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Carcass characteristics of lambs fed diets with mulberry hay

Características da carcaça de cordeiros alimentados com dietas contendo feno de amoreira

Luís Gabriel Alves Cirne[1]; Américo Garcia da Silva Sobrinho[2]; Fabiana Alves de Almeida[3*]; Valéria Teixeira Santana[4]; Viviane Endo[5]; Nivea Maria Brancacci Lopes Zeola[2]; Amelia Katiane de Almeida[6]

Abstract

The aim of this study was to evaluate the *in vivo* quantitative traits of carcass and commercial cuts of lambs fed diets containing 0, 12.5, and 25.0% mulberry hay replacing the concentrate. Twenty-four Ile de France lambs at approximately 60 days of age, with 15 kg body weight, were confined in individual stalls and slaughtered at 32 kg. Increasing levels of mulberry hay in the diet resulted in a linear increase in chest depth (R^2=0.84), leg muscularity index (R^2=0.71), and muscle:bone ratio (R^2=0.95); a linear decrease in leg compactness index (R^2 =0.75), shoulder weight (R^2=0.78), and femur weight (R^2=0.99) and length (R^2=0.86); and a quadratic response from chilling losses (R^2=1.0) and percentage of intermuscular fat. Mulberry hay can be used in the feeding of feedlot lambs without compromising their carcass quantitative characteristics.

Key words: Cuts. Morphology. Nutrition. Sheep. Yield.

Resumo

Objetivou-se avaliar as características quantitativas in vivo, da carcaça e dos cortes comerciais de cordeiros alimentados com dietas contendo 0; 12,5 e 25,0% de feno de amoreira em substituição ao concentrado. Foram utilizados vinte e quatro cordeiros Ile de France, com aproximadamente 60 dias de idade e 15 kg de peso corporal, confinados em baias individuais e abatidos aos 32 kg. Houve efeito linear crescente (R2 = 0,84) para a profundidade do tórax, índice de musculosidade da perna (R2=0,71) e para a relação músculo:osso (R2=0,95); decrescente (R2 =0,75) para o índice de compacidade da carcaça, peso da paleta (R2 = 0,78) e peso (R2=0,99) e comprimento (R2=0,86) do fêmur à medida que se aumentou o feno de amoreira na dieta; e comportamento quadrático para perdas por resfriamento (R2=1,0) e porcentagem de gordura intermuscular. O feno de amoreira pode ser utilizado na alimentação de cordeiros confinados sem prejudicar as características quantitativas da carcaça.

Palavras-chave: Cortes. Morfologia. Nutrição. Ovino. Rendimento.

[1] Prof., Universidade Federal de Roraima, UFRR, Boa Vista, RR, Brasil. E-mail: lgabrielcirne@hotmail.com

[2] Profs., Departamento de Zootecnia, Faculdade de Ciências Agrárias e Veterinárias, Universidade Estadual Paulista, UNESP, Jaboticabal, SP, Brasil. E-mail: americo@fcav.unesp.br; nivea.brancacci@ig.com.br

[3] Pós-Doutoranda, Departamento de Parasitologia, Instituto de Biociências, UNESP, Botucatu, SP, Brasil. E-mail: faalvesalmeida@yahoo.com.br

[4] Discente de Mestrado, Programa de Pós-Graduação em Zootecnia, Faculdade de Ciências Agrárias e Veterinárias, UNESP, Jaboticabal, SP, Brasil. E-mail: santana_vt@yahoo.com.br

[5] Discente de Doutorado, Programa de Pós-Graduação em Zootecnia, Faculdade de Ciências Agrárias e Veterinárias, UNESP, Jaboticabal, SP, Brasil. E-mail: endo_vica@hotmail.com

[6] Pós-Doutoranda, Departamento de Zootecnia, Faculdade de Ciências Agrárias e Veterinárias, UNESP, Jaboticabal, SP, Brasil. E-mail: almeida.amelia@gmail.com

[*] Author for correspondence

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Introduction

The carcass characteristics are among the main points of sheep meat sale, since these are the profitable attributes seen by the consumer. The carcass is the most important item in sheep production, as it contains the edible portion of greatest nutritional value.

