INFLUENCE OF USDA QUALITY AND YIELD GRADE ON PERCENT FAT, WARNER-BRATZLER SHEAR AND COOKING LOSS OF CHUCK MUSCLES

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Story in Brief

Neither quality grade nor yield grade significantly affected Warner-Bratzler shear or cooking loss of the chuck muscles tested. Chuck muscles from U.S. Choice carcasses had significantly higher percent fat than those from U.S. Good carcasses (5.21% vs 3.73%). Large variations were observed among chuck muscles for all traits. Some large chuck muscles may be tender enough to be used as steak meat if they were separated and trimmed as outlined in this study. There was a strong positive relationship between marbling and percent fat of chuck muscles. Warner-Bratzler shear value was correlated negatively with marbling or percent fat of the chuck muscles, but the relationship was low.

(Key Words: Quality Grade, Yield Grade, Chuck Muscles, Warner-Bratzler Shear, Cooking Loss)

Introduction

The wholesale beef chuck comprises over 26% of the beef carcass, but because of variability in tenderness and size of muscles, chuck has been merchandised in the form of low-priced roasts, stew and ground beef. However, current industrial practices such as the "boxed beef" concept have developed rapidly (Breidenstein, 1982) and make muscle groups and even single muscles available to consumers and processors. Thus, knowledge of beef chuck muscles could determine the optimum use of beef chuck.

Traditionally, intramuscular fat (marbling) has been thought to affect palatability; however, the studies of Tatum et al. (1982) and McKeith et al. (1985) showed positive but low relationships between marbling (or percent fat) and tenderness.

Few studies, however, have examined the influence of USDA quality and yield grade on the tenderness of chuck muscles. Paterson and Parrish (1986) evaluated the effect of USDA quality and yield grades on the tenderness of 9 chuck muscles. Steaks from U.S. Choice carcasses had lower ($P<.05$) amounts of detectable connective tissue and Warner-Bratzler shear (WBS) values and received higher ($P<.05$) overall palatability scores than those from U.S. Good carcasses, but those differences were small. They also found that sensory panel attributes and WBS values of steaks were not ($P>.05$) affected by yield grade.

The purpose of this study was to investigate the influence of USDA quality and yield grade on percent fat, WBS and cooking loss properties of chuck muscles; and to determine differences in these properties among 20 muscles from the square-cut chuck.

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Materials and Methods

Beef forequarters were selected from 16 steer carcasses (4 U.S. Choice, Yield Grade (YG) 2; 4 U.S. Choice, YG-3; 4 U.S. Good, YG-2; 4 U.S. Good, YG-3) in a commercial packing plant (USDA, 1975). Forequarters were held at 4 C for 4-5 days postmortem, and then fabricated into wholesale square-cut chucks (NAMP, 1983). Chucks were trimmed of subcutaneous fat and dissected to facilitate the complete separation of the following 20 muscles: biceps brachii, (BB); brachialis, (BC); brachiocephalicus and omotransversarius group, (BO); complexus, (CP); deep pectoral, (DP); deltoideus, (DT); extensor carpi radialis, (ECR); infraspinatus, (IF); latissimus dorsi, (LAD); longissimus dorsi, (LD); rhomboideus, (RB); serratus ventralis, (SV); splenius, (SL); subscapularis, (SB); superficial pectoral, (SP); supraspinatus, (SS); teres, (TR); trapezius, (TP); triceps brachii lateral head, (TBLA); and triceps brachii long head, (TBLO). The above twenty muscles were trimmed of intermuscular fat, tendon and visible epimysial connective tissue, and then weighed. Quality and YG characteristics of the 16 steer carcasses used for square-cut chucks are reported in the companion report (Choi et al., 1987).

Two steaks (2.54 cm) for Warner-Bratzler shear (WBS) determination (measurement of resistance to shear the steak) were obtained from the longitudinal center, vacuum packaged and frozen (-30 C) for subsequent analysis. The remaining portion of each muscle was coarsely ground, then finely ground and thoroughly homogenized with a Sorvall Omnimixer for 5 min, and then analyzed for percent fat (AOAC, 1980).

