BINDING AGENTS FOR LOW-SALT, LOW-FAT, RESTRUCTURED BEEF ROASTS: FISH SURIMI AND BEEF HEART OR SKELETAL MUSCLE

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Summary

Five percent fish surimi, unwashed or washed ground beef, and washed or unwashed beef hearts were evaluated in precooked, chunked and formed, restructured beef roasts to determine if they would increase bind in low-salt (0.2% NaCl) product. An industry-like product with 1.0% NaCl and 5% unwashed ground beef was prepared, as well as a product with 0.2% NaCl and no binder. Roasts without binder were comparable in texture and integrity to those prepared with binding agents. Washing ground heart improved the sensory traits, texture measured instrumentally, and oxidative stability of the resulting products. Color was more stable for roasts containing ground heart. Roasts with 1.0% NaCl were firmer ($P < .05$) and had greater tensile strength ($P < .05$) than all other treatments. Adding salt increased binding more than adding binders, even though acceptable products could be made with minimal salt. Using binders with or without washing is not recommended, unless processors want to expand use of beef hearts.

(Key words: Restructured, Beef, Low-salt, Bind, Muscle Washing.)

Introduction

As a result of greater concern over fat and its impact on coronary heart disease and because of consumer health concerns, emphasis has been placed on technology to produce low-salt, low-fat, meat products. But when salt is reduced in restructured products, processing and texture problems may arise. These effects can be partially overcome through the use of phosphates. More recently, fish surimi, a protein concentrate prepared from mechanically deboned fish, has been utilized as a binder. However, the cattle industry could benefit if a binder could be made from beef. Our experiment was designed to study the feasibility of manufacturing low-salt, low-fat, precooked, beef products; to determine if washing ground beef and hearts would improve their utility as binding adjuncts; and to determine if, in fact, binders are necessary in restructured roasts.

Experimental Procedures

Beef skeletal muscle from inside rounds and hearts (cardiac muscle) were separately ground through a one-eighth inch plate and mixed for 15 min with 5 volumes of tap water. Then the slurry was allowed to stand for 30 min. Water was decanted and the remaining residue was wrapped in cheesecloth and manually pressed to remove additional water. Total volume of water thus removed was recorded, then an equal volume of fresh water was added back, and the process was repeated. Following the second filtering and pressing, the residue was centrifuged, and the same levels of phosphate and sugar that were present in fish surimi were added as cryoprotectants.

Commercial fish surimi and the washed and unwashed ground beef skeletal muscle and hearts were each mixed with 4.0% salt, and the moisture content was standardized; then the binder blends were stored for 12 h at 38 to 40°F. Three major muscles from A-maturity beef chucks were manually trimmed of connective tissue and fat, chunked through a kidney plate, and stored for 12 h at 38 to 40°F. Then 5% binder was mixed with 95% muscle chunks, resulting in .2% salt in the raw product. Two additional treatments were evaluated: 1) 100% chunks, no binder, .2% NaCl; and 2)

95% chunks, 5% unwashed skeletal muscle, 1.0% NaCl. After air was evacuated the material was stuffed into #6, prestuck, fibrous casing and cooked to 147°F.

Proximate composition, instrumental and sensory texture, sensory flavor. and fat stability of the finished products were evaluated. Mineral content of each binder was measured.

Results and Discussion

Moisture ranged from 71 to 72%, fat from 3.9 to 4.3%, protein from 22 to 24%, and ash from 1.4 to 2.3% for cooked products. Products with 5% unwashed skeletal muscle and 1.0% NaCl (USM/1.0) had the highest ($P < .05$) Instron hardness, cohesiveness, and tensile strength values (Table 1). Although 1.0% NaCl was not sufficient to solubilize myosin, it did promote enough hydration for protein-water and protein-protein interactions during cooking to preserve structural integrity. Sensory evaluation (Fig. 1) showed that the product with 1.0% NaCl was firmer ($P < .05$) and more brittle than those of other treatments. At the 0.2% NaCl level (Fig. 1), products without binder (0/0.2)) were firmer ($P < .05$) than products with unwashed cardiac (heart) muscle (UCM/0.2) and commercial fish surimi (FS/0.2). Products without added binder (0/0.2) also had higher tensile strength (Table 1) than products with unwashed ground heart (UCM/0.2). Washing heart muscle increased ($P < .05$) firmness compared to unwashed cardiac muscle. Both unwashed and washed ground heart increased ($P < .05$) bloody-serumy flavor (Fig. 2) compared to all products, except those containing fish surimi. Higher TBA (thiobarbituric acid) numbers are an indication of more fat rancidity. Washing reduced ($P < .05$) 24-h TBA numbers (Fig. 3); however, those products still had higher ($P < .05$) TBA numbers than all other products, except those made without binder. Higher bloody-serumy scores and TBA numbers for heart (cardiac muscle) may be the result of higher iron levels; iron contributes to metallic flavor and acts as a prooxidant. Unwashed and washed heart contained 49 and 31 µg of iron per gm of tissue, respectively, compared to 23 µg/g for unwashed skeletal muscle, 7.3 µg/g for washed skeletal muscle, and 4.3 µg/g for fish surimi.