Both *in vivo* and on-carcass measures are aimed at establishing the standardization of the end product. One way of evaluating the carcass is by determining its conformation, which takes into account different anatomical regions and the distribution of muscle and fat tissues in relation to the skeleton. A carcass is defined as well-conformed if it has a short, wide, round, and compact shape (OSÓRIO; OSÓRIO, 2005).

The pre-slaughter management of lambs is based on the observation of the animal weight. However, in view of the demands of consumers for leaner meats and carcasses with greater muscle deposition, it is necessary to known the percentage composition of cuts and other parts that compose the animal. The carcass dissection is the most precise method to determine the tissue composition in muscle, fat, bone, and other components. It is not a viable method, though, as it is laborious and costly; thus, it is more common to dissect the shoulder and leg, which are cuts highly correlated with the carcass composition (SILVA SOBRINHO et al., 2008).

In meat sheep production developed in the feedlot, feeding is a component that elevates production costs. In this context, mulberry hay can be an alternative feedstuff due to its graminaceous features such as adaptation to different soils and climates; easy vegetative propagation; regrowth capacity; taproot system, with numerous secondary and tertiary roots, which allow good vegetative growth even in dry periods of the year (FONSECA; FONSECA, 1986); fresh mass production of 25 to 30 t ha^{-1} $year^{-1}$; crude protein content of 18 to 28% (BA et al., 2005); total digestible nutrients of 76% (BAMIKOLE et al., 2005); good acceptability (SANCHEZ, 2002); and dry matter digestibility of 75 to 85% (BA et al., 2005), which characterize this plant as an important alternative feedstuff (TAKAHASHI, 1988).

Some studies in the literature evaluated the use of mulberry on the performance of ruminants (LIU et al., 2001; SILVA, 2006; OKAMOTO et al., 2008; CIRNE et al., 2014); however, to this date, no research has investigated the influence of this nutrient source on the quantitative characteristics of lamb carcasses.

In this regard, the aim of this study was to evaluate the *in vivo* quantitative traits of carcass and commercial cuts of lambs fed diets containing mulberry hay.

Material and Methods

The study complied with the principles of Ethics in Animal Experimentation adopted by the Brazilian College of Animal Experimentation (*Colégio Brasileiro de Experimentação Animal*, COBEA), and was approved by the Committee for Ethics in Animal Use (*Comissão de Ética no Uso de Animais*, CEUA), under case no. 014105/11.

Twenty-four newly-weaned male uncastrated Ile de France lambs (average age of 60 days), with an average initial weight of 15.48 ± 0.07 kg, were used in this experiment. Lambs were housed in individual stalls measuring approximately 1.0 m^2, inside a covered shed with suspended slatted floor, equipped with feeder and drinker. At the beginning of the experiment, lambs were identified, dewormed, vaccinated with a polyvalent vaccine against clostridioses, supplemented with A, D, and E vitamins, and distributed at random into the treatments (eight animals per treatment).

Experimental diets (Table 1) were calculated to meet the requirements recommended by NRC (2007) for weaned lambs with an average weight gain of 300 g/day.

Treatments consisted of the following diets: 0%MH (mulberry hay) - forage sugarcane + concentrate; 12.5%MH - forage sugarcane + concentrate + 12.5% mulberry hay in the DM (dry matter); and 25%MH - forage sugarcane + concentrate + 25% mulberry hay in the DM, replacing the soybean meal and ground corn. The sugarcane composed 50% of the total diet. Feed was supplied in two meals: 50% supplied at 07h00, and the other 50% at 17h00, so as to allow at least 10% as refusals.

Table 1. Centesimal composition of ingredients and chemical composition of experimental diets.

