LEAN, FAT, AND CONNECTIVE TISSUE FROM BEEF SHANKS PROCESSED WITH A BAADER^{tm} DESINEWER

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SUMMARY

A Baader desinewer was used to improve beef shanks by removing connective tissue and fat. Tissue yield, composition, and sensory properties were evaluated. Two passes through the desinewer were necessary to achieve acceptable yields. Yields were affected by drum hole size and belt pressure setting. Yields of tissue from the first pass ranged from 66 to 73%, second pass yields ranged from 19 to 26%, and sinew was 6 to 7% of the shank. In lean from the first pass through the drum, tissue fat and collagen were reduced 36 and 27%, respectively, with 5 mm holes, and 54 and 47%, respectively, with 3 mm holes. Compared with ground beef patties made from whole shank, patties made from desinewed lean with and without re-incorporation of the flaked sinew had fewer detectable connective tissue particles and were preferred more by sensory panelists. Based on our research, desinewing shanks can add $1 to 3 to total carcass value. If the sinew can be modified and re-incorporated, added value may be as much as $5 per carcass.

INTRODUCTION

Shank meat is a low cost source of "manufacturing" beef. Shanks provide lean beef that has few other uses. Their major drawback is their high proportion of connective tissue. This sinew creates several problems, it is expensive to remove by hand, it causes gelatin pockets in batter products, and it produces unpalatable particles of gristle in ground beef. Tendon and gristle particles in ground beef are considered defects and adversely affect its quality (Cross et al., 1976). Further, use of shanks in batter-type products is limited by the high amounts of collagen (Wiley et al., 1979).

Considerable work has been done on collagen (Bailey, 1989; Jobing, 1984; Rao and Hendrickson, 1983) and some work on desinewers (Cross et al., 1978; Gillett et al., 1976; Wells et al., 1980). The advantages of using desinewing technology to add value to shank meat include increased availability of low-fat raw material for a variety of manufactured products and improved quality of the final product. However, we are not aware of studies on desinewed shanks or the defatting ability of the Baader desinewer. The objectives of this research were to determine yield and tissue composition of beef shanks processed through a Baader desinewer, and to evaluate low-fat ground beef made from desinewed lean and flaked sinew.

MATERIALS AND METHODS

Equipment used for this experiment included: a Hobart grinder with 10 mm and 3 mm plates (Model 4732, Hobart Corp, Troy, OH 45374); a Baader^{tm} desinewer with 3 mm and 5 mm drums (Model 696, Baader North America Inc, New Bedford MA); an Urschel Commitrol^{tm} with an 060 cutting head (Model 3600, Urschel Inc. Valparaiso, IN); a Hobart bowl mixer (Model 20, Hobart Corp, Troy, OH 45374); a Hollymatic Jet Flow Super patty maker (Model 54, Hollymatic Corp. Countryside, IL 60525); and a Foss-Let fat analyzer Foss Food Technology Corporation, Eden Prairie, MN 55344)

Three replications of eight treatments, described below, were used in this experiment.

Treatment	Fat %	Lean raw material	Baader used	Drum 1st pass	Drum 2nd pass	Added sinew %
20C, control	20	Knuckle	No	None	None	0
10C, control	10	Knuckle	No	None	None	0
WGS, whole ground shank	10	Shanks	No	None	None	0
5/5NS, no sinew added	10	Shanks	Yes	5 mm	5 mm	0
5/5S, sinew added	10	Shanks	Yes	5 mm	5 mm	7
3/5S, sinew added	10	Shanks	Yes	3 mm	5 mm	7
5/5S-F2x, sinew flaked twice	10	Shanks	Yes	5 mm	5 mm	7
3S, sinew added	5	Shanks	Yes	3 mm	None	7

Fat for all treatments was prepared from beef trim by removing all visible lean, grinding through a 3 mm plate, freezing, and storing at -28°C in vacuum packages. Lean material for treatments 10C and 20C was beef knuckle (quadriceps muscle) trimmed of visible fat, vacuum packaged, frozen, and stored at -28°C until needed. Lean was ground through 10 mm and 3 mm plates and formulated (5 Kg batch) to 10 and 20% fat, respectively. The fat and lean were mixed for 1 minute, reground (3 mm plate), and made into 113-g patties.

