in its work on isolated soy protein and would like to talk about the market needs, functional property, and application.

ISOLATED SOY PROTEIN MADE BY FUJI OIL

Market Needs in Japan

Soy protein products, such as concentrate washed with $CaCl_2$ ("Ca-soy protenate including residue"), together with acid washed concentrate and alkali washed concentrate, had been used in the meat industry as fillers. However, these products did not have any functional properties. Their markets were limited. Isolated soy proteins met the needs better. Market needs at the time were:

(A.) Cost savings.
(B.) Smooth sol at lower temperature like meat protein and gelling at high temperature with viscoelasticity. This functional property is unique since it is required by Japanese customers, because Japanese traditional foods, like fish kamaboko, have the same property. Furthermore, pressed ham, tuna, and swordfish also have a good viscoelasticity and were popular among the Japanese. Also, there are many sausages made of fish meat. We Japanese people prefer good viscoelasticity in our foods.
(C.) Capacity to hold much water.
(D.) Soluble in fresh water and salt water and emulsifying ability.
(E.) Improvement in quality. Substantial amount of starch was available in the market; but, to improve the quality of the product, soy protein was admitted to meet the requirement of these processed foods as a quality improver.
(F.) Prevention of the separation of water between the casing and the meat. The good functional properties of soy protein products gradually have been well accepted among the customers. The price of the soy protein products is rising, but at present these are indispensable in our meat industry.

Required Properties of Soy Products

Required properties of soy products are as follows:

(A.) Good sol in salt water with low viscosity.
(B.) Strong gel at heating.
(C.) The same gel property at 75% moisture as tuna and swordfish.
(D.) Good and smooth texture with meat.
(E.) Strong binding with meat.
(F.) Good emulsifying property with fat.
(G.) Good water binding, especially on heating.
(H.) Good color of the product.
(I.) No soybean flavor. Good mouth feel.

Applications

Applications are listed below:

(A.) Binder of pressed ham. Soy protein is used to make the functional properties of these materials, like tuna, swordfish, rabbit, and calf meat.
(B.) Control of moisture in the product.
(C.) Use as the stabilizer of emulsion in sausage.
(D.) Binder for sausage.
(E.) Capacity to hold the water in the sausage.
(F.) Protein supplement. Mutton or horse meat are used in Japan, but these have a special taste that should be avoided by washing. This causes the lower protein content of the product. Then, soy protein as enrichment of protein is added in the finished product.
(G.) Use as some meat products by JAS standard.

Our company now has, not only isolated soy protein, but also the concentrate and textured vegetable proteins. We will exert our best effort to develop soy protein products in the future.

Soy Proteins in French Products with a Meat Base

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INTRODUCTION

Soybeans have been used in China for thousands of years and have been produced for some time in the U.S. for oil. Very early, American technology tried to utilize the high food nutritive value of its proteins by concentrating them, isolating them from oil cake, then giving them texture by means of extrusion or spinning. For a few years, protein derivatives of soy have offered a great variety of presentation, as well as organoleptic qualities which never have been explored.

Their incorporation in products with a meat base is commonly practiced in the U.S. and in several European countries. A low producing cost and interesting technological properties make soy proteins an advantageous additive for meat products. Actually, their incorporation diminishes the cost while stabilizing emulsions and holding water in the final product.

In France the use of soy proteins, even of vegetable proteins, in traditional meat products is prohibited by definition in the code of practice. This legislation limits their use in new products without an actual outlet at the consumption level or in tinned goods destined for exportation, such as corned beef. Dog and cat food should offer an important outlet for soy, but at present giblets and bones are more interesting, economically speaking. Nevertheless, there is one notable exception: a significant use of soy base products is possible in stuffings and in ravioli croquettes, in couscous, and in several other dishes.

