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Expert group meeting on
soya bean processing and use

Peoria, Illinois, 17 - 27 November 1969

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

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C O N T E N T S

I. INTRODUCTION

Purpose of the meeting

1. The Expert Group on Soya Bean Processing and Use met under the auspices of the United Nations Industrial Development Organization (UNIDO) and the U.S. Department of Agriculture's Northern Utilization Research and Development Division at the latter's Northern Regional Laboratory in Peoria, Illinois, from 17-21 November 1969.

2. The meeting was convened to discuss and provide guidance to developing countries on the developmental aspects of soy and other vegetable protein foods. The Group reviewed the main issues involved in the processing of soy protein from the most simple to the most sophisticated forms, and various samples were demonstrated to the participants.

3. To ensure that the subjects discussed would relate closely to the conditions prevailing in the developing countries, two categories of experts were invited to the meeting: food technology scientists and representatives of various national enterprises from industrially developed countries who participate in research work, and experts from national and international organizations currently engaged in similar work in developing countries. As a result of the exchange of views between these two groups, conclusions and recommendations were adopted which are listed below. They are intended as a means of assistance to those who are responsible for soy bean processing and use in the developing countries.

Opening ceremony

4. Mr. H. Wautner, Chief of UNIDO's Light Industries Section, in welcoming the participants on behalf of the Executive Director of UNIDO, observed that the industrial techniques elaborated for soybean in the production of protein-enriched materials, defatted materials, isolated and hydrolised materials and textured proteins could be adapted for many other vegetable protein-bearing materials and also be used to improve poor-quality animal-protein raw materials. UNIDO would welcome any new approach to these problems in the developing countries. It was hoped that the Group would be able to suggest some solutions, bearing in mind that a food processing industry in a developing

country could be based on the same economic and technical principles that were commonly applied in developed countries.

5. Mr. R.J. Dimler, Director of the Northern Regional Laboratory, ARS, USDA, also welcomed the participants and briefly described the role played by his Laboratory in oilseed research and the functions of the other divisions in USDA.

Attendance

6. Twenty five experts participated in the meeting: one each from Uganda, India, Thailand, Colombia and Sweden, two from Australia, three from Japan and fifteen from USA. The participants attended in their personal capacities and not as official representatives of their organizations or Governments.

7. Certain Governments sent official representatives: one each from Bolivia, Canada, Nigeria, Turkey and Uruguay and three from Brazil.

8. A representative from FAO/WHO/UNICEF Protein Advisory Group attended the meeting and delivered a paper. A representative from UNICEF's Food Conservation Division participated in the discussions.

9. Eighteen members of USDA's Northern Utilization Research and Development Division were also present.

10. A complete list of names and addresses of participants, lecturers and observers at the seminar is given in Annex 2.

Election of officers

11. The meeting unanimously elected the following officers:

Chairman: Mr. R.J. Dimler (USA);
First Co-Chairman: Mr. D.W. Johnson (USA);
Second Co-Chairman: Mr. W.C. Witham (USA);
Rapporteurs: Messrs. W.C. Schaefer (USA), I.A. Akinsle (Nigeria), P.J. Moss (Australia) and F.K. Lawler (USA).

12. Mr. R.J. Dimler, Director of the Northern Regional Laboratory, was responsible for the organization of the meeting. Mr. W. Moreira-Dias acted as technical secretary in the preparation of the report. Mr. F.C. Hemried from UNIDO's New York Liaison Office was also present throughout the meeting.

Agenda

13. At the meeting's first session, the work programme and agenda, as reproduced in Annex 1, were unanimously adopted.

Documentation and working language

14. The Group's deliberations were based on the working papers presented by the lecturers in attendance. In addition, certain papers were prepared by participants and delivered to the seminar as country statements. The views and opinions expressed in the working papers are those of the individual authors and do not necessarily reflect the views of the Secretariat of UNIDO. A list of these documents is given in Annex 3.[1/]

15. At its closing session, the Group unanimously approved the draft report of the conclusions and recommendations formulated by the participants attending the meeting.

16. English was the official working language of the seminar.

[1/] Copies of these documents and their summaries are available and may be requested from the UNIDO Industrial Documentation Centre, P.O. Box 707, Vienna, Austria.

II. PAPERS AND DISCUSSIONS

Oilseed protein for food uses

17. The discussion of this item was introduced by a paper on "Oilseed protein for food uses" (ID/WG/45/8) which provided a comprehensive review of the use of oilseeds as protein sources for foods, with the main emphasis on soybeans. Attention was also devoted to the suitability of present and potential new varieties for growth in different parts of the world. The nutritive qualities of soybean protein were also mentioned as the high concentrations in soybean products are advantageous for raising the protein level as well as for improving the protein quality of the diet.

18. The various types of forms of soybean protein available commercially in the United States were described and the production of defatted soy flour, soy protein concentrate and isolated soy protein explained. Their functional properties were indicated and the importance of heat treatment of soymeal discussed.

19. The Group observed that trypsin inhibitor and other anti-enzyme factors which were destroyed in the course of further processing had received more attention than they warranted. However, there was no doubt that the limited data on human feeding indicated that trypsin inhibitor in soybeans had a bad effect. These effects would be even more harmful in connexion with infants suffering from kwashiorkor or protein malnutrition who receive a diet containing 10 per cent or less protein. It was pointed out that the trypsin inhibitor was destroyed within ten or even six minutes toasting time at 100°C. Maximum nutritive value, however, was only reached after fifteen minutes toasting. Thus, for all practical purposes, the trypsin inhibitor and all other anti-growth factors are destroyed before the maximum nutritive value has been reached.

