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ScienceDirect
Small Ruminant Research 67 (2007) 296–301
Small Ruminant Research
www.elsevier.com/locate/smallrumres

Technical note

Productive and reproductive performance of Romney Marsh and Merino Branco sheep in the Azores under different feeding regimens

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Received 23 March 2005; received in revised form 6 October 2005; accepted 12 October 2005
Available online 21 November 2005

Abstract

The objective of this study was to compare the productive and reproductive performances of Romney Marsh (RM) and Merino Branco (MB) ewes in the Azores. In a preliminary trial, fertility, prolificacy and fecundity of 25 RM and 27 MB ewes, mortality rate of lambs born and growth rate of lambs (14 RM and 20 MB) from birth to weaning at 24 kg live weight were determined. In a second trial following weaning, the same group of lambs were raised on pasture and supplemented either with concentrate or maize silage until slaughter (101 days later), and growth rate, carcass and meat characteristics were evaluated. Reproductive indices (fertility: 96% versus 93%; prolificacy: 117% versus 140%; fecundity: 112% versus 130%) and mortality rates (18% versus 17%) for RM and MB, respectively, were not significantly different. Pre-weaning gain was higher ($P < 0.05$) in RM lambs than BM lambs (236 ± 8.6 g/day versus 214 ± 5.8 g/day). After weaning, RM lambs grew 20% faster than MB when supplemented with concentrate, but 16% slower when supplemented with maize silage ($P < 0.05$). Growth of males was higher than that of females (110.3 ± 10.8 g/day versus 73.3 ± 9.3 g/day, $P < 0.001$). Lambs supplemented with concentrate grew twice as much as animals supplemented with maize silage (129.9 ± 9.8 g/day versus 60.5 ± 3.8 g/day, $P < 0.01$). Dressing percentage was not affected by breed, diet or sex. Characteristics of carcass and meat did not differ between breeds. Supplementation with concentrate resulted in thicker, fatter and wider carcasses ($P < 0.01$) compared to supplementation with maize silage. It was concluded that the RM and MB sheep breeds are not very different in terms of growth potential and carcass characteristics. RM performed better with improved feeding conditions, while MB was less affected when food quality declined. MB appears to be a good alternative breed for exploitation in the Azores.
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Keywords: Romney Marsh; Merino Branco; Fertility; Carcass; Supplementation

1. Introduction

The temperate Atlantic climate of the Azorean archipelago provides excellent conditions for milk and meat production, based on almost all-year-round grazing. On certain islands (e.g., S^ta Maria), however, a 2–3 month period of hot weather dictates a dramatic reduction in pasture availability with consequent need for diet supplementation. Sheep production is entirely devoted to meat, based on local breeds and the exotic British Romney Marsh (RM), which is a very productive breed under good nutritional conditions but is strongly affected by a decline in diet quality. Moreover, the

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0921-4488/$ – see front matter © 2005 Elsevier B.V. All rights reserved.
doi:10.1016/j.smallrumres.2005.10.009

breed also has the inconvenience of displaying strong reproductive seasonality. The Portuguese breed, Merino Branco (MB), is tolerant of pasture scarcity during summer months in the Mediterranean region and breeds at almost any time of year. In addition, this traditional wool breed has, over the last decades, been selected for meat production and now displays good growth potential and very acceptable carcass and meat characteristics (Santos-Silva and Portugal, 1990, 2001; Simões and Mendes, 1998; Santos-Silva et al., 2002). These considerations suggest that the MB could challenge the RM breed for a role in Azorean and similar sheep production systems. The objective of this study was to compare the two breeds in terms of reproductive parameters (i.e., fertility, prolificacy and fecundity), growth rate to weaning and from weaning to slaughter, and carcass and meat characteristics of lambs when subjected, during the period of grass scarcity, to two different pasture supplements, i.e., concentrate and maize silage.

