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Effect of crossbreeding on growth, feed efficiency, carcass characteristics and sensory traits of lambs from Lori-Bakhtiari and Romanov breeds

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ABSTRACT

This study compares the growth performance, carcass characteristics, and sensory traits of pure lambs of Lori-Bakhtiari fat-tailed sheep (LL genotype) and their crosses with Romanov tailed sheep breed (RL genotype). After weaning, the average daily gain (ADG) and feed conversion ratio (FCR) of male lambs were recorded at a fattening period of 80 days. Twenty-three male lambs were slaughtered, and the left sides of the carcasses were separated into six pieces to determine the lean meat, bone, subcutaneous fat (SCF), and inter muscular fat (IMF). Genotypes had different ADG (LL: 296.50 ± 11.57 v. RL: 249.11 ± 12.92 g/day) and FCR (LL: 6.12 ± 0.26 v. RL: 6.98 ± 0.30) ($P < 0.05$). The fat-tail weight in the crossbred lambs was about 80% less, but the weights of SCF and IMF were 55% and 33% greater than the purebred lambs, respectively ($P < 0.01$); however, the difference in the back-fat thickness (12–13th rib) was not significant between the two genotypes (LL:4.29 ± 0.32 v. RL:4.62 ± 0.37 mm) ($P = 0.41$). While abdominal fat (AF) was 65% greater than that of the purebreds ($P < 0.001$), the total body fat in the crossbred lambs was about 34% less than the purebreds ($P < 0.001$); it had been displaced with about 23% more lean meat ($P < 0.001$). A trained panel evaluated the tenderness and flavor of the LL and RL meat through a sensory evaluation. Tenderness score (LL: 6.75 ± 0.94 v. RL: 5.16 ± 0.94) was significantly affected by the genotype ($P < 0.01$); however, the panelists could not detect a significant difference in flavor score between the two genotypes (LL: 7.01 ± 0.82 v. RL: 6.85 ± 0.82). It can be concluded that crossbreeding the indigenous Lori-Bakhtiari sheep with Romanov breed can significantly improve carcass traits and increase meat production. The present data showed that, even though crossbred lambs could not compete with purebred in terms of ADG, FCR, and tenderness, the lower total body fat in crossbred lambs (34%) compensated the inferior high fat in the Lori-Bakhtiari breed.

1. Introduction

Iran uses three methods of sheep rearing: nomadic (extensive), rural (semi intensive), and industrial (very intensive), with a respective distribution of 55%, 40%, and 5% (Khaldari, 2014). As the Iranian sheep population has decreased over the last two decades, especially in the nomadic system, the recent intention has been to rear sheep in the industrial system. However, 27 native breeds are not suited to this system because of a very low reproductive performance including litter size (5–10%), fertility (85–93%), and age of sexual puberty (18 months), and a high percentage of fat-tail. Lori-Bakhtiari sheep is the heaviest breed in Iran; it has a big fat-tail that reaches to the hocks and a low reproductive performance. The sheep, which are reared in the southwest of the country, live indoors and on the lowlands in the winter and migrate to the uplands during spring and summer (Vatankhah et al., 2008). Usually, the sheep production systems depend heavily on the sheep's reproductive traits (Matika et al., 2003); documented reports show that the number of lambs born per ewe is 105% and the conception rate in Lori-Bakhtiari sheep is 90% (Vatankhah et al., 2008) compared to a 200% lambing rate for crossbreeds in Australia (Fogarty et al., 1992).

In addition, except for Zel (the only thin-tailed sheep breed in Iran), all of the sheep in Iran are fat-tailed, and the fat-tail makes up 20% of the carcass weight, which is not favorite of customers (Safdarian et al., 2008). The fat deposition in the body or tail requires more energy than the production of lean tissue, and farmers are concerned about the FCR. As consumers become more concerned about cardiovascular disease, there is an increased tendency to require high-protein and low-fat food (Yuan et al., 2016). In order to increase the performance of the local sheep breeds and decrease the fat-tail, it has been proposed crossbreeding local breeds with exotic breeds and improving environmental conditions. Some studies have thus been conducted to reduce the size of

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the fat-tail either by docking using rubber rings (Gokdal et al., 2003; Moharrery, 2007; Sarvar et al., 2009) or by cross breeding with the thin-tailed ram of Zel (Kashan et al., 2005; Khaldari et al., 2007) or another type of tailed sheep (Abdullah et al., 2010; Isani et al., 2012; Dvalishvili et al., 2015).

Accordingly, sheep breeders in Iran have opted to use the cross-breeding method to increase the frequency of lambing and the litter size per ewe/year, while attempting to decrease the carcass fat content. Thus, it is necessary to study the growth and carcass characteristics of indigenous breeds and their crosses with exotic breeds to obtain the optimum meat to fat ratio. It is important to evaluate qualities such as flavor and tenderness; however, these characteristics cannot be readily measured using instrumental and chemical test methods. Consumer and trained panels offer two alternative types of sensory evaluation measurement. When differentiating between two samples, a trained panel is more effective for increasing market competitiveness (Osman and Aldosari, 2006). The tailed Romanov breed is characterized by its valuable biological features of high fertility (3–5 litters) and polyestrous phenomena. Romanov lambs have a high ADG but the carcass and meat quality is low (Ricordeau et al., 1990). Therefore, the Romanov breed can be used to crossbreed with the Lori-Bakhtiari sheep to increase the number of lambs born per ewe and decrease the size of its fat-tail. To our knowledge, there is no documented study related to the effect of crossbreeding the Romanov sheep breed with the Lori-Bakhtiari sheep breed on growth performance, carcass characteristics and sensory traits. Therefore, the objective of this study was to evaluate the effect of crossbreeding the Romanov sheep breed with the Lori-Bakhtiari sheep on growth performance, feed efficiency, carcass quality, and sensory traits of meat.