20. The trypsin inhibitor factor was not held to be responsible for flatulence. The principal, if not only, cause was a group of sugars known as oligosaccharides which are not attacked by stomach enzymes, but are fermented by specific bacteria in the small intestine.

21. The discussion then turned to the replacement of certain imported raw materials with soy flour and the endeavours to increase nutritive value. It was reported that a new macaroni product was being tested in Latin America in which wheat was replaced by soy flour. A pilot plant was to be installed next year with an initial production of 1,000 kg daily to test the market and obtain further information on the subject. In Venezuela up to 10 per cent soy grit had been added to arepa, and in Mexico the Government was backing a programme which recommended adding 6-8 per cent soy flour to tortilla flour.

22. Following a discussion on the protein efficiency ratio value of soy, certain members of the Group felt that net protein utilization was far more valid as a measure of feed efficiency in terms of human or animal diets than PER value based on 10 per cent protein, as the latter had no quantitative meaning. Too much emphasis had been placed on PER and the 10 per cent level was quite arbitrary.

23. It was also stated that the problem of browning that is encountered when cooking to remove anti-nutritional factors is best overcome by pre-soaking the beans to about 25 per cent moisture.

24. The representative from FAO/WHO/UNICEF Protein Advisory Group expressed an interest in having products that did not have to be cooked when finally eaten. Pre-cooking improves keeping quality but entails somewhat higher costs. Extrusion, it was agreed, was one method of reducing the processing time and costs.

Food engineering

25. The discussion on this topic started with a paper entitled "The case for engineering new soy protein products"(TD/WG 45/7) which presented a space-age analogy. The speaker stressed that an equal amount of care should be devoted to the problem of nutrition as was devoted to the problem of manned space-flights. The Group's attention was drawn to man's disregard of his own environment which was overcrowded, polluted, contaminated and

unevenly allocated. Man could perhaps apply certain engineering solutions and endeavour to cultivate and irrigate more land, apply more fertilisers and use improved varieties of crops.

26. Intensive agriculture, however, is hampered by a lack of labour, shortage of water and the pollution factor. Less labour-intensive forms of farming should be sought after; preference should be given to agricultural procedures that do not require so much water and to farming methods that do not involve air pollution or contamination due to artificial fertilisers. As solar energy is the only non-depleting, non-polluting energy resource man has, it would be best to concentrate on plants which capture the most solar energy, some of which are ten to one hundred times more effective than animals as protein sources.

27. Plants or plant products need not be palatable in their natural state, nor must any one source contain all or most of the nutrients essential to the human diet. Food engineering would provide the ways and means of extracting and formulating nutrients into foods analogous to those man currently enjoys. Processors would have to think more in terms of proteins, carbohydrates, fats, vitamins, minerals, etc. not in terms of heterogeneous farm commodities with all the associate problems of unusable by-products.

28. The Group remarked on the difficulties of persuading people to accept vegetable protein as it failed to correspond to the standard beef-steak image and quite often there was a social stigma attached. Familiarization programmes would be needed to overcome initial consumer resistance and care would have to be taken to avoid adverse physiological reactions when introducing unfamiliar foods.

29. Surprise was also expressed at the extensive range of vegetable protein foods available in the United States. The importance of converting industrial by-products or plants conventionally termed weeds was recognised. The Group's attention was drawn to the Cuban project for the conversion of sugar-cane bagasse into valuable protein, the methodology of which was deemed applicable in other countries with traditional carbohydrate production.

10. The Group was also reminded of the Indian food yeast venture in the early post-war years which, amongst other reasons, failed owing to the lack of a proper education programme. It was essential that if was better to introduce new foods to higher levels of society, as terming the product 'starvation-category food supplement' would scarcely endear it to the social group it was intended for. Earlier attempts to introduce single-cell protein had been hampered by the endeavour to keep processing to a minimum. If a micro-organism was found to have an excellent yield, to be resume to disease and to possess easy handling characteristics, such as was the case with torula yeast, it was incorporated in foods in its natural state regardless of psychological preferences and the physiological reactions involved. Flavour control and detoxification processes were expensive and could prove to be critical when preparing foods for people with limited buying power.

11. It was pointed out that a major problem with single-cell protein, such as yeast grown on paper-mill effluents, was lowering the nucleic acid content to an acceptable level and obtaining the functional characteristics for incorporation in the human diet. The flavour problem that hampered the inclusion of fish protein in foods for human consumption on was present to a lesser degree in soybeans and the work currently being done to obtain acceptable soy products would offer some insight into the problem relating to single cell protein.

Non-Conventional Protein Food Processes

12. The secretary of the Non-Conventional Protein Advisory Group presented a paper on the protein food programme initiated by the above group with particular reference to soybean protein. In its early years FAO had concerned itself primarily with the nutritional usefulness and safety of proteins. However, as the emphasis began to switch to the problems of formulation and processing of new protein foods and food mixtures, FAO called upon the services of food technologists in industrial research, product development and production as well as persons concerned with acceptability and others experienced in dealing with governmental policies concerning the manufacture, control and distribution of high-protein foods.

33. FAO dealt with non-traditional protein sources, and particular attention was given to soy beans on account of their high nutritive value and their availability at a comparatively low cost when considered on a combined protein content and nutritive value basis. FAO also prepared and distributed as widely as possible a bulletin and other publications (guidelines) concerning the production and use of protein foods.