Steaks for WBS determination were thawed for 12-18 hr at 3 C and then broiled to an internal temperature of 70 C. Copper-constantan thermocouples were inserted into the approximate geometric center of each steak and attached to an Omega OM-202 Temperature Logger. Each steak was weighed both before and after cooking for cooking loss. After the steaks had cooled to room temperature, 2 cores (1.27 cm) were removed from each steak. Each core was sheared perpendicular to the muscle fibers using a WBS apparatus attached to a model 1122 Instron Universal Testing Machine. The crosshead speed was 100 mm/min and the chart speed was 200 mm/min.

Data was analyzed as a 2 x 2 factorial arrangement of treatments in a split-plot design using the Statistical Analysis System. Differences between muscles were analyzed by Duncan's Multiple Range test.

Results and Discussion

Influence of quality and yield grade (YG) on percent fat, WBS and cooking loss of square-cut chuck muscles are shown in Table 1. Chuck muscles from U.S. Choice carcasses had higher ($P < .05$) percent fat than those from U.S. Good carcasses (5.21% vs 3.73%). Chuck muscles from YG-3 carcasses had slightly higher percent fat than those from YG-2 carcasses. Although chuck muscles from U.S. Choice or YG-3 carcasses had lower WBS values than those from U.S. Good or YG-2 carcasses, the differences were not significant. This result partially agrees with those of Parrish et al. (1973) and Tatum et al. (1980), who reported that even though there was a trend for higher acceptability with increasing marbling scores, none of the taste panel scores or WBS values was affected by degree of marbling. According to Paterson and Parrish

Table 1. Influence of quality and yield grade (YG) on percent fat, WBS and cooking loss of square-cut chuck muscles.

Property	Quality grade[a]		Yield grade[a]		S.E.[b]
	Good[a] (N=8)	Choice[a] (N=8)	YG-2[a] (N=8)	YG-3[a] (N=8)	
Percent fat	3.73[c]	5.21[d]	4.07	4.86	0.33
WBS (kg)	5.19	4.62	5.07	4.73	0.19
Cooking loss (%)	27.54	28.36	28.05	27.85	1.12

[a]Based on descriptions included in USDA (1975) beef grade standard.
[b]Standard error of the mean.
[cd]Means in same main effect row with different superscripts differ (P<.05).

(1986), steaks from U.S. Choice grade carcasses had lower (P<.05) amounts of detectable connective tissue and WBS values and received higher (P<.05) overall palatability scores than those from U.S. Good grade carcasses, but those differences were small. They also found that sensory panel attributes and WBS values of steaks were not (P>.05) affected by YG. There were no differences (P>.05) in cooking loss of chuck muscles either between quality grade or yield grade in this study.

There were great variations in weight, percent fat, WBS and cooking loss of 20 chuck muscles (Table 2). The SV and TBLO were the largest (P<.05) muscles (2.52 kg and 2.40 kg, respectively) while the ECR was the smallest (0.11 kg, P<.05). For percent fat of muscle where all external fat and epimysial connective tissue were removed, the SV and IF showed the highest (P<.05) values (8.3% and 7.7%, respectively) while the ECR and SL had the lowest values (1.2% and 2.0%, respectively). For WBS value of chuck muscles, the IF had the lowest WBS value (2.97 kg) while the RB showed the highest WBS value (6.27 kg). This result agrees with those of Ramsbottom and Strandine (1948) and Paterson and Parrish (1986), who reported that the IF was the most tender muscle while the RB was the least tender muscle in the chuck. In this study, larger chuck muscles such as the SV, TBLO and IF had lower WBS values (more tender) than the LD while only the RB, BO, ECR, TBLA, BC, SL and TP showed higher WBS values (less tender) than the LD. In addition, the LD from "A maturity" carcasses is considered tender enough for dry heat cookery (NLSMB, 1973). Therefore, these results indicate that some large chuck muscles may be tender enough to be used as single steaks. For cooking loss, the SL and SB were the highest group (31.8% and 31.6%, respectively) while the ECR was the lowest muscle (23.6%).

