Report of

THE MISSIONS ON TECHNOLOGY DEVELOPMENT IN PLANT AND OTHER NOVEL PROTEINS.

April 1977.

Government of Canada — Gouvernement du Canada
Industry, Trade and Commerce — Industrie et Commerce

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FOREWORD

BY D.H. LEES

FOREWORD

This overview gives the latest and best information available on the current state of plant and novel protein development in those parts of the world where it is known to exist. Its substance was produced through the combined efforts of government, industry and academic specialists who participated in four fact-finding missions and applied their wisdom, knowledge and experience to preparation of the individual reports.

The Grain Marketing Office of Industry, Trade and Commerce initiated these missions in pursuit of its continuing commitment to the rational expansion of value-added processing of grains and oilseeds in Canada. To cover such diverse and diversified areas as the United States, Eastern and Western Europe, Oceania and the Far East, the office called upon the willing and expert services of "outsiders". Their assistance made it possible to embrace a task of this scope and to complete the work with commendable promptness.

In our opinion, the result is a valuable information source and reference on what is taking place in protein technology outside of Canada. Much additional information, which was gathered incidental to the missions, has been retained in the Grain Marketing Office and persons with specific interests and questions should contact the office for assistance.

Objective: To identify existing and potential opportunities for the Canadian plant protein industry.

Tasks:

1. To determine and evaluate the current state of development of plant and other novel protein technologies for food and feed and to gain information on future trends and planned development in these areas. Identification of specific companies, raw materials, processes, products and quality is included in this evaluation.

2. To determine current utilizations and markets for plant and other novel proteins in foods and feeds and forecasts over the next five years.

3. To identify and describe factors affecting development of plant and novel proteins abroad (i.e. raw material supply, regulatory, government programs, tariffs, non-tariff barriers, etc.) and to identify procedures for participating in opportunities identified (technology and products).

4. To identify opportunities, existing or developing, for Canadian plant or novel protein technologies and products and project their potential in quantitative terms.

5. To prepare a comprehensive report on plant and novel protein development and to make recommendations on means of exploiting specific opportunities identified and to generally assist in the development of Canada's protein industry.

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EXECUTIVE SUMMARY

D.H. LEES

EXECUTIVE SUMMARY

In early 1977, the Grain Marketing Office of Industry, Trade and Commerce sponsored four international missions on technology development in plant and other novel proteins. The mission teams were made up of representatives from government, industry and universities and each mission was abroad for approximately three weeks. The countries visited by the individual missions were: (a) Japan, Australia; (b) Sweden, Denmark, France, England; (c) Hungary, Poland, West Germany, The Netherlands; and (d) United States of America.

Interest and activity in plant and other novel protein sources and technology were found to be present in all countries visited. The reasons for this varied somewhat within each country; however, self-sufficiency in protein for feed and food and economics appeared to be the most common denominators. In some instances, the emphasis shifted from the protein materials themselves to technology development for marketing abroad which again was an economic factor for the countries involved.

In terms of total activity and interest, Japan, England and the United States must be considered to be the leaders. In Japan, the retail and institutional markets for plant protein are growing rapidly and, at present, are second only to the United States. Although their predominant plant proteins are wheat and soy, the potential exists for other protein sources based on their performance in foods and economic considerations. Japan is viewed as predominantly an importer of raw materials and protein products for further processing and utilization. England, on the other hand, is very much interested in the development of domestic protein sources for food and feed purposes. The retail and institutional food markets for plant protein are growing rapidly in response to economic pressures, with a number of companies participating in these markets. Even though the predominant plant protein for food use is soy, there is a great deal of interest in other sources such as fababean, pea and rapeseed. In England, there is also interest in new technologies for protein production.

The United States is the acknowledged leader in soy protein technology and products. Their domestic market is the largest in the world and provides a base for the growth of these products abroad. At the same time, the real interest in all countries visited for an alternative to soy dictates the requirement for the development of new products and technologies which are economically competitive.

Sweden, Denmark and France are not large markets for plant protein for food, although in each instance there are one or more sources in use. Sweden and Denmark are technology development oriented, and a good deal of this type of activity is underway. Of specific interest in France is the utilization of fababean flour in bread with virtually no concern on the part of the public, industry or authorities for favism. This has not prove to be a problem with fababean flour, in use since 1850.

The use of potato as a protein source in Denmark and The Netherlands is interesting and results from the need to modify potato processing plants.

In the Eastern European countries of Hungary and Poland, the use of plant protein in food is based on economic considerations, and opportunities exist in these countries for both new technologies and new protein products.

In West Germany, the intensity of effort on the development of fermentation technology for single cell protein production is worth noting.

Although there is interest and activity in plant and other novel proteins for food and feed uses, the development of these industries and markets has not been as rapid as was expected in the early 1970's. In fact, it is only now that markets are starting to expand as a result of economic pressures in some countries. Furthermore, it is not likely that widespread, rapid market growth will occur until three to five years from now. Therefore, Canadian participation in these markets is possible provided technologies and products are developed in accordance with market needs and taking into account the necessity for competitiveness with existent technologies and products.

Individual summaries and recommendations are included in each of the reports.

CURRENCY EQUIVALENTS AGAINST U.S. DOLLAR FOR APRIL-MAY, 1977

1.	Japan	.004015
2.	Australia	1.222096
3.	England	1.899368
4.	The Netherlands	.446921
5.	West Germany	.465420
6.	France	.222514
7.	Poland	.050200
8.	Hungary	.048540
9.	Sweden	.254362
10.	Denmark	.184780

Source: Bank of Canada

JAPAN, AUSTRALIA

JAPAN, AUSTRALIA

INTRODUCTION

The mission on technology development in plant and other novel proteins to Japan and Australia was conducted over a three-week period in April 1977.

The following report is based on discussions held during visits with a large number of organizations, institutes and individuals covering the industry, government and university sectors.

In these missions, the concept of cooperative effort by government, industry and university has proved to be successful in an assessment of current technological capabilities and in an appraisal of Canada's requirements and potential in the plant protein sector.

Simon J. Sigal
Market Development Officer
Grain Marketing Office
Department of Industry, Trade
and Commerce

SUMMARY

The Japanese are second only to the U.S. in the manufacture and utilization of vegetable protein. Indications are that Japan is fast becoming a major potential retail market for these proteins.

Factors such as high meat prices, reduced fish availability and current technology have accelerated the growth in Japan of the vegetable protein industry. It is further anticipated that consumer awareness and education will give the industry an even greater impetus. The ongoing westernization of the Japanese diet is adding opportunities for increased vegetable protein utilization.

The Japanese have to date been involved in the production and utilization of only wheat and soy protein but are prepared to consider other vegetable protein alternatives if the economics, functional properties and overall quality proves advantageous.

The Australian market potential for vegetable protein is limited as Australia is still a high animal protein producing country and there does not appear to be any anticipated shift in this dietary pattern in the near future.

Any major developments in the production of vegetable protein in Australia will be dependent on the market potential for these products in their traditional Pacific Rim trading area or upon the possibility of major increases in domestic production costs of animal protein. There will continue to be an increasing demand for protein for animal feed.

In examination of both markets, there is little doubt of the major potential for vegetable proteins in the Japanese marketplace and the requirement for further follow-up, whereas the Australian requirement is less urgent.

TABLE OF PRIORITIES

Major raw materials of interest for protein in greatest production in order of priority:

JAPAN	AUSTRALIA
Wheat	Wheat
Soy	Soy
Rapeseed	Lupin

ORGANIZATIONS CONTACTED (APRIL 4 - APRIL 22)

1. JAPAN

Japanese Vegetable Protein Food Association (JVPFA),
Tokyo.

Ministry of Agriculture and Forestry (MOAF),
Tokyo.

Nippon Flour Mills Co. Ltd.,
Tokyo.

Nisshin Foods Company Ltd.,
Tokyo.

Kyowa Hakko Kokyo Company Limited,
Tokyo.

Ajinomoto Company Inc.,
Tokyo.

Fuji Oil Co. Ltd.,
Osaka.

National Food Research Institute,
Tokyo.

National Research Institute of Food Products,
Tokyo.

Nisshin Oil Mills Ltd.,
Tokyo.

Danippon Ink & Chemicals Ltd.,
Tokyo.

2. AUSTRALIA

Division of Protein Chemistry CSIRO,
Melbourne.

Kimpton Minifie and McLennan Ltd.,
Melbourne.

Biochemistry Department, Bendigo College of Advanced Education,
Bendigo.

Food Standards Committee of the National Health and Medical
Research Council,
Canberra.

School of Food Technology, University of New South Wales,
Sydney.

Division of Animal Protein Production CSIRO,
Sydney.

Department of Chemical Engineering, University of New South Wales,
Sydney.

Alta-Lipids,
Sydney.

Industry Meeting - Food and Feed,
Sydney.

Drummond and Shirley Pty Ltd.,
Carlingford, N.S.W.

Edible Proteins Pty, Ltd.,
Granville, N.S.W.

Meggitt Limited,
Camellia, N.S.W.

McCorquodale Stockfeeds Pty Ltd.,
Parramatta, N.S.W.

Allied Feeds,
Rhodes, N.S.W.

Stauffer Chemical Co. (Aust) Pty Ltd.,
Camellia, N.S.W.

N.B. Love Industries Pty Ltd.,
Pyrmont, N.S.W.

Gillespie Bros. Pty Ltd.,
Pyrmont, N.S.W.

Davis Gelatine (Aust) Pty Ltd.,
Botany, N.S.W.

The Unisearch Ltd.,
Kensington, N.S.W.

Australian Meat Research Committee,
Sydney, N.S.W.

University of Sydney,
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Fielders Foods Ltd.,
Leichhardt, N.S.W.

Edgell,
Crows Nest, N.S.W.

Royal Alexandra Hospital for Children,
Camperdown, N.S.W.

State Government of New South Wales,
Division of Marketing & Economics,
Sydney, N.S.W.

Department of Agriculture,
Poultry Research Station,
Seven Hills, N.S.W.

CSIRO Food Research Division,
North Ryde, N.S.W.

Department of Agriculture,
Agriculture Journal,
Sydney, N.S.W.

JAPAN

I OVERVIEW

Japan is a country of 110 million people with limited land base, limited natural resources, requirements to import most of their foodstuffs and energy sources associated with a high degree of technology. Japan, in common with most of the Far East, has unique food technologies based on fish and soybean. These ancient food technologies led to the development of a number of traditional foods. The variety of foods, such as tofu, koritofu, kamoboko and others are an integral part of the Japanese diet and will not be readily changed. Japan, which has been a traditionally fish-eating nation, has in the past few years begun a switch to an animal protein diet. An interesting aspect of this change is that the consumption of the traditional protein sources is increasing along with an increase in the consumption of animal protein.

It should be borne in mind, however, that the consumption of animal protein in Japan is still low compared to that in the West. It is also safe to assume that the economic crisis of the last few years has slowed the rate of increase in animal protein consumption, although no figures are available. To meet the demand for protein at a reasonable cost, Japan has over the last few years turned to vegetable sources such as soybean and wheat. Protein products which are quite familiar to us on the North American continent have made their appearance in Japan in considerable quantities both as extenders of meat and even in products such as kamoboko and also for the production of simulated products. The restriction on fishing imposed by the 200 mile economic zone has greatly disturbed the Japanese and has strongly influenced their thinking regarding the protein supply. The potential reduction in fishing will undoubtedly make the Japanese look with greater interest at other sources of protein, and these are likely to be vegetable sources.

The two main sources of vegetable protein in Japan at this time are soybean and wheat. The consumption of protein materials from these two sources has risen from 12,000 tonnes in 1968 to 40,000 tonnes in 1976. In spite of this reasonable growth, it should be remembered that this represents only one per cent of Japan's protein requirements.

All Japanese food companies involved in the manufacture or use of vegetable protein are members of the Japanese Vegetable Protein Food Association. The Association was created because of the fact that vegetable proteins have not been accepted without reservations by the Japanese consumer. The major objective of the Association is to expand the consumption of vegetable protein foods, mainly through promotional efforts by the media and various food editors. The Japanese consumer, like his North American counterpart, is concerned about chemicals in his food. In spite of the fact that the Japanese have been consuming soybeans or some form of soy product for many years, vegetable protein as we know it carries a connotation of a synthetic product.

Meat and fish are covered under Japanese Agricultural Standards and only those proteins which are manufactured in Japan such as soy and wheat can be utilized. Therefore, any vegetable protein which might be offered to the Japanese trade, other than soy or wheat, could only be utilized in products other than meat and fish at present. In order to obtain approval for other proteins it will be necessary to have the Japanese Vegetable Protein Food Association recommend such protein to the Ministry of Agriculture and Forestry (MOAF) which would in turn have to recommend its inclusion in Japanese Agricultural Standards.

The Japanese consume, on the average, 78 grams of protein and 2,500 calories per day. Animal protein, including that from fish, represents about 40% of the total protein consumed. Rice and wheat supply an appreciable amount of protein -- roughly 33% -- and about 50% of the total calories. It is apparent that Japanese consumers, on the average, have adequate amounts of protein in their diet. The continued development of vegetable protein utilization will depend on the economics of protein utilization as well as the contribution of functional properties by these proteins.

Novel protein, such as single cell proteins, are encountering considerable difficulties in Japan. Most of the original research was carried out on petroleum products and these are considered, at present, to be both a health hazard and uneconomical. Because of the health hazard, elaborate testing must be undertaken before any approval will be forthcoming for feed or food purposes. SCP development using other substrates is still underway but similar safeguards will be implemented.

Some current prices for protein in Japan are as follows:

kamoboko - $2.27 per kilogram
tofu - 51¢ per kilogram
koritofu - $1.40 per kilogram
pressed ham - $3.90 per kilogram
ground beef - $3.50 per kilogram
textured wheat protein - $1.40 per kilogram
textured frozen wheat protein (65% moisture) - 32¢ per kilogram
textured soy protein (50% protein) - $1.20 per kilogram
soy concentrate - $1.67 per kilogram
structured soy protein (65% moisture) - 42¢ per kilogram
soy isolate (80% protein) - $2.20 per kilogram
wheat protein isolate (gluten) - 84¢ per kilogram
milk - $1 per litre
beef (manufactured) - $12 per kilogram
pork (manufactured) - $6 per kilogram

II PROTEIN SOURCES

1. Soybeans

Soybeans, containing about 40% protein and 21% fat, have a long history as a raw product for Japanese food products. Miso, tempeh, shoyu (soy sauce), tofu, koritofu, natto and kinako are still popular soybean products and were manufactured from whole soybeans in the amount of approximately 758,000 tonnes in 1972. Another 305,000 tonnes of these products were prepared from defatted soybeans. Approximately 2.6 million tonnes of soybeans are used for edible oil production. The soybean meal, a by-product of the oil extraction industry, is used mostly for feed, accounting for about 75% of the total meal. Meal is also for the production of miso, tofu, soy sauce and textured plant proteins.

More than 95% of the soybeans consumed in Japan are imported from other countries, with the U.S. as the major exporter. About 126,000 tonnes of soybeans were produced in Japan in 1975 compared with an import tonnage of 3,333,000 tonnes.

2. Traditional Soy Protein Foods

(a) Tofu

Tofu, a soybean curd made by coagulating soybean milk with a calcium salt, normally has a protein content of about 6% as well as 3% lipid and 88% water content. The protein content of tofu is higher than the original soybean on a dry weight basis since carbohydrates are lost in the whey after coagulation. About 400,000 tonnes of soybeans are used in Japan for the preparation of tofu and related products. Apparently, there are 40,000 small plants which manufacture tofu. Such a situation exists since tofu is readily spoiled and the structure of the curd is damaged during transportation. The production of tofu consists of preparing (i) a soybean milk through grinding, heating and filtering, and (ii) adding a calcium salt (calcium sulphate) to bring about coagulation, (iii) the curd is held to allow the whey to separate, (iv) the curd is molded in boxes and washed with water to remove the remaining free calcium sulphate. Slices of about 300 to 400 grams are cut and sold as fresh tofu. The yield of tofu is about 40 to 50 kilograms per 10 kilograms of dry soybeans.

The quality and yield of tofu is dependent on the total solids in the soybean milk, amount of calcium salt, coagulation temperature and rate of stirring. To preserve the product, five ppm of a nitrofuran derivative is permitted.

Tofu may be prepared from defatted soybean meal (two parts) along with whole soybeans (eight parts). A spray-dried soybean milk powder, prepared from water extracted soybeans, can also be used conveniently for tofu production. However, this powder has a short storage life.

With the availability of refrigeration and packaging machines, large scale production of tofu is possible. Several factories can produce five tonnes of tofu per day. Continuous cookers and continuous centrifuges can be used in these plants for the production of soybean milk. However, spray-dried soybean milk seems to be preferred for making packaged tofu. Coagulants are added to the milk in plastic bags in the form of calcium sulphate, glucono-deltalactone or a combination of the two. The bags are heated in the water bath to 90 degrees Centigrade for 40 to 60 minutes, during which time the milk coagulates gradually without the separation of whey.

(b) Koritofu

Koritofu is a dry tofu which has a porous sponge structure and can be stored at room temperature. Koritofu is prepared by freezing tofu, allowing it to age, thawing the product and squeezing. Mass production of koritofu has brought about a cost reduction of 30% of the fresh tofu calculated on a protein basis.

(c) Miso

Miso is a fermented soybean base which serves as a base for soups and sweet paste. This paste has a protein content of about 8 to 19%, as well as 2 to 10% lipid, 2 to 33% soluble carbohydrate and 5 to 10% sodium chloride. This variability and composition is due to the types of raw materials and the amount of salt used. Three major classes of miso are: rice miso made from rice, soybeans and salt; barley miso from barley, soybeans and salt; and soybean miso made with soybeans and salt. These classes are further broken down into sweet, medium salty and salty. Each variety is divided into whites, light yellow and red. About 520,000 tonnes of miso are produced industrially annually with 80% as rice miso, 11% barley miso and 9% soybean miso. Approximately 150,000 to 200,000 tonnes of miso are prepared in the home.

Manufacturing procedures of miso differ with each variety, but the basic principles are the same. For the fermentation, the kojimold, Aspergillus oryzae, is used so that the fermentation of proteins, carbohydrates and lipids can take place under conditions of high salt concentration. The mold supplies the hydrolytic enzymes whereas the halophilic and the lactic acid bacteria provide the characteristic flavor.

Rice miso is prepared by cooking soybeans, mixing cooked beans with koji rice and salt, and allowing the mixture to ferment in a tank or vat. Defatted soybean meal is not suitable for the manufacture of good quality miso. More specifically, raw soybeans are soaked in water and then cooked in water or steamed at a temperature of 115^{o}C for 20 minutes. The beans are ready for fermentation by koji rice. Koji rice is prepared by soaking rice in water at 15^{o}C for 15 hours and steaming for 40 minutes. Upon cooling to 35^{o}C, the rice is inoculated with Aspergillus oryzae spores and incubated for 40 hours at 30^{o}C. Thereafter, salt is intermixed with koji rice. Cooked soybeans are then mixed with the salted koji rice and with the culture yeast and lactic acid bacteria. After packing the mixture in the tank, fermentation is carried out at 25 to 30^{o}C for one to three months.

Miso soup can be prepared from miso by diluting one to ten with hot water. The soup, with a salt content of one per cent, is considered to be a good source of protein.

3. Soy Protein

Initially, three types of plant protein products were considered: powdered isolates, textured and spun. Isolates were considered for use as extenders of meat, sausages, fish jelly and eggs. The extruded textured plant protein could be used in ground meats for hamburgers and meat balls. Simulated meat products were considered possible by utilizing spun proteins. Since 1970, the plant protein industry in Japan has focussed its efforts primarily on the manufacture of textured plant protein and plant protein isolates. In 1976, 15,775 tonnes of soybeans were used as raw product for the manufacture of soy protein.

Defatted soybean meal is being used by some Japanese companies for the manufacture of textured protein and for protein isolates. The manufacturing procedures are similar to those developed in the U.S. Every Japanese manufacturer of soy protein has a licensing arrangement with an American counterpart. The textured protein products have protein values between 50 and 70% while the protein isolate has a protein content of about 90%. One Japanese company has an exclusive Japanese licence for the manufacture of structured protein, apparently prepared under high pressure and temperature. Structured protein can be flavored and colored successfully to simulate beef and jerky, corn beef (to be used with soy sauce) and meat filling for Syremai and Gyoza which have a steamed dough covering. Structured protein is also used to manufacture simulated fish products such as crab meat. The structured protein is normally marketed in hydrated frozen form.

Soy protein isolates with high solubility have been used in Japan for extending fish muscle in fish sausage, for extending meat and ham sausage, and as an ingredient of a curing solution for hams as well as an ingredient for special Japanese foods such as Age and Gammo. In the laboratories of a Japanese company, a process for the preparation of pressed ham using soybean isolate has been developed. In this process, an emulsion consisting of 12% oil, 80% water and 8% isolate, is mixed with washed mutton pieces and other meats, and then after adding dry curing agents, the mass is stored for four days to allow for curing. The binder meat and starch are added to the mass and thereafter stuffed into plastic bags. The product is cooked at 70°C for 1.5 hours. About 5% of isolate on a total product basis is added to ham and fish sausage mixes because of the requirement for good binding properties. Soybean isolate has been incorporated into the curing solution which is pumped into hams to the extent of 160°C of green weight. Such use of isolate has been reported by Swift and Company, Chicago. This company has claimed that since the isolate has water binding attributes, shrinkage during the cooking process was found to be about 9% for pressed ham and 4½% for the canned ham. Moreover, sliced products do not weep. Massaging of ham is required to distribute the isolate evenly throughout the meat.

4. Structured Protein

Two Japanese companies are producing so-called "structured protein" which has quality attributes similar to those of spun fibre products. The cost of the structured protein process is considerably lower than that for spun products. At present the companies are interested in developing simulated products such as shredded crab meat and shrimp. One method for the preparation of a simulated shrimp product involves the extrusion of a wheat protein (gluten) isolate curd (20% solids) at high temperatures and pressure. Another method involves the extrusion of a dough into a rope, the cutting of the rope into small pieces and the steaming of the pieces in an elongated cylinder to texturize the protein material. The structured wheat protein actually consists of fine intertwined threads.

5. Wheat Protein

The dietary pattern of the Japanese has changed progressively since the end of World War II, particularly with the increasing appeal of bakery products such as bread and cakes. Annual per capita consumption of wheat has increased from 26 kilograms in 1960 to 31 kilograms in 1973. Bread with a protein content between 8 and 9% is a significant source of protein in the Japanese diet. At present, one million tonnes of bread are produced per annum in Japan, replacing to a large extent products made from rice flour.

A natural outcome of flour production is the manufacture of gluten. Based on this interest, Japan manufacturers have developed wheat protein to a point where in 1976 the total production of wheat vegetable protein was in excess of 25,000 tonnes as compared to soy protein production of 15,000 tonnes. Interest in wheat protein is growing as it does not have the same flavor and flatulence problems with which soy protein is faced.

Wheat protein is manufactured in two basic forms in Japan, as an isolate or as a texturized product. Textured hydrated gluten is sold in the frozen state because the Japanese feel that upon rehydration, it is not possible to obtain the same moisture content as in the original product. There is also a tendency for hydrated frozen wheat protein to remain somewhat more tender. Wheat protein is also marketed as a dry powder. It has been possible to use up to two to three per cent wheat protein in fish paste without any apparent change in the final product. It is also combined with soy protein to produce a textured dry product for meat extension.

Hydrated gluten is used mainly for commercial production of fish sausage, and can also be structured to form a meat-like product with about 65% moisture.

6. Fish "Jelly"

Fish jelly is a general term for products prepared from washed macerated fish flesh. Kamoboko and fish sausage, the most popular fish "jellies", have a gel structure which can withstand steaming, broiling and frying. The production of traditional fish jelly products such as steamed and fried kamoboko has increased steadily in the past few years whereas fish sausage consumption has levelled off after a marked growth in the early 1960's. This levelling off of fish sausage can be attributed to an increased consumption of pork sausage and the reduction in product quality due to the use of low grade fish. The production figures for fish paste or jelly range from 1,081,000 tonnes for 1970 to 1,187,782 tonnes for 1973. Between 1970 and 1975, the pork sausage production increased from 105,840 tonnes to 143,800 tonnes. Kamoboko was originated in Japan about 400 years ago but fish sausage has been produced industrially only since 1953. These two products vary in texture and flavor because of the difference in raw materials and ingredients. Kamoboko has a greater elasticity than fish sausage.

Fish jelly manufacturing includes the following steps: separation of flesh from skin and bones with a perforated drum separator, chopping, grinding with salt and seasoning by a stone mortar, shaping, cooking and cooling. Salt in the amount of 2.5 to 4%, acts, to some extent, as a preservative although furylfuramide and sorbic can be added to inhibit the growth of spore-forming bacteria and mold. The fish jelly products are considered to be high in protein. Kamoboko has a protein content of about 12 to 13%, 0.8% fat and 77% water whereas fish sausage has a protein content of about 15%, a fat content of about 6% and 68.5% water.

Alaska pollack and horse mackerel are used extensively in fish jelly manufacture. Washing the comminuted flesh of these species has been found to improve the elasticity of the jelly and to remove unpleasant fish odors and fat. The removal of the water soluble proteins in the flesh by washing is considered to be the reason for the improvement of the gel structure. Frozen, washed, minced flesh of Alaska pollack is frequently used as raw product for fish jelly production. This raw product, called surimi, is distributed as two types: salt free with 0.2% polyphosphate and 5.8% sugar, and salted with 2 to 5% salt and 10% sugar.

The storage life of fish jelly is dependent on the type of packaging, presence of preservatives and storage temperature. Vacuum packaging of fish jelly in casings of vinyl chloride has become popular. After the casing has been sealed, the product is cooked at 80° to 90°C for semisterilization. The shelf life of such products is more than one month at room temperature.

7. Rice

Rice, the principal food item in the Japanese diet is served at breakfast, lunch and supper as a cooked whole grain product. Rice contains between 6 and 10% protein and 85 to 90% starch. In 1973 the average per capita consumption of rice in Japan was 91.1 kilograms. Due to changes in eating habits in Japan, the demand for rice is decreasing. As the Japanese government is interested in promoting the growth of its own crops, the price of rice is being subsidized in order to maintain its position with respect to wheat.

8. Rapeseed

Rapeseed is imported by Japan for the extraction of edible oil. From 1971 to 1975, imported rapeseed rose from 416,000 tonnes to 669,000 tonnes but production in Japan during this period dropped from 23,000 to 6,000 tonnes. The meal produced after oil extraction is used mainly as fertilizer but its use for animal feed is increasing. Considerable interest is expressed by oilseed company representatives in the extraction of edible protein from rapeseed meal which has a protein content of about 36%. They regard rapeseed protein as a good potential alternative to soy protein.

9. Novel Proteins

Several companies in Japan were at one time interested in the production of single cell protein (SCP) based on petroleum fractions as a substrate. In fact, plans were being finalized to build large scale plants. However, consumer advocates have raised such strong objections that the production of petroleum based SCP has been suspended by government decree. In fact, this material cannot be fed even to animals, the fear being that traces of carcinogens can be transmitted from animals to humans.

Attention has since turned to the production of SCP based on the by-products of agriculture and food processing. However, even here a very elaborate program to test the safety of this protein material is being carried out by the National Research Institute of Food Products. It is interesting to note that the SCP material is meant for use in feeds and not food. Aside from safety, one aim of the program is to avoid unauthorized use of SCP by developing the proper analytical methodology. Multiple generation feeding tests are planned in poultry, swine and fish. It is safe to estimate that SCP material will not be available in Japan for some years to come.

Japan is, nevertheless, concerned about the potential use of agricultural wastes as substrates for the development of SCP. At present, they produce approximately two million tonnes of rice husks which are being investigated. There are also an estimated 500,000 tonnes of citrus wastes which appear to have a high potential for the development of SCP.

III REGULATIONS

Regulations allow the use of plant proteins, specifically soy and wheat, in those products which are included in Japanese Agricultural Standards (JAS). Government regulations limit the use of vegetable protein in top grade products such as ham, sausage and kamoboko to 5% of total weight. For a lower grade product 10% is permitted and for an ungraded product 15%. In the last case, the product could no longer be classed as, for example, ham. The Japanese rely to a large extent on what is considered to be good manufacturing practice. This merely states, insofar as the Japanese government is concerned, that the manufacturer is expected to produce a product which falls within the normal parameters of what the product should be.

Labelling regulations have been in effect since 1976 and, although not as severe as in other countries, do indicate on the label the type of protein that is being used in the particular product. There are no regulations which prohibit the use of plant protein in bakery goods.

IV CONCLUSIONS

1. Japan represents a major potential market for vegetable protein. They are aware of the need for proteins other than the traditional soy and fish which are indicated to be too vulnerable to economic and political pressures.

2. As a result of the soy embargo in 1972, the Japanese look with interest at viable alternatives to soy. Wheat is, and will probably continue to be, of interest to the Japanese as a source of protein.

3. Pea, rapeseed, oats and other sources for extracted protein will interest Japanese industry.

4. The area in which the most significant consumption of vegetable protein is liable to occur is in the traditional foods such as kamoboko. For instance, with present annual consumption of 1.25 million tonnes of kamoboko and at a 10% (on a dry basis) replacement level, a market for 125,000 tonnes of plant protein can be realized.

V RECOMMENDATIONS

There are a number of recommendations which should be considered in evaluating the status of the Japanese vegetable protein industry and examining the role for future Canadian efforts with the Japanese protein manufacturers and marketing firms.

1. Rapeseed protein appears to have the greatest potential for utilization in those areas where soy and wheat protein are being utilized in Japan but also offer an opportunity for new uses.

2. Other Canadian plant proteins are being developed and improved and these must be carefully examined. The use of proteins with improved functional proportions in traditional Japanese foods appears to offer the most significant application.

3. Due to their high costs and supply problems, substitutes for milk and eggs could be a valuable area on which to focus. The utilization of plant protein products for such substitutes is not unknown but their further development in co-operation with Japanese food companies offers great scope.

4. In order to accomplish or consider these recommendations, there should be ongoing discussions with the Japanese Food Research Institute and liaison maintained with the Japanese Food Vegetable Protein Association. The potential for joint ventures with Japanese firms exists and should be a prime consideration.

Annual Per Capita Consumption of Principal Foodstuffs in Japan

(In kilograms)

F.Y.	1960	1965	1970	1971	1972	1973
Grains	149.6	145.0	128.5	127.0	125.0	124.6
Rice	114.9	111.7	95.1	93.2	91.7	91.1
Wheat	25.8	29.0	30.8	31.0	30.9	31.0
Barley, Rye, etc.	8.9	4.3	2.6	2.8	2.4	2.5
Potatoes	30.5	21.4	16.2	16.5	16.6	16.2
Starch	5.5	8.3	8.1	7.8	8.0	7.9
Beans	10.2	9.4	9.8	10.0	9.8	9.8
Vegetables	99.7	109.6	115.6	119.5	117.8	112.4
Fruits	22.3	28.5	38.2	38.1	44.2	43.7
Meat (excluding Whale Meat)	3.4	6.7	11.5	13.3	14.2	16.2
Beef	1.1	1.4	2.0	2.3	2.4	2.3
Pork	1.1	2.7	4.7	5.1	5.6	6.4
Poultry	0.8	1.9	3.7	4.3	4.7	5.1
Others (Mutton,etc.)	0.4	0.7	1.1	1.6	1.5	1.4
Chicken Eggs	6.3	11.6	14.8	14.9	14.6	14.5
Milk, Dairy Products	22.3	37.4	50.1	50.7	51.8	52.9
Sugary Foods	4.3	6.6	9.5	9.9	10.6	11.1
Marine Foods	27.8	29.2	31.8	33.3	33.3	34.3

Source: "Food Consumption Statistics," Ministry of Agriculture and Forestry.

Note: 1) Figures above relate to unadulterated foodstuffs.
2) Figures for fiscal 1972 include Okinawa Prefecture.

JAPAN - IMPORTS

('000 m.t.)

	1971	1972	1973	1974	1975
CEREALS					
Wheat C/	4,872.0	5,149.3	5,386.1	5,376.6	5,654.2
Oats	197.1	203.7	110.2	168.9	140.6
Barley	865.3	1,004.0	1,321.7	1,417.9	1,597.8
Corn	5,007.2	6,051.5	7,770.6	7,939.5	7,470.1
Rye	159.7	170.2	151.5	27.5	53.7
Rice	12.7	3.2	24.5	62.8	45.3
Sorghum	N/A	N/A	N/A	4,474.0	3,794.0
Buckwheat	25.3	28.2	18.4	16.2	N/A
Cereals NES 4/	3,854.2	3,558.1	3,824.8	73.4	98.7
Total	14,993.5	16,168.2	18,607.8	19,556.8	18,854.6
OILSEEDS					
Flaxseed A/	112.0	115.0	111.4	82.6	69.9
Rapeseed A/	416.1	613.7	693.1	678.9	668.6
Soybeans	3,211.6	3,395.6	3,634.6	3,243.9	3,333.8
Sunflowerseed	37.1	28.5	4.8	1.3	2.4
Cottonseed	247.8	180.2	159.1	123.3	116.0
Palm nuts & kernels	38.9	21.7	12.2	4.0	6.7
Groundnuts	52.4	62.3	76.3	52.7	51.2
Total	4,115.9	4,417.0	4,691.5	4,186.7	4,248.6
OILS					
Rapeseed A/	-	3.3	16.8	6.8	14.8
Linseed	L.T.	4.8	18.8	5.6	L.T.
Soybean	0.6*	0.9*	6.0	20.4	13.9
Palm	40.9	54.9	100.3	115.3	107.7
Cottonseed	0.5	13.6	19.7	16.9	9.5
Total	42.0	77.5	161.6	165.0	145.9

OILSEED CAKE & MEAL	1971	1972	1973	1974	1975
Rapeseed	13.4	6.4	10.8	11.3	-
Soybean	38.9	52.1	277.4	131.6	17.6
Cottonseed	3.1	0.1	9.6	0.4	-
Groundnut	122.0	143.1	182.4	119.0	25.9
Oilseed cake NES	101.8	84.7	88.7	60.5	65.1
Total	279.2	286.4	568.9	322.8	108.6

* Unofficial figure.

L.T. Less than 50 metric tons.

NES Not elsewhere specified.

A/ Includes mustard seed.

C/ Includes meslin.

4/ Cereals NES are in this case mainly sorghum and buckwheat but where figures for either are not available, Cereals NES is given for the remainder.

SOURCE: FAO Trade Yearbook 1975
Japan Custom Bureau

Market and Policy Analysis Division
Grain Marketing Office
Department of Industry, Trade and Commerce
March 1977

JAPAN - IMPORTS FROM CANADA

('000 m.t.)

	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76 P/
CEREALS						
Wheat	1,087.6	1,376.9	1,380.8	1,704.9	1,191.0	1,573.9
Wheat Flour	0.2	0.3	0.3	0.2	0.2	0.2
Barley	559.4	670.5	892.4	762.7	788.9	1,031.2
Rye	121.4	191.1	155.9	54.9	41.8	41.2
Buckwheat	28.3	23.1	24.9	21.4	6.5	13.3
Total	1,796.9	2,261.9	2,454.3	2,544.1	2,028.4	2,659.8
OILSEEDS						
Flaxseed	110.2	115.3	122.5	108.2	50.8	93.2
Rapeseed	363.0	505.1	698.6	662.8	503.5	618.6
Soybean	-	-	1.0	4.7	5.4	6.2
Mustardseed	9.3	7.5	6.1	8.5	7.3	9.7
Total	482.5	627.9	828.2	784.2	567.0	727.7

P/ Preliminary

SOURCE: Canada Grains Council, Statistical Handbook.