34. The speaker indicated that, in future, protein requirements would give rise to greater problems than calorie requirements. Tests had been performed which indicated that malnutrition had an effect upon the most varied factors ranging from length at birth to intelligence in young children. It was not to be assumed that meeting calorie requirements automatically satisfied protein requirements. It was also suggested that more vitamin A in the diet may be required when protein intake is increased as a treatment for protein deficiencies.

35. The speaker introduced the subject of leaf protein and pointed out that irrigated alfalfa offered a tremendous protein yield. However, it had to be admitted that an economically justifiable method of protein extraction continued to present problems. There were also the problems of acceptability conjured with leaf protein.

36. FAO wishes to draw attention to cereal mixtures which offered improved PER values. Amino-acid fortification was not expensive in terms of cost per pound, but since all the wheat had to be fortified in order to reach limited target groups, it was preferable to use soy or other natural protein sources in special foods to reach these groups. Adequate diets offered the advantages of personal well-being and improved physical and mental development. In terms of work efficiency, it was not to be forgotten that the development of the food industry played a significant role in industrial development.

37. PAG had [illegible] soy products common to the Far East [illegible] drawbacks of trypsin inhibitors and the low digestibility factor. Considerable consumer resistance to the [illegible] elsewhere. PAG had advised governments on issues relating to such matters as soy-milk, whose production and use it encouraged, acceptable aflotoxin levels in foods and the detoxification of oil-seeds. Most of the work was being done with the UN agencies, yet there was clearly a pressing need for better documentation and improved access to information. PAG was open to suggestions for improvement.

38. In the ensuing discussion it was pointed out that the form of soy beans to be used for weaning or baby foods varied greatly depending on market conditions. Some companies, however, preferred protein isolates as they had the least effect on flavour.

39. In answer to the question of the reversibility of mental retardation due to protein deficiency, it was stated that if protein was not administered promptly, mental retardation became increasingly irreversible with increasing age.

Isolated soy proteins and soy protein concentrates

40. The discussion began by considering the paper delivered on "Isolated soy proteins and soy protein concentrates" (ID/WG/45/6) which are of particular significance in view of the flavour problems associated with soy flour and soy grit products and the difficulties caused by fibre and other ingredients. Isolated soy proteins and soy protein concentrates could be used to enhance the acceptability of soy products in developing countries and their potential lower production costs would make them attractive substitutes for conventional protein-containing foods in the developed nations.

41. The paper gave illustrations of typical procedures, supplied details of estimated costs and discussed the factors influencing yield. It was

shown that in the case of isolated soy proteins overall costs decrease as the production rate increases. Flow sheets were presented for three processes that are used commercially in the United States for the production of soy protein concentrates: heat-treated flake water extraction process, aqueous alcohol extraction process and the acid leach process. The Group's attention was also drawn to the waste disposal problem conjunct with the production of isolated soy proteins or soy protein concentrates.

42. In the ensuing discussion attention was drawn to the incompleteness of certain patent literature and the need to approach companies in order to obtain trade secrets. The Group then discussed the importance of the percentage of water dispersible protein in the raw material. If the aim was low-cost production of high quality isolate, it was best to select beans with a high percentage of water dispersible protein. However, tests had shown that there could be certain drying and storage problems with the finished products.

43. It was pointed out that the water extraction of heat-treated soy flakes is the simplest and least expensive of the three processes developed for the production of soy protein concentrate.

44. Producing edible isolated soy proteins involved a high degree of sanitation to ensure a micro-organically clean product, not to speak of the attendant waste disposal problem. There was also the difficulty of obtaining flake suitable for edible protein as most soy-flour plants did not supply completely de-hulled raw material.

45. Importance was also attached to the method used for establishing the water dispersible protein factor. Confusion was currently being caused by the variety of terms and units being used. It was felt that this should be standardized.

46. It was also suggested that the contemporary methods of producing protein isolates were perhaps obsolete, and the Group's attention was once again drawn to the fact that the costs of unit production decreased with an increased volume of production.

Full-fat and defatted soy flours for human nutrition

47. Prior to the discussion, a paper was presented on "Full-fat and defatted soy flours for human nutrition"(ID/WG.45/5) which showed that low cost processes had been developed for the production of soy flours. It had proved possible to combat off-flavours and stable products had been developed.

48. An extrusion process for use in urban communities and a simple hand process for use in villagesof developing countries had been developed. Severe heat treatment during processing can reduce the availability of amino acids, impair oxidative stability, reduce vitamin content, and develop poor flavour characteristics in the product.

49. Lipoxygenase inactivation applied before roasting contributes significantly to a stable high-fat product. Good flavours in soy flours can thus be achieved and it helps to make them acceptable to the consumer as constituents in a wide range of processed foods.

50. In the discussion following the presentation, attention was drawn to the various processes required to impart desired flavour characteristics and functional properties. In this connexion, further details were given of the "village process" and "extrusion cooking" processes for full fat soy flour which had been developed by the Northern Utilisation Division and were being successfully used in several developing countries.

51. Analysis of the Uganda experience based on Africa Basic Foods Inc.

The paper entitled "Analysis of the Uganda experience based on Africa Basic Foods Inc." (ID/WG. 45/4) presented an outline summary of the experiences undergone in Uganda by Africa Basic Foods Incorporated. The speaker described the economic development, production and marketing of low-cost high-protein foods. In view of the urgent local need to improve nutritional standards and to combat the appalling death rate among children of pre-school age, a high-protein food was sought which could be bought by lower-income groups and be adapted to local eating habits.

52. Of the protein crops or foods available, which also included dry skim milk, cottonseed, fish meal, soybeans, and groundnuts, soybeans had been chosen because knowledge of their use was extensive and they represented a good cash crop.

