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DP/ID/SER.A/1008
17 May 1988
ENGLISH

ELABORATION OF TECHNOLOGY FOR FEED ADDITIVES PRODUCTION

DP/MON/86/008/11-51

MONGOLIA

Technical report: Preparatory assistance *

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

Based on the work of Zdeněk Řeháček,
Expert in microbial fermentation technology

Backstopping Officer: B. Galat, Agro-based Industries Branch

United Nations Industrial Development Organization
Vienna

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V.88-24843

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Explanatory note

During the period of mission 3,60 Tughriks were equal to 1,00 USD.

Abstract

"Elaboration of a Technology for Feed Additive Production"
MON/86/008/11-51/J13103
The objectives of the mission (March 22 - May 3, 1988) were fulfilled in close cooperation with UNIDO (Vienna), the Institute of Biotechnology of the Mongolian Academy of Sciences (MAS) and the UNDP Office in Ulan Bator.

The Government Implementing Agency for the project is the newly established Institute of Biotechnology MAS. Its Section of Microbiology will be directly in charge of the project implementation.

An assessment of infrastructure of the Institute of Biotechnology MAS, staff and needs for technical co-operation/assistance was made and is presented.

The experimental results of the Section of Microbiology were evaluated, particularly those of laboratories of microbial synthesis engaged with production of yeast biomass, lysine and other amino acids.

Urgent equipment and chemical requirements were specified as well as a training programme for three national fellowships (four months each) in the field of microbial synthesis, fermentation technology and technical microbiology.

A Draft Project Document MON/ and the Final Technical Report were formulated.

Special emphasis of the project is on setting up microbial manufacture of fodder additives, particularly lysine and microbial biomass.

Procurement of sophisticated fermentors under preparatory assistance (10 l) and under the project (100 l) becomes priority objective.

The up-to-date scientific information and the participation in the international R and D of microbial technology are utmost desirable.

For the implementation of the project financial support by the Government and external sources is needed.

I. INTRODUCTION

Mongolia is predominantly agricultural country. Livestock production constitutes the main proportion of the agriculture output and is largely based on a nomadic way of life of the rural population. The number of animals in the country (cattle, yaks, camels, horses, sheep, goats) per capita of the population is one of the highest in the world. The animals are mainly used for meat and milk production.

Due to the rapid growth of Mongolian population and increasing need to provide raw materials for light and food industries, modernization of national agriculture becomes a crucial target of the national economy. One of the major conditions for raising the livestock output and for increasing the productivity of the cattle is the provision of enriched animal feed and feed additives. At present the lack of protein additives to animal feed is estimated at around 300,000 tons per year.

The most economic way to produce feed additives, such as single cell proteins, amino acids, feed antibiotics and vitamins, is the development of microbial industry.

feasibility studies for establishing such an industry in Mongolia are under elaboration.

Strengthening and further development of the scientific and technical research as well as practical application of know-how in the agricultural sector fall among priority objectives of the National Plan for Economic and Social Development of the country.

Considering that biotechnology in Mongolia is presently at a very early stage of development and that it offers considerable potential for the development of fodder proteins and feed additives, initiation of a project in the field of microbial technology is fully justified.

It is envisaged that UNDP will assist the Mongolian Academy of Sciences in the development of research programmes, improvement of laboratory facilities and in the advanced training of highly qualified cadres.

For the above mentioned reason the Draft Project Document MON/ "Elaboration of a Technology for Feed Additive Production" was formulated within this preparatory assistance.

The project will start activities in July 1988.

The UNDP contribution to the project is supposed to be USD 200,000 and the Government contribution 2,325,000 Tughriks.

The preparatory assistance budget covers USD 70,000 (UNDP contribution, Annex I) and 2,589,000 Tughriks (Government contribution).

II. RECOMMENDATION

It is vitally important that Mongolia should have its own pool of fermentation specialists who are fully conversant with the problems of the country and skilled in using the domestic resources. For this very reason facilities and mechanisms for training such persons should be a prime concern of the project.

Following difficulties encountered in the course of the mission deserve outstanding attention:

- Procurement of two sophisticated fermentors (10 l volume under preparatory assistance, 100 l volume under project).
- Advanced training in microbiology, biochemistry and fermentation biotechnology.
- Transfer of up-to-date scientific information.

Participation in the international R and D of microbial technology is an essential concern.

The national R and D capacity in microbial technology would be improved by the establishment of a national network of the respective research institutes and laboratories. In this development the Institute of Biotechnology MAS could function as the main catalyst and key-coordinator.

The scientists in the field of microbial technology should play a role alongside professional economists, planners and technologists as equal and valued partners in building up their nation.

For the implementation of the respective activities financial support by the Government and external sources is needed.

III. DEVELOPMENT AND IMMEDIATE OBJECTIVES

Project MON/ to which the preparatory assistance is related is to assist the Government in setting up a microbial manufacture of fodder additives for cattle breeding.

The first Draft Project Document for assistance with the selection of appropriate technologies for experimental production of fodder additives by microbial synthesis and their scaling-up was prepared with the consultation of UNIDO and UNESCO experts and submitted to UNDP in April 1987. The preparatory assistance was formulated as a consequence of UNDP's appraisal of the request.

The immediate objectives of the preparatory assistance are:

- to make an assessment of infrastructure, staff and

needs for technical co-operation/assistance;

- to conduct the preliminary work relating to the project implementation, i.e. in relation to microbial strains and nutrient media for development of microbial technology;
- to assist in determining equipment requirements and prepering equipment specification;
- to assist in the preparation of a training programme for the national fellowships in the field of microbial synthesis, fermentation technology and technical microbiology;
- to formulate the draft project document containing project objectives, outputs, activities, the project inputs (UNDP, Govt) and other elements of the project.
- The consultant will also be expected to prepare a final technical report, setting out all findings of his mission and recommendations to the Government on the follow-up actions which might be taken.

IV. ACTIVITIES AND OUTPUTS

Assessment of the Infrastructure

The Government Implementing Agency for the project is the Institute of Biotechnology MAS, acting on behalf of the Mongolian Academy of Sciences. Since 1 January 1988 the Institute is located in a new building in Ulan Bator. It consists of four sections: microbiology, molecular genetics, cell engineering, and biophysics.

The Institute elaborates biotechnology R and D projects within the Academy of Sciences. It employs around 50 professional, sub-professional administrative and technical staff. Research and development activities are supported by the Academy of Sciences.

Section of Microbiology, which will be directly in charge of the project implementation (Annex II), deals mainly with soil microbiology, microbial biochemistry and physiology, and microbial syntheses.

In addition to the Institute of Biotechnology MAS, the Institute of Chemistry MAS actively participates

in the pre-project activities and will also take part in the project implementation, particularly in respect of carrying out investigations on hydrolysis of raw materials for microbial technology.

On behalf of Government of Mongolia , the Academy of Sciences and the State Committee for External Economic Relations supervise the pre-project activities and the project implementation, and provide their guidance and support.

Preliminary work relating to the project implementation

In the framework of pre-project activities a new building for the newly established Institute of Biotechnology MAS was constructed. Another building for the pilot plant is under construction.