2. Materials and methods

2.1. Experimental design and animal management

Animal handling followed the EU directive 86/609/EEC concerning animal care. The study comprised two phases. In trial 1, a group of 52 adult and multiparous ewes (25 RM and 27 MB) were used to evaluate the rates of fertility, prolificacy and fecundity of ewes, and the birth weight and pre-weaning mortality of lambs. A group of 34 lambs (14 RM: birth weight 4.25 ± 0.49 kg; 20 MB: birth weight 3.82 ± 0.12 kg) were selected to study their growth rate from birth to weaning at 24 kg live weight (RM: 23.8 ± 3.2 kg; MB: 24.7 ± 2.2 kg; age: RM: 83.1 ± 12.5 days and MB: 98.3 ± 9.5 days). Lambs were reared with their dams on pasture and had free access to the concentrate provided to ewes. All animals were stocked as a flock at 12 ewes and their lambs per hectare. Lambs were weighed fortnightly. In trial 2, the same group of lambs were, at weaning, randomly allocated by breed, sex and live weight to one of the following treatments: (i) RM lambs (3♂ + 4♀) reared on pasture and supplemented with a commercial concentrate; (ii) RM lambs (3♂ + 4♀) reared on pasture and supplemented with maize silage; (iii) MB lambs (5♂ + 5♀) reared on pasture and supplemented with a commercial concentrate; and (iv) MB lambs (5♂ + 5♀) reared on pasture and supplemented with maize silage. These feeding regimes extended for a period of 101 days, after which the animals were slaughtered. The animals, managed as a flock, rotated fortnightly between two 0.8-ha paddocks of *Lolium multiflorum* (pasture 1) and a mixture of *Trifolium subterraneum*, *Datcylis glomerata* and *Lolium perenne* (pasture 2). Table 1 shows the chemical composition of diets. In the evening, the animals were brought indoors, separated by groups and received 150 g/head/day (fresh weight) of concentrate or maize silage, which was gradually increased fortnightly by 50 g/head/day to a maximum of 500 g/day by the end of the experiment. Lambs were weighed fortnightly until slaughter. All animals were vaccinated against enterotoxaemia and pasteurellosis (at 2 months of age) and drenched against internal parasites every 2 months. Nitrogenous fertiliser was applied to pastures at a rate of 100–120 kg/ha/year.

Table 1
Chemical composition of diets

	Pasture 1	Pasture 2	Maize silage	Concentrate
Dry matter (%)	32.2	25.1	40.3	89.8
Crude protein	13.7	18.1	8.5	20.2
NDF	56.6	52.1	–	–
ADF	30.5	29.6	27.4	9.3
Ash	8.2	11.6	5.4	4.2

Values other than dry matter are expressed as percentage of dry matter.

2.2. Slaughter and evaluation of carcass and meat

On the day before slaughter, lambs were weighed on the farm before transportation to the abattoir of 'S^{ta} Maria' where slaughter occurred following 24 h of fasting with water ad libitum. Lambs were re-weighted just before slaughter. Weights of hot carcass and gastrointestinal content were recorded to determine dressing percentage (hot carcass weight/empty live weight). Carcasses were kept at room temperature for 5 h and then chilled at 4 °C. Twenty-four hours after slaughter the kidney knobs were removed and weighted. Carcasses were split along the spine and a series of measurements and weighings taken, before and after carcass cutting, according to Bocard (1973) and Craplet and Thibier (1980) (Fig. 1), namely, (i) carcass length (from the base of the tail to the base of the neck), (ii) carcass width (the highest width at the level of ribs and trochanters), (iii) round of leg, measured as the least distance between the perineum and the edge of tarsus-metatarsus joint (for the same carcass weight, the lower the distance the rounder the leg), (iv) width of *Lomgissimus lombarum,* taken at the level of the cut between the first and second lumbar vertebra (measurement B of Fig. 1), (v) thickness of subcutaneous fat covering the *L. lombarum,* taken by the extension of measurement B of Fig. 1 (measurement C), (vi) distance, at the level of tarsus metatarsus joint, between the edges