Although we cannot be absolutely certain, the French importation of products containing soy additives in 1972 must have been ca. 1000-2000 tons. It is also possible to ascertain that there is an ever increasing pressure on the part of the French curing industry to allow the incorporation of vegetable proteins in animal products. This demand is generated, at present, by four positive factors: economy, technology, acceptability by the French consumer, and nutritive value.

ECONOMIC FACTORS

Soy meals with a 50% protein content are priced more or less at 2F/kg. In contrast, the price of soy derivative concentrates is much higher and increases according to the protein content: 6F/kg for the 70% concentrate and 8F/kg for a 90% isolate. Products obtained by thermoextrusion (TVP) are resold at 9F/kg. Because of the flavor component in meat only one-third can be replaced by the rehydrated TVP. Volume usually is tripled by hydration. The resultant meat product, therefore, costs 3F/kg on an average. The use

TABLE I

Composition of Frankfurter Sausages[a]

Ingredient	Control	1% Soy	2% Soy
Lean pork	25	22.5	20
Ground breast	25	25	25
Fat	25	26	26
Water (ice)	25	25.5	27
Promine D	0	1	2
Yield after cooking	94.8	94.0	94.2

[a]In percentage.

of TVP in the indicated ratio can reduce the price of chopped meat by ca. 25%.

We have had occasion, in incorporating promine D in manufacturing frankfurters and chopped steaks, to verify the economic gain which can be realized in this manner. The price, not counting labor, of frankfurters decreased from 8.65F/kg for the pure sample to 7.35F/kg for the sample with 2% dried promine D, representing a 15% saving. The same applied for manufacture of hamburger, where the addition of promine D permitted a saving of 17%.

French consumption of ground and cooked pork in the form of charcuterie, tinned products, and cooked dishes should reach a total of ca. 500,000 tons in 1973. Assuming the hypothesis that soy products will be incorporated in only 5% dry products, the French market would represent a potential outlet of 25,000 tons. The saving thus realized and its repercussions on the flow of meat products are far from negligible.

TECHNOLOGICAL FACTORS

To verify the technological advantages of the use of soy proteins, tests were undertaken in our laboratory. Many products obtained from Central Soya were used in varying concentrations in different meat products of the French type. The soy products tested were: (A.) censoy and grits–soy meal, lipidless, with 50% protein content, more or less gross in granulation; (B.) TSP–soy meal with 50% protein content, textured by thermoplastic extrusion; (C.) promosoy 20/60–concentrate with 71% protein content; and (D.) promine D-isolate of a protein concentration >90%.

Frozen chopped beefsteak (of the hamburger type) will assume an important spot in French meat consumption in the near future. The different tests we did practically permitted us to incorporate, in single or combined form, most of the products derived from soy. Both the pure control samples and the test samples were adjusted to a given water content composition and to a fat content of 10% wt. beef and pork. The cooking, which consisted of a simple grilling process, did not show any difference in yield between the control samples and the samples containing soy products.

On the contrary, the binding of the bits of meat and the firmness of the steaks was improved significantly through the addition of the soy isolate or concentrate. The grits or the TSP's can be used to replace the meat up to a 15% proportion, or 5% of the dry wt.

We could show, for example, some tests for incorporating promine D in a ratio of 1-2% which would correspond to the addition of lactoproteins now in use. Tables I, II, and III summarize the compositions and results obtained for frankfurters, sausage, and liver paste. We can see that if the addition of soy makes practically no change in the result of cooking refined emulsions, it can improve sausages from 74-84%. In general, the tests present a state of consistency, preservation, and emulsion which is significantly better than in the control samples.

TABLE II

Composition of Sausages[a]

Ingredient	Control	2.5% Soy
Chopped breast of pork	96.8	89.5
Water	3.2	8.0
Promine D	—	2.5
Yield after cooking	74	84.4

[a]In percentage.

All the products obtained in the course of our experience have been studied particularly from the point of view of their organoleptic qualities.