Advanced training and horizontal transfer of scientific knowledge were improved by participation of one national research fellow in the Longterm postgraduate training course UNESCO "On modern problems in biology and microbial technology" (1986/87) organized by the Institute of Microbiology of the Czechoslovak Academy of Sciences, Prague, CSSR.

An English language training course (6 months) for selected project personnel (6 persons) was opened in February 1988.

In order to accelerate the R and D in fermentation processes a lecture on "Physiology of formation of secondary microbial metabolites" was given by the mission consultant to the staff of the Institute of Biotechnology MAS and the Institute of General and Experimental Biology MAS (6 April 1988). On this occasion a list of recent literature on amino acid fermentation (Annex III) and some reprints of papers in the field of microbial technology (Annex V) were offered by the consultant to the personnel in charge of the project implementation.

The problem of lack of basic laboratory equipment was partly solved within the Government contribution (Annex IV).

The investigation of the amino acid producing microorganisms has been carried out since 1977 (Annex VI). Within this work six Lactobacillus strains with low production of glutamic acid and a Brevibacterium strain were isolated from the soil samples. The Brevibacterium strain was improved by mutation induced by UV-irradiation and by consequent cultivation on nutrient media with increasing level of lysine. In this way a polyauxotrophic mutant Brevibacterium sp.83 was prepared producing 12-20 g/l of lysine when grown on a sucrose medium under conditions of submerged cultivation on a shaker machine. The mutant was found to be deficient in threonine, methionine and biotin. The laboratory fermentation procedure was successfully scaled-up in the Biocomplex at Songino using an industrial fermentor (2 m^3) with sucrose medium (1,5 m^3). Under these industrial conditions the mutant 83 produced 30-40 g/l lysine. From the total fermentation material of the fermentor 230 kg of a dried feed lysine concentrate was prepared. The concentrate contained following components of interest:

- Amino acids (%) (total 25)

lysine	17	arginine	0,6	asparagine	0,8
threonine	0,4	serine	0,4	glutamine	1,6
proline	0,6	glycine	0,6	alanine	0,8
valine	1,5	methionine	0,1	isoleucine	0,4
leucine	0,7	tyrosine	0,1	phe-nylalanine	0,2

- Vitamins (mcg/g) (total 258,29)

  nicotinic acid 250
  vit. B_1 2
  vit. B_6 6,25
  vit. B_{12} 0,04

- Microelements (mcg %)

  Mo 100, Cu 130, Cr 1300, Ni 1100.

Chicken treated with the dried feed lysine concentrate showed improvements of egg production (10-11 %), egg weight (0,3-1,5 g), and body weight (3,45 %).

The yeast research group was created in 1986. Its attention is focused on the submerged biomass production, at present on screening strains of the genera Saccharomyces and Candida and on an elaboration of cultivation media containing C-source(s) got from different local resources. Till now 75 different strains were isolated and tested on media with following components (in brackets: local production of the component in tons per year): wastes of ethanol production (31,200), whey (60,000), beer production wastes (1655), malt residues (8,851), ethanol (2,400), sawdust (300,000), straw (400,000), residues of potatoes starch production.

It is worth noting that several strains of Candida sp. when grown 72 h on medium with whey hydrolysate produced 23-34 g of biomass per litre with protein content 33-57 %. On wastes of ethanol 17-28 g/l of biomass was yielded containing 20-49 % of proteins. However, the biomass from the medium with whey hydrolysate showed better protein quality as for the amino acid composition and digestibility.

By manipulation of salt components of the whey hydrolysate medium and by statistical evaluation of the results the biomass yields were increased by 80 %. The results were verified in a laboratory fermentor (10 l). The principle of the medium improvement seems to be the simultaneous increase of level of K_2HPO_4 (1,25→7,0 g/l) and $MgSO_4$ (0,6→3,0 g/l).

Another attention was paid to a strain of Saccharomyces cerevisiae producing feed additive ergosterol (17 mg per g dry mass) under conditions of submerged cultivation.

Laboratory of microbial degradation is engaged with screening and investigation of microorganisms utilizing waste products, e.g. those of the local tanner factories.

Needs for technical co-operation/assistance

Modern fermentation equipment and respective chemicals are prerequisites for conducting advanced R and D of microbial technology. In this respect an assistence to the Institute of Biotechnology MAS is urgently needed. The present fermentation facilities of the Institute consist of one fermentor (20 l) only. Thus, most submerged fermentation experiments must be performed outside the Institute and even Ulan Bator, i.e. in the Biofactory at Songino. For this very reason the procurement of two sophisticated fermentors - one 10 l fermentor under preparatory assistance (Annex I), and one 100 l fermentor under the project (Annex X) - falls among most priorite objectives as well as procurement of rare chemicals which are not available in Mongolia.

Equipment and chemical requirements

Equipments and chemicals determined to be procured within the preparatory assistance budget covering UNDP contribution are listed in Annex VII .

Training programme

In order to improve and strengthen advanced training in the field of microbial synthesis, fermentation technology and technical microbiology a programme (Annex VIII) for three national fellowships (4 months each) was prepared to be realized under the preparatory assistance budget covering UNDP contribution.

V. UTILIZATION OF RESULTS

The preparatory assistance has created activities which reinforce national R and D in microbial disciplines.

The experimental results of the national research into production of yeast biomass and lysine (Annex VI) are inspiring stimuli for the implementation of the project.

Within the immediate objectives of the preparatory assistance the Draft Project Document (rev.)(Annex X) and the Final Technical Report were prepared by the consultant.

VI. CONCLUSIONS

The project to which the preparatory assistance is related reflects one of the most serious problems of the national agriculture and stresses the crucial role of the R and D of microbial technology in solving the urgent needs of the country.

The special emphasis of the project is on setting up a microbial manufacture of fodder additives for cattle breeding. Particular attention is given to lysine and microbial biomass.

The Government Implementing Agency for the project is the newly established Institute of Biotechnology HAS. Its section of microbiology with inspiring results in the field of production of yeast biomass and lysine will be directly in charge of the project implementation.

In order to accelerate research, development and application of the respective fermentation processes it is particularly necessary to provide the Institute with sophisticated fermentors and rare chemicals.

Up-to-date scientific information and advanced training are necessary prerequisites of R and D . Due to the fact that the University cannot offer education in modern microbial technology, postgraduate training and study tours are sought to speed up the process of preparing highly qualified fermentation specialists.

Participation in international activities in the field of microbial technology is desirable.

For the implementation of the project financial support by the Government and external sources is needed.

The fruitful co-operation of all parties involved in the preparation of the Draft Project Document and the Final Technical Report is greatly appreciated.