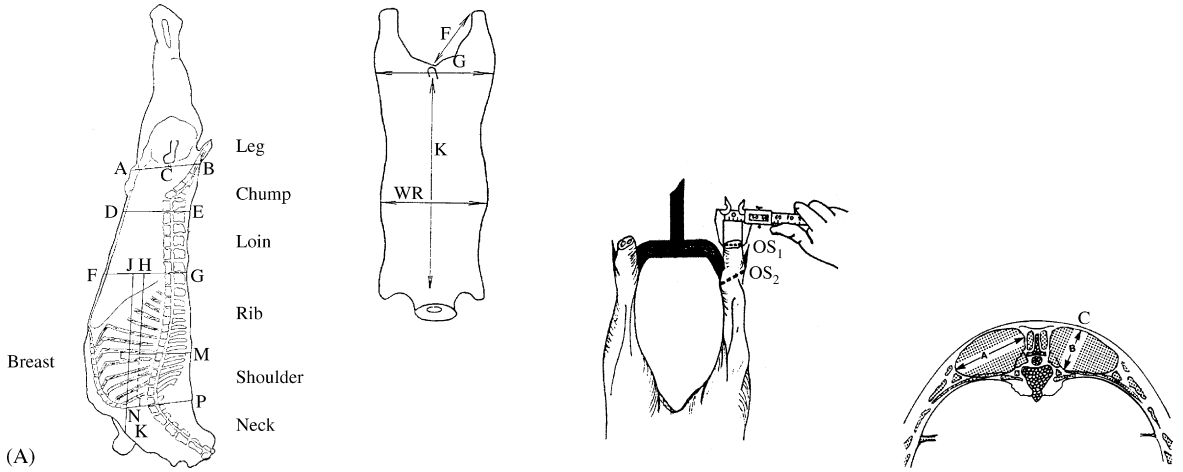

Fig. 1. Jointing procedure (A) and measurements made on lamb carcasses (Bocard, 1973; Craplet and Thibier, 1980).

of cuboid–scafoid and large cuneiform bones (measurement OS_1 of Fig. 1), and (vii) weights of leg + chump, loin and baron (leg + chump + loin), to estimate the weights of the higher priced cuts. Measurements B and OS_1 were used as indicators of muscle and bone contents of carcasses. Fat depots were estimated by weight of kidney knob and measurement C. Carcass thickness was determined as the ratio between hot carcass weight and carcass length. Samples from *L. lombarum* muscle were taken at the 1st and 2nd lumbar vertebra and then minced and stored at −20 °C until assayed for meat analysis (dry matter (DM), crude fat and crude protein (CP)).

2.3. Analytical procedures

Plucked samples of pastures 1 and 2 were randomly taken three times weekly over the duration of trial 2. These samples were stored at −20 °C and finally mixed to obtain a composite sample of each pasture. Maize silage was sampled weekly following the same procedure for pasture samples. Samples of feed were analysed for dry matter, crude protein and ash according to AOAC (1990), and neutral detergent fibre (NDF) and acid detergent fibre (ADF) according to Robertson and Van Soest (1981). Muscle samples were thawed at room temperature, dried at 65 °C until constant weight, minced and analysed for MS, CF and CP following AOAC (1990) methods. Crude fat was determined following a continuous hot extraction with petrol ether for 3 h in a Buchi 810 Soxhlet fat extractor.

2.4. Statistical analysis

Differences between breeds concerning reproductive parameters (rates of fertility, prolificacy and fecundity) and mortality rate were tested by χ^2 analysis. A Yates' correction was applied to χ^2 (Zar, 1996). Student's *t*-test was used to compare growth of lambs from birth to weaning. Data of lamb growth from weaning to slaughter, as well as data related to carcass characteristics, were analysed by multi-factorial analysis of variance (ANOVA) including breed, diet and sex as factors. Data expressed as percentage were previously transformed using the formula $P' = \arcsin \sqrt{P}$, P being the original value (Zar, 1996).

3. Results

3.1. Reproductive performance of ewes, birth weight, mortality and growth of lambs from birth to weaning (trial 1)

Fertility, prolificacy and fecundity rates in ewes and pre-weaning mortality of lambs from birth to weaning are shown in Table 2. No significant difference was found between the two genotypes. Romney Marsh lambs were born 11% heavier than Merino Branco ($P < 0.05$) and grew 10% more from birth to weaning at 24 kg live weight ($P < 0.05$) (Table 3).

