the medical team. To achieve control mixtures of available insulin preparations may be required (such as Insulin Injection and Isophane Insulin Injection) and these combinations have to be worked out for the individual patient.

The energy and carbohydrate intake must be adequate to allow normal growth and development but obesity should be avoided. The carbohydrate intake is not restricted in non-obese patients on insulin but should be distributed throughout the day in such a way that it suits the type of insulin used. Fine control of blood glucose can be achieved by moving portions of carbohydrate from one meal to another without altering the total intake.

Insulin doses are best determined on an individual basis, by gradually increasing the dose to the maximum tolerated without troublesome hypoglycaemic reactions. Care should be taken to avoid inducing obesity by the administration of too much insulin.

There are three main types of insulin preparations:

1. those of short duration which have a relatively rapid action, for example Insulin Injection (Soluble);
2. those with an **intermediate** action, for example Isophane Insulin Injection and Insulin Zinc Suspension, Amorphous (Insulin Semilente), and
3. those whose action is slower in onset and lasts for **long** periods, for example Insulin Zinc Suspension (Insulin Lente) and Protamine Zinc Insulin.

The type of insulin used and its dose and frequency of administration depend on the particular needs of the patient. Patients with moderate to severe insulin deficiency are best started on Isophane Insulin Injection twice daily and a short-acting insulin can later be added to cover any [illegible]

hypoglycaemia which may follow [illegible]

[illegible]

Care should be taken [illegible] a patient from conventional [illegible] insulin to the highly-purified [illegible] since there is usually an immediate fall in insulin requirements [illegible]

6.1.1.1 SHORT-ACTING INSULIN PREPARATIONS

Insulin Injection (soluble or regular insulin) is a clear solution of insulin of mixed beef and pork [illegible] It is used chiefly in those patients with severe insulin deficiency whose insulin requirements may be large and change rapidly, as in acute infections or at the time of operations.

[illegible]

INSULIN INJECTION

(Soluble Insulin)

Indications: diabetes mellitus; diabetic coma [illegible]

Cautions: drug interactions: see Appendix 1

Side-effects: local reactions and lipoatrophy at injection site [illegible]

Dose: adjusted according to patient's requirements

Insulin Injection, [illegible]

NEUTRAL INSULIN INJECTION

(Neutral Insulin)

Indications: [illegible]

Cautions; Side-effects; Dose: see under Insulin Injection

Actrapid MC® (Novo)

Injection, neutral insulin (porcine, highly purified) [illegible]

Hypurin Neutral? (Weddel)

Injection, neutral insulin (bovine, highly purified) [illegible]

Neusulin? (Boots, Wellcome)

Injection, neutral insulin (bovine, highly purified) [illegible]

Nuso (Boots, Evans, Wellcome)

Injection, neutral insulin [illegible]

Velosulin? (Nordisk)

Injection, neutral insulin (porcine, highly purified) [illegible]

6.1.1.2 INTERMEDIATE-ACTING INSULIN PREPARATIONS

Biphasic Insulin Injection (Rapitard MC) is a mixture of [illegible] insulin [illegible] pork insulin; it is usually given twice daily.

Isophane Insulin Injection [illegible]

[illegible]

BIPHASIC INSULIN INJECTION

Indications: diabetes mellitus

Cautions; Side-effects; Dose: see under Insulin Injection [illegible]

Rapitard MC® (Novo)

Injection, [illegible]

Copies may be obtained through any bookseller or, in any case of difficulty, direct from the publishers.

British Medical Association
Tavistock Square
London WC1H 9JP, England

The Pharmaceutical Press
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ANNEX 7.6

TERMS OF REFERENCE

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

PROJECT PROPOSAL I

PART A - BASIC DATA

COUNTRY/REGION	:	BOTSWANA
PROJECT NUMBER	:	
PROJECT TITLE	:	Feasibility Studies for Insulin pancreatin, Albumin, Amino Acids Gelatin and Hyalurindase and Training of Local Technologists
SCHEDULED START	:	April 1984
SCHEDULED COMPLETION	:	March 1985
ORIGIN AND DATE OF OFFICIAL REQUEST	:	
GOVERNMENT COUNTERPART AGENCY	:	Ministry of Commerce and Industry
UNIDO CONTRIBUTION	:	US$190,000
GOVERNMENT CONTRIBUTION	:	US$ 20,000
CURRENCY REQUIRED	:	US$ 200,000
UNIDO SUBSTANTIVE BACKSTOPPING SECTION	:	Pharmaceutical Industries Unit/CHEM/DIO
PROGRAMME COMPONENT CODE	:	32.1.D

PART B - NARRATIVE

1. Objectives

(a) Development Objective:

The development objective of this proposal is to make a quantative assessment of the viability of the industries to manufacture in Botswana the identified opotherapeutics from the point of input and output calculations, availability of both expatriate and patriate technical personnel and the demand for the products in the SADECC as well as other outside countries.

