1985

Variation in Sensory Properties of Meat as Affected by Sex Condition, Muscle, and Postmortem Aging

Steven C. Seideman
MARC

John D. Crouse
MARC

Variation in Sensory Properties of Meat as Affected by Sex Condition, Muscle, and Postmortem Aging

Steven C. Seideman and John D. Crouse[1]

Introduction

For several decades, the sensory properties of beef, particularly tenderness, have been of interest to the meat industry. Variations in sensory properties of beef have been attributed to muscle cut or muscle and postmortem aging. The objective of this study was to examine the sensory properties of five beef muscles, determine the contribution of connective tissue (i.e., collagen) to tenderness, and investigate the response of various muscles to postmortem aging.

Procedure

Eight bulls and eight steers of similar backgrounds were slaughtered. The longissimus dorsi (LD; ribeye), psoas major (PM; tenderloin), semitendinosus (ST; eye of round), semimembranosus (SM; top round), and biceps femoris (BF; bottom round) muscles were removed from the right and left sides of each carcass 24 h postmortem. The muscles from the right sides of all carcasses were immediately frozen (24 h postmortem) while the muscles from the left sides of all carcasses were aged at refrigeration temperatures for 7 days prior to freezing.

After freezing, all muscles were cut into steaks. Steaks were used for sensory panel evaluations, shear force determinations, and compositional properties. Sensory panel evaluations were conducted using an 8-member panel. Panelists rated steaks for juiciness, ease of fragmentation, amount of connective tissue, tenderness, and flavor intensity. Cores (1.3 cm) from cooked steaks were also sheared on an Instron Universal testing machine equipped with a Warner-Bratzler shear device. One steak from each carcass and each muscle was powdered in liquid nitrogen and analyzed for percentage fat, amount of collagen (expressed on a wet basis and fat-free basis), and percentage soluble collagen.

Results

Sensory and compositional properties of five bovine muscles are shown in Table 1. The psoas major muscle was the most juicy and most tender of all muscles. Muscles were ranked in order of sensory ratings; PM>ST>LD>BF>SM. The amount of fat (intramuscular) was highest in the PM muscle and lowest in the SM muscle. The amount of collagen on a fat-free basis was ranked LD>ST>BF>PM>SM. The percentage collagen solubility was ranked LD>PM>ST>BF>SM.

Simple correlation coefficients between compositional components and tenderness and shear force at 1 and 7 days postmortem are presented in Table 2. The percentage of fat within a muscle was significantly correlated to tenderness at 1 and 7 days postmortem and to shear force at 7 days postmortem. The amount of collagen was negatively correlated to tenderness and shear force at 1 and 7 days postmortem, whereas the percentage soluble collagen was never significantly correlated to tenderness or shear force.

Mean values for tenderness and shear force stratified by muscle and postmortem aging period are shown in Table 3. Sensory tenderness ratings were not affected by aging period; however, shear force values were lower after 7 days of aging as compared to samples aged for only 1 day.

The results suggest that muscles vary considerably in tenderness, but neither the amount or the percentage collagen solubility are solely responsible for differences in the tenderness between muscles, although the amount of collagen was, by far, the more closely correlated to tenderness differences. The sensory panel tenderness ratings did not appear to reflect any differences in aged muscle samples; whereas shear force values were substantially lower for muscles aged 7 days, as opposed to muscles aged for only 1 day. Research is continuing to determine why muscles differ in tenderness.

[1]Seideman is a research food technologist and Crouse is the research leader, Meats Unit, MARC.

Table 1.—Sensory and compositional properties of five bovine muscles

	Muscle				
Property	Longissimus dorsi	Psoas major	Semitendinosus	Semimembranosus	Biceps femoris
Sensory properties					
Juiciness[e]	5.3[b]	5.8[a]	5.2[b]	4.9[c]	5.2[b]
Ease of fragmentation[f]	4.7[c]	5.9[a]	4.9[b]	4.5[c]	4.6[c]
Amount of connective tissue[g]	4.6[c]	5.9[a]	4.8[b]	4.4[c]	4.5[c]
Tenderness[h]	4.8[bc]	5.9[a]	4.9[b]	4.7[c]	4.8[bc]
Flavor intensity[i]	5.7[d]	5.9[a]	5.7[cd]	5.8[bc]	5.9[ab]
Shear force (lb)	13.39[a]	5.49[d]	8.83[c]	9.37[bc]	10.10[b]
Compositional properties					
Fat (pct)	2.67[b]	3.43[a]	2.27[b]	1.36[c]	2.17[b]
Amount of collagen (mg/g)	5.73[b]	3.18[c]	7.53[a]	5.05[b]	7.43[a]
Collagen solubility (pct)	26.7[a]	16.6[b]	15.9[b]	9.1[c]	14.5[b]
Amount of collagen (mg/g) fat free	1.54[a]	0.56[c]	1.25[ab]	0.51[c]	1.10[b]

[abcd]Means on the same line followed by a common superscript are not different.
[e]Means based on an 8-point scale (8 = extremely juicy; 1 = extremely dry).
[f]Means based on an 8-point scale (8 = extremely easy; 1 = extremely difficult).
[g]Means based on an 8-point scale (8 = none; 1 = abundant).
[h]Means based on an 8-point scale (8 = extremely tender; 1 = extremely tough).
[i]Means based on an 8-point scale (8 = extremely intense; 1 = extremely bland).

Table 2.—Simple correlation coefficients between compositional components and tenderness and shear force at 1 and 7 days postmortem

Compositional components	Tenderness		Shear force	
	1 day	7 days	1 day	7 days
Fat (pct)	0.39***	0.59***	−0.19	−0.40***
Amount of collagen . . .	−0.42***	−0.33**	−0.42***	0.32**
Collagen solubility	−0.02	0.16	0.08	0.13

**P<0.01
***P<0.001

Table 3.—Mean values for tenderness and shear force stratified by muscle and postmortem aging period

Tenderness parameter	Postmortem aging period (days)	Muscle				
		Longissimus dorsi	Psoas major	Semitendinosus	Semimembranosus	Biceps femoris
Sensory tenderness	1	4.6	5.8	5.1	4.9	4.7
	7	4.8	5.9	4.9	4.7	4.8
Shear force (lb)	1	17.5	6.9	9.1	10.6	10.8
	7	9.6	5.4	8.1	8.3	9.1