UPDATE:
SOY ISOLATE — A PROTEIN TO AUGMENT MEAT SUPPLY

by
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PROTEIN PUMPING OF HAMS

Hams have been a part of our culture for so long that it is impossible to determine their technical source. It was probably a butcher with a lot of hogs, a lot of salt and a slow market. Regardless of its derivation, it is a part of our culture.

Arterial pumping of ham has been an industry practice for many years and the advent of stitch pumping machinery has created a great many changes in the industry as well as changes in the consumer's buying habits. It is not the purpose of this paper to review the literature on the development of hams, dry cured, arterial pumped or stitch pumped. The purpose of this paper is to present to you the basic technology we have developed that permits the meat industry to augment intact muscle protein with isolated soy protein as a component of the brine.

Technological innovations have little value to an industry unless there is a real need for the particular innovation. We did not need gigantic sausage plants to replace the neighborhood butcher until the population of people became so intense as to require the consolidation of the industry. We did not need skinless franks or cellulosic casings until the production demands of speed and economical necessity ruled out general use of natural gut casings. Ten years ago we did not need a method that permitted the meat processor to augment intact muscle systems with a protein brine.

Today we are faced with a major challenge. How do we provide economical high-quality foods to an increasing population in the face of ever-increasing costs of feed grains necessary to raise the animals of commerce? Clearly, we as food scientists are charged the responsibility of determining how we can utilize our total food resource in an economical manner so that the consumers' needs can be fully met. We must provide food to the consumer in culturally-acceptable forms. When the consumer wants an intact-muscle meat, a puree or a sausage will not serve. We must adapt our technology to the food culture when dealing with foods which, historically, have been acceptable to that culture. Because the consumer demands intact-muscle meat food, we had to find the means to obtain the desired results of meeting the demand for these foods and providing some economy at the same time. While it is possible to augment the meat supply by injecting water or water and starch slurries, we would be deluding the consumer because the net effect would be to reduce the protein content of the meat. Meat is purchased because it is a protein source. Our challenge was to find the means to augment the meat supply and still maintain the protein content at a nutritious level. We feel that we have met this challenge and created a new class of meat products that will aid in supplying the consumer with culturally-acceptable high quality intact muscle meats.

During the past three and one-half years, we have developed a method (U.S. Patent 3,989,851) that permits the addition of non-meat proteins, specifically an isolated soy protein, to aqueous curing systems commonly used in the production of cured items such as hams and corned beef. This new method permits pumping of the protein brine to achieve a cooked yield of 130% or more while maintaining a protein content of at least 17% in order to comply with the U.S.D.A. proposals on combination meat products.

This has been accomplished by employing a specially processed isolated soy protein that possesses the ability to form gels in water as well as an ability to form emulsion gels with animal fats and water. We call this isolated soy protein product Supro 640T Fortiblend. It contains the added salts, minerals and vitamins required by the U.S.D.A. and is tagged with titanium dioxide as required by law.

Guideline Formulation and Procedure
For Producing
A Combination Ham Product

Brine Formulation:

Ingredient	%
Water	80.2138
Supro 640T Fortiblend™ Isolated Soy Protein	10.0000

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Salt	8.3700
Sodium Phosphates	1.2000
Sodium Erythorbate	.1600
Sodium Nitrite	.0500
H&R Brown Sugar Flavor	.0050
Superesin™Clove	.0012
	100.0000

Determination of amounts of ingredients necessary for brine:

Using the following formulation and assumptions:

$$A = \frac{XY}{Z}$$

A = % Ingredient in brine

X = % Ingredient in green pumped product

Y = % Pumped Wt.

Z = % Pump

Based on this equation the above brine formulation was derived as follows:

Percent ingredient desired in finished cooked ham = X

X = 2.6% Salt
.4% Sodium Phosphate
.05% Sodium Erythorbate
.0156% Sodium Nitrite

Y = 145% Pumped Wt.

