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Carcass characteristics and tissue composition of commercial cuts of lambs fed with banana crop residues

Características da carcaça e composição tecidual de cortes comerciais de cordeiros alimentados com resíduos da bananicultura

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Abstract

The aim of this study was to evaluate the effect of substitution of *Cynodon* hay with banana plantation residue hay on the carcass characteristics and tissue composition of commercial cuts of feedlot Santa Inês lambs. Twenty-five whole lambs were used, with an average age of five months and an initial live weight of 26.95 kg (± 1.5), distributed in a completely randomized design with five treatments (1 = 40% *Cynodon* spp. hay + 60% concentrate; 2 = 20% banana leaf hay + 20% *Cynodon* spp. hay + 60% concentrate; 3 = 40% banana leaf hay + 60% concentrate; 4 = 20% banana pseudostem hay + 20% *Cynodon* spp. hay + 60% concentrate; 5 = 40% banana pseudostem hay + 60% concentrate) and five repetitions. The lambs were slaughtered on day 69 of the experiment. The variables evaluated were: live weight without fasting (LWWF), live weight post-fasting (LWPF), morphometric measurements *in vivo* and postmortem, hot and cold carcass weights (HCW, CCW), hot and cold carcass yield (HCY, CCY), biological performance and weight loss by chilling. The carcasses were divided into eight commercial cuts: neck, shoulder, foreshank and hindshank, breast and flank, loin, leg and rack. The leg, shoulder and loin were dissected into muscle, fat and bone. The animals fed on pseudostem hay showed higher LWWF, LWPF, body length, HCW and CCW; however, the HCY, CCY, morphometric measurements and commercial cut weights and yields were not altered by the treatments. The use of pseudostem hay allows for heavier carcasses; however, the use of coproducts changed the characteristics and carcass yield of the assessed commercial cuts.
Key words: *Musa* spp., pseudostem, coproducts

Resumo

Objetivou-se avaliar o efeito da substituição do feno de *Cynodon* spp. por feno de resíduos da bananicultura nas características de carcaça e composição tecidual dos cortes comerciais de cordeiros Santa Inês terminados em confinamento. Utilizou-se 25 cordeiros, não castrados, com idade média de

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cinco meses, peso vivo inicial de 26,95 kg (± 1,5), distribuídos em delineamento inteiramente casualizado com cinco tratamentos (1= 40% de feno *Cynodon* spp. + 60% concentrado, 2= 20% de feno de folha de bananeira e 20% de feno de *Cynodon* spp. + 60% concentrado, 3= 40% de feno de folha de bananeira + 60% concentrado, 4= 20% de feno de pseudocaule de bananeira e 20% de feno de Cynodon spp. + 60% concentrado, 5= 40% de feno de pseudocaule de bananeira + 60% concentrado) e cinco repetições. Os cordeiros foram abatidos aos 69 dias de experimentação. As variáveis avaliadas foram: peso vivo sem jejum (PVSJ), peso vivo com jejum (PVCJ), medidas morfométricas *in vivo* e da carcaça, peso da carcaça quente e fria (PCQ, PCF), rendimento da carcaça quente e fria (RCQ, RCF), rendimento biológico e perda por resfriamento. As carcaças foram divididas em oito cortes comerciais, sendo o pernil, paleta e lombos dissecados em músculo, gordura e osso. Os animais alimentados com feno de pseudocaule apresentaram maior PVSJ, PVCJ, comprimento corporal, PCQ, PCF, entretanto, o RCQ, RCF, medidas morfométricas da carcaça, pesos e rendimentos dos cortes comerciais não foram alterados pelos tratamentos. O uso do feno de pseudocaule permite a obtenção de carcaças mais pesadas, entretanto, os coprodutos alteram as características e rendimento da carcaça e dos cortes comerciais avaliados.