3.2. Growth rate of lambs after weaning and characteristics of carcass and meat (trial 2)

Table 4 summarizes the results of daily weight gains of lambs from weaning to slaughter, the series of weighing and measurements made on carcasses, and the analysis of meat constituents as affected by breed, feeding system and sex.

Post-weaning growth of lambs was significantly affected by breed ($P < 0.05$), diet ($P < 0.01$) and sex ($P < 0.01$). Overall, RM lambs grew 8% faster than

Table 2
Reproductive parameters of ewes and lamb mortality by breed

Breed	Fertility rate (%)	Prolificacy rate (%)	Fecundity rate (%)	Mortality rate (%)
RM	96	117	112	18
MB	93	140	130	17

Differences are not statistically significant. Fertility rate: ewes lambing/ewes presented to rams. Prolificacy rate: lambs born/number of lambings. Fecundity rate: lambs born/ewes presented to rams. Mortality rate: lambs dead from birth to weaning/lambs born. Includes stillborn lambs. RM: Romney Marsh; MB: Merino Branco.

Table 3
Birth weight and growth rate of Romney Marsh (RM) and Merino Branco (MB) lambs until weaning

Breed	Birth weight (kg)	Weight at weaning (kg)	Age at weaning (days)	Daily weight gain (g)
RM	4.25 ± 0.19[a]	23.8 ± 0.85	83.1 ± 3.34	236 ± 8.60[a]
MB	3.82 ± 0.12	24.7 ± 0.50	98.3 ± 2.12	214 ± 5.78

The values are expressed in mean ± S.E.M.
[a] Differences between breeds are statistically significant ($P < 0.05$).

MB lambs (100 and 92 g/day, respectively). There was a significant breed × diet interaction (Table 5), demonstrating that the superiority of RM lambs only existed in those supplemented with concentrate (+20%; 144 ± 14.6 g/day versus 120 ± 12.9 g/day; $P < 0.05$). In fact, when maize silage replaced concentrate, the order was reversed and MB lambs grew 16% more rapidly than RM lambs (64.2 ± 3.2 g/day versus 55.2 ± 7.8 g/day; $P < 0.05$). The effect of the breed × diet interaction on growth is shown in Fig. 2. Lambs supplemented

Table 4
Daily weight gain from weaning to slaughter, carcass characteristics and muscle composition of Romney Marsh (RM) and Merino Branco (MB) lambs reared on pasture and supplemented with concentrate (C) or maize silage (MS)