Market and Policy Analysis Division
Grain Marketing Office
Department of Industry, Trade and Commerce
March 1977

JAPAN - EXPORTS

('000 m.t.)

	1971	1972	1973	1974	1975	1976 P/
CEREALS						N/A
Wheat Flour	31.3	30.1	31.4	18.8	27.2	
Rice	912.1	182.7	540.2	308.5	11.2	
Total	943.4	212.8	571.6	327.3	38.4	
OILSEEDS D/						N/A
OILS						N/A
Rapeseed A/	9.1	7.5	2.9	2.6	1.8	
Linseed	3.4	1.5	0.7	3.1	0.4	
Soybean	18.3	3.7	9.2	2.9	0.1	
Palm & Palm Kernel	8.2	1.9	1.3	0.5	0.3	
Seed oils NES 1/	8.0	2.1	1.2	8.6	3.8	
Total	47.0	16.7	15.3	17.7	6.4	
OILSEED CAKE & MEAL						N/A
Soybean	L.T.	0.1	2.3	23.4	47.7	
Oilseed Cake & Meal NES	0.2	0.7	3.8	0.3	2.1	
Total	0.2	0.8	6.1	23.7	49.8	

A/ Includes meslin.

D/ Negligible amount.

1/ Mainly coconut, castorseed.

L.T. Less than 50 metric tons.

SOURCE: FAO Trade Yearbook 1975

Market and Policy Analysis Division
Grain Marketing Office
Department of Industry, Trade and Commerce
March 1977

JAPAN - PRODUCTION

('000 m.t.)

	1971	1972	1973	1974	1975	1976 P/
CEREALS						
Wheat	441	284	202	232	241	235
Oats	60	56	41	36	28	N/A
Barley	503	325	216	233	221	235
Corn	25	29	17	14	11*	N/A
Rice	14,153	15,391	15,778	15,963	17,101	16,100
Buckwheat	20	25	28	27	25 F/	N/A
Millet	10	4	2	2 F/	2 F/	N/A
Total	15,212	16,114	16,284	16,507	17,629	16,570
OILSEEDS						
Rapeseed	23	16	13	9	7 P/	6 E/
Soybean	122	127	118	133	126	120
Groundnut	111	115	97	91	71	71 F/
Total	256	258	228	233	204	197
OILS						
Rapeseed A/	168.7	201.8	264.2	265.0	277.7	N/A
Linseed	44.4	43.6	40.2	35.0	27.7	N/A
Soybean	440.1	454.9	482.6	492.6	466.5	N/A
Palm Kernel	19.0	11.2	6.8	2.0	3.2 R/	N/A
Sunflowerseed	16.0	9.9	1.7	T/	N/A	N/A
Cottonseed	46.7	33.3	29.0	25.8	19.6	N/A
Other K/	213.0	218.6	235.5	208.2	198.0	N/A
Total	947.9	973.3	1,060.0	1,028.6	992.7	

	1971	1972	1973	1974	1975	1976 P/
OILSEED CAKE & MEAL						N/A
Rapeseed A/	245.2	298.7	402.5	386.6	376.7	
Linseed	69.0	69.4	64.2	56.1	42.8	
Soybean H/	1,911.8	1,950.2	2,109.1	2,093.5	2,006.5	
Palm Kernel	19.1	11.2	6.8	1.9	3.2	
Sunflowerseed	21.9	15.8	2.8	T/	N/A	
Cottonseed	139.2	96.2	82.7	68.2	56.9 R/	
Groundnut	1.6	1.8	0.6	1.0	0.7 R/	
Other K/	529.5	533.6	534.5	525.3	501.4	
Total	2,937.3	2,976.9	3,203.2	3,132.6	2,988.2	

* Unofficial figure.

A/ Includes mustardseed.

F/ FAO estimate.

H/ Includes meal used for food (estimated at 430,000 metric tons for Jan/Dec 1975).

K/ Mainly rice bran and coconut.

N/A Not available.

R/ Revised.

T/ Less than 500 metric tons.

E/ Estimate.

SOURCES: FAO Monthly Bulletin of Agricultural Economics and Statistics, September 1976
FAO Production Yearbook 1975
USDA Foreign Agricultural Circular FOP 12-76, September
Oil World Weekly, ISTA

Market and Policy Analysis Division
Grain Marketing Office
Department of Industry, Trade and Commerce
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JAPAN

BTN Tariff Line	Commodity or Product Description	TARIFF GENERAL	TARIFF GATT	TARIFF TEMPORARY
10.01	Red Spring Wheat, except seed and Wheat, except seed NES	20%	--	Free
10.02	Rye	15%	--	5%
10.03	Barley	10%		Free
10.04	Oats, seed, mixed feed oats, Oats NES			Within quota free, otherwise 5%
11.07	Malt	15%		1/
11.08-1	Starches and Inulin (wheat)	25%	--	--
11.09	Gluten & gluten meal (wheat)	25%	--	--
23.02	Oat by-products NES Wheat bran, shorts & middlings Grain Feeds NES			
11.07-1	Buckwheat	15%		

1/ Varies according to type and quota. Embassy can supply details, if required.

BTN Tariff Line	Commodity or Product Description	TARIFF			
		GENERAL	GATT	PREFERENTIAL	TEMPORARY
15.07N	Vegetable oils & Fats NES	28Y/kg	--	--	23Y/kg
15.07-2	Groundnut oil	(20Y/kg) (28Y/kg)	acid value over 0.6		17Y/kg 23Y/kg
15.07-5	Cottonseed oil	20Y/kg	(30Y/kg) acid value over 0.6	--	-- 17Y/kg
15.07-8	Palm oil & palm kernel oil	(10%)	(8%)	--	8%
	Palm oil	--	--	4%	--
15.08	Animal & vegetable oils, boiled, etc. (see tariff extract)	(15%) 12%	(7.5%) 6%	Free	6%
23.04-2	Linseed oilcake & meal	Free	Free	--	--
23.04-2	Rapeseed oilcake & meal	Free	--	--	--
23.04-2	Soybean oilcake & meal	5%	--	--	Free
23.04-2	Other oilcake & meal		(Free)		
23.04-2	Palm oilcake & meal		(Free)		
12.01-1	Soybeans	4.80Y/kg	2.40Y/kg		Free
12.01-8	Flaxseed	Free	Free		
12.01-3	Rapeseed	6.10Y/kg	--		Free
12.01-3	Mustardseed	6.10Y/kg	--		Free

BTN Tariff Line	Commodity or Product Description	TARIFF		
		GENERAL	GATT	TEMPORARY
12.01-3	Mustardseed, Rapeseed, Oilseeds, Oilnuts, Oil kernels NES			
12.01-5	Cottonseed	Free	Free	
12.01-11	Palm Kernels	Free	Free	
12.01-2	Ground Nuts	(20%)	Free	10%
15.07-1	Soybean Oil	(20Y/kg) (28Y/kg)	acid value over 0.6 other	17Y/kg 23Y/kg
15.07-3	Rape, colza and mustard oils	(20Y/kg) (28Y/kg)	acid value over 0.6 other	17Y/kg 23Y/kg
15.07-9	Flaxseed or Linseed Oil	10% or 11Y/kg		
23.04-2	Sunflowerseed cake & meal		(Free)	
23.04-2	Groundnut cake & meal		(Free)	
23.04-2	Mustardseed cake & meal	Free	--	
23.04-2	Cottonseed cake & meal		(Free)	

JAPAN - APPLICABLE DUTY RATES:

The preface of the official Japanese Customs Tariff states that:

"For the purpose of assessment of duty, a Preferential rate shall be applied before a GATT rate, a GATT rate before a Temporary rate and a Temporary rate before a General rate. However, if a GATT rate is not lower than the other rates, the rate applicable shall be a Temporary rate, or, if no Temporary rate is provided, a General rate."

The simplest method for understanding this formula is to apply the lowest possible rate indicated for the goods in question, excluding, of course, the Preferential rate which is provided solely for imports from the developing countries.

A duty rate enclosed in brackets indicates that that rate is not actually applicable and when this occurs within the GATT column indicates that the bracketed rate is bound to GATT member countries.

The following examples may further clarify the above principles of interpretation:

Item	Product	Gen.	GATT	Pref.	Temp.	Rate Applicable to Canadian Exports
12.01-1	Soybeans	(4.80 yen/kg)	(2.40 yen/kg)		Free	Free

While soybeans are bound within GATT at 2.40 yen/kg, imports are temporarily entered free of duty from any source under the Temporary Tariff.

Item	Product	Gen.	GATT	Pref.	Temp.	Rate Applicable to Canadian Exports
12.01-2	Ground nuts	(20% or 14 yen/kg whichever is greater)			10%	
	when for oil extraction		Free			Free
	otherwise					10%

Ground nuts when imported for oil extraction are bound duty-free under GATT. When imported for other uses, they are dutiable at 10% under the Temporary Tariff.

Item	Product	Gen.	GATT	Pref.	Temp.	Rate Applicable to Canadian Exports
12.01-3	Rapeseed and mustardseed	(6.10 yen/kg)			Free	Free

Duty-free from any source under the Temporary Tariff.

Item	Product	Gen.	GATT	Pref.	Temp.	Rate Applicable to Canadian Exports
15.08	Animal and vegetable oils, boiled, etc.	(15%) 12%	(7.5%) 6%	Free		6%

Imports from Canada enter at 6% under the GATT tariff. Products of non GATT countries are subject to 12% duty under the General Tariff. Developing countries' products enter duty-free under the Preferential Tariff. Rates provided in brackets are those rates which existed prior to the Japanese across-the-board tariff reduction in 1972. Item is actually bound under GATT at 7.5%.

AUSTRALIA

I OVERVIEW

As a major wheat and meat exporting country, the situation of Australia is similar in some ways to that in Canada with regard to vegetable protein foods. Australia is protein rich, perhaps more so than most countries in the world. The estimated protein intake is 100 grams per person per day including 69 grams of animal protein. Australians consume almost three times as much protein as is required according to FAO standards. There is some limited development and production underway in Australia in the vegetable protein field and also with single cell protein. The development of the lupin crop in Western Australia seems to be an imaginative and interesting area and it is approaching a substantial scale. There is also work underway on the improvement of the protein quality of lupin by mechanical means. A wet milling procedure has been developed to extract lupin protein which provides excellent yields and also preserves the protein functional properties.

Investigation is ongoing in the recovery of protein from alfalfa and other herbage, but has not gone beyond a rudimentary pilot plant stage. The people involved appear to have considerable expertise in this field and one individual in particular has international status.

In spite of the lack of development in the plant protein field, the consensus in Australia is that the growth of plant protein is inevitable due to anticipated increases in costs of animal protein.

Some indicator costs of protein foods in Australia are as follows: (in Canadian dollars)

cow beef - 80¢ per kilo
mutton - 85¢ per kilo
lamb - $1.10 per kilo
boneless beef - 74¢ per kilo
retail milk - 31¢ for 600 ml
skim milk - $620 per tonne
sodium caseinate - $1,800 per tonne
eggs - $1.40 per dozen
soy isolate - $2,500 per short ton
soy concentrate - $1,700 per short ton
textured soy - $1,800 per short ton
whole egg powder - $6.45 per 18 kilo bag
spray-dried albumen - $8 to $10.60 per 12 kilo bag

II PROTEIN SOURCES

1. Soy Protein

Australia imports limited quantities of soy isolate, soy concentrate and textured protein from the United States. As there are no regulations in effect at this time for the use of soy in meats and other products, the utilization of such proteins is limited to health food products. There are a considerable number of health food stores in Australia and they have developed a wide range of simulated products made from soy protein. At present, approximately 1,000 tonnes of textured soy protein per annum are manufactured for use in pet foods and health foods.

2. Wheat Protein

In Australia, wheat is the major agricultural crop which in 1975 to 1976 amounted to 11.7 million tonnes. About nine million tonnes of this wheat were exported during the 1975 to 1976 period. Most of the wheat was shipped as kernels rather than milled form. In 1975, only about 245,000 tonnes of flour were exported.

Australia is one of the major gluten-producing countries in the world. Between 1968 and 1971, over 155 million pounds of gluten were produced in Australia. The gluten production estimate for the past year is about 50 million pounds, of which 20 to 25 million pounds are consumed in Australia. The U.S., U.K. and Greece have been the principal importers of Australian gluten. New uses for wheat starch are being sought.

3. Lupin

A great deal of attention is being paid to lupin and lupin protein. Lupin is a legume which grows well in Western Australia on sandy soil in the Perth area. It is a commercial crop which will soon reach a quarter of a million acres without replacing other crops. It is also possible to grow lupin and wheat in rotation. This serves to control weeds and pests and gets nitrogen into the soil.

The variety grown in Australia is Lupinus angustifolius. This variety is almost alkaloid free and is considered to be sweet lupin in contrast to the Mediterranean varieties which are bitter and contain alkaloids.

The lupin seed contains 30 to 40% protein on a dry weight basis with the remainder being starch. The powdered seed can be air classified to get a protein rich fraction. Lupin protein is lower than soy protein in lysine and methionine. At present it is being used as an ingredient in animal feeds, and opinions expressed by researchers did not consider it as a major potential for human food. It must be kept in mind, however, that Australia is a protein rich country and researchers tend to ignore the potential of these types of products for human consumption. Some lupin protein has been extracted and used in the traditional Australian meat pie.

4. Leaf Protein

Australian researchers are very interested in the recovery of protein from leaves and grasses or, as they call it, the succulent herbage. Investigation is ongoing in the extraction of leaf juice from the pulp of lucerne (alfalfa) and the precipitation and the separation of a leaf protein concentrate with a 50 to 70% protein content (dry weight basis). The principle of leaf protein concentrate production is to remove cellular protein from the plant leaves for use as a feed for non-ruminant animals and to use the fibrous residue as a feed for ruminants. The process seems to be considered potentially useful for on-farm operations.

The process includes the pulping of leaves by rapidly rotating beaters, the expression of the leaf juice by squeezing the pulp through either rollers or a pulp press, and heating of the juice to 90°C to precipitate the protein as a concentrate. Considerable research has been carried out on the factors influencing the extractability of protein. The yield of extractable protein appears to decline rapidly with the maturity of lucerne and perennial grass. The extractability of succulent lucerne is about 87 grams per kilogram of dry weight. To precipitate all of the protein in an extract, the pH must be well below five.

The digestibility of the leaf protein has been found to be high and the amino acid composition is similar to that of soybean meal. The nutritive value of leaf protein is decreased during heat processing. The xanthophyll pigments in the leaf protein concentrate are valuable in the diet of laying hens for coloration of yolks. Up to 10% leaf protein concentrate can be included in the hen's diet for satisfactory growth.

The separation of the leaf juice into cytoplasmic and chloroplasmic fractions has been studied by the Australian investigators as well as others in the U.S. and Britain. The use of these fractions for human food has been studied at the Western Regional Research Centre in the U.S. The percentage of protein in the cytoplasmic fraction is about 90, but the yield is fairly low. The separation of cytoplasmic protein from the chloroplasmic fraction involves heat treatment and centrifugation.

5. Single Cell Protein

During the past five years, the Commonwealth Government of Australia supported research on the production of single cell protein at the University of Sydney in the Department of Chemical Engineering. Studies have been focussed on the utilization of hydrolized wheat and cassava starches by yeast cells which can be processed for human food or used directly as an animal feed. Some investigation has been carried out on the texturization of the single cell protein.

The organism of choice, Candida utilis, grows well with glucose as the carbon source along with ammonium salts and minor nutrients. This yeast consists of about 55% protein on a dry weight basis, about 1 to 5% crude fibre and about 7% fat. The protein is high in lysine and has a PER of about 1.8. Growth of yeast cells offers the following advantages over other production systems for protein: independence of agricultural land space, utilization of inexpensive energy sources (particularly starch), and rapid cell growth in contrast to plants and animals. To illustrate the efficiency of yeast production, one acre of land can produce about 450 pounds of plant protein whereas a yeast plant occupying one acre of land can produce three million pounds of protein per year.

Australia has the potential to produce large amounts of reasonably priced starch as a substrate for yeast production. From the high production of wheat and with a well developed gluten industry, Australia has the availability of large tonnages of wheat starch. Cassava, a high yielding plant capable of producing 10 tonnes of dry starch per acre, is promising as an important starch crop. However, considerable agronomic research is still needed before cassava can be grown economically on large acreages in Australia.

Yeast samples, produced in the pilot plant at the University of Sydney, were sent to the Food Technology Department at Hawkesbury Agricultural College of Advanced Education for incorporation into meat products (sausages) and cereal products (biscuits). Although studies are still continuing, preliminary results indicate that the ruptured yeast cells can be utilized effectively for food product incorporation as a source of protein.

III REGULATIONS

Australia, at present, has no regulations for the use of vegetable protein, primarily because there has been no major need for them.

They recognize the fact, however, that this will probably change as animal protein costs continue to increase. There is ongoing effort at present to formulate these regulations.

Australia's regulatory aspects are somewhat unique. Recommendations from groups such as manufacturers and food technologists are submitted to the federal authority in Canberra. The National Health and Medical Research Council, which is a federal group, can then make recommendations to the Commonwealth and state governments. The administration of all food laws in Australia falls within the mandates of state authorities.

The composition and labelling of imported foods are supervised by the Bureau of Customs (Department of Industry and Commerce). The quality and labelling of foodstuffs for export is supervised by the Australian Department of Primary Industry.

IV CONCLUSIONS

1. Australia has a major potential for protein production. It has a vast quantity of protein sources, both vegetable and animal. It is unlikely that a significant vegetable protein market for food will develop in the near future.

2. Australia's vested interest is liable to be one of production of vegetable protein for export and it can only be assumed that Canada might become involved from a technology point of view and possible licensing of such technology to the U.S.

V RECOMMENDATIONS

1. Australia does have a growing interest, at present, in plant protein utilization. Some of their development work is of interest and should be further investigated.

2. Investigation is ongoing in Australia on dehulling of oilseeds and, in particular, rapeseed which might be pursued by the Canadian rapeseed industry. Their dehulling process is quite simple and appears to be relatively efficient although more data is required.

3. Australia has developed a single cell protein or, as they prefer to call it, a food yeast. There is a desire on behalf of developers of this product to create a joint venture company for the commercial production and sale of food yeast. A Canadian participant in a venture of this type could prove to be worthwhile.

4. Canadian researchers should maintain contact with their Australian counterparts in order to keep abreast of developments in the extraction of leaf protein. This could develop into a major industry.

5. As there appears to be increasing interest in the importation of vegetable oils and associated with first hand knowledge of rapeseed oil, Australia should be explored as a potential market for Canadian rapeseed oil.

AUSTRALIA

BTN Tariff Line	Commodity or Product Description	TARIFF
15.07.100	Palm oil	Free - all sources
23.02.000	Oat by-products NES Wheat bran, shorts & middlings Grain Feeds NES	Free - all sources
23.04	Linseed, Rapeseed and Soybean Oilcake and Meal and Oilseed Cake & Meal NES	Free - all sources
35.04.100	Protein isolates	Canada and developing countries - Free Other countries - 6%
35.04.900	Peptones	Free - all sources
19.02*	Preparations of flour, starch or malt extract, used as infant food or for dietetic or culinary purposes	Preferential - 12% General - 12%

* Not included in FAO Trade Yearbook.
$U.S.: Statistics Canada

1/ See BTN 19.02 for tariff information.

2/ See BTN 35.04 for tariff information.

<u>AUSTRALIA</u>

BTN Tariff Line	Commodity or Product Description	TARIFF
11.08.900	Other starches & Inulin (excluding maize starch)	Canada - A$0.02 per kg Other countries - A$0.042 per kg plus 7% revenue duty
11.09	Gluten and Gluten meal (of wheat)	Free - all sources <u>Exclusions</u>: - Flours and meals prepared for use as infant or dietetic foods. - Proteins extracted from wheat gluten. 2/
10.02	Rye	Free - all sources
12.01.900	Mustardseed, Rapeseed and Sunflowerseed	Free - all sources
12.01.900	Oilseeds, oil nuts, oil kernels NES	Free - all sources, unless groundnut
12.02	Flour and meal of Oilseeds, Oil nuts and oil kernels, non-defatted (excluding mustard flour)	Free - all sources
12.01.900	Flaxseed	Free - all sources
15.07.200	Soybean Oil	Canada - A$46.50 per ton Other countries - A$70.13 per ton
15.07.200	Rape Oil	Canada - A$46.50 per ton Other countries - A$70.13 per ton

BTN Tariff Line	Commodity or Product Description	TARIFF
15.07.900	Mustard oil	A$70.13 per ton any source
15.07.900	Linseed oil	A$70.13 per ton any source

AUSTRALIA - PRODUCTION

('000 m.t.)

	1971	1972	1973	1974	1975	1976 P/
CEREALS						
Wheat	8,510	6,434	11,902	11,357	12,023	6,200*
Oats	1,275	736	1,107	874	1,100	N/A
Barley	3,065	1,727	2,398	2,515	3,220*	2,600*
Corn	212	214	139	106	120*	129
Sorghum	1,297	1,228	1,018	1,061	901	N/A
Rye	22	9	8	9*	10*	N/A
Rice	299	248	309	409	387	445*
Millet	58	24	26	35	40 F/	N/A
Total	14,738	10,620	16,907	16,366	17,801	9,374
OILSEEDS						
Flaxseed	10	10	14	33	12*	11*
Rapeseed	53	25	11	9	12*	11*
Soybean	9	34	38	63	74	54*
Sunflowerseed	59	148	102	84	113	78
Cottonseed	39	86	63	50	54	41*
Groundnuts	31	46	39	29	32 R/	37
Oilseeds NES B/	9 E/	15 E/	4 E/	8 E/	34 E/	31 E/
Total	210	364	271	276	331	263

OILS

	1971	1972	1973	1974	1975	1976 P/
OILSEED CAKE AND MEAL	86	94	129	N/A	N/A	N/A

* Unofficial figure.

F/ FAO estimate.

E/ Estimate.

R/ Revised.

B/ Mainly safflowerseed.

SOURCE: FAO Production Yearbooks
FAO Monthly Bulletin of Agricultural Economics and Statistics
USDA Foreign Agricultural Circular
Oil World Weekly
Oilseeds: Situation and Outlook, Bureau of Agricultural Economics, Canberra

Market and Policy Analysis Division
Grain Marketing Office
Department of Industry, Trade and Commerce
March 1977

AUSTRALIA - EXPORTS

('000 m.t.)

	1971	1972	1973	1974	1975	1976 P/
CEREALS						
Wheat C/	9,088.6	8,459.0	5,391.0	5,128.2	7,860.1	N/A
Wheat Flour	284.4	182.3	170.1	145.9	245.1	
Oats	555.9	329.0	114.5	183.7	298.6	
Barley	1,123.0	1,816.7	804.1	808.5	1,749.1	
Corn	22.4	38.5	9.2	2.7	1.3	
Rice	102.4	178.6	156.8	136.2	175.6	
Cereals NES	539.4	1,037.0	762.3	783.4	881.6	
Total	11,716.1	12,041.1	7,408.0	7,188.6	11,211.4	
OILSEEDS						
Flaxseed A/	3.6	6.1	0.3	0.1	16.3	
Rapeseed A/	3.3	9.0	7.1	1.7	0.6	
Soybeans	L.T.	0.1	1.2	2.4	3.7	
Sunflowerseed	19.0*	75.2	33.4	8.4	15.1	
Cottonseed	2.5	6.8	6.3	4.0	3.3	
Groundnuts	1.5	1.0	4.9	6.8	1.8	
Oilseeds NES	N/A	4.9	-	0.3	8.8	
Total	29.9	103.1	53.2	23.7	49.6	
OILS	N/A	1.3	0.3	2.8	7.9	N/A
OILSEED CAKE & MEAL	N/A	4.2	19.3	0.3	3.4	21.5

* Unofficial figure.

A/ Includes mustard seed

C/ Includes meslin.

N/A Not Available.

P/ Preliminary.

L.T. Less than 50 metric tons.

SOURCE: FAO Trade Yearbook
OILSEEDS REPORT, Australian Bureau of Statistics
VEGETABLE OILSEEDS - Market News, Australian Department of Agriculture, Canberra

Market and Policy Analysis Division
Grain Marketing Office
Department of Industry, Trade and Commerce
March 1977

AUSTRALIA - IMPORTS

('000 m.t.)

	1971	1972	1973	1974	1975	1976 P/
CEREALS 2/	.9	.9	2.8	2.0	3.9	
OILSEEDS						
Flaxseed	-	-	6.0	2.1	-	N/A
Rapeseed A/	0.2	0.4	14.4	28.6	4.6	
Soybean	10.8	0.3	L.T.	32.9	16.0	
Groundnuts	1.6	1.6	1.0	1.1	0.3	
Total	12.6	2.3	21.4	64.7	20.9	
OILS						
Rapeseed A/	2.1	0.3	0.4	0.5	1.5	
Soybean	7.3	1.1	3.6	6.0	13.3	
Palm & Palm Kernel	8.0	10.2	7.7	14.1	16.2	
Groundnuts	5.3	4.8	2.4	3.5	2.8	
Seed oils NES 3/	8.5	7.0	6.2	9.8	6.6	
Total	31.2	23.4	20.3	33.9	40.4	
OILSEED CAKE & MEAL						
Soybean	30.0	23.8	10.8	19.5	10.7	N/A
Cake & Meal NES	0.3	0.3	0.7	0.4	0.3	
Total	30.3	24.1	11.5	19.9	11.0	

A/ Includes mustardseed.
L.T. Less than 50 metric tons.
2/ Mainly corn, rice and rye.
3/ Mainly olive, but includes linseed, sunflowerseed and cottonseed.

SOURCE: FAO Trade Yearbook

Market and Policy Analysis Division
Grain Marketing Office
Department of Industry, Trade and Commerce
March 1977

AUSTRALIA - IMPORTS FROM CANADA

('000 m.t.)

	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76 P/
CEREALS						
Wheat Flour	D/	D/	-	D/	-	-
Buckwheat	-	-	D/	D/	D/	-
Rye	-	-	2.2	1.5	1.5	5.1
Total	D/	D/	2.2	1.5	1.5	5.1
OILSEEDS						
Flaxseed	-	1.9	6.0	5.6	-	-
Rapeseed	-	3.4	21.1	13.3	1.4	-
Mustardseed	-	-	-	D/	D/	-
Total	-	5.3	27.1	18.9	1.4	-

D/ Negligible amount.

P/ Preliminary.

SOURCE: "Grain Exports", Canadian Grain Commission.

Market and Policy Analysis Division
Grain Marketing Office
Department of Industry, Trade and Commerce
March 1977

POLAND, HUNGARY, WEST GERMANY, THE NETHERLANDS

SUMMARY

All of the countries which the Eastern European Mission visited are large net importers of vegetable protein. These imports are, however, almost totally destined for poultry and livestock feeds, with Poland being the only country actively involved in incorporating vegetable protein into food products.

A wide variety of vegetable protein sources and forms are imported, but without exception, soybeans and soy products are the dominant imports. This dependence has resulted in these countries striving to achieve some degree of self-sufficiency in protein production and processing capabilities. Holland is the only exception as its position as a trader, processor and trans-shipment center for Europe is highly dependent upon soy markets.

Poland and Hungary are both concentrating on developing technology for processing domestic protein crops. Hungary is also examining single cell protein, leaf protein and non-protein nitrogen in this regard. Germany, on the other hand, has emphasized the development of biosynthetic protein and by-product waste recovery technology. The objective is to strengthen their economic situation via the export of technology. In each of these countries, the efforts to achieve self-sufficiency are primarily related to feed and, to a lesser extent, food requirements.

As noted, food applications for vegetable protein are relatively limited, with the exception of Poland. The key factor in this appears to be consumer acceptance. Polish government officials are reluctant to increase meat extension, citing possible consumer opposition to such action. Similarly, consumer preference for traditional pure food products has impeded the acceptance of vegetable protein in Hungary, West Germany and The Netherlands. As a result, government officials are reluctant to revise prohibitive food product regulations to allow the incorporation of vegetable protein. It is not anticipated that they will vary their stance relative to vegetable protein in the foreseeable future.

In conclusion, it should be noted that access to these protein markets is largely dependent upon price, although functionality and reciprocal trade arrangements could also influence purchasing decisions.

TABLE OF PRIORITIES

Major Raw Materials of Interest for Protein Ingredient Production

(in order of priority)

POLAND	HUNGARY
Rapeseed	Sunflower
Cereals	Rapeseed
Potato	Soybean
Fish	Single Cell Protein
Casein	Leaf Protein
Soybean	Non-protein Nitrogen

WEST GERMANY	NETHERLANDS
Single Cell Protein	Potato
Potato	Soybean
Meat By-products Protein	Faba Bean
Algae	Pulses
Rapeseed	Straw
Soybean	

ORGANIZATIONS CONTACTED (APRIL 19 - MAY 4)

1. POLAND

Ministry of Food Industry and Food Purchase Department of Technology,
Warsaw.

Institute of Meat and Fats Industry,
Warsaw.

Institute of Fermentation Industry,
Warsaw.

Central Office of Grain Milling Industry PZZ,
Warsaw.

Oil Industry Combine,
Research and Development,
Warsaw.

Rolimpex,
Technical Oil, Fats and Vegetable Protein Department,
Fats and Meals Department,
Warsaw.

2. HUNGARY

Budapest Polytechnical University (BME),
Department of Food Industry - Chemistry,
Budapest.

Alcohol Trust,
Budapest.

Research Institute for Vegetable Oil and Detergent Industry,
Budapest.

Ministry of Agriculture and Food,
Department of Food Industries,
Budapest.

Central Food Research Institute,
Budapest.

University of Horticulture,
VEPEX, Program Office on Protein,
Budapest.

3. WEST GERMANY

Hoechst Aktiengesellschaft,
Frankfurt.

Friedrich UHDE GMBH,
Dortmund.

Ministry of Science and Technology,
Ministry of Family, Youth and Health,
Ministry of Agriculture,
Bonn.

Institut fur Algenforschung U. Algentechnologie,
Dortmund.

Federal Research Institute for Grain and Potato Processing,
Detmold.

Institut für Biochemie und Technologie der Bundesanstalt fur
Fettforschung,
Munster.

Oelmukle Hamburg Aktiengesellschaft,
Hamburg.

Alfa - Laval Industrietechnik GMBH,
Hamburg.

Friedrich Krupp GMBH,
- Krupp Maschinenfabriken
- Division Edible Oil Plants
Hamburg.

4. NETHERLANDS

Avebe Cooperative,
Veendam.

Institute for Storage and Processing of Agricultural Produce
(I.B.V.L.),
Wageningen.

Central Institute for Nutrition and Food Research,
Utrechtseweg.

W. Ruitenberg CZN. N.V.,
Utrechtseweg.

Unimills BV,
Vlaardingen.

POLAND

I OVERVIEW

Poland is distinctly aware of the western world's interest and activities in the protein field. Poland's interest in protein is, however, influenced to a considerable degree by their pressing need for hard foreign currency to finance industrial development. Meat products are an important export and source of foreign currency, and it is the expansion of this export to which Poland is directing its efforts in protein technology. To date, protein technology has taken the role of extending domestic meat products although it could lead to the production of meat analogs in the future.

At present, between 14 and 16 per cent of all meat products are being extended in this country. While soy products are the chief extending ingredients, casein is also being used and hams are extended with polyphosphate solutions. In 1976, 14,000 tonnes of soy flour and 5,000 tonnes of casein were used for meat extension. The rate of extension varies from 8 per cent (dry basis) to 30 per cent (rehydrated). An exception is hamburger, a produce sold only in the extended form. which normally contains 20 percent rehydrated texturized soy protein. In all the extension programs carried out in Poland, the nutritional value of the finished extended product is not of primary concern. The people of Poland apparently consume an excess of high quality protein (100 grams per capita per day of which half is of animal origin) and, logically, the nutritional potentials of the extended products are of no great concern. This approach is both unique and practical. There is, in fact, no protein quality problem in Poland. The fact that the Polish food industry has chosen not to view extension as a protein problem is quite different from the approach taken in the North American market and well describes the very pragmatic direction behind the Polish program.

The soy products used in this extension program are of United States origin. Both soybeans and secondary processed protein products are imported as no plants exist in Poland for extracting protein. In an effort to find alternatives to United States soy and to utilize their own crops, the Poles are attempting to develop rapeseed protein products for meat extenders. They are also looking at cereals and potatoes as alternate extenders and sources of protein material. Geographic location rules out the production of any other sources of protein material.

Another factor that may have considerable influence on the future development of Poland's protein utilization is the introduction of "new" food products. The cost of producing food is increasing approximately 10-11% per year and the annual growth of food consumption is approximately 9-10%. In spite of this, the Polish government has encountered considerable consumer resistance to price increases and has not increased food prices over the past four years. In general, all basic foodstuffs are heavily subsidized and it is almost impossible to define exact levels of subsidies, or how or where they are applied within the food system. Consequently, price relationships are impossible to determine. However, the introduction of new food products, or food products that have been altered in some way, would allow the Polish government to set a "new" price for that particular product. The development of such new products could very well be the result of fabricated protein materials. It is also leading the Polish food industry to examine pasta products, pizza and Kentucky type fried chicken as possible new food products.

The annual animal feed production in Poland amounts to 4-6 million tonnes per year, of which Poland exports 1-1½ million tonnes of high protein animal feed in the form of meal cakes (rape and fish). Poland expects to import grain and protein meals to offset shortfalls in domestic production for at least the next 10-15 years. Feed requirements for the cattle industry are not extensive, nor is it a policy of the Polish government to channel imported feeds into cattle. These feedstuffs are intended for a rapidly expanding poultry industry and improved efficiency of hog production. This is deemed acceptable as increased poultry production increases the availability of red meat for export and improves hog throughput capabilities, the hams of which are primarily destined for export. The ownership of the Polish food industry is as follows:

	STATE	CO-OPERATIVE	PRIVATE
Overall Food Industry	50%	40%	10%
Slaughter facilities	100%	-	-
Secondary meat processing	50%	50%	-
Dairy Industry	-	100%	-
Fruit and Vegetable Industry	50%	50%	-
Grain Industry	100%	-	-
Fats and Oils Industry	100%	-	-

The fats and oils industry consists of eight state-owned companies processing rapeseed, soybeans and sunflower. Rapeseed is supplied domestically and shortfalls in production influence the importation of soybeans, while sunflower is supplied by other Soviet Bloc countries.

II PROTEIN SOURCES

1. Rapeseed

Rapeseed is Poland's principal protein crop, with approximately 425,000 hectares yielding 1 million tonnes annually. The majority of the meal is used for hog and cattle feed. However, rapeseed is seen as a means to displace soy protein products, and researchers are attempting to secure a method for extracting protein from rapeseed meal for human consumption. To date, these attempts have been unsuccessful.

In their efforts to extract protein from rapeseed, they have found that rapeseed protein can be texturized in conjunction with soybean (50% rapeseed, 50% soy). The major problem identified in the rapeseed processing industry was that of waste water pollution. A recent achievement cited was the reduction of water used in processing rapeseed, to five cubic litres per tonne of rapeseed crushed. Desolventizing of rapeseed protein was also mentioned as a problem and they were interested in Canadian work in this area.

The researchers spoken to cited Canadian involvement with rapeseed protein and expressed an interest in technological exchanges with Canada. It would seem possible that a good match could be made between Canada's technological expertise and existing protein products and Poland's needs.

Interest was also expressed in mustardseed and its utilization as a feed material since it can be grown more widely than rapeseed.

2. Cereals

As noted earlier, Poland is not interested so much in nutritional considerations as in the extension of the available meat supply. This interest is leading to the intensified development of pasta products as a means of reducing the consumption of meat products. The comment was made that "in North America they eat meat and potatoes, but in Poland we eat meat and meat".

