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ESTABLISHMENT OF A DEVELOPMENT PLAN
FOR THE PHARMACEUTICAL INDUSTRY

UC/ALG/85/062

ALGERIA

Technical report: Availability and utilization of animal organs in the production of bioactive substances*

Prepared for the Government of the Democratic and People's Republic of Algeria by the United Nations Industrial Development Organization

Based on the work of Mr. O. Scedrov, expert in the production of bioactive substances from animal origin

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## I. SUMMARY

As many data as possible were collected on Algerian import of opotherapeutics, cr better said on bioactive substances from animal sources. Pharmaceutical Department and Preventive Medicine Department of the Ministry of Public Health were visited and useful data collected. A visit was made to the ENAPHARM Drugs Control Laboratory. The bioactive substances activity determination in imported drugs was suggested, especially that of insulin activity checking. After a useful discussion at the Veterinary Department of the Ministry of Agriculture and Fishery, visits were made to the three slaughterhouses, as representative ones, in Algiers, El Harrach, and Blida. All of them are of small slaughter capacity. Some of them have freezing chambers at -20° or -10°C, but they were locked because they belonged to the Ministry of Commerce. Nowhere existed collecting of any slaughtered animal glands or blood. From the data received in written form of the Ministry of Agriculture and Fishery about the meat produced in 47 Algerian slaughterhouses, the number of cattle and sheep slaughtered per year were calculated (assuming that approximately 200 kg of meat can be obtained from a cow, and 20 kg of meat from a sheep). Added together were the slaughterhouses capacities of five major ones (provided with better cooling facilities) in Blida, Tizi-Ouzou, Algiers (includes three slaughterhouses), Annaba and Constantine. It was calculated that if pancreas were collected in all of them together, it could be possible to have only 11% of raw material needed for the least economic insulin production. For the pancreatin production, only 21% of the pancreas necessary for the minimum viable production were found. In the biggest Algerian slaughterhouse it could be possible to collect an amount of blood for less than half of the least economic capacity, even for blood meal production. There is no economic argument for bile collecting, because of too small a quantity for dry bile processing. In Algeria, approximately the same amount of beef and mutton is imported as produced in all Algerian slaughterhouses together.

After his discussions with relevant colleagues in Yugoslavia, the expert strengthened his attitude that it is not realistic to recommend any production of bioactive substances from animal sources in Algeria now.

The expert recommendations are to start developing in Algeria the methods and procedures of the applied biochemistry, the biotechnology, and the isolation and purification of bioactive substances from animal sources and their activity determination. Maybe the first step should be to establish such a laboratory or department at the Biological Institute, Houari Boumediene University in Algiers. During the expert's visit to the Institute he found there an interest and willingness to be involved in the country's practical problems and try to do some applied research needed for the country. It is further recommended to equip a laboratory with standard apparatus and devices needed for such work, and employ young specialists educated and trained at the University; send one of them for training in the isolation and purification procedures of bioactive substances from animal sources abroad in a well-known company, and another for training in bioactive substances activity determination. Another possibility would be to ask for the international experts assistance in introduction of such activities in Algeria. Immediately start collecting glands in all slaughterhouses where possible, with pancreas first and after that include the other glands, too. Maybe in the future there will be more raw material available from the slaughterhouses, and at the same time there will be an experience gained in this production technology. A new slaughterhouse is to be built in Algiers soon, maybe this year, to replace the old one visited by the expert. This would be a good chance to have a modern slaughterhouse on a true international level, of a slaughter capacity and with freezing chambers at $-30^{\circ}C$, big enough for animal blood and gland collecting in the amount needed for an economic production of some bioactive substances from animal sources. Maybe pancreatin, dry bile, or at least the blood and carcass meal will be possible to produce.

When in the future in Algeria there will operate one slaughterhouse big enough for collecting animal glands and blood necessary for an economic production of some bioactive substances, it would be advisable to ask for offers of complete know-how from a world-known company. This is the usual and the cheapest way in a new type of production establishment in any country.

## II. INTRODUCTION

### A. Project background

The Algerian Government would like to cover the country's needs in pharmaceutical products and asked UNIDO assistance for the preparation of a general plan of the pharmaceutical industry development in the next twenty years.

A high level UNIDO mission visited Algeria in the beginning of 1985. It was decided to arrange the preparation of such a general plan. For that purpose UNIDO fielded in Algeria an international team of 15 experts. The general plan mentioned will include syntheses, various fermentation procedures, opotherapeutics production, pharmaceuticals extracted from medical plants, contraceptive production, packaging materials, equipment for pharmaceutical industry, economy, and civil engineering.

The experts will prepare their separate reports independently and all reports will serve together as a basis for the elaboration of a general plan of pharmaceutical industry development in Algeria.

### B. Official arrangements

The starting date of the expert in opotherapeutics production was 13 July 1985, and the completion date was on 26 July 1985, according to the Job Description (Annex 5.1).

The mission included field work in Algeria and debriefing in UNIDO Headquarters in Vienna.

Due to the difficulties of conforming his air ticket, the expert left Algeria earlier, on 22 July, and the rest of the three days of his mission he spent in UNIDO Headquarters in Vienna, completing his report.

C. Objectives of the work

To evaluate the information available on importation and consumption of opotherapeutic drugs in Algeria.

To calculate the number of livestock in Algeria and the animals slaughtered yearly. To estimate the quality and quantity of the animal glands which could be collected in the country.

To propose a plan of development of the opotherapeutics industry with utilization of slaughterhouse byproducts, taking into consideration the actual capacity and possibility of the country's slaughterhouses.