(b) Immediate Objective:

The immediate objective of the project is as follows:

To field a mission of two experts (i) to make feasibility studies in respect of each one of the identified products and (ii) to recommend for Government consideration only those ones which would be internationally competitive in both price and quality.

2. Special Considerations

Once the immediate objectives have been accomplished they will enable decisions to be taken as regards the setting up of industries to manufacture pharmaceuticals based on meat by-products.

3. Background and Justification

1.1 This proposal derives from the mission of the Industrial Economist and opotherapeutic technologist to Botswana under the project RP/BOT/82/001. This mission took place between December 1982 and March 1983 and the Report of this mission recommended, inter alia the following:

(i) "The Ministry of Commerce and Industry of Botswana should like early action to institute feasibility studies in respect of opotherapeutic products identified in their survey. To this end the Government should request UNIDO to station a team of two experts, one an Industrial Economist and the other an Opotherapeutic Production Specialist for 12 months to complete their feasibility studies."

(ii) "The Government should also request UNIDO assistance in training two local chemists in biotechnology for one year in a country with such advanced technology."

1.2 The mission referred to in para. 1.1 made only a pre-feasibility survey of the production potential of opotherapeutics based on meat by-products, of the BMC and other slaughter houses of Botswana. The Industrial Economist was in the field only three weeks while the Opotherapeutic Technologist was a little longer for four weeks. During this short period, this mission could not do more than identify generally the potential opotherapeutic and other related products which could be manufactured in Botswana on the grounds of available raw materials, technology required and the prospective marketability. The mission has now made this recommendation to more specifically study the feasibility of industries to manufacture specific products of insulin, pancreatin, albumin, amino acids, gelatin and hyalurindase.

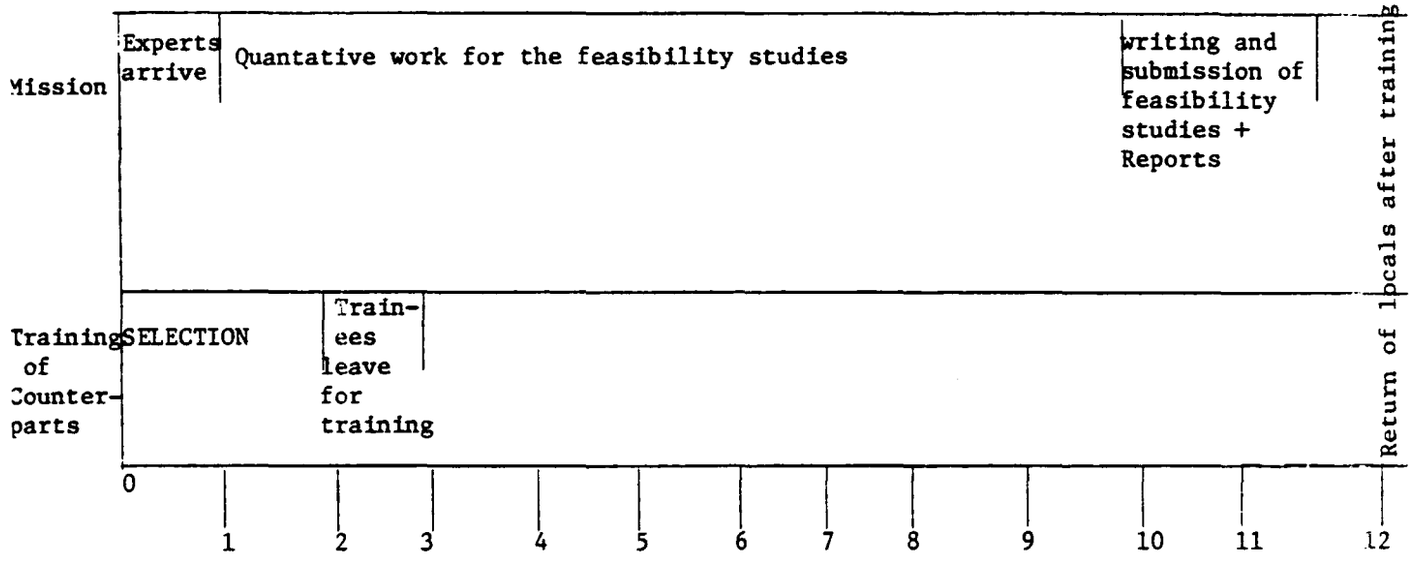
4. Project Outputs:

The Project Output will be several feasibility study reports in respect of the identified opotherapeutic products and two local personnel trained in biotechnology.