Parameter	Factor					
	Breed		Diet		Sex	
	RM	MB	C	MS	♂	♀
Daily weight gain (g)	99.6 ± 14.6	92.2 ± 9.1*	129.9 ± 9.8	60.5 ± 3.8**	110.3 ± 10.8	73.3 ± 9.3**
Dressing percentage	49.9 ± 0.9	54.7 ± 0.7	53.1 ± 0.7	51.9 ± 1.3	52 ± 1.0	53.1 ± 1.0
Carcass thickness (g/mm)	20.6 ± 1.1	21.6 ± 0.7	23.4 ± 0.7	18.9 ± 0.6**	22 ± 0.8	20.2 ± 0.9
Thickness L. lombarum (cm)	2.3 ± 0.2	2.5 ± 0.1	2.5 ± 0.1	2.2 ± 0.1	2.4 ± 0.2	2.4 ± 0.1
Fat cover (C′) (mm)	2.0 ± 0.5	1.2 ± 0.2	2.0 ± 0.4	0.9 ± 0.3**	1.2 ± 0.3	1.9 ± 0.5
Carcass length (cm)	58.7 ± 0.9	58.8 ± 0.8	60.4 ± 0.7	57.1 ± 0.8	59.7 ± 0.9	57.7 ± 0.6
Carcass width (trochanters) (cm)	15.5 ± 0.2	15.5 ± 0.2	16.0 ± 0.2	15.0 ± 0.2**	15.6 ± 0.2	15.5 ± 0.2
Carcass width (ribs) (cm)	21.7 ± 0.4	21.6 ± 0.4	22.0 ± 0.5	21.3 ± 0.3	22.0 ± 0.4	21.3 ± 0.3
Round of leg (cm)	24.1 ± 0.4	25.6 ± 0.3*	25.0 ± 0.4	24.8 ± 0.4	25.2 ± 0.4	24.6 ± 0.4
Weight of joints (% of carcass)						
Leg + chump	32.4 ± 1.0	34.2 ± 0.4	32.8 ± 0.4	34.0 ± 1.0	33.0 ± 0.4	33.8 ± 1.0
Loin	5.5 ± 0.4	6.5 ± 0.3	6.4 ± 0.2	5.9 ± 0.4	6.4 ± 0.4	5.9 ± 0.3
Baron	37.9 ± 0.6	40.7 ± 0.7	39.2 ± 0.6	39.9 ± 1.0	39.4 ± 0.7	39.7 ± 0.9
Kidney fat weight (g)	106.9 ± 17	114.5 ± 12	129.9 ± 15	91.9 ± 11	95.6 ± 11	128.4 ± 16
Bone (OS_1) (cm)	3.1 ± 0.05	3.2 ± 0.06	3.2 ± 0.07	3.1 ± 0.04	3.3 ± 0.06	3.0 ± 0.03*
L. lombarum						
DM (%)	30.1 ± 1.5	29.9 ± 0.8	31.7 ± 1.1	28.6 ± 0.6**	–	–
CP (%)	21.4 ± 0.2	22.0 ± 0.3	21.5 ± 0.3	22.0 ± 0.3	–	–
CF (%)	6.0 ± 1.2	5.0 ± 0.6	6.5 ± 0.9	4.4 ± 0.6*	–	–

Values are means ± S.E.M. For each parameter, differences within factors are statistically significant.
* $P < 0.05$.
** $P < 0.01$.

Table 5
Post-weaning daily weight gain (g) of Romney Marsh (RM) and Merino Branco (MB) lambs supplemented either with concentrate or maize silage

Breed	Supplement	
	Concentrate	Corn silage
RM	144 ± 14.6[a]	55.2 ± 7.8[a]
MB	120 ± 12.9	64.2 ± 3.2

The values are expressed in mean ± S.E.M.
[a] Differences between breeds are statistically significant ($P < 0.05$).

with concentrate grew twice as fast as lambs supplemented with maize silage (129.9 ± 9.8 g/day versus 60.5 ± 3.8 g/day; $P < 0.01$) and male lambs grew 50% more than females (110.3 ± 10.8 g/day versus 73.3 ± 9.3 g/day; $P < 0.01$). Interestingly, a significant diet × sex interaction revealed that females supplemented with concentrate grew faster than males supplemented with silage, which demonstrates that the factor diet overlapped the factor sex. With the exception of the measurement indicative of round of leg, which was higher in MB than in RM lambs (25.6 cm versus 24.1 cm; $P < 0.05$), no other significant differences were detected between breeds in any of the remaining carcass traits studied. Carcasses of lambs supplemented with concentrates were thicker ($P < 0.01$), wider in trochanters ($P < 0.01$), covered with more fat ($P < 0.01$), presented less water in the *L. lombarum* muscle ($P < 0.01$) and had a greater amount of intramuscular fat ($P < 0.05$). Apart from the growth rate, only the carcass bone content indicator (measurement OS_1) differed between males and females ($P < 0.05$). It is, however, worth emphasising

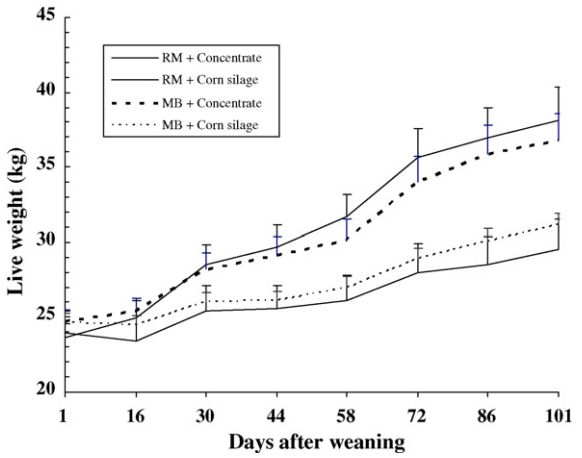

Fig. 2. Live weights of lambs from weaning to slaughter. RM—Romney Marsh, MB—Merino Branco; values are means ± S.E.M. ($n = 7$, RM; $n = 10$, MB).

that sex differentiation in the chemical composition of *L. lombarum* muscle was not available.

