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Expert Group Meeting on
Soya Bean Processing and Use
Peoria, Illinois, U.S.A., 17 - 21 November 1969

DRAFT REPORT OF THE
EXPERT GROUP MEETING ON
SOYA BEAN PROCESSING AND USE 1/

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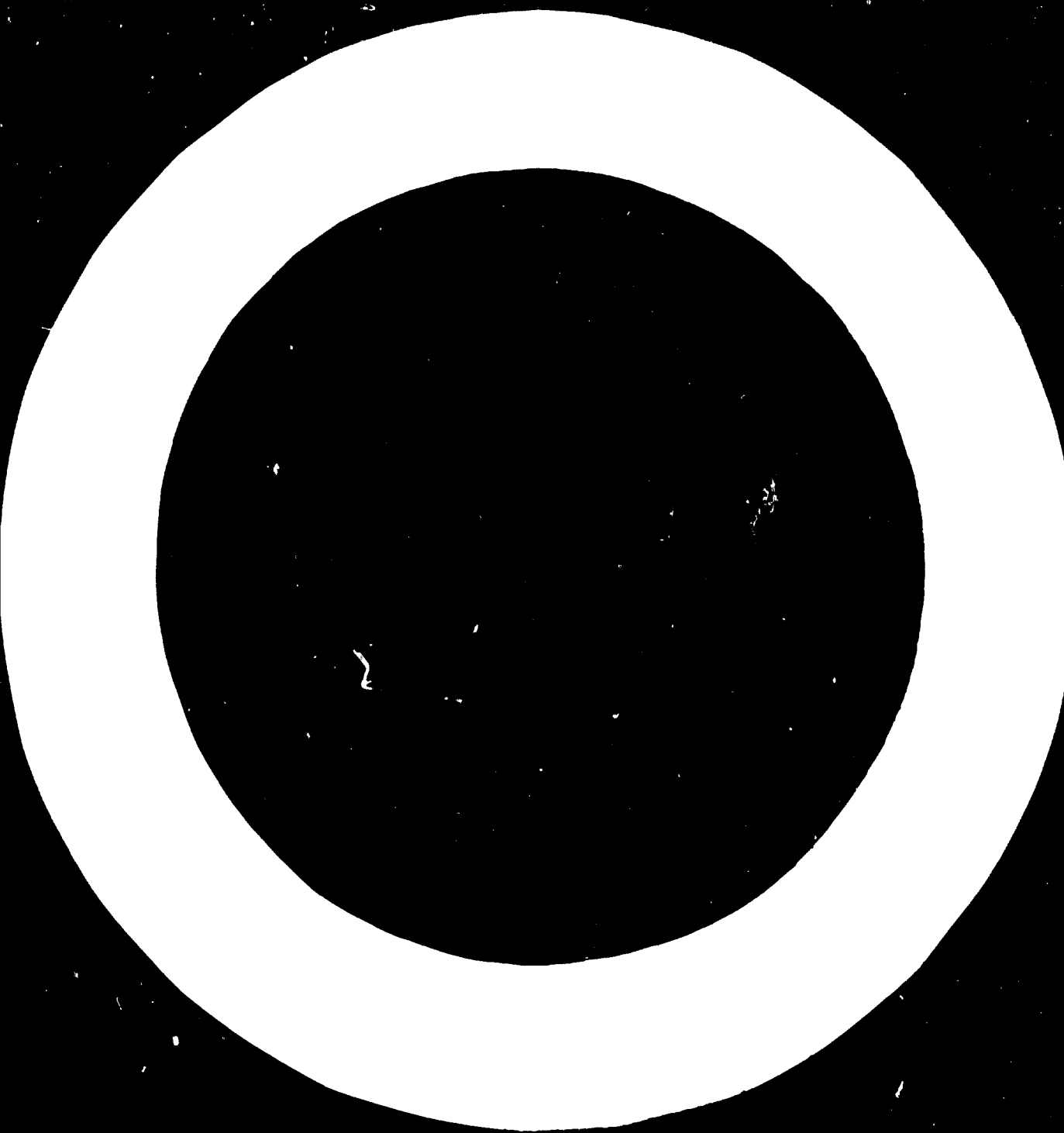


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1. GENERAL

From 17 to 21 November 1963 the United Nations Industrial Development Organization (UNIDO) in co-operation with the U.S. Department of Agriculture's Northern Utilization Research and Development Division (Northern Regional Laboratory) held in Peoria an expert group meeting to discuss various aspects of the industrial development of soy protein foods.

