Utilization of Vegetable Proteins in Meats of Large Cross Sectional Area

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ABSTRACT

Comminuted meat products such as luncheon meats, sausages, pate, etc, and whole meat cuts such as ham, corned beef, steaks, and roast are two principal forms in which meat is consumed. Soy protein products have been used in comminuted meat products for several years. New developments have made it possible to incorporate isolated soy protein into large pieces of muscle tissue. A brine containing isolated soy protein is injected or massaged into the muscle using cured meat technology. Alternately, the intact muscle pieces can be injected first with brine and then the protein incorporated by massaging or tumbling. This process can be used to increase yield 20-40% over the green weight. Product quality attributes include normal appearance, improved firmness and slicing characteristics over brine-cured hams, combined with less weepage under vacuum packaging.

INTRODUCTION

Vegetable proteins have been used in meat products for functional and economic reasons. Soy protein products were initially used in comminuted products such as sausages. The development of special isolated soy protein products and the refinement of cured meat technology has recently permitted use of isolated soy proteins in whole meat cuts or meats with large cross sectional areas.

Generally, cured meat products are prepared with a brine solution. The brine usually contains curing salts, phosphates, sugars, and flavorings. Special machinery is used to inject the brine directly into the muscle tissue to allow for fast and even distribution of the brine constituents. Using this machinery, it is now possible to incorporate isolated soy protein into whole cuts of meat which includes cured products such as hams, pork shoulders, pork loins, corned beef, and uncured products such as roast beef and poultry. The soy protein addition, while not reducing product quality, offers the advantage of reducing product cost while increasing the supply of these products.

CURRENT TECHNOLOGIES RELATED TO WHOLE CUTS OF MEAT

Currently, several meat products are prepared by the injection of brine into whole meat cuts to improve juiciness, taste, yield, and overall quality. The brine contains sodium chloride and in most cases curing salts such as nitrite, nitrate and ascorbate. These curing salts are required for the formation of the cured meat color and aid in protection against microbial spoilage. The brine may contain polyphosphates to help stabilize the product, particularly during heat processing. Sugar and flavorings are often included.

The brine may be prepared in a tank with a high speed mixer and injected into the pieces of meat with a multi-needle injector. Depending on the type of meat and the injection level, the meats will be massaged or tumbled with special machinery to facilitate diffusion of the salt and curing agents throughout the pieces of meat and to solubilize a sufficient quantity of meat protein to bind the pieces of meat together during cooking. The meat pieces move horizontally in a massager and vertically in a tumbler. The tumbler provides a higher level of energy input per unit time compared to the massager. After massaging or tumbling a resting period is often employed. The treated meats are put in molds, stuffed into casings, or canned. Next, they are heat processed to produce the final product.

INCORPORATION OF ISOLATED SOY PROTEIN IN WHOLE CUTS OF MEAT

Proteins employed in comminuted meat products must be excellent emulsifiers, stabilizers, and contribute to textural properties. Proteins used in meat products of large cross sectional area should have a low flavor profile, excellent nutritive quality, and the capability of being easily diffused throughout the muscle. The vegetable protein should be salt tolerant and contribute desired textural characteristics in the presence of salt, since the brines used to cure intact muscles contain high levels of salt. The protein product should have a high protein content in order to maintain the protein level of the finished product.

Isolated soy proteins function particularly well in this application. These proteins can be produced such that they are easily incorporated in brine systems and whole meat cuts. When the protein is uniformly distributed in the meat, quality properties of the finished product such as sliceability and reduced syneresis are enhanced.

Isolated soy proteins may be incorporated into whole cuts of meat by two methods: (a.) the injection method is based on the preparation of a protein brine which is subsequently injected into the meat cuts using standard injection procedures; (b.) the massaging-tumbling method is based on the preparation of a nonprotein brine which is injected into the meat followed by the addition of a protein slurry directly to the massager or tumbler. The details for each of these methods should be established by each manufacturer based on his formulation, equipment, and desired product characteristics.

The injection method involves preparation of a protein brine. The composition of this brine will depend on a number of factors such as type of product, pumping level, taste preferences, etc. Two examples of protein brine composition for use in cooked hams or shoulders are given in Table I.

The protein brine designed for 40% injection level contains polyphosphates. The other protein brine does not contain polyphosphates and is designed for a 30% injection level. The percentages of brine ingredients that will be present in the final meat products are also shown in Table I. The percentages are based on a 94% cook yield. Cook yield will vary depending on thermal processing equipment and methods employed.

The proper preparation of the protein brine is important

TABLE I

Typical Composition of Two Protein Brines Designed for 40% and 30% Injection Level in Hams

Ingredient	Injection level (40%)		Injection level (30%)	
	Composition (%)	Percent in finished product[a]	Composition (%)	Percent in finished product[a]
Water	79.6	17.8[b]	80.3	13.2[b]
Isolated soy protein	8.0	2.4	6.0	1.5
Salt	9.5	2.9	11.7	2.9
Polyphosphates	1.3	0.4	---	---
Sodium erythorbate	x[c]	x[c]	x[c]	x[c]
Sodium nitrite-nitrate	x[c]	x[c]	x[c]	x[c]
Sugar	1.6	0.5	2.0	0.5
	100.0	24.0	100.0	18.1

[a]Based on 94% cook yield.
[b]Means added water.
[c]Level normally used.

in the utilization of isolated soy protein in whole meat cuts. The protein must be thoroughly hydrated to ensure the preparation of a brine that is uniform, stable, and easily distributed throughout the pieces of meat.