High (1%) salt was more effective in improving texture than any of the other treatments. All low-salt (0.2%) products had acceptable texture, even without binder addition. Muscle washing and binder addition are not necessary, unless the processor wants to expand the use of beef hearts.

Table 1. Instron Tensile Strength, Hardness, and Cohesiveness of Precooked, Restructured Beef Formulated with Either .2 or 1.0% NaCl and Either with or without Unwashed and Washed Skeletal (USM and WSM) and Cardiac (UCM and WCM) Muscle and Fish Surimi (FS)

Treatment	Tensile strength (gm/cm^2)[a]	Hardness (KG)[b]	Cohesiveness[c]	Cook yield (%)
USM/.2	421.3[ef]	24.8[de]	28.6[d]	91.0[d]
WSM/.2	474.5[f]	25.6[de]	33.0[d]	94.2[e]
UCM/.2	342.9[d]	24.9[de]	27.4[d]	93.1[de]
WCM/.2	438.2[ef]	26.8[de]	30.9[d]	91.6[de]
FS/.2	380.1[de]	22.9[d]	33.2[d]	94.2[e]
0/.2	443.0[ef]	29.5[e]	29.9[d]	91.9[de]
USM/.0	637.0[g]	42.2[f]	43.4[e]	92.6[de]

[a]Tensile strength.
[b]Peak force of first compression to 50% of height.
[c](Total energy of second compression/total energy of first compression) × 100.
[defg]Columns only ($P < .05$).

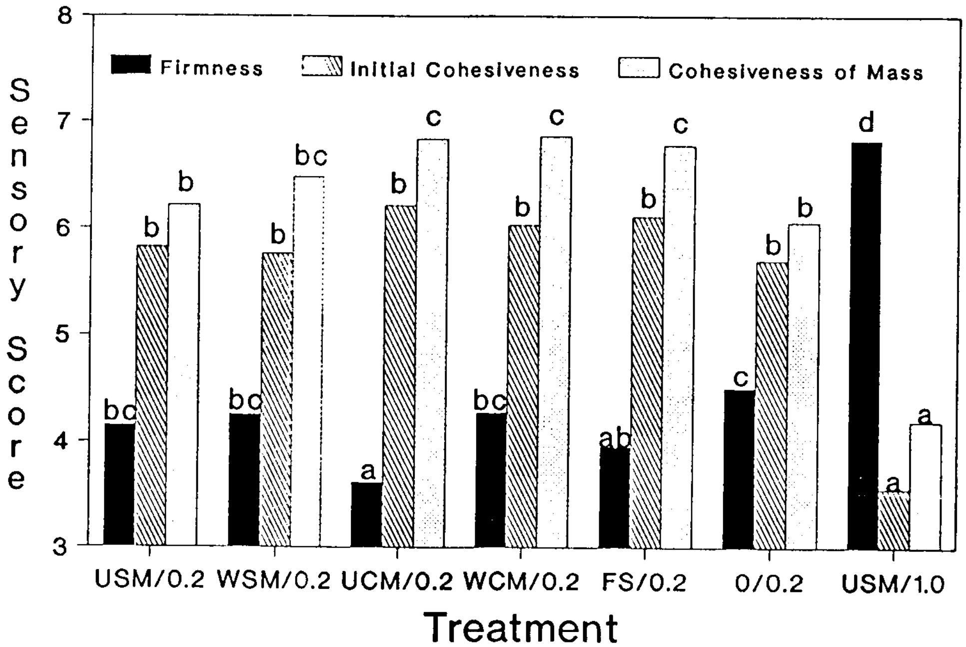

Figure 1. Sensory Textural Attributes of Precooked, Restructured Beef Formulated with Either .2% NaCl or 1.0% NaCl and Either with or without Unwashed and Washed Skeletal (USM and WSM) and Cardiac (UCM and WCM) Muscle and Fish Surimi (FS). ([abcd]$P < .05$).

