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ELABORATION OF A TECHNOLOGY FOR FEED ADDITIVE PRODUCTION

DP/MON/86/008

MONGOLIA

Terminal report*

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

Prepared by the Institute of Biotechnology,
Academy of Sciences, Ulan Bator

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* This document has not been edited.

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I. INTRODUCTION

Biotechnology, because of its benefits for agriculture, medicine and others was chosen as an one of the four priorities of the Mongolian Government's Programme for the National Development.

Due to the rapid growth of the Mongolian population and the increasing need to provide raw materials for light and food industries modernization of the national agriculture especially of the animal production through the development of biotechnology became the main target of the national economy.

Consequently, the National Plan for the Economic and Social Development for 1986-1990 envisaged a 10-12% increase of the average annual gross output in animal husbandry. The meat production was planned to reach the level of 530 thousand tons by 1990, the milk production 350 million litres and butter 5.3 thousand tons. Most of this growth in livestock production was to be achieved through the application of modern biotechnology.

One of the major conditions of raising the livestock output is to increase the productivity of the cattle by provisions of enriched animal feed and feed additives. In Mongolia the lack of protein additives for animals is estimated to be around 300,000 tons per year. The most economical way to produce feed additives, such as single cell proteins, aminoacids, feed antibiotics and vitamins, is the development of the microbiological industry. However, no microbiological industry existed in Mongolia at the moment of Project formulation and no feasibility studies were available to establish such an industry.

The Government's plan to support the development of biotechnology recognized the above-mentioned facts and aimed at getting foreign expertise, equipment and establishing the feed processing industry. Special emphasis was given to the training of the local labour force in new process biotechnologies and laboratory techniques. Thus, the Project "MON/86/008 Elaboration of a Technology for Feed Additive Production" reflected one of the four main priorities - development of biotechnology - expressed in the National Development Plan for 1986-1990.

II. MAIN PART

Starting date:	April, 1988
Duration:	3 years
UNDP contribution:	341,797 US $
Government contribution:	2,325,000 tughriks

The Executing Agency for the Project MON/86/003 was the United Nations Industrial Development Organization (Vienna) which was directly in charge of recruitment of international experts, procurement and delivery of equipments as well as of arrangements of study tour and individual fellowships.

The Implementing Agency was the Institute of Biotechnology, Mongolian Academy of Sciences, which was responsible for providing the building and facilities to install the Project equipment and carry out the Project activities, recruitment of the local staff and providing the laboratory research needed for the Project implementation.

The Project consisted of two parts: Preparatory Assistance and the main Project. During the Preparatory Assistance the available infrastructure and staff in the related field, as well as need for technical cooperation were assessed, the main Project was formulated and the local research staff was recruited (Annex 1). But during the Project implementation the local staff was changed in connection with the movement of the Institute's personnel and Project activities.

II.1. PROJECT OBJECTIVES

At the moment of Project formulation the Institute of Biotechnology possessed a collection of well characterized microorganisms (bacteria, actinomycetes and yeasts), mainly isolated from the soil. Among them there were two strains which could be used for elaboration of a technology for feed additive production (L-lysin and protein). However, because of (a)lack of sophisticated fermentors and chemicals for advanced research; (b)lack of highly qualified national personnel and (c)shortage of experience in biotechnology R and D and know-how the Institute could not carry out the research on microbial technology.

To overcome the difficulties so far encountered and to assist through the development of microbial technology in the application of biotechnological achievements for national production processes, especially with regard to livestock, the Project's

development and immediate objectives were formulated as following:

Development objective: to improve the national agricultural production through biotechnology-based improvement of livestock yields and development of fodder additives for animal feed.

Immediate objective: the development of a new technology for the production of feed additives through elaborating methods of microbial synthesis.

At the end of the Project implementation the following outputs were expected to have been produced:

Output 1: an experimental biotechnological pilot plant strengthened with modern fermentation facilities and laboratory equipment.

Output 2: a group of six scientific senior research staff from the Institute of Biotechnology trained in modern biotechnological methods of producing microbial protein, antibiotics, etc. and a number of junior researchers and laboratory personnel trained on the spot.

Output 3: a set of guidelines and methodologies on application of the advanced technology for production of feed additives (lysin concentrate, single cell proteins and antibiotics).