Country: Mongolia
Project Number: MON/
Project Title: Elaboration of a Technology for Feed Additive Production

ANNEX I

PREPARATORY ASSISTANCE BUDGET COVERING UNDP CONTRIBUTION

	TOTAL		1988	
10 PROJECT PERSONNEL	m/m	USD	m/m	USD
11-50 Short-term consultant	1/1.5	8,200	1/1.5	8,200
COMPONENT TOTAL	1/1.5	8,200	1/1.5	8,200
30 TRAINING				
31-00 Individual Fellowships	3/4	40,000	3/4	40,000
39-99 COMPONENT TOTAL	3/4	40,000	3/4	40,000
40 EQUIPMENT				
41-00 Expendable	-	4,000	-	4,000
42-00 Non-Expendable	-	17,300	-	17,300
49 COMPONENT TOTAL	-	21,300	-	21,300
51-00 Sundries	-	500	-	500
GRAND TOTAL	4/5.5	70,000	4/5.5	70,000

ANNEX II

COUNTERPART STAFF INVOLVED IN THE PROJECT IMPLEMENTATION

Name	Position held	Qualification
B. Dashnyam	Sci. Secretary of the Institute of Biotechnology MAS	PhD
T. Puntsag	Chief of the Sector for Microbiology	DSc
G. Urantsooj	Head of the Leboratory for Microbial Synthesis	PhD
L. Sandorj	Research Scientist	Univ. Degree
B. Badrakh	Research Scientist	Univ. Degree
D. Naranchimeg	Research Scientist	Univ. Degree
Ch. Dulamsuren	Research Scientist	Univ. Degree
T. Bold	Research Scientist	Univ. Degree
G. Dorj	Research Scientist	Univ. Degree
D. Tserendulam	Research Scientist	Univ. Degree

ANNEX III

RECENT REVIEWS DEALING WITH MICROBIAL AMINO ACID PRODUCTION

Bloom F.R., Kretschmer P.J.(1983) Effect of genetic engineering of microorganisms on the future production of amino acids from a variety of carbon sources. Chapt.5, 145-171, In Wise D.L.(ed.) Organic chemicals from biomass. The Benjamin/Cummings Publ.Co., London.

Herrmann K.M., Sommerville R.L. eds.(1983) Amino acids biosynthesis and genetic regulation. Addison-Wesley Publ.,London, 453 p.

Komose H. (1983) New genetic approaches to amino-acid-producing strains. Dev.Industr.Microbiol. 24, 109-119.

Soda K, Tanaka H., Esaki N.(1983) Amino acids,pp.479-530, In Rehm H.J. and Reed G.(eds.) Biotechnology 3, Verlag Chemie, Weinheim.

Enei H., Hirose Y.(1984) Recent research on the development of microbial strains for amino-acid production. Biotech.Gen. Eng.Rev.", 101-120.

Hamilton B.K., Hsiao H.Y., Swann W.E., Anderson D.M., Delente J.S.(1985) Manufacture of L-amino acids with bioreactors. Trends in Biotechnol.3, 64-68.

Hütter R., Niederberger P.(1985) Amino acid overproduction, pp. 49-59, In Alaeddinoglu N.G., Demain A.L., Lancini G.C. (eds.) Industrial aspects of biochemistry and genetics. Plenum Press, New York and London.

Tosaka O., Ikeda S., Nakamori S., Enei H., Hirose Y.(1984) Fermentative production of amino acids for animal feed. Dev.Industr.Microbiol.25, 327-334.

Aida K., Chibata I., Nakayama K., Takinami K., Yamada H.(eds.) 1986) Biotechnology of amino acids. Progr.Industr.Microbiol.24, 349 p.

Proc. 5th Internat.Symp. "Genetic of Industrial Microorganisms, GIM 86" (1986) by Alačević M., Hranueli D., Toman Z.(eds.), part B. Ognjen Prica Printing Works, Karlovac 1987, Various Chapters:

Hütter R. Genetic aspects of amino acid production; An introduction, pp. 211-215 In Proc.5th Symp. GIM 86;

Katsumata R., Mizukami T., Kikuchi Y., Kino K. Threonine production by the lysine producing strain of Corynebacterium glutamicum with amplified threonine biosynthetic operon, pp. 217-226;

Kisumi M. Construction of amino acid-hyperproducing strains of Serratia marcescens by transductional and recombinant DNA techniques. pp. 253-262.

Niederberger P., Prasad R., Hütter R. Genetic manipulation of tryptophan biosynthesis in yeast, pp. 263-272.

Kinoshita S.(1987) Amino acid and nucleotide fermentations: from their genesis to the current state. Dev.Industr. Microbiol. 28, 1-12.

ANNEX IV

GOVERNMENT INPUTS (EQUIPMENTS) DURING PRELIMINARY WORK RELATING TO THE PROJECT IMPLEMENTATION

		Tughriks
- Amino acid analyser AAA 881	CSSR	118,450
- Freeze dryer	Hungary	95,630
- Refrigerator centrifuge	GDR	30,084
- Continuous cultivation apparatus [illegible]CUK-2M	USSR	423,380
- Thermostat	GDR	19,850
- Thermostat	USSR	11,740
- Microscope ERGAVAL	GDR	30,000
- Autoclave		5,080
- Incubator shaker LE-204	Hungary	11,855
- Laminar box BA-900 (019-84)	Hungary	31,670
- Specord UV VIS	GDR	50,296
- Specol MK 6E	GDR	24,000
T o t a l		852,035

ANNEX V

Reprints of papers on R and D in microbial technology offered by the consultant to the personnel in charge of the project implementation

- Z. Řeháček, V. Krumphanzl (1987) New trends in microbial technology. Fol.Microbiol. 32, 65-81.
- S. Kinoshita: Glutamic acid bacteria.
- J. Plachý Amino acids. In Krumphanzl V., Řeháček Z.(eds.) Modern Biotechnology, SNTL Prague 1981, pp.677-708.
- D.E. Nicholson: Metabolic pathways. Koch light, Colnbrook 1977.
- K.F. Popp (1987) Organizing technology transfer from research to production. Drug.Develop.Ind.Pharmacy 13(3), 2339-2362.
- D.G. Martin, C. Biles, R.E. Peltonen (1986)Countercurrent chromatography in the fractionation of natural products. Ann. Laboratory, October.
- I. Shutherland (1987) Countercurrent chromatography. Lab. Practice, February.
- E. Bloch: Basic research - The key to economic competitiveness. Interdiscipl.Sci.Revs.12 (2), 101-107, 1987.
- A.R. Michaelis (1987) An international association for the advancement of science. Interdiscipl.Sci.Revs. 12 (2), 97-100.
- Z. Řeháček (1987) International postgraduate training. IAST Newsletter 1 (1), 1-13.
- International UNESCO sponsored postgraduate training courses in science and technology held in Czechoslovakia.

ANNEX VI

SOME PUBLICATIONS OF PERSONNEL IN CHARGE OF THE PROJECT IMPLEMENTATION

- Tserendulam D., Dugarjav J. (1978) Chemical analysis of alcohol wastes. Proc.Inst.Nat.Comp. 3, 99-101.

- Maidar Ch., Tserendulam D. (1980) Results of treatment of the carotene producing yeasts by chemical mutagens. Proc.Inst.Nat.Comp. 5, 129-132.

- Dalanbajr Ts., Tserendulam D. (1983) Physiological study of the carotene synthesis by yeast. Proc.Inst.Nat. Comp. 6, 58-62.