Z = 45% Pump

Salt:

$$A = \frac{XY}{Z}$$

$$A = \frac{(2.6\%)\ (145\%)}{45\%}$$

$$A = 8.3777\%$$

Sodium Erythorbate:

$$A = \frac{XY}{Z}$$

$$A = \frac{(.05\%)\ (145\%)}{45\%}$$

$$A = .1611\%$$

Sodium Nitrite:

$$A = \frac{XY}{Z}$$

$$A = \frac{(.0156\%)\ (145\%)}{45\%}$$

$$A = .0502\%$$

This formulation is provided as a guide-line only and is not intended to be a finished or mandatory brine. Other ingredients may be added as desired. Because of the gel forming properties of Supro 640T isolated soy protein, there are limits on the quantity that may be employed in a particular system. The limitations are a function of the viscosity of the finished brine and of the ability of the stitch pump to handle the high viscosity brine.

Preparation of Brine:

In order to derive full benefit from this system it is necessary that the isolated soy protein (Supro 640T Fortiblend™) be fully hydrated before the addition of the other ingredients for the brine. This requires the addition of the other ingredients in a dry form and eliminates the use of salt brines and phosphate solutions.

The following is one recommended procedure:

1. Water is either weighed or metered into a brine tank coupled with the pump and a Tri-Blender®; a uniquely designed blender which is manufactured by the Tri Clover Div., Ladish Co.
2. Start the centrifugal pump and Tri-Blender in sequence.
3. Place the required quantity of isolated soy protein in the hopper of the Tri-Blender. Open the valve and allow the protein to mix with the water.
4. After the protein has been mixed with the water and hydrated, the phosphate is added to the hopper and dissolved in the protein water slurry.
5. The phosphate is followed by the addition of the salt, erythorbate, nitrite and flavors.
6. After all ingredients have been added, the brine is ready for pumping.

Almost any commercial stitch pumping equipment can be employed to pump the green meats. However, many stitch pump machines are fitted with fine cloth or metal screens and these will usually have to be removed as the protein brine will not pass through the filters. Proteins are, after all, colloidal dispersions.

We recommend pumping to 145% of green weight as a starting point. This may require multiple passes through the machine depending on the make and model. A 145% pumping when cooked to an 89% smokehouse yield will produce a finish yielded ham of approximately 130%.

NOTE: It is not possible to use the artery pump system for this product as the colloidal particles of protein in suspension are larger than the inside diameters of the capillaries. If attempted, the capillaries will burst and brine distribution throughout the muscle cannot be accomplished. This will result in low yields and uncured or undercured areas in the finished product.

Preparation of Ham for Pumping:

Because of the viscous nature of the protein brine, as compared to ordinary brine, there is a tendency toward "pocketing" in the seam and seam fat areas of a ham. This results in an undesirable appearance in the finished product.

Therefore, we recommend boning the ham prior to pumping in the following manner:

1. Hams should be skinned and defatted.
2. Bone should be removed according to present open boning methods.
3. We recommend the removal of the heel, shank and butt kernel in addition to the star and seam fat. This eliminates some of the problem with two toning.

This also allows better control of complying with the U.S.D.A. Regulation with respect to the declaration of percentage ham on the label. After boning, trimming and sectioning the hams are ready for pumping. After pumping, the hams must be either massaged or tumbled in order to assure distribution and equilibration of the brine and provide a desirable finished product texture and appearance.

It is also recommended that the product be vacuum-mixed for one minute after massaging or tumbling and prior to stuffing. This step is necessary in order to remove entrapped air from the muscles.

Hams can be produced for canning, boiling, or smokehouse cooking. The brine formula would have to be adjusted to provide the proper protein content of the finished product. The prepared product can be finish cooked by a variety of methods. The only limitations you would be faced with are those established by the U.S.D.A. Arterial pumping of hams with a protein brine is not possible because the protein particles will clog the capillaries and effectively stop the pumping operation.

