CARCASS CHARACTERISTICS OF SHEEP FED WITH CASTOR BEAN HULLS IN REPLACEMENT OF TIFTON 85 HAY

Características de carcaça de ovinos alimentados com casca de mamona em substituição ao feno de capim Tifton 85

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ABSTRACT

Castor bean hulls (CBH), co-products of castor oil extraction, are high in dry matter (DM) and fiber and are emerging as alternative roughage in sheep feed. This could reduce feed costs since other sources of roughage can be more expensive. The effects of replacing Tifton 85 hay with CBH at 0, 33, 66 and 100% in the diet of sheep on the carcass characteristics, weights and yields of retail cuts and carcass measurements were studied. Twenty-eight non-castrated sheep averaging 7 ± 1.4 months of age with an initial weight of 19.5 ± 4.3 kg were slaughtered after 70 days of confinement. There was a linear decline ($P \leq 0.05$) in slaughter body weight, empty body weight, hot and cold carcass weight and longissimus muscle area (LMA) as the percentage of dietary CBH increased. A linear decrease ($P \leq 0.05$) of the weights of all retail cuts and a quadratic effect (minimum yield of 9.84% with the replacement of 56.9%) of the neck yield were also detected as the percentage of CBH increased. No treatment effects ($P > 0.05$) on the yield of the other cuts were observed, but there was a linear decline ($P \leq 0.05$) in the perimeters of the thorax, leg and rump and the carcass compactness index. Replacing Tifton 85 hay with CBH in sheep diets is not recommended because it decreases the slaughter body weight, cold and hot carcass weight, retail cut weights and morphometric measurements.

Index terms: Biodiesel, morphometry, sheep production, *Ricinus comunis* L.

RESUMO

A casca da mamona, coproduto da extração do óleo da mamona, por apresentar em sua composição elevados teores de matéria seca e fibra, surge como fonte alternativa de volumoso na alimentação de ovinos, podendo diminuir os custos com alimentação, uma vez que outras fontes são comercializadas a preços superiores. Avaliou-se o efeito da substituição do feno de capim Tifton 85 pela casca de mamona em 0, 33, 66 e 100% na dieta de ovinos sobre as características de carcaça, os pesos e rendimentos dos cortes comerciais e a morfometria da carcaça. Vinte e oito animais não castrados, com 7 ± 1,4 meses de idade e peso inicial médio de 19,5 ± 4,3 kg, foram abatidos após 70 dias de confinamento. Houve efeito linear decrescente ($P \leq 0.05$) para o peso corporal ao abate, peso de corpo vazio, peso de carcaça quente, peso de carcaça fria e área de olho-de-lombo, de acordo com os níveis crescentes de substituição. O decréscimo linear ($P \leq 0,05$) no peso de todos os cortes comerciais e o efeito quadrático do rendimento do pescoço (rendimento mínimo de 9,84% quando a substituição foi de 56,9%) também foram verificados com o aumento percentual da casca de mamona. Não houve efeito ($P > 0,05$) sobre os rendimentos dos demais cortes, mas o perímetro do tórax, da perna e da garupa e o índice de compacidade da carcaça decresceram linearmente ($P \leq 0,05$) com a substituição. A substituição do feno de capim Tifton 85 pela casca de mamona para ovinos diminui o peso corporal ao abate, os pesos de carcaça quente e fria, os pesos dos cortes comerciais e as medidas morfométricas.

Termos para indexação: Biodiesel, morfometria, ovinocultura, *Ricinus comunis* L.

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INTRODUCTION

Investments in research with sheep and the application of this research in the field have resulted in the development of the Brazilian sheep industry, particularly in the northeast, and the increased productivity and profitability of this activity are already considerable. However, although the species is highlighted by its high potential for meat production, the lack of rainfall in the semiarid regions of the northeast has caused problems in nutrition, making dietary supplementation necessary during the dry season.