53. In the initial stages of sales promotion, school meals had provided a major outlet. The plant's products ranged from full-fat soy flour, salted soy nuts and soy butter to various soy mixtures such as soy school porridge and soy maize. In referring to the difficulties encountered by the enterprise, the speaker drew attention to the fact that expert advice from overseas had been necessary while financial support had been forthcoming only from non-profit making organisations.

54. In the discussion that followed, the Group once more remarked on the need to adapt procedure to the local environment, drawing on local people and resources, and providing research, production and marketing expertise as needed. With regard to product acceptance, it was agreed that food products should fit into the cultural pattern of the local population, the goal being to improve health at a price within the means of the people. School meal programmes in Uganda had clearly shown the benefits of regular protein intake in the form of soy porridge.

55. Doubts, however, were expressed about the dominant role adopted by large international companies in developing countries. Despite the fact that food processing and food equipment manufacturers present at the meeting expressed their willingness to co-operate with UNIDO and other UN organisations in seeking feasible ways to satisfy the nutritional requirements of developing countries, the speaker's fears could not be allayed.

56. Industrial production of soybean foods in Japan

The discussion on this topic was introduced by a paper entitled "Industrial production of soybean foods in Japan" (ID/WG. 45/3) which described how the Japanese industry had succeeded in overcoming many of the problems of texture, toxicity and off-flavours associated with soybeans.

57. The paper described the general features of various traditional Japanese soybean foods such as kinako, tofu, fried tofu, kori-tofu, yuba, soy sauce, miso and natto, as well as new foods based on isolated soybean protein, textured protein and spun protein. The production processes were described in detail and the speaker gave figures relating to costs and yields.

58. The paper also reviewed the present and future demand for traditional soybean foods and appraised the new processes for the production of fibre protein and textured protein which had been recently introduced from the United States.

59. In the course of the ensuing discussion, it transpired that twenty-one Japanese companies were currently spinning food fibres. It was pointed out that soy spun fibres can be made from starting materials which are less refined than 95 per cent isolated soy protein. It was also agreed that the price of soy spun fibres would inevitably drop, and eventually they could be expected to be much lower as markets develop and production increases.

60. "Meatless meats" or simulated meats have been a successful commercial product in the United States for a number of years and were now being marketed in Japan. The Japanese forerunner of simulated meat was kori-tofu, and the principles originally used in its production were now being applied to a new textured protein.

61. In connexion with the fermented foods mentioned by the speaker, the Group's attention was drawn to tempeh, an Indonesian fermented soy food. Tempeh requires a short period of fermentation which improves the soybeans' nutritive value and removes the bitter beany flavour.

62. Following the presentation of the various working papers, industrial reports were given by representatives of four American companies working in the soy food sector.

Worthington Foods Incorporated

63. Following the showing of a film describing Worthington Foods Incorporated's endeavours in the field of vegetable protein foods, a company representative and his Indian associate outlined the company's experiences in India where they had co-operated on a 49:51 per cent equity basis with an indigenous firm.

64. Production had been geared to local tastes and soy products had been produced which were as similar as possible to popular indigenous foods. Soy had also been presented as an attractive crop for the farmer and educational schemes were being introduced to popularize the products among mothers and the medical profession.

65. The speaker stressed the importance of overcoming prejudice by choosing acceptable names for the products. Children were also being encouraged to develop a liking for soy products which could in the course of time become more sophisticated.

66. The Group's attention was also drawn to the soybean and other vegetable isolates and concentrates which had been marketed as enriching agents in food. The speaker also emphasized the fact that the spinning of vegetable protein fibre is not limited to protein isolate, but can also be accomplished with 50 per cent soy flour and similar concentrates. He also mentioned that the fibre spinning approach to the development of meat substitutes was more costly than the extruder method, but resulted in a more functional product.

67. The speaker also commented on the extreme flexibility of the extruder in the manufacture of meat substitutes and meat extenders, both of which could be used in countless ways. In his concluding remarks, the speaker enumerated some of the countries already using Worthington technology and emphasized that work was being conducted as a profitable business venture between his company and organizations in various parts of the world.

68. In the course of the ensuing discussion, the Group was given the opportunity to taste various samples. It was suggested that meat-like products made from vegetable proteins might have a longer shelf-life than corresponding conventional products. It was felt that as flavour preferences were an acquired taste, the greatest contributions were to be made in the field of flavour technology.

69. The Group's attention was drawn to the progress being made in the field of fermentation processes and single cell protein in Japan and the impact these processes would have in later years. The speaker also stressed that authorities responsible for control of foods in various countries should realise that the new foods were not necessarily substitutes or imitations. He also drew attention to the new soy beverages that were being contemplated for the adult market. These beverages were based on isolates and had a reasonably high protein and fat level. Their commerical potential was good and they were much more economical than milk.

Central Soya Company Inc.

70. The speaker outlined the potential role of soy flour and grit products in both simple and sophisticated processed foods, and presented a summary of the company's production of basic ingredients for the processing industry. Particular attention was devoted to the selection, cleaning and de-hulling of the beans, to the sanitation aspects, microbial control and process control for the desired functional and nutritional values. Central Soya did not produce full-fat flour since the company had not found a domestic market.

71. In connexion with the de-solventising and moist-heat treatment of de-fatted fibre, minimum heat treatment with maximum protein dispersibility was desirable for the extraction of protein and the production of white or low-heat flours, which were to be used in certain processed foods where the wet food was heat processed. On the other hand, more extensive heat treatment is employed for the development of maximum nutritional value, lower protein dispersibility and improved flour flavour. The speaker stressed that the control of moist-heat treatment was of proven value in developing certain characteristics.