Another side to the development of pasta products is that they have no price history and profit levels are not controlled by established pricing. Consequently, this is one area in which the food industry feels the greatest potential for generating profits exists.

The development of a pasta industry in Poland should provide opportunity for durum and durum semolina exports. The approach taken, however, must be methodical and complete at every stage, i.e. a thorough marketing study must be done to determine present and future volumes of pasta production; a complete organoleptic characterization must be made on the Polish pasta products; and a study of processes and equipment used for Polish pasta production should be initiated to provide back-up for any trade proposals.

A second item within the cereal area is that of wheat gluten which is not available domestically in Poland. It was drawn to our attention that the Polish government has recently purchased a large number (27) of automatic Japanese encrusting machines for the large scale manufacture of perogies. Perogies are a dough product, filled with fruit, meat or vegetables, and then boiled. Automatic machinery is more abusive to dough than manual methods. Therefore, a good possibility exists that they could use gluten supplementation or strong gluten cereals for this product. In this case, as in all others, some initial development work should be carried out in Canada before approaching Polish officials.

Since equivalent nutritional status is not required of extension materials, wheat mill stream by-products could also assume a significant role in the extension of some meat products.

3. <u>Potatoes</u>

Although the Poles did not appear to be actively pursuing research on the extraction of protein from potatoes, it was obvious that potatoes are important items in their total feed requirements. Approximately 55 million tonnes of potatoes are produced annually, but only 10% are utilized directly as human food; the rest are used primarily as hog fodder. While western nations are intensifying their hog feed operations, the Polish government has seen fit to encourage self-sufficient or "specialized" hog farms which are not dependent upon outside feedstuffs. Such specialized farms survived the feed crisis of the early 1970's and produced an average of 1,183 kilograms of slaughter livestock per hectare in comparison to other types of farms which produced 93.3 kilograms.

Approximatley 4,000 such farms are now in existence and the government plans to create 13,000 additional units of this nature. Such a move will undoubtedly increase the importance of potatoes while de-emphasizing the use of import cereals and protein materials.

4. <u>Fish Protein</u>

Although no direct references were made to this product, Swedish sources indicate that Poland has installed a 30,000 tonne per annum fish protein plant. The plant is said to be producing functional fish protein concentrate FFPC based on domestic technology.

The main limiting factor on future development of FFPC according to Swedish opinion, is the cost of raw materials. This need not be an economic constraint in terms of Poland since the return on exported meat products undoubtedly exceeds expenditures in the fishing industry.

5. Casein and Novel Protein

The domestic dairy industry is at present supplying 5,000 tonnes of casein for use in extending sausage products. Other dairy products are also being examined as possible extension materials.

Novel protein technology is not greatly developed in Poland. Some work is being done on producing single cell protein from waste water but no applications of the process are evident at present.

6. Soy Protein

Considering Poland's objective in protein technology, it is to be expected that soy protein is looked upon as a necessary evil. Approximately 6,000 tonnes of textured soy protein, 14,000 tonnes of soy grits and 180,000 tonnes of soybeans are imported annually from the United States. The rate of extension varied from 8% (dry basis) to 30% (rehydrated). To reduce this dependence on U.S. soy protein and reduce out-flow of foreign exchange, Poland is planning to construct a plant that will produce 20,000 tonnes of soy flour annually. This plant is expected to be on stream by 1978-79. The source of soybeans will probably still be the United States unless other suppliers offer better credit terms. Planned plant capacity will produce a quantity of soy flour that will likely exceed Poland's requirements by nearly 5,000 tonnes. The Poles intend to export this surplus to other Soviet Bloc countries.

III REGULATIONS

Polish regulations limit the amount of extender used in meat products to not more than 8% on a dry basis or over 30% on a rehydrated basis. Their meat extension program also does not require equivalent nutritional status but rather only the maintenance of acceptable texture and flavor. It is obvious that Poland would like to increase the percentage of meat extender used, but most government officials believe that consumer acceptance would not allow such action. At present there are no labelling requirements and there is limited public awareness of the fact that the majority of meat products are extended. In addition, it should be noted that Poland has a very limited list of approved food additives, which would undoubtedly prevent the introduction of meat analogs.

No other restrictions are known regarding the importation of protein products other than that they must be approved by the Institute for Meat and Fats.

The procedure for obtaining acceptance of a product is as follows:

1. A 10 kilogram sample must be submitted directly to the Institute for Meat and Fats with normal product documentation and information regarding product applications.

2. Once a product has received approval, prices and quantities available should be forwarded to the Institute and Rolimpex.

The impression is that if a product has specific functional or economic advantages, the Institute can intercede and influence Rolimpex's purchasing decisions.

IV CONCLUSIONS

1. In assessing potential marketing opportunities in Poland, the impact of centrally controlled state planning must be put in perspective.

2. The major development in plant and novel protein technology in Poland is in the use of processed vegetable protein for extending the supply of red meat. Currently, emphasis is being directed towards developing technology for the utilization of domestic protein crops to meet this objective.

3. Polish officials believe that rapeseed offers the most potential for developing a domestic protein material.

4. There are a number of distinct opportunities for Canadian exports to Poland in the areas of technical consulting and food ingredients for use in the development of new food products. Examples of such products are low alcohol beverages (protein based), pasta products, perogies and convenience foods such as pizza. An excellent example of the development of new food products is the American Soybean Association's financing the introduction of Kentucky style fried chicken to promote the use of soy oil.

5. Economic constraints restrict imports and have resulted in Poland taking a very cautious approach to new products and technology.

As such, any Canadian marketing efforts in Poland must initially be directed towards establishing Polish confidence in Canadian products and suppliers. Opportunities for beneficial reciprocal trade must also be taken into consideration as they could influence Polish purchasing decisions.

V. RECOMMENDATIONS

Opportunities exist in Poland in the area of new food products for technical conslutation and the utilization of some Canadian products as ingredients in food products such as pasta (durum), perogies (gluten), low alcohol beverages (pea protein) and convenience foods. In order to establish confidence in Canadian products and suppliers, our initial approach should be advisory in nature and directed towards advising on alternate methods of extending meat products. Some groundwork for this was initiated during the mission and could lead to a follow-up visit. Such an approach would permit a more in-depth examination of the Polish food industry and serve to determine what and how future activities should be undertaken, especially with regard to the developing pasta industry which holds considerable potential for developing durum exports. It should be stressed that technical consultation must be an essential part of any sales effort.

SELECTED STATISTICS ON RAW MATERIAL SUPPLY IN POLAND

(IMPORTS, IMPORTS FROM CANADA, EXPORTS AND PRODUCTION)

POLAND - Total Grain and Oilseed Imports

('000 m.t.)

	1969	1970	1971	1972	1973	5-Year Average	1974 P/
CEREALS							
Wheat	1,185.1	1,104.1	1,909.9	1,273.7	1,619.7	1,418.4	1,258.2
Barley	375.9	1,094.0	615.8	1,331.6	780.3	839.5	1,134.8
Corn	260.2	256.3	282.1	362.5	712.3	374.7	795.6
Rye	71.7	55.8	111.2	114.0	23.5	75.2	75.6
Rice	62.4	60.2	74.1	69.8	54.4	64.2	62.7
Oats	0.5	0.7	-	45.7	119.1	33.2	38.7
Total	1,955.8	2,571.1	2,992.6	3,197.3	3,309.3	2,805.2	3,365.6
OILSEEDS							
Soybeans	112.9	65.2	67.3	95.5	142.2	96.6	178.9
Palm Nuts & Kernels	18.5	13.2	0.6	less than 0.1	10.5	8.6	-
Sunflowerseed	3.1	5.6	4.9	9.8	3.6	5.4	5.4
Peanuts	3.2	2.2	4.9	6.7	4.6	4.3	6.5
Cottonseed	1.4	-	7.1	2.2	1.6	2.5	-
Total	139.1	86.2	84.8	114.2	162.5	117.4	190.8
OILS							
Linseed	27.8	27.0	33.9	38.7	42.7	34.0	40.9
Sunflowerseed	30.0	10.3	21.0	31.1	31.4	24.8	25.0
Soybean	3.8	5.8	13.5	7.2	0.5	6.2	4.0
Palm	3.9	1.5	5.3	7.5	9.9	5.6	17.8
Total	65.5	44.6	73.7	84.5	84.5	70.6	87.7

	1969	1970	1971	1972	1973	5-Year Average	1974 P/
OILSEED CAKE & MEAL							
Soybean	90.0*	103.0*	112.0*	210.0*	349.9*	173.0*	455.4*
Peanut	166.0*	200.0*	189.0*	246.0*	152.7*	190.7*	175.7*
Linseed	-	-	1.0*	30.0*	108.4*	27.9*	87.3*
Cottonseed	22.4*	9.7*	14.9*	20.0*	41.3*	21.7*	46.7*
Sunflowerseed	-	-	20.0*	30.0*	33.8*	16.7*	5.9*
Oilseed NES	-	-	1.9*	7.3*	30.3*	7.9*	20.4*
Total	278.4*	312.7*	338.8*	543.3*	716.4*	437.9*	791.4*
TOTAL GRAINS AND OILSEEDS	2,438.8	3,014.6	3,489.9	3,939.3	4,272.7	3,431.1 1/	4,435.5 P/

* Unofficial figure.

F/ FAO estimate.

1/ Totals for averages may not agree because figures have been rounded off.

P/ Preliminary.

SOURCE: FAO Trade Yearbook 1974.

POLAND - IMPORTS FROM CANADA

('000 m.t.)

	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76 P/
CEREALS						
Wheat	50.0	77.3	73.6	108.2	60.8	368.8
Rye	22.0	-	-	-	35.0	104.4
Barley	99.0	319.8	42.2	285.4	353.7	317.9
Total	171.0	397.1	115.8	393.6	449.5	791.1
OILSEEDS						
Flaxseed	-	-	-	18.7	10.7	8.2

P/ Preliminary.

SOURCE: "Statistical Handbook", Canada Grains Council.

POLAND - EXPORTS

('000 m.t.)

	1969	1970	1971	1972	1973	5-Year Average	1974 P/
CEREALS							
Barley	50.7	144.5	78.4	129.4	43.0	89.2	68.5
Oats	6.0	16.5	15.4	42.2	14.1	18.8	1.0
Total	56.7	161.0	93.8	171.6	57.1	108.0	69.5
Rapeseed and Mustardseed	85.5	44.6	52.3	4.5	53.7	48.1	2.7
Malt	31.6	33.9	30.7	30.8	35.5	32.5	28.3
TOTAL GRAINS AND OILSEEDS	173.8	239.5	176.8	206.9	146.3	188.7 1/	100.5

1/ Total does not agree because figures have been rounded off.

P/ Preliminary.

SOURCE: FAO Trade Yearbook 1974.
FAO World Trade Yearbook.

POLAND - PRODUCTION

('000 m.t.)

	1970	1971	1972	1973	1974	5-Year Average	1975	1976 P/
CEREALS								
Wheat	4,608	5,456	5,147	5,807	6,409	5,485.4	5,207	5,000
Barley	2,149	2,450	2,750	3,158	3,908	2,883.0	3,638	4,100
Rye	5,433	7,827	8,149	8,268	7,881	7,511.6	6,285 P/	6,600
Oats	3,209	3,195	3,212	3,221	3,244	3,216.2	2,930 P/	2,500
Mixed Grain	882	950	1,176	1,437	1,570*	1,203.0	1,660*	N/A
Corn	12	13	10	13	19	13.4	50 F/	N/A
Buckwheat	52	49	38	36	33	41.6	32*	N/A
Millet	26	23	18	17	13	19.4	20 F/	N/A
Total	16,371	19,963	20,500	21,957	23,077	20,373.6	19,822	18,200 P/
OILSEEDS								
Linseed	65	75	64	51	40	59.0	36	36 F/
Rapeseed	566	595	430	512	523	525.2	726	700*
Total	631	670	494	563	563	584.2	762	736 P/
TOTAL GRAINS AND OILSEEDS	17,002	20,633	20,994	22,520	23,640	20,957.8	20,584	18,936 P/

* Unofficial figure.
F/ FAO estimate.
P/ Preliminary.
N/A Not available.

SOURCE: Canada Grains Council - Statistical Handbook 1976.
FAO Production Yearbooks 1974, 1975.
FAO Monthly Bulletin of Agricultural Economics & Statistics, Volume 25, No.'s 9 and 10, September, October 1976.

POLAND - TARIFF

A new tariff schedule is to be introduced for the latest GATT negotiations, but as with most Eastern European countries with state trading systems, the tariff has little meaning and the State is free to impose it, not to impose it, or to apply rebates. Please refer to the EEC tariff schedule for tariff numbers as Poland uses standard Brussels Tariff Nomenclature (BTN).

Trade Agreements

Canada and Poland exchange most favored nation treatment under the Canada Poland Convention of Commerce (1935).

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TARIFF INFORMATION FOR RAW MATERIALS AND OTHER PROTEIN SOURCES

BTN Tariff Line	Commodity or Product Description	Tariff	
		Hungary	EEC
10.01	Red Spring Wheat, except seed and Wheat, except seed NES	10%	Variable-Levy
10.02	Rye	2%	Variable-Levy
10.03	Barley	3%	Variable-Levy
10.04	Oats, seed, mixed feed oats, Oats NES	3%	Variable-Levy
10.05	Indian corn, shelled	3%	
11.07	Malt	35%	Variable-Levy
11.08-1	Starches and Inulin	30%	Variable-Levy
11.08.900	Inulin	30%	
11.09	Gluten & gluten meal	30%	Variable-Levy
12.01D	Soybeans	0	Free-Bound
12.01E	Flaxseed	0	Free-Bound
12.01H	Mustardseed, Rapeseed, Sunflowerseed & Oilseeds, Oilnuts, Oil Kernels NES	0	Free-Bound
12.02	Flour & Meal of Oilseeds, Oilnuts & Oil kernels, non-defatted (excluding mustard flour)	5%	8%
	Flour of Soybeans	10%	
15.07	Fixed Vegetable Oils, Fluid or solid, crude, refined or purified	8%	
23.04	Oilcake and other residues (except dregs) resulting from the extraction of vegetable oils	0	
35.04	Protein, e.g. soy flour	N/A	

N.B. - Trade Agreement: Canada-Hungary Trade Agreement is in effect. It includes exchange of most favored nation treatment. However in the Hungarian state trading system the tariff tends to have little meaning.

EC TARIFF CATEGORIES FOR SOY PROTEIN
(The Netherlands, West Germany)

Tariff No.	Description	Rate of Duty: Autonomous Per Cent of Levy (L)	Rate of Duty: Conventional (Per Cent)
12.02	Flours or meals of oilseeds or oleaginous fruit, non-defatted, (excluding mustard flour) A. Of soybeans	10 1/	8
19.02	Preparations of flour, meal, starch, or malt extract of a kind used as infant food or for dietetic or culinary purposes, containing less than 50% by weight of cocoa: B. Other		
	1. Containing no milk fats or containing less than 1.5% by weight of such fats:		
	a. Containing less than 14% by weight of starch		
	1. Containing no sucrose or containing less than 5% by weight of sucrose (including invert sugar expressed as sucrose)	19.6 plus VC 2/	11 plus VC 2/
21.07	Food preparations not elsewhere specified or included:		
	B. Other		
	1. Containing no milk fats or containing less than 1.5% by weight of such fats:		
	a. Containing no sucrose or containing less than 5% by weight of sucrose (including invert sugar expressed as sucrose)		
	1. Containing no starch or less than 5% by weight of starch	25	20

Tariff No.	Description	Rate of Duty: Autonomous Per Cent of Levy (L)	Rate of Duty: Conventional (Per Cent)
23.04	Oilcake and other residues (except dregs) resulting from the extraction of vegetable oils:		
	B. Other	Free	Free
35.04	Peptones and other protein substances and their derivatives; hide powder, whether or not chromed.	12	8

1/ In certain conditions, the collection of a compensatory amount is provided for in addition to the customs duty.

2/ VC - Variable Charge.

SOURCE: Official Journal of the European Communities, Vol. 17, No. L295, Nov. 1, 1974.

USDA Foreign Agricultural Service - Utilization of Soy Protein in the European Community, July 1976.

HUNGARY

I OVERVIEW

Interest in vegetable protein is quite high in Hungary. The State is strongly in favor of direct inclusion of vegetable protein in Hungarian diets as a means of reducing imports of protein feed materials. This issue is, however, political from a number of aspects as the Hungarian government is determined to increase meat exports at a time when domestic demand is increasing for meat products. Hungarian consumers are also offering considerable resistance to the introduction of extended meat products which they view relative to their experience with ersatz products during the war and as an indication of a faltering economy. Consequently, progress to date in introducing vegetable protein has been limited to the extension of sausage products where 2.5% soy isolate is being used as a binder.

Food Research in Hungary is carried out by 16 institutes, all of which have a branch within the Central Food Research Institute (CFRI) which is responsible for co-ordinating all food research from agronomics to food technology. The Central Food Research Institute employs approximately 200 people, of which 60 are research scientists. The main fields of research indicated are:

1) the production of protein from plant and microbiological origin;

2) the production and utilization of enzymes;

3) pollution research in the areas of industrial wastes and air pollution;

4) methods of preserving food products including cooling, freezing, reverse osmosis, concentration and radiation.

Specific responsibility for protein research resides with Vepex (Program Office on Protein). Vepex coordinates all research programs, relative to protein, from plant breeding to industrial protein production. Although Vepex officials were prepared to discuss food protein technology, their main concern lies with increasing the supply and production of animal feeds to reduce Hungary's dependence on foreign protein materials (approximately 300,000 tonnes annually). This is evident as a great deal of discussion centers on plant breeding research aimed at increasing protein levels in feed crops and on production agronomics. There are indications of research being carried out on single cell protein, leaf protein extraction, potato protein and non-protein nitrogen as sources of protein for animal feed. Research into protein for food use is being concentrated on the extraction of protein concentrates from sunflower cake and rapeseed meal. This emphasis is relative to their oilseed crush:

140,000 tonnes sunflower
60,000 tonnes rapeseed
20,000 tonnes soybeans
10,000 tonnes linseed

The Hungarian diet is relatively high in protein (100 grams per day) of which 50-60% is animal protein with 50% in the form of comminuted meats. Per capita consumption of dairy products is approximately 130-140 kilograms with fluid milk consumption of 60-70 litres. The majority of the fluid milk is consumed by pregnant women and children. Hard alcohol consumption is quite high and the State is trying to encourage consumption of carbonated beverages and beer. Consumer acceptance of carbonated beverages has been limited while beer production cannot meet demand and, at present, breweries in Yugoslavia and Czechoslovakia are supplementing domestic production.

Snack foods are popular in Hungary and research is underway to improve the nutritional value of such products. As yet there is no indication that snack foods contain protein supplements. The Central Food Research Institute is working with an expanded product containing varying levels (40-80%) of soy flour and wheat starch (Cargill product). This Institute is also working on the development of pasta products containing soy. Approximately 140 kilograms of pasta products are consumed on a per capita basis.

Some current prices for Hungarian food products are:

(October 25, 1977 rate of exchange
37.5932 Forints - Canadian dollars)

	Wholesale	Retail	
Brisket, Ribs, Cutlet, Neck	25.90	29.0	Forints/Kilo
Rump of Beef	48.10	52.0	Forints/Kilo
Round of Beef	55.50	60.0	Forints/Kilo
Chopped Sirloin	38.85	42.0	Forints/Kilo
Boneless Ham	53.65	58.0	Forints/Kilo
Fluid Milk 2.8% Butterfat		5.0	Forints/Litre
Fluid Milk 3.0% Butterfat (only for pregnant women)		1.5	Forints/Litre
Fluid Milk 3.4% Butterfat		5.8	Forints/Litre
Eggs (depending on size)		1.7-2.2	Forints/Dozen
Milk Powder 3.1% Butterfat (equal to 8.33 litres milk)		12.5	Forints/Kilo

II PROTEIN SOURCES

1. Sunflower

Sunflower is Hungary's main oilseed crop with 130,000 tonnes produced annually of high oil content Russian varieties. Present sunflower crushing capacity is 140,000 tonnes, with an additional 1,000 tonnes per day expansion planned for 1980. A continuous crushing process is utilized with 15% of the oil obtained through pressing and the remainder removed via benzene solvent extraction. The crushing process is geared to maximum cake production, and front end dehulling is being avoided as it results in considerable reduction in capacity. It is felt that front end dehulling would have to result in a 50% protein cake before it would be adapted, since no differences in oil quality or quantity in the absence of dehulling are being experienced.

Three classes of cakes are produced -- 24%, 37% and 40% protein -- but since price differentials are very small, 24% cake is the main product. Milled sunflower hulls are pelleted and exported or used domestically as bulk in animal feeds.

The Research Institute on Vegetable Oils and Detergents indicated that they were attempting to develop food quality protein concentrates from sunflower cake. Chlorogenic acid is indicated as the major stumbling block although they note that the strong demand for all available oilseed cakes and meals for livestock feeds is also a deterrent to developing human foods from these materials.

2. Rapeseed

Rapeseed production in Hungary is approximately 65,000 tonnes, which puts it behind sunflower and soybean as far as total production is concerned. Total crush of rapeseed is, however, three times that of soy which is probably the main factor behind its elevated importance as far as research priorities are concerned.

Considerable effort is being directed towards the development of low erucic acid varieties but so far only 5,000 hectares of such varieties have been grown. The main obstacles to production are reduced yield and lack of price differentials. Rapeseed planting in general is increasing as winter rape returns an early cash flow and is a good preceding crop to wheat.

Traditionally, the rapeseed meal level in feeds has been limited to 2-3% but it is indicated that low erucic varieties are being used at the 7% level. High erucic acid oil is limited to a level of between 5-10% in margarine products.

3. Soybeans

Hungary is at present growing 30,000 hectares of soybeans, and State officials are optimistic about increasing production to 80,000-100,000 hectares. Soybean yields average 1,900 kilograms per hectare (average of dryland and irrigated production) with 100,000 tonnes produced in 1976. There might be some problem with soybean production relative to other oilseed crops since the stress appears to be on sunflower and rapeseed as having the most potential.

In addition to their 20,000 tonne commercial crushing facility for soybeans, the Hungarians are experimenting with a pea production line for dehulling soybeans. The soybeans are pressed, defatted and extruded. The resulting product appears to have food application potential. Indications are that they have not experienced any large degree of denaturization of the soy protein in removing soy flavor, and they consider the problems associated with soy to be exaggerated.

4. Single Cell Protein

Hungary is negotiating with the Soviets for joint participation in the construction of a 100,000-200,000 tonne single cell protein plant. No details are known as to the technology or substrate involved. Indications are that the production is intended for livestock feed. There is long-term research directed at developing uses for single cell protein in food products.

5. Leaf Protein

A successful process for the extraction of leaf protein from alfalfa has been developed by the Budapest Polytechnical University in cooperation with Alfa-Laval. This joint effort did, however, break down when Hungary sold the process to Japanese interests. As yet, no commercial leaf protein extraction facilities have been constructed. The technology used in the process consists of the following operations: disintegration, pressing, partial denaturation, separation of the precipitate proteins, biological conversion of the water-soluble fractions, vacuum evaporation, and spray drying. The process usually yields 90-95 kilograms of product containing at least 40% raw protein from 1,000 kilograms of green plant material. Researchers claim that the composition of organic nitrogen is very favorable and its biological value and amino acid content correspond to those of soy protein.

This product again is intended solely for use as a protein supplement in animal feeds.

6. Non-Protein Nitrogen (Urea)

The Budapest Polytechnical University is also responsible for the development of a urea-fatty acid adduct for use as a ruminant feed ingredient. There is only a pilot plant of 1,000 kilogram per hour capacity at present operating. Feed trials have been conducted, and initial results indicate that the adduct is not upsetting the rumen and is passing into the abomasum before being ingested. It is felt that this compound is the result of hydrogen or hydrophobic bonding. Fatty acids for this product are by-products of saponification processes.

7. Miscellaneous Protein Materials

Vital wheat gluten is being produced in Hungary primarily for use as a diabetic food ingredient.

Casein is also being used in the supplementation and extending of meat products.

A development of some interest concerns the ability to convert animal fats and vegetable oils to biomass. A yield of lipid to protein of 2:1 is claimed.

III REGULATIONS

Information concerning Hungary's regulations relative to vegetable protein has not as yet been received. It is understood that labelling would have to be very distinct, requiring the statement "Protein Extract from Vegetables". It would also appear that consumer resistance to extended meat products might limit their inclusion to very low levels. The acceptance procedure for having products approved as food additives entails submitting a 7 kilogram sample to the Central Research Institute through AGRIPEX.

IV CONCLUSIONS

1. In spite of the Hungarian government's expressed interest in encouraging direct consumption of vegetable protein, it appears that consumer resistance and the extremely strong demand for protein feed materials will impede the development of food products containing vegetable protein. Snack foods appear to have the most potential for development, but the impact of food ingredient regulations is uncertain.

2. The level of technical expertise in the protein field is quite advanced in a number of areas with major emphasis directed towards the increased production of protein crops and protein materials for feed.

3. The potential for expansion of trade between Canada and Hungary appears to be very limited considering their expanding technological expertise, the wide range of protein sources they have available domestically and their absolute commitment to self-sufficiency.

4. Technical exchange on rapeseed, sunflower, peas and faba beans appears to be the only area of potential interest to Canada.

V RECOMMENDATIONS

Technical exchange with Hungary appears to be the most likely area of potential interest to Canada. Although considerable interest was expressed in establishing the basis for a formal technical exchange agreement on protein technology and other agricultural subjects of common interest, it would appear that such a formalized approach would not readily facilitate the exchange of information. Alternately, it is recommended that Canada extend specific invitations to Hungarian researchers to visit Canada for such events as the University of Guelph's International Symposium on Protein Utilization and the World Bread Conference, at which time other visits could be arranged.

SELECTED STATISTICS ON RAW MATERIAL SUPPLY IN HUNGARY

(IMPORTS, IMPORTS FROM CANADA, EXPORTS AND PRODUCTION)

HUNGARY - TOTAL GRAIN AND OILSEED IMPORTS

('000 m.t.)

	1969	1970	1971	1972	1973	5-Year Average	1974 P/
CEREALS							
Barley	44.9	23.3	209.3	548.5	198.9	205.0	333.4
Oats	1.0	2.1	7.8	44.1	17.7	14.5	52.6
Rye	10.1	L.T.	29.6	53.7	49.1	28.5	L.T.
Rice	18.9	20.6	18.0	9.7	14.2	16.3	12.4
Corn C/	1.5	0.8	162.4	108.4	1.6	54.9	5.6
Wheat	301.9	178.5	405.3	35.9	0.9	184.5	4.0
Total	378.3	225.3	832.4	800.3	282.4	503.7	408.0
OILSEEDS							
Palm Nuts and Kernels	0.6	0.3	2.4	0.7	-	0.8	-
Soybeans	3.7	16.5	51.2	L.T.	0.2	14.3	0.6
Sunflowerseed	60.3	11.4	3.4	0.5	0.5	15.2	0.2
Linseed	3.2	0.8	2.8	0.1	0.1	1.4	0.1
Rapeseed A/	2.7	6.6	0.1	L.T.	L.T.	1.9	L.T.
Total	70.5	35.6	59.9	1.3	0.8	33.6	0.9
OILS							
Soybean	0.2	0.5	18.2	1.1	5.8	5.2	7.9
Sunflowerseed	12.0	5.6	6.0	0.8	4.6	5.8	3.2
Rapeseed A/	L.T.	L.T.	0.2	1.2	3.0	0.9	5.3
Linseed	2.7	2.4	4.6	L.T.	4.4	2.8	0.9
Palm	0.5	0.4	0.2	0.2	-	0.3	-
Total	15.4	8.9	29.2	3.3	17.8	14.9	17.3

	1969	1970	1971	1972	1973	5-Year Average	1974 P/
OILSEED CAKE & MEAL							
Soybean	134.6	228.0	242.4	242.1	305.7	230.6	462.3
Peanut	66.0	64.4	100.1	90.2	36.6	71.5	62.2
Cottonseed	34.9	14.7	9.0	29.5	27.5	23.1	26.9
Sunflowerseed	13.4	20.7	11.3	7.0	-	10.5	22.2
Linseed	9.4	6.5	5.4	4.4	5.6	6.3	1.5
Palm Kernel	-	-	-	3.5	0.9	0.9	2.1
Oilseed NES B/	-	2.1	0.2	-	-	0.5	-
Total	258.3	336.4	368.4	376.7	376.3	343.3	577.2
TOTAL GRAINS AND OILSEEDS	722.5	606.2	1,289.9	1,181.6	677.3	895.5	1,003.4

C/ Includes meslin.

A/ Includes some mustardseed.

B/ Not elsewhere specified.

P/ Preliminary.

L.T. Less than 50 metric tons.

SOURCE: FAO Trade Yearbook 1974.

HUNGARY - IMPORTS FROM CANADA

('000 m.t.)

	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76 P/
CEREALS						
Barley	-	-	25.4	29.7	-	-

P/ Preliminary.

SOURCE: Statistical Handbook, Canada Grains Council.

HUNGARY - EXPORTS

('000 m.t.)

	1969	1970	1971	1972	1973	1974	1975 P/
CEREALS							
Wheat C/	388.8	579.8	95.2	369.0	925.4	934.5	952.1
Wheat Flour	10.5	10.8	11.6	10.0	11.2	22.2	11.5
Oats	L.T.	L.T.	L.T.	0.7	L.T.	L.T.	L.T.
Barley	1.2	19.3	0.1	122.3	88.3	14.0	-
Corn	97.3	210.1	50.3	43.8	713.7	847.7	343.5
Rye	13.5	35.6	L.T.	L.T.	20.1	40.3	L.T.
Rice	0.7	1.1	0.1	4.2	6.2	1.7	0.8
Cereals NES	0.7	3.8	3.7	2.3	7.5	11.3	13.8
Total	512.7	860.5	161.0	552.3	1,772.4	1,871.7	1,321.7
OILSEEDS							
Flaxseed A/	N/A	1.7	1.4	7.1	2.4	3.3	6.6*
Rapeseed A/	0.1	18.7	26.1	7.3	1.7	6.5	11.0*
Sunflowerseed	35.9	24.1	24.1	21.5	23.0	23.3	26.9
Total	36.0	44.5	51.6	35.9	27.1	33.1	44.5
OILS							
Soybean	-	-	-	-	0.9	5.1	-
Sunflowerseed	47.2	18.9	17.8	28.5	27.2	29.0	29.3
Total	47.2	18.9	17.8	28.5	28.1	34.1	29.3

* Unofficial figure.
A/ Includes mustardseed.
C/ Includes meslin.
L.T. Less than 50 metric tons.
P/ Preliminary.

SOURCE: FAO Trade Yearbook.

[redacted]

HUNGARY - PRODUCTION

('000 m.t.)

	1970	1971	1972	1973	1974	5-Year Average	1975	1976 P/
CEREALS								
Corn	4,072	4,732	5,615	6,025	6,333	5,355.4	7,088	5,500 F/
Wheat	2,723	3,922	4,095	4,502	4,971	4,042.6	4,005	4,900 F/
Barley	553	785	807	874	899	783.6	699	750 F/
Rye	158	182	173	178	177	173.6	147	N/A
Oats	61	91	64	72	85	74.6	95	N/A
Rice	45	67	61	69	56	59.6	69	73 F/
Sorghum	1	1	3	4	5	2.8	5 F/	N/A
Millet	6	3	4	5	6	4.8	2 F/	N/A
Total	7,619	9,783	10,822	11,729	12,532	10,497.0	12,110	11,223
OILSEEDS								
Sunflowerseed	96	152	134	153	121	131.2	155	130
Rapeseed	46	71	52	68	45	56.4	65	65 F/
Soybeans	8	16	-	-	19*	8.6	48 F/	100 F/
Linseed	14	32	22	17	19	20.8	18	20 F/
Total	164	181	208	238	204	217.0	286	315
TOTAL GRAINS AND OILSEEDS	7,783	10,054	11,030	11,967	12,736	10,714.0	12,396	11,538

P/ Preliminary.

F/ FAO estimate.

* Unofficial figure.

N/A Not available.

SOURCE: FAO Production Yearbook 1975.

WEST GERMANY

I OVERVIEW

West Germany's interest in vegetable protein is minimal. Protein crops are viewed as offering limited export potential considering Germany's restricted production capabilities and the absence of EEC Common Agricultural Policy (CAP) support programs for such crops.

West Germany's dependence upon imported vegetable protein for livestock and poultry production, as emphasized by the United States' protein embargo of 1973, has, however, spurred interest in alternate protein sources. In assessing other protein sources, West Germany's economic prerequisites dictate that the raw protein sources be readily available domestically and have potential for the development of exportable technology. Food-use applications are not being considered as the German government is hesitant to alter stringent food regulations pertaining to traditional pure food products preferred by consumers. Consequently, emphasis is being directed towards biosynthetic protein and by-product protein waste recovery. These alternatives also offer additional benefits relative to pharmaceutical technology and the offsetting of anti-pollution expenditures. In addition, the Ministry of Science and Technology has set priorities on investigating a source of marine protein (krill), and the utilization of waste thermal energy from nuclear power plants for food production (thermal input for algae and greenhouse production). In support of these priorities, the West German government has made very significant financial inputs into the private and public sectors (e.g. approximately 65 million marks to Hoechst's single cell protein program, 2.21 Deutschemarks - Canadian dollar, April 1977).

Domestic production of protein crops other than cereals (21,258,000 tonnes) is minimal with only 199,000 tonnes of rapeseed. Imports amount to 6,573,200 tonnes of cereal, 3,933,400 tonnes of oilseeds and 2,098,700 tonnes of oilseed cake and meal. Soy is the predominant oilseed import with 3,463,700 tonnes of soybeans and 766,300 tonnes of soybean meal. A limited quantity of soy concentrates and isolates is also imported (50 tonnes). Domestic processors crushed 3,090,600 tonnes of oilseeds (2,793,900 tonnes of soybean meal). Exports amounted to 1,673,700 tonnes of cereals, 29,100 tonnes of oilseeds, and 695,700 tonnes of oilseed cake and meal. Processors also exported quantities of defatted soy flour (50%) and full fat soy flour to Sweden, Britain and Denmark (N.B. preceding statistics refer to 1975).

The West German government is concerned with proper nutrition and is engaged in a campaign to promote "Eating the Right Foods the Right Way". This program emphasizes West Germany's preoccupation with pure food products, as it promotes variety and moderation in consumption of traditional food products. It discourages consumption of fatty foods. German consumers prefer fresh foods and tend to consider canned and frozen foods as inferior products. Similarly, vegetable protein has a negative image as it is considered to be a synthetic substitute for meat and cereal products. West Germany's multilevel food regulations reflect these preferences and severely restrict the use of food additives into which vegetable protein is classified.

It should also be noted that German meat processors are strongly opposing the introduction of extended meat products on the basis that they have limited capabilities for blending textured vegetable protein and could not ensure uniform finished products.

Some current prices for food and protein products are:

(July 26, 1977 rate of exchange
2.1110 Deutschemarks - Canadian dollar)

Fluid milk 3.5% butterfat (depending upon packaging)	1.02-1.11	Deutschemarks/Litre
Eggs (Grade A medium)	2.904	" /Dozen
Beef, stewing beef	8.79	" /Kilogram
Beef loins	29.80	" / "
Roast beef	23.00	" / "
Pork deboned except loins	6.36-11.84	" / "
Veal schnitzel	24.90	" / "
Skim milk powder (spray dried)	3.10	" / "
Textured vegetable protein (lowest price valid for orders over 100 tonnes)	1.60-3.00	" / "
Soy concentrate	3.20	" / "
Soy isolate	4.80	" / "
Blood plasma	9.00-10.00	" / "
Egg white powder (crystallized on spray dried)	16.00-17.00	" / "
Sodium caseinate	3.90-4.50	" / "

II PROTEIN SOURCES

1. Single Cell Protein

As mentioned previously, the major emphasis on protein development in West Germany has been directed towards the acquisition of high level technology for export and the production of protein as a by-product of waste utilization for domestic feed use. To this end, the German Ministry of Science and Technology (BMFT) has placed its highest priority on developing biotechnology, specifically fermentation technology, and has contributed 65 million marks to the following research effort.

