1997

Finely Textured Lean Beef as an Ingredient for Processed Meats

Ying He
Iowa State University

Joseph G. Sebranek
Iowa State University

Extension Number: ASL R1361

Finely Textured Lean Beef as an Ingredient for Processed Meats

Abstract
Lean, finely textured beef (LFTB) is a lean product derived from beef-fat trimmings. Characterization of LFTB showed that, while it is high in total protein, the LFTB contains more serum and connective tissue proteins and less myofibrillar proteins than muscle meat. Because of the protein differences, LFTB has less functionality in processed meats, resulting in lower yields and softer texture. Appropriate use of sodium chloride, sodium tripolyphosphate, k-carrageenan, or isolated soy protein achieved desired stability and yields in frankfurters with FTLB. The softer texture may be used to advantage in high-protein, low-fat meat products where excessive toughness or firmness is often a problem.

Keywords
ASL R1361

Disciplines
Animal Sciences

Finely Textured Lean Beef as an Ingredient for Processed Meats

A.S. Leaflet R1361

Ying He, research assistant, and
Joseph G. Sebranek, professor of animal science,
professor of food science and human nutrition

Summary

Lean, finely textured beef (LFTB) is a lean product derived from beef-fat trimmings. Characterization of LFTB showed that, while it is high in total protein, the LFTB contains more serum and connective tissue proteins and less myofibrillar proteins than muscle meat. Because of the protein differences, LFTB has less functionality in processed meats, resulting in lower yields and softer texture. Appropriate use of sodium chloride, sodium tripolyphosphate, k-carrageenan, or isolated soy protein achieved desired stability and yields in frankfurters with FTLB. The softer texture may be used to advantage in high-protein, low-fat meat products where excessive toughness or firmness is often a problem.

Introduction

Lean, finely-textured beef (LFTB), previously called fat-reduced tissue or partially defatted tissue, is a lean meat ingredient derived from beef fat trimmings. A unique, low-temperature rendering and separation procedure produces a lean product (< 10% fat) that may be used as an ingredient in processed meats. Despite the low fat content, there has been concern that this material does not function well in processed meats such as frankfurters.

This study was initiated to determine the cause of the lower functionality in LFTB and to develop processing treatments to improve the functionality of LFTB. As an ingredient, LFTB represents a high value-added material and provides an excellent means of utilizing high-fat beef trimmings. Improved functionality of LFTB will add to the total value of beef carcasses.

Materials and Methods

For the first portion of the study LFTB was obtained from Beef Products, Inc. (BPI). A selective protein extraction procedure (Camou and Sebranek, 1991) was used to separate high-ionic-strength (HIS), low-ionic-strength (LIS), and insoluble (IS) protein fractions (Nuckles et al., 1990). Protein fractions were evaluated for heat-set gelation strength and submitted to sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE) (Laemmli, 1970). The latter procedure was used to identify the specific proteins in each protein fraction.

In the second portion of the study, salt (sodium chloride), phosphate, nonmeat gelling agents (carrageenan), and isolated soy protein were incorporated into LFTB to study potential to improve functionality. The LFTB was first evaluated for stability and cooking-yield effects by using a model system where LTFB was substituted for regular lean meat at 0%, 50%, or 100%.

Based on information from the model system, frankfurters were prepared with 0% or 50% LFTB, and incorporation of phosphates, carrageenans, isolated soy protein, and various levels of salt were studied to determine the best finished-product quality.

Results and Discussion

A simple comparison of heat-set gelation strength (Table 1) shows the softness and reduced functionality (water loss) as measured for LFTB. Gel strength was about 10% that of proteins from regular beef chuck muscles. This was true even though composition analysis showed protein concentration of LFTB to be very similar to beef chucks.

Fractionation of proteins showed the LFTB to be relatively high in insoluble proteins and collagen compared to beef chuck. The highly functional high-ionic-strength proteins were present in low concentrations. Thus, the lower functionality is not surprising. The SDS-PAGE showed low concentrations of actin and myosin, the HIS proteins most important to processed meat functionality. However, combining the LFTB proteins with HIS proteins from muscle (Table 3) resulted in relatively small changes in gel strength even at 50% LFTB. This implies that combinations of LFTB with regular meat sources would still be very effective.

Another option for processors would be to include gelling agents such as carrageenans or isolated soy protein. Both are effective (Table 4), with the carrageenan at 0.5% resulting in the greatest increase in gel strength. To further evaluate the stability of LFTB in combination with the gelling agents in a meat system, the cooked stability (Table 5) was measured. Addition of phosphate brings the LFTB mixture back close to the stability of the control, while addition of carrageenan and isolated soy both surpassed the all-meat control. Thus, appropriate nonmeat ingredients can be used in conjunction with the LFTB to achieve satisfactory stability in meat products. These results were confirmed with processed frankfurters (Table 6) where a consumer cook test (cooking frankfurters in boiling water) shows the frankfurters with LFTB and other nonmeat ingredients to be similar to controls. The LFTB frankfurters without the nonmeat gelling agents showed lower yields in the final consumer cooking comparison. Texture evaluation of the frankfurters showed the products with LFTB to be softer and more tender, a desirable characteristic for low-fat products.

