Utilization of High Levels of Soy Protein in Comminuted Processed Meat Products

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Due to increased availability of several new proteinaceous additives (soy flours, concentrates, isolates, and extruded and spun textured soy), the meat processor has been faced with the onerous task of deciding which one of these protein products will best serve his purpose as a functional additive in a given meat system.

For more than a decade U.S. processors have introduced soy proteins in finely comminuted meat emulsion systems primarily at relatively low levels as an "insurance ingredient." In this type of usage the processor, for economic reasons, may use skeletal meats high in myosin content sparingly in his formulation. The reduction of myosin in the meat emulsion system may lead to an emulsion breakdown during the manufacturing cycle. This potential instability of the emulsion may result from the reduction of myosin since myosin is the primary constituent in the meat emulsion responsible for emulsifying and binding the fat.

Here is when the processor may choose to add, as an "insurance ingredient," 1-3.5% of a low cost, non-meat functional protein with emulsifying capacity. This additional emulsifying capacity will alleviate the stress on the system caused by the reduction of available myosin, thus ensuring a stable product with little or no fat migration during or after the cooking cycle.

Another way soy proteins can be advantageously utilized by a meat processor is as a direct replacement for high levels of meat protein. U.S. meat processors are beginning to recognize the potential of this type of utilization.

This second type of utilization, which requires new considerations with respect to nutritional and functional aspects, involves the replacement of high levels of available meat protein in a particular meat emulsion product by soy protein. In this situation it not only becomes obviously critical to use a soy product with a high degree of emulsifying capacity (comparable to the emulsifying capacity of the meat protein replaced), it also becomes a paramount consideration to use a soy product capable of imparting a characteristic meat-like texture. The possession of this important structure-forming property of the soy protein is not as important when the protein is used as a mere "insurance ingredient." In this latter type of usage, there is still enough functional meat protein available to impart the desirable meat-like textural structure of the final cooked emulsion product. When soy protein is used as a replacement for 40-75% of the available meat protein, there is an insufficient amount of available meat protein in the formulation to provide the characteristic textural properties. Although the soy protein may have emulsifying capacity, if it does not possess structure-forming properties, the final product will be unacceptable because the available proteins in the emulsion system will not result in a physically "desirable" structure, that is the texture which is characteristic of certain recognized food items. For example, in frankfurters this "desirable" texture may be one which provides a certain degree of resiliency (springiness) and firmness during mastication—two of the properties which constitute what is more commonly referred to as "bite."

It is my opinion that the traditional manner of evaluating soy proteins for their functionality in potential usages is insufficient. This "traditional" method essentially has consisted of determining the protein's nitrogen solubility index, and/or its emulsifying capacity, and/or its water holding capacity, and/or its rate of water absorption. For reasons previously mentioned, a more meaningful and valid approach in the evaluation and screening of soy proteins for potential uses in comminuted meat systems must include a method by which the protein's structure-forming properties can be studied, measured, and categorized.

Although the protein's water solubility, water absorption, and emulsifying properties, along with its gelling and coagulating properties, have been known to influence directly, or at least indirectly, the type of structure formation realized, there is no method which can be used to predict the type of textural structure the soy proteins will impart when incorporated into meat emulsion systems. This absence of an effective means to screen proteinaceous additives for their structure-forming ability has provided the main impetus for many workers to explore the feasibility of developing a method enabling this to be accomplished.

One of the methods employed by Armour to study and characterize the structure-forming ability of soy proteins has been referred to as the canned meatless emulsion test. This involves making a meatless emulsion in which the soy protein in question is incorporated into the system at a specific protein:water:fat ratio. The resultant emulsion is processed to temperatures similar to those the soy protein will ultimately be subjected to when finally used in the appropriate meat product.

After processing the canned emulsion, the resulting textural structure of the emulsion product is evaluated by use of the Instron Universal Testing Instrument in which a dual measurement of firmness and resiliency is utilized.

Work involving establishment of a statistical correlation between data from this model system test and tests in which the same proteinaceous additive is incorporated (at high protein replacement levels) in frankfurters is still in progress. Results to date are encouraging for they indicate that meatless emulsions containing non-meat proteins which impart low resiliency characteristics and/or low firmness characteristics will impart similar "poor" textural properties in the meat emulsion products containing the tested non-meat protein.

Soy Proteins in Meat-like Products in Japan

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INTRODUCTION

My assignment is to talk about spun and textured soy protein in Japan. However, I am not really in a good position to cover the whole area, and since my time is

limited, I shall talk about a general view of our situation in Japan.

SPUN SOY PROTEIN

Ca. 10 years ago, we started research work on utilization of soybean meal as new products for human consumption. In 1968 top management of our company decided to enter into the spun soy protein business and built a new, modern commercial plant which is the only commercial plant in Japan built to help avoid shortage of meat products in the future.