To incorporate the proposals into a general plan of the pharmaceutical industry development in the next twenty years in Algeria, which plan will be elaborated by an international team of experts.

D. The meaning of the expression "Opotherapeutics"

It would be useful to discuss the expression opotherapeutic products. "Opotherapeutics" is an old term for a raw extract of animal organs or glands. Current products obtained from animal sources and used as pharmaceuticals and drugs are mainly chemically pure substances like insulin, heparin, hyaluronidase, etc. Maybe the word organotherapeutics would explain the meaning better, but it seems that the phrase bioactive substances from animal sources would be the best choice.

## III. FINDINGS

### A. Elaboration of the Expert Field Mission Work Programme

The Chief Technical Adviser of the Project (Annex 5.2.1.6) and the National Project Director (Annex 5.2.1.9) elaborated with the expert the work programme of the field mission, which included:

- Collecting the information available on the bioactive substances from animal sources (opotherapeutics) imported in Algeria.

- Data collecting on the slaughterhouses capacities and cooling facilities in the country,

- Visit the slaughterhouses on the international level in Algeria,

- Collecting the data on the livestock in Algeria, meat consumption, animals slaughtered, and the meat imports to the country,

- Possibility of activity determination of the bioactive substances from animal sources imported and produced locally in the future,

- Possibility to include young Algerian specialists in the problem of bioactive substances from animal sources production.

### B. Visit to the Ministry of Public Health

#### 1. Pharmaceutical Department

A visit was arranged by the National Counterpart Team Member (Annex 5.2.1.10) to the Director of the Pharmaceutical Department, Ministry of Public Health (Annex 5.2.1.12). The Chief Technical Adviser joined the visit. Information was collected that figures on the import of medicines and drugs in the country can be found in the "Market Survey ENPP-SAIDAL, January 1985", for the year 1982. Data on consumption of medicines and drugs in Algeria, including bioactive substances from animal sources, were not available.

2. Preventive Medicine Department

During the visit to the Director General of the Department (Annex 5.2.1.13) and his Deputy (Annex 5.2.1.14), a useful discussion was held. They have in Algeria too many kinds of very different medicines and drugs imported. Elaborating a nomenclature of the indispensable preparations is in process and will be completed soon. They will make a list of priorities for the future import of drugs, too. It will be specified which drug is of the first, second, third, etc. priority.

In Algeria they have approximately the same percentage of diabetics as in the developed countries. As Algeria has about 20 million inhabitants, that means about a million patients are suffering from Diabetes mellitus.

3. Data on bioactive substances from animal sources import in Algeria

The Chief Technical Adviser provided the expert with figures available in the official publication "Market Survey ENPP-SAIDAL, January 1985", for the year 1982. With the help of expert team member (Annex 5.2.1.7), some data on bioactive substances from animal sources import in Algeria were calculated, which are listed in Annex 5.3.

Some of these preparations, such as liver extract, are old-fashioned and not used any more in up-to-date medicine. Thus, liver extract production was discontinued in Yugoslavia 25 years ago, and in Egypt it was not produced any longer in 1977, according to the expert's own experience.

C. Visit to the Ministry of Agriculture and Fishery

The National Counterpart Team Member (Annex 5.2.1.10) arranged the visit to the Director of the Veterinary Department, Ministry of Agriculture and Fishery (Annex 5.2.1.15). The Director provided the expert with the figures on livestock in Algeria, in written form, and the quantity of meat imported in

Algeria, verbally. Livestock in Algeria in 1984:

- Cattle 1,400,000 head,
- Sheep 15,500,000 head,
- Goats 3,000,000 head,
- Horses 160,000 head,
- Mules and asses 700,000 head,
- Camels 150,000 head, and
- Poultry 150,000,000 head.

The cattle slaughter goes on in the north of Algeria, the sheep and goats everywhere, and the camels in the south of the country.

Meat import in Algeria in 1984:

- Beef 32,000,000 kg,
- Mutton 31,000,000 kg, and
- Goat meat 1,800,000 kg.

In Algeria there are 47 slaughterhouses, and five or six of them are on the international level.

The Veterinary Department Director suggested a visit to three of them, as representative ones, in Algiers, El Harrach and Blida.

Figures on the livestock planned in Algeria for 1985 to 1989 were collected also from a FAO expert (Annex 5.2.1.8) in UNDP Office in Algiers:

- Cattle 2,000,000 head and
- Sheep 13,000,000 head.

## D. Slaughterhouses visited

### 1. Algiers Slaughterhouse

Algiers Slaughterhouse was visited with the help of the National Counterpart Team Member (Annex 5.2.1.10) and discussion was held with the City Chief

Veterinary Inspector (Annex 5.2.1.21). After a round of the slaughterhouse, the expert can make a conclusion that the hygienic conditions are acceptable and the cooling space at 0°C is big enough.

They slaughter cattle and sheep only. Capacity of the actual slaughter amounts per day to about:

- Cattle 100 head and
- Sheep 500 to 1,000 head,

according to the Chief Veterinary Inspector's words.

Taking 300 working days in a year, it would be per year about:

- Cattle 30,000 head and
- Sheep 150,000 to 300,000 head.

They discard blood and all glands of the animals slaughtered. They never collect them. The Chief Veterinary Inspector was interested in collecting them, but they have no freezing chambers at all.

The slaughterhouse is an old one, built at the beginning of the century, and it will be abandoned this year. A new one will be built at another location in the city. According to the expert opinion, this would be a good opportunity to have an actually big-capacity slaughterhouse, with good and ample cooling facilities, including freezing chambers at -30°C, and permitting the collection of slaughtered animals' blood and glands.

