Paper presented by C.W. Kolar.

Soya Products in Meat, Poultry and Seafood

D.H. WAGGLE, C.D. DECKER and C.W. KOLAR, Ralston Purina Company, Checkerboard Square, St. Louis, MO 63188

ABSTRACT

The soya protein industry has produced a wide variety of products with specific functionality properties to meet the targeted needs required by the food industry. It is important to recognize that certain of these soya protein products have and perform specific functions in these foods, such as texture forming, gelation, fat and water binding, and emulsification. They contribute to the nutritional and general overall eating quality. Also important is to recognize the limits of application of soya protein technology based on maintaining the traditional quality of the meat, poultry or seafood products. Today, unlike just a few years ago, soya protein products are able to contribute to, not just extend, high-quality meat, poultry and seafood products. The combination of resource efficiency of soya proteins and new technological advances is constantly expanding the long list of applications worldwide. The function of soy protein products in a variety of processed meat, poultry and seafood products is discussed.

INTRODUCTION

Soya protein products make a significant contribution to the world's food supply by replacing or extending more expensive animal proteins in meat, poultry and seafood applications. Soya proteins offer more than the obvious economic advantages that vegetable proteins have over animal proteins. Advances in soya ingredient technology have resulted in a variety of commercial products which are able to perform many of the same functions in foods as the animal proteins.

Two basic categories of soya protein utilization are (a) in traditional foods or (b) in new foods. The success of soya proteins in traditional foods is based on reformulating traditional products in such a manner that the traditional quality of the product is maintained. In new foods, where quality standards may not have been established, soya products must also contribute to the overall appeal of the product.

Basic Principles of Utilization

The world's food supply is composed primarily of traditional foods, defined as those which have been consumed long enough to have an established standard of quality by the consumer. Products purchased as traditional foods which do not deliver the anticipated quality are commercially unsuccessful. Soya products have been the most successful in traditional products as a partial replacement of the animal proteins when the traditional food characteristics and quality are unchanged. A portion of the animal proteins can be replaced or extended with soya proteins while maintaining traditional quality. In addition to extending the supply of meat, poultry, or fish proteins, the unit cost of the food will be lower. Changes in food consumption patterns which are strongly embedded in the culture of all societies require considerable time and education and are often unsuccessful. As opposed to a complete replacement, partially replaced meat, fish and poultry products more successfully compare to the traditional counterparts, thus allowing for the continuation of basic consumption patterns.

To be successful, traditional products must be reformulated with soya proteins so that the traditional quality is maintained. This means identical color, flavor, texture, odor, overall eating quality, nutrition and chemical composition. Successes in the soya ingredient industry have been where traditional quality is maintained.

Meat

A major application of soya protein products is in meats for which experience has shown that traditional quality must be maintained for consumer acceptance.

The intact muscle and comminuted products are the two principal forms in which meat is consumed. Soya protein products are being used in each form (1,2). Comminuted products were one of the first meat applications of soya protein products. Emulsified meats (frankfurters) and coarse-ground meats (ground beef patties) are two important classes of comminuted products. In emulsified meats, the nonmeat proteins must perform the same functions as the salt-soluble meat proteins. These functions include emulsification, gelation, fat and water binding. Depending on the protein ingredient used and the meat product, levels of usage range from 1 to 4% in emulsified meat products. In coarse-ground meats, texture-contributing properties are particularly important.

Whole cuts of meat can be augmented with soya protein using techniques for cured meat preparation (2). A slurry of isolated soya protein, water and salts can be injected into the muscle using a stitch pump, or the slurry can be massaged into the muscle using other forms of cured meat technology. As with emulsified meat products, the protein ingredient must perform the same functions as the salt-soluble proteins.

Emulsified meats serve as an example of how traditional products have been reformulated with soya products while maintaining the traditional quality. The successful introduction of a new protein ingredient into a traditional meat involves more than the simple introduction of a hydrated soy protein product at the expense of meat. Recently, Salavatulina et al. (3) reported the research required to successfully reformulate a traditional, emulsified meat with isolated soya protein, while maintaining the traditional quality.

