Characterization of Finely Textured Lean Pork for Use in Processed Meats

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Summary and Implications

Lean finely textured pork (LFTP) is a low-fat protein source produced from fresh pork fatty trimmings. LFTP has similar protein and fat contents as lean meat, but is more economical for processed meat formulations. In order to recommend best utilization of this inexpensive meat ingredient, we studied the protein composition and functionality of LFTP. The protein composition of LFTP was different from that of muscle meats, containing more connective tissue proteins and less functional proteins. Difference in gelation characteristics of the proteins were shown to result in a soft texture and lower yield when used in frankfurters at 50% of the formulation. Addition of tripolyphosphate, kappa-carrageenan or isolated soy protein improved product stability. The softness produced by LFTP could be an advantage in very low-fat meat products where toughness and firmness are often a problem. The successful use of LFTP could improve economic returns to swine producers and reduce the cost of processed meat products to consumers.

Introduction

Lean finely textured tissue (LFTT) is a lean meat ingredient derived from beef or pork fatty trimmings by means of a unique low temperature separation process. LFTT is considered by the USDA to be the same as beef or pork for label declarations, and can be used as a lean meat source for meat product formulations. LFTT is high in protein (17–21%), low in fat (8–12%), and inexpensive in comparison to regular lean meat. Although LFTT contains a similar total protein content to that of muscle meats, its functionality has been observed to be somewhat different from muscle meats when used in processed meats. Understanding the functional components present in LFTT from pork will provide important information about how to best utilize this inexpensive protein source for processed meats. Therefore, the objective of this study was to characterize the functional components of LFTP for processed meat applications. LFTP was first evaluated for heat-induced gelation characteristics in comparison to lean meat, then fractionated into low ionic strength soluble, high ionic strength soluble, and insoluble proteins. SDS-gel electrophoresis was performed to identify the major proteins in the protein fractions and gelation properties of the proteins were determined.

A second objective of this study was to evaluate the effectiveness of several meat processing ingredients (salt, phosphate, carrageenan, and soy protein) for improving the functionality of LFTP in frankfurter formulations.

Materials and Methods

LFTP was obtained from a commercial supplier in frozen form and proteins extracted according to established procedures for high-ionic strength soluble (HIS), low-ionic strength soluble (LIS), and insoluble (IN) fractions.

The amount of protein in each fraction was measured and compared to fractions obtained from pork shoulder muscle. Protein solutions were evaluated for heat-set gelation by heating to 70°C and measuring water loss and gel firmness. Protein solutions also were studied for specific protein composition by utilizing sodium dodecyl sulfate-polyacrylamide gel electrophorsis. Effects of sodium tripolyphosphate (0, 0.25, 0.5%), kappa-carrageenan (0, 0.25, 0.5%) and isolated soy protein (0, 1, 2%) on heat-set gelation was studied by adding each compound at the appropriate level to protein solutions prior to heating, followed by measurement of gel firmness.

Frankfurters were manufactured with 50% of the meat block replaced by LFTP to evaluate yields, texture, color, and sensory quality effects of LFTP in the formulation.

Results and Discussion

Results showed the gel strength of proteins from LFTP to be about 15% of that of proteins from shoulder muscle (Table 1). Water loss from the gels when formed was also considerably more (~ 14%) for the LFTP. This means that proteins from LFTP are much less effective in forming the physical matrix which is very important to stability for processed meat products. The LFTP will result in soft product texture and more moisture loss during cooking.

The reasons for the difference in effectiveness between LFTP and pork shoulder muscle is largely due to differences in high ionic strength soluble (HIS) proteins (Table 1). These are the most important proteins for processed meat properties; LTFP has less than 20% as much as pork shoulder. The IN (insoluble) protein fraction is also much higher (about three-fold) in the LFTP and probably represents mostly connective tissue proteins. Collagen, for example, is about two-fold greater in the LFTP (Table 1). Polyacrylamide gel electrophoresis (data not shown) demonstrated low levels of actin and myosin (major proteins of importance to processing properties) in the LFTP relative to pork shoulder.