During the expert's visit there were several big Hungarian refrigerated trucks in the slaughterhouse yard and beef was just being unloaded from them.

In Algeria it is forbidden to slaughter young animals, as the Chief Veterinary Inspector explained to the expert. The rennet production is possible only from calf and lamb stomachs of animals younger than six weeks. This is the only raw material for rennet production. So, it is not possible to make rennet in Algeria.

2. El Harrach Slaughterhouse

El Harrach can be considered as one of Algiers suburbs.

The slaughterhouse is of a modest size, with slaughter of:

- Sheep 100 to 250 head per day,
- Cattle 20 to 40 per week, and
- Horses 100 per week,

according to the Technician's (Annex 5.2.1.22) verbal explanation. It was about noon and he was the only responsible person there. The slaughter began early in the morning and all was finished by that time.

The approximate slaughter per year could be calculated from the figures mentioned:

- Sheep 30,000 to 75,000 head,
- Cattle 1,000 to 2,000 head, and
- Horses 5,000 head.

The slaughterhouse is an old one, too, and though smaller than that in Algiers, there exist special canals for slaughtered animals blood collecting. They had collected it several years ago, and the glands too. The blood was sent to SANATRAC factory and fertilizer was made and used successfully. Today Algeria imports fertilizer, and they did not need blood any more and they stopped collecting it.

El Harrach slaughterhouse has big freezing chambers at -20°C, but they were locked. The Technician explained that the freezing chambers belonged to another ministry, the Ministry of Commerce.

3. Blida Slaughterhouse

Blida is a town of 200,000 inhabitants, about 60 km south of Algiers, and nearby to the mountains.

After obtaining the mayor's permission, in addition to the letter of the Ministry of Agriculture and Fishery, a discussion was arranged with the Slaughterhouse Director (Annex 5.2.1.23). He informed the expert and the Chief Technical Adviser verbally about the slaughter and cooling facilities.

The slaughter in June 1985 amounted to:

- Cattle 710 head and
- Sheep 8,086 head,

but the least monthly slaughter amounts to:

- Cattle 300 head and
- Sheep 7,000 head.

The approximate slaughter per year could be calculated from these figures:

- Cattle 3,600 to 8,500 head and
- Sheep 84,000 to 97,000 head.

There are freezing chambers at -10°C, of a big capacity, and another one at +6° to +7°C, big too, but all of them were locked.

After the visit to the three slaughterhouses, it can be concluded that all of them are of too small a capacity for any reasonable production of bioactive substances from animal sources. In addition, the freezing chambers are in doubt, because in cases where they exist they were locked as belonging to another ministry. The freezing chambers are a vital part of any slaughterhouse and it would be advisable not to separate them administratively.

E. Control Laboratory of ENAPHARM in Algiers

The Control Laboratory is independent of pharmaceuticals producers and belongs to ENAPHARM, the enterprise dealing with drug and medicine imports in Algeria.

The Laboratory is well equipped and, according to the Laboratory Director (Annex 5.2.1.19), they checked all drugs and medicines imported in Algeria.

Unfortunately, they have no method available for insulin activity determination, and believe in the declarations of foreign suppliers.

According to the expert's experience from his other missions, especially in Burma, insulin activity in vials can diminish at the high local temperature, as is the case in Algeria, too. An additional examination of insulin activity is needed. The Pharmacology Department of the Control Laboratory is equipped well enough for the insulin activity determination by a biological method. The Pharmacologist (Annex 5.2.1.20) would like to do it and asked the expert to send them a good procedure for insulin activity determination.

F. The Houari Boumediene University

In Algiers there is a new University of Natural and Technical Sciences, the Houari Boumediene University, located in all new buildings and with about 15,000 students.

The University is very well equipped. Amongst others, there is a Biological Institute. The Institute includes the Biochemistry Laboratory, the Microbiology Laboratory, etc.

According to the Biological Institute Director (Annex 5.2.1.16), Professor of Microbiology (Annex 5.2.1.17) and the Biochemist (Annex 5.2.1.18), they are dealing primarily with scientific problems. At the same time, they would like to be involved in the country's practical problems, and they would like to do some applied research needed for the country's development, too. Now, they are vexed with how and where to employ the new graduate students. They are very interested in establishing some new sections of the Institute, as for instance for Applied Microbiology and Biotechnology.

According to the expert's opinion, this is the most important for the pharmaceutical industry development on the whole, and particularly for the production of bioactive substances from animal sources, in the country. Without well-trained young specialists involved and interested in these problems, it will not be possible to achieve any success, even if enough raw material would be available locally.

G. Calculations on the basis of figures obtained on the Slaughterhouse capacities in Algeria

In Table 1 (Annex 5.4) presented are figures received in written form from the Director of the Veterinary Department, Ministry of Agriculture and Fishery (Annex 5.2.1.15), through the National Counterpart Team Member (Annex 5.2.1.10), the day before the expert left Algeria. The figures list the meat obtained in Algerian slaughterhouses from January to March 1985, that means for three months. From those figures calculated can be the quantity of meat produced in Algeria during three months, and multiplying the figures by four, the yearly amount of meat produced in Algerian slaughterhouses can be deduced.

Assuming that, on average, 200 kg of meat is obtained from a cow and 20 kg of meat from a sheep (Annex 5.2.2.4 and 5.2.2.5), the number of animals slaughtered in all Algerian slaughterhouses per year can be computed, and divided by 300, the daily slaughter in the country can be obtained. These figures are listed in Table 2 (Annex 5.5).