In the beginning we had many problems. These are discussed below.

Flavor. The product got beany flavor and sometimes gave some sense of a chemical smell during cooking.

Color. The color of the finished product was darker than the one from our pilot plant.

Chewiness. It was evaluated by the meat industry that our product was good for fish sausage, fish ham, and pressed ham, which are very important in Japan. However, it was found that chewing properties needed to be improved when soy protein was blended with authentic meat.

Processing cost. Many ingenious mechanical and chemical devices were made to lower the cost and to compete with prices of meat.

Labeling. Japanese consumers were critical of labeling of the processed food. The words like artificial meat, meat analogue, and imitation meat gave bad impressions in Japan. Meat processors, therefore, were reluctant to use spun soy protein, in spite of the fact that it was difficult to tell our finished products from authentic ones.

The problems of flavor, color, and chewiness are being improved.

Prices of food, especially meat and meat products, are rising rapidly in Japan. Recently, the meat processors tend to show much more interest in the spun soy protein, because of economical reasons, particularly after the world-wide movement to control whale hunting.

We organized a new society, Association of Vegetable Protein Products, of which Y. Sakaguchi, president, Nisshin Oil Mills, is chairman.

This organization is composed of representatives from more than 15 companies which deal with vegetable protein, including wheat protein. The objective of the Association is to promote the use of their new but unfamiliar products by: exchanging information, contacting government, standardizing specifications, and conducting joint educational campaigns.

I personally think highly of their activity, in spite of some big problems which still remain. At this point I want to thank the American Soybean Association in Japan for their kind assistance to the total industry.

Thus, the untiring efforts of the soy protein industry are improving the Japanese acceptance of soy protein products little by little. In addition, the economical environment appears to be changing in favor of the industry.

Our plant is operating at limited capacity to meet demands at higher and more favorable prices. However, I feel that it will still take some time before the business can get satisfactory returns. I am strongly convinced that we need to keep running the plant to help avoid the shortage of meat-like products in Japan in the future.

Meanwhile, I think there will be a new governmental role in the development of the products in terms of labeling, standardization, education, and so on, due to the food crisis all over the world.

I would like to outline briefly the serious difficulty we have encountered this year. It is the "soybean shock." U.S. soybeans have played an important role as the most reliable source for the Japanese food industry. We Japanese use soybeans in various food industries, as well as in the crushing industry.

The Japanese government, however, decided to abolish importing regulations for soybeans in 1961 and thereafter removed the import tariff on soybeans. This meant that in addition to domestic soybeans the U.S. soybean would be a reliable source for the food industry at present and in the future. The domestic soybean production decreased rapidly to ca. one-fifth during this decade, bringing it down to 100,000 M/tons a year. Therefore, the industrial structure of Japanese food manufacturers has been erected on the base of this particular situation. In addition, our soy protein business has relied 100% on U.S. soybeans for raw material. We are trying to lower the prices of our products but every cost tends to rise.

High prices for soybeans, which began last fall, followed by the export ban of U.S. soybeans this summer seriously hurt the industry in Japan. I personally could understand the situation; however, as a matter of fact, it is really difficult to manage the plant. I do hope the U.S. can be relied upon as a friendly, dependable supplier of soybeans to meet the demand of the present day, as well as the future.

TEXTURED VEGETABLE PROTEIN

Many of the crushing industries and food industries have their own textured soy protein products on the market. Besides the textured soy protein products, many starch companies have joined the business to utilize their by-product, wheat gluten, as a raw material, which might be less expensive than soy protein.

Those products come out in a dried or frozen form, depending upon the manufacturer. Our company supplies meat processors mainly with frozen textured soy protein for hamburger and some Chinese-Japanese meat products like gyoza, shumai, etc.

The competition on the market is keen, but I think the Japanese tend to eat more of such foods. The textured vegetable protein is getting a good reputation among the meat industry, because its price is competitive with fish meat and chicken.

The background of textured vegetable protein, such as labeling, education, and standardization, is more or less the same as for soybean spun fiber.

I would like to propose two questions. How and or by what means can we solve those problems? What is the best way for implementing education? Any comments on these matters would be appreciated.

The business of soy protein products for meat analogue is still new. It has to compete with wheat gluten products and also with fish and chicken products. Thereafter, it has to overcome the prejudice against meat analogue for it to enjoy a fruitful life in the future.

Sakaguchi in Tokyo has mentioned that the Japan Association of Vegetable Protein Products will by all means continue their activities in the upcoming years.

In addition to cooperation among the industry, guidance and support of the Japanese government certainly will be needed for the development of the products. I also would like to emphasize that more activities of the American Soybean Association will be most appreciated.

A willingness to face the present situations in a forward-looking, realistic way will lead our industry to a higher level of success.