Diet composition (% DM)	Mulberry hay (%)		
	0	12.5	25.0
Ingredient			
Forage sugarcane	50.00	50.00	50.00
Mulberry hay	-	12.50	25.00
Soybean meal	28.49	24.60	21.33
Ground corn	17.80	9.00	0.00
Soybean meal	1.00	1.00	1.00
Urea	0.80	0.80	0.80
Mineral-vitamin supplement[1]	0.50	0.50	0.50
Calcitic limestone	0.47	0.43	0.25
Dicalcium phosphate	0.94	1.17	1.12
Chemical composition			
Dry matter	58.44	56.94	57.18
Organic matter[2]	93.63	92.56	91.92
Mineral matter[2]	4.17	4.99	5.87
Crude protein[2]	18.88	18.51	18.40
Ether extract[2]	2.88	2.55	2.21
Lignin[2]	2.07	2.19	2.32
Neutral detergent fiber[2]	23.56	24.26	25.01
Acid detergent fiber[2]	14.66	15.84	17.06
Total carbohydrates[2]	73.27	72.95	72.76
Non-fibrous carbohydrates[2]	49.71	48.68	47.75
Metabolizable energy (Mcal kg^{-1} DM)	2.99	2.95	2.55

[1] Provides per kg of product: calcium, 120 g; chloride, 90 g; cobalt, 10 mg; copper, 50 mg; sulfur, 34 g; iron, 1,064 mg; phosphorus, 50 g; iodine, 25 mg; magnesium, 54 g; manganese, 1,500 mg; selenium, 20 mg; sodium, 62 g; zinc, 1,600 mg; fluorine (max), 0.73 g; vitamin A, 100,000 IU; vitamin D3 40,000 IU; vitamin E 600 IU.
[2] in % DM.

The (forage-purpose) sugarcane variety used was IAC 86-2480, harvested and chopped daily to 1.0 cm particles and supplied fresh to animals. Mulberry branches, originating from the Sericulture Section at FCAV - Unesp, were cut at 60 days of regrowth and later dried in the sun until they reached a hay point below 20% moisture. After haying, this material was ground through a sieve with 0.8 mm mesh aiming to facilitate its uniformity when mixing it with the concentrate ingredients and prevent selectivity by the animals.

Lambs were weighed weekly, and upon reaching 32.20 ± 0.49 kg body weight (BW) they were fasted for solid feeds during 16 h and weighed again to determine their body weight at slaughter (BWS). Next, *in vivo* morphological measurements were taken following recommendations of Searle et al. (1989); Osório et al. (1998) and Yáñez et al. (2004). Based on these measurements, body compactness was calculated as the ratio between BWS and body length.

Lambs were stunned by electronarcosis with an electric shock of 250 V for two seconds and slaughtered by sectioning the jugular veins and carotid arteries for bleeding, followed by evisceration, and removal of head and limb extremities. The gastrointestinal tract content (measured as the difference between full and empty gastrointestinal tract) was used to determine empty body weight (EBW = BWS − gastrointestinal content), according to Silva Sobrinho (2006).

After the evisceration, carcasses were weighed, generating the hot carcass weight (HCW), which was used to determine the hot carcass yield (HCY = HCW/BWS × 100), and transferred to a cold room at 6 ºC, where they remained 24 h hung by the tendons of the *gastrocnemius* muscle on appropriate hooks, spaced 17 cm apart from each other. Subsequently, the cold carcass was weighed (CCW), and the chilling loss percentage (CL = (HCW − CCW/HCW) × 100), cold carcass yield (CCY = (CCW/BWS) × 100), and dressing percentage (DP = PCQ - BWS) × 100) were calculated.

The conformation, which considers the distribution of muscle masses on the bone base, was evaluated always by the same person subjectively, according to Colomer-Rocher et al. (1988), by assigning scores of 1 (inferior) to 5 (excellent); and the fatness, or fat cover degree, also by assigning a score of 1 (no fat) to 5 (excess fat). Next, carcass measurements were taken according to Osório et al. (1998) and Yamamoto (2006).

Based on the previous determinations, we calculated the carcass compactness index (CCI) = CCW/CIL (carcass internal length), expressed in kg/cm, and the leg compactness index (LCI = rump width/leg length). Subsequently, carcasses were divided lengthwise, and the left half was sectioned into five anatomical regions (neck, shoulder, ribs, loin, and leg), according to Silva Sobrinho (2006), which were weighed individually to determine the percentages, representing the whole.