5. Project Activities:

(i) The team of two experts will be stationed at the Ministry of Trade and Commerce of the Botswana Government for one year. They would work in collaboration with the relevant officials of the Ministry and two local counterparts and also in consultation with the BMC and other slaughterhouses of Botswana.

(ii) Two locals will be selected by the experts in consultation with the Government and nominations submitted to UNIDO through the UNDP office. Time schedule will be as follows:



6. Project Inputs

(i) Government inputs

The Botswana Government would constitute US$20,000 in local currency for local travelling and subsistence outside Gabarone of the two experts, provision of office space, telephone facilities secretarial assistance and stationery and office equipment. The Government will have to attach two local counterparts to the two experts and one secretary and one manager and provide a vehicle with a driver for their use.

(ii) UNIDO Inputs

		US$
Two Fellowships		30,000
Mission of Two experts	24 m/m	140,000
Contingencies etc.		20,000
		190,000

6. Evaluation Plans

The two experts will send half-yearly reports on their work to UNIDO for evaluation and follow-up and a final report about the accomplishment of the objective of their mission.

UNITED NATIONS

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNIDO

JOB DESCRIPTION

Post title INDUSTRIAL ECONOMIST

Duration 12 MONTHS

Date required 1 April 1984

Duty station Gaborone

Purpose of project To carry out feasibility studies and submit reports in respect of INSULIN, PANCREATIN, ALBUMIN, AMINO ACIDS GELATIN AND HYALURINDASE.

Duties The expert will be specifically expected to:

(i) Visit BMC and their slaughterhouses to make quantative assessment of available meat by-products.

(ii) Discuss with local entrepreneurs market possibilities of these products.

(iii) Visit financial institutions to make an assessment of availability of financial capital.

(iv) Evaluate the prospective markets in the region on the basis of present and potential consumption.

(v) Prepare jointly with other experts the feasibility reports.

(vi) Help in the selection of locals for training abroad in biotechnology.

(vii) Submit half-yearly and final reports to UNIDO on the work.

..../..

Applications and communications regarding this Job Description should be sent to:

Project Personnel Recruitment Section, Industrial Operations Division
UNIDO, VIENNA INTERNATIONAL CENTRE, P.O. Box 300, Vienna, Austria

V.81-33106

Qualifications

(i) An Industrial Economist with a knowledge of opotherapeutic products and experience in feasibility studies.

(ii) Experience in African countries

Language

English

Background information

A mission of two experts, an Industrial Economist and a specialist in opotherapeutic production, carried out a techno-economic survey of the production potential of opotherapeutics based on meat by-products in Botswana. They identified several products such as Insulin, Pancreatin Amino Acids, Gelatin and Hyalurinades as potentially viable industries. They recommended inter alia that the Ministry of Commerce and Industry should take early action to institute feasibility studies in respect of each one of them. The Ministry has now requested a two team of experts o be stationed in Gabarone for 12 months to complete these studies and also to arrange training of two locals in biotechnology to be utilized in the opotherapeutic industries which the Government may decide to set up on the basis of the feasibility studies.

UNITED NATIONS

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNIDO

JOB DESCRIPTION

Post title BIOTECHNOLOGIST

Duration 12 months

Date required 1 April 1984

Duty station Gaborone

Purpose of project To carry out feasibility studies and submit reports in respect of INSULIN. PANCREATIN, ALBUMIN, AMINO ACIDS GELATIN AND HYALURINDASE.

Duties

The expert will be specifically expected to:

(i) Visit BMC and their slaughterhouses to make quantative assessment of available meat by-products.

(ii) Interview local institutes and specialists using biotechnology related to opotherapeutic technology.

(iii) Prepare jointly with the Industrial Economist the Feasibility reports.

(iv) Help with selection of locals for training abroad in biotechnology.

(v) Submit half-yearly reports and final report to UNIDO

..../..

Applications and communications regarding this Job Description should be sent to:

Project Personnel Recruitment Section, Industrial Operations Division
UNIDO, VIENNA INTERNATIONAL CENTRE, P.O. Box 300, Vienna, Austria

7.31-33106

Qualifications (i) A bio-chemist or a pharmaceutical technologist with experience in bio-active substance production from meat by-products.