II.2. ACTIVITIES AND OUTPUTS PRODUCED

All activities for the implementation of the Project have been carried out in close cooperation between the UNIDO (Vienna), UNDP Resident Representative and the Institute of Biotechnology. Most of planned activities have been successfully implemented except the activities relating to the output 3. It was suggested from the UNDP Resident Representative not to invite the expert on fermentation equipment because Mr. M.Lingnau from Prings (Germany) had already installed the 100 L fermenter and carried out on-the-job training of the counterpart personnel. The Institute took into account that opinion and agreed not to invite such an expert, but in its turn suggested to train one researcher in the field of taxonomy of industrially important actinomycetes, what was then approved by the UNDP and UNIDO.

Output 1

Pilot plant and laboratory equipment in accordance with the list prepared by the Project staff and UN expert (excepting the 100 L fermenter) were received and installed in due course (Annex 2). Delay in delivery the fermenter was caused by the difficulties in its transportation to Mongolia. However, the fermenter was received and successfully installed at the end of February, 1991.

The equipment delivered by the Government (three 20 L fermenters, steam generator, vacuum evaporator, atomizer dryer and etc.) were installed in collaboration with the local and CMEA member country's specialists (Annex 2).

Thus, now there is an experimental biotechnological pilot plant strengthened with modern fermentation facilities and laboratory equipment at the Institute of Bioteohnology. At present it is used for elaboration methods of microbial synthesis of -carotene by yeasts and fermentation technology for production of bakery yeasts. The concentration and drying of materials for traditional medicine and food are carried out here as well.

Output 2

in the course of the Project implementation great attention was paid to the training of the national staff in different fields of modern biotechnology. As a result there are 10 researchers successfully trained in microbial fermentation, biochemistry, genetics, taxonomy and fermentation equipment. Study tour for 2 scientists in France was organized as well (Annex 3). On-the-job training of the counterpart personnel on fermenter was carried out with the consultation of Prings specialist Mr.Lingnau in the time of joint experiment on yeast fermentation just after the installation of 100 L fermenter.

The Project stimulated the scientific activity of the Institute's personnel and the Government organized fellowships in the form of post-graduate course for 5 young researchers involved in the Project. Now they are doing their Ph.D. thesis abroad in different fields of modern biotechnology (Annex 4).

However, it should be noted here that some researchers trained in the Project frame left the Institute for private

business because of the new economic situation in the country. It was not good for research activity of the Institute, but it might be a significant contribution to the achievement of the project development objective because they set up the company named "Shim" for production of feed additives (lysin, single cell protein and etc.) and microbial fertilizers (Annex 5).

Thus, there are scientific staff trained for advanced research in microbial synthesis and fermentation technology who is now engaged in elaboration the methods of microbial synthesis of feed and food additives and their production.

Output 3

As it was mentioned above according to the opinion of the UNDP Representative the invitation of the UNIDO expert on fermentation equipment was cancelled. Probably, because of this the compilation of guidelines and methodologies for the production of feed additives was not provided by the UNIDO. However, the national staff elaborated the technology on lysin and single cell protein production. In 1991 this technology with the feasibility study data was transferred to the former Ministry of National Development (Mr. Buudaykhuu).

In collaboration with the researchers from the Institute of New Antibiotics (Moscow, Russia) it was found that the antibiotic produced by the examined strain was new and belonged to the aureolic acid group of antibiotics. The results will be published in journal "Antibiotics and Chemotherapy" (Moscow, Russia). The suitability of this new antibiotic to be a feed additive is an object of further study and, therefore, technology for its production cannot be elaborated here.

Thus, there is a set of guidelines and methodologies on application of the technology for production of lysin concentrate and single cell protein.

III. CONCLUSIONS AND RECOMMENDATIONS

Now at the end of the Project implementation the following conclusions can be made:

1. The Project was first and significant step towards the

setting up the microbiological industry in Mongolia. It laid the basis (pilot plant and laboratory facilities and trained staff) for research in microbial synthesis and further development of microbial technology not only for feed additives but different products of microbial synthesis as well.

2. The technology on production of feed additives such as lysin concentrate and single cell protein was developed through the elaboration methods of microbial synthesis. At present there is a focal point for training of the Institute's personnel and the personnel of other biotechnological institutions and university students dealing with fermentation technology. A number of works on fermentation and drying the biological materials are carrying out at the pilot plant. Thus, it can be noted that the immediate objective of the Project is achieved.

3. The pilot plant and laboratory facilities set up as a result of the project implementation were aimed to provide research and training in the field of microbial synthesis and fermentation technology, but not to produce feed additives. Therefore, to achieve the development objective, i.e.to improve the national agricultural production through biotechnology-based improvement of livestock yields and development of fodder additives for animal feed, large-scale microbiological processing industry had to be set up. However, due to the current economic problems in the country, it is not possible to achieve the mentioned goal in the near future. Nevertheless, the private company which is involved in the production of feed additives and microbial fertilizers has recently been set up and it should be considered as a salutary sign that the development objective might be achieved in visible future.