Representatives of developing countries of Africa, Asia and Latin America, in contact with industrialists, scientists and experts of national and international organizations, were able to review the varied developmental aspects of soy and other vegetable protein foods. The processing of soy protein from the most simple to the most sophisticated forms was discussed, and samples of products were displayed and demonstrated to the participants.

Opening statements were made by:

- Mr. Mihajlo MAMPUR, Chief of the Light Industries Section, Industrial Technology Division, UNIDO, on behalf of the Executive Director of UNIDO, Dr. Ibrahim Ismail Madafari;
- Dr. R.H. DIMLER, Director of the Northern Utilization Research and Development Division, Agricultural Research Service, U.S. Department of Agriculture, Peoria, Illinois.

Mr. MAMPUR's proposal to invite Dr. R.H. DIMLER, Director of the Northern Regional Laboratory, ARS, USDA, to act as Chairman of the meeting, was unanimously accepted. Dr. Ralph J. MCNEIL, Executive Vice-President of Crest Products, Park Ridge, Illinois, was appointed First Co-Chairman, and Dr. W.C. STELLER, Assistant Director of the Northern Regional Laboratory was appointed as Second Co-Chairman. As Chief Rapporteur, Dr. J.C. SCHAMBER, Assistant to the Director of the Northern Regional Laboratory was appointed, with Dr. I.A. AKINOLA, of the Federal Institute for Industrial Research, Lagos, Nigeria, Professor M. ROSS, of the University of New South Wales, Sydney, Australia, and Dr. S. LILLET, Editor-in-Chief of Food Engineering Magazine, Philadelphia, as Co-Rapporteurs.

2. CONCLUSIONS AND RECOMMENDATIONS

I. Conclusions

In the discussions and presentations it was emphasized that soy protein foods offer one of the most promising possibilities for producing protein for developing countries. This was particularly demonstrated through the presentation of the experiences in countries such as Uganda, Colombia and Brazil. Some basic points were emphasized during the discussion on the basis of which the following conclusions were drawn up.

A. Economics

1. New food industries for developing countries should be based mainly on locally available raw materials and should encompass processing and distribution. An attempt should be made, within the limits imposed by the relevant economies of scale, to concentrate the productive cycle, from development of raw materials to distribution of the finished product, in the country.
2. Efforts should be made in the developing countries to make use of the experience of the United States, where rapid expansion of soybean production and utilization has occurred in the areas of both human food and animal feed.
3. Rather than attempt to impose a solution on a developing country, the goal should be to adapt procedures to the local environment, drawing on local people and resources, and providing research, production, and marketing expertise as needed.
4. We should strive to start with a market and develop a product for that market from available raw materials in a profitable manner. We should not confuse protein need (ought to have) with economic demand (ability to buy).
5. It is an economic fact that cost of unit product decreases dramatically with increasing volume of production.
6. The food processing and food equipment manufacturers present at the meeting expressed their willingness to co-operate with UNIDO and other UN organizations in seeking feasible ways to satisfy the nutritional requirements of developing countries.

B. Processes

1. There are definite process requirements to impart desired flavour characteristics, functional properties, and nutritive value to soybean products.
2. Water extraction of heat-treated soy flakes is the simplest and least expensive of the three processes for producing soy protein concentrate.
3. The "Village Process" and the "Extrusion Cooking" processes for full fat soy flour developed at the Northern Utilization Division are being used successfully in several developing countries.

C. Nutrition

1. Moist-heating is effective in eliminating antinutritional factors in soybeans. In the production of full-fat soy flour, lipoxidase enzymes can be destroyed with dry heating or steaming to ensure good shelf life.
2. Although processors should strive for maximum quality of product, antinutritional and flatulence factors may have received more attention than they deserve.
3. There is relatively little risk of aflatoxin contamination associated with the use of soybeans.
4. There is no mycotoxin problem with Japanese fermented foods when proper methods have been employed.
5. Satisfying caloric needs with cereal grain products does not automatically satisfy protein needs.
6. Advantages of mixing proteins from different sources should be considered, because the mixture may have higher PER than its constituents used alone. Protein mixing may obviate the need for amino acid fortification.
7. Interaction of soy protein with other food ingredients is an area that should be studied further.
8. More vitamin A in the diet may be required when protein intake is increased as a treatment for protein deficiencies.