Measurements were taken from the *Longissimus* muscle over the $^{12th\ and\ 13th}$ thoracic ribs to calculate the loin eye area (LEA), according Silva Sobrinho (1999), using the ellipse formula: (A/2×B/2)xπ, where A = maximum length of the *Longissimus* muscle, in cm, and B = maximum depth of the L*ongissimus* muscle, in cm. The fat thickness was calculated with a digital caliper over the L*ongissimus dorsi*, in mm.

The leg dissection followed the methodology described by Brown and Willians (1979). The legs of the left half-carcasses were separated, packed individually in plastic bags, and frozen at −18 ºC for later dissections. For dissection, legs were thawed at 10 ºC in a BOD incubator for 20 h inside the plastic bags. The following groups of tissues were separated: subcutaneous fat, intermuscular fat, muscles, bones, and others (comprising tendons, cartilages, connective tissues, glands, and blood vessels). The leg muscles surrounding the femur were removed and weighed separately to determine the leg muscularity index. The first muscle removed was the *Biceps femoris*, followed by the *Semitendinosus, Adductor, Semimembranosus*, and lastly the *Quadriceps femoris*. The other muscles that did not surround the femur directly were removed and weighed together to determine the percentage of total muscle. Bones were weighed together, except for the femur, which was weighed separately and had its length measured in a stainless box with extremity adjusted and an attached ruler.

The leg muscularity index (LMI) was calculated by the following formula, described by Purchas et al. (1991): $LMI = (\sqrt{W5M/FL})/CF$, where W5M = weight of the five muscles (*Biceps femoris*, *Semimembranosus*, *Semitendinosus*, *Quadriceps femoris*, *and Adductor*) in g, and FL = femoral length, in cm.

The experimental design was completely randomized, with three treatments (0, 12.5, and 25.5% mulberry hay, in the DM), and eight replications. Results were evaluated by analyses of variance and regression, with the degrees of freedom broken down into linear or quadratic effects, according to the percentages of mulberry hay. The significance of regressions was obtained by the F test at 5% probability using Sisvar statistical software (FERREIRA, 2000).

Results and Discussion

Inclusion of mulberry hay in the diet did not influence (P>0.05) body weight at slaughter, *in vivo* measurements, or body compactness of the lambs (Table 2). The observed values are within the recommended standards for Ile de France lambs slaughtered with approximately 32 kg body weight.

Table 2. Body weight at slaughter, *in vivo* measurements, and body compactness of lambs fed diets containing mulberry hay in the concentrate.

Variable	Mulberry hay (%)			P		SEM
	0	12.5	25	L	Q	
Body weight at slaughter (kg)	30.82	30.98	30.58	ns	ns	0.140
Body condition[a]	2.75	3.00	2.67	ns	ns	0.082
Body length (cm)	57.25	58.30	57.66	ns	ns	0.464
Back height (cm)	59.43	57.74	58.63	ns	ns	0.387
Rump height (cm)	58.98	58.16	58.82	ns	ns	0.570
Femur length (cm)	54.00	53.70	53.50	ns	ns	0.430
Chest width (cm)	21.38	22.08	20.72	ns	ns	0.268
Rump width (cm)	22.27	22.04	21.70	ns	ns	0.259
Chest circumference (cm)	73.58	75.30	74.83	ns	ns	0.575
Thigh circumference (cm)	33.17	32.40	31.92	ns	ns	0.602
Leg length (cm)	31.75	28.80	29.58	ns	ns	0.551
Body compactness (kg cm^{-1})	0.57	0.57	0.56	ns	ns	0.0041

P = probability; L = linear; Q = quadratic; SEM = standard error of the mean; [a]Scores of 1 to 5, where 1 = excessively lean, 2 = lean, 3 = normal, 4 = fat, and 5 = excessively fat.