To strengthen the achievements reached and further improvement of research and application of microbial synthesis and fermentation technology in different fields of National Economy the next steps should be recommended to undertake:

1. To finish the equipping of pilot plant and laboratories by supplying the fermenter for 500 L, freeze dryer, capping machine, filter press, gas chromatography, high performance liquid chromatography and etc. to provide the elaboration of entire process of microbial fermentation technology for food, feed and

pharmaceutical industry.

2. To train researchers in the field of purification of microbial products, improvement of strain productivity, fermentation technology of antibiotics and vitamins, management and marketing of biotechnological products.

ACKNOWLEDGEMENT

The Institute of Biotechnology, Mongolian Academy of Sciences, and the Project national staff thank the Mongolian Government, the UNDP, the UNDP Representative in Mongolia, the UNIDO, the international experts and everybody who promoted and assisted to the Project formulation, approval and its successful implementation.

LITERATURE CITED

1.UNDP Project Document MON/86/008 "Elaboration of a Technology for Feed Additive Production", 1989.
2.Technical Report: Preparatory assistance. Vienna, May 17, 1988.
3.Project Performance Evaluation Report of 1990 and 1991.

Annex 1

NATIONAL AND INTERNATIONAL STAFF

A.National staff

Name	Position	Start	Finish
1.T.Puntsag	Chief of the Sector of Microbiology	Apr 1988	Oct 1991
2.G.Urantsooj	Head of the Lab.	Apr 1988	Aug 1990
3.L.Sanjdorj	Research scientist	Apr 1988	Aug 1990
4.B.Badrakh	Research scientist	Apr 1988	Sept 1989
5.D.Naranchimeg	Research scientist	Apr 1988	March 1990
6.Ch.Dulamsuren	Research scientist	Apr 1988	Oct 1991
7.T.Bold	Research scientist	Apr 1988	Sept 1989
8.G.Dorj	Research scientist	Apr 1988	Sept 1989
9.D.Tserendulam	Research scientist	Apr 1988	Oct 1991
10.Ts.Damdingaa	Research scientist	Apr 1989	Oct 1991
11.D.Monkhbat	Research scientist	Apr 1988	Oct 1991
12.D.Dulmaa	Research scientist	Aug 1989	Oct 1991
13.T.Narantsetseg	Head of the Lab.	Aug 1989	Oct 1991
14.B.Tsetseg	Head of the Lab.	Aug 1990	Oct 1991

B.International staff

Name	Position	Period of stay
1.Rehacek Z.	UNIDO expert on Preparatory assistance	April 1988
2.Rehacek Z.	UNIDO expert on Microbial synthesis	September 1989

Annex 2

LIST OF NON-EXPENDABLE EQUIPMENT DELIVERED BY THE UNIDO

Description	Quantity	Price, US$
1.Microscope Axioscop Opton with accessories	1	3,840
2.PC/AT Compatible Personal Computer System	1	2,100
3.Seikosha SP-180AI Printer	1	240
4.Analitical Balance Ohaus GA 110	1	2,272
5.Schott PH-meter CG 838/42	1	333
6.Electronic Balance Ohaus E 120	1	1,206
7.Safety Cabinet Ehret ET 100/H	1	5,076
8.Jar Fermenter 10-746 type M	1	18,800
9.Pilot Fermenter 100 L with accessories	1	113,226
TOTAL		147,093 US$

LIST OF NON-EXPENDABLE EQUIPMENT DELIVERED BY THE GOVERNMENT

Description	Quantity	Price, tughriks
1.Steam Generator (Russia)	1	36,000
2.20 L Fermenter (Czechoslovakia)	3	814,200
3.Vacuum Evaporator (Denmark)	1	400,310
4.Atomizer Dryer (Denmark)	1	503,320
5.Compressor (Russia)	1	2,460
TOTAL		2,027,690 tughriks

Annex 3

STUDY TOUR AND FELLOWSHIPS ORGANIZED BY THE UNIDO

A.Study tour

1.Name:	T.Puntsag
Position:	Chief of the Sector of Microbiology
Field of study:	Management of research in Biotechnology
Place of study:	Several institutions in France
Duration:	15 days
2.Name:	B.Arya
Position:	Research scientist
Field of study:	Research lab. facilities
Place of study:	Several institutions in France
Duration:	15 days

B.Fellowships

1.Name:	G.Urantsooj
Position:	Head lab.
Field of study:	Microbial synthesis
Place of study:	University of Tokyo, Japan
Duration:	4 months
2.Name:	L.Sanjdorj
Position:	Research scientist
Field of study:	Technical microbiology
Place of study:	Institute of Microbiology, Prague, Czechoslovakia
Duration:	4 months
3.Name:	B.Badrakh
Position:	Research scientist
Field of study:	Fermentation technology
Place of study:	Several institutions in Germany
Duration:	4 months
4.Name:	T.Narantsetseg
Position:	Head of the Lab.

