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EFFECTS OF FEEDING SYSTEM AND BREED ON LAMB PRODUCTIVE AND CARCASS CHARACTERISTICS IN THE SOUTH MEDITERRANEAN REGION

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Original scientific paper

SUMMARY

The objective of this study was to evaluate the effect of feeding regimes and breed type on growth, non-carcass components and carcass characteristics of light lambs. Twenty four light lambs from the rustic fat-tailed Barbarine (BB) breed and 21 from the thin-tailed Sicilo-Sarde (SS) breed were used. For each breed, animals were divided into 3 groups (8 BB and 7 SS breed, each) by live weight (LW). Two groups were conducted on rotational grazing of barley grass (GB) or perennial ryegrass (GR) and received daily 350 g of concentrate per lamb. The last group was conducted on feedlot system (FL) with 450 g of ryegrass hay and 650 g of the same concentrate per lamb per day. The whole grass yield was 5 t DM/ha for ryegrass prairie and 4.2 for barley one. The final LW was higher for GB and GR lambs (28.3 kg) than for FL ones (26.9 kg). Irrespective to breed, the average daily gain was higher for both grazing groups than FL system, 144, 137 and 121 g for GR, GB and FL regimes, respectively. Slaughter LW was higher for BB (29.0 kg) than SS breed (26.5 kg). Barbarine lambs had more fat (23 vs. 17%) and less muscle (53 vs. 57%) than SS ones. FL lambs carcasses were more adipose (26%) than those of both grass groups (18%), while grass lambs had more muscle (57 vs. 51%). Grazing grass based diets increased carcass muscle and decreased fat proportions, which could be a useful feeding strategy to naturally manipulate lamb meat nutritional characteristics.

Key-words: grass, grazing, concentrate, growth, lambs, carcass traits

INTRODUCTION

In Southern Mediterranean area, sheep feeding is based on natural resources, range land and stubble. To satisfy nutrient needs, intensive husbandry systems are developed, given the availability of such resources is uncertain throughout the year. However, the humid and sub-humid regions present an important fodder potential and must play a more determining role in ruminants feeding. Grazed ryegrass has a relative superior nutritional value than grass silage (Kennedy et al., 2008) and grass hay (Nefzaoui and Chermiti, 1989). Also, dairy ewes grazing ryegrass or green barley compared with FL or green barley, conventional practice, engendered promising results (Atti et al., 2006). Moreover, lambs finished on feedlot (FL) were fatter than lambs grazed on perennial ryegrass forage (McClure et al., 1994), green barley or natural fallow (Atti and Abdouli, 2001). The objective of this study was to compare the growth and carcass characteristics of lambs by the feeding strategy, feedlot vs. grazing, and the breed. The considered breeds were the Barbarine (BB), the dominant Tunisian breed, and the Sicilo-Sarde (SS), the breed of the humid area of Tunisia.

MATERIAL AND METHODS

For this study, 24 light lambs from the rustic fat-tailed Barbarine (BB) breed and 21 from the thin-tailed Sicilo-Sarde (SS) breed were used. For each breed, animals were divided into 3 groups (8 and 7 breed, each) according to live weight (LW), which initially averaged 14.8±2.9 kg. Two groups were conducted on

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rotational grazing with a stocking rate of 60 lambs per ha in separate pastures of barley grass (GB) or perennial ryegrass (GR). Both grazing groups received 350 g/lamb/day of concentrate at 18% crude protein (CP) content. The third group was conducted during the same period indoors on FL and fed individually ryegrass hay (8.5% CP) and concentrate *ad libitum*. Feed intake was daily and individually controlled indoors. In pasture, the whole herbage production was calculated after cutting and weighting grass in 15 quadrates of 0.25 m^2 before entering each paddock. The mean daily grass availability was calculated as the ratio of paddock grass production by lambs' number and by number of days spent in the paddock. For hay, concentrate, and grass, DM was determined by drying at 105°C and nitrogen by Kjeldahl method (CP=N×6.25). Animals were weighed weekly and then slaughtered at the end of the growth trial (97 days). Lambs LW were recorded just before slaughter. After slaughter, weights of the different components of offal were determined (skin, head, feet, red organs and gut). Visual evaluations of carcass conformation and fat scores were determined by trained INRAT personnel according to photographic standards using a 15 points scale. After cooling for 24 h at +4°C, cold carcass were weighted (CW) and each carcass was split longitudinally in halves. The left half-carcass was cut into six joints (leg, lumbar region, flank, thoracic region, neck and shoulder). Every joint was weighed and dissected into muscle, fat, bone and waste (tendons, lymph nodes etc). For data analysis, animals were considered as experiment unit, the GLM procedure of SAS (SAS Institute, 2004) was used in a balanced 2x3 factorial experiment (2 breeds and 3 feeding regimes) and their interaction. Then, the Duncan test was used to compare diet mean effects (P=0.05). Animals grazed in groups; feed intake was not included in the data analysis.