It would be better to compute the capacity of five to six slaughterhouses mentioned as the biggest ones and on the international level. (Even this is in question, after the expert's visit to the three of them as representative ones.) They are in Blida, Tizi-Ouzou, Algiers (including three slaughterhouses), Annaba, Constantine and Oran. As for the Oran Slaughterhouse, there are no figures in Table 1, only slaughterhouses in five towns can be taken into consideration. It can be calculated in the same way

as in Table 2, and the figures are presented in Table 3 (Annex 5.6).

Adding the meat from all Algerian slaughterhouses and that imported per year, the meat consumption in the country can be seen. Using the method mentioned, the number of animals slaughtered yearly for the Algerian consumption can be calculated. From these figures one can see the percentage of meat imported in the country. All these figures are listed in Table 4 (Annex 5.7).

## H. Discussion on the insulin production possibility in Algeria

Talking about the bioactive substances from animal sources, in our mind is insulin, the well-known and the most important drug derived from animal glands. Insulin is the only medicine for the more serious cases of Diabetes mellitus.

Let me discuss the possibility of insulin production in Algeria. Insulin is still produced mainly from animal sources, about 90% on the world market. The rest of 10% is obtained through genetic engineering. Pig and bovine glands are used as raw material. Sheep pancreas was excluded because of serious side effects of sheep insulin. Bovine glands are no longer the main raw material, as of several years ago, because of four differing amino acids in the bovine insulin. Pig insulin differs in only one amino acid from the human one, and causes the least side effects. In addition, this amino acid can be changed by organic synthetic methods. The human insulin so obtained is called "semi-synthetic insulin".

In Algeria they do not use pig meat at all, and so the pig pancreas is not available. They use beef and mutton mainly. As sheep pancreas has to be excluded for insulin production, so bovine pancreas remains only.

For an economic viability of insulin production, at least 200 tons of pancreas per year are needed. Taking into consideration that a single

bovine pancreas has on an average 170 gr, the slaughter of 1,200,000 head of cattle per year is needed.

In Algeria they consume yearly 85,676 tons of beef, including imported meat, which amounts to about 428,000 head of cattle (Table 4, Annex 5.7). This will be 37% of raw material needed for a viable insulin production. But this is not a reality. Only the slaughter in the slaughterhouses on an international level can be taken into consideration. So, we can count on the five slaughterhouses mentioned before, in the best case. That means the slaughter of about 132,000 head of cattle per year together (Table 3, Annex 5.6), or only 11% of the quantity of glands needed for a viable insulin production.

It will be better to look for other possibilities of getting bioactive substances from animal sources.

The formulations of insulin in vials are mostly new ones and it is not so easy to make them. Lente, Semilente, Retard, etc. forms of insulin in vials ask for very skilled work. The well-known Protamine-Zinc-Insulin is an old insulin formulation, and is generally not used any more.

In addition, an increase of insulin production through genetic engineering is expected in the near future.

It is not easy to forecast the actual figures for the next ten years, and especially not so for the next twenty years.

## I. Discussion on the possibility of some bioactive substances from animal sources production in Algeria

On the last day of his field mission in Algeria the expert discussed such a possibility with the National Project Director (Annex 5.2.1.9) and the National Counterpart Team Member (Annex 5.2.1.10). Mentioned was the

slaughtered animals' blood processing as the only possibility, and perhaps the pancreatin production, too. The expert received the data of slaughterhouses capacities in Algeria in written form only the day before leaving Algeria, and so he made the calculations from these data in Vienna. So figures obtained on the number of animals slaughtered in several Algerian slaughterhouses were mainly similar to those obtained verbally in the slaughterhouses.

According to the data collected from other specialists (Annex 5.2.2.3, 5.2.2.4 and 5.2.2.5) and to the expert's own experience:

- a bovine pancreas weighs about 170 gr and
- a sheep pancreas weighs about 20 to 30 gr, or an average of 25 gr.

Approximately 10 kg of blood can be collected from a cow after slaughter, and 0.6 to 1.0 kg, on average 0.8 kg, of blood from a sheep.

Taking into consideration the five major Algerian slaughterhouses, in all of them a total of pancreas can be collected as follows:

- cattle, 22 tons per year and 75 kg per day, and
- sheep, 10 tons per year and 32 kg per day, which amounts to the
- total of 32 tons per year and 107 kg per day.

In the case of blood it would be advisable to take into account only one slaughterhouse, as the transportation of blood is very clumsy. In the largest one, in Algiers, slaughtered were 45,285 head of cattle per year or 151 per day, and 231,655 head of sheep per year or 772 per day (Table 3, Annex 5.6). The blood quantity which could be collected in the Algiers slaughterhouse (or slaughterhouses) amounts to:

- cattle, 453 tons per year and 1,510 kg per day, and
- sheep, 185 tons per year and 618 kg per day, which amounts to
- the total of 638 tons per year and 2,128 kg per day.

The least economic capacity of pancreatin production requires 500 kg of pancreas per day, or assuming 300 work days in a year, 150 tons of pancreas per year. From one kg of pancreas 150 to 200 gr of pancreatin can be obtained.

In five major Algerian slaughterhouses 32 tons of pancreas per year could be collected altogether, which amounts to 21% of the least economic production capacity. So, unfortunately, the pancreatin production is not advisable in Algeria.

Bile collecting should also not be advisable because of too small a quantity of bile that could be collected.

According to the expert's knowledge and experience from other missions, as in Botswana and Mongolia, at least 1,000 tons of blood per year have to be collected for the minimum viable capacity even of blood meal production.