Partial correlation coefficients between selected carcass characteristics and muscle properties of square-cut chuck are shown in Table 3. YG was correlated positively with percent fat (r=0.29, P<.05) and negatively with WBS value (r=-0.17, P<.05); however, their relationships were low. There was a strong (P<.01) positive relationship (r=0.50) between marbling and percent fat in chuck muscles. This result agrees with that of Campion et al. (1975). WBS was correlated negatively with marbling (r=-0.10) or percent fat (r=-0.22, P<.05) of chuck muscles; however, the relationship was low.

Table 2. Rank of twenty muscles from square-cut chuck by weight, percent fat, WBS and cooking loss[m].

Muscle rank	Muscle weight (kg)	Percent fat	WBS (kg)	Cooking loss (%)
1	SV 2.52[a]	SV 8.3[a]	IF 2.97[a]	SL 31.8[a]
2	TBLO 2.40[a]	IF 7.7[a]	BB 3.78[ab]	SB 31.6[a]
3	BO 1.76[b]	SP 6.1[b]	SV 4.04[bc]	DT 30.9[a]
4	IF 1.73[b]	TP 5.7[bc]	TR 4.27[bcd]	BC 30.0[ab]
5	CP 1.30[c]	RB 5.7[bc]	TBLO 4.35[bcd]	TBLA 29.8[ab]
6	DP 1.20[cd]	CP 5.0[bcd]	SB 4.42[bcd]	TR 29.7[ab]
7	SS 1.13[de]	BB 4.9[bcd]	CP 4.51[bcd]	SS 29.3[abc]
8	RB 1.01[e]	LAD 4.8[cde]	LD 4.58[bcd]	CP 29.2[abc]
9	SL 0.75[f]	LD 4.8[cde]	DP 4.91[cde]	RB 29.1[abc]
10	TP 0.67[fg]	SS 4.1[def]	SS 4.92[cde]	SV 28.4[abc]
11	LAD 0.66[fg]	BO 4.0[def]	LAD 4.96[cde]	TBLO 27.1[bcd]
12	TR 0.58[gh]	DT 4.0[def]	SP 4.99[cde]	DP 27.0[bcd]
13	SB 0.54[gh]	TBLA 3.8[def]	DT 5.19[de]	TP 26.8[bcd]
14	TBLA 0.45[hi]	TBLO 3.8[def]	TP 5.25[e]	SP 26.6[bcd]
15	DT 0.40[ij]	TR 3.7[ef]	SL 5.31[ef]	LAD 26.5[bcd]
16	BB 0.37[ijk]	DP 3.6[ef]	BC 5.62[efg]	IF 26.1[bcd]
17	LD 0.31[jk]	BC 3.2[fg]	TBLA 5.66[efg]	BO 26.0[bcd]
18	BC 0.29[jk]	SB 3.2[fg]	ECR 5.82[efg]	LD 24.8[cd]
19	SP 0.25[k]	SL 2.0[gh]	BO 6.24[fg]	BB 24.7[cd]
20	ECR 0.11[l]	ECR 1.2[h]	RB 6.27[g]	ECR 23.6[d]

[a-l]Means in same column with different superscripts differ (P<.05).
[m]BB=biceps brachii; BC=brachialis; BO=brachiocephalicus and omotransversarius; CP=complexus; DP=deep pectoral; DT=deltoideus; ECR=extensor carpi radialis; IF=infraspinatus; LAD=latissimus dorsi; LD=longissimus dorsi; RB=rhomboideus; SV=serratus ventralis; SL=splenius; SB=subscapularis; SP=superficial pectoral; SS=supraspinatus; TR=teres; TP=trapezius; TBLA=triceps brachii lateral head; and TBLO=triceps brachii long head.

Table 3. Partial correlation coefficients between selected carcass characteristics and muscle properties of square-cut chuck.

	Marbling[a]	Percent fat	Cooking loss (%)	WBS(kg)
YG[a]	0.04	0.29*	0.04	-0.17*
Marbling[a]		0.50**	0.05	-0.10
Percent fat			-0.02	-0.22*
Cooking loss				0.16

[a]Based on descriptions included in USDA (1975) beef grade standard.
*P<.05
**P<.01

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