Body condition score averaged 2.8, which, in the description scale, provides a normal condition. This variable is aimed at establishing the carcass fatness degree, through the estimate of the muscle:fat ratio (OSÓRIO; OSÓRIO, 2005), which may determine the ideal moment for slaughter. One of the measurements that complement the data on body weight at slaughter is body length. The BWS:body length ratio generates body compactness; the higher this variable, the better, since muscle deposition increases as the animal size is increased, with the same weight. The body compactness value of 0.57 was similar to the 0.55 kg/cm reported by Endo et al. (2015) and Moreno et al. (2010), who evaluated Ile de France lambs confined from 15 to 32 kg and fed forage sugarcane as roughage. According to Osório et al. (2005), there is a high correlation (0.7) between body condition and body compactness. Although no effect occurred, a downward trend was observed for the values of these two parameters with inclusion of 25% mulberry hay.

The average carcass conformation score was 2.79, and fatness was 2.93 (Table 3). Conformation and fatness are criteria that define the quality of a carcass, since well-conformed and fattened carcasses are usually given higher prices at sale, especially in countries where lamb production is traditional. Besides, a fatness degree is necessary so as to reduce water losses from chilling (OSÓRIO et al., 1995).

Table 3. Morphological measurements of carcass of Ile de France lambs fed diets containing mulberry hay.

Variable	Mulberry hay (%)			P		SEM
	0	12.5	25	L	Q	
Conformation[a]	2.83	2.80	2.75	ns	ns	0.071
Fatness[b]	2.59	3.28	2.92	ns	ns	0.211
External length (cm)	53.67	54.92	54.33	ns	ns	0.308
Internal length (cm)	55.67	55.85	56.67	ns	ns	0.388
Leg length (cm)	32.92	33.95	31.22	ns	ns	0.531
Thigh circumference (cm)	31.83	32.24	32.42	ns	ns	0.309
Rump circumference (cm)	60.00	60.93	60.23	ns	ns	0.247
Rump width (cm)	22.05	21.98	22.20	ns	ns	0.196
Chest width (cm)	23.68	22.32	22.83	ns	ns	0.390
Chest depth (cm)	22.90	23.54	23.63	0.045	ns	0.151
Chest circumference (cm)	66.43	66.76	65.93	ns	ns	0.275
LCI[c]	0.67	0.65	0.71	ns	ns	0.015
CCI[d] (kg cm^{-1})	0.25	0.25	0.24	0.040	ns	0.0023
	Regression equation					R^2
Chest depth	Y = 22.991111 + 0.014667x					0.84
CCI	Y = 0.248611 − 0.000233x					0.75

P = probability; L = linear; Q = quadratic; SEM = standard error of the mean; [a]Scores of 1 to 5, where 1 = inferior, 2 = regular, 3 = good, 4 = very good, and 5 = excellent; [b]Scores of 1 to 5, where 1 = no fat, 2 = scarce fat, 3 = medium fat, 4 = uniform fat, and 5 = excessive fat; [c]Leg compactness index; [d]Carcass compactness index.

As the mulberry hay was included, chest depth increased linearly (R^2=0.84) and carcass compactness index decreased linearly (R^2=0.75) (Table 3). It can be inferred that animals with a higher chest depth show less compact carcasses, and despite the lack of differences, there is a trend for them to have carcasses with lower conformation (Table 3). Marques (2006) observed a linear decrease in chest depth with inclusion of Christmas cactus hay (*Schlumbergera truncata*) as a consequence of the reduced body weight at slaughter as the hay was included.

The carcass yield depends on factors related to the animal, the environment, and the carcass itself. In the ovine species, carcass yields range from 40 to 50% (SILVA SOBRINHO, 2006). In the present study, the HCY was 45.91%, CCY was 44.45%, and DP was 54.64%, on average (Table 4).

Mulberry hay inclusion influenced chilling losses, which responded quadratically (R^2=1.0), with lower losses (2.89%) in the carcasses of lambs that did not receive this ingredient (Table 4). Although no effect of mulberry hay inclusion was observed on fatness (Table 3), values trended towards a quadratic effect, which may be related to the response shown by chilling losses (Table 4), since these two parameters are negatively correlated.