In 1971, BMFT encouraged a joint partnership, consisting of the firms Hoechst AG, Unde GmbH and Gelsenberg AG, to develop processes for the production of single cell protein and new aspects of biotechnology. This partnership combined Hoechst Pharmaceutical Division's interests in new fermentation technology and new sources of pharmaceutical intermediates, and Gelsenberg's raw material interests with the intention of utilizing Unde for plant commercialization. Gelsenberg AG withdrew from the project when n-paraffin(Candida lypolytica yeast) was eliminated as a feedstuff due to its high cost and the impact of the fuel crisis.

Methanol was subsequently substituted as the main substrate material, although the development of processes with various substrates (ethanol and sugar containing wastes), microorganisms (yeasts and mixed cultures), and technical equipment is continuing.

The main process is based on methanol and the bacteria Methylomonas clara (0.5 micron, rod-shaped), utilizing newly designed loop fermenters (800-1,000 cycles per hour) with axial and radial mixing and aeration devices. The process is run on an aseptic, continuous basis at 37°C. Electrothermal pretreatment of the cell mass coming from the fermenter is used before centrifuge mechanical dewatering. The liquid phase is recycled to the fermenters. The concentrated cell slurry (20-25% moisture) is finally dried in a spray drier and granulated. The resulting crude product contains 80-85% crude protein (69-72% amino acids), 10-15% nucleic acids and 9% fat. The fatty acid pattern consists of a spectrum of common, even-numbered, partly unsaturated fatty acids. Work is also underway to develop a process for further purifying the biomass to yield a protein isolate and other fractions.

At present, only Newtonian fluids have been utilized although the researchers are hoping to use non-Newtonian materials in the future.

Plans are also being made for the scaling up of the SCP processes and the optimization of biotechnical production stages in conjunction with the construction of a 1,000 tonne per annum pilot plant at the Hoechst research and testing facilities in Frankfurt. The pilot plant was scheduled to be completed by early 1978. It is being built by Uhde and will employ sophisticated technology with respect to safety and pollution control, i.e. an "autoinertial" spray drier with additional extraction and combustion of waste gases.

The concept of a simple turnkey plant for use in developing countries is also being considered. The processes under development comprise simple, small, reliable fermentation units which will not require complex instrumentation or sterility. It is intended that the reactors will also be capable of utilizing a variety of substrates and microorganisms. This work has entailed examining hydrogen, methane, methanol, ethanol, alkane and crude oil as raw materials. Processes using waste products such as cellulose, straw, whey, refuse and carbon dioxide have also been considered.

In spite of the technological input to date, very little work has been done on the finished product in terms of its practical utilization. No molecular profiles or rheological work are indicated. However, some work has been done on pasta formulas, extrusion, pelletization and genetic recombination to improve the metabolic potential of their single cell protein product. It is indicated that animal feeds are considered to offer the most potential for single cell protein products.

The technology encountered is extremely interesting, but the mission's members feel that the development of fermentation technology is, in itself, the goal. This opinion is based on the restrictive German feed regulations encountered and the limited utilization research that had been undertaken at the time of the mission, even though this program has been underway since 1970.

Hoechst priorities appear to be:

1. Biotechnology
2. Plant Construction and Engineering
3. Feed Applications
4. Food Applications.

Other Single Cell Protein Activities in the Research Stage

Institut fur Mikrobiologie Uni. Gottingen (Schlegel)	-Bacteria, 300 litre reactors C-source oxhydrogen gas, product not yet perfected
Institut fur Garungsgewebe and Biotechnologie, TU Berlin (Dellweg)	-Bacteria and yeasts, C-source, in particular methanol, alkane (no products for relevant series of tests)
MPI fur Limnologie, Plon (Overbeck)	-Bacteria, 30 litre reactors C-source methane (no products for relevant series of tests)
Bundesforschungsanstalt fur Ernahrung, Karlsruhe (Bruckmann)	-Bacterial, C-source cellulose (no products for relevant series of tests)

Further work is being carried out by:

Krupp-Essen	-processing of molasses
Dornier-Friedrichshafen	-whey
Institut fur Mikrobiologie - Munster	-basic research
Institut fur chemishe Verfahrenstechnik-Hanover	-basic research
GSF - Abt. f. Algenforschung Dortmund (Soeder)	-algae, medium sized facilities, particularly in Peru, Thailand, India. C-source CO_2. Smaller amounts produced in initial tests.
Bundesanstalt f. Milchforsch Kiel (lembke)	-yeasts, laboratory processes C-source whey
GBF-Ges. f. Biot. Forschung Stockheim (Wagner)	-Bacteria, yeasts, 300 litre reactors, semi-continuous operation. C-source methanol, alkane and cellulose. Smaller amounts produced in initial test.
Hoechst-Unde Gemeinschaft (Frankfurt)	-Bacteria, yeasts, 3-400 litre reactors, continuous operation. C-source methanol, alkane products (100-500 kg) in initial test. Pilot plant to produce 1,000 t/year from 1978 on. Registration of products approximately 1979-80.

Additional auxiliary work is being carried out by:

Institut f. Tierernahrung (Munich)	-animal experiments.
Bundesforschungsanst. f. Landw. (Brunswick)	-animal experiments
Bundesforschungsanst. f. (Ern. Karlsruhe)	-animal experiments
Inst. f. Allg. Biol. (Bochum)	-basic research
Inst. f. Mikrobiol. (Hohenheim)	-basic research
Inst. f. chem. Verfahrenstechnik (Stuttgart)	-basic research

Product Cost Estimates - Using Process Line I

- Products from bacteria/methanol basis (Protein content 70-85%)	1.00 - 1.40 DM/kg.*
- Products from yeasts/methanol basis (Protein content 40-50%)	1.20 - 1.80 DM/kg.
- Products from yeasts/alkane basis (Protein content 45-65%)	1.50 - 2.20 DM/kg.

Using Process Line II

- Products from algae/CO_2 basis (Protein content 45 - 55%)	3.80 - 8.60 DM/kg.

Comparison

soy	0.50 - 1.00 DM/kg.	(45% protein content)
fish meal	1.00 - 1.50 DM/kg.	(65% protein content)
casein	2.50 - 4.00 DM/kg.	(80-90% protein content)

Summary

Of the development carried out in Germany, only the methanol based process using bacteria promises to be a success. Methanol is the least expensive raw material and does not entail marked dependences as do crude oil, alkane, etc. This also applies to applications outside of Germany. Moreover, local recycling processes are attracting increased attention.

2. Potato Protein

Potato protein recovery from potato processing effluent is being carried out by the Federal Research Institute for Grain and Potato Processing in Detmold.

The protein recovery process for potato protein extracts the juice by a heat treatment precipitation method. At present, there is one plant which recovers 3,000 tonnes of protein during the 100 day processing season. Ultrafiltration is used for the concentration of the protein. The crude material contains approximately 90% protein on a dry matter basis. The concentrated protein is 4% mineral matter and cannot generally be used for cattle feed as it has a problem with dispersability.

* (Exchange Rate: 2.21 Deutschemarks - Canadian Dollar, April 1977)

Research has been conducted on the use of potato protein, with gluten and milk, in the production of bread. However, German experience has shown that it reduces the loaf volume and results in a poor color. More success was achieved using this mixture in the production of a Swedish bread since Swedish bread does not have the dough rising requirements of West German breads.

The Institute indicates potential applications of potato protein in food products such as dumplings, potato soup, fabricated potato chips and processed cheese products. It is noted that Holland has already completed a considerable amount of work on the production of a protein cheese utilizing potato protein.

Potato protein is also being used as an ingredient in calf milk replacers. This market accounts for 30,000 tonnes of protein annually.

The main objective of their research is the extraction of protein from potato effluent to offset anti-pollution costs encountered in purifying processing effluent. Anti-pollution measures are now required by law, although the German government has been lenient in enforcing this legislation.

3. Meat By-Product Protein

Currently, West Germany requires all slaughter houses to render their meat by-products within their slaughter facilities, and does not allow the removal of such products to central rendering facilities. Consequently, smaller slaughter facilities have in the past disposed of most of their waste by-products, such as blood, into their sewage systems. It is estimated that 60% of all blood is drained directly into the rivers. New anti-pollution legislation is, however, resulting in a rationalization of the present 80 slaughter facilities in order to facilitate economic waste recovery. To date, this has resulted in 35 processors installing equipment for:

- continuous fat rendering (high quality fat and tallow)
- dewatering of blood (blood meal)
- inedible rendering (bone meal, meat meal and technical fat).

The technology utilized is either Alfa-Laval's (Centriflow, Centriblood or Centrimeal) or similar processes developed domestically.

Aside from the recovery of edible fats, the majority of by-products recovered are being directed towards the feed industry.

4. Algae

Algae research is carried out by the Institute fur Algenforschung in Dortmund. Until recently, research on algae was given a relatively low priority. However, new anti-pollution efforts have resulted in the Federal Ministry of Science and Technology elevating the priority of this research as a method of biological waste water treatment with emphasis on the production of feed ingredients.

The Institute's algae research was initiated in the 1950's with the objective of producing algae based fertilizers from a carbon dioxide process. This work subsequently diverged in the 1960's and concentrated on screening algae species for their production and feed potential.

Presently, the Institute does not appear to be working on a continuous culturing process. Their existing process involves harvesting 80% of the algae every two to four days. In examining methods to improve the digestibility of the algae protein, freezing and mechanical disintegration by glass particles have been experimented with. The inclusion of these process steps has been found to decrease the negative taste factors, but does not improve digestibility, which is considered the main limiting factor.

Efforts have also been directed at separating the protein by chemical precipitation.

It was also mentioned that the Institute is cooperating with Israel on a project involving the harvesting of algae from sewage.

Feed applications have been examined relative to hogs, poultry and ruminants, but no conclusive results are evident. Long-term feeding programs with mice, up to seven generations utilizing 10% algae protein, indicate declines of up to 10% in fertility rates of female mice, while their longevity was extended up to 60%. Inconclusive evidence of liver disorders is also indicated.

Limited food applications are evident. The Institute has been involved in an algae protein supplementation program carried out in Thailand. The program involves incorporating 15-20 grams per day in food products as part of a school lunch program. No results are available.

In spite of some of the developments noted, it does not appear that commercialization of algae production would be feasible within the near future.

5. Rapeseed

West Germany produced approximately 200,000 tonnes of rapeseed and processed 147,800 tonnes of rapeseed meal in 1975. It should be noted that crushers indicate they would not crush rapeseed if it were not for the $100 per tonne subsidy they receive. This is indicative of the relatively low priority placed on rapeseed development.

Rapeseed research is concentrated at the Institut fur Biochemie und Technologie der Bundesanstalt fur Fettforschung in Munster. The Institute is extremely interested in promoting rapeseed protein for human food. It has developed a process for extracting rapeseed protein isolates using countercurrent extraction and isolelectric precipitation, which extracts greater than 90% of the meal nitrogen and yields two protein isolate fractions, both containing more than 90% protein.

Please contact the Grain Marketing Office for copies of the following research papers on this subject:

Protein Isolates from New Varieties of Rapeseed
by A.S. El Nockrashy

Rapeseed Protein Isolates by Countercurrent Extraction and Isoelectric Precipitation
by A.S. El Nockrashy
K.S. Mukherjee
H.K. Mangold

Research is also being carried out on tissue culture as a tool for propagating and breeding rape and other plants, and the use of sex attractants for flea beetle control.

6. Soy

West Germany imported 766,300 tonnes of soybean meal, and imported and processed 3,463,700 tonnes of soybeans, while exporting 568,700 tonnes of soybean meal for a residual consumption of 2.9 million tonnes of meal in 1975.

The majority of this meal is utilized in animal feeds, while a smaller proportion is further processed into defatted soy flour (50% protein) and full fat soy flour (50% protein toasted and untoasted). A portion of this production is used in the manufacture of calf milk replacers, a 30,000 tonne per year market. The production of concentrates and isolates has not been considered because of prohibitive investment costs and tight economic conditions. Ralston

Purina in Ypres, Belgium is the only European producer of soy isolate. Germany is an exporter of soy flour with markets in Sweden, the United Kingdom and Denmark and imports soy flour from France, soy concentrates from Denmark, soy isolates from the United States, and textured soy protein from the United States, United Kingdom and Sweden.

There are three basic food market outlets for soy protein products in Germany: retail, institutional and the food processing industry. Of the three, the retail area is the most limited and is presently confined to full fat soy flour, produced domestically and sold in local health food stores. On the other hand, a variety of food items containing soy protein products are used by the institutional and food processing sectors.

Food processors are also incorporating textured soy protein in dietetic, health and vegetarian foods, baby foods and pet foods. In addition, soy concentrates and soy isolates are being used in burgers, pies and other preparations containing meat, but where meat does not characterize the product. Isolates are also used in soft drinks. The use of concentrates or isolates in bakery products is, however, not considered economical.

7. Miscellaneous Protein Materials

Cereals and Legumes

In West Germany, almost all breeding work on cereals and legumes is being performed by private agencies whose emphasis has been on yield rather than on protein content. Similarly, limited effort has been directed towards extracting protein from these crops, although the blending of cereal flours is being examined as a means of increasing the quantity and quality of protein in cereal flours.

Krill

Krill have been investigated as a possible source of protein. However, harvesting and processing are too energy-extensive and may limit the commercialization of such a product.

III REGULATIONS

The use of vegetable protein in foods is severely restricted by German food legislation.

Meat Products

The composition of meat and meat products is covered by the "Fleisch Verordnung" as republished June 6, 1973 (BGGI I.S. 553) and last amended May 10, 1976 (BGGI I.S. 1200/1202). There are no minimum meat contents laid down, but a meat product is understood to be one in which meat predominates, i.e. is more than 50% of the product. The addition of vegetable protein to meat products is specifically prohibited under the meat regulation and this prohibition is taken to include the meat portion of products which contain less than 50% meat. Under no conditions must vegetable protein be mixed with meat. It is understood that there is no objection to the sale of products based entirely on vegetable protein provided that they are clearly labelled and the customer could not be misled over the exact nature of the product. Other exceptions are:

- the addition of non-meat proteins to products, "in airtight packages or containers having been submitted to thermic operations in view of conservation". In all instances the additives must be included on the label.

- soy flour or proteins are allowable for use as emulsifiers in "ready-to-serve dishes" containing meat if necessary in the manufacture of such products. It is not permissible to add protein products in amounts greater than technically necessary or required for efficient manufacture. In this instance, labelling or marking is not necessary as the permissible addition of protein products is not considered adulteration. The meat regulation does not, however, provide a definition of "ready-to-serve dishes", although they are understood to exclude sausages in any form, raw ham, or similar meat products.

Milk Products

It is not permitted to add foreign protein to milk products including yogurt, kefir, buttermilk, cream, etc., or to mix milk products with up to 30% of other foods added, e.g. fruit yogurt. If a product based on vegetable protein and a milk product is offered for sale, no names may be used which relate to any recognized designations for milk products. These requirements do not relate to ice cream, which is covered by separate regulations. The Edible Ices Regulations are such that only kunstspeiseis (artificial ice), the lowest grade, could contain vegetable protein.

Bakery Products

There is no provision for the addition of soy protein to bread as a supplement, although soy flour and products containing lecithin are permitted as baking aids. According to the official commentary on the Bread Regulation, the quantity of any baking aids used should not exceed 3%. There are guidelines on extended shelf life baked goods (e.g. biscuits) which state that other starches or protein rich flour may be used only so far as is necessary technically or for flavoring. The regulations also state that the use of leguminous flours, except soy flour and soy protein, is not the usual practice. The guidelines on fine baked goods (e.g. cakes, pastries) do allow for the use of other types of cereal products, but this again does not appear to include leguminous products. Care must be taken to ensure that if milk or eggs are replaced by vegetable protein, such action could not be considered to be deceiving the purchaser as to the nature of the product.

Agricultural Legislation and Licensing

Legislation of this Ministry is aimed at controlling the use of artificial and biosynthetic materials intended for use as livestock feedstuffs. In order to obtain a licence an applicant must provide:

- a detailed analysis of feeding trials conducted in Germany at a recognized institute,*

- an analysis of the products including pollutants such as heavy metals and organic compounds,

- a detailed method of analysis for identifying the pure product and any admixture,

- details on the reactions which result when this product is mixed with other feed ingredients,

- data to substantiate that the product is not hazardous to health from a toxicological point of view. (This aspect is controlled by the Ministry of Family Youth and Health - equivalent to Canada's Department of Health and Welfare).

* In the case of imported products, such work can be carried out by an equivalent foreign institute, but it must be substantiated or supported by West German scientists.

Once such an analysis is compiled and it has been determined that a licence can be granted, a decision has to be made as to whether the product will be treated as a standard or non-standard product. Generally, it is preferred to obtain a standard product licence as it requires less analysis and substantiating data and may be used relatively freely in feed compounds.

Ministry of Family, Youth and Health

The German Food and Drug Act (see Paragraph I and II) would probably consider materials such as pea flour as additives, although there may be some room for interpretation. Most new products are, however, being regarded as additives and must be licensed as such. In addition to obtaining licensing for a specific additive, a licence must be obtained for use of it in each specific end product. The labelling of retail products must not, in any way, mislead or misrepresent a product to the customer.

Paragraph I - Foodstuffs

(1) For the purposes of this law, "foodstuffs" means substances that are intended for human consumption in a natural, prepared or processed form: substances that are primarily intended to be consumed for purposes other than nutrition or their gustatory or stimulant effect are excluded.

Paragraph II - Additives

(1) For the purposes of this law, "additives" means substances that are intended to be added to foodstuffs in order to influence their condition or to obtain specific properties or effects; substances of natural origin or chemically equivalent to natural substances and which are primarily used, following generally accepted practice, on account of their nutritive, olfactory or flavoring value or as "Genusmittel" as well as drinking water and table water, are excluded.

There are standards of composition for most foodstuffs in Germany. Therefore, for any product in which there may be a use for vegetable protein, one must check on the standards for that product. Queries relating to the standards or to non-standardized foods can be addressed to:

Bundes - Ernahrungsministerium
Bonn - 53
German Federal Republic

IV CONCLUSIONS

1. The West German vegetable protein market is dominated by soy (approximately 70%) and is almost totally directed towards livestock and poultry production. The domestic oilseed crushing industry accounts for 75% of West Germany's oilseed cake and meal requirements.

2. The relative levels of support programs for protein crops under the CAP have impeded their development and stressed cereal production.

3. The influence of the CAP and internal economics have resulted in West Germany stressing biosynthetic protein and by-product protein waste recovery. Actual protein production is, however, secondary relative to the development of fermentation and filtration technology for export.

4. West Germany's multilevel food regulations reflect consumers' preferences for fresh traditional food products and severely restrict the use of vegetable protein, which is considered to be an inferior food additive.

5. There are very limited opportunities in West Germany for Canadian Feed protein materials unless Canadian prices are competitive and/or West German oilseed stocks are in short supply.

6. Although restrictive food legislation impedes the use of vegetable protein, the institutional sector offers some future potential as institutional products are less visable as compared to the retail sector's products. Similarily, food processors may offer potential marketing opportunities for vegetable protein products in soups, convenience foods, frozen foods, baby foods and dietary preparations.

V RECOMMENDATIONS

West Germany offers only marginal potential for Canadian vegetable protein products. In the case of feed products, domestic availability and price are the main market access determinates. Functionality and price are the main factors in the protein market.

SELECTED STATISTICS ON RAW

MATERIAL SUPPLY IN WEST GERMANY

(IMPORTS, IMPORTS FROM CANADA,
EXPORTS AND PRODUCTION)

WEST GERMANY - IMPORTS

('000 m.t.)

	1971	1972	1973	1974	1975 P/
CEREALS					
Wheat C/	2,158.2	2,908.6	2,421.7	1,701.5	1,428.1
Wheat Flour	76.8	76.4	85.8	95.8	83.7
Barley	1,770.6	1,579.7	1,459.8	1,392.8	1,545.8
Oats	508.7	469.0	585.8	259.2	247.1
Corn	3,283.2	3,280.4	3,488.6	3,380.2	3,001.9
Rye	42.7	61.8	63.3	76.4	34.1
Rice	180.5	155.4	164.1	154.5	145.2
Cereals NES	135.8	36.1	83.1	66.2	87.3
Total	8,156.5	8,567.4	8,352.2	7,126.6	6,573.2
OILSEEDS					
Rapeseed A/	248.0	120.2	276.9	218.5	130.3
Soybeans	2,095.6	2,236.6	2,837.4	3,714.5	3,463.7
Sunflowerseed	48.5	119.2	181.5	120.2	126.3
Flaxseed	111.3	236.5	133.2	93.9	62.4
Palm Nuts & Kernels	69.1	24.7	34.0	58.0	41.9
Groundnuts	134.2	110.0	141.6	115.5	108.8
Total	2,658.2	2,847.2	3,604.6	4,320.6	3,933.4
OILS					
Rapeseed A/	12.6	12.9	17.9	33.6	16.6
Linseed	67.3	37.3	53.1	38.8	31.3
Palm Kernel	31.5	22.0	16.9	33.6	16.6
Sunflowerseed	140.1	146.3	157.9	137.3	104.9
Palm	150.2	151.4	151.6	133.0	209.8
Cottonseed	35.6	26.3	17.2	25.5	13.5
Soybean	41.9	26.7	22.5	36.9	24.8
Groundnuts	54.7	71.5	66.3	51.2	38.1
Olive	4.7	4.2	3.9	3.1	3.4
Total	538.6	498.6	507.3	483.3	461.5

OILSEED CAKE & MEAL	1971	1972	1973	1974	1975 P/
Rapeseed	67.9	67.5	55.9	41.8	41.1
Linseed	391.5	205.4	144.0	157.3	172.1
Soybean	1,270.3	1,353.8	1,171.2	616.9	766.3
Palm Kernel	241.1	266.1	224.2	272.3	299.3
Cottonseed	287.4	305.7	317.3	160.7	178.6
Groundnut	120.7	146.6	136.7	64.9	82.4
Sunflower	140.4	129.9	105.3	105.8	156.6
Oilseed NES	180.7	198.2	265.0	305.0	402.3
Total	2,600.0	2,673.2	2,419.6	1,724.7	2,098.7

A/ Includes some mustardseed.

C/ Includes some meslin.

P/ Preliminary.

SOURCE: FAO Trade Yearbook 1975.

WEST GERMANY - IMPORTS FROM CANADA

('000 m.t.)

	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76 P/
CEREALS						
Wheat	616.8	286.0	227.9	353.7	93.3	85.9
Wheat Flour	L.T.	0.1	0.1	0.1	L.T.	0.1
Oats	90.0	17.6	-	-	2.1	-
Barley	625.2	252.4	86.2	204.5	40.3	235.1
Rye	-	2.1	-	-	-	-
Total	1,332.0	558.2	314.2	558.3	135.7	321.1
OILSEEDS						
Flaxseed	80.1	94.9	112.5	110.7	93.6	46.7
Rapeseed	100.6	42.3	70.9	26.4	17.2	-
Soybean	1.2	L.T.	L.T.	0.7	0.2	L.T.
Mustardseed	11.7	8.7	7.5	7.7	3.8	1.6
Total	193.6	145.9	190.9	145.5	114.8	48.3
OILS						
Rapeseed D/						
Linseed 1/	-	-	2.0	-	-	-
Total	-	-	2.0	-	-	-

1/ Expressed as grain equivalents.

D/ Negligible amount.

L.T. Less than 50 tonnes.

P/ Preliminary.

WEST GERMANY - EXPORTS

('000 m.t.)

	1971	1972	1973	1974	1975	1976 P/
CEREALS						N/A
Wheat C/	118.6	441.1	934.4	447.5	679.1	
Wheat Flour	427.9	396.2	416.6	389.3	388.3	
Oats	22.5	6.3	31.2	64.5	30.2	
Barley	145.6	545.3	352.3	425.0	330.5	
Corn	323.8	161.1	235.7	267.6	198.7	
Rye	217.8	222.4	275.3	210.6	18.5	
Rice	17.7	34.2	35.2	29.4	28.0	
Cereals NES	0.3	0.5	1.2	0.4	0.4	
Total	1,274.2	1,807.1	2,281.9	2,334.3	1,673.7	
MALT	87.3	84.3	111.4	171.7	180.8	
OILSEEDS						N/A
Flaxseed	27.1	23.7	31.1	7.6	0.4	
Rapeseed A/	126.8	47.6	35.0	62.6	11.7	
Soybeans	11.0	20.5	45.4	11.6	13.9	
Sunflowerseed	0.1	19.0	38.1	22.2	1.5	
Groundnuts	3.3	4.6	4.0	2.9	1.5	
Oilseeds NES*	0.2	1.8	0.1	0.3	0.1	
Total	168.5	117.2	153.7	107.2	29.1	
OILS						N/A
Rapeseed A/	67.9	63.7	106.3	96.8	63.9	
Linseed	17.8	33.2	32.1	30.4	28.6	
Soybean	75.5	62.7	134.1	241.1	293.9	
Palm & Kernel	8.8	9.0	9.9	19.6	27.3	
Sunflowerseed	10.9	23.8	31.7	36.4	19.1	

	1971	1972	1973	1974	1975	1976 P/
Cottonseed	1.1	0.1	0.9	0.7	0.6	
Groundnut	3.4	5.2	6.5	10.9	9.8	
Coconut	43.9	94.9	51.9	12.7	115.1	
Seed Oils NES B/	3.4	4.2	2.1	3.1	4.2	
Total	232.7	296.8	375.5	451.7	562.5	
OILSEED CAKE & MEAL						N/A
Rapeseed	58.1	63.4	119.3	138.9	80.2	
Linseed	16.0	21.0	21.9	11.1	8.6	
Soybean	249.6	394.8	898.9	991.4	568.7	
Palm Kernel	1.6	1.4	0.5	0.6	1.6	
Sunflowerseed	33.3	37.1	65.1	15.3	16.2	
Cottonseed	10.7	5.0	31.0	0.6	0.9	
Groundnut	7.5	3.9	10.1	3.4	1.6	
Cake & Meal NES G/	22.7	16.7	6.6	4.8	17.9	
Total	399.5	543.3	1,153.4	1,166.1	695.7	

A/ Includes mustardseed.

B/ Mainly coconut and castor.

C/ Includes meslin.

G/ Includes coconut.

* Includes palm nuts and kernels.

SOURCE: FAO Trade Yearbook.

WEST GERMANY - PRODUCTION

('000 m.t.)

	1971	1972	1973	1974	1975	1976 P/
CEREALS						
Wheat	7,142	6,608	7,134	7,761	7,013	6,620
Oats	3,037	2,888	3,045	3,482	3,445	2,800
Barley	5,774	5,997	6,622	7,049	6,971	6,410
Corn	594	564	573	521	531	N/A
Rye	3,032 2/	2,917 2/	2,576	2,560	2,125	2,150
Mixed Grain	1,367	1,270	1,226	1,282	1,173	N/A
Industrial Grains	N/A	N/A	10,777	11,706	N/A	N/A
Total	20,946	20,244	31,953	34,361	21,258	17,980
OILSEEDS						
Rapeseed	228	249	222	301	199	215
Total	228	249	222	301	199	215
OILS						
Rapeseed	116.1	111.1	156.9	166.7	98.1	N/A
Linseed	24.4	64.0	32.5	27.5	19.9	N/A
Soybean	360.8	399.4	491.4	665.5	622.4	N/A
Palm Kernel	31.3	15.4	16.0	26.6	19.0	N/A
Sunflowerseed	12.0	26.6	37.8	38.4	37.4	N/A
Groundnut	9.0	1.4	8.2	6.5	4.4	2 D/
Other 3/	17.9	19.4	20.1	23.3	21.8	
Total	571.5	637.3	762.9	954.5	823.0	2

	1971	1972	1973	1974	1975	1976 P/
OILSEED CAKE & MEAL						
Rapeseed	167.4	165.9	244.9	245.9	147.8	N/A
Linseed	43.1	113.2	57.4	48.6	34.1	
Soybean	1,647.8	1,791.6	2,224.5	2,932.4	2,793.9	
Palm Kernel	38.0	17.8	17.4	29.8	19.8	
Sunflowerseed	14.7	39.0	58.3	58.3	56.8	
Groundnut	10.7	1.5	9.8	7.9	5.4	3 D/
Other 3/	22.7	26.7	28.0	35.0	32.8	
Total	1,944.4	2,155.7	2,640.3	3,357.9	3,090.6	3

D/ Estimate.

P/ Preliminary.

N/A Not available.

2/ Includes West Berlin (calendar year 1970 to 1973 figures given for West Germany plus West Berlin).

3/ Including maize, but excluding castor.

SOURCE: FAO Production Yearbooks 1972, 1974, 1975.
Oil World Weekly I.S.T.A. No. 23/1976, No. 23/1974.
German Federal Ministry of Agriculture.
Canada Grains Council - Statistical Handbook 1976.

THE NETHERLANDS

I OVERVIEW

The Netherlands' major interest in vegetable protein is directly related to its status as an international cereal and oilseed trader and trans-shipment center for Europe more than for its domestic requirements. This has resulted in The Netherlands' sizable vegetable protein industry being dominated by multinational companies and soy. Government interest in vegetable protein is directed at taking advantage of as many aspects of the EEC Common Agricultural Policy (CAP) as possible. Aside from their interests in maintaining dairy and meat production they have little concern for other considerations, although anti-pollution measures are influencing the development of potato protein.

Domestic production of protein crops other than cereals (970,000 tonnes in 1975) and forage (1.3 million hectares) is negligible, with only 5,000 tonnes of flaxseed and 40,000 tonnes of rapeseed grown in 1975. Imports amounted to 8,825,400 tonnes of cereals, 1,508,100 tonnes of oilseeds, 355,600 tonnes of vegetable oils and 1,306,200 tonnes of oilseed cake and meals. In comparison, exports amounted to 5,069,500 tonnes of cereals, 118,500 tonnes of oilseeds, 370,200 tonnes of vegetable oils and 677,800 tonnes of oilseed cake and meals in 1975.

Most domestic grain production is used for food and industrial purposes. The majority of The Netherlands' feedstuff requirements (11 million tonnes annually) is supplied by imports. Practically 100% of The Netherlands' concentrated feeds are processed in farmer cooperative mixed feed plants located near the ports. Since the bulk of the ingredients is imported, the mix is essentially the result of the economics of the world market and not of domestic production costs. The costs of imported feeds are, however, offset to some extent by their large exports of meat and dairy products and various programs within the CAP. Veal production of 400,000 tonnes annually accounts for 160,000 tonnes of milk replacer. This is produced primarily from soy flour, with approximately 7,000 tonnes originating from the U.S. and the remainder supplied from domestically produced soy and potato protein.

The use of vegetable protein in food products is generally prohibited, although certain exceptions exist in snack and catering products where the word "meat" is not used. These products account for the domestic disappearance of 2,000 tonnes of soy flour and textured soy protein annually. Consumer acceptance of vegetable protein is relatively indifferent and is impeded by traditional standards of pure staple items with which the Government is loath to interfere.

Dutch nutritional standards are quite high with the Government directly involved in promoting nutrition. The present nutritional program promotes increased consumption of fresh vegetables and decreased consumption of animal fats, sugar and fried foods.

Research into protein sources has encompassed leaf protein extraction, single cell protein and straw. Present efforts are, however, centered on further development of potato protein, straw and faba beans. An appeal is also being made for the reinstitution of funds to support pulse research, but the lack of CAP support will undoubtedly inhibit work in this area. It should be noted, however, that none of these materials is looked upon as having any food application potential. The Netherlands' efforts in developing vegetable protein for food applications are centered on soy and are concentrated in the hands of the multinationals such as Unilever. It should also be noted that Dutch researchers obtain a large portion of their funding from private sources, which, in many instances, adds an international perspective to their work, due to Holland's international trade status.

Some current prices for food and protein products are:

(October 24, 1977 rate of exchange
2.1853 Florins, 0.9007 U.S. dollars - Canadian dollars)

Fluid milk	1.02-1.16	Florins/litre
Eggs (Grade A)	3.00	Florins/dozen
Minced Beef (very lean)	12.00-15.00	Florins/kilogram
Chucks	12.00-13.00	Florins/kilogram
Loins	24.00-28.00	Florins/kilogram
Soy Texturized protein	600-700	U.S. Dollars/tonne
Soy Isolate	1800-2000	U.S. Dollars/tonne
Soy Concentrate	1000-1500	U.S. Dollars/tonne
Sodium Caseinate (for meat industry)	1900-2200	U.S. Dollars/tonne
Skim Milk Powder (World market price, FOB, Rotterdam)	420	U.S. Dollars/tonne
Blood Plasma Powder (Feed technical grade)	4.50	Florins/kilogram
Food Grade	8.00-8.50	Florins/kilogram
Domestic skim milk powder (Ex Plant)		
Food Grade	3.17	Florins/kilogram
Feed Grade	3.16	Florins/kilogram

(N.B. Feed grade skim milk powder reduced to 1.33 florins/kilogram upon denaturing).

II PROTEIN SOURCES

1. Potatoes

Holland is currently the largest potato processor in Europe with 2.5 million tonnes processed for starch annually. The effluent water pollution from this industry has resulted in considerable emphasis being applied to the recovery of protein material as a means of offsetting anti-pollution measures required by 1981. Avebe Coop (the sole potato starch processor) presently operates 10 starch plants (two of which have protein recovery equipment) with capacities ranging from 18 tonnes/hour to 60 tonnes/hour. Protein recovery was initiated in 1953 as a pollution reduction measure. Present reconstruction plans will rationalize Avebe's starch production to three facilities, one 180 tonnes/hour and two 360 tonnes/hour, each of which will utilize ultrafiltration technology and eight-stage evaporation to recover protein from waste water. It is expected that these changes will result in 30,000 tonnes of potato protein being recovered annually.

At present, the largest market for this protein is the manufacturing of calf milk replacers. Although the price of potato protein is slightly higher than soy and fish protein, there is considerable pressure in Holland, and indeed Western Europe, to utilize domestic products (potato protein and milk powder) in calf milk replacers and animal feed.

Research efforts on potatoes account for 35 man years at the Institute for Storage and Processing of Agriculture Produce (IBVL) while Avebe Coop has three research facilities with 120 people actively involved in potato research. The majority of this research is directed towards developing new potato varieties and starch products while a lesser portion is being directed towards feed and food application of potato protein. Two areas in which this research is being directed are solubility and flavor problems. Color has not proved to be a problem. Poor functionality, resulting from heat coagulation, coupled with solubility and flavor problems are viewed as limiting potato protein potential in most food applications. It is noted that their research has shown the egg and potato combination result in higher PER's than egg alone.

2. Soy

The Netherlands is active in soybeans and soy products as an importer, processor and exporter thereby making trade and production data difficult to interpret. In 1975, 1.3 million tonnes of soybeans, 73,500 tonnes of soybean oil and 849,900 tonnes of soybean meal were imported into The Netherlands, while 95,000 tonnes of soybeans, 162,100 tonnes of soybean oil and 558,800 tonnes of soybean meal were exported for a net consumption of approximately 152,400 tonnes of soybean oil and 1,255,100 tonnes of soybean meal. Increases in production capacity, brought on stream in 1974, have resulted in almost a complete reversal of soybean meal imports relative to soybean imports. U.S. data indicates, though, that soy protein exports to The Netherlands averaged 372 tonnes per year between 1972-1974 and increased to 8,886 tonnes in 1975. It is believed that this increase was attributable to the fact that construction of domestic soy protein production facilities fell behind schedule. The completion of these facilities has, however, resulted in a 100% over-capacity.