Palavras-chave: *Musa* spp., pseudocaule, coprodutos

Introduction

The production of lamb meat in Brazil has been stimulated by the high potential of the market in large urban centers. The incipient supply and the quality of the products affect the consumption of this meat in the country (YAMAMOTO et al., 2013). These issues can be overcome by improving the production systems that are currently based on extensive breeding with low technological levels, which impacts on the slaughter of animals at advanced ages and with low carcass quality.

In this context, the use of agro-industrial residues in lamb feeding has emerged as an alternative to alleviate the variability of food supply, especially in semi-arid regions, where adverse climatic conditions reduce the viability of forage at certain times of the year. The use of these materials may enable the use of a more intensive breeding system, such as confinement, as it represents an alternative to reduce the dependency of lamb on cereals that may or may not be used for human feeding, and thereby represents a high production cost (ALVES et al., 2007).

The leaves and pseudostem of banana trees are residues from culturing or fruit harvesting practices, and may be viable byproducts for use in lamb feeding (ARCHIMÈDE et al., 2012; MARIE-MAGDELEINE et al., 2009), especially in the semi-arid regions of Brazil, due to the availability and nutritional characteristics of these products. Ribeiro et al. (2007) found high crude protein content (17.20%) in banana leaves. Geraseev et al. (2013) evaluated the inclusion of up to 40% banana leaf or pseudostem hay in the diet of growing lambs and concluded that these byproducts are potentially usable for animal feeding.

It is known that the body composition of animals can be manipulated by a nutritional plan (GERASEEV et al., 2006) and that the yield of carcasses and cuts is a preponderant factor in the evaluation of the commercial quality of the product and the profitability rates of a diversity of segments in the production chain of lamb meat. In this way, in order to include these byproducts in the diet of lambs further research aimed at evaluating the effect of these residues on the composition and characteristics of carcasses is necessary.

Faced with these considerations, this study aimed to evaluate the effect of the substitution of *Cynodon* spp. hay with banana crop residue hay on the carcass characteristics and tissue composition of commercial cuts of Santa Inês lambs finished under confinement.

Material and Methods

The experiment was carried out in the sheep breeding sector at the Institute of Agricultural

Science of the Federal University of Minas Gerais, in Montes Claros, Minas Gerais. This region is situated at latitude 16º51'38''S and longitude 44º55'00''W, and is characterized as climate type Aw, which is considered tropical savanna, with a long dry period and wet period during summer, according to the classification of Köppen (1948).

The procedures adopted in this study were approved by the Ethics Committee in Animal Experimentation at the Federal University of Minas Gerais (Comitê de Ética em Experimentação Animal da Universidade Federal de Minas Gerais - CETEA,UFMG) under protocol number 164/11.

The study included 25 whole lambs, with a mean age of five months and initial live weight of 26.95 kg (± 1.5). The experimental design was completely randomized with five treatments and five repetitions. The animals were identified, weighed, vaccinated and dewormed, and placed in individual stalls measuring 1.2 m in width, 2.0 m in length and 1.0 m in height. All stalls had feeders and water drinkers, where food and water were provided to the animals. The experiment lasted for 90 days, of which the first 21 days were used as an adaptation period and the remaining 69 days were used for data collection.

The diets were formulated according to the recommendation of NRC (2007) aiming towards a 200 g average weight gain per day. Treatments consisted of the inclusion of 0, 20 or 40 % of banana leaf or pseudostem hay (1 = 40% of *Cynodon* spp. hay + 60% concentrate; 2 = 20% of banana leaf hay + 20% of *Cynodon* spp. hay + 60% concentrate; 3 = 40% of banana leaf hay + 60% concentrate; 4 = 20% of banana pseudostem hay + 20% of *Cynodon* spp. hay + 60% concentrate; 5 = 40% of banana pseudostem hay + 60% concentrate).

The leaves and pseudostem of banana trees used for animal feeding were chopped and dried under the sun until 10-15 % humidity was achieved. The materials were then separated into appropriate bags and stored in a cool and ventilated place.