The subcutaneous fat thickness recorded in the current experiment was 1.33 mm (Table 4), which is much lower than the 3 mm considered ideal for meat-purpose animals (SILVA SOBRINHO, 2006). The low metabolizable energy content of the diet (2.93 Mcal kg^{-1} DM) likely contributed to this low value. Moreno et al. (2010) evaluated lambs of the same breed slaughtered with similar weights, fed diets with 3.32 Mcal kg^{-1} DM, and observed higher values for subcutaneous fat thickness (3.5 mm). Another qualitative trait of the carcass is the loin eye area (LEA), which determines its muscle quantity. The average value recorded for LEA was 13.74 cm^2 (Table 4) which is in line with the recommended range (8 to 14 cm^2) for lambs slaughtered between 15 and 40 kg LW (SILVA SOBRINHO, 2006).

Table 4. Empty body weight, hot and cold carcass weights, hot and cold carcass yields, dressing percentage, chilling losses, fat thickness, and loin-eye area of the carcass of Ile de France lambs fed diets containing mulberry hay.

Variable	Mulberry hay (%)			P		SEM
	0	12.5	25	L	Q	
Empty body weight (kg)	26.00	26.28	25.35	ns	ns	0.649
Hot carcass weight (kg)	14.24	14.27	13.89	ns	ns	0.509
Cold carcass weight (kg)	13.83	13.77	13.45	ns	ns	0.489
Hot carcass yield (%)	46.22	46.06	45.45	ns	ns	1.575
Cold carcass yield (%)	44.88	44.48	44.00	ns	ns	1.568
Dressing percentage (%)	54.79	54.29	54.83	ns	ns	1.843
Chilling losses (%)	2.89	3.45	3.18	ns	0.04	0.419
Fat thickness[a] (mm)	1.40	1.17	1.40	ns	ns	0.115
Loin eye area[b] (cm^2)	13.73	13.64	13.86	ns	ns	0.392
	Regression equation					R^2
Chilling losses	$Y = 2.8865 + 0.038973x - 0.000663x^2$					1.0

P = probability; L = linear; Q = quadratic; SEM = standard error of the mean. [a]Fat thickness obtained at the 12th rib; [b]Formula: LEA = (A/2 × B/2)π (SILVA SOBRINHO, 1999), where A is the maximum length and B is the maximum muscle depth, in cm.

The diets with mulberry hay did not affect the weights and percentages of the region cuts from the lamb carcasses (Table 5), except for shoulder weight, which decreased linearly (R^2=0.78), showing 1.49, 1.48, and 1.41 kg for diets zero and with 12.5% and 25% mulberry hay, respectively.

Table 5. Weights and percentages of region cuts from the carcass of Ile de France lambs fed diets containing mulberry hay.

Variable	Mulberry hay (%)			P		SEM
	0	12.5	25	L	Q	
LHCW (kg)[1]	6.93	6.94	6.79	ns	ns	0.063
Shoulder						
kg	1.49	1.48	1.41	0.047	ns	0.015
%	21.61	21.79	21.28	ns	ns	0.190
Neck						
kg	0.56	0.51	0.53	ns	ns	0.017
%	8.09	7.50	7.94	ns	ns	0.222
Ribs						
kg	1.72	1.63	1.64	ns	ns	0.025
%	24.99	23.92	24.62	ns	ns	0.254
Loin						
kg	0.77	0.82	0.78	ns	ns	0.019
%	11.22	12.02	11.79	ns	ns	0.245
Leg						
kg	2.34	2.33	2.28	ns	ns	0.023
%	33.96	34.18	34.28	ns	ns	0.261
	Regression equation					R^2
Shoulder weight	$Y = 1.498556 - 0.01467x$					0.78

P = probability; L = linear; Q = quadratic; SEM = standard error of the mean. [1]LHCW = left half-carcass weight.