Annual consumption of soy flour is estimated at 8,000 tonnes - 20 percent for human consumption and the balance for animal feed. Soy flour destined for human food is used in bakery products, snack foods and a limited portion is used in pharmaceutical fermentation. Restrictive food regulations have limited soy protein use in most other food products. The larger proportion of soy flour is used in pet foods and particularly calf milk replacers.

Textured vegetable protein consumption is estimated at 400-500 tonnes annually and is used almost exclusively in pet and institutional foods. Isolates and concentrates are used by meat packers, but mostly for meat products destined for export.

The most popular uses for soy flour and textured vegetable protein are breadings, and snack and institutional food products which are sold without ingredient identification in automats, cafeterias and other institutional food outlets. The word "meat" is not used and "fantasy" rather than generic names are used. An example of such a product is the croquette which is commonly sold under a brand name "Sunshine". It may contain no meat but usually contains 5-10% with the remainder of the product being soy flour and spices. Similar products are used in Ragu sauces, and an assortment of Indonesian products (fricadellen, nassi bollen).

A minced beef product containing 30% soy flour is also produced and marketed under the name EET (the word for meat is MEET in Dutch and EET is also an abbreviation for extra added protein in Dutch so consumers are aware, to some extent, of the vegetable protein being used in this product). An earlier attempt at such a product failed because of poor quality control which resulted when it was blended at the local butcher shop level where most minced beef is primarily sold. Another complicating factor is that Dutch minced beef is very lean and oil or fat is often added to the pan when cooking. When this procedure is used for cooking the extended product, it results in the soy flour retaining the fat and oil which proves to be unpallatable to the consumer. EET, on the other hand, is being centrally blended (25% textured soy protein on a rehydrated basis) and sold for 25% less than minced beef. It should also be noted that it is not being promoted as a minced beef replacement. In fact, sales of EET are not cutting into normal minced beef sales. This product has been on sale since August 1976 and it is experiencing quite good repeat sales.

The texturized soy protein product used in EET is manufactured in The Netherlands from a new method of extracting soy flour which removes various off-flavor components. It appears to involve a solvent (possibly alcohol) extraction which results in a 60% defatted, deflavored soy concentrate which is texturized under pressure to restrain expansion. The non-texturized soy concentrate is not denatured. Although no commercial spinning is being done, it can be spun from water and salt, that is, without dissolving the material in caustic. The advantage of this is that the formation of lysine alaine is prevented. A considerable amount of work has also been done on the development of meat flavors which are polar in nature. This results in the flavor being kept in the product during extrusion so that the phenomenum of having one or two chews before the product becomes tasteless is overcome.

Research is also being directed towards developing soy's functional properties relative to extending the shelf life of bread, facilitating the production of pasta without using durum wheat, protein enrichment, novel protein rich foods, meatless sauces and snacks. The poor image of soy and Dutch food regulations are the major obstacles limiting its wider use in retail products.

3. Faba Beans

Faba bean research was reinstituted at the Institute for Storage and Processing of Agricultural Produce (IBVL) in 1973 after having been deactivated shortly after the war. Five man-years are presently devoted to faba bean research with agronomic and processing techniques being examined simultaneously.

This work started as a possible means of utilizing potato processing facilities which usually operate only four months of the year, February through May.

Initial research was devoted to examining agronomics and seed stocks still available since most lines had been lost since 1940. A number of large bean varieties - Paardebonen (½ inch), Wierbonen (26-34% protein, 5,000 kilograms/hectare), Puivelbonen (tick bean) and Tiunbonen (canning variety, 7,000 kilograms/hectare) - have been under investigation.

Sebeco, a seed company to which Wierbonen belongs, is the only company actively involved in faba bean breeding. IBVL research efforts are being concentrated on the total mechanization of production and the selection of strains that have consistent yields of the 7,000 - 8,000 kilograms/hectare and first pods above 30 cm. It should be noted that total mechanization is imperative as hand labor would eliminate any possibility of commercial production. Yields to date have been quite erratic but use of light clay soils and adequate moisture has resulted in yields of up to 7,000 kilograms/hectare. It is felt that 3,000 kilograms of protein/hectare are necessary for faba beans to be competitive with other crops. Post harvest technology has been developed to produce an air classified protein fraction similar to Pro-Star's pea protein. Considerable variation has been noted in the trypsin inhibitor levels between varieties, and pH levels are felt to be an influence when heat treatment produces inactivation. Their research indicates that 85% of the tannins are in the hulls, with white varieties having relatively low levels. Work is also underway on examining off-flavors that have been encountered at high processing temperatures, flocculation carbohydrates, aldyhydes and acetones. Tests to date indicate that calf milk replacers and pet foods hold the greatest potential for faba bean flour. Lack of price supports under the CAP could also influence the future development of faba beans.

4. Miscellaneous Protein Materials

Leaf protein extraction from alfalfa and grass has been examined but, in spite of the vast potential presented by 1.3 million hectares of grass and alfalfa, it has been found that the processes are uneconomic and potential polluters.

Straw is being looked at by IBVL in cooperation with Hoechst, for the production of cellulose, acetone and acetic acid.

Pulse crops, although good sources of protein, have had many of their subsidization programs withdrawn because their production required relatively high levels of energy input. As a result, Dutch farmers have opted for other crops. Research institutions such as IBVL are, however, lobbying for the reinstatement of the support programs for producers and increases in research funding. They believe that pulse production has one of the greatest potentials for protein production per hectare. Considerable interest is expressed in Pro-Star's pea protein and samples are requested for assessment.

In spite of the West German research on single cell protein (SCP), Dutch officials are skeptical that it will become a reality because of the availability of other protein and the economics of production.

Since 1973, corn production in The Netherlands has gone from a few thousand hectares to 90,000 hectares. Although most of the production is for fodder, Cargill's decision to build a factory at Bergen op Zoom (southwest of Holland) to process 200,000 tonnes of corn into glucose annually, will undoubtedly divert substantial quantities for processing. The choice of Bergen op Zoom as a location was partly determined by its favorable position in respect both to the ports of delivery for corn and the access to major markets in Western Europe.

III REGULATIONS

Food regulations with respect to traditional food products such as meat, dairy and bakery products are very specific and generally prohibit the inclusion of vegetable protein. The use of color additives or tracer substances (titanium dioxide) in food products in general is forbidden, especially in meat.

Meat Products

The Meat and Meat Products Decree is quite explicit and does not allow the addition of vegetable protein to meat as extenders, binders or emulsifiers. However, textured vegetable protein products may be sold either alone or mixed into meat products, provided the word "meat" is not used or implied. Examples of this are catering and snack products containing meat such as "fricadellen" (beef/pork rolls), "croquettes", "nassi bollen" (fried rice balls with meats and spices) and "pate". Fantasy rather than generic names are usually applied to such products to prevent any misrepresentation. Vegetable protein can also be used in canned or dry soups as long as the name of the soup or the label does not indicate that meat is included and the label specifies the contents. Another exception for the use of protein is in products that are cooked in the package, such as luncheon meats, where caseinates are allowed at the 2% level.

Milk Products

The Milk Decree covers all dairy products and prohibits the addition of vegetable protein.

Bakery Products

One or more types of meal, flour and/or starch other than those derived from wheat or rye may be incorporated into bread provided the types of flour, meal or starch used are stated on the label. Flour may contain a maximum of 0.2% lecithin in the form of lecithin preparations. Up to 3% soy flour may also be used in bread flour. There is a minimum milk content for bread; this minimum cannot be replaced by vegetable protein. It should be noted that it is necessary to get permission for new product formulations if the composition of the bread differs from the standards laid down in the regulations. Although other bakery products are non-standardized, care should be taken if milk or egg is replaced or non-standard ingredients used to ensure that there could be no perceived deception.

Future Developments

At present, Government authorities are trying to apply existing legislation or modify it as required. The Minister of Public Health is working on new legislation, but this is more related to a merchandizing act. Other legislation is being planned in conjunction with the EEC but it will probably be two to three years before it is enacted. It is thought that the Meat and Meat Products Decree will be modified to allow extended meat products, with a specific declaration and maximum levels of extension according to an approved list.

Considering the state of flux The Netherlands' vegetable protein legislation is in, it would be advisable to consult with the Dutch authorities before undertaking any activities in this market.

Ministerie voor Landlouw en VISSERIJ
Le Van den Boschstraat 4
The Hague
The Netherlands

IV CONCLUSIONS

1. The Netherlands' vegetable protein market is dominated by soy. This is a result of the lack of domestic protein sources and The Netherlands' status as an international trader and transshipment center for Europe. This has subsequently resulted in soy dominated multinationals establishing facilities in Holland.

2. The emphasis placed on the production of potato protein is a result of anti-pollution requirements which must be met by the potato starch industry by 1981.

3. The Dutch Government has made no other firm efforts to redirect agriculture towards producing other protein crops, primarily because the CAP does not provide support for such crops.

4. The use of vegetable protein is generally prohibited in traditional food products although exceptions exist in snack and institutional foods where the word "meat" is not used.

5. The greatest potential for food applications of vegetable protein lies in the snack and institutional food sector, while the 160,000 tonne calf milk replacer market offers significant potential for feed applications of protein concentrate.

6. Price is the most important consideration in gaining access to this market, although complementary functionality, especially relative to potato protein, could offset some price differential.

V RECOMMENDATIONS

The Dutch protein market offers relatively little potential for Canadian vegetable protein products unless they have some particular price or functionality advantages relative to soy. It would, however, be advisable for Canadian manufacturers to liaise with Dutch researchers and industrial food representatives as their interest in pulses could be altered by changes in the CAP and their involvement in international vegetable protein markets could result in indirect sales.

SELECTED STATISTICS ON RAW

MATERIAL SUPPLY IN THE NETHERLANDS

(IMPORTS, IMPORTS FROM CANADA,
EXPORTS AND PRODUCTION)

NETHERLANDS - IMPORTS 2/

('000 m.t.)

	1971	1972	1973	1974	1975	1976 P/
CEREALS						N/A
Wheat C/	1,341.4	1,523.3	1,890.6	1,436.4	2,347.9	
Wheat Flour	13.3	13.3	11.2	16.8	17.0	
Oats	83.1	73.2	78.7	29.9	12.8	
Barley	171.8	172.2	218.9	334.6	391.0	
Corn	2,756.0	2,445.2	3,918.9	4,404.9	5,236.3	
Rye	25.8	32.9	31.5	28.6	45.3	
Rice	56.9	70.9	95.9	86.7	112.9	
Cereals NES	386.3	100.5	230.1	854.0	662.2	
Total	4,834.6	4,431.5	6,475.8	7,191.9	8,825.4	
BARLEY MALT	52.8	47.0	51.1	57.7	57.3	
OILSEEDS						N/A
Flaxseed A/	147.3	201.4	58.6	1.1	22.0	
Rapeseed A/	53.1	49.3	57.9	51.5	47.8	
Soybeans	1,208.9	1,608.7	1,269.1	1,590.2	1,282.1	
Sunflowerseed	2.7	5.9	10.4	15.1	3.0	
Palm nuts & kernels	214.7	230.2	121.5	149.0	97.9	
Groundnuts	40.2	48.4	47.8	46.6	55.3	
Total	1,666.9	2,143.9	1,565.3	1,853.5	1,508.1	
OILS						N/A
Rapeseed A/	9.8	10.3	9.4	18.8	8.7	
Linseed	30.4	34.4	24.3	24.1	16.2	
Soybean	24.3	12.3	39.1	79.3	73.5	
Palm & palm kernel	138.7	163.6	178.3	170.8	226.3	

	1971	1972	1973	1974	1975	1976 P/
Sunflowerseed	33.3	45.8	47.3	25.2	20.8	
Cottonseed	3.6	0.7	0.2	2.1	0.4	
Groundnuts	10.5	9.5	20.0	15.5	9.2	
Seed Oils NES Q/	0.5	0.5	0.6	0.7	0.5	
Total	251.1	277.1	319.2	336.5	355.6	
OILSEED CAKE & MEAL						N/A
Rapeseed A/	67.0	111.0	77.4	92.3	84.6	
Linseed	224.9	98.0	62.4	64.3	69.9	
Soybean	650.9	555.5	531.7	781.8	849.9	
Palm kernel	0.2	14.5	11.6	12.6	20.7	
Sunflowerseed	42.8	41.7	31.4	34.2	16.2	
Cottonseed	1.2	38.9	32.5	3.1	2.8	
Groundnut	12.0	34.1	27.7	47.5	9.1	
Cake & Meal NES	231.7	298.9	278.8	197.7	253.0	
Total	1,230.7	1,192.6	1,053.5	1,233.6	1,306.2	

A/ Includes mustardseed.

C/ Includes meslin.

Q/ Olive.

2/ Includes intra-EEC trade.

SOURCE: UN/FAO Trade Yearbook 1975.

NETHERLANDS - IMPORTS FROM CANADA

('000 m.t.)

	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76
CEREALS						
Wheat	238.7	264.8	124.4	33.9	156.3	61.6
Oats	39.2	24.0	16.5	-	-	8.5
Barley	215.0	69.6	14.0	21.2	23.5	46.8
Rye	17.2	19.4	5.4	1.5	11.5	6.9
Buckwheat	7.5	2.3	1.6	-	-	-
Total	517.6	380.1	161.9	56.6	191.3	123.8
OILSEEDS						
Flaxseed	172.0	284.2	133.3	52.4	44.7	15.2
Rapeseed	206.2	111.8	61.3	50.1	7.1	13.1
Soybean	0.1	0.1	0.3	L.T.	-	-
Mustardseed	9.4	13.0	11.4	13.5	14.9	8.2
Total	387.7	409.1	206.3	116.0	66.7	36.5
OILS						
Rapeseed 1/	L.T.	-	0.1	-	3.2	-
Linseed	-	-	-	-	23.0	39.4
Total	-	-	0.1	-	26.2	39.4
RAPESEED CAKE & MEAL 1/	13.5	5.7	5.1	3.2	4.9	9.7

1/ Data based on calendar years from 1971 to 1974; but for cake and meal, includes all cake and meal until 1974/75 where figures are for rapeseed only.

L.T. Less than 50 metric tons.

SOURCE: Grain Exports, Canadian Grain Commission.

NETHERLANDS - EXPORTS 2/

('000 m.t.)

	1971	1972	1973	1974	1975	1976 P/
CEREALS						N/A
Wheat C/	511.0	551.9	427.2	474.5	1,536.8	
Wheat Flour	109.6	749.6	162.9	154.7	204.9	
Oats	77.6	75.2	72.9	69.6	77.5	
Barley	131.8	195.8	137.7	140.6	282.4	
Corn	390.7	411.8	1,466.5	1,411.8	2,553.2	
Rye	44.4	26.3	59.4	7.7	16.6	
Rice	17.4	21.6	34.2	36.5	57.8	
Cereals NES	50.5	19.5	123.1	414.2	340.3	
Total	1,333.0	2,051.7	2,483.9	2,709.6	5,069.5	
BARLEY MALT	10.3	8.2	21.7	49.5	41.6	
OILSEEDS						N/A
Flaxseed	3.1	4.7	3.3	3.6	5.0	
Rapeseed A/	12.3	33.2	17.6	19.2	10.9	
Soybeans	5.1	247.8	65.8	3.1	95.3	
Sunflowerseed	0.6	1.0	1.8	1.0	0.9	
Groundnuts	7.5	7.4	7.0	7.1	6.3	
Oilseeds NES	0.3	6.2	6.4	2.4	0.1	
Total	28.9	300.3	101.9	36.4	118.5	
OILS						N/A
Rapeseed A/	16.2	22.8	33.4	23.4	32.9	
Linseed	7.3	13.0	23.5	11.9	8.2	
Soybean	50.6	124.9	118.1	197.0	162.1	
Palm & kernel	101.1	110.4	96.2	91.0	87.2	
Sunflowerseed	17.6	23.7	25.9	19.9	6.9	
Cottonseed	2.4	0.2	0.4	1.0	-	
Groundnuts	5.3	4.1	14.8	12.2	5.6	
Seed Oils NES B/	25.5	37.7	49.1	52.0	67.3	
Total	226.0	336.8	361.4	408.4	370.2	

	1971	1972	1973	1974	1975	1976 P/
OILSEED CAKE & MEAL						N/A
Rapeseed	6.7	3.7	14.5	12.8	19.7	
Linseed	9.5	22.2	17.4	1.9	13.7	
Soybean	423.0	589.1	567.8	595.0	558.8	
Sunflowerseed	2.3	2.1	0.4	7.4	3.8	
Cottonseed	0.5	0.5	1.1	0.3	0.2	
Palm kernel	105.1	93.1	38.3	39.4	43.9	
Groundnut	10.7	0.7	0.5	1.9	0.8	
Cake & Meal NES B/	16.2	8.0	63.0	28.3	36.9	
Total	574.0	719.4	703.0	687.0	677.8	

A/ Includes mustardseed.

B/ Mainly coconut.

C/ Includes meslin.

2/ Includes intra-EEC trade.

P/ Preliminary.

SOURCE: UN/FAO Trade Yearbook, 1975.

NETHERLANDS - PRODUCTION

('000 m.t.)

	1971	1972	1973	1974	1975	1976 P/
CEREALS						
Wheat	706	673	725	746	528	707
Oats	210	140	135	163	158	
Barley	375	340	383	315	336	263
Corn	11	10	11	10		
Rye	209	150	105	78	63	
Mixed grain	7	4	2	2	2	
Total	1,518	1,317	1,361	1,314	1,087	970
OILSEEDS						
Flaxseed	5	4	3	6	5	6
Rapeseed	33	45	40	45	40	32
Total	38	49	43	51	45	38
OILS						
Rapeseed	29	21	34	28	30	N/A
Linseed	6	17	21	-	7	N/A
Soybean	192	258	217	270	227	280
Coconut	34	37	64	70	93	92
Palm kernel	100	109	54	62 P/	50	
Total	361	442	390	430	407	372

	1971	1972	1973	1974	1975	1976 P/
OILSEED CAKE & MEAL						
Rapeseed	42	30	49	40 P/	42 P/	
Linseed	6	32	39	-	13 P/	
Soybean	870	1,130	966	1,200	1,030	1,222
Palm Kernel	112	125	67	72	60*	
Coconut (copra)	20	22	37	37	39	
Total	1,050	1,339	1,158	1,349	1,184	1,222

P/ Preliminary.

* October 1974 - September 1975.

SOURCE: UN/FAO Production Yearbook.
Oil World Weekly, 1975, 1976.
USDA Foreign Agriculture Circular FOP 21-76.

SWEDEN, DENMARK, FRANCE, ENGLAND

INTRODUCTION

The mission on technology development in plant and other novel proteins to Sweden, Denmark, France and England was conducted over a three-week period in late April and early May 1977.

The following report is based on discussions held during visits with a large number of organizations, institutes and individuals covering the industry, government and university sectors.

In these missions the concept of co-operative effort by the government, industry and university sectors has again been proved to be the best approach for ensuring the development of Canadian capabilities.

David H. Lees*
Technical Services Manager
Cambrian Engineering Group Limited
MISSISSAUGA, Ontario

*Formerly Chief, Market Development Division, Grain Marketing Office. Dr. Lees was responsible for initiating and co-ordinating the missions on protein development.

SUMMARY

In all of the countries visited there were active research and development programs on plant and novel proteins for utilization in food and feed products. The leading countries for technology development were Sweden and Denmark while England represented the most active market for protein products.

In Sweden although relatively small amounts of protein products are used in food, there are a number of research and development programs oriented toward the development of technology for producing proteins for food and feed uses. This technology would be marketed abroad in addition to being used domestically.

Denmark has a number of companies which are producing plant protein product for food and some feed applications. The predominant interest in Denmark is to replace soy with a domestically produced protein source or with other proteins which may be partially domestically produced. It is interesting to note that in Denmark the emphasis in research and development programs is not on oilseed protein sources but rather on cereal and other crops such as potatoes. The domestic market for plant proteins in foods is small.

In France research is centering on rapeseed, sunflower and faba bean as protein sources with some activities in single cell protein. The main emphasis is on developing a domestic source of protein for food and feed. The retail market for plant protein in foods is approximately 2,000 tons per year. Of particular interest is the use, since 1850, of faba bean flour in bread.

England is viewed as the center of activity for plant proteins in food in Europe. Economic conditions have favoured the production of retail and institutional products for the domestic market which is currently 50,000 tons (hydrated basis) per year and is forecast to grow at 10% per annum. Thus a number of companies are active in the market place and research is underway on alternative protein sources with domestically produced, or produceable, sources being of prime interest. Other European countries are closely observing the use of plant protein in England which can be considered as a template for their own developments.

Regulations, or lack of regulations, covering the food uses of plant protein are an important consideration in all of the countries. In general it can be said that in all cases regulations are in the formulative stages with modifications and changes likely to be made over the next two to three years.

SWEDEN, DENMARK, FRANCE, ENGLAND

TABLE OF PRIORITIES

Major raw materials of interest for protein ingredient production (in order to priority).

SWEDEN	DENMARK	FRANCE	UNITED KINGDOM
Rapeseed	Barley	Faba beans	Legumes
Cereals	Straw	Sunflower	Rapeseed
Fish	Potato	Rapeseed	
Single Cell Protein		Cereals	

It should be noted that soy protein is the sole or major protein source currently in use in all of the countries visited, however, in all cases there is a strong desire and effort to replace soy with domestic protein sources.

ORGANIZATIONS CONTACTED
(APRIL 18 - MAY 3)

1. SWEDEN

IVA (The Swedish Academy of Engineering Science),
Stockholm.

Federation of Swedish Farmers,
Stockholm.

National Food Administration,
Uppsala.

Royal Agriculture College,
Uppsala.

Karlshamns Oljefabriker,
Karlshamn.

(Institution for Plant Physiology),
University of Lund,
Lund.

Meat Research Institute,
Kavlinge.

LK-Protein AB,
Kavlinge.

2. DENMARK

Carlsberg Research Centre,
Copenhagen.

Denmark Technical University,
Copenhagen.

Dansk Gaerings Industri,
Copenhagen.

NOVO Industries,
Copenhagen.

State Food Institute,
Copenhagen.

Biotechnical Institute,
Billund.

Aarhus Oliefabrik,
Aarhus.

3. FRANCE

Service de la Repression des Fraudes et du Controle de la Qualite. Direction de la Qualite, Ministere de l'Agriculture,
Paris.

CNERNA: Centre National de Coordination des Etudes et des Recherches sur la Nutrition et l'Alimentation/
CNRS: Centre National de la Recherche Scientifique/ Secretariat d'Etat aux Universites,
Paris.

EUROPROTEINES/PROLAIT,
Paris.

Association pour la Promotion Industrie-Agriculture (APRIA) Societe pour l'Etude et le Development de l'Industries, de l'Agriculture et du Commerce (SEDIAC),
Paris.

Centre de Recherches Agro-Alimentaires INRA,
Nantes.

Institut National de Recherche Agricole
Paris.

RHONE-POULENC S.A.,
Paris.

Grandes Minoteries a Feves de France,
Paris.

CETIOM,
Paris.

Direction Generale de la Recherche,
Scientifique et Technique,
Paris.

4. ENGLAND

British Food Manufacturing Industries Research Association,
Leatherhead, Surrey.

International Consultancy to the Food, Animal
Production and Pharmaceutical Industries,
London.

Spillers Limited,
Research and Technical Center,
Cambridge.

Cadbury Typhoo Limited,
Birmingham.

Griffith Laboratories (U.K.) Limited,
Somercotes.

British Soya Products Limited,
Puckeridge.

Ministry of Agriculture,
Fisheries and Food,
London.

S. Daniels & Company Limited,
London.

BP Proteins Limited,
London.

Chambers & Fargus Limited,
Hull.

Tariff information for raw materials and other protein sources.

BTN Tariff Line	Commodity or Product Description	Tariff Sweden	EEC
10.01	Red spring wheat, except seed and wheat, except seed NES	Free (a)	Variable-Levy
10.02	Rye	Free (a)	Variable-Levy
10.03	Barley	Free (a)	Variable-Levy
10.04	Oats, seed, mixed feed oats, oats NES	Free (a)	Variable-Levy
10.05	Indian corn, shelled		
11.07	Malt	Free (a)	Variable-Levy
11.08-1	Starches and Inulin	Free (a)	Variable-Levy
11.08.900	Inulin	Free (a)	
11.09	Gluten & gluten meal	6%	Variable-Levy
23.02	Oat by-products NES Wheat bran, shorts & middlings, grain feeds NES		Variable-Levy 1/
12.01D	Soybeans	Free (a)	Free-Bound
12.01E	Flaxseed	Free (a)	Free-Bound
12.01H	Mustardseed, rapeseed, sunflowerseed & oilseeds oilnuts, oilkernels NES	Free (a)	Free-Bound
12.02	Flour & meal of oilseeds, oilnuts & oilkernels non-defatted (excluding mustard flour)	Free (a)	8%

BTN Tariff Line	Commodity or Product Description	Tariff Sweden	EEC
15.07.101	Soybean oil crude	Free (a)	
15.07.109	Soybean oil refined	Free (a)	
15.07.501	Flaxseed or linseed oil unbleached	Free	
15.07.300	Sunflower oil	Free (a)	
15.07.351	Rape crude	Free (a)	
15.07.352	Rape refined	Free (a)	
15.07.353	Mustard oils	Free (a)	
23.04	Linseed, rapeseed & soybean oilcake & meal and oilseed cake & meal NES	Free (a)	
35.04	Protein, eg., soy flour	Free	

(a) There are supplementary tariff charges which are explained in the attached USDA note headed "Import Control Devices".

1/ For industrial use

a) Crude
Ex 3 other (rapeseed, linseed, sunflower) 5%

b) Refined
Ex 2 other (rapeseed, linseed, sunflower) 8%

IMPORT CONTROL DEVICES

Supplementary Import Charges -- Sweden employs an extensive system of supplementary import charges which are assessed in addition to the regular tariffs. Operating primarily in the meat, grain, dairy, and fats and oils sectors, these levies serve to protect Sweden's domestic production and at the same time provide a source of revenue to help subsidize Sweden's exports of these commodities.

The levies are subject to continuous review and change in the light of domestic and world price levels for the products involved and of variations in the consumer price indexes. The current 3-year agricultural agreement between the Swedish government and the domestic farmers' organizations provided for increased prices to producers as of July 1, 1971, 1972 and 1973. In addition, the agreement's so-called "inflation rule" provides for upward adjustments as of January 1, 1972, 1973 and 1974 to offset inflation to the extent that the consumer price index has increased since the last adjustment under this rule occurred. A series of changes under the present agricultural agreement and the preceding one has resulted in sharp increases in many import charges during recent years. Significant increases have been made within the past year for beef, powdered milk, vegetable oils, corn and turkey rolls.

It should be noted that, for most agricultural products, these levies are generally charged according to the net weight of the imported item (i.e., so many Krona per kilo), rather than its landed value in relation to the domestic price. Therefore all imports of a particular product are not raised to the same price level by the import charge. However, although this supplementary import charge system may retain a would-be exporter's price competitiveness vis-à-vis other exporters, the levy itself may be so high that the exporter cannot compete with Swedish producers of the same of substitute products. For example, the supplementary fee on corn imports currently is $66 per metric ton.

In a few cases EFTA countries are exempt from the import charges and on certain products (fats and oils) these levies are also assessed on domestic products.

EEC TARIFF CATEGORIES FOR SOY PROTEIN

Tariff No.	Description	Rate of Duty: Autonomous Per Cent of Levy (L)	Rate of Duty: Conventional (Per Cent)
12.02	Flours or meals of oil seeds or oleaginous fruit, non-defatted, (excluding mustard flour) A. Of soybeans	10[1]	8
19.02	Preparations of flour, meal, starch or malt extract of a kind used as infant food or for dietetic or culinary purposes containing less than 50% by weight of cocoa:		

Tariff No.	Description	Rate of Duty: Autonomous Per Cent of Levy (L)	Rate of Duty: Conventional (Per Cent)
19.02	B. Other		
	1. Containing no milk fats or containing less than 1.5% by weight of such fats:		
	a. Containing less than 14% by weight of starch		
	1. Containing no sucrose or containing less than 5% by weight of sucrose (including invert sugar expressed as sucrose)	19.6 plus VC[2]	11 plus VC[2]
21.07	Food preparations not elsewhere specified or included:		
	B. Other		
	1. Containing no milk fats or containing less than 1.5% by weight of such fats:		
	a. Containing no sucrose or containing less than 5% by weight of sucrose (including invert sugar expressed as sucrose)		
	1. Containing no starch or less than 5% by weight of starch.	25	20
23.04	Oilcake and other residues (except drugs) resulting from the extraction of vegetable oils:		
	B. Other	Free	Free
35.04	Peptones and other protein substances and their deritivatives; hide powder, whether or not chromed.	12	8

1. In certain conditions, the collection of a compensatory amount is provided for in addition to the customs duty.

2. VC - Variable charge

Source: Official Journal of the European Communities,
Vol. 17, No. L295, 1 Nov. 1974

USDA Foreign Agricultural Service - Utilization of Soy Protein
July 1976 in the European Community

SWEDEN

I OVERVIEW

Interest in vegetable and novel proteins in Sweden lies in two areas: one being the development of technology for the production of these proteins and the other being the production and utilization of these proteins for domestic and export markets.

Sweden has quite intensive total research and development programs with SKr. 5,000 million being spent in 1976, corresponding to almost 2% of the total national product. Also it is interesting to note that the private sector performs roughly two-thirds of Sweden's research and development with the balance being performed in governmental and semi-governmental research organizations and universities. In the agricultural sector it is estimated that approximately SKr. 500 million was spent in 1976/77 on research equivalent to almost 5.5% of the total processing value in the agricultural and food industry. A significant difference in the general approach of research and development within the food industry, as compared to Swedish industry as a whole, is the allocation of a larger proportion of investments to the improvement of process technology rather than to improvement of existing products.

An important factor in considering the development of the vegetable protein industry in Sweden is the strong influence on domestic agricultural policy of the Federation of Swedish Farmers. This organization is directly involved with domestic pricing of agricultural commodities and products and influences Swedish import and export policies. There is a national goal of government and the Federation to reduce or eliminate the need to import protein materials for food or feed purposes. The long-term plan being to supply all requirements through conventional agricultural methods using existing land and other grasslands which could be used in the future for agricultural purposes. Raw materials of particular interest in Sweden included rapeseed, alfalfa, fish and industrial by-products for conversion into single cell protein.

At present soy protein is utilized in a number of products being offered in the retail market and it is believed that this market may expand due to economic pressures on consumers even though meat is heavily subsidized.

Of particular interest is the developing market for meat products extended with vegetable proteins in the food service area. There is a great deal of interest in Sweden in other potential sources of protein that Sweden could produce and in which R & D is being performed in Canada. Rapeseed is viewed as the largest single potential source of plant protein for food purposes once its development is complete.

Sweden's imports in 1976 for plant protein for food use are unofficially estimated at: soy flour - 500 tons, soy concentrates - 200 tons, soy isolates - 500 tons. No other plant protein sources are imported for food purposes. There is at present no tariff on imports of plant proteins for food use, however, an agricultural import levy of SKr. 80/100 Kg. is assessed on the protein materials.

In Sweden approximately 21% of the population's protein intake comes from dairy products as does 17.5% of their energy intake. Cheese is a more important source of protein than beef. Therefore, as can be expected, the price of dairy commodities is very important in Sweden in determining the price of any other protein which may be utilized in food products and to a lesser extent in some feed products.

In Sweden a ceiling was put on milk, meat and pork in the early 1970's to protect Swedish consumers from price increases. Also, domestic producers and industries are protected by a system of import levies.

Some current prices for protein in Sweden are:

Domestic Skim Milk Powder	Feed 3.5 Food 4.5	SKr/Kilo " "
World Price Skim Milk Powder	1.8	" "
Textured Vegetable Protein	6-9	" "
Soy Isolate	7-9	" "
Soy Concentrate	5-7	" "
Blood Plasma	15-20	" "
Egg White Powder	30	" "
Sodium Caseinate	8.5-10	" "

Milk in Store	- 1.4 SKr/Litre	(1 SKr/1 subsidy)
Eggs	- 9.2 SKr/Kilo	(16 eggs, no subsidy)
Meat	- 6 SKr/Kilo	($1.50/Kilo) Subsidy is 30%

Any utilization of vegetable protein in Sweden will have to take into account the subsidization of agricultural products.

II PROTEIN SOURCES

1. Rapeseed

Rapeseed is the main oilseed of Sweden with domestic production being approximately 300,000 tonnes and imports 1,000 tonnes (none from Canada). Sweden produces about 100,000 tonnes of rapeseed oil and 80 - 90,000 tonnes of meal along with imports of 1,000 tonnes of both oil and meal. Exports are 100,000 tonnes of seed and 30 - 40,000 tonnes of oil.

Little information was obtained on the economic competitiveness of rapeseed relative to other protein sources. However, generally speaking, the crop is seen as the major oilseed source and is competitive to soy through subsidy programs.

Although Sweden is one of the leaders in the development of technology for upgrading rapeseed into human food products, there is as yet no such use of the protein fractions. No firm data could be obtained on the current status of this development work but it is believed that toxicity problems as well as flavour and color negatives still persist in the products limiting their commercialization.

There is a considerable amount of research and development activity on rapeseed in Sweden and the problem areas identified were found to be essentially identical to those recognized in Canada, including (a) cardiovascular effects of rapeseed oils and marine oils; (b) toxicity testing of rapeseed protein concentrate produced by Karlshamn/Alfa Laval process; (c) need for process improvements which will enhance the esthetic qualities of rapeseed protein concentrate; and (d) breeding rapeseed varieties of lower glucosinolate content, lower fibre content and improved fatty acid balances.

The main research programs on rapeseed in Sweden are as follows:

(a) Production Major studies continue on breeding and agronomic aspects of rapeseed production. International collaborations with many countries are fostered and maintained by Sweden. The ultimate development of rapeseed as the leading oilseed crop source is a commitment of the Swedish government.

(b) Processing The Karlshamn/Alfa Laval process for RPC production is developed and patented. Recent statements indicate a major decline in funds devoted to further process development until more information (international in origin) is available regarding the safety of this for human consumption. This is complicated by the uncertainty existing in most countries of the world regarding the criteria and protocols which may be required for such clearance. This situation applies to new food sources such as SCP, faba bean, as well as rape. Matters of dehulling, improving oil quality and detoxification processes remain as most important processing subjects, with color and flavour being the major concerns of ultimate users.

(c) Utilization No limits exist on the utilization of rapeseed meal in animal feeds in Sweden. Regulations on erucic acid content of edible oil do exist, as well as probable regulations regarding total long chain fatty acids.

The Swedish view the major future uses of meal and RPC products to be in pet foods and milk replacers for young animals. They see also the need for dehulled meal as a higher energy feed source for poultry and monogastric animals. RPC from Sweden has been evaluated in the United Kingdom and found to be fairly suitable for texturization either alone or in mixture with soy flour or concentrate, although requiring greater solubility, better color and flavour.

2. Cereal and Leaf Protein

Sweden currently produces about 3.5 million tonnes of barley and oats and about 1.2 million tonnes of wheat. There is activity in Sweden on varietal improvement of barley and wheat to produce high lysine varieties for feed with some success being achieved in the case of barley. However, these varieties are not yet available in commercial quantities.

The objective behind this activity is the replacement of imported protein supplements in animal feeds by the higher protein cereals. This replacement is viewed as being economically attractive due to the high cost of soy and other protein supplements. However, to date only limited utilization of high lysine cereals has occurred. Additional work is required on the high protein cereals to overcome the problem of poor yields.

