EFFECT OF SEX AND GROWTH PATH ON CARCASS CHARACTERISTICS AND MEAT QUALITY OF PELIBUEY SHEEP: PRELIMINARY RESULTS

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Introduction

The interest and demand for Pelibuey sheep in Sonora has been increasing. The evidence of this trend is the increase in the production of this species and the incorporation of new producers. The Pelibuey is the most widespread breed of sheep in Cuba and is an animal very tolerant to extreme environmental conditions.

Carcass composition is influenced by weight as well as genetics and breed differences (Fogarty *et a*l. 2000), sex of the lamb (Lee *et al*. 1990), and growth path (Murphy *et al*, 1994). Color, texture and flavor are considered the most important meat quality criteria in lamb. Meat texture is considered the most important parameter for consumers and is mainly influenced by pH (Devine et al. 1993), the contractile state, state of myofibrillar components and connective tissue properties. Meat characteristics change distinctly due to the age or growth of the animal and, in addition, they are also markedly influenced by the breed and sex of the animal.

This research is a part of an inter-institutional ongoing project aiming to compare growth conditions on carcass and meat quality. Sheep producers need information about the meat quality that is taking place and will provide the basic information to devise breeding programs that enhance quality and take into account regional variations.

Objectives

The purpose of this study was to evaluate the effect of growth rate and sex on carcass composition and meat quality of this breed as a basis to implement a strategy to produce carcass.

Methodology

Carcass

Thirty Pelibuey sheep from the same producer were used. Three groups consisting intact males, castrated males and females were established, and each group consisted of ten sheep with the same average live weight, and the animals were housed in individual pens. All animals were fed *ad libitum* with a commercial diet composed of protein (13%), corn (15%), barley (40%), and the appropriate amount of minerals and vitamins.

After 153 day feeding, the sheep were shipped to the plant of slaughter of the Agriculture and Cattle Department of the University of Sonora. All animals were approximately 215 days of age at the time of the slaughter. All sheep were slaughtered using standard commercial procedures, according to welfare codes of practice. Live and hot carcass weights were collected immediately after of slaughter. Carcasses were chilled at 4 ± 1°C, and at approximately 24 h postmortem cold carcass weight was recorded and the carcasses were ribbed between the 12^{th} and 13^{th} ribs. Dressing percentage was calculated according to the following equation: 100*cold carcass weight/slaughter live weight.

The following carcass morphology measurements were assessed according to the methodology described by De Boer *et al*. 1974: carcass length, internal depth of breast, limb length and thickness. The longissimus muscle area at the 12^{th} rib was recorded using a graduate sheet of acetate placed on the surface of the loin; both sides of carcass were recorded. Dorsal fat thickness was recorded with a digital caliper (Mitutoyo, Japan).

The meat pH was measured using a penetrating electrode and thermometer (Hanna, USA) in the *m. longissimus* between the 12^{th} and 13^{th} ribs, 45 min after the slaughter and 24 h *postmortem,* three readings were made. Color was measured using a Minolta Spectrophotometer (CM2600d model), in the *m. longissimus* between the 12^{th} and 13^{th} ribs, 24 h *postmortem,* CIE L*, a* and b* values were recorded.

Meat

At 24 hours after slaughter Mm. *longissimus thoracis* (LT) and *semimembranosus* (SM) muscles were removed from carcass for sarcomere length and texture evaluations.

Sarcomere length was determined by the method described by Torrescano *et al*. (2003). Shear force was measured on raw and cooked meat. Samples were cooked in a water bath at 80 °C to an internal temperature of 75°C, then cooled in running tap water for 45 min and stored in a refrigerator for approximately 4 hours. Shear force was measured with a Warner Bratzler device mounted on an Instron 1132 (Instron Corporation, USA), on ten cores with section 1 x 1 cm for each animal.

Statistical analysis

Significance differences ($p<0.05$) among samples were determined by analysis of variance (ANOVA) using the Least Square Difference method of the General Linear Model procedure of SPSS (SPSS 1995).

Results & Discussion

The means of carcass yield and quality measurements in each group are shown in Table 1. Significant differences in live weight were observed between groups, standing out intact male with 43.8 kg ($p<0.05$), this data is in agreement with that reported by the FAO for this breed, the weight at 300 days is 39 kg and 35 kg, for males and females respectively. On the other hand, hot and cold carcass weights showed no differences ($p>0.05$) among groups evaluated. Cold carcass weights ranged from 21.5 to 22 kg, being the female carcass the lightest. The lowest dressing percentage corresponded to intact male (49.3%) while castrate male and female had 55.6 y 56 %, respectively. Although no official sheep carcass grading standards exist in Sonora, the sheep carcass in this study had greater body weight than those in most of the studies reviewed by Sañudo *et al*. (2003), which may have resulted in compositional differences.