We are not limited to pumping hams with the protein brines and we have been successful in working with beef brisket, beef rounds and bacon. The brine curing system for these products is modified slightly to include spices or adjust protein:salt ratios to obtain the desired end product yield, analysis and flavor profile.

While we started with pumping of hams to augment the particular supply because of the challenge it represented, we expanded our work to include other pork cuts and then cured beef. It soon became apparent to us that the need to augment non-cured meat systems was also very real and we then began to direct our efforts in this area. We have been very successful in employing protein slurries to provide greater yields per carcass of beef rounds for roasting, rib eyes, veal shoulder, turkey breasts and other non-cured meats.

The finished product quality of augmented meats produced with this technology is very high and can be attested by the growing number of processors employing the process.

Processors of meats (beef, pork, mutton, fish, chicken, and turkey) around the world are searching for new technology that will make it possible to utilize the total food resource more effectively. Consumers and governments are also aware of the need to solve the problems of feeding a growing population. We are reporting to you, as members of the food processing community, a technological innovation that can offer some relief to the problems we all face.

United States Patent [19] **[11] 3,989,851**

Hawley et al. **[45] Nov. 2, 1976**

[54] *METHOD FOR PROTEIN FORTIFICATION OF EXTRA PUMPED MEATS*

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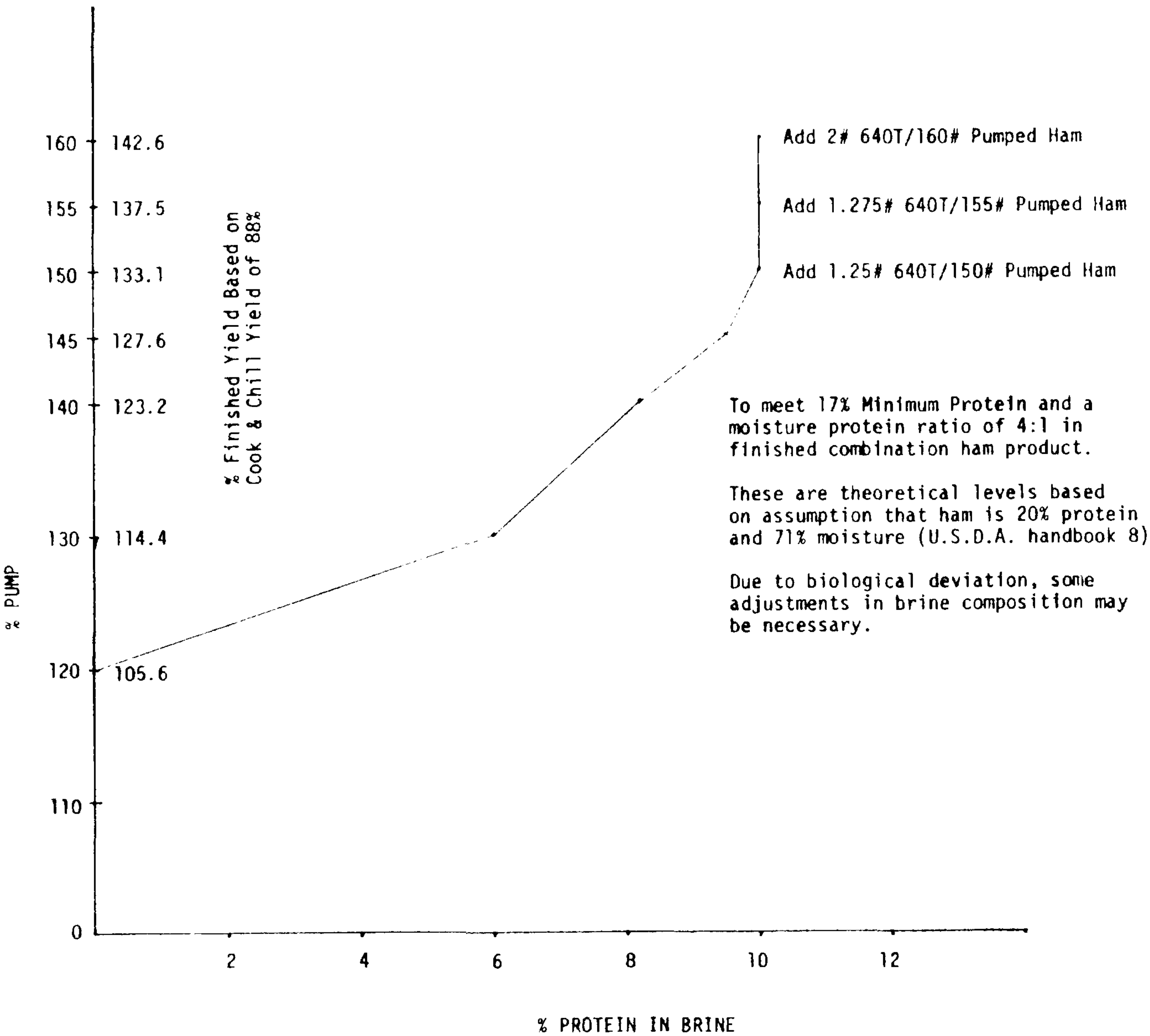