Leaf protein is attracting considerable interest in Sweden and there is a pilot plant located at the University of Lund for the extraction of leaf protein. Since work on leaf protein has all been at the pilot plant level no real costs were available for its production and utilization. However, it is expected to be price-competitive and laboratory tests on some species have indicated yields of up to 1,200 kg of protein per hectare. Current work is centering on extraction techniques, the problems presented by phenolic constitutents and drying techniques.

No problems are anticipated with regard to the acceptance of leaf protein in food or feed products, however, no evidence of acceptance or nutritional tests are available.

3. Fish Protein

Fish is a protein source world-wide and Sweden has long been recognized as a world leader in the development of fish protein technology with Astra Pharmaceutical Company and Alfa Laval being perhaps the main developers of this technology. It is fair to say, however, that fish protein concentrate (FPC) has not materialized or matured as originally anticipated. This is due to the fact that the raw material supply, i.e. fish, has proved to not be as readily and economically available as required and technology has not produced the desired products.

Available technology produces an FPC which is non-functional and can only be used for fortification purposes where it presents color and flavour problems. FPC is available as an animal feed and modifications of this product for this use are under active study.

Efforts at the present are concentrating on the development of processes for improving the functional properties of the products. According to Swedish sources, Poland has installed a 30,000 tonne per annum fish protein plant producing functional fish protein concentrate (FFPC), based on technology developed at the Polish Research Institute. In addition, Alfa Laval is working on a process for fish protein concentrate using a urea solubilization technique that shows some promise. They are also developing a process for full fat fish protein.

The main economic constraint for FPC is the cost of the raw material and this will continue to be a limiting factor on future development.

4. Single Cell Protein

Swedish industry has been working for a considerable time on single cell protein (SCP) processes as a means of utilizing waste and by-product streams. A pilot fodder yeast plant using the SYMBA process with potato waste as a raw material has been in operation for a number of years with CANDIDA UTILIS as the organism. At present the plant is only in semi-commericial operation due to technical problems and concern about its economic viability. This Finish Pekilo process which makes fodder yeast, using a fungue organism on sulphite-pulp waste liquor, is at the same stage of development.

At present a Swedish chocoloate firm is growing yeast on methanol to produce a product called "NOPRO" which is used in animal feed.

Alfa Laval has a process for reducing the nucleic acid content from SCP protein products, which is quite expensive, but essential before an SCP product could be used for human consumption (not required for animal feed).

The Swedish Wood Research Institute is working on an R & D project to produce SCP products from board liquor which contains sugar. For every 100 gms. of cellulose the process produces 55 gms. of mycelium containing 30% protein, so that out of 100 gms. of cellulose, 18 gms. of protein is obtained. The organism involved is SPOROTRICHUM PULVERULENTUM. At present the process is too expensive and the product cannot complete with soy.

The future outlook for SCP processes in Sweden is not favourable, because they cannot compete with SOY or with other vegetable protein products for human consumption. SCP plants have too high a capital cost per lb. of product compared to SOY. Also the cost of obtaining government approval for SCP products for human consumption is very expensive making the product development costs high.

5. Soy

Generally speaking, in Sweden soy occupies a much smaller role in human foods as compared with animal feeds. At the moment, no soy is grown in Sweden although there are 75,000 tons of soy meal imported per year into the country, with most of this being used for animal feeding. Considerable work is underway looking at various alternatives to reduce the Swedish dependence on soy.

There is no commercial manufacturer of TVP, soy concentrate of soy isolate in Sweden.

Efforts to grow soy in Sweden have shown some promise with test plots 150 miles south of Stockholm showing good yields -- 2.2 tons per hectare -- using Fiskeby #5, a strain from Japan.

The Alfa Laval Company has worked on a soy beverage process using full fat beans. These are dehulled, ground, dispersed in water and then heat treated by spray drying. The beany flavour is removed, but the product has a grainy flavour. At the moment, Alfa Laval has not yet sold this process.

6. Straw

There is interest in Sweden in the use of straw from cereals as an animal feed in combination with other protein sources, i.e. rapeseed meal. Thus, in reality, it is used as an energy source, as well as offering some protein, with oat straw having only about 7.5% protein. The Swedes have shown that in the cast of oats, 30-40% of the plant after the grain has been removed has a good feeding value and they have developed a new harvesting system that separates this feed fraction from the remainder of the plant which has a much reduced feed value. This process is in use at a full scale plant in the south of Sweden based on 2,000 hectares of land and is proving to be economically viable.

There is no shortage of cereal straw in Sweden with the potential tonnage available being several million tons and thus raw material will not be a limiting factor.

The actual economics of the process are unknown, however, it was learned that the one plant in operation is commercially successful. The raw material costs would be very low as the straw is a by-product of cereal grain production. As stated earlier, the straw is not considered a protein source as such as it is an energy source and therefore cannot be considered in direct competition with other protein sources although it does supply small amounts.

The current use of the cereal crop in Sweden is as follows: farm consumption 45%, seed purposes 5%, fodder 25%, milling 11%, breweries 1%, export 14%.

Research is being conducted on the development of higher yielding varieties of cereal grains which will result in larger quantities of straw being available with possibly higher quality and quantity of protein.

7. Potato

The mission did not learn of any activity in Sweden on the direct use of potatoes for protein production. The use of potato waste as a substrate for fodder yeast using the Symba process was discussed and is covered elsewhere in the report. Also some work has performed on the development of ultrafiltration technology for use in concentrating potato fruit water which was subsequently commercialized in The Netherlands and is covered in the mission report on that country.

8. Meat By-Product Protein

Two organizations note marked interest in the development of protein ingredients from meat by-products. These are the Swedish Meat Institute and Ellco Protein. Blood is the major product of concern and Ellco Protein is a company which now collects blood sanitarily from all abattoirs in Southern Sweden. The blood is viewed as a potential source of food raw materials, biochemicals, drugs and feed ingredients. No figures on total supply are available.

At present, Ellco sells products to meat industry and to feed companies. Prices quoted are -

Plasma (frozen 9% solids, 7% protein)	1.8K/Kg
Hemoglobin (spray dried, feed use)	2.5K/Kg
Hemoglobin (spray dried, food use, 80% protein)	4.K/Kg

Resistance by the population of Sweden exists for any utilization of blood or blood components in other than meat products. This is a general concern and poses serious marketing questions, although markets do exist in fresh meat products and a "blood-bread" eaten with meat.

The major problems identified in development of protein ingredients from blood include: (a) the development and maintenance of sanitary collection and storage procedures; (b) the lack of acceptability in other than meats; (c) the expense in drying or maintaining frozen products in distribution and (d) the oxidation effects from use of hemoglobin in food products (rancidity development).

Utilizations for the present are concentrated in the meat industry. Acceptance and labelling regulations are critical to expanded use in other food products. The products currently used have been commercialized by Ellco and are as follows:

Blood Centrifugation

Plasma		Red Blood Cells	
Use in Sausage	Dried or Frozen	Dried For Feed 2K/Kg	Dried For Food 4K/Kg

III REGULATIONS

Regulations allow the use of plant proteins in some food products in Sweden as follows:

Meat Products - A minimum meat content of 60% for meat balls and 80% for hamburgers is specified by the regulations. For other meat products the minimum is 20%. A maximum of 3% vegetable protein may be added to meat sausage, calculated on the dry product.

Foods which resemble meat products (i.e. analogs) but do not comply with the meat regulations must not be sold under a name similar to the name of the meat product or with information which implies it is a meat product. Such products must be labelled in a manner designating the nature of the product, i.e. "Soy sausage" or "sausage with soy ".

The Swedish regulations allow the incorporation of plant protein of up to 3% (dry weight basis) in meat products for functional purposes. In this instance, these proteins appear only in the list of ingredients on the label of the product.

Milk Products - Addition of foreign protein to milk, cream, yoghurt, etc.,is not permitted.

Bakery Products - Vegetable proteins may be utilized in bread. The sources of protein must be stated on the label.

The food regulations in Sweden are the responsibility of the Swedish National Food Administration. As regards plant and other novel proteins, they consider such factors as safety of the protein, nutritional value of the protein and the administrative problems dealing with the labelling requirements for products incorporating the proteins and the value/price relationship for the consumers of the products.

The National Food Administration is still deliberating on the use of rapeseed protein in human food. There are, however, no regulations currently preventing its use in foods; hence the producer of a product is responsible for its safety.

IV CONCLUSIONS

1. Sweden is very active in protein research and development, the largest percentage being centered in universities and and government research organizations.

2. The current emphasis in protein research in Sweden is on the replacement of imported proteins with domestic sources.

3. Rapeseed is still the number one plant protein priority in Sweden even taking into account reports of decreased Alfa Laval and Karlshamn activities.

4. Markets do exist for extended meat products in the food service area and these products are available in retail stores. These markets will grow where a price advantage exists but general use will develop slowly.

5. The Federation of Swedish Farmers has a very strong influence on food policy in Sweden and their somewhat negative attitude on plant protein in foods must be taken into account.

6. A predominant interest in Sweden is the development of technology for protein extraction and production which can be marketed domestically and abroad. The Swedish national income is highly dependent on its ability to export technology.

7. The Swedish food regulations are favourable to the domestic development of plant proteins in food products.

V RECOMMENDATIONS

1. Opportunities exist in Sweden for Canadian developed protein sources and technology. These opportunities should be persued through such means as (a) technical seminars and promotions, (b) provision of product samples to potential end users, and (c) participation in technology and product trade fairs.

2. The most promising area for Canadian technology is in the area of non-meat applications and this should be taken into account in development programs.

SELECTED STATISTICS ON RAW MATERIAL SUPPLY IN SWEDEN

(IMPORTS, IMPORTS FROM CANADA, EXPORTS AND PRODUCTION)

SWEDEN - IMPORTS FROM CANADA

('000 m.t.)

	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76
CEREALS						
Wheat	1.6	2.1	1.2	-	-	-
OILSEEDS						
Soybeans	0.9	0.6	0.7	1.1	1.2	-
Mustardseed	-	-	-	L.T.	L.T.	0.1
TOTAL	0.9	0.6	0.7	1.1	1.2	0.1

SOURCE: Grain Exports,
Canadian Grain Commission.

Market and Policy Analysis Division
Grain Marketing Office
Department of Industry, Trade and Commerce
April, 1977

SWEDEN - IMPORTS 2/

('000 m.t.)

	1971	1972	1973	1974	1975	1976 P
CEREALS						N/A
Wheat C/	22.8	21.6	18.6	6.7	12.9	
Wheat flour	0.4	2.9	1.7	0.6	0.4	
Oats	L.T.	L.T.	22.0	66.5	-	
Barley	1.2	L.T.	36.9	79.2	L.T.	
Corn	32.2	31.1	47.0	126.0	79.0	
Rye	L.T.	L.T.	4.0	3.0	L.T.	
Rice	14.8	17.2	16.6	17.0	16.4	
Cereals NES	1.3	1.4	1.1	1.3	1.3	
Total	72.7	74.2	147.9	300.3	110.0	
Barley Malt	29.0	26.5	12.8	6.7	9.5	N/A
OILSEEDS						
Flaxseed A/	0.2	0.2	0.2	0.2	0.2	
Rapeseed	1.1	1.3	1.2	0.9	0.9	
Soybeans	9.1	7.1	1.2	1.2	1.5	
Sunflowerseed	2.7	2.8	3.0	2.9	1.5	
Groundnuts N/	0.9	1.4	1.5	1.1	1.2	
Oilseeds NES	-	-	0.4	-	0.2	
Total	14.0	12.8	7.5	6.3	5.5	
OILS						N/A
Rapeseed A/	-	L.T.	0.4	1.4	1.1	
Linseed	5.0	3.9	3.9	2.4	1.9	
Soybean	47.3	37.7	44.6	52.8	42.4	
Palm & Palm Kernel	9.1	9.1	8.8	8.7	14.3	
Sunflowerseed	3.2	0.8	1.5	1.7	1.6	
Cottonseed	11.7	14.4	12.0	16.3	9.9	
Groundnut	2.5	2.8	3.8	3.1	2.0	
Seed Oil NES Q/	0.2	0.3	0.2	0.2	0.2	
Total	79.0	69.0	75.2	86.6	73.4	

SWEDEN - IMPORTS 2/

('000 m.t.)

	1971	1972	1973	1974	1975	1976P
OILSEED CAKE & MEAL						N/A
Rapeseed	1.8	-	1.6	-	0.8	
Linseed	1.0	0.7	0.3	0.3	0.1	
Soybean	166.9	197.2	190.3	243.0	213.0	
Palm Kernel	0.3	3.8	2.5	16.0	2.9	
Sunflowerseed	3.0	-	-	-	-	
Cottonseed	89.8	106.9	95.4	64.5	71.0	
Groundnut	22.9	15.9	1.0	0.5	L.T.	
Cake & Meal NES	0.2	1.3	0.4	0.6	-	
Total	285.9	325.8	291.5	324.9	287.8	

A/ Includes mustardseed
C/ Includes meslin
N/ Palm nuts & Kernels
Q/ Olive
2/ Includes intra-EEC trade
L.T. Less than 50 metric tonnes

SOURCE: UN/FAO Trade Yearbook 1975

Market and Policy Analysis Division
Grain Marketing Office
Department of Industry, Trade and Commerce
April, 1977

SWEDEN - EXPORTS

('000 m.t.)

	1971	1972	1973	1974	1975	1976[P]
CEREALS						N/A
Wheat C/	147.3	287.1	370.9	672.5	798.8	
Wheat Flour	10.9	28.9	16.3	30.5	39.7	
Oats	401.6	542.7	147.2	25.4	172.2	
Barley	438.8	291.0	122.9	68.0	310.5	
Rye	103.0	64.2	104.1	101.7	116.0	
Cereals NES *	0.1	0.6	0.2	0.3	0.1	
Total	1,101.7	1,214.5	761.6	898.4	1,437.3	
MALT	0.1	2.2	9.1	5.4	10.3	
OILSEEDS						N/A
Rapeseed A/	59.9	104.5	161.3	161.3	117.8	
Oilseeds NES **	L.T.	L.T.	0.4	0.1	0.8	
Total	59.9	104.5	161.7	161.4	118.6	
OILS						N/A
Rapeseed A/	32.3	38.3	38.3	30.9	38.7	
Palm & Kernel	0.1	1.0	1.2	0.4	0.6	
Cottonseed	0.1	0.3	0.3	0.5	0.3	
Groundnut	0.2	0.1	0.4	0.3	0.3	
Seed Oils NES B/	0.2	L.T.	0.1	0.4	0.8	
Total	32.9	39.7	40.3	32.5	40.7	

SWEDEN - EXPORTS

('000 m.t.)

	1971	1972	1973	1974	1975	1976[P]
OILSEED CAKE & MEAL						N/A
Soybean	L.T.	0.1	-	-	0.9	
Cottonseed	-	-	0.9	-	-	
Groundnut	-	-	1.4	1.6	-	
Cake & Meal NES G/	1.4	L.T.	-	-	-	
Total	1.4	0.1	2.3	1.6	0.9	

A/ Includes mustardseed
B/ Mainly coconut and castor, also linseed, soybean and sunflowerseed
C/ Includes meslin
G/ Includes coconut
L.T. Less than 50 metric tonnes

* Includes corn and rice
** Includes palm nuts, kernels and groundnuts

SOURCE: FAO Trade Yearbook

Market and Policy Analysis Division
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SWEDEN - PRODUCTION

('000 m.t.)

	1971	1972	1973	1974	1975	1976[P]
CEREALS						
Wheat	995	400	1,335	1,826	1,476	1,615
Oats	305	1,630	1,210	1,685	1,320	1,420
Barley	2,030	1,885	4,402	2,400	2,000	1,860
Rye	305	365	325	440	325	
Mixed grain	202	200	162	249	170	
Total	3,837	4,480	7,434	6,600	5,291	4,895
OILSEEDS						
Flaxseed						
Rapeseed	255	330	340	350	330	280
Mustardseed	2.4	1.1	1.2	2.4	2.0	
Total	257.4	331.1	341.2	352.4	332.0	280.0
OILS						
Rapeseed 1/	91	55	63	62[P]	65[P]	106
Linseed	48	55	63	62	N/A	N/A
Soybean	1.4	1.2	N/A	N/A	N/A	N/A
Coconut	-	30	32	26	N/A	N/A
Total	140.4	141.2	158	150	65	106

SWEDEN - PRODUCTION

('000 m.t.)

OILSEED CAKE & MEAL	1971	1972	1973	1974	1975	1976 P
Rapeseed 1/	70	83	99	95	94	108
Linseed	N/A	N/A	N/A	N/A	N/A	N/A
Soybean	5	7	-	-	-	-
Copra	17	18	15	10	13	13
Total	92	108	114	105	107	121

P - Preliminary

1/ - Includes mustardseed

SOURCE: UN/FAO Production Yearbook
Oil World Weekly No. 13 (April) '77
USDA - Foreign Agriculture Circular-FOP 21-76

Market and Policy Analysis Division
Grain Marketing Office
Department of Industry, Trade and Commerce
April, 1977

DENMARK

I OVERVIEW

Denmark is a technology intensive country with a great deal of expertise in new technology development. With a relatively small land base for domestic agriculture, there is a strong effort to develop technologies for upgrading agricultural materials and by-products to food and feed grade materials and thereby lessen dependence on imported materials.

The Danish Institute of Technical Science studied the protein situation in Denmark during 1973-76 and published a study which concluded that Denmark inefficiently utilized protein in livestock rations which contributed to the use of almost 2,000,000,000 DKr/year of imported soybean meal, sunflowerseed and cottonseed meal for feed. Thus it was established as a goal to develop new domestic proteins for food and feed uses and possibly the conversion of some of the fodder proteins for food use such as field beans, oats and rapeseed. This interest has also led to research on the development of high lysine barley varieties and the production of single cell protein on waste materials.

As far as food grain plant and novel proteins are concerned the only source in use at the present time is soy, although there is generally an open-minded approach to this question and the opportunity exists for other protein sources including rapeseed, peas, potatoes and fish.

It was stressed by some sources that high grain costs in Denmark coupled with low world prices on soy products, make it extremely difficult to economically develop a plant protein industry. Only in time of crisis does this aspect come up. It was stated that if soy prices remain low, then Denmark should not develop a plant protein industry.

The oilseed crushing industry in Denmark is heavily dependent on imported oilseeds with U.S. soy being the predominant source. One plant, situated in the eastern part of the country, ships oil and meal to Sweden, while the other in western Denmark exports its surplus to West Germany and supplies the Jutland livestock industry with meal. One of the crushers produces soy concentrate for use in both food and feed products (calf milk replacers) and currently enjoys approximately 60% of the market in Denmark.

Due to their interest in technology development, Denmark is outward looking in the development of value-added processing of agricultural materials.

In trade with Denmark Canada enjoys MFN tariff treatment. Denmark is now a member of the European Economic Community. The import tariffs for soy flour is 8% ad valorem and for other vegetable protein flour 0.5% ad valorem.

The largest factor restricting the growth of plant protein for foods in Denmark is consumer resistance. Some indicator prices of protein sources are as follows:

Skim Milk Powder (subsidized)	7.3 DKr/Kilo
Soy Concentrate - Animal use	6.0 " "
- Human use	7.0 " "
Sodium Caseinate	12.0 " "
Soy Isolate	12.5 " "
Textured Soy Concentrate	7.5- 8.0 " "

II PROTEIN SOURCES

1. Barley

Considerable work is being done in Denmark on the development of protein from barley and to a lesser extent, oats. Barley is the single most important cereal in Denmark both as a feed ingredient and for malting, representing approximately 80% of the total grain grown domestically.

The Bioteknisk Institut, Kolding, is working on the development of an air classification process for barley for separation into a high protein fraction for use as a swine feed (thus reducing the need for soy protein) and a low protein fraction to which urea could be added for use as a cattle feed. Also the starch fraction is being examined for possible use in the production of glucose syrups. The protein fraction obtained constitutes approximately 25% of the weight of the starting material and is about 30% protein.

At present, the economical practicability of the process is somewhat marginal and very much dependent on the external economics of such things as EEC prices and policies, grain prices, etc. If specialized properties were found for the protein fraction which would enable its use in food products, then better returns would be possible and the economics improved.

2. Straw

At the Bioteknisk Institut, a great deal of work has been carried out on the improvement of straw as a fodder and on the use of straw as a substrate for single cell protein production.

In the case of straw improvement, the system developed is the "Dry Alkali Treatment System", in which sodium hydroxide is used to improve the nutritional value of the straw for ruminants by improving the cellulose availability. The straw is cut, treated with sodium hydroxide and cubed using high pressure and temperature with the final product being a cube or briquette sufficiently dry for storage. This product is used as an energy source in a feed ration.

In the second case of producing single cell protein from straw substrate, the chopper, alkali treated straw is sterilized and inoculated with bacterium to produce single cell protein. The bacterium is removed by filtration or centrifugation and concentrated by centrifugation or ultrafiltration to obtain a concentrated product. At the present stage of development, 100 pounds of straw produces about five pounds of protein although the theoretical yield is 20 pounds of protein.

Straw is considered as a waste product in Denmark and is available at a rate of approximately seven million tons per annum so that raw material is not a limiting factor.

The Dry Alkali Treatment System is utilized commercially in Denmark and is being marketed internationally in Great Britain, Poland, Australia, Japan, Greece and Finland and Canada. In Denmark, 12 factories currently produce approximately 80,000 tons of treated straw per year and some farm size units of two tons/hour are being marketed domestically and abroad.

The production of SCP from straw is still being developed at the pilot plant stage and at present the economics of the process are not competitive with soy protein. Nevertheless, the feeling in Denmark was that soy prices will increase to the point where their process will be competitive.

The intended use of both the alkali treated straw and the single cell protein from straw is in animal feeds although eventually the SCP could be utilized in human food.

3. Potato

Denmark produces special potato varieties for starch which contain 23% dry matter of which 8% is protein, 2% fibre and 13% starch (in comparison with table potatoes at 20% dry matter with 12% protein). The single largest problem with the potato processing industry is pollution control and therefore the Bioteknisk Institut at Kolding undertook to develop a process for potato processing which yields both protein and starch while reducing pollution problems.

The basic process developed involves peeling, washing, disintegrating, spray drying, milling and air classifying the potato material into a protein rich and a starch fraction. In the process, approximately 85% of the potato proteins are recovered. Approximately 20% of the dry matter is recovered in the fines fraction with a protein level of 45% while 80% goes to the starch fraction with only a 2.5% protein content.

100 lbs. dry potato → 80 lbs. starch fraction (2.5% protein)
100 lbs. dry potato → 20 lbs. protein fraction (45% protein)

100 Kilos Potatoes

23 Kilos Dry Potato

4.6 Kilos Protein Fraction	18.4 Kilos Starch Fraction

It is believed that the protein fraction obtained could compete with milk and whey proteins and they have been shown to have a very good amino acid profile.

The economics of the process have only been evaluated on the basis of a small pilot plant. Notwithstanding this fact, the developers believed it was economically viable in Denmark where processing of potatoes could be combined with the production of condensed and dry milk powder thus enabling maximum utilization of capital equipment. It is believed that 4 KDr/Kilo could be obtained for the protein fraction.

The potato protein has been found to have good functional properties and in terms of emulsification, favourable to those of soy. The starch fraction is being evaluated in the food industry as a low viscosity starch and as a brewing adjunct (although maize grits are available at 1.4 DKr/Kilo vs 1.6 DKr/Kilo for potato starch). Also the potato protein is being evaulated in extruded starch items.

4. Rapeseed

Denmark produces about 100,000 tonnes of rapeseed and imports only small quantities. Between 30-40,000 m.t. of rapeseed oil is produced from the domestic seed sources and only small quantities of oil (300 m.t.) are imported. The meal produced in country varies from 50-60,000 m.t. over the past four years, but imports have been substantial varying between 30-60,000 m.t. Denmark exports approximately 60,000 m.t. of rapeseed from 1-7,000 m.t. of oil and from 1-5,000 m.t. of meal. Imports from Canada are minimal.

Denmark looks to rapeseed as one source of protein for future human use but is not concentrating its efforts upon this source as is Sweden.

Rapeseed oil is utilized along with other vegetable oils in shortening and margarine products. The meal is used exclusively in animal feeds at levels which are below the recommendations of the Rapeseed Association of Canada. There is limited or no availability of low/low varieties in Denmark as yet. Since feed use of meal is limited, the overall acceptance as a meal is judged to be still somewhat suspect at levels recommended in Canada. In fact, throughout Europe, there is a need for more information on the feeding studies and results from Canada.

Denmark does not appear to maintain an active program on rapeseed R & D, but seems to be looking to Sweden and Canada as primary sources of information. New varieties will be introduced as they become available and this will aid in both oil use questions and improved animal feed utilization through lower glucosinolate content.

No major R & D activities or rapeseed were uncovered. Human fractions from meal are viewed as distant, and when available, they will be compared to present soy usage.

5. Soy

Denmark imports large quantities of soy meal for animal feeding purposes, although as indicated, strenuous efforts are being made to replace this imported material with native sources.

Soy is used in the manufacture of food grade protein material, namely concentrates and textured concentrates. Soy is also used in the manufacture of calf milk replacers and in pet foods.

All of the major American manufacturers of soy products have representation in Denmark as does Unilever. According to one source, Denmark is viewed as the "playground" for the development of plant proteins due to the freedom provided under their regulations.

The use of soy in human food is not extensive and consumption is not increasing too rapidly, although there are some extended and analog products on the market.

6. Single Cell Protein

Denmark Technical University is greatly interested in single cell protein research and is studying potato, barley, oats and cassava as sources of cheap substrate. Also the university is working on the economics of individual unit process operations in the production of SCP to lower the capital cost of production.

There is technology available in Denmark for SCP processes including yeast from sulfite liquor and removal of nucleic acids from yeast.

All of the current SCP research and development work in Denmark is done on a laboratory scale and there are no commercial plants in operation.

III REGULATIONS

The State Food Institute controls the use of plant proteins and other novel proteins in food products. At present there are no regulations in effect covering meat products although there are administrative guidelines. Plant protein can be incorporated into meat products for functional purposes at 3% or less without appearing on the label. Above the 3% level it must be declared on the list of ingredients. Also the label must make it clear that the product is not pure meat but meat plus protein, i.e. soy-wieners. In the case of analogs, they must be clearly labelled as such with unique names not resembling the meat product.

Plant protein is considered as a replacement in Denmark and not as an additive so that it can be utilized in accordance with regulations covering the marketing of dangerous or fraudulent foods. If there is a known concern or problem with a plant protein, then safety testing would be required.

In the case of milk products, only milk protein is allowed although the Minister of Agriculture has the power to grant exemption from this.

Bakery products are not standardized and it would be advisable to seek permission on use of plant protein in those products.

IV CONCLUSIONS

1. Denmark is committed to the replacement of soy protein with domestically produced or other protein sources.

2. It is interesting to note that in Denmark, the main efforts are in cereals, potatoes, etc., and not on oilseed protein sources.

3. Denmark is prepared to import technology for oilseed processing from other countries such as Canada and U.S.

4. Overall EEC regualtions on the food uses of plant protein will have definite effects on developments in Denmark and it is unlikely much will occur before these regulations are known.

V RECOMMENDATIONS

1. There is considerable interest in Denmark in plant protein technology being developed in Canada. Thus, Denmark provides an opportunity for Canadian industry to establish capability in Europe.

2. Progress on the utilization of potato and straw as protein sources should be monitored with a view to potential applications in Canada and abroad.

3. Close contact should be maintained with several Danish R & D organizations as a means of information and technology exchange and cooperation.

SELECTED STATISTICS ON RAW
MATERIAL SUPPLY IN DENMARK

(IMPORTS, IMPORTS FROM CANADA,
EXPORTS AND PRODUCTION)

DENMARK - IMPORTS 2/

('000 m.t.)

	1971	1972	1973	1974	1975	1976 P
CEREALS						N/A
Wheat C/	2.5	9.6	18.5	7.1	14.9	
Wheat Flour	46.0	43.0	19.0	18.0	0.4	
Oats	63.4	20.9	29.6	28.8	79.0	
Barley	374.2	136.1	130.3	176.3	27.8	
Corn (Maize)	252.7	285.2	224.9	224.3	195.6	
Rye	32.8	15.7	3.0	4.2	L.T.	
Rice	10.7	14.8	14.0	11.6	9.3	
Cereals NES	33.1	31.0	67.0	71.0	36.0	
Total	815.4	556.3	506.3	541.3	363.0	
OILSEEDS						N/A
Flaxseed	70.0	135.0	96.1	33.0	36.1	
Rapeseed A/	11.0	0.5	80.1	0.4	0.6	
Soybeans	491.1	533.3	389.8	471.0	-	
Sunflowerseed	0.5	0.7	0.5	0.6	0.6 F	
Palm nuts & kernel	256.0	156.0	166.0	223.0	174.0	
Groundnuts	12.1	13.0	13.1	11.0	0.9	
Total	840.7	838.5	745.6	739.0	212.2	

DENMARK - IMPORTS 2/

('000 m.t.)

	1971	1972	1973	1974	1975	1976 P
OILS						N/A
Rapeseed	L.T.	L.T.	0.1	0.3	0.3	
Linseed	4.5	5.0	2.5	2.0	1.6	
Soybean	11.0	2.2	46.0	2.2	1.3	
Palm oil & palm kernel	10.5	8.3	10.2	11.5	8.3	
Sunflowerseed	28.0	27.0	20.1	19.1	18.0	
Groundnut oil	15.0	23.1	10.1	0.8	0.7	
Olive oil	0.2	0.2	0.2	0.1	0.1 F	
Seed oils NES B/	L.T.	L.T.	L.T.	0.1	0.1	
Total	69.2	65.8	89.2	36.1	30.4	
OILSEED CAKE & MEAL						N/A
Rapeseed	31.4	38.8	33.0	57.1	43.9	
Linseed	25.7	22.8	19.2	18.8	17.9	
Soybean	262.6	343.7	359.5	426.3	443.2	
Sunflowerseed	886.0	72.4	58.7	84.2	53.2	
Cottonseed	277.6	339.1	384.1	327.2	498.5	
Groundnut	0.1	L.T.	0.4	L.T.	-	
Cake & meal NES J/	1.8	6.3	5.1	1.1	6.4	
Total	1,485.1	823.1	859.6	959.7	1,056.7	

A/ Includes mustardseed
B/ Includes cottonseed
C/ Includes meslin
F/ FAO estimate
J/ Includes palm kernel and groundnut
2/ Includes intra-EEC trade

SOURCE: FAO Trade Yearbook

Market and Policy Analysis Division
Grain Marketing Office
Department of Industry Trade and Commerce
April, 1977

DENMARK - IMPORTS FROM CANADA

('000 m.t.)

	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76
CEREALS						
Wheat	1.6	-	-	-	-	-
Barley	41.1	-	-	-	-	-
Total	42.7	-	-	-	-	-
OILSEEDS						
Flaxseed	1.3	2.0	2.0	-	-	-
Rapeseed	-	-	4.5	-	-	-
Total	1.3	2.0	6.5	-	-	-

SOURCE: Grain Exports, Canadian Grain Commission.

Market and Policy Analysis Division
Grain Marketing Office
Department of Industry, Trade and Commerce
April, 1977

DENMARK - EXPORTS

('000 m.t.)

	1971	1972	1973	1974	1975	1976P
CEREALS						N/A
Wheat C/	71.6	128.6	152.9	165.3	234.3	
Wheat Flour	0.2	2.7	1.2	1.8	1.6	
Oats	4.5	4.7	6.3	12.7	7.1	
Barley	149.2	196.4	170.9	477.8	746.6	
Corn	1.8	1.4	0.4	0.1	0.1	
Rye	0.1	0.4	18.0	6.6	20.8	
Rice	0.3	3.6	1.7	2.7	1.3	
Cereals NES	0.4	0.5	0.2	0.2	L.T.	
Total	228.1	338.3	351.6	667.2	1,011.8	
MALT	29.3	41.0	49.4	50.2	40.3	
OILSEEDS						
Rapeseed A/	43.1	37.4	59.0	155.0	61.9	
Palm nuts & kernels	0.9	-	-	0.5	-	
Oilseeds NES *	0.2	0.1	0.2	0.1	0.1	
Total	44.2	37.5	59.2	155.6	62.0	
OILS						N/A
Rapeseed A/	-	2.6	7.4	4.7	1.2	
Linseed	0.1	0.1	0.3	0.2	0.1	
Soybean	46.5	46.0	33.1	31.7	34.3	

DENMARK - EXPORTS

('000 m.t.)

	1971	1972	1973	1974	1975	1976P
OILS						
Palm & kernel B/	0.9	0.2	0.3	2.2	2.9	
Seed Oils NES	0.6	0.9	0.4	0.6	0.5	
Total	48.1	49.8	41.5	39.4	39.0	
OILSEED CAKE & MEAL						N/A
Rapeseed	0.4	2.2	1.1	1.4	4.8	
Linseed	0.1	0.3	0.2	0.1	0.1	
Soybean	117.8	130.2	68.5	112.5	70.9	
Palm kernel	10.4	10.3	5.7	7.6	7.1	
Sunflowerseed	0.4	-	-	1.6	0.1	
Cottonseed	6.4	15.8	18.2	16.9	15.7	
Cake & Meal NES G/	13.7	16.6	12.5	17.1	9.4	
Total	149.2	175.4	106.2	157.2	108.1	

A/ Includes mustardseed
B/ Mainly coconut and castor, also sunflowerseed and groundnuts
C/ Includes meslin
G/ Includes coconut
L.T. Less than 50 metric tonnes
* Includes flaxseed, soybean, sunflowerseed and groundnuts

SOURCE: FAO Trade Yearbook

Market & Policy Analysis Division,
Grain Marketing Office,
Department of Industry, Trade & Commerce.
April, 1977.

DENMARK - PRODUCTION

('000 m.t.)

	1971	1972	1973	1974	1975	1976[P]
CEREALS						
Wheat	585	592	542	592	538	670
Oats	701	640	444	472	370	-
Barley	5,460	5,572	5,432	5,967	5,176	5,050
Corn	-	-	-	-	-	-
Rye	150	155	140	168	167	-
Mixed grain	132	111	75	62	50	-
Total	7,028	7,070	6,633	7,261	6,301	5,720
OILSEEDS						
Flaxseed	0.115	0.055	0.060	0.15	0.15	-
Rapeseed	51.	51.	112.	112.	130.	90.
Mustardseed	4	2.6	9.8	28.	28.	-
Total	55.115	53.655	121.860	140.15	158.15	90.
OILS						
Rapeseed	18	18	33	40	41	32
Linseed	-	-	-	-	-	-
Soybean	92	89	72	75	70[P]	75
Palm kernel	10	10	8[P]	9[P]	N/A	N/A
Total	120	117	113	124	111	107

DENMARK - PRODUCTION

('000 m.t.)

	1971	1972	1973	1974	1975	1976^{P}
OILSEED CAKE & MEAL						
Rapeseed	26	26	47	57	59^{E}	46^{E}
Soybean	410	393	324	350	315	335
Palm kernel	11	10	8^{P}	10^{P}	9*	N/A
Total	447	429	379	417	383	381
	447	429	379	417	383	381

* October 1974 - September 1975
E Estimated
F Forecast
P Preliminary

SOURCE: UN/FAO Production Yearbook
Oil World Weekly 1975, 1976
USDA Foreign Agriculture Circular FOP 21-76

Market & Policy Analysis Division,
Grain Marketing Office,
Department of Industry, Trade & Commerce.
April, 1977.

