PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 8 (4): 345-348, 2009
ISSN 1680-5194

Carcass Composition of Crossbred and Straightbred Lambs Finished on a High Concentrate Diet

S.A. Mohammed, M.A. Razzaque, R.C. Malik and N.M. Al-Khozam
Department of Aridland Agriculture and Greenery, Food Resources and Marine Sciences Division, Kuwait Institute for Scientific Research, P.O.Box 24885, Safat 13109, Kuwait

Abstract: The body measurements and carcass composition of 35 Naeemi x Border Leicester Merino (NaeemixBLM) crossbred and 9 Naeemi straightbred lambs were investigated. The Naeemi lambs were, on average, 2 kg heavier and had the Body Conditioning Scores (BCS) that were 0.78 points lower and body lengths that were 10.2 cm shorter than the crossbred lambs. There were no significant differences between the genetic groups for (GR) or (BT) but crossbred lambs had significantly more kidney fat. They also had 5.5% higher dressing percentages and 14% higher carcass yields than the Naeemi lambs. Carcass moisture and protein were 6.3 and 1.6% higher and fat was 7.8% lower in the whole carcasses of the Naeemi lambs than in those of the crossbred lambs. It is concluded that the Naeemi x BLM lambs produce heavier carcasses but also accumulate more carcass fat than straight Naeemi lambs.

Key words: Naeemi, BLM, lambs, feedlot, carcass

INTRODUCTION

Sheep are highly desired and bred principally for meat throughout the Arab world, where lamb meat is relished. However, the demand for lamb meat in Arabian Gulf countries, including Kuwait, exceeds the amount produced locally several times over. One reason for the inability of the producers to meet consumer demands with the local fat-tailed breeds of sheep is the relatively low reproductive rates of these breeds. This has prompted a shift toward crossbreeding local breed sires with highly productive imported ewes. Malik *et al.* (2001) showed that mating sires of the local fat-tailed Naeemi breed (a local strain of the Awassi breed) with Australian Border Leicester x Merino (BLM) ewes can almost double the number of Lambs Born (LB/EJ) compared to matings of Naeemi sires with Naeemi ewes. The 3-way-cross lambs retain many of the characteristics of the sire breed and are readily acceptable in the market both as live animals and as dressed carcasses. This crossbreeding system allows large-scale breeding flocks to be established quickly at a lower cost than using local breed ewes (Brightling and Lightfoot, 2000). Although crossing Naeemi with BLM can increase lamb production relative to straightbred Naeemi, it is of interest to compare the meat quality of crossbred and local Naeemi lambs finished intensively on a high-cereal diet.

The objective of this study was, therefore, to compare the chemical composition of dressed carcasses of crossbred and Naeemi lambs. The effects of genetic group (crossbred v. Naeemi) and sex (male v. female) on dressing percentage, chemical composition (moisture, lipid and protein), back-fat thickness, GR (tissue depth on the 12th rib) and kidney fat were examined.

MATERIALS AND METHODS

Lambs and their management: The 44 carcasses used in this study were obtained from 35 Naeemi x BLM (crossbred) and 9 straightbred Naeemi (control) lambs. At 8 weeks of age the animals (30 males and 14 females) were vaccinated with clostridial vaccine (Websters Australia), housed in 2x1.5 m individual pens on concrete flooring and adapted to a high-concentrate diet for two weeks. The experiment commenced when lambs were 10 weeks old when they weighed 24.8 kg. None of the lambs had their tails docked. All lambs were fed a diet composed of 70% concentrate and 30% lucern hay of total 18% crude protein. The concentrate mixture consisted of 50% yellow maize, 27% barley, 20% soybean meal and 3% other supplements (vitamins, minerals and common salt). Mineral licks were provided in feeding troughs and fresh desalinated water was available in each pen. The lambs were fed *ad libitum* to an average target weight of 40 kg (ranging from 35-45 kg) at about 5 months old.