In the samples of hay and the other compounds of the ration provided, the contents of dry matter (DM), crude protein (CP), ether extract (EE), non-nitrogen extracts (NNE), crude fiber (CF), neutral detergent fiber (NDF), acid detergent fiber (ADF) and ash (A) were determined according to the methodology proposed by Silva and Queiroz (2006). The content of the total digestible nutrients (TDN) was calculated according to the equation proposed by Kearl (1982) for hay: TDN = -17.2649 + 1.2120 CP + 0.8352 NNE + 0.4475 CF + 2.4637 EE, for energetic food: TDN = 40.2625 + 0.1969 CP + 0.4028 NNE - 0.1379 CF + 1.903 EE, and for proteic food: TDN = 40.3217 + 0.5398 CP + 0.4448 NNE - 0.7007 CF + 1.4223 EE, in which NNE = DM - (CP + EE+ CF + Ash).

The chemical compositions of banana leaf, pseudostem and *Cynodon* spp. hay are presented in Table 1. The proportion of the ingredients used and the chemical composition of the diets are presented in Table 2.

Table 1. Chemical composition of banana pseudostem and leaf hay and *Cynodon* spp. hay content of dry matter (DM), crude protein (CP), ether extract (EE), total digestible nutrients (TDN), neutral detergent fiber (NDF), acid detergent fiber (ADF) and crude fiber (CF)

Food	DM %NM	CP %DM	EE %DM	TDN %MS	NDF %DM	ADF %DM	CF %DM
Banana leaf hay	92.52	10.04	6.49	56.37	71.01	38.79	40.75
Banana pseudostem hay	90.15	3.42	1.07	43.76	78.83	34.85	40.86
Cynodon spp. Hay	92.12	10.66	3.85	48.06	78.40	44.07	45.90

Note: DM = dry matter, NM = natural matter, CP = crue protein, EE = ether extract, TDN = total digestible nutrientes, NDF = neutral detergent fiber, ADF = acid detergent fiber, CF= crude fiber. *TDN= 17.2649+1.212x CP x 0.8352x NNE+2.4637xEE+0.4475xCF (KEARL, 1982).

Table 2. Percentual and chemical composition of the experimental diets (% DM).

Ingredientes	Treatments				
	40% Cyno	40%BLH	20%BLH	40%BPH	20%BPH
Cynodon spp.	40.00	0.00	20.00	0.00	20.00
Banana leaf hay	0.00	40.00	20.00	0.00	0.00
Banana pseudostem hay	0.00	0.00	0.00	40.00	20.00
Corn grain	39.03	37.83	38.51	30.69	34.95
Soy meal	10.14	10.92	10.51	18.13	14.12
Cotton Meal	8.00	8.00	8.00	8.00	8.00
Limestone	0.45	0.35	0.50	0.28	0.47
Dicalcium Phosphate	0.00	0.52	0.09	0.51	0.08
Common salt	0.28	0.28	0.28	0.28	0.28
Ureia	0.50	0.50	0.50	0.50	0.50
Vitamin-Mineral Premix	1.60	1.60	1.60	1.60	1.60
Chemical composition of the experimental diets (%DM)					
Nutrients (%)	Treatments				
	40% Cyno	40%BLH	20%BLH	40%BPH	20%BPH
DM (%)	89.09	89.20	89.13	88.26	88.65
CP (%)	16.00	16.00	16.00	16.00	16.00
TDN (%)	72.47	72.74	72.67	67.29	69.95
NDF (%)	44.36	39.13	40.75	42.30	43.34
ADF (%)	22.00	19.63	20.81	18.75	20.36
EE (%)	7.60	8.68	8.19	6.23	6.97

40% Cyno = 40% Cynodon spp. hay, 40% BLH = 40% banana leaf hay, 20% BLH = 20% banana leaf hay and 20% Cynodon spp. hay, 40% BPH = 40% banana pseudostem hay, 20% BPH = 20% banana pseudostem hay and 20% Cynodon spp. hay, DM = dry matter, NM = natural matter. CP = crue protein. EE = ether extract. TDN = total digestible nutrientes. NDF = neutral detergent fiber. ADF = acid detergent fiber. TDN*=-17.2649 +1.2120 CP + 0.8352 ENN + 0.4475 CF + 2.4637 EE, for energetic food, TDN= 40.2625 + 0.1969 CP + 0.4028 ENN - 0.1379 CF + 1.903 EE, for proteic food, TDN= 40.3217 + 0.5398 CP + 0.4448 ENN - 0.7007 CF + 1.4223 EE, in which ENN= DM - (CP + EE+ CF + Ashed) - (KEARL, 1982).