FRANCE

I OVERVIEW

Although there is interest and activity in the industrial and research communities in France in plant and novel protein development, there is great reluctance on the part of the French population to accept these products. Restrictive legislation on incorporation and labelling are also detrimental to the expanded use of these products.

This situation prevails in spite of the fact that meat is very expensive in France compared to vegetable protein ingredients that are available (i.e. 35 FR vs 2 RR). Also, the generally negative attitude of the French media to any type of plant protein product is a main factor in influencing the general populace and this attitude is not forecasted to change.

As indicated, however, there is research and development activities underway in France on plant proteins. The Institute Nationale de Reserche Agricole (INRA) has established pilot plant facilities at NANTES for R & D on plant proteins. Also Grandes Minoteries a Feves de France commercially produces faba bean flour for use in bread.

The predominant protein sources of interest in France are soy, rapeseed, sunflower, faba bean and, to a lesser extent, single cell protein.

The current use of vegetable protein in France is estimated to be 2,000 tons/annum with all of this being from soy. The main markets for this usage are the food processing industry and institutional foods market with only a small percentage being sold directly to consumers.

France, like other European countries, has a goal of self-sufficiency in animal feed proteins by 1980 and hence there is considerable activity in trying to upgrade or improve domestic sources of feed protein.

II PROTEIN SOURCES

1. Faba bean

Faba beans have been used in France as a bleaching agent and crust improver in bread since 1850. Grandes Minoteries a Feves de France is the sole producer of faba bean flour with mills located at Le Havre and Marseilles. Although the main market is to millers there are also some retail sales of the product.

This company is also developing a process for the production of a faba bean protein concentrate and are building a pilot plant for development purposes.

The supply of faba bean in France is 25 per cent domestic with the remainder imported from China, England, Poland and Denmark. The price of fababeans is approximately 730 FR per tonne but in France the farmer receives 1030 FR including a 300 FR subsidy. Yields of faba average about 3.5 tonnes per hectare.

Favism is not regarded as a problem in France and authorities are not concerned with this aspect. It is hoped that faba will be able to compete with soy as a food protein in France.

II PROTEIN SOURCES

2. Sunflower

The major emphasis on sunflower as an oilseed crop was seen in France although it is produced in several other European countries. France produces approximately 100,000 m.t. and imports about 100,000 m.t. of sunflower producing about 30,000 m.t. of oil and 30,000 m.t. of meal. In addition, France imports about 100,000 m.t. of oil and 20-50,000 m.t. of meal. France considers sunflower as an important oilseed source of protein.

No firm economic data was obtained, however, the crop appears to be an economical raw material for production of oil, meal and protein although some agronomic improvements are required to increase the yields currently obtained and to overcome problems with disease.

No protein ingredients are currently available and sunflower is used only as seed for confectionary purposes or in cereals. The absence of toxic factors and the mild flavour seems to indicate that products from sunflower would be acceptable. The removal of chlorogenic acid is required, however, to overcome potential color problems in utilization.

The main problems existing for utilization of sunflower as a plant protein source are (1) removal of chlorogenic acid, (2) the development of a total process for fractionation and (3) the requirement for applicable dehulling technology.

R & D at the INRA pilot plant at Nantes and at CETIOM in Paris is concentrating on processes to obtain protein fractions from sunflower. The Nantes work is directed towards producing isolates, which now appear to be obtained only in very low yields, while CETIOM sees the need for protein concentrators as well and is working on this area.

There should be no problems in utilization if sunflower concentrates and isolates can be prepared while retaining functional properties.

3. Rapeseed

France produces approximately 500,000 tonnes of rapeseed and imports approximately 40,000 tonnes. From this is produced 150-200,000 tonnes of oil and 200-250,000 tonnes of meal. Only small quantities of oil and meal are imported. Rapeseed is a major oilseed in France and can be produced successfully to meet demand, dependent on competition with other crops.

Rapeseed meal is competitive as an animal feed in France. Currently no rapeseed protein is utilized in human food and this usage is dependent on legislative controls and economic production of a food grade rapeseed protein.

Researchers in France believe that rapeseed concentrates and isolates currently available are acceptable although no large scale tests of this have been conducted.

The major problem areas for rapeseed recognized in France are similar to those in other rapeseed producing countries. France has maintained a significant R & D program on rapeseed utilization, mostly conducted at various government laboratories. The prime incentive for this work is to utilize the 500,000 tonnes of meal produced from the 700,000 tonnes of rapeseed produced in France. At present dehulling of rapeseed is viewed as being of major importance as a means to provide an improved animal feed while interest continues in detoxification and protein product preparation for human use. INRA's approach, however, appears to be pointed to isolate rather than rapeseed protein concentrate preparation.

On this mission tour, three research programs on rapeseed were encountered, being those of CETIOM, INRA and Europroteins (a commercial concern). The latter appears to be inactive on rapeseed following the original work published about 5 years ago by Dr. Starron, the originator of the fermentative process for detoxification of rapeseed.

The INRA program, which also applies to sunflower, is concentrating, as indicated, on the development of processes by which to obtain protein isolates for human use, and a series of by-products of varying composition, destined for animal feed or discard.

CETIOM, on the other hand, appear to be facing the R & D needs in a practical way, approaching the overall fractionation process in a step-wise manner, and concentrating their efforts on dehulling, extraction of dehulling cotyledon, and on detoxification of the defatted dehulled material. They support work in rapeseed protein concentrate as well as isolates, and view the economics of these processes much more strictly than does INRA.

All centers view human use in the relatively distant future, but concentrate and isolate fractions have been texturized and spun to fibres and the results have indicated the technical feasibility of such utilization.

4. Single Cell Protein

France is carrying out a very limited amount of research in the field of single cell protein technology. The research is being mainly conducted in the universities and tends to be academic in nature. Any plans for single cell protein appear to be rather long-term although there is an objective to be producing 4,000 tonnes per year by 1990.

III REGULATIONS

The regulations in France for the use of plant and novel proteins in food are quite restrictive.

In the case of meat products, a level of 1.5% (dry basis) can be used as an ingredient without any label change being required and only declaring the protein source in the list of ingredients. Above 1.5% the product must be marketed under a different name.

As a major ingredient in foods, the maximum allowable addition is 30% and in these cases the name of the product must be modified so as to indicate the presence of vegetable protein. The name of the product must be changed in such a manner as to ensure the consumer is not misled.

No limits exist on the use of milk proteins in foods in France.

Baker's yeast and torula grown on sugars or starches is permitted in feed and food. Yeasts from other substrates are permitted and used in feed as are bacterial and fungal sources up to 15% but they are not allowed in food.

It would appear that rapeseed is accepted for food and feed purposes but this was not confirmed.

IV CONCLUSIONS

1. The existence of restrictive regulations and strong consumer resistance, particularly against extended products will result in very slow market growth for plant proteins in food in France.

2. The use of faba bean protein flour in bread is interesting and would seem to indicate that one should not be restrictively concerned with the potential problems of favism with this protein source.

3. France is strongly committed to protein self-sufficiency for food and feed within the next 10-15 years and there is intensive government planning and participation (through funding of programs) in programs to achieve this goal.

V RECOMMENDATIONS

1. Close communication should be maintained with French government and producer organizations involved with development of protein resources.

2. Opportunities may exist in France for Canadian technology in processing oilseeds and grains into protein products.

3. The development of faba bean protein should be closely followed to determine opportunities for potential Canadian applications, raw material markets and technology.

4. In view of problems with food uses emphasis in France should be on feed uses of Canadian protein sources, e.g. calf-milk replacers.

SELECTED STATISTICS ON RAW

MATERIAL SUPPLY IN FRANCE

(IMPORTS, IMPORTS FROM CANADA,
EXPORTS AND PRODUCTION)

FRANCE - IMPORTS 2/

('000 m.t.)

	1971	1972	1973	1974	1975	1976P
CEREALS						N/A
Wheat C/	218.4	273.1	323.4	195.3	433.1	
Wheat flour	10.3	11.6	20.4	19.6	20.6	
Oats	L.T.	0.2	0.3	0.3	1.3	
Barley	3.6	14.1	1.6	9.0	111.3	
Corn	437.2	250.8	367.0	238.2	531.3	
Rye	12.8	1.3	1.7	1.9	2.4	
Rice	100.9	127.2	153.9	153.6	150.5	
Cereals NES	17.5	26.3	28.8	28.9	36.7	
Total	800.7	704.6	897.1	646.8	1,287.2	
Barley Malt	0.6	3.6	0.5	0.8	4.0	N/A
OILSEEDS						N/A
Flaxseed A/	61.2	56.1	45.4	23.2	27.2	
Rapeseed	199.4	195.3	46.1	45.7	54.9	
Soybeans	479.3	458.4	507.8	564.0	416.2	
Sunflowerseed	17.1	53.5	3.5	46.9	22.2	
Palm nuts & kernels	40.9	20.7	18.2	17.2	12.5	
Groundnuts	224.5	145.5	242.9	236.9	199.3	
Oilseeds NES M/	0.6	-	-	-	-	
Total	1,023.0	929.5	895.9	933.9	732.3	

FRANCE - IMPORTS 2/

('000 m.t.)

	1971	1972	1973	1974	1975	1976P
OILS						N/A
Rapeseed A/	11.1	6.2	7.6	5.1	1.5	
Linseed	11.2	11.9	11.2	7.7	3.6	
Soybean	43.7	39.6	47.8	85.4	90.0	
Palm & Palm Kernel	70.0	73.2	79.7	74.5	71.6	
Sunflowerseed	75.1	62.5	88.1	108.8	90.5	
Groundnut	124.0	205.9	167.3	142.6	180.4	
Seed Oils NES Q/	36.9	37.7	42.4	25.7	21.8	
Total	372.0	437.0	444.1	449.8	459.4	
OILSEED CAKE & MEAL						N/A
Rapeseed	8.3	10.3	22.4	1.7	6.8	
Linseed	103.7	88.9	83.8	49.6	69.6	
Soybean	939.4	1,047.5	1,147.3	1,512.8	1,496.3	
Palm Kernel	11.9	11.5	19.0	6.2	5.5	
Sunflowerseed	49.4	45.9	55.1	18.7	14.0	
Cottonseed	48.2	35.1	50.2	17.6	5.7	
Groundnut	214.7	342.0	322.7	198.4	254.0	
Cake & Meal NES	27.8	23.6	24.2	19.7	16.9	
Total	1,403.4	1,604.8	1,724.7	1,824.7	1,869.8	

A/ Includes mustardseed
C/ Includes meslin
M/ Cottonseed only
Q/ Mainly olive
2/ Includes intra-EEC trade
L.T. Less than 50 metric tonnes

SOURCE: UN/FAO Trade Yearbook 1975

Market and Policy Analysis Division
Grain Marketing Office
Industry, Trade and Commerce.
April, 1977.

FRANCE - IMPORTS FROM CANADA

('000 m.t.)

	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76 P
CEREALS						
Wheat	51.1	16.3	10.5	36.7	50.5	29.0
Wheat Flour	D/	-	-	-	-	-
Oats	-	-	1.1	-	-	-
Barley	9.4	-	-	-	-	-
Buckwheat	-	-	0.6	0.2	-	-
Total	60.5	16.3	12.2	36.9	50.5	29.0
OILSEEDS						
Flaxseed	17.4	11.4	9.1	5.6	4.3	-
Rapeseed	101.4	174.1	45.1	13.5	-	-
Soybeans	-	-	-	0.1	0.4	0.1
Mustardseed		4.9	1.0	L.T.	0.3	0.3
Total	118.8	190.4	55.2	19.2	5.0	0.4

D/ Negligible amount

L.T. Less than 50 metric tonnes

P Preliminary

SOURCE: Grain Exports; Canadian Grain Commission

Market and Policy Analysis Division,
Grain Marketing Office,
Department of Industry, Trade and Commerce.
April, 1977.

FRANCE - EXPORTS 2/

('000 m.t.)

	1971	1972	1973	1974	1975 p	1976
CEREALS						N/A
Wheat C/	3,357.2	5,753.1	7,023.1	7,384.4	6,280.5	
Wheat Flour	804.9	728.7	970.8	1,120.0	1,121.4	
Oats	94.1	270.0	145.9	167.3	90.1	
Barley	2,715.3	3,695.2	4,137.2	4,315.0	2,587.1	
Corn	4,121.4	3,480.9	3,419.6	3,835.0	2,551.7	
Rye	26.6	62.2	78.9	71.6	29.7	
Rice	9.6	5.1	4.0	3.1	2.7	
Cereals NES H/	90.1	175.7	138.3	197.6	129.0	
Total	11,219.2	14,170.9	15,916.8	17,094.0	12,792.2	
OILSEEDS						N/A
Flaxseed	5.6	7.1	7.8	11.1	17.3	
Rapeseed A/	211.7	273.0	154.2	259.1	47.8	
Soybeans	L.T.	0.1	0.3	0.1	L.T.	
Sunflowerseed	28.3	12.0	23.1	15.9	8.3	
Groundnuts	1.0	1.0	1.5	1.2	1.2	
Oilseeds NES B/	1.4	L.T.	0.2	L.T.	L.T.	
Total	248.0	293.2	187.1	287.4	74.6	

FRANCE - EXPORTS 2/

('000 m.t.)

	1971	1972	1973	1974	1975 P	1976
OILS						N/A
Rapeseed A/	59.9	104.0	111.6	121.8	117.9	
Linseed	0.8	1.8	3.2	2.6	3.6	
Soybean	42.3	59.4	62.5	80.9	80.5	
Palm Kernel	2.8	1.6	2.7	2.8	1.2	
Sunflowerseed	7.2	7.0	7.8	8.8	19.8	
Groundnut	13.9	12.4	17.7	14.8	43.9	
Olive	11.1	21.1	19.6	4.6	3.3	
Seed Oils NES B/	6.2	7.6	4.5	6.0	8.1	
Total	144.2	214.9	229.6	242.3	278.3	
OILSEED CAKE & MEAL						N/A
Rapeseed A/	142.6	133.3	71.9	89.2	65.1	
Linseed	10.6	8.2	1.9	6.4	7.2	
Soybean	12.0	17.8	29.5	26.8	22.8	
Palm Kernel	-	0.4	0.5	1.8	0.2	
Sunflowerseed	0.7	1.2	2.9	10.5	6.2	
Cottonseed	0.2	L.T.	0.7	3.5	0.3	
Groundnut	7.4	6.1	26.0	17.9	13.6	
Cake & Meal NES	14.1	19.4	16.9	32.9	22.1	
Total	187.6	186.4	150.3	189.0	137.5	

A/ Includes mustardseed
B/ Mainly coconut
C/ Includes meslin
H/ Includes sorghum
L.T. Less than 50 metric tonnes
P - Preliminary
2/ Includes Intra-EEC trade

SOURCE: FAO Trade Yearbook

Market and Policy Analysis Division,
Grain Marketing Office,

Department of Industry, Trade and Commerce.
April, 1977.

FRANCE - PRODUCTION

('000 m.t.)

	1971	1972	1973	1974	1975 1/	1976 P
CEREALS						
Wheat	15,482	18,046	17,850	19,100	15,041	15,800
Oats	2,540	2,478	2,208	2,059	1,898	N/A
Barley	8,910	10,532	10,948	9,972	9,336	8,100
Corn	8,954	8,252	10,692	8,885	8,143	5,600 *
Sorghum	234	235	306	293	300	N/A
Rye	294	328	327	312	307	N/A
Rice	77	41	69	49	46	40 F
Buckwheat	19	15	14	15	13	N/A
Millet	1	1	2	2	2	N/A
Mixed Grain	633	663	629	583	593	N/A
Total	37,144	40,591	43,045	41,270	35,679	29,540 P
OILSEEDS						
Flaxseed	21.3	19.5	19.5	22.6	39.7	40.0 F
Rapeseed	650.0	713.0	653.0	685.0	532.0	490.0 *
Mustardseed	6.2	3.0 F	2.9	3.2	1.3	N/A
Sunflowerseed	68.0 R	71.0	84.0	73.0	110.0	57.0 *
Oilseeds NES 2/	0.1	1.6	2.2	7.7	5.0	N/A
Total	745.6	808.1	761.6	791.5	688.0	587.0 P
OILS						
Rapeseed	238.3	245.4	216.9	210.0	155.2	N/A
Linseed	21.8	23.3	19.5	11.0	15.1	N/A
Soybean	86.8	87.2	91.7	102.2	77.5	N/A
Palm Kernel	17.6	12.9	8.5	8.0	6.5	N/A
Sunflowerseed	12.1	36.4	38.2	43.1	28.0 R	N/A

FRANCE - PRODUCTION

('000 m.t.)

	1971	1972	1973	1974	1975 1/	1976 P
OILS						
Groundnut	103.2	50.2	110.0	101.8 R	93.7 P	105.0 E
Olive Oil	3.0 *	1.1 *	2.3 *	1.8 *	1.9 F	N/A
Seed Oils NES 3/	37.0	35.6	31.3	30.0	36.5	N/A
Total	519.8	492.1	518.4	507.9	414.4	105.0 P
OILSEED CAKE & MEAL						
Rapeseed	311.0	320.2	283.0	280.0	202.5 R	N/A
Linseed	38.0	39.4	33.5	19.0	26.6 R	N/A
Soybean	385.7	387.3	407.7	454.1	344.4	N/A
Palm Kernel	18.7	13.7	9.0	8.0	6.9	N/A
Sunflowerseed	13.2	37.7	40.4	46.0	30.1 R	N/A
Groundnut	111.9	54.4	119.3	110.4	101.6	115.0
Cake & Meal NES 3/	18.8	18.1	15.9	15.0	18.5	N/A
Total	897.3	870.8	908.8	932.5	730.6	115.0 P

* Unofficial figure
E Estimate
F FAO Estimate
N/A Not available
R Revised
1/ Where 1976 figures are not available, figures for 1975 are preliminary
2/ Mainly soybeans, poppyseed & hempseed
3/ Mainly coconut

SOURCE: FAO Production Yearbook
FAO Monthly Bulletin of Agricultural Economics & Statistics
Oil World Weekly

Market and Policy Analysis Division,
Grain Marketing Office.

Department of Industry, Trade and Commerce
April, 1977.

ENGLAND

I OVERVIEW

There is a great deal of activity and interest in the United Kingdom in the use of plant and other novel proteins in food products as well as in pet food and animal feeds. It is estimated that the U.K. market for plant protein in food and pet foods is approximately 50,000 tons on a hydrated basis and this is forecast to grow at 10% per annum. England is looked upon as the laboratory for Europe in the development of the vegetable protein industry.

The predominant reason behind this market in the U.K. is economic pressure on the consumers that is, in effect, forcing them to accept substitute food products which are available on a low cost basis. Little information was obtained on the various prices of vegetable proteins in the U.K. due to the competitiveness of the market. Despite this fact, by checking in supermarkets it was found that canned analog meat products were selling for approximately 30p. versus the all meat products at 45-50p. To date all of the products introduced in the retail market have been meat analogs (due to existent regulations). Also, they have been oriented to the lower end of the price scale where acceptance is greatest due to price differentials.

The predominant and, in fact, only vegetable protein in use in the U.K. today is soy and virtually all of the starting material is imported from the United States, be it raw beans or soy flour for further processing.

There is significant interest, however, in other vegetable protein sources and technologies. Particularly those which could be grown and produced to some extent in the U.K. These include such crops as rapeseed, fababeans, peas, lupins and sunflower.

The development and promulgation of regulations permitting the widespread use of vegetable proteins in the U.K. will constitute a major step in the enlargement of this market. The most significant factor to date is the use of vegetable protein in domestic school lunch programs at the rate of 10% substitution on a meal cycle, i.e. one meal out of 10 is a vegetable protein analog in schools utilizing plant protein.

Several companies have launched products on the retail market including Spillers, Cadbury, S. Daniels and Co. and Nestles. To date all products are based on extruded soy flour, concentrates or spun isolates and the marketing programs stress this point to the consumer.

There is no doubt that U.K. developments are being closely watched by other European countries to determine the acceptance of vegetable proteins and their economic effects and that this will influence the development of the total European market for vegetable proteins.

II PROTEIN SOURCES

1. Soy

Soy is the sole source of plant protein for use in human food with the exception of wheat gluten. Several retail products are available in the marketplace using either spun isolate or mixtures of textured concentrates and isolates. All of these products are sold either as analogs or as dry ingredients to be added by the consumer.

Although the market is growing quite rapidly, there is currently a large overcapacity for the production of soy protein products for food use in the U.K. All of the major American companies are active in the U.K. in addition to a number of English companies such as Spillers Limited, British Soya Products and Charles and Fargus. Therefore, competition is intensive and advertising plays a major role in market development.

In addition to food uses of soy it is also widely used in animal feeds and pet foods.

2. Faba beans

Faba beans are grown widely in the U.K. and have been extensively studied as a source of plant protein. Recently a process has been developed for production of a faba bean concentrate and isolate. This technology is available for commercialization and will depend on economic conditions.

3. Rapeseed

The production of rapeseed is increasing in England and it is viewed as the major alternative oilseed to soy. The U.K. produces about 100,000 m.t. of rapeseed and imports about 50,000 m.t., to produce approximately 50,000 m.t. of oil and 60,000 m.t. of meal.

Rapeseed meal is now a competitive animal feed, although the same factors as discussed for Sweden apply to the economics of rape as a source for human food ingredients. No rapeseed meal components are presently used as human food in the U.K. Industrial experimentation with available rapeseed protein indicate adverse factors with respect to color, flavour and protein solubility for human food use. No large-scale acceptability tests have been carried out.

The discussion of utilization of rapeseed as a source of protein ingredients for human use was more specific in the United Kingdom visits. Certainly rapeseed is looked to as a viable oilseed crop in the United Kingdom as in other northern European countries. Its present use is confined to oil for the vegetable oil industry and meal for animal feed. The same problems as recognized in other countries appear here. The United Kingdom has maintained close liaison with Sweden on the development of RPC (more so than with Canada) and has expressed opinions re needs for

- clearance as human food
- increased protein solubility
- improved color and flavour characteristics

They know it is amenable to texturization by processes now applied to soy, but that such products are not yet equal to soy in all characteristics. They feel confident that if clearance was obtained, development would proceed faster on the other aspects.

The utilization of rapeseed meal as animal feed is viewed with great importance in the United Kingdom. This produce is used at levels below those recommended by Canadian sources and this is complicated by the availability of low glucosinolate material. They noted the importance of more research on

- liver hemoragic syndrome in poultry
- fishy taint in eggs and poultry

and stressed the hope that Canada would concentrate on these areas in the future.

Little was learned regarding active R & D on rapeseed protein products in the United Kingdom. They seem to be looking to Canada, Sweden and France for the information, but they are keeping up with evaluation in food products as new materials appear.

4. Straw

The mission did not have any discussion on the use of straw as a substrate for protein production in the U.K. Nevertheless, it should be noted that there is activity in the U.K. on the upgrading of straw for use in animal feed through sodium hydroxide treatment. This is viewed as a means of reducing the requirement for the importation of high energy animal feeds and increasing the value of straw as a by-product of grain production.

5. Single Cell Protein

The U.K. is generally acknowledged as one of the world leaders in the development of single cell protein technology. In fact, BP was the first company in the world to build a plant for SCP production from oil for animal feeds. Also Rank-Hovis-McDougal developed new technology for mycelial protein production in starch substrates for use in food analogs. However, changing economics, government regulations and potential health hazards have all combined to reduce the potential current application of these technologies.

B.P. (Proteins) Ltd. do have pilot plants located at Grangemouth, U.K. and at Lavera, France for production of SCP. While commercial plants have not commenced operations for a diverse number of reasons, the potential still exists and this technology will be utilized in the future.

Another company, I.C.I. has announced its intentions to construct a 40,000 ton/year demonstration plant using Pseudomonous species bacteria on a methanol substrate.

The report of the Food Standards Committee on Novel Protein Foods, 1974, published by the Ministry of Agriculture, Fisheries and Food, provides a detailed discussion on the development and use of vegetable protein in foods in the U.K. and is recommended as a guide.

The recommendations of the Committee, which are under evaluation, were to allow up to 30% (rehydrated basis) substitution of meat with vegetable protein in standardized meat products. In addition the Committee recommended that vegetable protein foods could be used to replace up to 10% of the animal protein content on a menu cycle basis of meals served in institutions. This is currently interpreted as one meal out of 10 in school lunch programs where analogs are being used.

Vegetable protein analogs may be marketed in the U.K. at present subject to the general requirements of the U.K. Food and Drugs Act.

Vegetable proteins may be used as ingredients in other food products unless there are specific regulations prohibiting their addition. Also, standards of composition for foods must be adhered to.

In meat products, vegetable proteins can be added in addition to the minimum meat content as specified in the meat standards regulations but cannot be used to substitute for any of the required meat content.

In bread products, rice and soy flour can be added to a maximum of 2% of the flour. In greater quantities the label would have to be changed to show the presence of the additive, i.e. soy bread or bread with soy. There are no specific regulations on cakes, biscuits and other flour confectionary products.

Vegetable proteins are not permitted in cheese, cream, butter, chocolate products, honey and certain specified sugars.

The Ministry of Agriculture, Fisheries and Food has responsibility for regulations on use of vegetable proteins in foodstuffs in the U.K. They are currently formulating regulations which will cover vegetable protein ingredients and their nutritional composition. As well, the regulations will cover the labelling of protein ingredients and products and analogs. These regulations should be promulgated within the next few months.

In the case of extended meat products, it is unlikely regulations will be forthcoming before mid-1979 and this will prevent the development of this application of vegetable proteins.

The Ministry anticipates that the use of vegetable proteins as functional ingredients (i.e. at levels up to 3%) will fall outside of the extension regulations and will only require their listing on the label as ingredients.

IV CONCLUSIONS

1. The plant protein market in the U.K. is growing rapidly in both the industrial and retail sectors. This market expansion creates opportunities for both Canadian protein products and protein technologies. Although soy is the predominant current source, there is a demand and desire to diversify sources and develop proteins from crops which can be produced domestically.

2. The promulgation of food regulations covering usage of plant proteins as extenders as well as analogs will have a significant effect on the total available market and should result in new opportunities.

3. The U.K. is viewed by other EEC and European countries as a leader in use of plant proteins in food and may be considered as a template for use in these countries.

4. There is significant interest in the U.K. in new protein technologies and sources with particular emphasis on rapeseed and legumes.

5. Continuing economic pressures will result in continued market expansion creating opportunities for new ventures in which Canadian companies could participate.

V RECOMMENDATIONS

1. Canadian companies and government officials must initiate and maintain close communications with the oppropriate U.K. companies and government officials to optimize the opportunities for Canadian technology and products. Without this contact awareness will be lost.

2. The U.K. represents the best opportunity for Canadian participation in supply of technology and products. Seminars on Canadian capabilities in these areas should be conducted in the U.K., as well as participation in U.K. trade shows.

3. The potential of faba bean and other legumes as a source of plant protein for food should be reviewed from a Canadian viewpoint.

SELECTED STATISTICS ON RAW MATERIAL SUPPLY IN ENGLAND

(IMPORTS, IMPORTS FROM CANADA, EXPORTS AND PRODUCTION)

UNITED KINGDOM - IMPORTS [2/]

('000 m.t.)

	1971	1972	1973	1974	1975 [1/]	1976 [P]
CEREALS						N/A
Wheat [C/]	4,605.9	4,191.1	3,779.2	2,866.7	3,629.6	
Wheat Flour	73.9	65.8	18.4	6.2	3.6	
Oats	19.3	25.4	8.0	25.5	28.8	
Barley		740.4	291.5	811.4	502.0	
Corn	2,957.6	3,144.1	3,389.6	3,272.0	3,029.0	
Rye	24.5	43.1	46.1	17.6	33.2	
Rice	147.5	128.8	142.1	128.9	138.1	
Cereals NES	126.9	171.5	99.7	448.8	494.5	
Total	9,040.6	8,510.2	7,774.6	7,577.1	7,858.8	
OILSEEDS						N/A
Flaxseed [A/]	66.0	62.7	59.4	46.2	30.4	
Rapeseed [A/]	65.1	105.1	94.6	68.8	47.8	
Soybeans	306.5	537.7	779.4	803.6	754.0	
Palm Nuts & Kernels	48.6	28.1	34.9	55.3	74.7	
Groundnuts	50.2	63.3	74.0	64.9	71.7	
Oilseeds NES [M/]	-	0.1	-	-	-	
Total	536.4	797.0	1,042.3	1,038.8	978.6	

UNITED KINGDOM - IMPORTS [2/]

('000 m.t.)

	1971	1972	1973	1974	1975[1/]	1976[P]
OILS						N/A
Rapeseed [A/]	5.9	8.7	13.1	10.8	7.4	
Linseed	39.6	33.0	26.0	13.2	12.3	
Soybean	90.7	62.8	13.5	39.6	29.1	
Palm & Kernel	259.7	266.6	317.5	279.8	270.1	
Sunflowerseed	23.9	28.8	21.8	18.1	6.9	
Cottonseed	34.7	30.0	27.3	20.9	7.8	
Seed Oil NES [N/]	3.2	3.0	3.4	2.4	1.8	
Total	525.5	494.1	497.4	421.1	364.2	
OILSEED CAKE & MEAL						N/A
Rapeseed [A/]	96.3	95.9	90.8	52.2	48.6	
Linseed	1.6	2.2	0.4	-	-	
Soybean	318.8	220.6	201.0	290.2	250.4	
Sunflowerseed	37.9	28.0	30.1	11.0	10.7	
Cottonseed	109.1	97.8	180.3	68.5	34.7	
Groundnut	292.5	297.6	317.6	161.0	211.3	
Cake & Meal NES	26.4	20.1	44.7	60.6	72.4	
Total	882.6	762.2	864.9	645.5	628.1	

A/ Includes mustardseed
C/ Includes meslin
M/ Cottonseed only
N/ Olive only
1/ Where figures for 1976 are not available, figures for 1975 are preliminary
2/ Includes Intra-EEC trade

SOURCE: FAO Production Yearbook

UNITED KINGDOM - IMPORTS FROM CANADA

('000 m.t.)

	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76[P]
CEREALS						
Wheat	1,757.1	1,282.7	1,186.5	1,238.2	1,567.0	1,189.5
Wheat Flour	56.7	45.9	32.8	14.9	4.2	4.7
Oats	0.5	5.5	1.9	-	3.2	-
Barley	642.3	616.7	238.5	39.8	30.8	57.7
Rye	22.5	31.3	13.2	6.1	6.9	10.9
Buckwheat	0.1	L.T.	L.T.	L.T.	L.T.	-
Total	2,479.2	1,982.1	1,472.9	1,299.0	1,612.1	1,262.8
Barley Malt	7.7	3.9	3.1	6.9	2.4	2.0
OILSEEDS						
Flaxseed	47.7	48.7	47.8	42.8	24.2	9.4
Rapeseed	6.8	17.0	3.0	-	4.6	3.3
Soybeans	18.7	36.1	26.4	19.4	L.T.	0.1
Mustardseed	0.1	0.8	0.5	L.T.	1.1	0.8
Sunflowerseed	L.T.	L.T.	L.T.	L.T.	N/A	-
Total	73.3	102.6	77.7	62.2	29.9	13.6

UNITED KINGDOM - IMPORTS FROM CANADA

('000 m.t.)

	1971	1972	1973	1974	1975	1976P
OILS						
Rapeseed	N/A	N/A	1.2	1.2	N/A	-
Linseed [3/]	11.3	13.6	8.9	2.4	0.8	0.3
Seed Oils NES	3.8	4.4	12.1	N/A	N/A	-
Total	15.1	18.0	22.2	3.6	0.8	0.3P
OILSEED CAKE & MEAL					N/A	N/A
Rapeseed	N/A	N/A	11.6	7.6		
Linseed	2.3	4.8	2.3	N/A		
Soybean	120.2	86.7	94.9	102.0		
Cake & Meal NES	6.6	33.8	N/A	N/A		
Total	129.1	125.3	108.8	109.6		

N/A Not Available
P Preliminary
L.T. Less than 50 metric tonnes
3/ Based on a crop year

SOURCE: Statistical Handbook, Canada Grains Council.
Grain Exports, Canadian Grain Commission.

UNITED KINGDOM - EXPORTS 2/

('000 m.t.)

	1971	1972	1973	1974	1975	1976 P
CEREALS						N/A
Wheat c/	9.3	12.1	10.0	2.1	216.5	
Wheat Flour	6.8	5.4	16.2	36.1	27.2	
Oats	12.1	6.2	39.1	12.7	4.3	
Barley	71.8	51.8	268.8	163.3	1,068.0	
Corn	14.5	4.1	14.5	19.5	64.9	
Rye	L.T.	L.T.	2.0	0.1	1.5	
Rice	1.8	2.4	1.4	1.3	1.2	
Cereals NES	2.0	0.3	3.4	2.3	27.5	
Total	118.3	82.3	355.4	237.4	1,411.1	
OILSEEDS						N/A
Rapeseed	1.8	1.2	2.1	6.1	1.9	
Soybean	0.4	0.1	0.8	0.2	0.8	
Paln nuts & kernels	0.1	L.T.	0.5	1.9	1.1	
Groundnuts	1.8	3.9	3.4	3.4	2.2	
Oilseeds NES G/	0.1	0.2	L.T.	L.T.	L.T.	
Total	4.2	5.4	6.8	11.6	6.0	
OILS						N/A
Rapeseed A/	0.4	0.2	0.1	0.3	0.3	
Linseed	3.7	3.7	3.5	3.6	2.3	
Soybean	0.3	0.1	0.7	1.0	3.6	

UNITED KINGDOM - EXPORTS 2/

('000 m.t.)

	1971	1972	1973	1974	1975	1976P
OILS						
Palm & Kernel	0.3	3.2	1.1	1.8	3.0	
Cottonseed	0.5	L.T.	L.T.	0.1	L.T.	
Groundnut	0.4	0.3	0.8	3.2	0.7	
Seed Oils NES	1.1	2.6	1.7	1.9	0.9	
Total	6.7	10.6	7.9	11.9	10.8	
OIL CAKE & MEAL						N/A
Soybean	0.9	25.0	44.8	20.0	58.2	
Cottonseed	0.1	0.5	0.6	0.5	0.4	
Groundnut	0.1	1.0	1.6	0.7	0.6	
Cake & Meal NES J/	0.3	0.7	0.2	2.0	1.6	
Total	1.4	27.2	47.2	23.2	60.8	

A/ Includes mustardseed
C/ Includes meslin
J/ Includes rapeseed and linseed
G/ Includes flaxseed and cottonseed
2/ Includes intra-EEC trade

SOURCE: FAO Trade Yearbook

Market and Policy Analysis Division
Grain Marketing Office
Department of Industry, Trade and Commerce
April, 1977.

UNITED KINGDOM - PRODUCTION

('000 m.t.)

	1971	1972	1973	1974	1975 1/	1976 P
CEREALS						
Wheat	4,817	4,782	5,005	6,130	3,338	5,125
Oats	1,364	1,254	1,084	959	821	N/A
Barley	8,565	9,251	9,013	9,133	8,442	8,100*
Rye	18	19	16	14	15	N/A
Mixed Grain	206	221	192	150	126	N/A
Total	14,970	15,527	15,310	16,386	13,842	13,225 P
OILSEEDS						
Rapeseed	10	14*	30	56	61	120*

	1971	1972	1973	1974	1975 P	1976 E
OILS						
Rapeseed	29.5	44.7	47.2	45.6	43.6	N/A
Linseed	23.9	22.4	19.6	17.9	10.6	N/A
Soybean	45.6	83.0	128.3	137.0	126.9	195 E
Palm Kernel	20.7	16.5	13.6	20.8 E	31.0	N/A
Groundnut	-	-	-	-	2.4	-
Seed Oils NES 2/	35.2	32.3	36.5	27.9 E	22.1	14 3/
Total	154.9	198.9	245.2	249.2	236.6 P	209.0 E

UNITED KINGDOM - PRODUCTION

('000 m.t.)