72. The company was also very active in the development of a new type of defatted soy flour which had been designed for the large-scale production of white bread and cake mixes. The increased use of soy flour in the bakery sector had been stimulated by the increasing costs of non-fat dry milk in the USA, and the speaker indicated that a similar situation would perhaps occur later in Western Europe, Australia and New Zealand.

73. In describing the protein concentrates the company produced which had improved the flavour characteristics as compared to soy flours commercially available, the speaker was pleased to note that the Northern Regional Research Laboratory had indicated in one study that the alcohol extracted product had a better flavour characteristic than the acid-washed product. In addition to the nutritional value, food technologists had also noted that soy protein concentrates were useful in moisture absorption, juice holding and fat binding. Flatus generation was also felt to be lower than in soy flour, all of which added to the concentrates' flexibility.

74. In connexion with isolated soy protein, the speaker said that Central Soya produced isolates from defatted flakes using a minimum of heat treatment. However, if the protein was to meet food standards, critical attention must be paid to equipment design, construction of the process flow and sanitation control.

75. There was ample evidence that properly processed and properly utilised soy flour and concentrates proved good nutritional value, while soy isolate properly used as, for example, in the extended meat sector could make a significant nutritional contribution.

76. In the ensuing discussion, the price difference between isolates and spun protein was discussed and ascribed to the high capital investment and the amount of labour involved. Current fibre prices also reflected the producers' desire to recover their research and development costs, but it was felt they would drop in the course of time.

77. Spray drying was no longer an expensive operation, though one participant did suggest that drum drying, which was far easier and cheaper, could offer a better product. The speaker countered, however, that in large-volume production the erection of one large spray-drying tower would certainly be cheaper than the purchase of several roller dryers. If fired by natural gas, spray dryers would be cheaper to operate and the advantage of building upwards would help reduce working area requirements.

Archer Daniels Midland

78. The company representative spoke of ADM's work in the field of textured vegetable protein. In view of the fact that high-protein residues from cotton, peanut, sesame, sunflower and other oilseeds are most often fed to animals or used as fertilizers since they are not consumable in a palatable form, the company had developed a texturising process to put protein into a form fit for human consumption.

79. The company serves as a food ingredient supplier, producing functional, palatable protein to combine with animal fat trim. The company produced a wide variety of texturized soy flours, and had succeeded in neutralising the inherent soy flavour in soy flour. TVP was available in every conceivable colour and there was an equally extensive range of shapes and sizes.

80. One of the main market obstacles was the uncertainty of the authorities vis-à-vis a protein so closely resembling animal meat. The speaker felt that the wholesomeness and nutritious qualities of a food were more important than the origins of the protein, carbohydrates, fats, minerals and vitamins it contained. A further hindrance was consumer unfamiliarity and disbelief which would only be overcome by time and consumer education.

81. The two main advantages of TVP to developing countries were its storage properties and price in relation to meat. However, there were numerous factors that had to be considered before a successful market could be developed: import regulations, tariff duties, overseas packaging

and labelling, warehouse facilities and costs, distribution, transportation, credit terms, advertising and promotion, assessment of competitive products, food regulation, level of food processing, local eating habits, mode of preparation and preservation, marketing channels, customer service, and local manufacturing considerations such as joint-ventures, etc.

82. When talking of the future, the speaker stressed that TVP did not constitute a threat to the beef industry which supplied a large part of the raw material. The meat-packing industry was in the same position as the dairy product manufacturers had been a decade earlier. They would ultimately be forced to experiment with new combinations of raw materials to produce new and better products. It was a unique opportunity to expand their markets.

83. In the ensuing discussion it was emphasised that the process of extending the supply of existing meat products was not strictly governed by economic considerations. In many cases, the functional characteristics of the additive may enhance the overall quality of the finished product. It was also felt that the developing countries should concentrate upon the establishment of integrated plants producing basic ingredients and processing them into textured protein foods which was preferable to reliance upon imports of isolates and semi-finished products from developed countries.

84. Discussion also centred upon the difficulty of finding names for the new products which would satisfy the authorities and not alienate consumer sympathies. It was suggested that the term "imitation" be avoided, and certain labelling problems were discussed.

Ralston Purina International

85. The speaker summarised the company's highly diversified activities in the animal feed sector, sea foods and human foods as well as market research and marketing at home and abroad. The company was hoping to contribute significantly to the field of protein research and develop higher quality protein, new sources of protein and improve the economics of the processes.

86. The company had already developed a chemically isolated soy protein powder which had been specially processed to preserve the well-known nutritive value of soybean protein. It was an extremely bland product and, like other soy protein powders from the same company, was a versatile and highly desirable protein ingredient used to fortify a wide variety of products in the food industry. The company also produced textured, purified soy protein isolates that could be converted into continuous filament or fibre form by a patented process. The material's versatility made it possible to fabricate a broad range of products while a fifth isolated soybean protein produced by the company was used as a protein source in purified or semi-purified diets for experimental animals.

87. In the ensuing discussion, topics ranged from the efficiency of catfish farming to the potential threat vegetable protein represented to the beef industry. It was also indicated that the demand for protein would increase more in the field of human requirements than in the animal feed sector.

88. The Group also discussed the case of algae and single-cell protein, and it was felt that at the present stage they would scarcely lend themselves to certain texturising activities. In this connection, there was also the problem of tolerance by the human body and the issue of flavour could not be glossed over. Nevertheless, it was agreed that the range of algae was greater than the range of plants and the meeting was reminded that single-cell protein was extensively used as an animal feedstuff in eastern Europe.