Morphological measurements on the carcass also showed significant differences among sexes, especially for carcass length, where female carcass showed had longer ($p<0.05$) carcass than male carcass. Carcasses from female sheep had smaller ($p<0.05$) internal depth of breast that the rest of the groups. Carcasses from castrate male had longer limb length and limb thickness ($p<0.05$). No differences in loin area and fat thickness ($p>0.05$) were observed among groups, averaging 13.5 cm^2 and 0.15 cm, respectively.

Table 2 shows the values of pH and color of the carcasses evaluated. At 45 min the female carcass had the higher pH value (6.8). At 24 hours the pH was 5.7 for the three sexes, which can be considered as normal. L* values showed that females were lowest ($p<0.05$), indicating darker samples; a* and b* were more redness and yellowness ($p<0.05$) in this sex. Intact and castrate males were similar in these parameters, indicating that male castration not have influence in all these color parameters.

Means and standard deviations for sarcomere lengths and texture are presented in Table 3. The data reveal significant differences in sarcomere lengths values in LT muscle ($p<0.05$) between samples of female (2.1 μm) and males (1.8 μm). The raw meat from castrate males presented a higher value of shear force, in the three muscles evaluated. However, in this sex breed, a lower shear force on cooked meat was observed; the intact males and females were significantly tougher than castrate males.

The advantage of castrate males is primarily in the greater cold carcass weight and meat tenderness.

Conclusions

The sheep sex has an important effect on meat quality characteristics. In particular, the castrate males show very good morphological traits and tenderness. Although there was a tendency to lower tenderness in carcasses, sensory analysis with consumers would be needed to confirm this trend. The information generated by this project will be important for devising breeding strategies to meet the market demands.

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Tables and Figures

Table 1. Means and standard deviations of carcass yield and quality measurements stratified by sex.

Item	Intact male	Castrate male	Female
Live wt, kg	43.8 ± 2.4[b]	39.5 ± 1.9[a]	38.2 ± 4.0[a]
Hot carcass wt, kg	24.3 ± 3.8[a]	24.1 ± 3.0[a]	22.2 ± 2.7[a]
Cold carcass wt, kg	21.6 ± 2.7[a]	22.0 ± 1.9[a]	21.5 ± 2.5[a]
Dressing percentage	49.3 ± 6.4[a]	55.6 ± 6.0[b]	56.0 ± 2.6[b]
Carcass length, cm	49.0 ± 2.5[b]	36.0 ± 1.3[a]	57.7 ± 2.1[c]
Internal depth of breast, cm	20.0 ± 2.1[b]	22.0 ± 2.3[b]	17.6 ± 0.4[a]
Limb length, cm	38.1 ± 3.1[a]	49.0 ± 3.4[b]	38.8 ± 2.4[a]
Limb thickness, cm	20.0 ± 2.1[b]	22.0 ± 2.3[b]	17.6 ± 0.4[a]
LT muscle area,cm^2	13.9 ± 1.3[a]	13.4 ± 0.9[a]	13.5 ± 0.4[a]
Fat thickness, cm	0.10 ± 0.03[a]	0.19 ± 0.13[a]	0.18 ± 0.10[a]

[a-b]Means on the same row with different superscript differ significantly (P<0.05)

Table 2. Measures of pH and color of carcass stratified by sex.

Item		Intact male	Castrate male	Female
pH				
	45 min PM	6.2 ± 0.08[a]	6.2 ± 0.2[a]	6.8 ± 0.2[b]
	24 h PM	5.7 ± 0.03[a]	5.6 ± 0.1[a]	5.7 ± 0.01[a]
Color				
	L*	45.1 ± 3.56[b]	40.11 ± 11.02[b]	30 ± 2.3[a]
	a*	18.8 ± 3.38[a]	20.25 ± 6.2[a]	25.3 ± 2.6[b]
	b*	16.1 ± 3.05[a]	18.26 ± 3.99[a]	23.5 ± 2.2[b]

[a-b]Means on the same row with different superscript differ significantly (P<0.05)
PM: *post mortem*

Table 3. Measures of sarcomere length and texture 24 h *postmortem.*

Item		Intact male	Castrate male	Female
Sarcomere length (µm)				
	LT	1.8 ± 0.1[a]	1.8 ± 0.2[a]	2.1 ± 0.2[b]
	SM	2.1 ± 0.2[a]	2.1 ± 0.2[a]	2.2 ± 0.2[a]
Shear force (kgf)				
	raw			
	LL	2.7 ± 0.5[b]	3.04 ± 0.76[b]	1.2 ± 0.3[a]
	LT	2.0 ± 0.07[a]	2.38 ± 0.5[a]	1.2 ± 0.3[a]
	SM	4.5 ± 1.6[b]	5.88 ± 1.2[b]	2.7 ± 1.1[a]
	cooked			
	LL	2.6 ± 0.7[a]	2.58 ± 0.24[a]	2.7 ± 0.7[a]
	LT	2.5 ± 0.08[a]	2.33 ± 0.3[a]	2.6 ± 0.7[a]
	SM	3.1 ± 0.5[b]	2.03 ± 0.59[a]	3.2 ± 0.7[b]

[a-b]Means on the same row with different superscript differ significantly (P<0.05)