D. Products

1. "Meatless meat" is now on the market in Japan and has been a successful commercial product in the United States for a number of years. The original form of meatless meat in Japan is kori-tofu ; a new textured protein is now being developed by the application of the principle originally used in producing kori-tofu.
2. Tempeh, an Indonesian fermented soy food, requires a short fermentation which improves the nutritive value of soybeans and removes the bitter beany flavour.
3. Soy spun fibres can be made from starting materials less refined than 95% isolated soy protein. Twenty-one companies in Japan are spinning food fibres. The price of soy spun fibres is expected eventually to be much lower than present prices as markets develop and production increases.
4. Meat-like products from vegetable protein may have longer shelf life than corresponding conventional products.

E. Product Acceptance

1. Flavour preferences are acquired. Soy acceptance can be developed by aiming foods initially at the infant and child markets.
2. Social clubs can be an avenue of contact for the introduction of new foods. New food products must fit into the cultural pattern of the people. The goal is to improve health at a price within the means of the people.
3. Several international firms are producing soybean foods in developing countries such as Uganda, Nigeria, Colombia and India. Moreover, twenty-one companies are starting to make spun and textured protein foods in Japan.

II. Recommendations

The development of soy protein foods should be stimulated in developing countries since they represent a very economical source of protein. The following recommendations are proposed:

1. Use all of the processes from the most modest to the most sophisticated according to market possibilities and requirements.
2. Make joint ventures with organizations and enterprises in order to make use of developed technology.
3. Study new approaches for the production of protein isolates and concentrates in order to improve economic aspects of the processes.
4. Make a comprehensive study of the thermal properties of the functional enzymes in soybeans in order to promote the incorporation of soybean products into the local foods of developing countries.
5. Stimulate the development of soybean varieties with increased protein content and quality, and encourage international co-operation in this field as is already being done for corn and wheat.

UNIDO and the other United Nations Agencies are at the disposal of developing countries for assisting them in the establishment of soy protein food industries and their assistance should be officially requested by developing countries.

Special reference should be made to the FAO/WHO/UNESCO Protein Advisory Group, which is able to provide guidance in technological, economic, social, nutritional, and regulatory aspects concerning agro-industrial soy protein development.

3. STATEMENT BY MR. W. L. GOTTSHALL, DIRECTOR, TECHNICAL SERVICES, CONSUMER PRODUCTS, BAKSTON PERINA COMPANY, INTERNATIONAL DIVISION, CHECKERBOARD SQUARE, ST. LOUIS, MISSOURI

The food processing and food equipment manufacturing industries present would like to express their willingness to co-operate with UNIDO in seeking realistic ways of meeting the nutritional requirements of the developing countries.

NOTE: Mr. Gottshall's statement is included because it is pertinent to the recommendations of the meeting.

4. AGENDA

1. Opening statements and addresses of welcome
2. Election of Chairman, Vice-Chairman and Rapporteurs
3. Oilseed protein for food uses
4. The case for engineering - new soy protein food products
5. The FAO/UNICEF/WHO protein food programme with special reference to soybean products
6. Isolated soy proteins and soy protein concentrates
7. Full-fat and defatted soy flours for human nutrition
8. Analysis of the Uganda experience based on Africa Basic Foods Inc.
9. Industrial production of soybean foods in Japan
10. Demonstration of some soy food items
11. Processing and merchandising soy protein products for food and feed use with related information on their position in food protein production
12. Textured protein
13. Some thoughts on protein and its future development
14. Conclusions and recommendations

5. LIST OF DOCUMENTS

The meeting had before it the following documents:

- | | |
|------------|--|
| ID/WG.45/8 | Oilseed Protein for Food Uses, presented by Dr. F. J. Bialer, Director, USDA Northern Regional Research Laboratory, Agricultural Research Service, Peoria, Illinois, U.S.A. |
| ID/WG.45/7 | The Case for Engineering - New Soy Protein Food Products, presented by Dr. K. A. Hutchins, Department of Agricultural Engineering, Ohio State University, Columbus, Ohio, U.S.A. |
| ID/WG.45/6 | Isolated Soy Proteins and Soy Protein Concentrates, presented by Mr. Dale T. Johnson, Executive Vice President, Crest Products Inc., Park Ridge, Illinois, U.S.A. |
| ID/WG.45/5 | Full-fat and Defatted Soy Flours for Human Nutrition, presented by T. C. Mastakas, USDA Northern Regional Research Laboratory, Agricultural Research Service, Peoria, Illinois, U.S.A. |

ID #G.45/4

Analysis of the Uganda Experience Based on Africa Basic Foods Inc., presented by Dr. D. H. Harrison, President, Africa Basic Foods Inc., Kampala, Uganda

ID #G.45/3

Industrial Production of Soybean Foods in Japan, presented by Dr. Takaji Iatanabe, Food Research Institute, Ministry of Agriculture and Forestry, Tokyo, Japan

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ANNEX 1

ADDRESS BY DR. R. J. DINLER, DIRECTOR
NORTHERN UTILIZATION RESEARCH AND DEVELOPMENT DIVISION
U.S. DEPARTMENT OF AGRICULTURE, PEORIA

Ladies and Gentlemen,

We are very pleased to have you here at the Northern Laboratory, and we hope that your stay will be both pleasant and profitable.

I am going, first of all, to take a few moments to say something about the Northern Regional Laboratory. The Northern Division is a part of the United States Department of Agriculture. There are today five Divisions of this type, doing research on the use of farm products. You probably realize that a great deal of the work of USDA is concerned with growing farm products. This part is concerned with what can be done with these products after they have been produced. Initially, there were four Utilization Divisions. They were constructed and completed in 1940. The purpose of their research was to search for new or increased uses for the farm products of their particular regions. These four were geographically located, north, south, east and west. The Northern Division was given responsibility for research on cereal grains, and particularly corn or maize, wheat and grain sorghum. They also were given responsibility for research on oilseeds and the ones particularly concerned were soybeans and flax seed. In addition, after several years of operation, we were also given responsibility for doing research on seeds and plants that are not used as crops in the United States, looking for the possibilities of a new crop that would provide a new and unusual oil or protein or carbohydrate component or be useful as an annual paper-pulp source.

The other Laboratories or Divisions were given responsibilities for farm products that were most important to their particular areas. The Southern Division for example has a large programme of research on cotton, and combined with that is a programme of research on cotton seed, so that they have concern about the proteins and the oil of cottonseed which parallels and complements the research on the proteins and oils of soybeans. They also are doing research

on the fruits and vegetables of the southern region, including some research on citrus fruits. They are doing research on rice, because that is one of the important commodities, plant products, of the southern region. Sweet potato, palm oil and naval stores are others of the farm or agricultural products on which they are conducting research.

Our Western Laboratory has a programme of research on wool, a programme of research on poultry and eggs, research on fruits and vegetables of the western region including peaches and citrus fruits. They have research on peanuts and share with us research on wheat and the feed uses of wheat. That research is being done primarily at the Eastern Laboratory. Here at Peoria we are concentrating on the industrial uses of wheat and on the milling of wheat. The Western Laboratory also has research on rice as part of their programme.

The Eastern Division has research on meat and meat by-products including hides and leather, milk and milk products, also research on tobacco, research on fruits and vegetables of the eastern region and research on maple syrup and maple sugar. I may have left out a few items on each of these, but that gives you a general picture of the main areas of research of these different Divisions.

The fifth one, the South-Eastern Regional Laboratory, was just completed. They have only begun operations in the last few months, and they will have a programme of research on forage crops of the south-eastern region. The Western Laboratory has research on alfalfa, which is an important forage crop of the western region, and the South-Eastern Laboratory will be concerned with some of the forages that are particularly important in that part of the United States. They will have research on poultry complementary to the research being done at the Eastern Regional Laboratory. They will also have research on the fruits and vegetables of the south-eastern region with particular interest in the processing of these. Most of the fruits and vegetables of the south-eastern region have gone directly into the fresh fruit and vegetable market. There has been relatively little canning or processing of the fruits and vegetables of that region. Our South-Eastern Regional Laboratory will bring together work of agronomy, of plant production and breeding, and utilization and marketing, to develop a greater activity in the processing of the fruits and vegetables of the south-eastern region. They will be looking for new varieties that would lend themselves better to processing as well as looking at processing itself as an operation.