Field of study: Biochemistry
Place of study: Institute for Nutritional Resources, Beijing, PR of China
Duration: 2 months

5.Name: D.Dulmaa
Position: Research scientist
Field of study: Strain improvement
Place of study: Institute for Nutritional Resources, Beijing, PR of China
Duration: 2 months

6.Name: Ts.Olziybaatar
Position: Research scientist
Field of study: Biochemistry
Place of study: Institute for Nutritional Resources, Beijing, PR of China
Duration: 2 months

7.Name: Ts.Damdingaa
Position: Research scientist
Field of study: Fermentation equipment
Place of study: Institute of Microbiology, Prague, Czechoslovakia
Duration: 2 months

8.Name: D.Monkhbat
Position: Engineer
Field of study: Fermentation equipment
Place of study: Institute of Microbiology, Prague, Czechoslovakia
Duration: 2 months

9.Name: D.Suvd
Position: Research scientist
Field of study: Mutagenesis of Amylase
Place of study: National Institute of Agrobiological Resources, Tsukuba, Japan
Duration: 6 months

10. Name: B.Tsetseg
Position: Head of the Lab.
Field of study: Taxonomy of Actinomycetes
Place of study: University of Newcastle upon Tyne, UK
Duration: 6 months

Annex 4

STUDY TOURS AND FELLOWSHIPS ORGANIZED BY THE GOVERNMENT

A. Study tours

1. Name:	T. Puntsag
Position:	Chief of the Sector of Microbiology
Field of study:	Fermentation equipment
Place of study:	JZD Agrokombinat, Slusovice, Czechoslovakia
Duration:	15 days
2. Name:	G. Dorj
Position:	Research scientist
Field of study:	Fermentation equipment
Place of study:	JZD Agrokombinat, Slusovice, Czechoslovakia
Duration:	15 days
3. Name:	L. Sanjdorj
Position:	Research scientist
Field of study:	Meeting of CMEA member countries on amino acid production
Place of study:	Institute of Biotechnics, Moscow, Russia

B. Fellowships

1. Name:	T. Bold
Position:	Research scientist
Purpose of study:	Postgraduate course
Place of study:	Institute of Bioorganic Chemistry, Moscow, Russia
Duration:	3 years
2. Name:	G. Dorj
Position:	Research scientist
Purpose of study:	Postgraduate course
Place of study:	J. Attila University, Szeged, Hungaria

Duration:	3 years
3.Name:	B.Badraldh
Position:	Research scientist
Purpose of study:	Postgraduate course
Place of study:	Humboldt University, Berlin, Germany
Duration:	3 years
4.Name:	D.Naranchimeg
Position:	Research scientist
Purpose of study:	Postgraduate course
Place of study:	Institute of Biochemistry, Sofia, Bulgaria
Duration:	3 years
5.Name:	D.Tserendulam
Position:	Research scientist
Purpose of study:	Yeast fermentation
Place of study:	Institute of Microbial Biochemistry and Physiology, Puschino, Russia
Duration:	1.5 months

Annex 5

RESEARCHERS TRAINED IN THE PROJECT FRAME AND NOW ENGAGED IN "SHIM" COMPANY

1. G.Urantsooj
2. L.Sanjdorj
3. D.Dulmaa

Annex 6

BACKSTOPPING OFFICER'S COMMENTS

The Institute of Biotechnology at the Academy of Sciences in Ulaanbaatar, which prepared this terminal report, participated actively in the completion of the project activities.

We are pleased to notice that 3 years after the completion of the project the report comes to confirm its successful implementation through the achievement of the output. This terminal report will be a reference for both UNIDO (the experience of Mongolia could be applied in other countries) and Mongolia, which has now got a national capacity in the feed additive production technology.

We recommend that the achievements reached be strengthened within the framework of a follow-up action to be determined by the Mongolian Institute of Biotechnology and submitted to the Mongolian Government.