The addition of other processed meat ingredients offers some potential to improve the effectiveness of LFTP.

For example, use of tripolyphosphate significantly improved moisture retention as expected (data not shown) and both carrageenan and soy protein improved the gel strength (firmness) as shown in Table 2. However, none of these treatments achieved the gel strength observed for proteins from pork shoulder muscles (table 1).

Comparison of the effects of phosphate, carrageenan, and soy protein in product formulation of frankfurters with LFTP is shown in table 3. The use of LFTP alone clearly results in lower yields after smokehouse processing, after chilling (total processing yield) and after reheating for consumption (consumer cook). In all cases, tripolyphosphate, carrageenan, and soy protein improve yields but not always to the same level as the controls (without LFTP). Sensory panels showed similar results for firmness and cohesiveness of the frankfurters. The softening effect of LFTP is clear; use of other meat ingredients increased textural firmness and cohesiveness but not to the level of the controls.

It is clear from this study that LFTP, an economical lean meat ingredient recovered from fat pork trimmings, must be considered differently than other lean meats when used in further processed products. Products made with LFTP will be softer and retain less moisture than other lean meat sources. The LFTP may have the greatest potential for use in very low fat products where hardness is often a problem. Use of LFTP in these products would provide textural improvement from a very economical lean meat source and would help control formulation costs of low-fat products.

Table 1. Gelation properties and protein fractions from lean, finely textured pork (LFTP) and pork shoulder muscle.

	Pork Shoulder	LFTP	SEM[c]
Gel Strength (Newtons)	3.85[a]	0.58[b]	.002
Water Loss (%)	48.6[a]	62.9[b]	1.07
HIS[d] Proteins (%)	49.1[a]	9.3[b]	2.1
LIS[e] Proteins (%)	28.9[a]	25.5[b]	2.1
IN[f] Proteins (%)	22.1[a]	65.2[b]	3.1
Collagen (%)	9.3[a]	19.6[b]	2.8

[a,b] Means in the same row with different letters are significantly different.
[c] Standard error of a mean.
[d] High ionic strength soluble.
[e] Low ionic strength soluble.
[f] Insoluble.

Table 2. Effects of carrageenan and isolated soy protein on the gel strength of protein extracts from lean, finely textured pork.

Treatments	Gel Strength (Newtons)–LFTP[a]
Carrageenan (%)	
0.00	0.5147[c]
0.25	0.6831[c]
0.50	0.8126[b]
SEM[d]	0.0023
Isolated Soy Protein (%)	
0.00	0.5147[c]
1.00	0.5066[c]
2.00	0.8406[b]
SEM[d]	0.0013

[a] Lean finely textured pork.
[b,c] Means with different letters in the same column are significantly different ($P<0.05$).
[d] Standard error of a mean.

Table 3. Processing yield, consumer cook yield, firmness and cohesiveness of frankfurters made with lean, finely textured pork (LFTP).

	Yield (%) of Frankfurters with or without LFTP			Sensory Panel	
Treatments	Smokehouse	Total Processing	Consumer Cook	Firmness	Cohesiveness
Control (No LFTP[e])	91.20[bc]	89.40[a]	99.05[a]	5.27[b]	5.27[a,b]
LFTP	89.99[d]	88.26[c]	96.07[b]	3.13[e]	4.06[e]
STPP[f]	90.70[c]	88.88[b]	97.21[ab]	3.51[de]	4.43[d]
STPP+Carrageenan	91.56[ab]	88.85[b]	98.13[ab]	3.83[cd]	4.73[cd]
STPP+Isolated Soy Protein	92.04[a]	88.97[ab]	96.93[ab]	4.16[c]	4.83[c]
SEM[g]	0.14	0.11	1.92	0.09	0.33

[a,b,c,d] Means with different letters in the same column are significantly different ($P<0.05$).
[e] Lean finely textured pork.
[f] Sodium tripolyphosphate.
[g] Standard error of a mean.