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Enhancement of Beef Chuck and Round Muscles with Ammonium Hydroxide

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Summary

By increasing muscle pH with ammonium hydroxide, shear force values of triceps brachii, biceps femoris, and rectus femoris were decreased and sensory scores for tenderness improved with higher levels of added solution. Any level of treatment was beneficial. In all cases, there were no shear force differences between steaks pumped to 15% and 22.5%. Ultimate pH was strongly related to shear force values. These data suggest adjusting pH in beef with 20% of a solution of ammonium hydroxide can increase tenderness in beef chuck and round muscles.

Introduction

Tenderness is one of the major factors affecting consumer acceptability of beef steaks.

Due to the large tenderness inconsistencies between carcasses, muscles, and locations within a muscle, enhancement procedures have been developed to create a more consistent product. Traditionally enhancement has been done with a solution of water, salt, and phosphates. A new procedure injects a solution comprised of water, salt, ammonium hydroxide, and carbon monoxide. Currently this enhancement procedure is done on high-value cuts from the loin. The objectives of this study were to evaluate the tenderness of low-valued muscles from the beef chuck and round when enhanced with this solution at varying pump levels, and to determine the optimum pump level for the muscles.

Procedure

This study examined four pump levels (0%, 15%, 22.5%, and 30%) on three muscles from the beef chuck and round (triceps brachii, biceps femoris, rectus femoris). Beef clod hearts, sirloin caps, and knuckles (n=60 each) were randomly assigned to each treatment and one of three replications. Subprimals were injected with a solution containing water, salt, ammonium hydroxide, and carbon monoxide (patent pending technology from Freezing Machines, Inc.) at Beef Product Inc.'s facility in Dakota City, Neb. Three steaks were cut from each subprimal to a thickness of 1 inch, trimmed of excess fat and other muscles, vacuum packaged in trays, and frozen. Steaks were then shipped to the University of Nebraska Loeffel Meat Lab where they were used for determination of Warner-Bratzler shear force, pH, and trained taste panel ratings. Thaw loss, cook loss, and cook time were also recorded when steaks were cooked for Warner-Bratzler shear force and trained taste panels. A trained taste panel evaluated steaks for tenderness, connective tissue, juiciness, and off-flavor on eight-point scales (8=extremely tender, no connective tissue, extremely juicy, no off-flavor; 1=extremely tough, abundant amount of connective tissue, extremely dry, extreme off-flavor).

Table 1. Taste panel ratings[1] and shear force values between varying pump levels for each muscle.

Muscle	Tenderness	Connective Tissue	Juiciness	Off-Flavor	Shear force, lbs
Clod (Triceps brachii)					
0%	5.49 [a]	5.44 [a]	5.29 [a]	7.22 [a]	8.97 [a]
15%	6.14 [b]	5.97 [b]	5.77 [b]	7.52 [b]	7.89 [b]
22.5%	6.56 [c]	6.36 [c]	6.17 [c]	7.49 [b]	7.21 [b]
30%	7.07 [d]	6.67 [d]	6.66 [d]	7.52 [b]	6.06 [c]
SE	0.15	0.15	0.18	0.11	0.13
Knuckle (Rectus femoris)					
0%	5.33 [a]	5.11 [a]	5.47 [a]	6.76 [a]	9.59 [a]
15%	6.00 [b]	5.76 [b]	5.58 [a]	7.07 [b]	7.39 [b]
22.5%	6.20 [b]	5.93 [b]	5.84 [ab]	7.08 [b]	6.90 [bc]
30%	6.35 [b]	5.96 [b]	6.18 [b]	7.16 [b]	6.50 [c]
SE	0.21	0.22	0.22	0.11	0.13
Sirloin cap (Biceps femoris)					
0%	5.71 [a]	5.65 [a]	5.61 [a]	6.80 [a]	8.86 [a]
15%	7.12 [b]	6.75 [bc]	6.34 [bc]	7.36 [b]	5.89 [b]
22.5%	7.00 [b]	6.65 [b]	6.24 [b]	7.45 [b]	5.24 [b]
30%	7.46 [c]	7.10 [c]	6.66 [c]	7.46 [b]	4.34[c]
SE	0.16	0.18	0.18	0.13	0.14

[1]Taste panel ratings based on 8-point scale (8=extremely tender, no connective tissue, extremely juicy, no off-flavor; 1=extremely tough, abundant amount of connective tissue, extremely dry, extreme off-flavor.
[a,b,c,d]Means within the same column with different superscripts are significantly different ($P<0.05$).

Results

For all muscles (Table 1), shear force decreased as the target pump level increased ($P<0.05$). In all cases but one (juiciness of the rectus femoris), the control had the least desirable ratings and shear force values ($P<0.05$). There were no significant shear force differences between the 15% and 22.5% pump levels ($P>0.05$). Table 1 shows as percentage pump increased, pH increased. The ultimate pH was strongly related to shear force (r=0.70, 0.80, and 0.55 for Triceps brachii, Biceps femoris, and Rectus femoris, respectively). Generally, a higher pH means a greater amount of water is held within the tissue, often resulting in lower shear force values. Trained taste panels revealed an increase in tenderness, decrease in connective tissue, and an increase in juiciness as pump level increased for all muscles. The optimum target pump level was determined to be 20% due to the fact that muscles pumped to 30% tended to have an uncharacteristic soft and mushy texture, as well as the fact that there were no significant characteristic differences between muscles pumped to 15% and 22.5%.

Data show that enhancement with ammonium hydroxide and salt is effective in low-value muscles from the beef chuck and round. In addition, the optimum pump level for all muscles was determined to be 20%.

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