- Tserendulam D., Bajrlkhagva D. (1986) Amino acid content in protein of yeast strains. Proc.Inst.Gen.Exptl. Biol. 21,

- Tserendulam D., Badrakh B., Bold T. et al. (in press) Search for raw materials for yeast fermentation nutrient media. Proc.Inst.Gen.Exptl.Biol. 22,

- Tserundulam D., Bold T.(1988) Changing of the biological and digestion values of yeasts in dependence on the nutrient medium components. Proc.Acad.Sci.MPR.

-Bajrlkhagva D., Dorj G. (1985) Study of the carotene preparation for the chicken as a fodder additive. Inst.Gen. Exptl.Biol. 20.

- Sanjdorj L., Dulamsuren Ch., Puntsag T. (1987) Study of morphology and physiology of lysine synthesizing microorganisms. Inst.Gen.Exptl.Biol. 19, 189-193.

- Sanjdorj L., Dulamsuren Ch., Chulanbat, Puntsag T. (1985) Results of the study of a lysine preparation for the bird fodder additive. Proc.Inst.Gen.Exptl.Biol. 20.

- Sanjdorj L., Dulamsuren Ch.(1988) Results of the study of the lysine synthesizing strain Brevibacterium sp. 73. J. "Information" AS MPR.

- Sanjdorj L., Dulamsuren Ch. (1987) Biologically active substances of the lysine preparation. Proc.Inst. Gen.Exptl.Biol. 22.

- Sanjdorj L., Dulamsuren Ch., Puntsag T., Onkhor G., Shirnen L. (1987). Lysine producing strain Brevibacterium sp.83. Authors' Certification No 313.

ANNEX VII
FOR PREPARATORY ASSISTANCE

List of equipments and chemicals
reguired for the elaboration of a technology
for feed additive production

Title	Supplier	Model	Qty	Price	Total price /USD/
Thin Laver Chroma-tograpry's supplies:					
TLC Tank lid	Sigma	T 7882	4ea	4,75	19,00
TLC Glass develo-ping tank	Sigma	T 9877	2ea	37,10	74,20
Spotting gyide and R reader	Sigma	S 2009	20ea	2,5	50,00
Silica gels for TLC Type G	Sigma	S 6503	500g		21,85
Silicaa Gel on po-lyester	Sigma	T 6145	10 box	49,5	495,00
SPRAY REAGENTS FOR TLC:					
Isatin	Sigma	I 4130	2ea	8,25	16,50
Antimony pentach-loride	Sigma	A 6653	2ea	14,00	28,00
Antimony trichlo-ride	Sigma	A 6528	2ea	16,50	33,00
Ninhudrin	Sigma	N 0507	20ea	88,5	177,00
Orcinol-Ferric chloride	Sigma	O 7875	2ea	8,25	16,50
Rhodamine B	Sigma	R 7378	2ea	8,25	16,50
TIPS AND PIPETMANS:					
Yellow tips C 20	Gilson	23802	20 box	88,00	176,00
Blue tips C 200	Gilson	23812	20 box	88,00	176,00
Natural tips C 5000	Gilson	23969	20 box	88,00	176,00
Adjustable pipetman P 20	Gilson	23600	2ea	78,00	156,00
Adjustable pipetman P 200	Gilson	23601	2ea	78,00	156,00
Adjustable pipetman P 1000	Gilson	23602	4ea	78,00	312,00
Adjustable pipetman P 5000	Gilson	23603	4ea	78,00	312,00
CHEMICAL REAGENTS:					
Inulin	Sigma	I 3754	100g		23,90
Lyticase	Sigma	L 8012	100mg		29.20
-D(+)Melibioze (pfs)	Sigma	M 5500	100g		120,00
2-Mercaptoethanol	Sigma	M 6250	500mg		16,50

N-Methyl-N-Nitro-N-Nitrozoguanidine	Sigma	M 7629	20g		29.50
Dimethyl-d Sulfate (pfs)	Sigma	D 6762	1g		17.00
Xylose,D(+)	Sigma	X 1500	100g		11.00
Arabinose, D(-)	Sigma	A 3131	100g		25.70
Thiamine (B)	Sigma	T 4625	25g		5.60
Riboflavin(B)	Sigma	R 45.00	50g		10.50
Pyridoxine (B)	Sigma	P 9755	25g		9.25
Ergocalciferol (D)	Sigma	E 5750	5g		36.40
Cyanocobalamin (B)	Sigma	V 2876	1g		26.20
L-Amino Acids	Sigma	LAA-21	2kit	35.30	70.60
Carbohydrates	Sigma	Car-11	1kit	44.15	44.15
Lactobacillus MRS Broth	Serva	48236	500g		55.00
SCIENTIFIC MARKING PEN: Cole-Parmer R-9965-00					39.90

BOOKS:

Microbiological methods, 5-th ed., C.H.Collins and P.M. Lyne, Butterworth. Co., London, 1985	Sigma	M 0773	1ea	34.95	34,95
Immobilised cells and enzymes: A practical Approach. J. Woodward, Ed., IRL Press, Oxford, 1985	Sigma	I 3760	1ea	20,00	20,00
Practice of thin layer chromatography, 2nd ed., J.C.Touchstone and M.F.Dobbins, John Wiley & Sons, New York, NY, 1983	Sigma	P 0909	1ea	55.00	55.00
					3099,90

Jar Fermentor, 10-0476	IKEMOTO scientific technology CO!,LTD	Type M	1ea	6600	6600
optional accessories:					
pH controller					4000
DO indicator					3000
automatic defoamer					1867
automatic recorder w/chart					2000

"The Prokaryotes" A Haudbook on Habitots, Isolation, and Identification of bacteria. Ed. by M.P.Starr; H.G.Truper, A.Balows, H.G.Schlegel; 1,2 volumes Springer-Verlag Berlin Heidelberd 1981				200
Bergey's Manual of systematic Bacteriology (Bergey's Manual of Determinative Bacteriology). 1,2,3,4 volumes. Williams a. Wilkins, Baltimore 9th edition				400
Reinforced Clostridial Broth	Serva	48108	0.5kg	58
Nutrient Broth	Serva	48500	0.5kg	45
Sabourand Liquid Medium	Serva	48360	0.5kg	32

total US $ 21,300

TRAINING PROGRAMME FOR THE NATIONAL FELLOWSHIPS

(3/4 m/m ; USD 40,000)

Name	Country	Institution	Training Field	Timing
G. Urantsooj	Japan	- University of Tokyo, Tokyo - Kyoto University, Kyoto - Kyowa Hakko-Kodyo Co Tokyo	microbial synthesis	May-August 1988
B. Badrakh	West Germany	- GBF-Gesellschaft für Biotechnologische Forschung, Braunschweig - Institut für Mikrobiologie der Universitat Bonn, Bonn - Universität Hannover, Hannover	fermentation technology	May-August 1988
L. Sanjdorj	CSSR	- Institute of Microbiology, Cz.Acad.Sci., Prague - Research Institute of Antibiotics and Biotransformation, Roztoky near Prague	technical microbiology	May-August 1988