One of the most important constraints in tropical livestock production systems is underfeeding due to limitations in both the quantity and quality of the feed (MENDIETA-ARAICO, et al., 2011),which becomes more severe in semiarid regions. However, byproducts appear to be alternative ingredients in ruminant feed during periods of food shortage (MOLINA ALCAIDE; YÁÑES RUIZ, 2008).

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The downward trend in the use of petroleum-based energy sources in Brazil has been encouraging the production of renewable energy sources, such as biodiesel (BRUNSCHWIG et al., 2012). The cultivation of castor fruit has established a chain of biofuel production in semi-arid regions (CESAR; BATALHA, 2010). Castor bean hulls, co-products of the castor oil extraction, contain high concentrations of dry matter and fiber and are thus emerging as alternative roughage in ruminant diets (GOMES ET AL., 2009; SANTOS et al., 2011). Their use could reduce feed costs because other sources of roughage such as Tifton 85 hay, sell for higher prices. Tifton 85 hay, widely recognized as having high nutritional value (ATAÍDE JÚNIOR et al., 2000), can cost US$ 0.68 kg^{-1} during periods of food shortage, impairing the viability of animal production.

Carcass yield is important in the evaluation of animal production because it is directly related to the commercial value of the animal, being usually one of the first indexes to be considered. It is expressed as the percentage ratio between the carcass weight and live animal weight (ZUNDT et al., 2006). The proper conformation of the carcass indicates a proportional development of the different anatomical regions, and the best conformations are achieved when the parts with the greatest commercial value are well pronounced (OLIVEIRA et al., 2002). These objective and subjective measures can be used to evaluate the characteristics of a carcass (REIS et al., 2001), and estimating the carcass characteristics is important to complement the evaluation of the animal's performance during its development (JORGE et al., 1999).

The objective of this study was to evaluate the effect of Tifton 85 hay replacement by CBH on carcass yield and commercial cuts and on the carcass morphometry of feedlot sheep.

MATERIALS AND METHODS

The experiment was carried out at the goat and sheep farm of the Animal Science Department of the Universidade Federal Rural de Pernambuco, located in Recife – PE, Brazil, in the micro-physiographic region of Litoral da Mata, belonging to the Metropolitan Region of Recife. A total of 28 sheep (without defined breed) coming from the same property, at 7±1,4 months of age and an initial weight of 19.5 ±4.3 kg, with body condition score of 2.5±0.15, were used. They were housed individually, with feeders and water available. After being weighed, identified, subjected to the control of endo- and ectoparasites and vaccinated against clostridial diseases, the animals underwent a 30-day period of adaptation to the management and facilities.

Feed was weighed and performed twice daily (8.00 and 15.00 h) with complete feed and water always available. Daily, the leftovers were collected and weighed to match supply and to calculate dry matter intake. Animals were weighed every 14 d following 16 h of fasting, starting at day 0.

For an estimation of total digestible nutrients (TDN), a digestibility trial was performed 40 d after the start of the experiment. To estimate fecal dry matter, a lignin enriched and purified (LIPE®) external marker was used by forced ingestion of one capsule of 250 mg/day for 7 d: 2 d for adaptation and 5 d of feces collection. Feces were collected directly from the rectum once a day at 6:00, 8:00, 10:00, 12:00 and 14:00 h, as described by Ferreira et al. (2009). The estimated value of TDN was calculated with the aid of the equation described by Weiss (1999): TDN = DCP + (2.25 × DEE) + DNFC + DNDF, where

Digestible crude protein (DCP) = (CP intake - fecal CP),

Digestible ether extract (DEE) = (EE ingested - EE feces),

Digestible non-fibrous carbohydrate (DNFC) = (CNF ingested – CNF feces), and digestible neutral detergent fiber (DNDF) = (NDF ingested - fecal NDF).

The experimental diets were isoproteic, with the base diet being formulated to meet the requirements for maintenance of animals of 24 kg and allowing weight gain of 200 g / day, according to the requirements prescribed by National Research Council-NRC (2007). Diets consisted of replacement levels of Tifton 85 hay with CBH at 0, 33, 66, 100% (Table 1).