4. Discussion

Reproductive performance of ewes and mortality rate of lambs did not differ between RM and MB. Fertility, prolificacy and fecundity of MB in this study was considerably higher than that reported by Direcção Geral de Pecuária (1991) for the same breed (ranging 80–85%, 110–115% and 95–100%, respectively). Alvarez et al. (1996) reported prolificacy rates of 112–143%. For RM, Sousa and Leitão (1995) found values for fertility and prolificacy of 75.5–94.5% and 114–169%, respectively, in a consecutive 2-year study involving four flocks in conditions similar to the present study. All these results indicate that prolificacy of both RM and MB breeds is reduced and needs improvement if these breeds are to be used for meat production in semi-intensive production systems. Mortality rates did not differ between breeds and were very high. Deaths occurred mainly during the first 5 days of life, which could be related to the adaptive process of breeds to the region. RM lambs were heavier at birth and grew faster than MB (daily gains of MB lambs were, however, higher than the 167 g/day reported by Costa (1987)) during milk feeding, resulting in an advancement of 15 days to reach similar weights at weaning. This must be explained by the low milk yield of MB ewes (Borrego, 1985; Costa, 1987; Ribeiro and Sobral, 1991).

From weaning to slaughter, the overall growth rate of RM lambs was higher than MB, but this parameter was affected by the nature of the supplement offered. RM lambs performed better with concentrate but MB lambs exceeded RM when concentrate was replaced by maize silage. These results suggest a superior adaptability of MB breed, which adapted better to food scarcity during the dry season. The low daily weight gains of lambs in this experiment reflects the adverse feeding conditions during the summer on S^{ta} Maria' island. In the Alentejo region of Portugal, where the MB breed was developed, growth rates of lambs range from 155 to 234 g/day under grazing conditions without or with concentrate supplementation (Santos-Silva et al., 2002) and 342–362 g/day for pen-fed lambs (Santos-Silva and Portugal, 1990, 2000). RM and MB lambs proved to be very similar in dressing percentage, carcass measurements, proportion of prime meat cuts, proportion of bone and fat in carcass and *L. lombarum* composition. Only the leg of RM lambs was slightly rounder than MB, which is an advantage for the RM breed. The proportions of baron (i.e., 2 legs + 2 champs + 2

loins) in carcasses, which evaluates the importance of prime cuts, were generally low. Craplet and Thibier (1980) suggest values of 38 and 48% for bad and ideal carcasses, while Costa (1987) found a value of 46.8% in MB rams but this trait was not influenced by breed, diet supplement or sex. The utilization of concentrate rather than maize silage as supplement resulted in higher growth rates and thicker and fatter carcasses. Fat depth (evaluated by the thickness of fat covering the *L. lombarum* muscle) in carcasses of lambs supplemented with concentrate was twice as much as fat depth of lambs supplemented with maize silage. However, a significant diet × breed interaction was detected, which indicate that RM lambs had higher fat depth than MB when lambs were supplemented with concentrate (2.8 mm versus 1.2 mm), but the opposite was observed when lambs were supplemented with maize silage (0.4 mm versus 1.2 mm). This fact reaffirms the better adaptation of MB to adverse feeding conditions.

In conclusion, the results of the present study suggest that, despite the greater growth rate of RM lambs, MB lambs performed better with reduced forage availability. Carcass characteristics and reproductive performance of MB ewes are not limiting factors for the exploitation of this breed when compared with RM. Thus, Merino Branco seems to be better suited for sheep production in the Azores islands (or regions with similar sheep production conditions) where periods of forage scarcity require the use of cheap forage supplements.

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