RESULTS AND DISCUSSION

The grass amount produced by the whole ryegrass plot during all grazing period was higher than the barley one. The whole grass yield was 1240 and 1050 kg DM being equivalent to 4.96 and 4.20 tons of DM per ha of ryegrass and barley, respectively. By these amounts and experiment duration, the mean daily herbage availability was 0.850 and 0.720 kg DM per lamb of ryegrass and barley, respectively. For FL lambs of both breeds, mean daily DM intake was 0.450 kg of hay and 0.650 kg of concentrate. The mean CP content of grass for both species was 137 g/kg DM; it is higher than ryegrass hay CP content (Table 1).

Table 1. Chemical composition of experimental foods

	Ryegrass hay	Concentrate	Ryegrass grass	Green barley grass
Dry matter (g/kg)	830	835	310	210
Organic matter (g/kg DM)	937	960	871	877
Crude protein (g/kg DM)	85	143	120	125
Crude fiber (g/kg DM)	285	78	290	233
Ash (g/kg DM)	63	40	129	122

The average daily gain (ADG) was 145 g for BB breed compared to 121 g for SS one ($p<0.01$); it was 144, 137 and 121 g for GR, GB and FL treatments, respectively ($p=0.07$). Consequently, slaughter LW was higher for BB breed (29.0 kg) than SS one (26.5 kg) without significant difference. It was higher for GB and GR lambs (28.3 kg) than for FL ones (26.9 kg), but it did not differ among GB and GR treatments. The higher nutritive quality of grassland grazing system could engender higher ADG of the lambs in the grazing system. Many studies showed that daily gain of concentrate fed lambs was lower compared to grass ones (Atti and Abdouli, 2001; Nuernberg et al., 2008). For dairy cattle (Kennedy et al., 2008) and dairy ewes (Atti et al., 2006), milk yield and quality were higher for grass than FL system. For the Tunisian native sheep breeds, the higher growth performance for grazing than FL lambs was shown (Khaldi, 1989; Atti and Abdouli, 2001). So, grazing grassland sheep resulted in a higher growth than FL animals. Consequently, with the half amount of concentrate, grass feeding lambs reached the slaughter weight earlier than FL ones. Hence, this system constitutes an economic way of producing meat lamb. The differences in growth rate between animals from BB and SS breeds resulted from vocation of each breed. In fact, SS sheep is raised as a dual purpose breed, but its breeding program has neglected growth performances, placing more emphasis on milk production. However, BB breed is raised to produce meat lambs. The widely variation in breed performance in a common environment was known and differences in growth between dairy and meat breeds were mentioned (Emmans and Friggens, 1995).

Carcass weight and carcass fat score were similar for all the treatments (Table 2). These parameters depend on live weight at slaughter (Colomer-Rocher and Espejo, 1972; Mahouachi and Atti, 2005) which was statistically similar for all the treatments. However, carcass conformation was higher for BB than SS breed ($p<0.05$) and GB than FL groups ($p<0.01$).

Head and feet weights were affected neither by breed nor by feeding system, while grazing animals (GB and GR) had heavier ($p<0.01$) red organs than the FL ones (Table 2). The weight of offal components high in bone content (head and feet) did not vary or varied slightly with diet since these components are early maturing parts (Wallace, 1948; Atti et al., 2003; Mahouachi and Atti, 2005). Conversely, the weight of red organs (liver, heart, lungs) increased for grazing

lambs compared to FL ones. Nutrients produced by fermentation of grass based diets are probably important factors in liver weight changes (Ortigues and Doreau, 1995). This phenomenon may explain the higher weight of these organs. The skin was higher for BB than SS lambs since lambs were unshorn and the BB wool production is higher than SS one.