The diets were provided *ad libitum* at 0700 and 1700 as a complete diet. The food offered and the remainder were weighed daily in order to adjust the offered amount to 15% remainder based on dry matter content. During the experimental period, samples of the dietary ingredients were collected every 14 days, and these constituted the real sample at the end of the trial. In order to evaluate the weight development, lambs were weighed weekly in a cage-type mobile mechanical balance.

At the end of the confinement period, the live weight without fasting (LWWF) was obtained by weighing the animals. The lambs were then taken to the abattoir where they were submitted to 16 h of fasting and then reweighed to obtain the live weight post-fasting (LWPF).

The *in vivo* morphometric measurements were taken from the animals in a forced state, which means that anterior and posterior limbs were measured at a perpendicular angle on a flat concrete floor. Measurements were taken with the aid of a measuring tape.

The *in vivo* morphometric measurements were: body length (regional distance from the spot between the neck and the withers to the spot where the haunch and tail meet), forelimb height (measured by the distance between the most dorsal part of the withers to the most distal point of the forelimb), hindlimb height (distance between the most dorsal spot of the dorsal tuberosity to the most distal spot of the hindlimb), thoracic perimeter (external circumference of the thoracic cavity, on the midsection).

The animals were slaughtered followed by skinning and evisceration, in which the visceral organs were removed in order to obtain the empty body weight (EBW=LWPF-visceral weight). Just after slaughtering the carcasses were weighed to obtain the hot carcass weight (HCW) followed by a chilling procedure in a chamber at 4 ºC for 24 h, hanging by tarsal-metatarsal joint in appropriate hangers 17 cm apart. At the end of this period, the carcasses were weighed to obtain the cold carcass weight (CCW), and the weight loss by chilling (WLBC = (HCW-CCW) *100/HCW), yield of hot carcass (HCY = HCW/LWWF x 100), yield of cold carcass (CCY = CCW/LWWF x 100) and biological yield (BY= EBW/CCW x 100), calculated according to Osório et al. (1995).

Morphometric measurements of the carcasses were carried out according to Santos (2008). The following were determined on hot and cold carcasses: thoracic depth (distance between the sternum and the back of the chuck), haunch perimeter (the perimeter measured around the haunch, having the spot where the measuring tape touched the trocanthers of the femurs as reference), haunch width (maximal distance between the trocanthers of femurs), internal carcass length (the maximum distance between the anterior edge of the ischium-pubic symphysis and the anterior edge of the first rib at its midpoint), leg length (distance between the femoral-tibial joint and the inner edge of the tarsal-metatarsal joint) and subcutaneous fat depth (SFD) (measured under the inferior part of the 13th rib, using a micrometer).

Carcasses were divided lengthwise into two half-carcasses, which were individually weighed. The left half was divided into the main commercial cuts: neck, shoulder, foreshank and hindshank, breast and flank, loin, leg and rack, according to Santos (1999). Cut yield was determined in relation to the percentage between the weight of the cut and the weight of the half-carcass.

The shoulder, rack and loin cuts were placed in plastic bags and stored in a freezer at -18 °C to be dissected. For dissection, the cuts were thawed for 20 hours in a refrigerator at 10 °C, and muscles, bones and fat were separated. The results were expressed as an absolute number and its relation to the weight of its respective cut (MCCUTCHEON et al., 1993).