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[58] *Field of Search* 426/656, 657, 652, 281, 426/654, 332, 321, 641, 643, 644, 647, 264, 266, 335

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[57] *ABSTRACT*

Meats are effectively pumped in excess of 140% of their green weights, yet maintain their original proteinaceous posture and nutritional value by a critically controlled preparation and injection of a protein medium. A salt tolerance protein isolate is hydrated in water and subsequently curing salts are admixed to the hydrated salt tolerant protein isolate. Upon curing the liquid medium, which has been pumped into the meat, cooks to a uniformly distributed, meat-like gel, the extra pumped meat product maintains the same nutritional protein value and substantially identical textural properties of natural meat tissue, the protein substantially retains its hydrated form in the final product and there is substantially no protein separation.

6 Claims, No Drawings

METHOD FOR PROTEIN FORTIFICATION OF EXTRA PUMPED MEATS
BACKGROUND OF THE INVENTION

This application is a continuation-in-part of copending application Ser. No. 500,219, filed Aug. 26, 1974, and now abandoned.

The present invention relates to protein fortification of cured meats.

It is known to add certain inorganic phosphorus containing compounds, especially polyphosphates, to meat and meat products in order to improve their structure and juice retention, especially when heated.

For example, hams are injected with aqueous solutions of table salt and sodium polyphosphate, which not only cause an improved color but also a better juice retention. By this injection the water, the ham's proteins and aromatics dissolved therein, and the meat juices are better retained during subsequent processing, such as cooking and/or smoking.

Additionally, it is known to incorporate pure, naturally occurring amino acids and mixtures of amino acids, derived from hydrolysis of natural proteins, into cure solutions in order to overcome taste defects and other imperfections encountered during curing.

For the reasons discussed in U.S. Pat. 2,767,096 with substantial clarity and completeness, it has been the general practice to conduct the above-described injection procedures through the circulatory systems, including the veins and arteries, of cured meats.

These techniques have been very successful and widely adopted throughout the United States, yet they have also met considerable skepticism. For example in spite of the excellent distribution of cured solutions via artery and vein pumping, the meat cannot be pumped in excess of 110% of its green weight (weight prior to heat processing wherein shrinking occurs) without significant loss in nutritive value. Since amino acids have a finer particle size and are more readily dispersed in aqueous media, and were believed to be more efficiently circulated than pure protein isolates, attempts were made to bolster the protein content of pumped hams by injection of amino acids. However, in spite of the improvement in taste experienced with limited levels of amino acids, when amounts sufficient to provide adequate nutritive value were utilized, a severely undesirable off-taste developed. In the face of a rapidly increasing food shortage throughout the world, the need to provide pumped meats even in excess of 140% of their green weights serves to magnify the previous taste defects and other problems beyond practical acceptability.