89. In connexion with legislation, it was pointed out that the PAG believed that certain protein concentrates, isolates and extracts, nutritionally suitable oils, and acceptable carbohydrates are useful in proper combination as major ingredients of milk-like liquids or beverage powders and toned animal milks, where the resulting products are not nutritionally inferior to milk or corresponding milk products. Whereas the PAG favoured efforts to stimulate milk production in protein-deficient areas, in those situations where animal milk is not available or is too costly, the production and use of any clearly labelled, nutritius, milk-like or toned milk product as a protein source should be encouraged. PAG also felt that research and development aimed at improving the quality and lowering the cost of such products should be intensified.

90. On the penultimate day of the meeting, a visit was paid to the University of Illinois where talks were given on the University's international agricultural programmes, high-lysine maize studies, the US regional soybean laboratory, the University's India soybean programme and soybean studies in the food science department of the University.

91. On the final day of the meeting, the participants from the developing countries presented statements concerning the actual stage of development of soy protein foods in their home countries. Following this, the meeting discussed the final recommendations prior to their adoption. A statement was also made by Mr. W. Z. Gottshall of Ralston Purina Company in which he expressed the willingness of the food processing and food equipment manufacturing industries present at the meeting to co-operate with UNIDO in seeking realistic ways of meeting the nutritional requirements of the developing countries.

III. RECOMMENDATIONS

The meeting made the following recommendations:

1. THAT new food industries for developing countries be based mainly on locally available raw materials and encompass processing and distribution. In this connexion, 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. THAT efforts be made in the developing countries to make use of the experience of the United States where rapid expansion of soybean production and utilisation has occured in the areas of both human food and animal feed.

3. THAT, as soy protein foods represent a very economical source of protein, use be made of all processes from the most modest to the most sophisticated according to market possibilities and requirements.

4. THAT joint ventures be entered into with international organizations or enterprises in order to make use of developed technology.

5. THAT new approaches be studied relating to the production of protein isolates and concentrates in order to improve economic aspects of the processes.

6. THAT a comprehensive study be made 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.

7. THAT steps be taken to stimulate the development of soybean varieties with increased protein and quality, and to encourage international co-operation in this field as is already being done for corn and wheat.

8. THAT UNIDO and other UN agencies be at the disposal of developing countries to assist them in the establishment of soy protein food industries and that their assistance be officially requested by developing countries.

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

ANNEX I

Agenda and programme of work

Monday, 17 November 1969

9.00 Opening Session

Opening address by Mr. M. Mautner, Chief, Light Industries Section, UNIDO, on behalf of Mr. I.H. Abdel-Rahman, Executive Director.

Opening statement by Mr. R.J. Dimler, Director, Northern Regional Research Laboratory.

10.00 Adoption of the agenda

11.00 Technical Sessions

Oilseed protein for food uses by Mr. R.J. Dimler

Discussion

12.00 Lunch interval

14.00 The case for engineering new soy protein food products by Mr. K.A. Markusen

Discussion

16.00 The FAO/WHO/UNICEF protein food programme with special reference to soybean products by Mr. M. Jul

Discussion

Tuesday, 18 November 1969

9.00 Isolated soy proteins and soy protein concentrates by Mr. D.W. Johnson

Discussion

11.00 Full-fat and defatted soy flours for human nutrition by Mr. G.C. Mustakas

Discussion

12.00 Lunch interval

14.00 Analysis of the Uganda experience based on Africa Basic Foods Inc., by Mr. W. Harrison

Discussion

16.00 Industrial production of soybean foods in Japan by Mr. T. Watanabe

Discussion

Wednesday, 19 November 1969

9.00 Worthington Foods Inc., and their food items in India by Messrs. C. Parrett and L. Magnish

Discussion

10.30 Central Soya: the processing and merchandising of soy protein products for food and feed use by Mr. E.W. Meyer

Discussion

12.00 Lunch interval

14.00 Archer Daniels Midland and textured protein by Mr. L.C. Aiolphnor

Discussion

15.30 Ralston Purina International: protein products and their future by Mr. W.O. Gottshall

Thursday, 20 November 1969

8.00	Depart from Voyager Inn for University of Illinois, Urbana, Illinois
10.00	Arrival at Mumford Hall, University of Illinois
10.15	Welcoming address by Mr. G.K. Brinegar, Director, International Agricultural Programmes
10.30	High-lysine maize studies by Mr. D.E. Alexander
10.15	U.S. Regional Soybean Laboratory by Mr. H.L. Cooper
12.00	Lunch interval
13.15	India soybean programme by Mr. K.R. Lenz
14.00	Soybean studies in food science [illegible] by Mr. J. Hetrick
15.00	Depart for Peoria, Illinois

Friday, 21 November 1969

8.30	Statements by participants from the developing countries concerning the actual stage of development of soy protein foods in their home countries.
11.00	Discussion and finalization of recommendations and their adoption
12.00	Closing session

ANNEX 2

LIST OF PARTICIPANTS

Speakers

Mr. R.J. DIMLER
Director
Northern Utilization Research and Development Division
Agricultural Research Service
United States Department of Agriculture
Peoria, Illinois 61604, U.S.A.

Mr. K.A. [illegible]
Department of Agricultural Engineering
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Mr. H. JUL
Secretary
FAO/WHO/UNICEF Protein Advisory Group
United Nations, New York, U.S.A.