Data were subjected to analysis of variance, and in the case of significant difference, means were compared by the Scott-Knott Test at 5% probability using the SAEG - Sistema de Análises Estatísticas e Genéticas (UFV, 2007) software. Analyses of simple correlation between the weight and *in vivo* morphometric measurements were performed using the Pearson correlation equation.

Results and Discussion

The inclusion of banana leaf (BLH) and pseudostem hay (BPH) increased ($P \leq 0.05$) live weight without fasting (LWWF) and post-fasting (LWPF) (Table 3). The greater weight gain observed for animals fed on 20 or 40 % of BPH justifies, in part, the higher values of LWWF and LWPF observed for these treatments, which may have exuded an effect of the higher dry matter intake of the animals fed on the byproducts. Nunes-Oliveira et al. (2014) found a greater degradability for BPH when *in vitro* effective degradability of *Cynodon* spp. hay, BLH and BPH were evaluated, reporting means of 46.36, 58.22 and 76.34 %, respectively.

Table 3. Dry matter intake (g/day), weight and morphometric measurements of lambs fed with banana leaf hay (BLH) and banana pseudo stem hay (BPH) in substitution to *Cynodon* spp. hay (Cyno).

Parameters	Treatments					CV (%)
	40% Cyno	20% BLH	40% BLH	20% BPH	40% BPH	
DM Intake (g/dia)	877b	979b	932a	1265a	1342a	15.30
Live weight gain (kg)	6.22b	6.76b	6.04b	10.15a	10.20a	22.96
Live weight without fasting (kg)	35.76 b	36.12 b	36.38 b	43.45 a	40.46 a	9.04
Live weight after fasting (kg)	32.48 b	32.66 b	33.36 b	39.95 a	36.62 a	9.48
Body lenght (cm)	60.50 b	62.60 b	60.40 b	66.00 a	63.25 a	3.41
Thoracic perimeter (cm)	85.25	76.35	78.40	81.00	81.75	13.76
Forelimb height (cm)	64.75	63.80	67.10	65.63	66.34	3.47
Hindlimb height (cm)	65.38	65.50	69.30	67.38	69.63	4.02

Correlation between body weight and morphometric measurements

	Live weight without fasting	Live weight after fasting
Body length	0.70*	0.68*
Thoracic perimeter	0.22	0.13
Forelimb height	0.46	0.49
Hindlimb height	0.11	0.17

Means followed by the same letters on the same lines do not differ by Scott Knott test (P≤5%)
* = Only significant correlations were presented (P≤0,05).
40% Cyno = 40% Cynodon spp. hay, 40% BLH = 40% banana leaf hay, 20% BLH = 20% banana leaf hay and 20% Cynodon spp. hay, 40% BPH = 40% banana pseudostem hay, 20% BPH = 20% banana pseudostem hay and 20% Cynodon spp. hay.

For *in vivo* morphometric measurements, an influence of the treatments on body length (BL) was observed, where higher values occurred for diets containing BPH (66.0 and 63.25 cm for 20 and 40 % of BPH, respectively) in comparison to the other treatments that did not differ amongst themselves (Table 3). These results are justified by the greater weight gain of lambs fed with BPH, as positive correlations of 0.70 and 0.68 were observed among LWWF and LWPF and BL. Researches carried out by Costa Junior et al. (2006), Landim et al. (2007) and Santana et al. (2001) using Santa Inês lambs also reported positive correlations (high and medium) of 0.66, 0.42 and 0.87, respectively, between BL and weight when slaughtered.

The empty body weight (EBW) and hot and cold carcass weights (HCW, CCW) were positively affected (P≤0.05) by the addition of BPH in the diet, with means superior to the other treatments, though the difference between 20% and 40% inclusion was not significant (Table 4).

The EBW is mainly influenced by the fasting period and gastrointestinal content, which is dependent upon the nutritional composition of the diet, especially fiber content. Silva et al. (2014) observed a reduction of EBW as the level of NDF increased (32.5; 37.6; 42.6; 47.7% of DM) in diets of finishing lambs. Consequently, it can be inferred that the higher EBW reflected on the superior weight gain of lambs fed on BPH (Table 1).