In the Algiers slaughterhouse(s) it is possible to collect altogether 638 tons of blood per year or 64% of the least economic capacity. According to the National Counterpart Team Member (Annex 5.2.1.10) and the Chief Veterinary Inspector (Annex 5.2.1.21) in Algiers there are three slaughterhouses, and all figures pertain to all of them together. El Harrach Slaughterhouse, visited by the expert, was never mentioned in Table 1 (Annex 5.4) with data received from the Veterinary Department Director, Ministry of Agriculture and Fishery. It can be concluded that this slaughterhouse is considered as one of the Algiers slaughterhouses, too. In any case any single Algiers slaughterhouse is of smaller capacity than all of them, and less blood could be collected than stated for the three Algiers slaughterhouses together.

Upon his return home, the expert held useful discussions with several specialists from:

- "Pliva" Pharmaceutical Works in Zagreb (Annex 5.2.2.1),
- "Galenika" Pharmaceutical Industry in Belgrade (Annex 5.2.2.2 and 5.2.2.3), and
- Slaughterhouse in Zagreb (Annex 5.2.2.4 and 5.2.2.5).

The opinions of all the specialists visited were very similar, i.e. that there is no feasibility for any bioactive substances production from animal sources in Algeria, not even for the blood processing.

The Chief Engineer of "Galenika" (Annex 5.2.2.2) was the most definite. According to him, at least 2,000 tons of blood per year are needed for an economic production, even of blood meal and carcass meal. This is twice as much as the expert evaluated originally.

In "Galenika" they started, years ago, with 20 kg of pancreas per day in the first laboratory experiments of pancreatin production, and in five Algerian major slaughterhouses together only 107 kg of pancreas per day could be collected. "Galenika" is willing to train a young Algerian specialist in the production of bioactive substances from animal sources and another specialist in bioactive substance control, especially in the determination of bioactive substances activity. Start with laboratory experiments in applied biochemistry, and gain some experience in the methods and procedures of the production of bioactive substances from animal sources and of the activity determination.

## IV. RECOMMENDATIONS

It is not realistic to recommend any production of bioactive substances from animal sources in Algeria now.

It should be suggested to develop the methods and procedures of applied biochemistry, the isolation and purification of bioactive substances from animal organs and glands, and their activity determination, on a laboratory scale. This would be the first prerequisite to acquire locally an experience in this field of science and technology.

### A. Immediate Actions

#### 1. Training of a young specialist at the University level

For developing the applied biochemistry, the biotechnology and the isolation and purification of bioactive substances from animal sources and their activity determination, the first step could be to have such a laboratory or department at the university. The Biological Institute at the Houari Boumediene University in Algiers could be the right place for that purpose. Educate some young specialists to be familiar with these problems, and include postgraduate courses. Establish a good connection between the laboratory and the pharmaceutical industry in the country, and especially with the slaughterhouses, for glands collection.

#### 2. Experimental production of some bioactive substances from animal sources on the Laboratory scale

Equip a special laboratory with a standard apparatus and devices for such work and employ young specialists educated and trained at the University. Send one of them for training with a well-known company abroad. "Galenika" in Yugoslavia offers this kind of training. Another possibility is to ask an international expert assistance for the introduction of such an activity in Algeria.

Start and develop the activity in the laboratory. Produce bioactive substances from animal sources on the laboratory scale. Maybe in the future there will be more raw materials available from the slaughterhouses, and at the same time experience will be gained in such production technology.

3. The activity determination of the bioactive substances from animal sources

The expert was asked in the ENAPHARM Control Laboratory in Algiers to send a prescription for insulin activity determination. There are such usable prescriptions in many well-known pharmacopoeias, as the British Pharmacopoeia of 1980, the U.S. Pharmacopoeia XX of 1980, the European Pharmacopoeia, the French Pharmacopoeia, etc.

As Algeria belongs to the French-speaking countries, the European Pharmacopoeia (Pharmacopée Européenne) of 1975, or the French Pharmacopoeia (Pharmacopée Francais) X of 1983 could be recommended.

In any case, start as soon as possible with the insulin activity determination in all insulin batches imported. Insulin activity in vials can easily diminish because of the possibility of insulin destruction, especially at higher temperatures. The activity determination has to be done in all other drugs and medicines imported (and produced locally) which contain any bioactive substance from animal sources.

Introduce the activity determination in the experimental laboratory for the isolation and purification of bioactive substances from animal sources.

Perhaps send a specialist to be trained in this field abroad in a well-known laboratory or company. "Galenika" in Yugoslavia offers such a training. Another possibility is to ask an international expert to assist in Algeria in the introduction of activity determination of bioactive substances from animal sources.

4. Collecting the glands from slaughterhouses

Start immediately to collect the glands in all slaughterhouses where it is possible, with pancreas first and after that include other glands, too.

The glands have to be removed from the animals as soon as possible after slaughter, cleaned of fat and connective tissue and lymphatic glands, and immediately after that put in a freezing chamber at -20°, still better at -30° to -40°C. The glands can be kept under these conditions no longer than six months, because the bioactive substance destruction starts even in the frozen state. Arrange with the Ministry of Commerce the use of the freezing chambers in the slaughterhouses for the collecting and keeping of the glands.

5. Construction of a slaughterhouse of bigger capacity and of better freezing chambers

According to the information obtained from the National Counterpart Team Member (Annex 5.2.1.10) and the Chief Veterinary Inspector in Algiers (Annex 5.2.1.21), a new slaughterhouse is to be built in Algiers soon, possibly this year, to replace the old one visited by the expert.