List of persons met by the consultant during the preparation of the Draft Project Document and the Final Technical Report in Ulan Bator (March 24 - April 30, 1988)

Y.I. Lithoukhin	UNDP Resident Representative
Mrs. Enktuja	UNDP Project Officer
Dr. Ts. Zhanchiv,DSc	Director of the Institute of General and Experimental Biology MAS
Dr. J. Batsuur	Director of the Institute of Technology MAS
Dr. B. Dashnyam	Scientific Secretary of the Institute of Biotechnology MAS Chief of the Section of Molecular Genetics
Dr. T. Puntseg , DSc	Chief of the Section for Microbiology, Institute of Biotechnology MAS
Dr. G. Urantsooj	Head of the Laboratory for Microbial Synthesis, Inst.Biotechnol. MAS
Dr. Cieceg	Head of the Laboratory of Biochemistry and Physiology of Soil Microorganisms, Inst. Biotechnol. MAS
Dr. D.D. Kyamaa	Chief of the Section for Biophysics, Inst. Biotechnol. MAS
Dr. C. Dash	Institute of Chemistry MAS
L. Sandorj	Section for Microbiology, Ins.Biotech.MAS
B. Badrakh	dtto
D. Maranchimeg	dtto
Ch. Dulamsuren	dtto
T. Bold	dtto
G. Dorj	dtto
D. Tserendulam	dtto
Dr.D. Badga, DSc	Director of the Institute of Chemistry MAS

ANNEX X

UNITED NATIONS DEVELOPMENT PROGRAMME

Project of the Government of

MONGOLIA

DRAFT PROJECT DOCUMENT

Title:	Elaboration of a Technology for Feed Additive Production
Number: MON/ 88/002/01/37	Duration: Two years
Primary function:	Institution building
Secondary function:	Direct support
Sector: (Govt.class) Science and Technology	(UNDP class. and code): Sceince and Technology (1600)
Sub-sector: (Govt.class.) Promotion of Sceince	(UNDP class. and code): Promotion of Sceince (1690)
Government Implementing Agency:	Institute of Biotechnology, Academy of Sceinces of MPR
Executing Agency:	United Nations Industrial Development Organization (UNIDO)
Estimated starting date:	July 1988
Government inputs: 2,325,000 (in kind) (Tughriks)	UNDP inputs: 200,000 (US Dollars)

Signed: _____ N. Bayuu
(On behalf of the Government)
Deputy Minister of Foreign Economic Relations and Supply

Date: 29 April 1988

_____
(On behalf of the Executing Acency)

Date: _____

_____
(On behalf of the United Nations Development Programme)

Date: _____

PART I. LEGAL CONTEXT

This Project Document shall be the instrument referred to as such in Article I, Paragraph 1, of the Assistance Agreement between the Government of the Mongolian People's Republic and the United Nations Development Programme, signed by the Parties on 28 September 1976.

The Government Implementing Agency shall, for the purpose of the Standard Basic Agreement, refer to the Government Co-operating Agency described in that Agreement.

PART II. THE PROJECT

PART II. A. Development Objectives

The development objectives, to which the project is related, are to improve the national agricultural production through biotechnology-based improvement of livestock yields and development of fodder additives for animal feed.

PART II. B. Immediate Objectives

The immediate objective of the project is the development of a new technology for the production of feed additives through elaborating methods of microbial synthesis.

PART II. C. Special Considerations

Not applicable.

PART II. D. Background and Justification

Agriculture accounts for 16.3% of Mongolia's total national domestic production and employs about 46% of the country's labour force. Livestock production constitutes the main proportion of the agriculture output and is largely based on a nomadic way of life of the rural population. The number of animals in the country (cattle, yaks, camels, horses, sheep, goa per capita of the population is one of the highest in the world. The animals are mainly used for meat or milk production or for both. The average milk yield of Mongolian cows is comparatively low (600 - 1000 kgs yearly) but the milk has quite a high fat content (4-5%).

Due to the rapid growth of the Mongolian population and the increasing need to provide raw materials for light and food industries, moderniation of national agriculture, specifically animal production becomes one main target of the national economy. Consequently, the National Plan for the Economic and Social Development for 1986-1990 envisages a 10-12% increase of the average annual gross output in animal husbandry. The meat production is planned to reach the level of 530 thousand tons by 1990, milk 350 million litres and butter 5.3 thousand tons. Most of this growth in livestock production is to be achieved through the application of achievements of modern biotechnology.

One of the major conditions of raising the livestock output is to increase the productivity of cattle by provisions of enreached animal feed and

feed additives. At present, 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, amino acids, feed antibiotics and vitamins is the development of the microbiological industry. However, no microbiological industry exists in Mongolia at present and no feasibility studies are available to establish such an industry.

Strengthening and further development of scientific and technical research as well as practical application of know-how in the agricultural sectors fall among first priority objectives of the country's National Plan for Economic and Social Development.

There are plans to strengthen the pilot and experimental base in this particular field and, in this regard, to better staff the national research institutions with skilled and trained personnel. In view of this, the international co-operation is envisaged to assist in the application of biotechnological achievements for national production processes, especially with regard to livestock.

So the Government of Mongolia is actively participating in the comprehensive programme of CMEA member countries on biotechnology. At present there is a section in the Institute of Biotechnology, Academy of Sciences, which is the only national body engaged in R and D microbial technology. This section of microbiology is staffed with 29 specialists, 15 of which have special high education in the field. The section possesses a collection of well characterized microorganisms (bacteria, actinomycetes and yeasts), mainly isolated from the soil. The microbial strains and isolates have not been selected for increasing biological activity except for one bacterial strain producing high yield of L-lysine. Ongoing research is focused on screening appropriate raw materials for bacterial and yeast cultivation. Therefore, microbial selection and optimizing the technology is the issue of further development.

The major difficulties faced through realizing above-mentioned R and D are the following:

(a) lack of sophisticated fermentors and chemicals for advanced research;

(b) lack of highly qualified national personnel, especially biotechnologists;

(c) shortage of experience in biotechnology R and D and of know-how.

In order to overcome the difficulties so far encountered the Government has decided to approach UNDP for technical assistance in this particular field. The project is, therefore, planned to assist in the development of microbial technology in the country and to supplement national R and D efforts through building up appropriate laboratory facilities, acquiring international consultancy, training national personnel through study tours and fellowships with UNDP assistance. The project is expected to contribute to the intensification of the country's agricultural production (livestock).

While preparing the project concept several consultations have been held in during the period from 1985 to 1988, with experts from UNIDO, FAO, UNESCO and other organizations.

It is envisaged that the practical application of the project's results will be achived through close co-operation of the Academy of Sciences, the Ministry of Agriculture and Food Industry.

PART II. E. Outputs

Output 1. 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.

Timing: September 1988 - June 1990.

Output 2. An experimental biotechnological pilot plant strengthened with modern fermentation facilities and laboratory equipment.

Timing: April - December 1989.

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

Timing: January - July 1990.

PART II. F. Activities

(1) Pre-project activities

- Construction of two buildings by the national authorities, one for the laboratory and the other for the pilot plant.