In this study, the weights of shoulder, neck, loin, leg, and ribs corroborated those of shoulder (1.37 kg), neck (0.53 kg), loin (0.77 kg), leg (2.27 kg), and ribs (1.63 kg) obtained by Endo et al. (2015), who evaluated Ile de France lambs (32 kg LW) fed diets with the same roughage (forage sugarcane) and the same roughage:concentrate (50:50) ratio as those used in the present study, but with concentrate ingredients varying. Marques et al. (2007) detected a decreasing linear effect on shoulder, neck, ribs, loin, and legs of lambs fed 33, 66, and 100% Christmas cactus hay and observed variations in carcass weight resulting from the large variation in body weight at slaughter.

There was a quadratic effect (R^2=1.0) on the percentage of intermuscular fat; a linear decreasing effect on weight (R^2=0.99) and length (R^2=0.86) of the femur; and a linear increasing effect on leg muscularity index (R^2=0.71) and muscle:bone ratio (R^2=0.95) (Table 6).

Table 6. Tissue composition and leg muscularity index (LMI) of Ile de France lambs fed diets containing mulberry hay.

Variable	Mulberry hay (%)			P		SEM
	0	12.5	25	L	Q	
Leg weight (kg)	2.34	2.33	2.28	ns	ns	0.023
Leg yield (%)	33.96	34.18	34.28	ns	ns	0.261
Total muscle (%)	65.82	67.02	69.79	ns	ns	0.867
Leg muscles (g)	863.33	902.00	885.00	ns	ns	12.96
Biceps femoris	170.00	187.0	181.67	ns	ns	4.111
Semitendinosus	86.67	86.00	89.17	ns	ns	1.859
Aducctor	92.50	97.00	100.00	ns	ns	2.052
Semimembranosus	205.00	219.00	222.50	ns	ns	4.137
Quadriceps femoris	308.33	317.00	305.83	ns	ns	6.169
Total fat (%)	9.84	10.35	9.29	ns	ns	0.327
Subcutaneous	6.96	5.96	5.88	ns	ns	0.269
Intermuscular	2.88	4.39	3.41	ns	0.008	0.235
Total bone (%)	14.56	14.59	14.53	ns	ns	0.260
Femur weight (g)	133.33	127.00	119.22	0.006	ns	2.205
Other (%)[a]	1.62	1.48	1.36	ns	ns	0.159
Femur length (cm)	16.57	16.02	15.92	0.026	ns	0.123
LMI	0.43	0.46	0.47	0.044	ns	0.007
Ratio						
Muscle:bone	6.49	7.15	7.44	0.028	ns	0.178
Muscle:fat	3.90	3.99	4.55	ns	ns	0.166

	Regression equation	R^2
Intermuscular fat (%)	$Y = 2.881667 + 0.109967x - 0.00198x^2$	1.0
Femur weight (g)	$Y = 133.575 - 0.282333x$	0.99
Femur length (cm)	$Y = 16.492778 - 0.013x$	0.86
LMI	$Y = 0.439444 + 0.00667x$	0.71
Muscle:bone ratio	$Y = 6.555 + 0.019x$	0.95

P = probability; L = linear; Q = quadratic; SEM = standard error of the mean. [a]Others = tendons, cartilages, connective tissues, glands, and blood vessels.

As stated by Silva Sobrinho et al. (2008), the relative proportions of fat depots, as well as the total amount of fat in the carcass, are influenced by the weight and age of animals at slaughter. In the presence study, addition of mulberry hay influenced the deposition of subcutaneous fat, but lambs were slaughtered at similar weights (30.8 kg BW) and ages (126 days).

The weight (2.32 kg) and the yield (34.14%) of the leg are in line with the 2.09 kg 34.53% reported by Endo et al. (2015), who studied Ile de France lambs slaughtered at 32 kg BW. The length and weight of the femur decreased as the mulberry hay was included in the diet; as a consequence, there was an increase in muscularity index and muscle:bone ratio of the leg (Table 6). Such characteristics are desirable, since carcasses with a larger amount of muscle are desired. According to Silva Sobrinho et al. (2008), increases in the proportion of muscle in the carcass result from a decrease in the percentage of fat or increases in the muscle:bone ratio.

Conclusion

Mulberry hay can be used in lamb diets up to 25% without changing the main quantitative characteristics of the carcass, which makes it a good alternative in the feeding of feedlot lambs.

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