This represents a good chance to have a modern slaughterhouse on a true international level, of a slaughter capacity big enough for animal blood and gland collecting in the quantity needed for an economic production of some bioactive substances from animal sources, maybe pancreatin, dry bile, or at least the blood and carcass meal production.

Do not forget freezing chambers of as big a capacity as possible, and of a good freezing ability at -30°, or if possible at -40°C.

B. Long term activities

We hope that in the future in Algeria there will operate one slaughter-

house of slaughter capacity big enough to permit collecting the slaughtered animal glands and blood needed for an economic production of some bioactive substances from animal sources.

It is advisable, in that case, to ask for offers for complete know-how from well-known companies as Alpha-Laval, Tumba, Sweden, or Niro, Soeborg, Copenhagen, Denmark, or Westphalia, West Germany, or Schoeller Bleckmann, Linz, Austria, etc. This is the usual way, and even the cheapest one, in establishing a new type of production on the industrial level in any country.

And finally, the expert would like to send his message to the project. According to the expert's experience gained from his other missions in Burma, certain Arab countries (Egypt, Sudan, Syria, Iraq), Botswana and Mongolia, of prime need is a local experienced specialist who will be particularly interested in the production of bioactive substances from animal sources. The expert found such a man only in Mongolia, and only in Mongolia exists a "living" project, of all the projects mentioned. Without such a local specialist, the expert's report will remain a sheet of paper only, and will be not transformed into a living reality.

ANNEX I

Meetings and discussions held with various specialists and other persons

1 During the Mission

1.1 A. Tcheknavorian, Ph.D., Chief of Pharmaceutical Industries Unit, UNIDO, Vienna, Austria, 24 and 25 July 1985.

1.2 Z. Csizer, Ph.D., Pharmaceutical Industries Unit, UNIDO, Vienna, Austria, 23 to 25 July, and in Algiers, Algeria 13 to 15 July 1985.

1.3 D. Whaley, Resident Representative, UNDP, Algiers, Algeria, 14 July 1985.

1.4 Lj. Andrejević, FAO Representative, Algiers, Algeria, 16 July 1985.

1.5 Hebbadj, Programme Officer, UNDP, Algiers, Algeria, 13 to 17 July 1985.

1.6 K. Ivanov, Ph.D., Chief Technical Adviser of the Project, Algiers, Algeria, 13 to 22 July 1985.

1.7 R. Trannoy, Expert Team Member, Algiers, Algeria, 13 to 20 July 1985.

1.8 A. Touati, FAO Expert, UNDP, Algiers, Algeria, 16 July 1985.

1.9 R. Ghebbi, National Project Director, Algiers, Algeria, 14 to 21 July 1985.

1.10 Antri-Bouzar Elies, National Counterpart Team Member, Algiers, Algeria, 14 to 21 July 1985.

1.11 Belkebir, SAIDAL Director General, Algiers, Algeria, 14 July 1985.

1.12 D. Brikci, Ph.D., Director of the Pharmaceutical Department, Ministry of Public Health, Algiers, Algeria, 20 July 1985.

1.13 Professor H. Lekchal, Director General of the Preventive Medicine Department, Ministry of Public Health, Algiers, Algeria, 20 July 1985.

1.14 Chakour, Ph.D., Deputy Director of the Preventive Medicine Department, Ministry of Public Health, Algiers, Algeria, 20 July 1985.

1.15 A. Abda, Ph.D., Director of the Veterinary Department, Ministry of Agriculture and Fishery, Algiers, Algeria, 15 July 1985.

1.16 Professor M. Bensalem, Director of the Biological Institute, Houari Boumediene University, Algiers, Algeria, 20 July 1985.

1.17 Professor Chikhi, Department of Microbiology, Biological Institute, Houari Boumediene University, Algiers, Algeria, 20 July 1985.

1.18 B. Mermouri, Department of Biochemistry, Biological Institute, Houari Boumediene University, Algiers, Algeria, 20 July 1985.

1.19 Menouar, Director of the Control Laboratory of ENAPHARM, Algiers, Algeria, 21 July 1985.

1.20 S. Bougdal, Chief of the Department of Pharmacology, Control Laboratory of ENAPHARM, Algiers, Algeria, 21 July 1985.

1.21 F. Bessaih, Ph.D., City Chief Veterinary Inspector, Algiers, Algeria, 17 July 1985.

1.22 Ghemri, Technician, El Harrach Slaughterhouse, El Harrach, Algeria, 17 July 1985.

1.23 B. Djellal, Director of Blida Slaughterhouse, Blida, Algeria, 21 July 1985.

2 After the Mission

2.1 D. Veble, M.Sc., Technical Counsellor, "Pliva" Pharmaceutical Works, Zagreb, Yugoslavia, 29 July 1985.

2.2 M. Miočinović, Chief Engineer, "Galenika" Pharmaceutical and Chemical Industry, Belgrade, Yugoslavia, 30 July 1985.

2.3 L. Živković, M.Sc., Collaborator of the Research Institute, "Galenika" Pharmaceutical and Chemical Industry, Belgrade, Yugoslavia, 30 July 1985.