Beef shanks were the lean source for the other six treatments. Fore and hind shanks from A-maturity, fed-beef carcasses were vacuum packaged and frozen for not more than 6 months. For the whole-ground shank (WGS) treatment, 5 Kg of tempered shanks were ground through the 10 mm and 3 mm plates, adjusted to 10 % fat, mixed for 1 minute, reground through the 3 mm plate, and made into 113-g patties.

Shanks for treatments 5/5NS, 5/5S, and 5/5S-F2x were passed through the Baader twice. The first pass used a 5 mm drum with a belt setting of 2. To obtain accurate yields, sufficient shank was passed through the drum to fill it with raw material, and then the drum was weighed prior to processing material for the treatments. Lean from the first pass was weighed and sampled for analysis. The drum and the material that bypassed the drum (first-pass sinew) were weighed to determine first-pass yields. First-pass sinew was then re-run through the Baader at belt setting 4. The drum, second-pass lean, and second-pass sinew were weighed to calculate second-pass yields. Second-pass lean and sinew were sampled for analyses.

Sinew for treatments 5/5S, 5/5S-F2x, 3/5S, and 3S was prepared by grinding the second-pass sinew through a 10 mm plate, freezing, and then flaking through the Urschel Commitrol. The flaked sinew was never allowed to thaw. For the 5/5S-F2x treatment, the flaked sinew was passed through the Urschel Commitrol a second time.

Lean meat blocks for treatments 5/5NS, 5/5S, and 5/5S-F2x were prepared by mixing first- and second-pass lean together in proportionate amounts and formulating to 10% fat. These mixtures with and without flaked sinew added back at 7% were mixed for 1 minute, reground through a 3 mm plate, and made into 113-g patties.

Shanks for treatments 3/5S and 3S were run through the Baader using a 3 mm drum and a belt setting of 3 to make the first-pass lean. As with the 5-mm material, the drum first was filled with lean and weighed prior to processing and yield calculations for these treatments. The first-pass sinew was then re-run through the Baader with the 5 mm drum and a belt setting of 4. Preliminary tests using the 3 mm drum for both passes resulted in reduced total lean yields. Treatment 3/5S was made by mixing proportionate amounts of 3 mm first-pass lean and 5 mm second-pass lean together and formulating to 10% fat. Then 7 % (by weight) flaked sinew was added. This treatment was mixed for 1 minute, reground through the 3 mm plate, and made into patties. Treatment 3S had only first-pass lean from the 3 mm drum, flaked sinew added at 7%, and 5 % fat. This mixture was mixed for 1 minute, reground through the 3 mm plate, and made into patties.

Patties were stacked two high on trays and blast frozen for 2 hours before they were vacuum packaged and stored at -28° C. Samples from each treatment were pulverized in liquid nitrogen and analyzed using AOAC (1990) procedures for moisture and fat (Foss-Let). Total collagen was extracted (Hill, 1966) and hydroxyproline determined (Bergman and Loxley, 1963). Patties from 20C, 10C, WGS, 5/5NS, and 5/5S were thawed and cooked on a grill (150° C) to 71° C. Portions of patties were served to a consumer panel ($n=70$) who scored patties for detectable particles of connective tissue and overall juiciness and acceptability. Data from three replications were analyzed using AOV procedures of SAS (1990), and when appropriate, T-tests were used to separate means.

RESULTS AND DISCUSSION

Yields (Table 1) of recoverable lean from two passes of shank meat through the Baader desinewer were over 92%, and the sinew removed from shanks was 6.5 to 7%. These values agree with those from large packers using similar technology in the USA. Yields of first- and second-pass leans varied with the hole size in the Baader drum and with the pressure applied to the drum by the rubber belt. Based on current prices of whole shanks and 90% lean trimmings, the value added by desinewing shanks would be $2 to 3 per 320 Kg carcass. If the 7% sinew could be modified and re-incorporated with the desinewed lean and sold at the 90% trimmings price, value added would increase to $3 to 5 per carcass.

The pH of meat from shanks (6.1) was 0.2 to 0.3 units higher than that of quadriceps muscle (5.8) from knuckles (Table 1). This higher pH would be beneficial for water-holding capacity in manufacturing meat and pH may help explain the greater juiciness scores

(Table 2) of patties made from shank.