The protein brine can be prepared using a tank equipped with a high speed mixer commonly used to prepare a standard brine. First, water of 5 C is metered into the tank. While the water is mixed vigorously, isolated soy protein is gradually added and mixing continued until the protein is thoroughly hydrated. The phosphates (if used) are added gradually and allowed to dissolve in the protein-water slurry. Salt and other ingredients are added and mixing continued until dissolved. After dissolving, the protein brine is ready for injection.

In recent years more sophisticated equipment has become available which allows the preparation of a protein brine in a short time and with excellent quality. The protein brine is prepared by a procedure similar to that described above. First, the protein is thoroughly hydrated, then polyphosphates are dissolved, followed by the addition of salt and other ingredients.

A properly prepared protein brine will have good physical stability without protein precipitation and can be stored for up to 48 hr provided the temperature is kept below 5 C to prevent microbial growth.

A certain amount of meat preparation is recommended prior to injection of the protein brine. The meat should be lean since the protein will not diffuse properly into fatty tissue. This may require trimming excess fat from the meat. The meat should also be boneless to allow proper processing in a massager or tumbler.

The injection of the protein brine is done with a standard multineedle injector. The injection level will depend on the type of product and on the wishes of the manufacturer, but will generally range from 15% to 50%. After protein brine injection, the product is massaged or tumbled following procedure developed for the specific product. The process cycle and duration will depend on a number of factors such as type of equipment, augmentation level, type of product, etc. During this process the meat proteins are extracted and together with the isolated soy protein will assure excellent binding between the pieces of meat as well as provide texture and stability to the finished product.

The final processing which usually includes stuffing, cooking, smoking, and packaging is essentially unchanged from methods used for standard products.

The injection method provides for fast distribution of the brine ingredients into the meat pieces. The system can be used for large pieces of meat and provides a reliable cure throughout the muslce.

The second method for extending whole cuts of meat is the massaging-tumbling method. The massaging-tumbling method is accomplished by first injecting a nonprotein brine in the meat cuts. Next, the meat is placed in a massager or tumbler, and the protein is added in hydrated form. A regular bowl cutter is used to hydrate the protein. The dispersion is normally prepared at about a 12.5% protein concentration. Higher concentrations may result in high viscosity or a protein gel which would be difficult to be properly absorbed by the meat pieces. In some instances, only low energy systems are available for producing the protein dispersion. In this case some of the sugars normally occuring in the brine formulation may be dry mixed with the protein to facilitate the preparation of the protein dispersion.

The massaging-tumbling method is quite simple and can easily be incorporated into a standard operation. This method would be especially appealing to ham processors artery-pumping their hams, since protein brines cannot be artery-pumped. As with the injection method, the finished product has an appearance and eating characteristics very similar to the traditional counterpart.

TYPICAL APPLICATIONS

Cooked hams and shoulders are very suitable for utilization of this process, since these products are traditionally injected with a brine during processing. This brine contains curing salts necessary for proper color formation and product stability. These products are well suited for extension with isolated soy proteins. Either the injection method or the massaging-tumbling method can be used. An augmentation of 10% to 15% over and above the traditional injection level can easily be obtained. This will result in a finished product containing 1% to 3% isolated soy protein. The isolated soy protein will contribute substantially to the stability of the cooked products.

Boneless pork loins are generally injected with 15-20% of brine-containing cure. Massaging or tumbling is not normally performed, and these meats are immediately cooked and/or smoked. Cooking losses are often as high as 15-18%. By injecting a protein brine and increasing the pumping level, one can substantially minimize the cooking losses without affecting the stability or the eating quality of the finished product. However, the loins injected with protein brine must be tumbled gently, preferably under vacuum, prior to cooking.

Another application of this technology is in show meat. Many traditional cooked sausages are manufactured by mixing pieces of meat into a meat emulsion followed by stuffing and cooking. These pieces of meat are called show meat, and are obtained by coarsely chopping or grinding lean meat. The show meat is the more expensive portion and can be extended 15% to 30% with isolated soy protein using the massaging method. In most cases a traditional

meat mixer can be substituted for the massager. Generally, the protein dispersion will be absorbed by the meat pieces in a shorter period of time than larger pieces of meat such as hams. The extended pieces of meat can be used immediately for mixing with the meat emulsion to produce an excellent cooked sausage containing show meat. Generally, salt and curing agents are used in the protein dispersion.

Corned beef is a cured and cooked beef product. It may be canned and sterilized. Corned beef can be prepared by the injection method, wherein a 30% pump is used with 8% isolated soy protein in the brine. Finished yield is 100% after water cooking, compared to only 75% yield obtained with standard products. The finished product is essentially unchanged in appearance and textural attributes from the traditional product.

Roast beef is augmented using the injection method. A brine containing 10% isolated soy protein, 5% salt and 85% water is injected at the 30% level. After massaging, the product is stuffed in plastic bags and water cooked to the desired internal temperature. Typically, a yield of 110% will be obtained. The finished product is excellent in quality and comparable to the standard roast beef.

Poultry products are successfully extended with isolated soy proteins. Either the injection method or the massaging method can be applied. Yields of products such as cooked turkey breasts and poultry roasts can be increased by 10% to 20%. Again, the isolated soy proteins are compatible with the meat and become an integral part of the finished product. Eye appeal is retained even in light colored products such as turkey breasts.