Slaughter procedure and measurements: At the end of the feeding period, the unshorn lambs were weighed after overnight fasting (approximately 16 h) and their Body Condition scores (BCs) and body measurements (Length and height) recorded. Body length was measured from the point of the shoulder to the tip of the pin bone (ischium) in a standing position. The height was measured vertically from the point of the withers to the ground. The animals were then slaughtered by severing the carotid arteries and jugular veins on both sides of the neck. The head was removed at the atlanto-occipital joint and the fore and hind legs removed at the knee (carpus) and hock (tarsus) joints, respectively. The animals were skinned and the tail was removed at the last sacral and first coccygeal vertebrae and weighed. The hot carcass weight was recorded and the dressing percentages were calculated; then the carcass was carefully sawed into 2 halves and each side was weighed. After overnight chilling at 4°C, the GR tissue depth (the depth of muscle and fat of the carcass to the lateral surface of the 12th rib, 110 mm from the midline) was recorded. Backfat thickness (BT) was measured between ribs 12 and 13 over the *M. Longissimius thoracis et lumborum* (eye muscle) at the deepest part of the muscle. The right sides were jointed between the 12 and 13th ribs into fore- and hindquarters, weighed and stored in sealed plastic bags at -20°C until required for dissection.

The stored sides (both quarters) were thawed at room temperature, reweighed, deboned and minced (excluding the bone). Duplicate samples of the thoroughly mixed mince were taken to determine moisture by freeze-drying and the freeze-dried samples were analyzed for fat (soxhlet) and protein (Kjeldhal).

Statistical analysis: The least-squares procedure (Harvey, 1990) was used to test the effects of genetic group, sex and genetic group x sex interaction for the carcass and non-carcass traits. Fasted slaughter weight was included as a covariate for the analysis of dressed carcass weight and weights of skin, head, feet, tail, kidney fat and internal organs. GR and BT were adjusted for dressed carcass weight difference by regression analysis. Moisture, fat and protein were expressed as percentages and analyzed for the fixed effects of genetic group and sex. Since all of the sources of variation included in the statistical models were fixed, residual mean square was used to test the significance of the fixed effects and regressions included in the analyses.

RESULTS

There was no significant genotype x sex interaction for any of the carcass traits studied; therefore, interaction means are not presented. Least-squares means for the fasted slaughter weight (unadjusted), BCS, body length and body height (adjusted for slaughter weight) for the Naeemi and Naeemi x BLM crossbred lambs are presented in Table 1. The Naeemi lambs were, on average, 2 kg heavier and had BCs 0.78 points lower and body lengths 10.2 cm shorter than the crossbred lambs (P = 0.05). Naeemi lambs were 2.4 cm taller than the crossbred lambs, but this difference was significant only at P = 0.06. The linear regression on fasted slaughter weight was significant for BCS (P = 0.05) but not for length and height. The low average BCs of 1.19 and 1.97 for the Naeemi and the crossbred lambs, respectively, in the present study was due to their young age (5 months) at finish when being slaughtered. The crossbred lambs had dressing 5.5% greater than the Naeemi lambs. Genotype but not sex significantly affected the dressed carcass weight and dressing percentage. The dressing percentage and dressed carcass weight were lower for the Naeemi breed due to its heavier tail (3.1 kg) compared to the crossbred

Table 1: Least-squares means (± S.E.) for fasted slaughter weight (unadjusted), body condition score (BCs), body length and body height

Factor	Fasted slaughter weight (kg)	BCs	Body length (cm)	Body height (cm)
Genetic group	*	**	**	p<0.06
Naeemi x BLM	38.3±0.43	1.97±0.08	71.4±0.97	66.0±0.58
Naeemi	40.3±0.82	1.19±0.15	61.2±1.75	68.4±1.05
Sex	**	ns	ns	*
Male	40.8±0.52	1.51±0.10	67.9±1.21	68.4±0.73
Female	37.7±0.70	1.64±0.13	64.7±1.55	65.9±0.93
Regression on fasted	--	0.071±0.028	0.145±0.329	0.140±0.198
Slaughter weight	--	*	ns	ns

*P = 0.05; ** P = 0.01; ns = not significant at P = 0.05

Table 2: Least-squares means (± S.E.) for dressed carcass weight, dressing percentage, GR, backfat thickness and kidney fat