(ii) experience in African countries

Language English

Background information A mission of two experts, an Industrial Economist and a specialist in opotherapeutic production, carried out a techno-economic survey of the production potential of opotherapeutics based on meat by-products in Botswana. They identified several products such as Insulin, Pancreatin Amino Acids, Gelatin and Hyalurinades as potentially viable industries. They recommended inter alia - the Ministry of Commerce and Industry should take early action to institute feasibility studies in respect of each one of them. The Ministry has now requested a two team of experts to be stationed in Gabarone for 12 months to complete these studies and also to arrange training of two locals in biotechnology to be utilized in the opotherapeutic industries which the Government may decide to set up on the basis of the feasibility studies.

Fellowships

Two fellowships

Qualifications required:

1. Degree in bio-chemistry or chemistry
2. Work experiencein a chemical laboratory or chemical industry
3. Age : between 25 - 40 years

Annex 7.7

TERMS OF REFERENCE

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

PROJECT PROPOSAL

PART A - BASIC DATA

COUNTRY /REGION	:	Botswana,Zimbabwe,Lesotho,Swaziland
PROJECT NUMBER	:	
PROJECT TITLE	:	Survey ofthe possibilities of pooling raw materials for establishment of viable pharmaceutical industries based on meat-by-products in any oneof the four countries (Botswana,Zimbabwe, Lesotho and Swaziland)
SCHEDULED START	:	January 1984
SCHEDULED COMPLETION	:	April 1984
ORIGIN AND DATE OF OFFICIAL REQUEST	:	
GOVERNMENT COUNTER-PART AGENCY	:	Ministry of Industry
UNIDO CONTRIBUTION	:	US$ 40.000
GOVERNMENT CONTRIBUTION	:	US$ 10.000
CURRENCY REQUIRED	:	US$ 40.000
UNIDO SUBSTANTIVE BACKSTOPPING SECTION	:	Pharmaceutical Industries Unit Chemical Industries Branch/DIO
PROGRAMME COMPONENT CODE	:	32.1.D

PART B - NARRATIVE

1. Objectives

The primary objective of this proposal is the utilization of the raw materials in all the countries of the SADECC region free offood and mouth disease for the production of pharmaceuticals based on meat by-products for the overall development of the region. The specific immediate objective of the project is as follows:

To field a mission of two experts for a three month period to make (i) an assessment of the material position of Zimbababwe, Lesotho and Swaziland for viable production of pharmaceuticals especially Insulin and Gelatin (ii) examination of any existing institutional arrangements in these countries for their production and (iii) the evaluation of the prospective markets for the products primarily in the SADECC region.

The specificobjectivewhen accmplished will enable decisions to be taken as regards the future manufacture of pharmaceuticals based on meat-by products in the region.

2. Background and Justification

1.1 This proposal emerges from a mission of the industrial economist and the expert on opotherapeutic production to Botswana,under the project RP / BOT/ 82/ 001 /11-02 and 11-03 This mission took place between December 1982 - March 1983 and the report of the mission recommended ,inter alia , the following : "UNIDO should initiate action to send to each one of the countries of Zimbabwe,Lesotho and Swaziland a team of a bio-technologist and an industrial economist to survey the possibility of pooling of raw materials for estabalishment of viable opotherapeutic industries in Botswana or any one of these countries to cater first the needs of SADECC countries and then outside ".

1.2 The mission referred in para 1.1 had found that the raw material. which could be provided by Botswana, was not adequate for a viable insulin industry in Botswana and recommended that the

possibility of obtaining the requested balance from the other countries in the SADECC free from foot and mouth disease. The idea of policy resources first originated in the cours of intervies of the Mission with the relevant specialists in Botswana.It was notpossible to arrange visits to the other three countries while the mission was in Botswana.Therefore the mission in its report has made this recommendation.

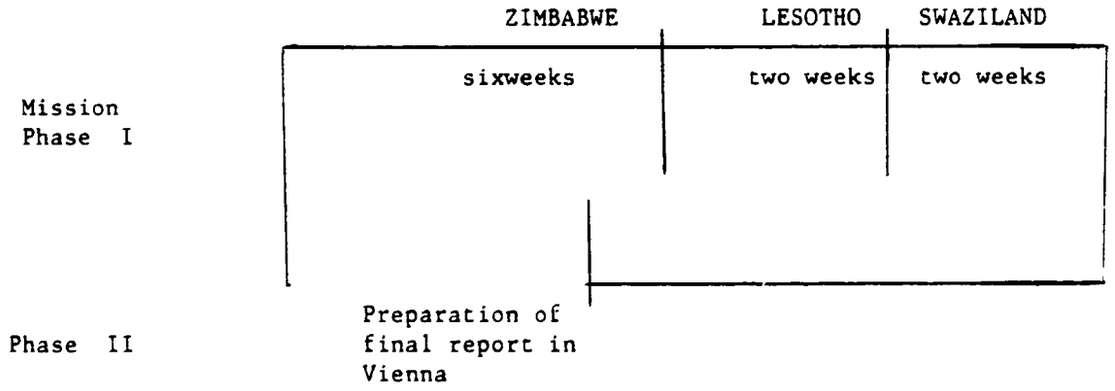
3. Project Outputs

The project output will be one Technical Report embodying the above objectives ,namely "Potential for Regional Development of Pharmaceuticalsbased on meat-by products by pooking of raw materials in the relevant countries of the region."