Each of the four laboratories that have been in operation employ between 450 and 500 people. Of these, about 300 are the scientific and technical staff. About 300 of our people are technical staff, the others are the necessary complement of shops, maintenance and stenographic services, etc. So you can see we have a rather good-sized organization so far as research is concerned. It is spread over a considerable range of types of study. The soybean research which we will be including in the discussions at this meeting is of course just one part of the whole programme. On the other side, we do have work on corn, as I have mentioned, which we have brought into complementary relationship with some of our soybean work through studies on the combining of soybean and corn in food products. I hope that somewhere during the days ahead we will find a suitable hour that we can devote to giving you a chance to see some of our facilities, and to get an idea of some of the other things that we are doing in addition to the research on soybeans

ANNEX 2

OPENING ADDRESS BY MR. M. MAHMOUD, CHIEF,
LIGHT INDUSTRIES SECTION, INDUSTRIAL TECHNOLOGY DIVISION
OF LEGAL OFFICE, EXECUTIVE DIRECTOR OF UNIBO

Ladies and Gentlemen,

I have the great honour of opening on behalf of Mr. Ibrahim Helmi Abdel-Rahman, the Executive Director of UNIBO, this Expert Group Meeting on Soy Bean Processing and Use, which is devoted to an extremely interesting subject, namely, to the challenging problem of mankind to produce protein food in bigger quantities and at less expense for human consumption by up-to-date engineering methods in food processing industries.

We have deliberately devoted this meeting to soybean, this vegetable species which is a representative of those plants which have been able to provide a nearly complete protein complex to millions of hungry people throughout the centuries and which has shown such a tremendous development in this most advanced country. This raw material is in turn becoming the basis for an up-to-date industrial animal husbandry and is now in the process of being used more and more as food for direct human consumption.

We have deliberately chosen Peoria as the site for this meeting and this not only because of the International Conference held there in 1956 but also because our generous hosts, the Northern Utilization Research and Development Division has been, and still is, one of the most important catalysts whose contribution drives this development ahead for the benefit not only of this country but generously enough also for the welfare of the countries of the world.

My first words of appreciation and thanks should be expressed to our hosts and to all those who contributed time, money and efforts to organize this modest conference.

UNIBO's aim in organizing this Conference was not to add to or repeat work initiated here. Our main concern is to contribute towards a step forward in the application of already existing "know-how" for the use of developing countries.

The last decade was devoted to making known the lack of proteins for human consumption. The deficiency was thoroughly analysed and brought to the attention of the world, and a great number of technical solutions have been proposed for the production of more protein by traditional and non-traditional processes - out-going from traditional or non-traditional sources - using the entire scale of possibilities in agriculture, biology, technology, economy and market analysis. In this endeavour, we have all learned that in some way it was easier to analyse the world situation, to earmark some ideas on how to proceed, to invent some non-traditional crop richer in protein, to enrich with protein some traditional dishes or food, to produce by industrial processes amino-acids and compounds and/or to develop a new protein-consistent meaning food, than to provide more protein to the hungry of the world and to close the increasing gap between demand and supply.

These efforts have ended in findings and facts, building a true obstacle for fast further development. These facts are as follows:

1. The protein-enriched compounds or concentrates invented, produced and shipped to developing countries, have not raised the interest of the consumer by their taste, appeal or trading value to the extent expected for a promising merchandise.
2. The cost of production and shipment of imported protein materials (particularly of non-traditional origin) has grown to such levels that the cost was 3 to 7 times higher in comparison with indigenous, traditional foods and dishes. Such foods could be distributed only to consumers if the donor Government or the Government in the receiving country largely subsidized the production or distribution of the merchandise to a price far below the cost of production.
3. The cost of production of most of the protein enriched compounds produced in developing countries was again not able to meet the buying force of the indigenous customer, despite the fact that the complete raw material was sometimes supplied by the country itself.
4. Not one of all these products, despite very persuasive clinical results, has been able to initiate a profitable, commercial-sized industrial production, which would be deliberately planned by an enterprise or by

a food processing company because of the inconvenience of price and because of lack of all these properties which are necessary to build up a brand or an article for which the consumer is willing to pay the price requested.