The only previous attempt to extra-pump meats with soy protein isolate was reported by the Central Institute for Nutrition and Food Research in Brussels, Belgium in August of 1966 (Report No. R2239). It was therein concluded that artery and vein pumping was impossible and that stitch pumping directly into the muscle tissue could provide a 6% improvement in protein content for hams pumped to only 121% of their green weights. But the protein and method of making the medium create an unsuitable product when pumped above 140% green weight because there is a separation of protein. Additionally, the protein was found to decrease the juice retention characteristics of the cure solution.

Accordingly, a method of providing pumped meats in excess of 140% of their green weights and simultaneously fortifying the protein content in excess of 6% so as to provide a finished cooked product with a salt tolerant nutritious protein content substantially identical to that of unpumped meats would substantially advance the art.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a method for extra pumping meat such as ham at a yield in excess of 140% of its green weight and fortified with a protein level equivalent to that of an unpumped ham, yet avoiding degradation of the protein and taste.

Other objects will become apparent from the following description of the invention.

Generally, the objects of this invention are fulfilled by controlled preparation of a curing medium containing proteinaceous material, oleaginous material, and conventional curing ingredients. The medium is stitch pumped into the muscle tissue of the meat, taking care to avoid injection solely into veins and arteries.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The product of the present invention is a uniquely prepared high protein curing medium which is particularly advantageous in extra-pumping meats. The curing medium is composed of, in addition to conventional curing ingredients, proteinaceous material and, if desired, oleaginous materials.

The proteinaceous material of the curing medium is a food grade isolate, substantially devoid of the fibrous and carbohydrate materials naturally occurring in concert with the protein. The isolate is derived from either vegetable or animal sources provided it possesses physical and chemical characteristics amenable to the formation of an emulsion with hydrogenated vegetable oil, particularly that of salt tolerance; i.e., is stable in the presence of salt. Additionally, the isolate must form an irreversible gel upon heat setting. Gelatin, although a protein, is not within contemplation of this invention because it does not form an irreversible gel. Also, the protein isolate must be capable of providing the nutritional value of natural meat protein-gelatin also lacks this capability. Soy protein isolate is preferred for purposes of the present invention. It is important to note that other nutritious proteinaceous materials derived from both animal and vegetable sources can be utilized in the present invention provided they are modified to form stable dispersions or emulsions compatible with curing solids.

Generally, the amount of protein incorporated into the curing medium will be sufficient to provide a meat, pumped to in excess of 140% of its original or green weight, with the same nourishing proteinaceous posture as that of an unpumped meat. This amount must be in excess of 6% by weight of the curing medium. However, the amount cannot be so great as to render the curing medium too viscous to be pumped through injection needles. The precise amount will vary depending on the desired texture, flavor, taste, appearance, and type of meat product. Preferably protein isolate is utilized in an amount of from about 7-10% by weight of the curing medium. The final meat product will have an overall protein content of from about 17 to about 20% by weight of the meat for proper proteinaceous posture.

If desired, oleaginous materials such as hydrogenated vegetable oil, rendered animal fat such as beef tallow and lard, and adipose tissue can also be incorporated into the curing medium. By doing so, the medium will be in the form of an emulsion rather than a watery dispersion. This form is quite advantageous for several reasons. For example, since the level of solubility of protein in water is at most a colloidal dispersion, the emulsion will provide improved stability over the dispersion. Additionally, the emulsion serves to improve the cohesion of meat chunks when cured meats are rendered and subsequently recompacted.