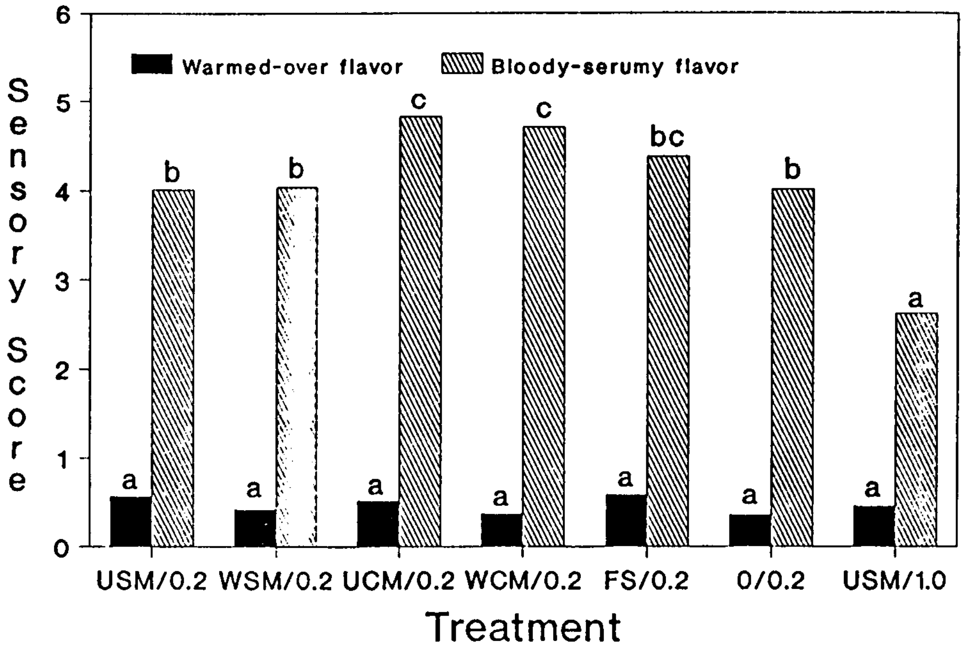

Figure 2. Sensory Flavor Attributes of Precooked, Restructured Beef Formulated with Either .2 or 1.0% NaCl and Either with or without Unwashed and Washed Skeletal (USM and WSM) and Cardiac (UCM and WCM) Muscle and Fish Surimi (FS) ([abc]$P<.05$).

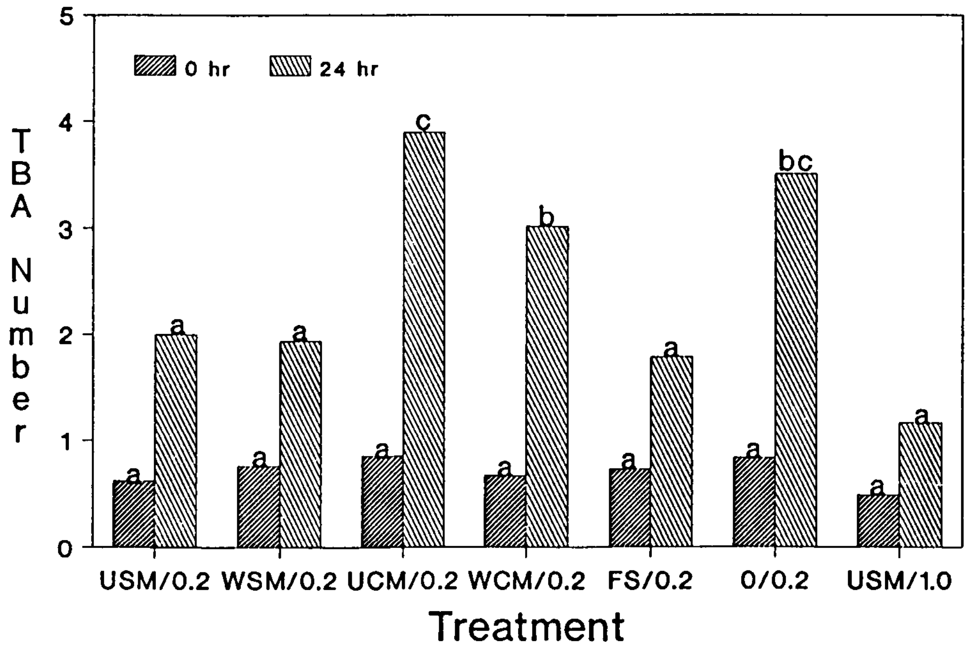

Figure 3. TBA Numbers (µg malonaldehyde/g) of Precooked, Restructured Beef Formulated with Either .2 or 1.0% NaCl and Either with or without Unwashed and Washed Skeletal (USM and WSM) and Cardiac (UCM and WCM) Muscle and Fish Surimi (FS) ([abc]$P<.05$).