The results of this study showed that LFTB recovered from beef fat tissue can be used successfully in further processed products. Yields and binding characteristics can be improved through appropriate use of phosphates, carrageenan, and/or isolated soy protein. A particular advantage is that high yields and bind can be retained while the product remains tender, a very useful property for low-fat products.

Implications

This work shows that recovered lean tissue from fat trimmings can be used successfully for high value-added processed products, thus increasing the overall value of beef carcasses.

Acknowledgments

Financial support and materials used for this project were provided by Beef Products, Inc. (Dakota Dunes, SD).

Table 1. Comparison of gelation characteristics between muscle meats and lean, finely textured beef (LFTB).

Samples	Gel strength (N)	Water loss (%)
Beef chuck	3.2447[a]	56.56[b]
LFTB[c]	0.3350[b]	71.39[a]
SEM[e]	0.0030	0.77

[a,b] Means within the columns in the same section followed by the different letters are significantly different ($p < 0.05$).

[e] Standard error.

Table 2. Protein fractions and collagen content in beef and LFTB[a].

Samples	LIS[b] proteins (%)	HIS[c] proteins (%)	IN[d] proteins (%)	Collagen in IN fraction (%)	Collagen in total protein (%)
Beef chuck	25.52[f]	43.70[f]	30.78[e]	18.25[e]	5.50[e]
LFTB	17.85[e]	4.90[e]	77.25[f]	36.77[f]	27.86[f]
SEM[g]	2.12	2.13	3.11	9.11	2.77

[a] Lean, finely textured beef.

[b] Low -ionic-strength soluble.

[c] High-ionic-strength soluble.

[d] Insoluble.

[e,f] Means within the same column followed by the different letters are significantly different ($p < 0.05$).

[g] Standard error.

Table 3. Gel strength of heat-induced gels made with combinations of high-ionic-strength soluble (HIS) proteins from muscle and high-ionic-strength soluble (HIS) proteins from lean, finely textured beef (LFTB).

Substitution with LFTT proteins (% w/w of extracts)	Beef with LFTB[a]
0	0.7090
5	0.6759
10	0.6873
15	0.6525
20	0.6485
30	0.6328
40	0.6809
50	0.6331
SEM[b]	0.0394

[a] Lean, finely textured beef ($p > 0.05$).
[b] Standard error.

Table 4. Effects of carrageenan and isolated soy protein on the gel strength of protein extracts from lean, finely textured beef.

Treatments	LFTB[a]
Carrageenan (%)	
0.00	0.3554[c]
0.25	0.4158[c]
0.50	2.8365[b]
SEM[d]	0.0149
Isolated soy protein (%)	
0.00	0.3554[c]
1.00	0.3537[c]
2.00	0.5402[b]
SEM[d]	0.0337

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

Table 5. Stability[a] of meat batters with lean, finely textured beef.

Treatments	Water (ml)	Fat (ml)	Total (ml)
Control (No LFTB)	15.19[c]	0.52[e]	15.71[c]
LFTB	20.70[b]	2.62[b]	23.32[b]
STPP[f]	14.74[c]	1.38[c]	16.12[c]
STPP+carrageenan	12.33[d]	1.08[d]	13.38[d]
STPP+isolated soy protein	12.54[d]	0.39[e]	12.99[d]
SEM[g]	1.16	0.01	1.25

[a] The fat, water and total cookout were expressed as volumes (ml) per 100 g raw meat batter.
[b,c,d,e] Means with different letters in the same column are significantly different ($p < 0.05$).
[f] Sodium tripolyphosphate.
[g] Standard error.

Table 6. Processing yield and consumer cook yield of frankfurters made with lean, finely textured beef (LFTB).

Treatments	Yield (%) of frankfurters with LFTB		
	Smokehouse	Total processing	Consumer cook
Control (no LFTB)	91.00[a]	89.89[a]	97.71[a]
LFTT	90.30[b]	88.75[b]	86.12[b]
STPP[c]	89.76[b]	88.81[b]	96.74[a]
STPP+carrageenan	89.44[b]	88.72[b]	99.16[a]
STPP+isolated soy protein	89.90[b]	88.65[b]	93.19[a]
SEMd	0.24	1.13	1.14

[a,b] Means with different letters in the same column are significantly different ($p < 0.05$).
[c] Sodium tripolyphosphate.
[d] Standard error.