Mr. D.H. [illegible]
Executive Vice President
Grain Products Inc.
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Mr. O.L. [illegible]
Principal Chemical Engineer
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Northern Utilization Research and Development Division
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Mr. D.M. [illegible]
President
African Manic Foods Inc.
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Mr. S. [illegible]
Food and Nutrition Division
Food Research Institute
Ministry of Agriculture and Forestry
Tokyo, Japan

Mr. C. [illegible]
Vice President
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Worthington Foods Inc.
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Mr. L. NAGAICH
Director, Vegetable Industries and Products
C-28 West End
Diplomatic Enclave
New Delhi, India

Mr. E.W. MEYER	Manager Protein Research, Chemurgy Division Central Soya Company Inc. Chicago, Illinois 60639, U.S.A.
Mr. L.C. ADOLPHSON	Export Sales Manager Soy Specialities Archer Daniels Midland Company Decatur, Illinois 62525, U.S.A.
Mr. W.G. GOTTHALL	Director of Technical Services Consumer Products Ralston Purina International St. Louis, Missouri 63199, U.S.A.

Government Representatives

BOLIVIA	Mr. R. MURILLO SUAREZ Credit Manager Bolivian Agricultural Bank La Paz
BRASIL	Mr. S. IRINEU DA COSTA Centro Tropical de Pesquisas e Tecnologia de Alimentos Campinas São Paulo, S.P.
	Mr. T.J. BARRETO DE MENEZES University of São Paulo São Paulo, S.P.
	Mr. S. MIYASAKA Instituto Agronômico de Campinas São Paulo, S.P.
CANADA	Mr. M.M. ARIF Food Research Institute Central Experimental Farm Ottawa Ontario
NIGERIA	Mr. I.A. AKINRELE Director Federal Institute of Industrial Research Lagos

TURKEY	Mr. F. AKDOGAN Devlet Planlama Teskilatinda Uzman Ankara
URUGUAY	Miss E.R. MORANDI Instituto Nacional de Alimentacion Montevideo

United Nations

UNIDO	Mr. M. MAUTNER Chief, Light Industries Section Industrial Technology Division
	Mr. M. MOREIRA-DIAS Industrial Development Officer Light Industries Section Industrial Technology Division
	Mr. R.G. HENRIED Senior Industrial Development Officer New York Liaison Office
FAO/WHO/UNICEF Protein Advisory Group	Mr. M. JUL Secretary Protein Advisory Group New York
UNICEF	Mr. R.A. HILL Senior Engineer Food Conservation Division New York

Northern Utilization Research and Development Division, ARS, USDA

Mr. M.J. ALBRECHT	Engineering and Development Laboratory
Mr. R.A. ANDERSON	Engineering and Development Laboratory
Mr. G.H. BOCKMALTER	Engineering and Development Laboratory

Mr. J.C. COWAN	Chief, Oilseed Crops Laboratory
Mr. F.R. EARLE	Industrial Crops Laboratory
Mr. A.C. ELDRIDGE	Oilseed Crops Laboratory
Mr. E.L. GRIFFIN, Jr.	Chief, Engineering and Development Laboratory
Mr. J.E. HUBBARD	Assistant to the Director
Mr. D.L. MILLER	Assistant Director
Mr. J.J. RACKIS	Oilseed Crops Laboratory
Mr. W.C. SCHAEFER	Assistant to the Director
Mr. H.M. TESTER	Assistant Director
Mr. C.H. VAN ETTEN	Industrial Crops Laboratory
Mr. H.L. WANG	Fermentation Laboratory
Mrs. L.C. WANG	Oilseed Crops Laboratory
Mr. W.C. WITHAM	Assistant Director
Mr. W.J. WOLF	Oilseed Crops Laboratory
Mr. D. MAYERSON	Public Information Officer Information Division

Other Participants

Mr. H. AKAHORI	Morinaga Confectionery Co. Ltd., Shimo Sue Yoshi Tsurumi-Ku Yokohama Japan
Mr. A. ATHINIRATANA	Director Institute of Food Research and Product Development Kasetsart University Bangkok Thailand
Mr. A. CIVETTA	Project Leader Research and Development Instituto de Investigaciones Technologicas Av. 30 No. 52-A-77 Bogota Colombia

Mr. J.A. JACOBS	Professor of Crop Production University of Illinois Urbana Illinois 61801, U.S.A.
Mr. T.T. KAJIWARA	Assistant Manager Nippon Soda Co. Ltd. 437 5th Avenue New York N.Y. 10016, U.S.A.
Mr. N. KATSUYA	Superintendant Ajinomoto Co. Takara-Cho, Chuo-ku Tokyo, Japan
Mr. R.K. LANGER	Editor-in-Chief Food Engineering Magazine Philadelphia Pennsylvania 19139, U.S.A.
Mr. E.R. LEWIS	Assistant Director International Agricultural Programs University of Illinois Urbana Illinois 61801, U.S.A.
Mr. C.C. LEO	Manager Product Development Carnation Company Van Nuys California 91412, U.S.A.
Mr. P.J. ROSS	School of Biological Technology, Professor University of New South Wales Sydney Australia
Mr. H. SHILTRON	De Laval Separator Co., (Alfa-Laval) Poughkeepsie New York, U.S.A.
Mr. G.R. SOPER	Head, Department of Biological Process Engineering University of New South Wales Sydney Australia
Mr. J.I. THAR	Special Project Manager Research and Development Group Staff Alfa-Laval AB Tumba Sweden
Mr. Y. YAMAMOTO	Teijin Limited New York Office 80 Pine Street New York 5, U.S.A.