The process first involves developing a model system which details the composition of the product and method of processing it. Methodology must also be developed to evaluate the finished product both objectively and subjectively. When the model system and evaluation methodology are available, a systematic study can be conducted to establish reformulation techniques that will allow for maximal meat replacement, while quality is unchanged. The reformulation must compensate for changes in color due to the removal of heme pigment, and change in flavor due to the reduction of meat content.

For any specific soya product, a maximal level of meat replacement is achieved, beyond which reformulations to improve color, texture and flavor do not maintain traditional quality. Under these conditions, an improved soya protein product is required to increase the level of meat replacement. Sofos et al. (4) indicated that it would be a major error to conclude that all soya products are alike. Mattil (5) also provided data showing significant differences among soya protein products. Soya ingredient manufacturers are continually conducting research to develop products with improved meat replacement capabilities.

Ground beef is a coarse-ground, comminuted product that also serves as an example of how a traditional product has been reformulated with soya proteins. Again, there are differences between soya products in this application, and the levels of successful replacement vary from one soya ingredient to the next (6–11).

Poultry

Unlike meats which are consumed in two basic forms, poultry products are consumed traditionally as whole cuts. Because the initial technology of using soya ingredients in meats revolved around comminuted products, it is not surprising that soya products were introduced into the poultry industry via new products rather than traditional products. In many cases, soya proteins are essential to the final quality of the product. For example, a soya protein fiber has been used to give structure to mechanically deboned poultry meat (12–17). Many new products, such as poultry rolls and poultry-based convenience foods contain this soya protein ingredient. Poultry breasts pumped with slurries of isolated soya protein, salts and flavors also are becoming popular. It has been reported that soya protein may be a necessary element of quality in these products (18).

Seafood

Japanese fish paste products are an example of soya products which have been used in traditional seafood products. Kamaboko, chikuwa and agekama are traditional, comminuted gel-like products that have been consumed in Japan for centuries. These products are based on a minced, fish-flesh ingredient called surimi. Systematic studies have been conducted to determine the amount of surimi which can be replaced with soy protein, while traditional quality is maintained (19–22). Japanese fish sausage, which also contains surimi, has been successfully reformulated with isolated soya protein.

Outside Japan, soya protein products are not being widely used in traditional seafood. The major application is in new products. Soo et al. (23) used a soya protein to improve the springiness of a fabricated shrimp patty. New products based on a soya protein fiber to replace crab in salads and cakes have been introduced into the U.S. markets. Bello and Pigott (24) used the fiber to enhance the binding and rehydration properties of a dried fish product for people in developing countries. However, the use of soya protein in seafood has lagged behind its use in meat. The increased application of soya protein products in seafood is expected as the world becomes more efficient at using its protein sources.

Maintenance of Traditional Quality

Results of a reformulation experiment will be used to illustrate the concept of maintaining traditional quality (Fig. 1).

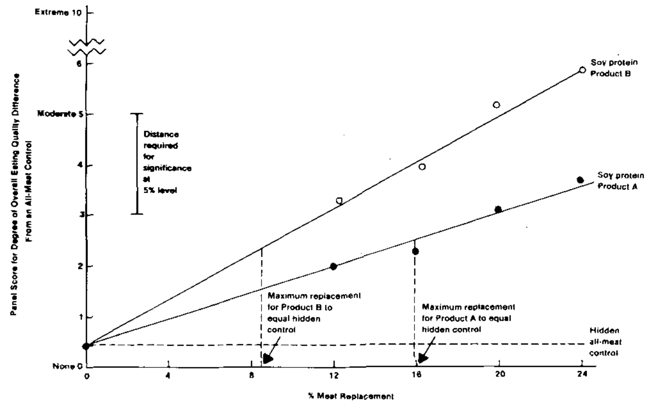

FIG. 1. A comparison between two soy protein products regarding the effects of meat replacement upon the overall eating quality difference from an all-meat control.