Timing: June 1985 - January 1988.

- Nomination of the National Project Director and of other project personnel.

Timing: May 1988.

- Organization of an English language training course for selected project personnel (6 persons) by an appropriate Government organization.

Timing: February - July 1988.

(2) Project activities

Activities for output 1

- It is envisaged to organize fellowships on biotechnology for 4 national postgraduated fellows in CMEA member countries. Expenses for the fellowships will be allocated by the Government Implementing Agency. Besides that individual fellowships are to be organized by the Executing Agency on microbiology and fermentation equipment for 2 Mongolian fellows.

Timing: September 1988 - July 1989.

- Study tour visits of two leading scientists of the Section of Microbiology to selected biotechnology institutions to be organized in Europe in order to get acquainted with up-to-date biotechnology programmes and research activities in this area. This activity is to be carried out by the Executing Agency in collaboration with the Government Implementing Agency and UNDP.

  Timing: September 1988.

- On-the-job training of counterpart personnel and carrying out joint experiments throughout the project operation and in particular during the internationally recruited consultants' mission in order to develop the appropriate fermentation technology for microbial products.

  Timing: April - December 1989
  January - July 1990.

Activities for Output 2

- Preparation of a detailed list of equipment and chemicals by the National Project Director, in consultation with UN experts, to be procured by the Executing Agency.

  Timing: August 1988

- Procurement, delivery and installation of the pilot plant equipment (100, 250, 640 L fermentors, steam generator, high pressure device, etc.) to be done in collaboration with CMEA member countries.

  Timing: October - November 1989.

- Procurement and delivery of equipment to be organized by the Executing Agency; its installation and testing by the Institute of Biotechnology in consultation with international experts.

  Timing: 1st part: April - May 1989
  2nd part: October - November 1989

Activities for Output 3

- Preparation of job descriptions for recruitment of UN experts in the field of microbiology and fermentation equipment. The job descriptions are to be prepared by the National Project Director in collaboration with the Executing Agency and UNDP.

  Timing: July 1988.

- Compilation of guidelines and methodologies for production of feed additives.

  Timing: January - June 1990.

PART II. G. Inputs

(a) Government Inputs

A breakdown of the MPR Government inputs is given in the budget, covering the following items:

- Provision of national scientific research, laboratory and pilot plant staff for the project with sufficient qualifications and practical experience as well as sub-professional administrative and support personnel;
- Fellowship grants and related resources for development of the national staff at the project;
- Adequate laboratory and pilot plant premises;
- Equipment, supplies and services;
- Local transportation for the project international and counterpart personnel.

Structure and function of the national counterpart inputs

Description	Location	Starting Date/Duration
1. Project personnel		
- National Project Director	Ulan-Bator	May 1988-September 1990 (24 months)
- Chief of the Microbiological Section	Ulan-Bator	July 1988-continuously
- Chief of the Laboratory for Microbial Synthesis	Ulan-Bator	July 1988-continuously
- Ten research workers in the following fields:	Ulan-Bator	July 1988-continuously
(a) Microbial Synthesis (9 persons)		
(b) Fermentation Technology (1 pers.)		
- Two engineers (Electronics and Mechanics)	Ulan-Bator	July 1988-continuously
- Technicians to the research workers (4 persons)	Ulan-Bator	July 1988-June 1990 (24 months)
- Supporting personnel (Secretary/Interpreter)	Ulan-Bator	July 1988-June 1990

	Description	Location	Starting Date/Duration
2.	Training components		
-	Fellowships	USSR, CSSR, Hungary, GDR	March-June 1989 (4/3 m/m)
-	English Language Training	Ulan-Bator	February-July 1988 (6 months)
3.	Laboratory and Pilot Plant Premises	Ulan-Bator	Constructed
4.	Equipment and Supplies		January-February 1989 and continuously

The transport within the country is to be paid by the Mongolian Government. The Government inputs will also cover the costs of the maintenance of the project office and laboratory premises, office supplies, electric power, water, heating, etc.

(b) UNDP Inputs

	Description	Location	Starting Date/Duration
-	Short-term consultancy in the field of:		
-	microbiology	Ulan-Bator	April 1989 (1/1 m/m)
-	fermentation equipment (The consultants will take part in the preparation of scientifically based instructions and methodologies, apply modern biotechnological methods in feed additives production, assist in the installation and testing of the equipment and instruments, put them into operation and train local personnel on the spot.)	Ulan-Bator	November 1989 (1/1 m/m)
-	Training of Mongolian specialists in the field of:		
-	microbiology	Japan	March-May 1989 (1/3 m/m)
-	fermentation equipment	Italy	April-June 1989 (1/3 m/m)
-	Organization and implementation of a study tour (2 persons)	W. Germany, Sweden, Denmark	September 1988, 1 month

Description	Location	Starting Date/Duration
- Procurement of equipment and chemicals (Annex II)		February-March, October-November 1989.
- In-depth discussion and evaluation of the progress of the project implementation and plan the follow-up activities (staff member travel)		

PART II. H. Preparation of Work Plan

A tentative work plan is given in Annex I. A detailed work plan will be prepared by the National Project Director in consultation with the UNIDO experts, during their visits to the project. The agreed upon work plan will be attached to the project document as an Annex and will be considered as part of that document. The work plan will be reviewed from time to time and amended accordingly when necessary.

PART II. I. Preparation of the framework for effective participation of national and international staff in the project

The activities necessary to produce the indicated outputs and achieve the project's immediate objective will be carried out jointly by the national and international staff assigned to it.

The respective roles of the national and international staff will be determined by their leaders, by mutual discussion and agreement at the beginning of the project, and set out in a framework for effective participation of national and international staff in the project. the framework, which will be attached to the Project Document as an Annex, will be reviewed from time to time. The respective roles of the national and international staff shall be in accordance with the established concept and specific purpose of technical co-operation.

PART II. J. Development Support Communication

Not applicable.

PART II. K. Institutional Framework

The Government Implementing Agency for the project is the Institute of Biotechnology, acting on behalf of the Academy of Sciences MPR. The Institute is located in Ulan-Bator and consists of four sections: microbiology, molecular genetics, cell engineering, biophysics. The Institute elaborates biotechnology R and D projects within the Academy of Sciences and employs around 50 professional, sub-professional, administrative and technical staff. Research and development activities are supported by the Academy of Sciences. The Section of Microbiology which will be directly in charge of the project implementation deals mainly with soil microbiology, microbial biochemistry and physiology and microbial synthesis.

On behalf of the Government of Mongolia the Academy of Sciences and the Ministry of Foreign Economic Relations and Supply will supervise the project implementation, particularly in respect of carrying out investigation on hydrolysis of raw materials for microbial technology.

the project will be located in the new building of the Institute of Biotechnology.

PART II. L. Prior Obligations and Prerequisites

1. Prior to the approval of the Project Document and the commencement of the project activities the Mongolian Government authorities will provide:

Prior Obligations

- Adequate laboratory premises with basic equipment to be supplemented and strengthened through the project.