ANNEX 3

List of papers prepared for the Meeting

ID/WG.45/8 Oilseed protein for food uses, presented by Mr. R. J. Dimler, Director, USDA Northern Regional Research Laboratory, Agricultural Research Service, Peoria, Illinois, U.S.A.

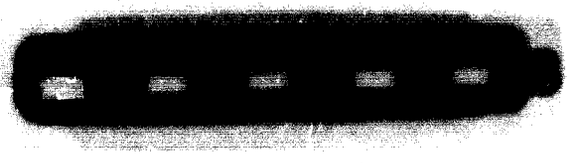
ID/WG.45/7 The Case for engineering - new soy protein food products, presented by Mr. K.A. Harkness, Department of Agricultural Engineering, Ohio State University, Columbus, Ohio, U.S.A.

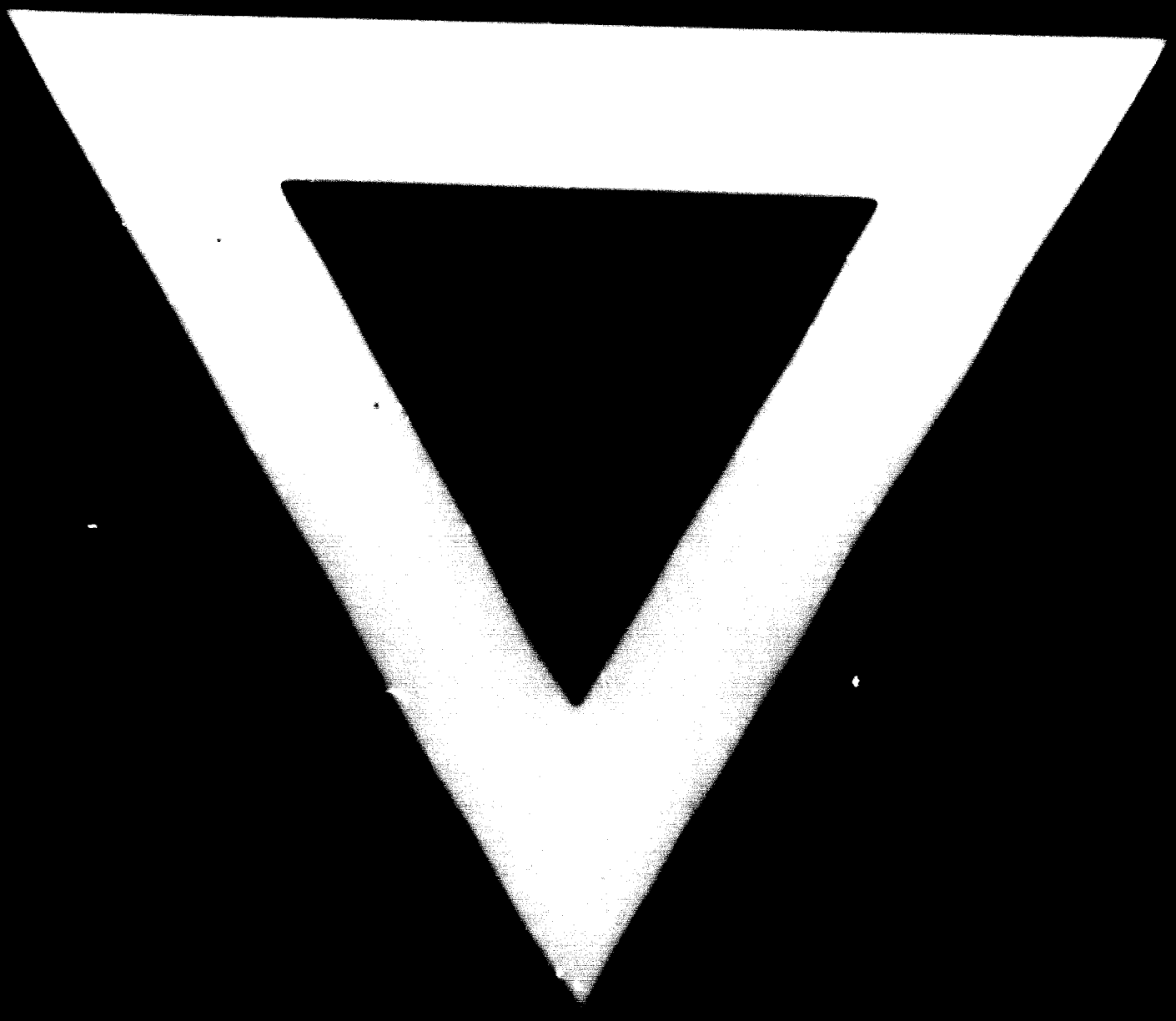
ID/WG.45/6 Isolated soy proteins and soy protein concentrates, presented by Mr. Dale W. Johnson, Executive Vice President, Crest Products Inc., Park Ridge, Illinois, U.S.A.

ID/WG.45/5 Full-fat and defatted soy flours for human nutrition, presented by C.C. Mustakas, USDA Northern Regional Research Laboratory, Agricultural Research Service, Peoria, Illinois. U.S.A.

ID/WG.45/4 Analysis of the Uganda experience based on Africa Basic Foods Inc., presented by Mr. D.W. Harrison, President, Africa Basic Foods Inc., Kampala, Uganda.

ID/WG.45/3 Industrial production of soybean foods in Japan, presented by Mr.Tokuji Watanabe, Food Research Institute, Ministry of Agriculture and Forestry, Tokyo, Japan.





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