ACCEPTANCE BY THE FRENCH CONSUMER

A panel of tasters, selected at first from the personnel of our laboratory, compared products with and without the incorporated soy protein by means of a triangular test. The results were thereupon interpreted statistically.

Products of the luncheon meat type are not appreciated by the French consumer because they are considered too spongy and unpleasant in consistency. In general, the recognition of the control sample was not significant, since incorporation of soy proteins never exceeded 5% dry wt. Nevertheless, 10% grits or the TSP's gave a biscuit or flour taste to the chopped steaks which the tasters could recognize easily and did not like.

Thus, if the presence of soy products does not exceed 15% moist wt, the panel could not tell any difference from the control sample, and its criticisms mainly were based upon matters of seasoning or quantity of fat.

NUTRITIVE VALUE

Research is currently going on in France with animals and human beings to study the nutritive value of proteins of vegetable origin used as meat substitutes. R. Pion (personal communication) shows in tests done with rats that the apparent coefficients of digestive utilization of the organic matter of the samples with soy protein of 50-70% were slightly inferior to those of the isolates of 90% proteins. The difference is more marked in the coefficient of digestion of nitrogen. In fact, one sample of an isolate is 90% when the sample of 50-70% proteins lies between 76-84%.

In calculation by difference of the amino acid composition of the supplementary nitrogenated matter excreted by the two lots of animals, it was found that they were poor in cystine and histidine but rich in lysine. This composition is closer to that of bacteria than nitrogenated matter of endogenous origin. Pion, therefore, sets forth the hypothesis that the significant presence of polysaccharides in the soy meals facilitates the proliferation of microorganisms in the distal parts of the digestive tract. However, the majority of samples of soy products, conveniently supplemented with amino acids, caused an excellent growth rate of the rats.

TABLE III

Composition of Liver Paste[a]

Ingredient	Control	1% Soy
Liver	21	18
Fat	41	40
Whole eggs	4	3
Milk	34	38
Promine D	—	—
Yield after cooking	98.5	99

[a]In percentage.

Recently, Poullain, et al., (2) in the course of a study on the utilization of textured soy protein in human food, demonstrated that there is no significant difference in the nitrogen balance between a diet of meat or one comprising TVP. However, seven out of 10 subjects had a better protein balance during the period in which they had the meat diet.

In general soy products are well established as a source of protein which can replace, at least partially, meat in the human diet. Their incorporation in the manufacture of meat products of the French type can be beneficial from a technological and economical point of view, when the level of substitution in meat does not exceed 15%, to assure the preservation of its highly organoleptic attributes.

Their use in France is, however, singularly held back by a regulation problem. In fact, demonstrational tests and data on dosage of soy proteins in meat products were proposed in foreign countries, particularly in Germany. In general, these tests are based upon methods of electrophoresis or immunology. Frouin, et al., (3) then presented a simple method at the last European Meeting of Researchers for Meat.

It seems that the curing industry is favorably inclined to the utilization of soy proteins in meat products. A revision of the methods and norms of additions must be undertaken; and, at the moment, there are two different tendencies. The first concerns isolates of 90% proteins and concentrates of 70%, the utilization of which would be authorized as additives, at a dry percentage of ca. 1%, analogous to that which is, at present, permitted for lactoproteins. Beside meeting the additive requirement, this addition would comply with the law on labeling of October 1972 and would be mentioned under the category of vegetable protein binding agent.

The second possibility of incorporation concerns the textured proteins, be it by means of thermoplastic extrusion or by means of spinning. Since the taste is neutral or can be camouflaged by other flavors, the texture would permit more widespread use. The labeling of these products would describe clearly their composition by using terminology, such as fancy vegetable patty.

REFERENCES

1. Poullain, R., D. Guisard, and G. Debry, Nutr. Metabol. 14:298 (1972).
2. Frouin, A., C. Barraud, and D. Jondeau, Nineteenth European Meeting of Researchers for Meat, Paris, September 1973.