- Sufficient funds for procurement of additional items of equipment and supplies to supplement the laboratory facilities, as well as for maintenance of the equipment.

- Nomination of the National Project Director and other project staff as envisaged by the Project Document, to be released from other duties, thus enabling their full engagement in the project activities.

- Nomination of the project secretary and other administrative personnel, as envisaged by the Project Document, as well as provision of office premises.

Prerequisites

- English language training courses and timely nomination of candidates for training.

- Transportation for the project staff within the country.

2. The Executing Agency takes full obligation to provide:

- Inputs as described in the Project Document and in accordance with the work plan jointly agreed upon by all three parties concerned.

- To qualitatively and quantitatively backstop the project activities, thus enabling smooth implementation and timely completion of the project.

3. The Project Document will be signed by the Resident Representative on behalf of UNDP, and UNDP assistance to the project will be provided only if the prior obligations stipulated above have been met to UNDP's satisfaction.

PART II. M. Future UNDP Assistance

The scope and level of the future UNDP assistance will be determined in the course of the project operation. Such assistance may be needed for extending/supplementing the level of the immediate objectives.

PART III. SCHEDULES OF MONITORING, EVALUATION AND REPORTS

PART III. A. Tripartite Monitoring Reviews, Technical Reviews

The project will be subject to periodic reviews in accordance with the policies and procedures established by UNDP for monitoring the project and programme implementation.

PART II. B. Evaluation

The project will be subject to evaluation, in accordance with the policies and procedures established for this purpose by UNDP. The organization, terms of reference and timing of the evaluation will be decided by consultation between the Government, UNDP and the Executing Agency.

PART II. C. Progress and Technical Reports

The National Project Director will be obliged to prepare Project Progress Reports on six months intervals. The reports are to be prepared in English on the pre-printed UNDP forms. The exact schedule of the submission of the reports will be set in the final version of the Work Plan which is to be prepared immediately upon commencement of the project operation.

The National Project Director is obliged to prepare the Internal Evaluation Reports together with every second Project Progress Report. The reports are to be prepared on pre-printed UNDP report forms.

Two copies of the Progress Reports and Internal Evaluation Reports are to be submitted directly to the Executing Agency by the Project Director with other copies to the UNDP office for distribution to UNDP headquarters and the Government (3 copies).

The UNIDO experts, in close collaboration with the National Project Director, are obliged to prepare the Agency Draft Terminal Report at least two months prior completion of the project's operation.

PART IV. BUDGETS

A. PROJECT BUDGET COVERING UNDP INPUTS
(in US Dollars)

Country: Mongolia
Project Number: MON/88/002/01/37
Project Title: Elaboration of Technology
for Feed Additive Production

		TOTAL		1988		1989		1990	
		m/m	USD	m/m	USD	m/m	USD	m/m	USD
10	PROJECT PERSONNEL								
11	Experts/Consultants in								
-	microbiology	1/1	7,500	-	-	1/1	7,500	-	-
-	fermentation equipm.	1/1	7,500	-	-	1/1	7,500	-	-
16	staff memb.miss.cost		5,000	-	-		5,000	-	-
19	COMPONENT TOTAL	2/2	20,000	-	-	2/2	20,000	-	-
30	TRAINING								
31	Indiv. Fellowships in								
-	microbiology	1/3	11,700	1/3	11,700	-	-	-	-
-	fermentation equipm.	1/3	11,700	1/3	11,700	-	-	-	-
32	Study Tour	2/1	12,000	2/1	12,000	-	-	-	-
39	COMPONENT TOTAL	4/7	35,400	4/7	35,400	-	-	-	-
40	EQUIPMENT								
41 -	Expendable	-	3,100	-	1,000	-	1,100	-	1,000
42 -	Non-expendable	-	140,500	-	-	-	140,500	-	-
49	COMPONENT TOTAL	-	143,600	-	1,000	-	141,600	-	1,000
50	MISCELLANEOUS	-	1,000	-	300	-	500	-	200
99	GRAND TOTAL	-	200,000	-	36,700	-	162,100	-	1,200

B. PROJECT BUDGET COVERING GOVERNMENT CONTRIBUTION (In Kind)(In Tughriks)

Country: Mongolia
Project No: MON/88/002/01/37
Project Title: Elaboration of a Technology for Feed Additive Production

	TOTAL		1988		1989		1990	
10 PROJECT PERSONNEL	m/m	T	m/m	T	m/m	T	m/m	T
11-01 National Project Director	1/24	40,500	1/6	10,125	1/12	20,250	1/6	10,125
11-02 Chief of section	1/24	34,000	1/6	8,500	1/12	17,000	1/6	8,500
11-03 Ten Research Works	10/24	192,000	10/6	48,000	10/12	96,000	10/6	48,000
11-04 Two Engrineers	2/24	38,600	2/6	9,650	2/12	19,300	2/6	9,650
11-05 Four Technicians	4/24	48,500	4/6	12,185	4/12	24,250	4/6	12,125
11-06 Secretary/Interpreter	1/24	24,000	1/6	6,000	1/12	12,000	1/6	6,000
11-09 COMPONENT TOTAL	19/144	377,600	19/36	94,400	19/72	188,800	19/36	94,400
30 TRAINING								
31 Fellowships	4/3	40,000	-	-	4/3	40,000	-	-
32 English Language Course	6/6	14,400	6/6	14,400	-	-	-	-
39-99 COMPONENT TOTAL	10/9	54,400	6/6	14,400	4/3	40,000	-	-
40 EQUIPMENT								
41 Expendable	-	40,000	-	20,000	-	10,000	-	10,000
42 Non-Expendable	-	600,000	-	500,000	-	50,000	-	50,000
43 Premises	-	1,250,000	-	1,250,000	-	-	-	-
19 COMPONENT TOTAL	-	1,890,000	-	1,770,000	-	60,000	-	60,000
50 MISCELLANEOUS	-	3,000	-	2,000	-	500	-	500
GRAND TOTAL		2,325,000		1,880,800		289,300		154,900

TENTATIVE WORK PLAN

Country: Mongolia
Project Number: MON/88/002/01/37 ANNEX 1
Project Title: Elaboration of a Technology for Feed Additive Production

Activities	1988												1989												1990						
	2	3	4	5	6	7	8	9	10	11	12	I	1	2	3	4	5	6	7	8	9	10	11	12	I	1	2	3	4	5	6	7
Construction premises	*											I													I							
Nomination of National Projct Director, other project personnel				*								I I I													I I I							
English languages training for selected project personnel	*	*	*	*	*	*						I I I													I I I							
Preparation of job description						*						I I													I I							
Preparation of detailed list of equipment and ordering							*					I I I													I I I							
Study tour for two Mongolian project personnel in West Germany, Sweden, Denmark								*				I I I I													I I I I							
Fellowship programme (Governm.Input) for 4/3 m/m												I I I													I I I							
-microbiology in USSR												I			*	*	*								I							
-fermentation technology in CSSR												I I			*	*	*								I I							
-microbial screening in GDR												I			*	*	*								I							
-biochemistry in Hungary												I				*	*	*							I							