For HCW and CCW, means of 19.28; 17.64 kg and 18.71; 17.18 kg were obtained for 20 and 40 % BPH in the diet, respectively, which may have been influenced by the higher EBW. Similar results were found by Silva et al. (2014) when evaluating the characteristics of Santa Inês lambs finished under confinement, and submitted to different levels of substitution of corn silage (0, 20, 40 and 60 %) for a byproduct of guava, with higher HCW and CCW in the treatment with superior EBW.

Table 4. Means of weight, hot and cold carcasses, morphometric measurements of carcasses of lambs fed with banana crop residues.

	Treatments					
	Cyno	20% BLH	40% BLH	20% BPH	40% BPH	CV(%)
Empty body weight (kg)	27.85b	27.73b	28.83b	36.31a	32.89a	9.95
Hot carcass weight (kg)	15.06 b	15.19 b	15.41 b	19.28 a	17.64 a	9.23
Cold carcass weight (kg)	14.57 b	14.71 b	14.93 b	18.71 a	17.18 a	9.28
Hot carcass yield (%)	46.43	46.59	46.22	48.22	48.25	3.51
Cold carcass yield (%)	44.92	45.14	44.79	46.8	46.99	3.48
Biological yield (%)	54.18	54.85	53.46	53.06	53.70	2.83
Losses by chilling (%)	3.23	3.12	3.07	2.95	2.59	16.22
Thoracic depth (cm)	25.40	25.90	26.80	28.38	26.40	4.38
Haunch width (cm)	22.63	22.70	23.75	24.50	23.90	4.10
Haunch perimeter (cm)	59.68	58.80	58.25	60.67	60.00	2.78
Internal carcass length (cm)	68.40	69.10	70.70	74.75	72.50	4.52
Thickness of subcutaneous fat (mm)	3.46	4.48	3.53	4.36	4.32	36.92

	Correlations between weight and morphometric measurements of carcass	
	Weight of hot carcass	Weight of cold carcass
Thoracic depth	0.62*	0.61*
Haunch width	0.53*	0.52*
Haunch perimeter	0.70*	0.70*
Internal carcass length	0.67*	0.68*

Means followed by the same letters on the same lines do not differ by Scott Knott test (P≤5%)
* = Only significant correlations were presented (P≤0.05).
40% Cyno = 40% Cynodon spp. hay, 40% BLH = 40% banana leaf hay, 20% BLH = 20% banana leaf hay and 20% Cynodon spp. hay, 40% BPH = 40% banana pseudostem hay, 20% BPH = 20% banana pseudostem hay and 20% Cynodon spp. hay.

Values of HCY and CCY were not affected (P ≥0.05) by the addition of BLH or BPH in the diet, as the yields were calculated by the ratio between the weight of cold or hot carcasses and the weight when slaughtered. Mean values of 47.1 and 45.7 for HCY and CCY are in agreement with those reported in the literature for Santa Inês lambs (LIMA et al., 2013; SILVA et al., 2014; RODRIGUES et al., 2011).

According to Alves et al. (2013), the carcass yield, when calculated in relation to the empty body weight, is more consistent than when the live weight is considered, due to the variation of gastrointestinal content. In this study, however, no influence was observed on the biological yield (BY) of the carcasses, although the addition of BPH in the diets triggered higher EBW.

For morphometric measurements, no significant differences were observed for the variables analyzed, although positive correlation was verified for these parameters and HCW and CCW.

Garcia et al. (2000) did not find a significant difference (P≥0.05) for subcutaneous fat depth (SFD) in a diversity of genotypes of lambs fed with coffee hulls as part of the diet. The authors obtained means of 2.77 and 3.72 mm, which were inferior to those obtained in this study (3.46 and 4.48 mm). Fat deposition is higher in animals at more advanced ages, which explains the greater amount found in this study, as in the aforementioned study the animals were slaughtered at 120 days and in this study the slaughtering occurred at 180 days. Urano et al. (2006) observed means of 1.5 m of SFD in Santa Inês lambs slaughtered at 150 days of age.