Fat and collagen were significantly lower in lean passed one time through the desinewer than in whole shanks (Table 1). First-pass lean ranged from 4 to 8% fat depending upon the drum used. Thus, Baader technology can effectively improve lean content of a portion of the shank simultaneously while desinewing. Collagen in first-pass lean was reduced 27 to 47% depending upon the drum hole size; the smaller the holes, the greater the reduction in fat and collagen; however, product yields also decreased.

Ground beef patties made from whole shank and desinewed shank had a higher pH than patties made from knuckles (Table 2). Composition data of patties indicated that formulation goals for fat (20, 10, and 5%) were achieved. Collagen content was greater in patties made from whole ground shank (WGS) than in control patties (10C and 20C) made from quadriceps muscles. As expected, desinewing reduced collagen in treatments 5/5NS and 3S. Addition of 7% flaked sinew with desinewed lean resulted in collagen levels similar to those of WGS patties.

One purpose of this research was to determine if the removed sinew could be modified and re-incorporated with the desinewed lean as low-fat ground beef. Panelists found fewer detectable particles of connective tissue (Table 2) in treatments with (5/5S) and without (5/5NS) flaked sinew compared with WGS and the control treatments. Apparently, the collagen bound more water or the higher pH of the shank-containing patties increased juiciness. Although additional sensory work is needed to confirm these data, sinew modification and re-incorporation with desinewed lean appear promising.

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Table 1. Means for yields, composition, and pH of beef shank, knuckle, and fat tissues

Tissue	Yield, %	pH	Composition, %		Collagen, mg/g
			Moisture	Fat	
Desinewed shank 5mm drum, 2 passes					
1st-pass lean	72.8	5.99	72.1	7.0	10.5
1st-pass sinew	27.2	---	---	---	---
2nd-pass lean	19.6	6.11	67.5	13.6	13.8
1st plus 2nd leans	92.4	6.06	69.3	10.0	11.3
2nd-pass sinew	6.7	5.72	67.1	14.1	29.5
Desinewed shank 3 mm then 5 min drums					
1st-pass lean	66.1	6.15	73.1	5.3	7.6
1st-pass sinew	33.9	---	---	---	---
2nd-pass lean	25.1	6.12	63.6	18.8	27.9
1st plus 2nd leans	92.1	6.14	68.3	10.6	13.2
2nd-pass sinew	6.8	5.65	68.0	14.3	29.3
Whole shank	---	6.07[a]	69.5[b]	10.3[b]	14.5[a]
Knuckles	---	5.79[b]	76.5[a]	2.5[c]	5.3[b]
Fat	---	5.57[c]	14.1[c]	82.0[a]	---

[a,b,c] Means in a column with a different superscript letter are different ($P<0.05$).

Table 2. Means for pH, tissue composition, and consumer panel scores of ground beef made from desinewed shank

Treatment[d]	pH	Composition, %		Collagen, mg/g	Consumer panel scores		
		Moisture	Fat		Particle detection	Overall juiciness	Overall acceptability
20C	5.80[b]	63.4[c]	19.0[a]	5.2[b]	3.1	4.2	4.6
10C	5.81[b]	70.8[b]	9.4[b]	5.3[b]	2.7	3.9	4.3
WGS	6.08[a]	69.6[b]	10.4[b]	14.5[a]	4.5	6.1	6.0
5/5NS	6.02[a]	69.4[b]	11.2[b]	6.1[b]	4.0	5.5	6.2
5/5S	6.06[a]	68.4[b]	11.5[b]	14.8[a]	3.9	5.5	6.3
3/5S	6.12[a]	68.7[b]	11.0[b]	14.3[a]	---	---	---
5/5S-F2x	6.04[a]	68.7[b]	11.3[b]	12.3[a]	---	---	---
3S	6.07[a]	72.0[a]	7.0[c]	9.5[ab]	---	---	---

[a,b,c] Means in a column with a different superscript letter are different ($P<0.05$).
[d] 20C and 10C = 20 and 10% fat control beef knuckle; WGS = whole ground shank; 3 and 5 = 3 or 5 mm drum; NS = no sinew added; S = 7% flaked sinew added to desinewed shank; F2x = sinew flaked twice and added to desinewed shank.