Table 2. Live weight (LW), average daily gain (ADG), empty body weight (EBW), carcass weight (CW), carcass conformation score (C Score), fat score and offal weight

	Breed$^{\mu}$ (Br)		Feeding system$^{\mu\mu}$ (FS)			p value	
	BB	SS	GB	GR	FL	Br	FS
Initial LW (kg)	14.9	14.7	14.7	14.6	15.2	ns	ns
ADG (g)	145	121	137^{ab}	144^{a}	121^{b}	0.006	0.07
Slaughter LW (kg)	29.0	26.5	28.0	28.6	26.9	0.6	0.06
EBW (kg)	23.4	22.1	22.8	23.6	21.9	ns	ns
CW (kg)	12.2	11.4	11.6	12.4	11.4	ns	ns
C Score	8.2	7.0	8.8^{a}	7.5^{ab}	6.7^{b}	0.03	0.006
Fat score	6.7	6.5	6.1	7.1	6.5	ns	ns
Head (kg)	1.7	1.7	1.7	1.7	1.7	ns	ns
Feet (kg)	0.7	0.7	0.7	0.8	0.7	ns	ns
Red organs	1.2	1.2	1.3^{a}	1.3^{a}	1.0^{b}	ns	0.001
Gut	2.3	2.2	2.3^{a}	2.3^{a}	2.1^{b}	ns	0.06

$^{\mu}$BB: Barbarine; SS: Sicilo-Sarde; $^{\mu\mu}$GB: Green barley pasture; RG: ray grass pasture; FL: Feed lot; Means in the same line with different alphabets (a, b, c) are significantly different ($p<0.05$); ns: not significant ($p>0.05$).

As proportions of the carcass, joints had similar values for all groups (38.5, 21.1, 13.9, 8.5, 9.7 and 8.3 for leg, shoulder, thoracic region, lumbar regions, flank and neck, respectively). This results in constancy of joint proportions in the carcass concord with the anatomical harmony established by Boccard and Dumont (1960) and confirmed by several authors (Sents et al., 1982; Atti et al., 2003; Karim et al., 2007). So, neither feeding system nor breed affect the proportion of first category joints.

Lambs from BB breed had more fat proportion and less muscle and bone ($p<0.01$) than those from SS one (Table 3). The lean and bone weights were affected neither by the feeding system nor by the breed. Bone is a tissue with early development in all-animal species and does not depend on regimen at older ages (Wallace, 1948; Atti et al., 2003). Grass (GB and GR) regimens resulted in a decrease in the fat tissue weight and proportion (18 vs. 26%) and an increase in muscle proportion ($p<0.01$). So, carcasses of grazing grass lambs were leaner than carcasses produced on hay and concentrate diets. Fat mass of FL lambs represented 140% of fat mass recorded with grazing animals. This tendency confirmed our anterior results (Atti and Abdouli, 2001). Hence and for the similar amount of muscle, the mean fat weight of grazing sheep represented 0.7 times of fat weight for FL groups; which is equivalent to a reduction of 80 g of fat per kg of carcass. Increased fat deposition in concentrate fed animals compared to those on pasture has been reported by several authors (Borton et al., 2005; Nuerberg et al., 2008).

Table 3. Mean weights of tissue (g) and as a percentage of whole carcass

	Breed$^{\mu}$ (Br)		Feeding system$^{\mu\mu}$ (FS)			p value	
	BB	SS	GB	GR	FL	Br	FS
Bone (g)	1179	1174	1211	1219	1102	0.9	0.1
Bone (%)	21.6	23.2	23.3^{a}	22.7^{a}	21.1^{b}	0.01	0.01
Muscle (g)	2926	2889	2956	3115	2659	0.8	0.08
Muscle (%)	53.1	56.9	56.7^{a}	57.6^{a}	50.7^{b}	0.002	0.001
Fat (g)	1314	930	967^{b}	1019^{b}	1394^{a}	0.01	0.03
Fat (%)	22.9	17.9	17.7^{b}	17.7^{b}	26.0^{a}	0.002	0.001

$^{\mu}$ BB: Barbarine; SS: Sicilo-Sarde; $^{\mu\mu}$GB: Green barley pasture; RG: ray grass pasture; FL: Feed lot; Means in the same line with different alphabets (a, b, c) are significantly different ($p<0.05$). ns: not significant ($p>0.05$)

CONCLUSION

The results of this study showed that ryegrass forage production was higher than barley one suggesting the extension of humid and sub-humid South-Mediterranean areas reserved to ryegrass culture. Lamb's growth was higher for grazing system than feedlot diet (hay and concentrate). So, fattening lambs on cultivated prairie in sub humid areas with a relatively high stocking rate (60 lambs/ha) and low concentrate supply (350 g/head/day) is interesting. This management system can be recommended to reduce the concentrate feeds and feeding cost and, hence, increase farmer's income. Moreover, grazing system resulted in a similar amount of muscle with only 0.7 fat mass of that produced by lambs reared in FL. So, grazing grass could be a simple feeding strategy to naturally manipulate dietetic characteristics

of sheep products; the carcasses of grassland lambs, being leaner, will be demanded by the consumers and may be recommended by the nutritionists.

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