The variable WLBC is mainly related to the uniformity of subcutaneous fat distribution that protects the carcass against humidity and weight losses during the chilling process (MORENO et al., 2014). This information corroborates with the results of this study in which WLBC values varied from 2.59 to 3.23 %, evidencing that the similarity (P≥0.05) observed was a reflection of the similarity with EGS. Cartaxo et al. (2011), when evaluating the effect of inclusion from 2.40 to 2.90 Mcal/kg in the diet of lambs, found lower WLBC when EGS was higher.

The diets did not affect (P≥0.05) the weight or yield of commercial cuts (Table 5). These results differ from those obtained by Dantas et al. (2008) when evaluating the characteristics of the carcasses of Santa Inês lambs slaughtered at 30 kg, and subjected to a diet with two supplementation levels (1.0 and 1.5 % live weight). The authors observed higher weight in the commercial cuts (leg, loin, rack and shoulder) for heavier carcasses. According to Lombardi et al. (2010), there is a high and positive correlation between CCW, and leg and shoulder weights, respectively, although this was not observed in this research.

Table 5. Weight (kg) and yield (% in relation to the weight of cold carcass) of comercial cuts of lambs fed with residues of banana crop.

Treatments	Cyno	20% BLH	40% BLH	20% BPH	40% BPH	CV(%)
	Weight of cuts (kg)					
Neck	0.97	0.87	0.99	1.09	1.03	13.00
Foreshank	0.28	0.27	0.28	0.31	0.30	8.91
Shoulder	1.12	1.34	1.25	1.43	1.33	14.61
Breast	1.34	1.41	1.28	1.92	1.79	20.79
Rack	0.96	0.95	0.96	1.19	1.06	17.00
Loin	0.44	0.58	0.53	0.60	0.61	13.97
Hindshank	0.37	0.41	0.39	0.44	0.41	14.05
Leg	1.97	1.51	1.94	2.37	2.15	20.89
	Yield of Cuts (%)					
Neck	6.65	5.91	6.63	5.83	5.99	27.03
Foreshank	1.92	1.83	1.87	1.66	1.75	27.75
Shoulder	7.69	9.11	8.37	7.64	7.74	26.88
Breast	9.20	9.58	8.57	10.26	10.42	33.24
Rack	6.59	6.46	6.43	6.36	6.17	30.02
Loin	3.02	3.94	3.55	3.21	3.55	29.57
Hindshank	2.54	2.79	2.61	2.35	2.39	26.33
Leg	13.52	10.26	12.99	12.67	12.51	30.62

Means followed by the same letters on the same lines do not differ by Scott Knott test (P≤0.05)
40% Cyno = 40% Cynodon spp. hay, 40% BLH = 40% banana leaf hay, 20% BLH = 20% banana leaf hay and 20% Cynodon spp. hay, 40% BPH = 40% banana pseudostem hay, 20% BPH = 20% banana pseudostem hay and 20% Cynodon spp. hay.

The addition of BPH or 40% BLH influenced (P≤0.05) the weight of leg and shoulder muscle tissue, promoting superior means for these cuts in comparison to the other treatments. The muscle weight of the loin was not influenced by the diets (Table 6). These results may be justified by the development of these cuts, as observed by Furusho-Garcia et al. (2006) when evaluating the allometric growth of different cuts in Santa Inês, Texel, Île de France and Bergamácia lambs (males and females), observing an isogonic growth in the shoulders of males of all studied breeds, and in the leg for males of Santa Inês, Texel and Île de France breeds. For male and female Santa Inês, Texel and Bergamácia lambs a heterogeneous growth was observed in the loins, indicating a slower growth of muscle in relation to the carcass.