	1971	1972	1973	1974	1975 P	1976 E
OILSEED CAKE & MEAL						
Rapeseed	42E	62	65	59P	56	N/A
Linseed	41E	30	35	31	19	N/A
Soybean	210E	377	588	608	574	883
Palm Kernel	23E	18	15P	21P	N/A	N/A
Cake & Meal NES 3/	11	14E	12	12	9	7
Total	327	511	715	731	658	890E

* Unofficial figure
E Estimate
P Preliminary
N/A Not Available
1/ Where figures for 1976 are not available, figures for 1975 are preliminary
2/ Mainly coconut and castor
3/ Coconut only

SOURCE: FAO Production Yearbook
FAO Monthly Bulletin of Agricultural Economics & Statistics.
Oil World Weekly

Market and Policy Analysis Division,
Grain Marketing Office,
Department of Industry, Trade and Commerce,
April, 1977.

THE UNITED STATES OF AMERICA

THE UNITED STATES OF AMERICA

INTRODUCTION

The Canadian Government - Industry Technical Mission on plant and novel proteins to the United States of America was carried out between April 25 and May 13, 1977. Thirteen industrial firms with a predominant emphasis on textured vegetable protein manufacturers, five United States Department of Agriculture research centers and two academic institutions were visited. All organizations visited were most cooperative in discussing the factors involved in the production, processing and marketing of plant and novel proteins as the officials of these organizations were assured that their names and their companies' strategy or plans would not be quoted in the report.

Information on Canadian production, processing and use of Canadian plant proteins, particularly rapeseed and field peas, was made available to the persons contacted.

SUMMARY

Soybean protein completely dominates the U.S. plant protein market, notwithstanding persisting flavor and flatulence problems. Cottonseed and peanut protein are some years away from continuing commercial production, while academic interest only is shown in sunflower and safflower development. Expanded interest is evident in wheat gluten production based on use in bakery products, meat fabrications and pet foods. A defatted corn germ flour may satisfy a market for new applications. "Natural" fibres are being exploited to meet significant market requirements. The pulses are not perceived at present as a viable source for plant protein processing. Food yeasts are being used as flavor enhancers or modifiers but other single cell protein development has elicited only academic interest.

The general market outlook for plant proteins is improving although the growth rate will be more conservative than was forecast in the early 1970's. Continued market penetration will be based on use as a functional ingredient or as a substitute for higher priced animal proteins. Meat extension provides the largest market for plant protein and, with estimated plant over-capacity between 200 and 500% for textured protein, the market is extremely competitive. Blends of soy and whey are penetrating deeply into the market previously held by non-fat dry milk solids.

The major constraints to increased market development for plant protein involve government regulations, resistance to change in dietary habits, price relationships with animal protein and quality problems of soy.

TABLE OF PRIORITIES

The major raw materials of interest for protein ingredient production in the United States would be dominated overwhelmingly by soy. Several other raw materials would be aggregated as a second and considerably less priority. These raw materials are cottonseed, peanut, wheat and corn. A third priority would be food yeasts.

1. Soy - Predominant
2. Cottonseed
   Peanut
   Wheat
   Corn
3. Food Yeasts

ORGANIZATIONS CONTACTED

A.E. Staley Manufacturing Co.,
North 22nd Street,
Decatur, Illinois. (217-423-4411)

Archer-Daniels-Midland Co.,
4666 Faries Parkway,
Decatur, Illinois. (217-424-5200)

Amoco Foods Co.,
Warrenville Road and Mill Street,
Naperville, Illinois. (312-420-5292)

Cargill, Inc.,
P.O. Box 9300,
Minneapolis, Minnesota.

Far-Mar-Co., Inc.,
960 North Halstead Street,
Hutchinson, Kansas. (316-663-5711)

General Mills, Inc.,
9000 Plymouth Avenue, North,
Minneapolis, Minnesota. (612-540-2829)

Gold Kist Research Center,
2230 Industrial Road,
Lithoinia, Georgia.

Grain Processing Corp.,
1600 Oregon Street,
Muscatine, Iowa. (319-264-4248)

Griffith Laboratories, Inc.,
12200 South Central Avenue,
Alsip, Illinois. (312-371-0900)

Massachusetts Institute of Technology,
International Nutrition Planning Program,
18 Vassar Street,
Cambridge, Massachusetts. (617-253-3131)

Miles Laboratories, Inc.,
1127 Myrtle Street,
Elkhart, Indiana. (219-264-8870)

Nabisco, Inc.,
East Hanover, New Jersey. (201-264-0500)

Pillsbury Co.,
311 Second Street, N.E.,
Minneapolis, Minnesota. (612-330-4797)

Ralston Purina Co.,
900 Chouteau Street,
St. Louis, Missouri. (314-982-3167)

Texas A. & M. University,
Food Protein R. & D. Center,
College Station, Texas.

U.S. Department of Agriculture,
Grain Marketing Research Center,
Manhatten, Kansas. (913-539-9141)

U.S. Department of Agriculture,
Northern Regional Research Center,
1815 North University Avenue,
Peoria, Illinois. (309-685-4011)

U.S. Department of Agriculture,
Richard B. Russell Agricultural Research Center,
P.O. Box 5677,
Athens, Georgia.

U.S. Department of Agriculture,
Southern Regional Research Center,
1100 Robert E. Lee Blvd.,
New Orleans, Louisiana. (504-589-7544)

U.S. Department of Agriculture,
Western Regional Research Center,
Albany, California. (415-486-3506)

THE UNITED STATES OF AMERICA

I OVERVIEW

Soybean protein, in its many forms, dominates the U.S. vegetable protein market at present and will probably continue to maintain its position. Constraints such as flatulence and beany flavor continue to impose restraints on wider acceptance of soy protein but technology is working to improve the situation. Success in these areas, coupled with gradually increasing yields per acre and excellent returns on the edible oil component, could ensure dominance ad infinitum.

There continues to be an interest in cottonseed protein for food uses with gossypol removed through processing or plant breeding but this is still some years from successful commercialization. There is a small production of edible peanut flour but any major development here is inhibited by the support price for peanuts and the need for primary processing that avoids the protein denaturation and color development associated with the present pre-press solvent extraction plants. For other oilseeds, such as sunflower and safflower, there is academic interest but nothing imminent in commercial development. There is mild interest in the state of Canadian development of rapeseed protein as a food ingredient, primarily because of its reported high nutritional value.

In the cereal proteins, there is considerable activity in wheat gluten production in the U.S. Present facilities are being expanded and new ones constructed, based on conventional processing of flour, and novel processes, starting with the whole wheat berry, are at the pilot or semi-production stage. This expansion is predicated on gluten use in the bakery trade, meat fabrications and pet foods and offsets present U.S. imports of gluten and increased demand anticipated with the advent of high fibre breads. Blends of gluten and soy protein to improve nutritional and/or functional characteristics are being considered but except for the meat analog area are of more academic than commercial interest at present.

Corn, as corn gluten, still finds its major outlet as animal feed, although a defatted corn germ flour may possibly have future useful applications. There is little that is new in cereal proteins aside from gluten. There is laboratory interest in oats, triticale and rye. Canadian wheat and corn starches cannot compete in the U.S. market.

"Natural" fibre sources such as cereal brans are, of course, receiving much attention and the overall impression is that the high fibre products, based on "natural" fibre sources are likely to assume and maintain a significant market position.

There does not appear to be any serious consideration being given to pulses, peas and beans as sources of processed plant protein.

Turning to other novel proteins, food yeasts are finding a slowly growing market as a useful ingredient in a variety of foods, primarily as a flavor enhancer or modifier although other functional characteristics are also claimed. The food yeasts are considered separated from other potential single cell protein (SCP) because of their established use and acceptance in food products. For SCP in general, it appears that their development for either feed or food in North America is some distance down the road because of availability of more economical and acceptable products from oilseeds and cereals. Development is more likely to take place in other countries where self-sufficiency and other political considerations override economic considerations.

Research is continuing on the potential of leaf proteins, primarily for feeds and to a lesser extent for foods. Increasing energy costs have a somewhat more negative impact on leaf processing than on other protein production, and it again appears likely that any developments may take place in those countries where lack of alternate supplies and different economic considerations make it more feasible.

The overall market outlook for vegetable proteins in the U.S. has gone from the extremely optimistic predictions of a decade ago to the rather dismal picture of the past two years, and now appears to be on the upswing again but with much more conservative estimates of the rate of growth. There is no need and therefore no market for processed vegetable protein simply as a source of protein in the American diet. In both the U.S. and Canada, the market for vegetable protein is as a functional ingredient in foods or as an economic substitute for existing high priced animal proteins. An example of the former is soy isolate as a binder in comminuted meat products and of the latter replacement of non-fat dry milk with a soy-whey blend in baking products.

The major area of commercial activity in volume terms in the U.S. for vegetable protein products still resides in meat extension with soy flours and concentrates and, in particular, for ground beef or hamburger. The entrance of the large commodity traders into this market and an estimated present over-capacity in the U.S. of anywhere from 200 to 500% for the production of textured soy protein has made this a very competitive commodity market. Even so, the need to give the consumer a 20% or 20 cent per pound reduction on an extended product means ground beef prices of well over $1.00 per pound and probably closer to $1.50 are required for this market to develop. Beef prices are expected to rise but whether they will go sufficiently high for a sufficient time to establish extended hamburger as a continuing major market is hard to estimate.

Soy flours, concentrates and isolates are finding broader ingredient applications across a wide spectrum of food and pet food products. Functional contribution, rather than nutritional impact, appears to be the catalyst for use, when accompanied by cost savings. Non-fat dry milk solids are a case in point, wherein blends of soy and whey are penetrating deeply into the market sector, formerly dominated by the now expensive non-fat dry milk solids.

In conclusion, the vegetable protein market in the U.S. appears to be on an upswing with a more moderate growth rate than anticipated a decade ago. The emphasis on isolates is changing the picture rapidly. Realizing the limited use for textured protein, isolates are being developed with specific functionality, and plans are being made to increase production of isolates quite substantially. Market development will be in the area of functional ingredients, i.e. it will be added to improve product qualities other than nutritional, or as substitutes for high cost animal proteins. The major potential area for substitution, extender for ground beef, will be very much a commodity market subject to all the vagaries of such markets.

The main restraints to a more rapid development of vegetable protein market are:

1. Government regulations, particularly regarding labelling;
2. Resistance to change in dietary habits;
3. Economics - price of soy relative to animal proteins; and
4. Quality problems such as flavor, texture, flatulence, etc., with soy.

Opinions varied as to the relative importance of these factors although number one frequently topped the list.

II PROTEIN SOURCES

Soybeans

The number one problem of soybeans is the beany flavor. Attempts are continuing to reduce the flavor level in soy protein products. Indications that oxidation products of phosphotidyl choline may be responsible for the bitter component in soy flavor have led to trials with mixed solvents, in particular a hexane-ethanol azeotrope, for oil extraction to remove these more polar lipids. This technology is proprietary and is unproven in large scale manufacture. The success and impact of this approach on the industry remains to be seen. Flavor reductions by careful handling or special treatment during preparation of textured products, concentrates and isolates are also claimed.

Substantial capital expenditures have been made and are planned for soy concentrate and isolate development. Special extrusion techniques have been developed which give more retort-stable textured products for use as extenders or analogs. Spun protein production has markedly declined and is likely to disappear from the American scene. In the case of extended products, spun protein will be replaced by the improved extruded products and in the analogs, by heat setting protein blends. Protein isolate production is increasing because of its low flavor, absences of flatulence-causing components and its greater versatility as a functional ingredient in a variety of food uses.

A recent development in extended products which is showing promise is the use of "pumping isolates". Soy isolate in brine solution is pumped between muscle layers in products such as uncured hams. The ham is then massaged by tumbling to distribute the soy protein and, on curing, provides a 20 to 25% gain in final weight of product that is very difficult to distinguish from regular ham. This process can also be applied to such products as turkey breasts, fish fillets or reformed beef products. Labelling regulations could pose a problem but names such as "composite ham product" are being proposed which could be quite acceptable to the consumer.

One area that is receiving considerable research attention is the production of cheese analogs. Such products are available commercially, based on caseinate, and at the laboratory level from soy isolates. Flavor becomes a major concern in a product as bland as processed cheese.

The newest entry in the soy derivatives area is a germinated or malted soy flour with improved organoleptics and the apparent ability to participate actively in doughing and baking processes.

There is evidence that nothing new has developed in the feed industry in the past few years. Feed formulation is a mature technology with soy meal firmly entrenched as the standard protein supplement and least-cost computer programs dictating the particular blend of ingredients to be used on any given day or week.

Soy protein has achieved a virtually unassailable position in the marketplace for use in value-added formulations. In the U.S., soy yields the most economic and versatile protein materials for formulation development work and has the added advantage that it has already been employed in food for decades without real problems.

Over the past four years, the soybean crush in the U.S. has varied between 700 million and 900 million bushels with a value of between $2.5 and $4.5 billion. In the fall of 1975, Merrill Lynch Pierce Fenner and Smith Incorporated published a Soy Protein Survey which indicated that the annual rate of soy protein production was as follows:

Commodity	Current Annual Rate of Production (in millions of pounds)	Price per Pound	$ Sales (in millions)	Production in Pounds of Soy Flour (in millions)
Soy Flour	585	$0.11	$64.4	585
Concentrates	88	0.29	25.5	110
Isolates	46	0.64	29.4	131
Textured	204			
- Extruded	177	0.17	30.1	177
- Spun	27	1.15	31.1	77
			$180.5	1,080

Since that time, excess production capacity has continued to exist in all areas except soy isolates.

The major anticipated market for textured soy protein as an extender for ground beef has not developed primarily because of low beef prices. The image of soy protein as an inferior substitute product and labelling regulations requiring its prominent display on the package mean that a substantial price incentive is required - about 20¢ per pound - for significant penetration of the market. Even with textured protein being a highly competitive commodity product, currently priced around 27¢ per pound, ground meat prices in excess of $1.00 per pound would be required at the processing level. Beef prices are expected to rise with estimates running as high as $2.00 per pound for ground beef before the end of 1978. These extremely high estimates possibly include some wishful thinking on the part of soy processors. Prices in the range of $1.50 per pound, if reached, would however encourage a good deal of soy use with two factors potentially favoring a more sustained market than during the 1973 surge in meat prices ($1.50 per pound ground beef given current soybean prices $6.00 - $8.00 per bushel). One factor is that texturizing technology has improved, giving better products, and the other is that a recent Gallup Poll reportedly shows better knowledge and better acceptance of soy protein on the part of consumers.

Extension of comminuted meat products faces the same economic factors as ground meat only the base price of emulsions for such products are much below that for ground beef, making a price differential of 20¢ at the retail level virtually impossible to meet. There is, however, a rapidly growing place for soy isolate at the 2 to 3% level in comminuted meat products as a functional binder giving an improved product. In the U.S., such additions only have to appear on the ingredient list but, in Canada, soy would have to appear as part of the product name.

In the field of meat analogs, good quality products are available from blended protein sources, soy caseinate and gluten but the cost of their fabrication is equal to or, in some cases, exceeds that of the meat product they simulate. Their market is based on health considerations, primarily the absences of cholesterol and animal fats, and represents a slowly growing market to a particular segment of the population. This also applies to the egg analog.

Another major market for soy protein has developed as a result of high prices for non-fat dry milk. Whey-soy protein blends either co-dried or dry mixed have reportedly replaced milk powder in up to 80% of the bakery trade and, with continuing high support prices for dry milk, further inroads by whey-soy blends can be expected.

There is very little interest in the fortification of breads, other bakery goods or pasta products with protein for the North American market. There is no protein shortage and therefore no need for such products. One exception is pasta products for the school lunch program. This latter is a very difficult market since each school unit purchases individually on an annual basis on a lowest bid system. It is a low margin, fragmented market that does not allow or encourage much in the way of product development whether in meat extenders, baked goods or pasta products.

The U.S. foreign aid program supplying CSM or WSB blended products continues but has reached a plateau. It, too, is supplied on a competitive bid system that allows little margin for expansion of the vegetable protein industry.

One of the major constraints to the greater use of plant proteins in foodstuffs is the innate resistance of people to changes in their dietary habits. Regardless of the conclusions reached in the Gallup Poll cited (sponsored by food protein interests), soy protein has developed the image of a cheap, inferior substitute for the more desirable animal proteins. This, coupled with regulations requiring the prominent displaying of the name soy along with imitation, substitute, etc., on the packaging, has resulted in poor consumer acceptance that is going to take time and considerable economic incentives to overcome.

Consumer education, government regulations and economics appear to be more constraining factors than lack of technology at present.

2. Cottonseed

Technology of cottonseed processing has been naturally targeted at gossypol removal from the meal and flour, with preparation of concentrates or isolates of secondary importance. The liquid cyclone process (LCP) for gland removal did offer potential, and still does, for production of an edible cottonseed flour. Unfortunately, the attempt at commercializing this process for food grade protein has been set back by engineering problems; it may be some years before further development takes place.

Some success has been achieved at the laboratory level on separating the glands in cottonseed meal by fine grinding and air classification. The main problem is grinding sufficiently fine without rupturing the glands.

The development of glandless varieties has reached the stage of commercial contracting with growers in particular locations. The major problems have been in obtaining fibre yield equivalent to the glanded types and the susceptibility of the glandless types to insect damage. The former has been nearly overcome and the latter circumvented as much as possible by contracting in areas less subject to insect problems. Initial production of glandless meal is intended for use in poultry rations but success of the program could provide cottonseed flour with less than 450 ppm gossypol for food uses.

Cottonseed is reportedly a product with mild flavor, no flatulence and useful functionality but the economics of the current technology is apparently not attractive. If they can be produced at competitive prices, food grade cottonseed flour, concentrate and isolate could find markets in many products currently utilizing soy products. Cottonseed flour, although not completely bland, has a less pronounced and much more acceptable flavor than soy flour which could give it some market advantage.

Glandless cottonseed meal would give it a much wider market in non-ruminant feeds. The potential of gossypol free cottonseed production is predicated on the economics of fibre production which, at this time, is not favorable. There is said to be extensive breeding effort concentrating on raising the fibre yield of gossypol free cultivars which, if successful, will open up a substantial protein source. This source will, however, have to find a place in the market based on its functionality or enter the textured market as a commodity.

Development of an economic gossypol free, or low gossypol, flour is the major constraint. The liquid cyclone process has not achieved commercial success and the gossypol free varieties are just being contract-produced on a trial basis.

3. Peanuts

Shelled peanuts are generally pre-pressed plus solvent extracted to produce oil and meal. The meal, under these conditions, is highly denaturated, dark colored and not suitable for recovery of edible protein. Only a small amount is specially processed to produce an edible protein flour. Methods have been developed for direct solvent extraction to give a superior product. An aqueous extraction process has been developed which gives oil and a protein concentrate or isolate directly. These newer processes have only been carried to the laboratory or pilot stage because present price support programs discourage processing of peanuts for edible protein.

Peanut flour with its mild flavor, high protein content and lack of flatulence-causing compounds is, in these regards, comparable to soy concentrate. From a consumer image and food efficacy point of view, there are distinct advantages in favor of peanut protein. In addition, peanut protein is claimed to have functional characteristics making it particularly well adapted to replacing milk proteins, including use in cheese analogs and in meat extension.

Economics is the main constraint. Price support programs designed to aid the peanut grower make it uneconomic to produce peanut protein in competition with soy. There is talk of introducing a two price system - one for peanuts for roasing, peanut butter, etc., and a lower price for peanuts for processing to oil and meal. Should peanuts for processing to edible protein come under the latter class, there could be significant developments in this area.

4. Other Oilseeds

Interest in other oilseeds such as sunflower, safflower, crambe and mustard for protein production is only at the laboratory level, with nothing of imminent commercial potential. Breeding successes in eliminating dehulling and chlorogenic acid problems are necessary to give impetus to development work on sunflowers.

5. Wheat

The new development here is the hydro-processing or wet processing of the whole wheat berry as opposed to starting with first clears flour. The new process claims a cleaner separation of the bran and germ from the endosperm, and subsequent producton of prime starch and vital gluten. These processes have reached the pilot or semi-production scale with full production scheduled in 18 months to

A second interesting point is the plant breeding program to develop special high protein wheats for the process which still maintain all the desired agronomic characteristics and gluten properties. Anticipated protein levels of over 20% would markedly improve the economics of the gluten starch separation.

The U.S. has been a large importer of wheat gluten but the domestic industry is closing this gap by expansion of present facilities and construction of new ones using conventional methods as well as the new process mentioned above.

Gluten goes primarily into the bakery trade and an increased market is expected here with the advent of high fibre products, particularly breads. The concensus is that high fibre products, based on natural fibre such as brans, are likely to take a significant and sustained place in the market.

Pet foods, particularly the intermediate moisture type, hydrolyzed vegetable protein and meat analogs are other gluten markets that are expanding. There is interest in gluten blends with soy protein to modify functional properties and improve amino acid balance but generally, such blends have not reached a commercial level.

Disposal of the starch by-product at an adequate price is the main constraint on gluten production. This is really an economic constraint since the wheat starch must compete with corn for the major starch markets. In at least one instance, wheat starch is being converted to neutral spirits.

6. Corn

The major development in corn has not been in the protein but in the sweetener area with the upsurge in production of fructose syrup. There is some production of edible corn germ flour both by expeller and solvent extraction and by enzyme heat deactivation. This material, with a protein content of 22-25%, has a PER of 2.3.

Corn germ flour has an acceptable flavor, no flatulence problem and sells at about half the price of soy flour. It has a commercial market, primarily in baked goods and cereal products.

The production of edible corn germ flour is limited by the present market for the product and the low margin of food over feed use.

7. Other Cereals

There is laboratory work on protein concentrates and isolates from oats, rye and triticale. Some, such as oats, show interesting properties but there is no indication of any immediate commercial interest.

8. Food Yeasts

The latest development is the continuous, aseptic production of torula from food grade ethyl alcohol as opposed to more conventional production of torula yeast from waste streams such as sulfite waste liquor. One advantage claimed by the new process is a lower flavor in the dried yeast for inclusion in rather bland foods.

The food yeasts are used as minor ingredients at the 0.1 to 3% level in a variety of foods. One major use is as a flavor enhancer or modifier and, for this and other functional effects, there appears to be a slowly growing market.

The content of RNA (ribonucleic acid) in yeast cells - around 9% - limits the amounts that can be used in food but in its current role as a minor ingredient, this is not a serious constraint. Price and time to demonstrate its effectiveness as an ingredient are probably the major constraints at present.

9. Single Cell Protein (SCP)

Food yeasts are excluded from this general class because of their long time use and acceptance in food items. For other single cell proteins, there is academic interest, but general agreement is that SCP in foods or feeds are quite away down the road in North America.

The availability and acceptability of proteins from oilseeds and cereals at economically attractive prices in North America make it more likely that SCP will develop in some other area first. A desire for self-sufficiency in feed protein and different economic constraints make SCP much more attractive in countries such as Japan, parts of Europe and East Bloc countries.

10. Industrial Use of Low Quality Grains

Work is in progress to produce anhydrous alcohol from low quality grain for blending with gasoline. The use of mouldy grain must be avoided to eliminate processing problems.

The State of Nebraska is said to support the concept of gasohol and may construct a plant to produce the material. Authorities have recommended the use of up to 10% of the volume of gasoline by anhydrous alcohol for the efficient functioning of the internal combustion engine. With the U.S. consuming some 115 billion gallons of gasoline per year, 10% would require the use of approximately 4 billion bushels of grain. The average production of grain in the U.S. has been between 12 and 15 billion bushels in the past three years. Such a use of the grain supplies would put a severe strain on animal production, to say nothing of effectively eliminating the U.S. as a major grain exporter.

III REGULATIONS

Soy Flour

In the United States, the permitted level of soy, mainly flour, in human foods is:

White bread	- up to 3%
Macaroni and noodles	- up to 12½% of wheat plus soy
Margarine	- up to 10% of the weight of the water as finely ground soybeans
Beef patties	- in amounts as binder or extender not conflicting with compositional characteristics
Frankfurters	- up to 3½% soy flour
Chili con carne	- up to 8% soy flour
Spaghetti and spaghetti products	- up to 12% soy flour in meat ball ingredient and meat balls must be 12% meat

Labelling requirements call for the main container panel to show clearly the presence of soy or other protein ingredient and where there is no Standard of Identity for a product, the name must be a truthful description. The word "imitation" must appear in the same size and style of letter of imitation products as the other parts of the name in the case of Standard of Identity products.

Soy Protein Concentrate

Up to 3½% total soy protein concentrate with an item of a Standard of Identity is permitted. Not all uses are required to be stated.

Textured Vegetable Protein

The requirement to use titanium dioxide food grade remains despite some misgivings by the public and food manufacturers. It appears that such a requirement will continue until other reasonably economic analytic methods to measure soy protein as an ingredient are defined and agreed upon. Difficulties in definitions, Standards of Identity and labelling regulations for the control of textured vegetable protein have delayed agreements in finalizing legislation. The general principle which has been accepted is that the nutritional value of the new product should be equal, or nearly equal, in nutritional value to the product which it simulates.

Labelling requirements establish that the specific ingredients of any textured vegetable product be in a form such as "Textured Vegetable Product" (soy flour, salt, caramel coloring). In meat products which contain large particle textured vegetable products in the final food product, only the declaration of "Textured Vegetable Product" is required provided the percentage of the large textured vegetable product does not exceed the following limits:

Product Type	Examples	%
High meat products (not sausage)	Meat loaves, meatballs, pizzas, Salisbury steak	5
Meat with gravy or sauce	Sliced beef and gravy	4
Sauce or gravy with meat	Chili, sauce with sliced meat or ground beef	3
Meat salads or hashes	Includes salads, hashes and spreads	3
Sauce or gravy with meat and vegetables	Meat pie, chili with beans or meat stew	2
Starch or beans with meat in sauce	Spaghetti, macaroni, beans with meats, ham, bacon, etc.	1
Meat sauce	Spaghetti or chili sauce with meat, hotdog sauce with meat	½

The quality and quantity of protein and the quantity of minerals and vitamins in sausage products must be within the 90-150% range of each of these nutritional properties in the sausage it resembles. In the case of "Patties with Meat", other ingredients of water, binder and/or extender materials and other by-products could be used but the amounts must be specified by percentage on the label. The protein quality and quantity again shall not be less than a minimum of 90% of the product it replaced, i.e. "Meat Patties".

Proposed Revised Regulations for Plant Protein

It is important and interesting to note that although U.S. authorities are proposing regulations for nutritional equivalency of plant protein products as Canadian authorities have done, there is a significant difference in the approach taken. In Canada, our regulations concern themselves with the food products as they are to be consumed and to a lesser extent with the actual protein ingredients utilized. In the United States, the proposed regulations deal solely with the plant protein ingredients to be added and set nutritional equivalency for the plant protein ingredients with casein depending upon the percentage of plant protein to be utilized. These differences are very important to Canadian manufacturers planning to participate in international marketing of their protein ingredients.

IV CONCLUSIONS

1. The U.S. requirement for plant protein is as a functional ingredient or replacement for high priced animal proteins. There is no requirement for processed plant protein simply as a nutritional item, but nutrition should not be ignored.

2. Soy completely dominates the U.S. plant protein market.

3. There is a 200-500% over-capacity to produce textured soy protein in the U.S. based on present markets.

4. Because of the U.S. processing over-capacity and U.S. tariffs, soy is a very real competitor to any plant protein production developed in Canada for export.

5. U.S. manufacturers consider that since Canadians have similar dietary habits to Americans, the potential Canadian market for plant protein products is comparable to the U.S. but the market is not nearly as developed in Canada.

6. Developing an alternative source to soy means either producing superior products or equivalent products at lower costs.

7. The present mood of health authorities in both the U.S. and Canada makes work on products that have any question regarding their safety a rather risky investment.

8. The expansion of gluten production in the U.S., a major export market for Canadian gluten, does not auger well for any expansion of Canadian wheat processing for the U.S. market.

V RECOMMENDATIONS

1. Since it seems unlikely that Canadians could produce equivalent products at lower costs, efforts at developing new crops for protein production should concentrate on superior functionality for particular applications.

2. Field peas, currently receiving attention as a potential Canadian protein source, will depend on developing markets where they have distinct advantages over soy and should not expect to enter the market as a commodity product against soy. Work in developing such special markets could benefit this potential industry.

3. Development of new uses and markets for Canadian gluten could assist in maintaining an established industry.

4. With the objective of penetrating the U.S. market, a feasible development in Canadian plant protein production would be an expansion of soy processing based on advanced technology.

VI. TRADE INFORMATION

USA - IMPORTS FROM CANADA
('000 m.t.)

	1973/74	1974/75	1975/76
CEREALS			
Wheat	76.5	0.2	21.6
Wheat flour	3.3	9.7	2.2
Oats	0.9	4.1	0.9
Barley	281.3	340.9	281.6
Rye	-	6.6	27.7
Buckwheat	3.1	2.2	0.9
Seed Wheat	2.5	1.5	0.4
Total	367.6	365.2	335.3
BARLEY MALT	14.6	33.5	43.0
OILSEEDS			
Flaxseed	8.5	-	4.9
Rapeseed	D/	-	-
Soybeans	L.T.	L.T.	0.4
Mustardseed	32.8	30.8	36.5
Total	41.3	30.8	41.8
OILS			
Rapeseed	N/A	1.1	1.9
Linseed	0.8	L.T.	D/
Total	0.8	1.1	1.9
OILSEED CAKE AND MEAL			
Rapeseed	N/A	2.0	0.1

D/ Negligible amount.

L.T. Less than 50 metric tons.

SOURCE: Grain Exports, Canadian Grain Commission.

USA - EXPORTS 1/

	Unit	1974	1975	1976
CEREALS				
Wheat	BU	1,104,601	999,236	975,039
Wheat Flour	CWT	15,583	13,158	16,065
Oats	BU	56,656	9,812	10,249
Oatmeal & Oats, Rolled	LB	9,635	20,659	5,121
Barley	BU	85,284	38,277	50,684
Rye	BU	26,840	3,957	164
Bulgur Wheat	LB	392,286	544,188	460,239
MALT & MALT FLOUR	LB	96,578	73,007	48,089
OILSEEDS				
Flaxseed	BU	632	371	409
Soybeans	BU	516,127	404,514	563,359
Soybean Flour, Meal, N/defatted	LB	273,451	213,776	171,143
Cottonseed	LB	98,162	14,051	142,879
Sunflowerseed	LB	137,209	344,213	879,262
OILS				
Soybean incl. hydrogenated	LB	1,212,404	1,360,437	1,124,354
Linseed incl. boiled	LB	134,438	134,264	20,891
Cottonseed incl. hydrogenated	LB	558,437	653,324	520,927
Peanut	LB	68,963	35,744	105,427
OILSEED CAKE AND MEAL				
Soybean	STN	5,133	4,503	5,360
Linseed	STN	123	135	119
Cottonseed	STN	75	14	33
MISCELLANEOUS				
Starches, NEC, Inulin	LB	34,760	16,793	15,460
Gluten and Gluten Flour	LB	12,685	1,721	1,336
Corn-Soy-Milk Blends	LB	165,136	204,446	191,503
Wheat-Flour-Soy Blends	LB	106,636	126,831	156,653
Vegetable Proteins	LB	6,284	11,874	54,076
Protein Substances incl. NEC	LB	8,829	2,127	2,075

1/ Calendar year.

SOURCE: U.S. Foreign Agricultural Trade Statistical Report - Fiscal Years 1974, 1975, 1976.

USA - PRODUCTION

('000 m.t.)

	1974	1975	1976 P/
CEREALS			
Wheat	48,884.2	58,100.6	58,442.9
Oats	8,909.0	9,545.6	8,164.0
Barley	6,621.3	8,358.9	8,213.9
Corn	219,737.3	250,679.3	264,314.3
Sorghum	22,307.9	26,136.8	24,983.9
Rye	490.1	454.0	423.4
Rice	5,098.1	5,804.7	5,307.9
Total	312,047.9	359,079.9	369,850.3
OILSEEDS			
Flaxseed	344.0	381.5	186.9
Soybeans	33,061.5	42,078.5	34,424.7
Sunflowerseed	291.0	356.5	335.7
Cottonseed	4,091.3	2,748.8	3,660.7
Groundnuts	1,663.6	1,749.5	1,694.4
Oilseeds NES J/	160.6 E/	180.6 F/	N/A
Total	39,612.0	47,495.4	40,302.4
OILS			
Linseed	137	115	124
Soybeans	7,006	5,501	6,889
Sunflowerseed	99	81	172
Cottonseed	735	668	484
Corn	236	216 P/	230 E/
Groundnut	149	157 P/	165 E/
Seed Oils NES J/	63	54	60
Total	8,425	6,792	8,124
OILSEED CAKE AND MEAL 1/			
Linseed	253	213	229 E/
Soybeans	31,467	24,707	30,943 E/
Sunflowerseed	111	92	173
Cottonseed	2,010	1,826	1,323 E/
Groundnut	179	189	198 E/
Total	34,020	27,027	32,866

E/ Estimate.
F/ FAO Estimate.
J/ Mainly safflowerseed.
P/ Preliminary.
1/ Meal production estimated on the basis of average extraction rates and crushings as indicated and therefore represent potential rather than actual meal production.

SOURCE: Statistical Handbook 1976, Canada Grains Council.
Annual Summary Crop Production, 1976 - USDA.
Oilseeds and Products, Foreign Agricultural Circular, No. 12, 1976.

VII TARIFF INFORMATION

USA TARIFF TABLE

TSUS	COMMODITY	RATE
132.55	Starches, NSFP	0.55¢/lb.
140.75	Soy flour and other vegetable materials reduced to flour	13% ad valorem
175.39	Rapeseed	1¢/lb.
175.48	Soybeans (certified seed)	1¢/lb.
175.49	Soybeans, NES	1¢/lb.
175.51	Sunflowerseed	0.4¢/lb.
176.46	Rapeseed Oil, edible, imported for manufacture of rubber substitutes or lubricating oil	0.45¢/lb.
176.47	Rapeseed Oil, edible, NES	2.4¢/lb.
179.10	Hydrogenated Oils, Fats and Greases	5¢/lb.
182.96	Wheat Gluten	10% ad valorem
182.98	Edible preparations not otherwise provided for, e.g. plant proteins	10% ad valorem
184.52	Vegetable Oilcake and Meal, NSFP	0.3¢/lb.

OVERALL RECOMMENDATIONS

1. The desire on the part of all countries visited to develop alternative plant protein sources, both domestically produced and imported, to soy indicates an opportunity for Canadian protein crops, products and technology. A coordinated developmental program to ensure participation in offshore markets should be undertaken by the federal government in cooperation with Canadian industry.

2. Particular emphasis must be placed on developing Canadian products that are competitive to soy protein for food and feed uses.

3. It must be realized that offshore markets constitute the largest opportunity for present and future development, as opposed to domestic requirements. Additional specific market intelligence (i.e. needs, end uses, food habits, etc.) is essential to the successful participation in these markets.

4. Additional technical and marketing missions abroad should be supported by the federal government to assist in the development of Canadian plant protein technology and products.

5. Specialized applications of plant protein constitute increasingly important markets and efforts must be made to identify these uses and promote Canadian developments in these areas.

6. Notwithstanding the requirement for alternate plant protein sources to soy, Canada should not ignore the possibility of utilizing soy technology as well as the opportunity to develop improved soy protein products.

In summary, although plant protein requirements are somewhat low at present, there is a good deal of development ongoing throughout the developed countries, and it is anticipated that the market for suitable plant protein will increase. Canada should, therefore, maintain an ongoing effort to develop both technology and products which will meet the demands of the market.