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CARCASS CHARACTERISTICS, MUSCLE COMPONENTS, AND PALATABILITY ASSESSMENTS OF MEAT FROM *CALLIPYGE* VERSUS NORMAL LAMBS

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INTRODUCTION: A genetic mutation that causes extreme muscling in sheep has been identified (Cockett et al., 1993). Market lambs that display this extreme muscle hypertrophy phenotype, referred to as *Callipyge*, are very lean and muscular in appearance. While this phenotype seems desirable to the producer, there remain questions about the use of these extremely muscular animals in the meat industry. Initial research indicates that muscle from these lambs is less palatable than muscle from lambs with normal muscle phenotype (Jackson et al., 1994a). With the possible benefits from the inclusion of this phenotype into the commercial lamb population from a producer standpoint, the objective of this study was to determine the effect of extreme muscle hypertrophy on quality and palatability of meat by examining specific factors responsible for tenderness and palatability.

MATERIALS AND METHODS: Wethers expressing a normal phenotype (control, n = 10) and extreme muscle hypertrophy (*Callipyge*, n = 9) were obtained and fed at the Texas A&M University Sheep Center. Lambs were slaughtered at the Rosenthal Meat Science and Technology Center upon reaching maximum growth potential. To characterize the population, live weight (kg), hot carcass weight (kg), fat thickness (cm), ribeye area (cm^2), and kidney and pelvic fat (%) were measured, and a USDA yield grade was assigned to each animal. From each carcass, Biceps femoris (BF), Semitendinosus (ST), Semimembranosus (SM), M. longissimus (LD), and Triceps brachii (TB) were identified and samples were excised for subsequent analysis. Calpastatin enzyme activity at 24 hours postmortem (Shackelford et al., 1994), sarcomere length (Cross et al., 1981), and fat and moisture percentages (AOAC, 1990) were determined for the five muscles. Warner-Bratzler shear force and trained sensory panel (Cross et al., 1978) of BF and LD were determined. Data were analyzed using GLM procedure of SAS (1990) with a significance level of $P < .05$. Unadjusted means were reported for live animal and carcass characteristics, and means were separated using Tukey's Studentized Range Test ($P < .05$). Least-squares means were generated for chemical, sensory and shear attributes. These means were tested for significance ($P < .05$) using Bonferoni's procedure (Lenter and Bishop, 1993).

RESULTS AND DISCUSSION: Carcass weights did not differ, but fat thickness was lower, ribeye area was higher, and USDA yield grade was lower for lambs expressing muscle hypertrophy (Table 1). There was no ($P > .05$) treatment by muscle interaction for calpastatin activity; however, there was a significant treatment effect. *Callipyge* muscles had higher ($P > .05$) calpastatin activity levels than control muscles (3.11 versus 2.47). Across muscles, those from the leg

Table 1. Mean characteristics ± SE of control (n = 10) and *Callipyge* (n = 9) lambs

Trait	Control	*Callipyge*
Live weight, kg	$56.7^a \pm .6$	$52.3^b \pm .9$
Hot carcass weight, kg	$32.3 \pm .7$	$32.2 \pm .7$
Fat thickness, cm	$.56^a \pm .05$	$.30^b \pm .05$
Ribeye area, cm^2	$16.6^b \pm .9$	$24.4^a \pm .6$
Kidney/pelvic fat, %	$1.7 \pm .2$	$1.1 \pm .2$
USDA yield grade	$2.6^a \pm .2$	$1.6^b \pm .2$

^{a,b} Means within a row lacking a common superscript letter differ ($P < .05$).

had similar ($P > .05$) calpastatin activity levels (BF = 2.64, ST = 2.89, SM = 2.64), but the TB had the highest ($P < .05$) activity level (3.35). The LD muscle had the lowest calpastatin activity (2.43), but did not differ in calpastatin activity from the BF and SM. *Callipyge* muscles exhibited a higher ($P < .05$) percentage of moisture than the control group (74.71 versus 73.74).

Fat percentages (Table 2), except for the BF, were higher for the control muscles versus *Callipyge* muscles. Sarcomeres from the *Callipyge* BF were the longest while other muscles were similar. Between muscles, BF and ST had longer sarcomere lengths than SM, LD, and TB. Shear force values did not differ between control and *Callipyge* BF. Shear force values for control LD were lowest, but did not differ from BF. *Callipyge* LD had the highest shear values, but did not differ from either the control or *Callipyge* BF.

There was a treatment by muscle interaction for sensory panel tenderness and connective tissue amount ratings. The BD did not differ between control or *Callipyge* in myofibrillar or overall tenderness or for connective tissue amount. However, *Callipyge* LD received the lowest tenderness ratings and the control LD received the highest. This interaction followed that observed for shear force values.

Table 2. Least-squares means for treatment x muscle effect on sarcomere length (µm), fat (%), and Warner-Bratzler shear force (kg).

Muscle	Control	*Callipyge*
Sarcomere length (µm)		
Biceps femoris	1.85[b]	1.96[a]
Semitendinosus	1.87[b]	1.82[bc]
Semimembranosus	1.75[d]	1.74[d]
M. longissimus	1.77[cd]	1.72[d]
Triceps brachii	1.73[d]	1.70[d]
Fat (%)		
Biceps femoris	.22[e]	.12[e]
Semitendinosus	6.36[a]	2.71[cd]
Semimembranosus	3.46[bc]	1.88[d]
M. longissimus	4.07[b]	1.92[d]
Triceps brachii	3.60[bc]	2.37[d]
Shear force (kg)		
Biceps femoris	2.91[ab]	3.14[ab]
M. longissimus	1.96[b]	3.62[a]

a,b,c,d,e Means within a subheading lacking a common superscript letter differ (P < .05).

Table 3. Least-squares means for treatment x muscle effect on sensory attributes.

Sensory attribute[a] / muscle	Control	*Callipyge*
Myofibrillar tenderness		
Biceps femoris	6.2[c]	5.9[c]
M. longissimus	7.0[b]	5.0[d]
Connective tissue		
Biceps femoris	6.0[c]	6.3[c]
M. longissimus	7.1[b]	6.1[c]
Overall tenderness		
Biceps femoris	6.0[c]	6.0[c]
M. longissimus	6.9[b]	4.9[d]

[a] Sensory attributes were rated on an eight point scale where 1 = extremely tough, abundant connective tissue; 8 = extremely tender, no connective tissue.
b,c,d Means within a sensory attribute lacking a common superscript letter differ (P < .05).

CONCLUSION: Carcass characteristics favored lambs expressing extreme muscle hypertrophy; however, data suggest that muscle from lambs with normal muscle phenotype was more tender and palatable. Muscle from the control lambs had lower calpastatin activity levels and lower shear force values for LD. Sensory data indicate advantages in myofibrillar and overall tenderness, and connective tissue amount for control LD. Presence or absence of the *Callipyge* gene had a significant effect on LD, while BF was not affected. Carcass data are consistent with current research on lambs expressing the *Callipyge* gene (Koohmaraie et al., 1994; Jackson et al., 1994a), and quality data follow trends as seen in Jackson et al. (1994b). Therefore, quality and palatability of meat may be decreased in lambs expressing extreme muscle hypertrophy.

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