2.4 S. Rukavina, Veterinary Counsellor, Zagreb Slaughterhouse, Zagreb, Yugoslavia, 31 July 1985.

2.5 T. Kolar, M.Sc., Veterinary Inspector, Zagreb Slaughterhouse, Zagreb, Yugoslavia, 31 July 1985.

ANNEX II

Data on import in Algeria of some bioactive products from animal sources

Calculated from "Market Survey ENPP-SAIDAL, January 1985", for the year 1982. Calculations made with help of another expert team member (Annex 5.2.1.7):

| | | |
|---|---|---|
| - Liver extract | 7031 | kg |
| - Pyloric extract | 626 | kg |
| - Bovine gastric mucous-membrane and muscles extract | 4300 | kg |
| - Hyaluronidase | 0.15 | kg |
| - Thiomucase | 407.5 | kg |
| - Insulin, injections in several forms: $86 \times 10^6$ International Units, or expressed as crystalline insulin | 2.83 | kg |
| - Alpha-Chymotrypsin | 3 | kg |
| - Heparin | 16.75 | kg |
| - Dry bovine bile | 103.5 | kg |
| - Pancreatin | 900 | kg |

Pancreatin with dry bovine bile are in the form of "Festal" and "Pancreflash" pills.

ANNEX III

Statistic Data of the controlled slaughter in Algeria on the first three months, 1985

Unit = kg
Others = Caprines, Camelines, Equines
N.C. = Information not communicated

Sources: Wilayate veterinary inspections

| WILAYATE | JANUARY | | | FEBRUARY | | | MARCH | | | TOTAL, FIRST QUARTER 1985 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cattle | sheep | others | cattle | sheep | others | cattle | sheep | others | cattle | sheep | others |
| Adrar | 7,146 | 6,118 | 9,508 | 4,057 | 8,585 | 18,785 | 4,873 | 3,749 | 14,844 | 16,076 | 18,492 | 43,137 |
| Chleff | 38,178 | 26,367 | 5,517 | 79,566 | 16,879 | 2,887 | 76,932 | 31,441 | 5,203 | 224,671 | 75,187 | 1,360 |
| Laghouat | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | 92,149 | 46,137 | 22,971 |
| Own-El-Bouaghi | 93,560 | 72,538 | 6,019 | 84,070 | 48,962 | 5,135 | 71,887 | 39,205 | 5,093 | 249,517 | 140,705 | 16,247 |
| Batna | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | 220,178 | 108,375 | 18,442 |
| Bejaia | 104,791 | 31,345 | 3,759 | 89,168 | 11,482 | 2,096 | 86,185 | 11,089 | 2,953 | 280,144 | 53,916 | 8,808 |
| Biskra | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | 68,760 | 70,428 | 15,840 |
| Béchar | 84,761 | 8,250 | 12,965 | 19,919 | 9,827 | 8,567 | 222,075 | 8,075 | 17,525 | 326,755 | 25,652 | 39,057 |
| Blida | 141,160 | 69,260 | N.C. | 244,189 | 98,683 | N.C. | 195,286 | 73,594 | N.C. | 580,635 | 241,537 | N.C. |
| Bouiru | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | 144,275 | 31,225 | 2,490 |
| Tamanrasset | 1,743 | 10,892 | 34,029 | 1,338 | 10,220 | 63,467 | 1,518 | 10,800 | 65,702 | 4,599 | 31,912 | 193,198 |
| Tebessa | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | 86,114 | 60,937 | 19,321 |
| Tlemcen | 73,715 | 99,503 | 1,024 | 77,680 | 72,382 | 899 | 75,495 | 41,528 | 845 | 226,890 | 213,413 | 2,368 |
| Tiaret | 73,479 | 13,368 | 4,490 | 83,457 | 130,724 | 12,555 | 44,298 | 59,721 | 10,699 | 201,284 | 203.813 | 27,744 |
| Tizi-Ouzou | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | 2,510,720 | 252,510 | 6,875 |

| Wilayate | January | | | February | | | March | | | Total, 1st quarter 1985 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cattle | sheep | others | cattle | sheep | others | cattle | sheep | others | cattle | sheep | others |
| Alger | 701,193 | 376,622 | 109,039 | 741.192 | 358,797 | 124,225 | 821,851 | 822,822 | 127,816 | 2,264,236 | 1,158,274 | 361,082 |
| Djelfa | 48,595 | 42,679 | 8,827 | 25,809 | 77,658 | 4,787 | 26,510 | 31,654 | 10,120 | 100,914 | 152,191 | 23,734 |
| Jijel | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | 411,624 | 25,205 | 1,275 |
| Setif | 92,500 | 24,873 | N.C. | 98,045 | 27,945 | N.C. | 80,911 | 29,481 | N.C. | 271,556 | 82,301 | N.C. |
| Saida | 69,816 | 13,387 | 5,350 | 61,292 | 19,246 | 4,324 | 14,021 | 3,414 | 150 | 151,129 | 36,347 | 9,824 |
| Skikda | 318,188 | 12,887 | 1,783 | 441,228 | 21,784 | 3,040 | N.C. | N.C. | N.C. | 759,416 | 34,671 | 4,823 |
| Sidi-Bel-Abbes | 72,807 | 34,930 | 857 | 72,574 | 39,452 | 993 | 61,929 | 48,854 | 2,097 | 207,470 | 723,256 | 2,147 |
| Annaba | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | 613,425 | 98,970 | N.C. |
| Guelma | 35,690 | 16,743 | 2,616 | 22,268 | 14,154 | 2,192 | 30,172 | 14,975 | 2,010 | 88,130 | 45,872 | 6,868 |
| Constantine | 245,871 | 60,230 | N.C. | 117,766 | 54,291 | N.C. | 245,756 | 43,054 | N.C. | 609,393 | 157,574 | N.C. |
| Medea | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | 245,534 | 99,727 | 3,090 |
| Mostaganem | 69,710 | 37,767 | 7,566 | 61,160 | 43,588 | 4,798 | 66,670 | 61,365 | 6,123 | 197,540 | 142,130 | 18,487 |
| M'sita | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. |
| Mascara | 77,935 | 71,432 | 3,788 | 65,285 | 59,790 | 1,240 | 61,080 | 73,980 | 2,225 | 204,300 | 205,208 | 7,253 |
| Ouargla | 85,120 | 51,105 | 47,588 | 45,940 | 52,896 | 46,248 | 85,460 | 64,066 | 44,236 | 216,920 | 168,066 | 138,072 |
| Oran | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. |
| El-Bayadh | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | 27,092 | 9,012 | 1,753 | 21,092 | 9,012 | 1,753 |
| Illizi | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. |
| Bordj-Bou-Arreridj | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | 228,300 | 273,690 | 14,600 |
| Boumerdes | 159,622 | 69,029 | 470 | 202,874 | 50,340 | 170 | N.C. | N.C. | N.C. | 362,496 | 119,369 | 640 |