4. Project Activities

The activities of the project would be the fielding of the mission as follows:

(i) two experts will visit the ghree countries for 10 weeksas follows and spend the remaining two weeks in Vienna for writing and finalisation of the report as follows:



5. Project Inputs

(i) Government inputs

The three governments of Zimbabwe,Lesotho and Swaziland would respectively contribute US$ 6.000 , US$ 2.000 and US$ 2.000 totalling US$ 10.000 for travelling within the country and provision of other supporting facilities such as office space, secretarial assistance.

(ii) UNIDO inputs

Mission:	2 experts 3m/m	US$ 4.000
	contingences, report	US$ 1.000
		US$ 5.000

6. Evaluation plans

The project will be evaluated in the approved fashin for UNIDO projects after the presentation of the report by the relevant government officials togetherwiththe Special Technical Adviser of UNIDO substantive section.

7. Follow-up Action

Consequent to the evaluation of the technical report and the detailed study of the technical report, follow-up action will be taken to field ateam for feasibility study.

UNITED NATIONS

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNIDO

JOB DESCRIPTION

Post title	Industrial Economist
Duration	3 months
Date required	1 January 1984
Duty station	Harare
Purpose of project	To make an assessment of the raw material position of Zimbabwe, Lesotho and Swaziland for viable production of opotherapeuticals
Duties	The expert will be specifically expected to: (i) assess the availability of meat by-products by visiting slaughterhouses and other institutions connected with their production and marketing in these three countries. (ii) examine any existing industrial arrangements for formulation ofpharmaceuticals based on such products (iii) evaluatethe prospective markets for these products primarily in the SADECC region (iv) prepare the joint technical report embodying the findings and recommendations for follow-up action.

..../..

Applications and communications regarding this Job Description should be sent to:

Project Personnel Recruitment Section, Industrial Operations Division
UNIDO, VIENNA INTERNATIONAL CENTRE, P.O. Box 300, Vienna, Austria

7.81-33106

Qualifications	Industrial economist or development economist preferably with aknowledge of pharmaceutical products based on meat by products.
	Experience in African Countries
Language	English
Background information	A mission of two experts anIndustrial Economist and Opotherapeutic Technologist in Botswana carried out a techno-economic survey of the production of pharmaceuticals from meat by products . It emerged from their joint report a recommendation to poolthe raw materials from all slaughterhouses ofSADECC countries free of foot and mouth disease, namely Botswana, Zimbabwe,Lesotho and Swaziland,for viable production of products such as Insulin andGelatin.

UNITED NATIONS

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNIDO

JOB DESCRIPTION

Post title	Expert in the production of bio-active substances from meat by-products
Duration	3 months
Date required	1 January 1984
Duty station	Harare
Purpose of project	To make an assessment of the raw material position of Zimbabwe, Lesotho and Swaziland for viable production of opotherapeuticals
Duties	The expertwill be specifically expected to: (i) assess the availability of meat by-products by visiting slaughter-houses and other institutions connected with their production and marketing in these three countries. (ii) examine any existing industrial arrangements for formulation of pharmaceuticals based on such products (iii) evaluate the prospective markets for these products primarily in the SADECC Region. (iv) prepare the joint technical report embodying the findings and recommendations for follow-up action.

..../..

Applications and communications regarding this Job Description should be sent to:

Project Personnel Recruitment Section, Industrial Operations Division
UNIDO, VIENNA INTERNATIONAL CENTRE, P.O. Box 300, Vienna, Austria

7.81-33106

Qualifications	(i) biochemist or pharmaceutical technologist with experinece in bio-active substances production from meat-by-products. (ii) experience in aAfrican countries
Language	English
Background information	A mission of two experts, an industrial economist andopotherapeutic technologist in Botswana carried out a techno-economic survey of the production of opotherapeuticals from meat-by products.It emergedfrom their joint report a recommendation to pook the raw materials from all slaughterhouses of SADECC countries free of foot and mouth disease, namely Botswana, Zimbabwe ,Lesotho and Zwaziland, for viable production of products such as insulin and gelatin.

Annex 7. 8

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