The oleaginous material of the present invention can be selected from any of the many vegetable oils commercially available. Alternatively, other oils, rendered animal fats such as beef tallow and lard, and adipose tissue can be employed. The oils of this invention may be, for example, soy oil, corn oil, peanut oil, etc. The amount of oil can be 0 to 15% depending on whether a thick emulsion or dispersed solution is desired. It is preferred to utilize an emulsion having about 9% oil by weight of the curing medium.

The other curing ingredients are, for example, inorganic phosphates such as sodium tripolyphosphate, sodium hexametaphosphate, trisodium pyrophosphate, and monosodium orthophosphate; salts such as sodium chloride and sodium erythorbate; inorganic nitrogen sources such as sodium nitrate and nitrite; sugar such as that commonly used in meat curing; and, of course, water. The type and amounts of curing ingredients will vary depending on the type of meat to be cured. A typical formulation by weight based on overall weight of the curing medium for the present invention will contain 75 to 90% water, 4.0 to 10.0% NaCl, .1 to 2.0% sugar, 0.05 to 0.2% sodium nitrite, .005 to .01% sodium nitrate, and .05 to 0.2% sodium erythorbate.

It is critical in the preparation of the curing medium of the present invention that the protein isolate must be hydrated, in intimate contact with the water, prior to the addition of the curing salts. The phosphate and other salts must be added to the hydrated protein in dry form. If the hydrated protein is added to a solution of the phosphate, the protein will curd like cottage cheese. These curds significantly reduce the injection capability of the curing medium and will cause precipitation or unwarranted degradation of protein during the curing cycle. Additionally, previous problems in regard to moisture retention are significant results. It is believed that previous failures in extra pumping hams with protein isolates may have resulted from failure to observe this critical order of addition.

The curing medium is particularly desirable for pumping cured meats such as pork or red meat, poultry, fish, beef brisket, beef rounds and preferably hams to from about 140 to about 165% of their green weights. Even meats such as whale and mutton are within contemplation of this invention. Also the meats need not be fresh, they can also be washed meats.

In the process of the present invention the curing medium is stitch pumped directly into the muscle tissue of the meat. More specifically, meats for canned hams are excised from the bone prior to injection and if desired are recompacted and then injected. It is important to note that meats can be pumped to as low as 110% of green weight and distinctions over the prior art can still be observed. Although the distinctions are not nearly as drastic at the 140% pumps, they are nonetheless characteristically different from other pumping procedures.

The product of this invention is a novel meat product which is uniformly distributed with an added protein gel. The meat-like gel is irreversibly heat set such that greater than 50% of the meat product consists of nonmeat material yet the nutritional and textural properties of the meat are maintained. The elimination of protein separation is believed due to the fact that by changing the order of addition, the protein is more completely hydrated such that upon curing, the curing medium is converted to a gel, wherein the protein retains its hydrated form, thus remaining in tact.

This invention is further illustrated by the following specific examples. It is understood that the invention is not to be restricted to the details of these examples.

EXAMPLES

EXAMPLE 1

Two hams weighing approximately 18 lbs. were skinned, defatted and deboned by seaming the muscles. The meat was divided into three categories:

		Pounds
(a)	ham leans	26
(b)	lean trim	3.5
(c)	fat trim	3.0

The curing medium was prepared by first dispersing 2.336 lbs. of hydrolyzed soy protein isolate into 28.05 lbs. of water. Then the following amounts of solids were added:

Solids	*Pounds*
NaCl	1.6
Sodium tripolyphosphate	0.3
Sugar	.64
$NaNO_3$	.0384
$NaNO_2$	.0704

The ham leans were stitch pumped with this dispersion. The weight was pumped to 38.5 lbs. or 147% of green weight with no undesirable separation of protein. The ham was allowed to cure for 48 hours, then the leans were placed in a vacuum tumbler and 28 inches of vacuum was applied. They were tumbled for 6 hours, removed and pumped with an identical curing medium. The weight was increased to 42.6875 lbs. or a yield of 163% of green weight, with still no separation of protein.