2. Material and methods

2.1. Animals

This research was conducted at the faculty of agriculture and natural resources of Lorestan University. The campus is located in the western part of Iran at 33.3˚north and 48.18˚east and 1125 m above sea level. A total of 100 Lori-Bakhtiari ewes belonging to the sheep and goat breeding Ins. of Gahare Dorood and agro-industry and Tourism Company of Lorestan were used for this study. All of the ewes were weaned and treated with intravaginal sponges containing progesterone for 12 days in April 2016. During synchronization, the ewes were range-fed, and each ewe received about 350 g concentrate (40% barley, 40% corn, 15% wheat bran, 2% DCP, 2% V&M supplement, and 1% salt) every evening by hand. Fifty-five hours after removing the sponges, 60 ewes were randomly inseminated with the frozen sperm of three Romanov rams via laparoscopy. The sperm was supplied by OC Flock Management Inc., Canada. The remaining ewes (40 ewes) were naturally mated with three Lori-Bakhtiari rams. Lambing happened in August. A total of 35 LL and 41 RL lambs were born.

The lambs were weighed at birth and weaned at 75 days of age. Two weeks after lambing, the lambs were vaccinated against Enterotoxaemia two times in 14 days. The lambs suckled two times in day for 75 days, and they had access to alfalfa *ad libitum* and a concentrate with 18% CP and 2.5 McCall/kg ME (barley 40%, corn 28%, wheat bran 10%, soybean meal 20%, DCP 0.5%, V&M supplement 1%, salt 0.25%, and bicarbonate sodium 0.25%). After weaning, 12 male lambs of each genotype which were had higher uniformity by weight were allocated in order to record of growth performance and carcass traits (LL:Lori-Bakhtiari × Lori-Bakhtiari, and RL: Romanove × Lori-Bakhtiari). They were then treated for internal and external parasites and settled into individual boxes with dimensions of 1.5 m × 1 m. The fattening period lasted for 80 days, and two ratios were balanced for the first and second halves of the fattening period. The diets were formulated for each half of the fattening period. The diets fed for each fattening period have presented in Table 1. Two weeks were assigned as an adaptation period. During 80 days of fattening, the lambs were fed *ab libitum* and weighed once every10 days. The feed used by each lamb was weighed during each 10 days to calculate the FCR. One lamb of the RL genotype died of pneumonia at day 50 of fattening.

Table 1
Chemical and physical composition of fattening period ratios (%).

	The first half diet		The second half diet	
Alfalfa	30		25	
Barley	34		39	
Corn	22.75	CP (%) = 14.7	26	CP (%) = 13.7
Soybean meal	8	Mcal/kg ME = 2.43	5.5	Mcal/kg ME = 2.55
Wheat bran	3	Ca(%) = 0.59	2.75	Ca(%) = 0.45
V & M supplement	1	P (%) = 0.33	1	P (%) = 0.32
DCP	0.5		0.25	
Salt	0.25		0.25	
Bicarbonate sodium	0.5		0.25	

V and M = vitamin and mineral; DCP = dicalcium phosphate; CP = crud protein; Ca = calcium; P = phosphorous; ME = metabolic energy.

2.2. Carcass traits

At the end of the fattening period, all of the lambs were slaughtered and the weights of the blood, internal organs, rumen and intestines, head, feet and legs, skin, and carcass were recorded. The carcasses were split longitudinally into two parts. The left side of the carcasses were cut into six pieces (neck, shoulder, rib and brisket, loin, hunch, and fat-tail) according to (Kyanzad, 2001), and were weighed separately (Fig. 1). The individual joints were then dissected into lean meat, bone, SCF, and IMF and weighed. The fat surrounding the intestine and abdomen were weighed and considered the AF, and the kidney and pelvic fat (KPF) were considered internal fat.

2.3. Sensory evaluation

Using sensory evaluation, a trained panel evaluated the tenderness and flavor of the LL and RL meats. Ten individuals, who were identified as possessing good discriminatory skills, received training to improve their ability to recognize and quantify sensory attributes. Samples were taken from the M. longissimus dorsi at loin area because a high correlation exists between the characteristics of this muscle and the carcass sections (Yarali et al., 2014). The steaks were cut into dimensions of 1.27 cm by1.27 cm by 2.54 cm and stored at −18 °C for seven days, according to recommendations (American Meat Science Association, 1995). The steaks were roasted in a broiler oven at 170 °C for 60 min. Two samples of each subject were served to each panelist daily (one to test the tenderness and the other to test the flavor). Panelists were given four steaks to evaluate the tenderness score four

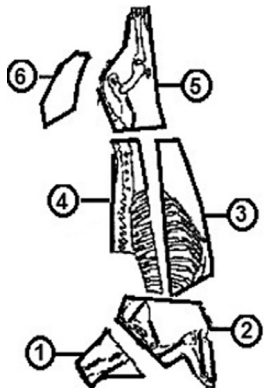

Fig. 1. Wholesale cuts of lambs' carcass. (1) Neck, (2) shoulder, (3), brisket, (4) loin, (5) hunch, and (6) fat-tail.