5. Most of these protein-rich foods, particularly of the so-called non-traditional type, were not produced to satisfy the taste of the average or of the richer customer, in spite of the fact that the development of each market has to begin by satisfying just this class of purchasers, which can easily - or with more ease - make a decision to buy a new brand.
6. This trend to produce protein-rich foods for the subsidized consumer does not work in a developing country. An advanced country is not able to subsidize foods for 50, 60, 80 or even 90 per cent of their babies or adults. Therefore should not expect that a country in the first stage of development should subsidize the production of protein-rich food for a substantial part of its children or inhabitants, nor can it afford to import protein-rich foods in quantities relevant to the real needs.
7. The process of increasing the naturally grown protein-rich foods from traditional vegetable or animal sources is a very slow one, particularly in developing countries having in general less arable land, less water supply, less "know-how" and less skills, etc. Thus this natural trend does not satisfy the explosion of demand, and thus industrial production must be established able to meet this challenge.

What should be done under these circumstances? Should we not concentrate our efforts on a more promising protein food? It is my honest persuasion that this question has already been cleared up, thanks also to the efforts of our hosts.

Soybean processing and soybean foods production are not just a particular exercise, but far more, namely, they are an indication of how we should proceed in the other fields of protein-rich foods produced by industrial means. Soybean products have nearly found their consumer, and they should serve as a model for other proteinaceous raw materials.

The technique which was elaborated for soybean in the production of protein-enriched materials, defatted materials, isolated, hydrolyzed materials and textured proteins as well, can be adapted to many other vegetable protein bearing materials, but can be adapted also for the improvement of poor quality animal protein raw materials.

Our evaluation and judgement of an investment opportunity to produce more proteins by industry should not be substantially influenced by nutritional, political, social, biological or other more or less vital aspects of life, nor by other noble human aspects. Our only concern should be to establish a viable, profitable business which will be able to expand on its own, at the same rate as the protein gap becomes wider here as the rapid birth continues.

In my opinion, textured soy protein will generate textured fish protein, textured single-cell protein, textured vegetable oil cake protein, and even textured animal and vegetable protein mixtures, thereby improving the quality of our nutrition and providing at the same time an opportunity for the industry in developing countries to be viable and profitable, to be self-sustaining, and to grow even more rapidly than the protein gap. That is, we must find cheaper processes for the production of protein concentrates and isolates, and we must find ways of how to transfer this know-how to developing countries.

We have convened this meeting in the hope that we will be able in this most advanced country to find the "know-how", and the willingness to have it transferred for the sake and benefit of developing countries.

I am certain that we will discuss our subject along the lines of this goal. But it is not only the new stage of applying this technique to other materials based on the work in connexion with soybean protein that has provoked our interest. The other very important achievement was the success in soy products in obtaining such final products, which have the appeal, the good taste, and can be used by people who wish to have a diversified and versatile supply of protein in a form which can be easily stored, transported and used in various forms and mixtures, and on the basis of which a profitable food industry can be established.

There is no doubt that the establishment of a sound food processing industry in a developing country can be based exclusively on the very same economic and technical pre-requisites as in advanced countries.

Industrial production of proteins and protein-rich foods must be self-sustaining and profitable because this is the only basis for an expansion of the protein production by industry to the extent that it can have an impact on the closing of the protein gap; self-sustaining and profitable also because otherwise we are not able to find new sources in developing countries nor partners abroad.

The industrial aspect of profitability thus excludes many other criteria to be kept in mind in the decision-making on the establishment of industrial enterprises in this field.

I hope that on the basis of such premises we will be able to make here again a modest step forward in this very delicate but important field of food industry.

The water, land, labour, electricity, and all of what you have seen in this country, as far as the knowledge and experience of a true worker almost exclusively for the benefit of the people of this country, contributing in this way towards the better understanding and development of mankind.

Your work here and your energy, your recommendations, will be appreciated, and forwarded to the governing body of UNIDO for the approval for further UNIDO operational activity in this field of industrial development.



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