A bologna-type emulsified meat containing 90% lean beef, 65% lean pork, and pork backfat was reformulated with graded levels of a commercial soya protein product (A) such that the fat and protein contents of the final products were constant and equal to those of the all-meat control. Color of the reformulated products was held constant by using low levels of beef blood as a source of heme pigment. A similar series was prepared with another commercial soya protein product (B). A trained, 16-member panel compared the reformulations to the all-meat control for difference in color, flavor, odor, texture and overall eating quality. Products were presented to panelists using an incomplete block design that considered the effects due to days, panelists, level of meat replacement, ingredients and order of presentation. A maximum of three samples was presented at each evaluation period and each sample was compared to an identified, all-meat control for degree of difference using a scale from 0 (no difference) to 10 (extreme difference). An unidentified control was included among the samples being evaluated. A good linear relationship existed between the percentage of meat replacement and degree of overall quality difference for emulsified meats, prepared from both soy protein products A (R=0.997) and B (R=0.996). About 16% of the meat could be replaced with soya protein product A before the extended product became significantly different than the hidden all-meat control, whereas only 9% meat could be replaced with soya protein product B before the differences became significant. Because a color correction had been made, the differences were primarily due to flavor and texture. These data also indicate that all soya protein products are not the same with regard to their ability to maintain traditional quality.

Preference or acceptance testing is often used to evaluate products reformulated with soya ingredients, and it is not uncommon to find reports of reformulated products that are significantly preferred over the all-meat control. This type of testing misses the concept of maintaining traditional quality in which the goal is to be exactly like the control—not superior or inferior to the control. Difference testing can help avoid erroneous or misleading conclusions when maintaining traditional quality is of interest, and particularly when the tests are conducted by a culture or group of people that are different than the ones for which the information is intended.

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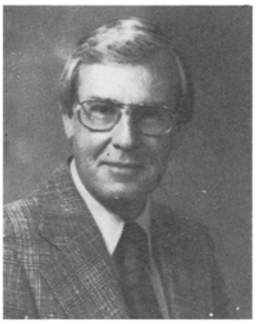

Paper presented by Hoover.

Soya Protein Products in Cereal Grain Foods

D.K. DUBOIS and **W.J. HOOVER**, American Institute of Baking,
1213 Bakers Way, Manhattan, KS 66502

ABSTRACT

The largest food usage of soya flour is in bakery products. The soya industry now supplies a wide range of products for the baking inudstry, and these products in turn offer a wide variety of functional uses in different bakery foods. Although the technology for soya use in bakery foods is well established and reasonably simple, the functional properties and flavor are continually being improved through major research efforts. The current status of the use of soya products in bakery foods is presented in this paper, and a look to some of the future uses including a major worldwide potential for fortification of cereal grain products is offered.

INTRODUCTION

Soya products, because of their unique functional and nutritional properties, have become major ingredients in many food systems. The use of soya protein as an ingredient, extender, or analog has spread to every category of foods, and consumption of edible soya protein in the U.S. has grown from less than 100 million lb/year in the early 1960s to over one billion lb/year in 1978 (1). New and improved processing techniques have been developed, resulting in products having a wide range of properties adaptable to various food systems. In addition to these functional properties, the excellent nutritional quality of soya protein has become of increasing importance in recent years.

One of the food categories in which the use of soya products is gaining wide acceptance is bakery foods; one source reported the sale of soya flour to the baking industry as more than 132 million lb in 1978. This paper will review soy products which have gained acceptance in bakery foods and the benefits gained from their use.

QUALITY FACTORS

Soya protein products, particularly flours for bakery food applications, are specified on the basis of protein content, fat content, protein solubility, urease activity, lipoxidase activity and granulation. Of these, protein solubility is the major factor affecting functionality.

Protein solubility is a measure of the percentage total protein soluble in water under controlled conditions, and is a measure of the degree of heat treatment to which the soya flake has been subjected. The protein solubility is closely related to functional properties for bakery food applications. Several methods are used to determine protein solubility, the main tests being Nitrogen Solubility Index (NSI), the Protein Dispersibility Index (PDI) and the Protein Solubility Index (PSI). Each test indicates the percentage of total soluble nitrogen in water and the range of values is 0-100%. A lightly toasted soya flour will have a rating of 60-80%, whereas a heavily toasted soya flour will rate 10-20%.

The enzyme activity of soya flour is related to protein solubility, in that the heat treatment destroys enzyme activity. The primary enzymes in soya flour are lipoxidase, urease, amylase, lipase and protease. Thus, if a lipoxidase active flour is desired, a relatively high PDI flour should be used.