Soy Protein Concentrates and Isolates in Comminuted Meat Systems

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Although stable meat emulsions can be made using meat proteins alone, the variance in the quality and type of meat trimmings used in sausage making may lead to the breaking of the emulsion and excessive water and fat losses during cooking. The addition of soy proteins prevents such losses, and at the same time increases protein content and yield of the final product. Both soy protein isolate and soy protein concentrate are used for this purpose. In this paper their performance in coarsely and finely ground meat systems will be demonstrated by a number of practical examples.

SOY PROTEIN ISOLATE

Soluble soy protein isolates are used mainly for their emulsifying capability, their emulsion stabilizing effect, and their property of increasing viscosity and forming gels on heating. All these properties contribute to the formation of a stable meat emulsion and a high quality product without separation of fat or gelly. This is particularly important in products that require high processing temperatures.

An example is the use in cooked sausages; Table I shows the application in frankfurters. Two frankfurter formulations are given, one with a total meat protein content of 10% and another with a total meat protein content of 11%. In both cases, 1% of the meat protein is replaced by 2% soy protein isolate, and both are adjusted.

Table II relates the effects of isolated soy protein (ISP) on quality characteristics of the product. These data were obtained by subjecting the products to a trained taste panel. Flavor scores are based on a 7 point hedonic scale, with larger numbers indicating a more acceptable product. Soft/firm ratings also are based on a 7 point scale; the smaller numbers indicate a firmer product. Statistical evaluation of our taste panel procedure indicated that a differential of 0.4 units is necessary to obtain a significant

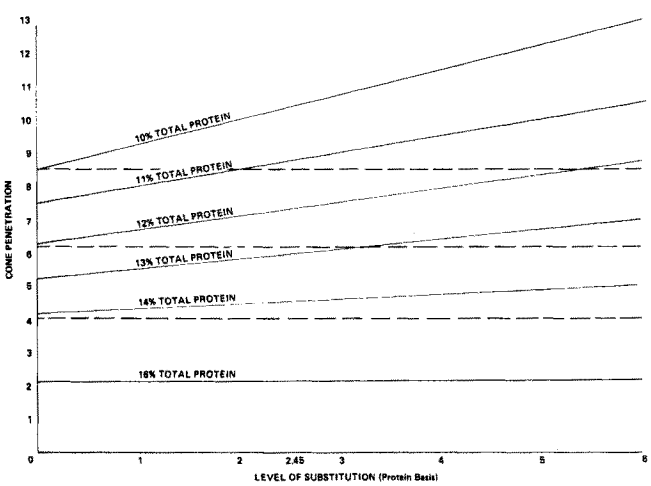

FIG. 1. Cone penetration vs. soy protein concentrate substitution.

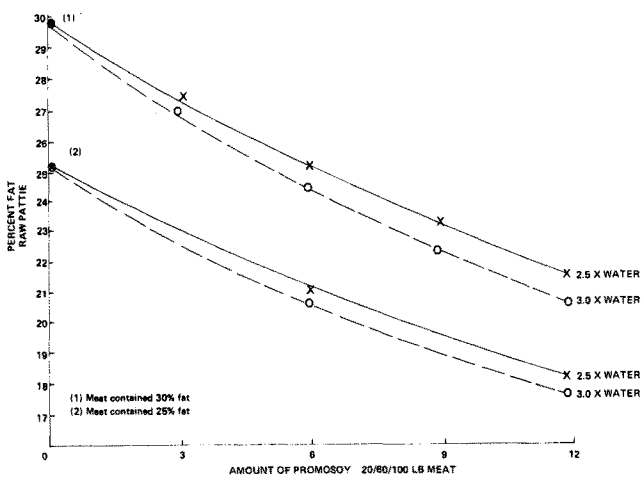

FIG. 2. Percentage fat in raw patties at various levels of soy protein concentrate and various levels of water addition. (Initial fat content of meat block 30 and 25%.)