Factor	Dressed carcass weight (kg)	Dressing percentage	GR** (mm)	BT thickness (mm)	Kidney fat (kg)
Overall Mean	17.0±0.16	43.5±0.39	10.29±0.78	5.95±0.61	0.336±0.023
Genetic Group	**	**	n.s.	(P=0.10)	**
NaeemixBLM	18.1±0.16	46.2±0.36	10.55±0.67	6.92±0.52	0.442±0.022
Naeemi	15.9±0.28	40.7±0.68	10.03±1.38	4.97±1.08	0.231±0.040
Sex	ns	ns	ns	ns *	
Male	17.1±0.19	43.6±0.43	9.26±0.80	6.01±0.63	0.282±0.028
Female	16.9±0.25	43.3±0.58	11.31±1.24	5.88±0.97	0.390±0.036
Regression on Fasted slaughter weight	0.450±0.053**	---	---	---	--
Regression on dressed Carcass weight	---	---	0.225±0.429ns	-0.318±0.335ns	0.009±0.008ns

*P = 0.05; **P = 0.01; ns = Not significant

Table 3: Least-squares means (± S.E.) for the chemical composition of the deboned whole carcass, forequarter and hindquarter of lambs

	Genetic group			Sex		
Trait	NaeemixBLM	Naeemi	Significance	Male	Female	Significance
Whole Carcass (%)						
Moisture	51.4±0.62	57.7±1.18	**	57.2±0.75	51.8±1.00	**
Fat	33.3±0.82	25.5±1.54	**	27.2±0.98	31.7±1.32	**
Protein	14.7±0.29	16.3±0.55	**	15.9±0.35	15.0±0.47	*
Forequarter (%)						
Moisture	50.2±0.59	58.2±1.12	**	56.9±0.71	51.5±0.95	**
Fat	35.0±0.85	25.3±1.61	**	27.3±1.02	33.0±1.37	**
Protein	14.0±0.26	15.7±0.49	**	15.4±0.31	14.3±0.42	*
Hindquarter (%)						
Moisture	52.5±0.65	57.1±1.23	**	57.5±0.78	52.0±1.05	**
Fat	31.6±0.78	25.7±1.47	**	27.0±0.94	30.3±1.26	*
Protein	15.3±0.32	16.8±0.60	**	16.4±0.38	15.7±0.51	ns

*P = 0.05; **P = 0.01; ns = not significant (p>0.05)

(0.66 kg). The hot carcass yield (dressed carcass weight) for the Naeemi was 14% lower than that for the crossbred. Regression of dressed carcass weight on slaughter weight was significant and positive (Table 2). Dressed carcass weight and dressing percentage adjusted for slaughter weight were similar for male and female lambs.

The effect of genotype and sex on GR and BT was not significant (P = 0.05, Table 2), although for BT the difference between the genetic groups was large (6.92 mm for crossbred vs. 4.97 mm for Naeemi; P = 0.10.). The regression of GR and BT on dressed carcass weight was also not significant. The weight of kidney fat in the crossbred lambs was about twice than that in the Naeemi (P = 0.01).

Moisture and protein were 6.3 and 1.6% higher and fat 7.8% lower in the whole carcasses of the Naeemi than in those of the crossbred (Table 3). There was a similar pattern of differences between the genetic groups in the chemical compositions of the fore- and hindquarters. Male lambs generally had more moisture, less fat and more protein in the whole carcass, forequarter and hindquarter than females, except for the hindquarter protein, which was similar for both sexes.

DISCUSSION

The average live weight at slaughter for crossbred lambs was 5% lower, but their average dressed carcass weight (adjusted for slaughter weight) was 7% higher than that Naeemi lambs. The lower dressed carcass weight of Naeemi lambs, when compared at the same slaughter weight, is consistent with the lower dressing percentage of Naeemi lambs than of Naeemi x BLM lambs shown earlier by Al-Sabbagh *et al.* (1996). The main reason for the lower dressed carcass weight of the Naeemi is its heavy fat tail. Gaili (1992) reported that about a third of the total body fat in Awassi sheep was in the tail, which contributes nothing to the carcass yield. This observation is equally applicable to Naeemi, which is a local strain of the fat-tailed Awassi sheep.