Table 6. Weight and percentage of muscle, fat and bones on leg, shoulder and loin, ratio muscle:fat and muscle:bone of the cuts leg, shoulder and loin of lambs fed with residues of banana crop.

	Treatments					
	Cyno	20% BLH	40% BLH	20% BPH	40% BPH	Cv(%).
Leg						
Muscle (g)	1295.0 b	12330 b	13200 a	15300 a	14260 a	901
Fat (g)	147.5	1690	1520	1880	1990	3042
Bone (g)	282.5	2800	2820	3260	2950	94
Muscle (%)	71.9	697	722	707	709	28
Fat (%)	8.2	94	83	86	99	271
Bone (%)	15.8	159	155	150	147	78
M:F*	9.3	83	91	88	74	301
M:B*	4.6	44	47	47	48	90
Shoulder						
Muscle (g)	643.8 b	6850 b	7590 a	8300 a	7820 a	791
Fat (g)	120.0 b	1790 a	2080 a	2210 a	1990 a	1932
Bone (g)	162.5	1770	1820	1940	1830	980
Muscle (%)	66.1	629	646	650	650	350
Fat (%)	12.2	165	177	174	164	1850
Bone (%)	16.7	162	156	152	152	1110
M:F*	5.9 a	39 b	37 b	39 b	40 b	2530
M:B*	4.0	39	42	43	43	1240
Loin						
Muscle (g)	252.5	2980	2970	3170	3330	182
Fat (g)	66.3	1010	790	900	940	326
Bone (g)	67.5	950	1080	1060	1240	398
Muscle (%)	64.6	597	600	620	589	73
Fat (%)	16.8	192	160	177	168	217
Bone (%)	17.0	189	218	188	217	190
M:F*	3.9	36	38	36	36	250
M:B*	4.1	32	28	35	28	265

Means followed by the same letters on the same lines do not differ by Scott Knott test ($P \leq 5\%$)
40% Cyno = 40% Cynodon spp. hay, 40% BLH = 40% banana leaf hay, 20% BLH = 20% banana leaf hay and 20% Cynodon spp. hay, 40% BPH = 40% banana pseudostem hay, 20% BPH = 20% banana pseudostem hay and 20% Cynodon spp. hay.

The addition of banana crop residues to the diet increased ($P \leq 0.05$) fat deposition in the shoulder cut in comparison to the treatment containing 40% *Cynodon* spp. This fact may be a reflection of the heterogeneous growth of fat tissue (SANTOS et al., 2001a).

The proportion of muscle, fat and bone tissue of the cuts and the muscle-to-bone ratio (M:B) were not altered ($P \geq 0.05$) by the inclusion of banana crop residues in the diet. According to Silva and Pires (2000), bone growth is sharp at the early stage of lamb life with deceleration as the animal ages, while the opposite process occurs for muscle tissues. When the M:B ratio was evaluated in lambs slaughtered at birth, 28 and 33 kg, the authors found an increase in M:B from birth to weaning, with no changes after this period. Tissue deposition occurs in an order of priority according to the physiological maturity of the animal, with early, intermediary and late deposition respectively for bone, muscle and fat tissues (SANTOS et al., 2001a, 2001b; SILVA; PIRES, 2000).

No differences were observed for the muscle:fat ratio (M:F) of leg and loin cuts among the diets, although the inclusion of banana crop residues promoted a smaller ratio of these tissues in the shoulder. These results can be justified by the allometric growth of the cut, as although isogonic growth was observed (FURUSHO-GARCIA et al., 2006), it tended to promote a negative heterogeneous growth, which means that it developed at a higher intensity in relation to CCW. This is supported by the higher deposition of fat tissue in this cut, considering the late fat increase (ROSA et al., 2002).

Conclusions

The substitution of *Cynodon* spp. hay with banana crop residues at the levels of 20 and 40 % alters the carcass characteristics and the tissue composition of the leg and shoulder cuts in confined feedlot lambs. However, the aforementioned diet alteration did not influence the *in vivo* and postmortem morphometric measurements of carcasses, except for the body length variable.

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