EXAMPLE 2

Same as Example 1 except 9% of the curing medium (water portion) is replaced by hydrogenated vegetable oil. An emulsion is formed and injected. There are excellent results.

EXAMPLE 3

Same as Example 1 except part of the water is held out to dissolve the phosphate prior to admixing it with the protein. Curds form in the curing medium. Injection results in undesirable separation of protein and off-taste.

EXAMPLE 4

Same formula as example 1 except that the ham was pumped to 147% of green weight, placed in a meat massager for 18 hours and then heat processed for cure.

what is claimed is:

1. In a method of forming a meat product of the type wherein a liquid medium including a nutritional protein isolate, water and curing salt is prepared, stitch pumped into natural meat muscle tissue and allowed to cure, the improvement comprising:

a. preparing the liquid medium by first hydrating, at least 7% by weight of the medium, a salt tolerant protein isolate which forms a gel upon heat setting, in water, prior to admixing the curing salts;

b. subsequently admixing the curing salts to the hydrated salt tolerant protein isolate;

c. stitch pumping the natural meat tissue with the liquid medium to from 140 to 165% of its green weight;

wherein, upon curing, the liquid medium cooks to a uniformly distributed, meat-like gel, the extra pumped meat product maintains the same nutritional protein value and substantially identical textural properties of natural meat tissue, the protein substantially retains its hydrated form in the final product and there is substantially no protein separation.

2. The method of claim 1 wherein the amount of protein isolate is from 7 to 10% by weight of the medium.

3. The method of claim 1 wherein the amount of water used to hydrate the protein is from about 75 to 90% by weight of the medium.

4. The method of claim 1 wherein the water is partially replaced by oleaginous material selected from the group consisting of hydrogenated oil, rendered animal fat and adipose tissue in an amount of about 9% by weight of the medium.

5. The method of claim 1 wherein the natural meat muscle tissue is selected from the group consisting of lean ham, beef briskets, beef rounds, poultry, mutton, whale and fish.

6. The method of claim 1 wherein the natural meat muscle tissue is lean ham.

DISCUSSION

LARRY BORCHERT: Thank you Bob. I am sure he will be happy to entertain any questions you may have on soy isolate augmented ham.

JOHN ZIEGLER, Penn State: The yield looks good, but what does it taste like?

BOB HAWLEY: Well if it is a ham, it tastes just like ham. You have some advantage with this system over normal processing of meat in that you can control flavor much better. With flavor I am associating succulence. Beef rounds typically are very dry. The beef we had for lunch was somewhat on the dry side. Pumping that beef with this system makes it much more succulent and more highly acceptable. In hams it increases the succulence considerably.

BILL SCHWARTZ, Eckrich: It looks good and tastes good. What is the cost?

BOB HAWLEY: Cost you know is a very personal thing within a given plant. What do you pay for your raw material? How efficiently do you utilize it? And how efficient is your labor utilized? Typically we have observed a 15 cent per pound cost reduction in processed hams. In beef it is considerably greater in some instances.

MARTY MARCHELLO, North Dakota State: Are there some restrictions as far as to how much of this you can add?

BOB HAWLEY: Yes, there are government programs regulating this industry. A law was proposed which had to be rescinded because some errors made in it, but rules are established by the USDA currently to monitor this program. Your quality control procedures have to be approved and labels approved. The product has to contain at least 50% meat in order to be called by its name. We talk here of ham. It would be called a combination ham product followed by a statement of the percent ham contained in that product, i.e., 76% ham. If you went below 50% ham content, I think it would have to be called a combination soy product with ham as the ingredient.

CURTIS MELTON, Tennessee: Have you done any studies with the shelf life keeping quality of these products?

BOB HAWLEY: We have done some studies. I hesitate to report on studies done in a testing laboratory such as ours because we are not meat processors. We have seen no decrease whatsoever in the shelf life of this product. Several meat processors using this process and others contemplating it have made shelf studies and have found that it is equal to normal water-added ham.