The crossbred lambs in this study had about 5% higher dressing percentage than the straightbred lambs at the same slaughter weights (46 vs. 41%; P = 0.1). Sharaby and Suleiman (1988), working with four breeds of fat-tailed Arabian and Turkish sheep and one docked-tail Australian Merino cross (with an average slaughter weight 41 kg) did not find significant differences in dressing percentage. The dressing percentages they reported were on the higher side (ranging for 55-57%) because the dressed carcasses in their study also included the fat tail, heart, kidneys and liver. In comparison, carcasses in the present study were dressed according to the normal commercial procedure in Kuwait, which includes removal of tail, liver, heart and kidneys.

The Naeemi x BLM lambs had longer length and shorter height measurements, whereas Naeemi lambs were taller and had shorter lengths. Kirton (1976) suggested that longer carcasses contain more muscle and bone and less fat than blockier carcasses of similar weight. However, the relatively higher percentages of chemical fat and lower percentages of chemical protein in the carcasses of Naeemi x BLM crossbred lambs than in the carcasses of straightbred Naeemi lambs indicates that body measurements exclusively may not be satisfactory indicators of carcass composition. This seems to be even more so when comparison is made with fat-tailed Naeemi sheep, which has a distinct pattern of excess fat stored in the tail, away from the carcass. These results suggest that the Naeemi x BLM lambs should be slaughtered at a lower weight in order to avoid excessive accumulation of fat in the carcass. In contrast to crossbred, Naeemi lambs can be slaughtered at 40 kg finished weight without adverse effects on carcass quality, a conclusion also supported by the lower BCs of Naeemi lambs.

The Naeemi x BLM had lower percentages of water and protein and a higher percentage of fat, indicating a lower proportion of muscle and a higher proportion of adipose tissue in their carcasses. On a percentage basis the fat content can be expected to exhibit a characteristic inverse relationship with protein and water (muscle). The higher level of BT in the crossbred lambs (6.92 mm for Naeemi x BLM vs. 4.97 mm for Naeemi), while statistically significant at P = 0.1, indicates a higher level of fat in their carcasses. The fatness characteristic of the crossbred lambs was also extended to the kidney fat depot but it was not reflected in the GR. The GR tissue depth measurement has been used by the lamb and beef meat industry in Australia and New Zealand for carcass grading purposes as it closely reflects carcass fat levels (Kirton, 1989). The non-significant difference for GR between the Naeemi and the Naeemi x BLM carcasses is difficult to explain in view of the other fatness variables, *viz.*, carcass chemical fat, BT and kidney fat, which indicated higher fat accretion in Naeemi x BLM lambs. In broad terms our results are in line with findings of Hopkins and Fogarty (1998), where Texel-sired progeny was found to be leaner than Poll Dorset-sired progeny at the 5th rib, but GR measurements on the 12th rib were similar for the progeny of both types. Both studies demonstrate that GR measurements may not reliably describe fat level variations in the whole carcass.

In the present study the deboned male carcasses had 3.5% less fat, 6.4% more water and 0.9% more protein than female carcasses. Higher chemical fat percentages in the carcasses of ewe lambs in the present study were consistent with the literature reviewed by Kirton and Morris (1989) in that ewe lambs are fatter than ram lambs at the same carcass weight.

Conclusion: In conclusion, the results of this study indicate that the Naeemi lambs have shorter body length, greater height than the Naeemi x BLM crossbred lambs. Naeemi lambs produce leaner carcasses, but their carcass yield is markedly lower than with the crossbred. At the same weight, females have more carcass fat and less protein and water (muscle) than males. The relatively higher percentage of chemical fat, in the crossbred lamb carcasses suggests that these lambs should be slaughtered at a lower weight in order to avoid the accumulation of excessive fat in their carcasses. Similarly, female lambs should be slaughtered at a lighter weight than male lambs to avoid excess carcass fat.

ACKNOWLEDGMENT

This research was partly funded by the Kuwait Livestock Transport and Trading Company and the Kuwait Foundation for the Advancement of Sciences. Mr. Waleed Al-Gallaf is thanked for his technical assistance and supervision of sheep flocks.

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