| Wilayate | January | | | February | | | March | | | Total, 1st quarter, 1985 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cattle | sheep | others | cattle | sheep | others | cattle | sheep | others | cattle | sheep | others |
| El-Tarf | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | 11,774 | 2,284 | 1,019 |
| Tindouf | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. |
| Tissemssilt | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. |
| El-Oued | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | 18,680 | 43,455 | 78,306 |
| Khenchela | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | 7,002 | 27,837 | 10,560 |
| Souk-Ahras | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | 118,979 | 64,028 | 16,594 |
| Tipaza | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | 238,128 | 98,374 | 6,753 |
| Mila | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | 170,149 | 66,824 | 23,780 |
| Ain-Defla | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | 393,631 | 22,236 | 4,145 |
| Eulma | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | 19,551 | 10,084 | 145 | 19,551 | 10,084 | 145 |
| Ain-Témouchent | 63,376 | 18,225 | 5,023 | 49,483 | 22,668 | 885 | 56,576 | 28,297 | 3,756 | 169,435 | 69,192 | 9,669 |
| Ghardaia | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | 87,106 | 165,414 | 19,537 |
| Relizane | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. | N.C. |

Slaughter in all Algerian slaughterhouses

| Slaughter in all Algerian slaughterhouses | Meat obtained in kg | | Number of animals slaughtered, approximately | |
|---|---|---|---|---|
| | Jan.-Mar. 1985, i.e. for three months | Per year | Per year | Per day |
| Cattle | 13,419,072 | 53,676,288 | 268,381 | 895 |
| Sheep | 5,076,014 | 20,304,056 | 1,015,203 | 3,384 |
| Total | 18,495,086 | 73,980,344 | - | - |

ANNEX V

Slaughter in major Algerian towns

| Slaughter in five largest Algerian towns | Cattle | | | | Sheep | | | |
|---|---|---|---|---|---|---|---|---|
| | Meat obtained in kg | | Number of animals slaughtered approximately | | Meat obtained in kg | | Number of animals slaughtered approximately | |
| | Jan.-Mar.85, i.e. for three months | Per Year | Per Year | Per Day | Jan.-Mar.85, i.e. for three months | Per Year | Per Year | Per Day |
| Blida | 580,635 | 2,332,540 | 11,613 | 39 | 241,537 | 996,148 | 48,302 | 161 |
| Tizi-Ouzou | 2,510,720 | 10,042,880 | 50,214 | 167 | 252,510 | 1,010,040 | 50,502 | 168 |
| Algiers | 2,264,236 | 9,056,944 | 45,285 | 151 | 1,158,274 | 4,633,096 | 231,655 | 772 |
| Annaba | 613,425 | 2,453,700 | 12,269 | 41 | 98,970 | 395,880 | 19,794 | 66 |
| Constantine | 609,393 | 2,437,572 | 12,188 | 41 | 157,574 | 630,296 | 31,515 | 105 |
| Total | 6,578,409 | 26,313,636 | 131,569 | 439 | 1,908,865 | 7,635,460 | 381,773 | 1,272 |

Meat consumption in Algeria from animals slaughtered

| Kind of animals | Meat per year | | | | | | From head of animals slaughtered approximately | |
|---|---|---|---|---|---|---|---|---|
| | From all Algerian slaughterhouses | | Imported | | Total | | | |
| | kg | % | kg | % | kg | % | Per year | Per day |
| Cattle | 53,676,288 | 63 | 32,000,000 | 37 | 85,676,288 | 100 | 428,381 | 1,428 |
| Sheep | 20,304,056 | 40 | 31,000,000 | 60 | 51,304,056 | 100 | 2,565,203 | 8,551 |
| Total | 73,980,344 | 54 | 63,000,000 | 46 | 136,980,344 | 100 | - | - |

ANNEX VII

Water solution of blood for poultry feed

Healthy animal blood was collected after slaughter in milk cans. It was put immediately in a refrigerator at $0^{\circ}$ to $4^{\circ}$C, and left 4 to 5 days. After that, the blood clots were ground in a meat grinder, sera added (liquid remainder of blood), and then the same weight of water was added. After one hour the mixture was boiled slowly during another hour. The preparation obtained is ready for use. In case it has to stand until the next day, 10% of NaCl should be added as a preservative.

This preparation can be given to poultry in their feed twice a day, in the morning and in the evening, for three months. Each animal should receive 1 to 2 ml of the preparation every day, depending on body weight.

The poultry with the preparation in the feed will be 30% heavier after three months on average than the poultry without the preparation from blood in the same type of feed.