ANNEX 1 (continued)

Activities	1988												1989												1990						
	2	3	4	5	6	7	8	9	10	11	12		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7
Fellowship programme (UNDP Input) -microbiology in Japan 1/3 m/m															*	*	*														
-fermentation equipment in Italy 1/3 m/m																*	*	*													
Short-term consultancy -fermentation equipment 1/1 m/m																							*								
-microbiology 1/1 m/m																*															
Procurement of equipment and installation (Governm.Input)																						*	*								
Procurement of equipment and installation (UNDP Input)														*	*							*	*								
Mid-term evaluation of the project activities																			*												
Final report setting findings and recommendation																											*	*	*		
Compilation of guidelines and methodologies for feed additive production																											*	*	*	*	

List of equipments reguired for the elabiration of a technology for feed additive production

Title	Supplier	Model	Qty	Price	Total price US
Jar Fermentor, 10-0476	IKEMOTO scientific technology CO.,LTD.	Type M	1	6600	6600
optional accessories:					
pH controller					4000
DO indicator					3000
automatic defoamer					1867
automatic recorder w/chart					2000
Analytical balances 30-115	____ ____	SD-200	1		1900
pH meters 25-3008	____ ____	TD-20RF	1	780	780
Electronic balances 30-116	____ ____	YP2-300			900
Micro Pipets (variable volume) 20-128	____ ____	1100 V			
(multi range)					
25-50-100 mkl			4	130	520
200-500-1000 mkl			4	130	520
tip for 5 to 100 mkl		TS	4case	60	240
tip for 120 to 1200 mkl		TL	4case	60	240
Pipet stand 20-128	____ ____	DGS	4	124	496
Safety Cabinet, standard version 90-1040	____ ____	SCV8ECIIA			13266
Personal computer with accessories	Taiwan China	IBM/PC/XT			2600
Demineralizer 50-31	IKEMOTO scientific technology	MA-1			1000
Pipet washers 20-156	____ ____	409			140
Dual-band uv lamp	Cole-Parmer	k-9818-02	1		200

(220 VAC)

lamp stand	k-9818-50	1		40
Replacement filter	k-9816-10	1		132
long-wave 6-watt tube	k-9814-26	2	5,5	11
short-wave 6-watt tube	k-9813-27	2	10	20
Fermentor 1001	LKB Sweden			100000
				Total USD
				140,472

List of chemicals

Title	Supplier	Model	Qty	Price	Total price /US $/
D,L- -E-Diaminopimelic acid (pfs)	Sigma	D 1377	10g		51,60
Gentamicin sulfate	Sigma	G 3632	1g		32,30
Ammonium ferric citrate 17% Fe reseach grade	Serva	13367	500g		13,4
Citric acid anhydrous	Fluka	27487	1kg		11,7
Peptone from Casein, tryptic digest	Fluka	70172	0,5kg		25
Tween 80	Fluka	93780	100ml		16,65
L(-) Malic acid	Fluka	02290	250g		40
Succinic acid	Fluka	14079	0,25kg		4,175
Vitamins	Sigma	V-1	1kit		48,85
sym-Diphenylcarbazide (pfs)	Sigma	D7766	100g		55.00
Glycerol (pfs)	Sigma	G 5516	500ml		21,80
Pyrogallol (pfs)	Sigma	P 0381	500g		54,00
d-Cysteine Hydrochloride; Anhydrous (pfs)	Sigma	C 1276	100g		51,60
Cetrimide Agar	Serva	48088	0,5kg		64
Lactobacillus MRS Broth	Serva	48236	0,5kg		55

Malt extract Agar	Serva	48278	0,25kg	34,5
Malt extract Broth	Serva	48280	0,5kg	60
Nytrient Agar DEV	Serva	48140	0,5kg	67
Reinforced Clostridial Broth	Serva	48108	0,5kg	58
Liver Powder Servabacter	Serva	48015	0,25kg	52
Meat extract Servabacter (Dryed)	Serva	48020	0,5kg	77
Nutrient Broth	Serva	48500	1kg	90
Sabourand Liquid Medium	Serva	48360	0,5kg	32
Aluminum Foil	Serva	90103	12rolls	50
Roll dispenser	Serva	90141	1ea	28
Nynhydrine	Sigma	N 0507	10ea	88,5
Glass spray unit (pfs)	Sigma	S 7256	2ea	59,4
Bromcresol Green	Sigma	B 7382	2ea	16,50
Fluorescomine	Sigma	F 55756	1ea	10
z-Mercaptoethanol	Serva	28625	500ml	19
EDTA	Serva	11278	3kg	46,5
D-Mannitol	Serva	28410	1kg	27,5
D-sorbitol	Serva	35230	1kg	10,9
L-Amino-Acids	Sigma	LAA-21	1kit	35,30
Carbohydrates	Sigma	CAR-11	1kit	44,15
Yeast extract	Sigma	Y 400	2kg	31
Lysozyme	Sigma	L 6876	25g	158,05
Ergosterol	Fluka	45480	50g	41,66
Albumin	Fluka	05440	5g	35
TRIS (hydrochloride)	Fluka	93349	1kg	58
-Glucuronidase	Sigma	G 0501	5,000000 units	145

Ribonuclease A	Serva	34388	1 g	150
Ribonuclease	Serva	34390	3 g	140
TLC Tank lid	Sigma	T 7882	6 ea	28,50
TLC Glass developing tank	Sigma	T 9877	3 ea	111,30
D (+) Melibiose Monohydrate	Fluka	63630	20 g	31,67
Silica gei Typ G	Sigma	S 6503	1 kg	43,7
Lyticase	Sigma	L 8012	1 g	292
Silica gel on poliester	Sigma	T 6145	6 box	297,0
Antimony pentachloride	Sigma	A 6653	6 ea	48
L-Glutamic acid (pfs)	Sigma	G 5638	500 g	9,70
L-Glutamic acid	Sigma	G 5889	0,5 kg	7,90
Total				3,100 USD

Justification for Equipment Procurement

In order to accelerate the development, scaling-up and practical application of fermentation processes sophisticated equipment is necessary. Therefore, it is reasonable to expect that the procurement and installation of modern fermentation facilities will progressively be faster and speed up the elaboration of a technology for feed additive production as well as the research into the biological effects to the respective products. In addition, the extension of the research area and the field of practical application will be facilitated and the methodological level of the national staff will be considerably improved. For this very reason assistance to the Institute of Biotechnology MAS, which is in charge of the project implementation, is vitally important. At present, e.g. the fermentation capacity of the Institute consists of only one simple fermentor (20 l) and most fermentation experiments must be performed in the Biofactory at Songino, i.e. outside the Institute and even outside Ulan-Bator. Thus, particularly the procurement of three fermentors (10 l; 10 l; 100 l), fully equipped for automated process control, falls among most priority objectives.

The installation of modern fermentation facilities at the Institute of Biotechnology MAS will substantially increase the project activities and will enable very advanced scientific research to be carried out. This trend reflects the need for the development of national biotechnology and foresees the possibilities of its practical application to meet the actual needs of the country.