After 70 d on their respective experiment feeds (not including adaptation period), animals were subjected to a water diet and solid fasting for 16 h. Immediately before slaughter they were weighed to obtain "weight at slaughter" (SW). At slaughter, the animals were stunned by concussion, followed by bleeding out through a section of the carotid artery and jugular vein. After skinning and evisceration, the head (sectioned at the atlanto-occipital joint) and the feet (sectioned at the metacarpal and metatarsal joints) were removed, and hot carcass weight (HCW) was registered. The gastrointestinal tract was weighed full and empty to determine the empty body weight (EBW) and biological yield [BY (%) = HCW / EBW × 100].

Table 1 – Ingredients and chemical composition of the experimental diets.

Ingredients (g/kg DM)	Level of replacement of Tifton 85 hay by castor bean hulls (%)			
	0	33	66	100
Spineless cactus	400	400	400	400
Tifton 85 hay	300	200	100	0
Castor bean hull	0	99	198	297
Soybean meal	185	185	185	185
Ground corn	100	100	100	100
Sodium chloride	05	05	05	05
Mineral mix	10	10	10	10
Urea	0	01	02	03
	Chemical composition			
Dry matter (g/kg)	249.9	250.1	250.2	250.4
Crude protein (g/kg DM)	139.4	138.7	138.1	137.5
Ether extract (g/kg DM)	16.0	15.1	14.1	13.1
Mineral matter (g/kg DM)	106.8	104.3	101.9	99.4
Neutral detergent fiber (g/kg DM)	404.9	402.3	399.6	397.0
Acid detergent fiber (g/kg DM)	167.4	178.4	189.5	200.5
Total digestible nutrients (g/kg DM)	626.1	624.9	566.0	561.1

DM = Dry matter.

The carcasses were chilled for 24 h in a 4° C cold room and hung by means of hooks, with the metatarsal joints spaced at 17 cm. After cooling, the carcasses were weighed, deducting the weight of the kidney and perirenal fat, to obtain the cold carcass weight (CCW) and to calculate the chilling losses [CL (%) = HCW - CCW / HCW × 100]. The hot carcass yield was calculated as [HCY (%) = HCW / SW × 100], and the commercial yield was calculated as [CY (%) = CCW / SW × 100]. After the cooling period, the following measures were taken on the whole carcass as proposed by Cezar and Sousa (2007): internal length, thorax depth, thorax width, leg length, leg perimeter, rump width, rump perimeter, thoracic perimeter. Subsequently, the leg compactness index, ratio between rump width and leg length, and the carcass compactness index, the ratio between the cold carcass weight and the carcass inner length were calculated (CEZAR; SOUSA, 2007).

After the measurements, carcasses were cut in half and half of each carcass was weighed. The left half was sectioned into seven anatomic regions, using the methods adapted from Cezar and Sousa (2007), originating the commercial cuts: neck, shoulder, leg, loin, true ribs (section between the 1st and 5th thoracic vertebrae), false ribs (section between the 6th and 13th thoracic vertebrae) and sawcut. Our adaptation of the previous methodology consisted of dividing the ribs into true and false. We recorded the individual weights of each cut and then calculated the yield of each cut coming from the left half of the carcass compared to its reconstituted weight.

In the left half of the carcass, as proposed by Cezar and Sousa (2007), a cross-section between the 12th and 13th ribs was made to measure the longissimus muscle area (LMA) of the *longissimus dorsi* muscle by tracing the muscles contour on a transparent plastic sheet for later area determination using the average of three readings from a digital planimeter (Haff®, Digiplan model). Additionally, a caliper was used to measure the thickness of the subcutaneous fat on the *longissimus dorsi* muscle section (between the last thoracic vertebra and the first lumbar) at two-thirds the total length of the LMA.

The experimental design was a randomized blocks, with animals assigned to these according to the animal's initial weight (Block 1 = 14.950 ± 1.380 kg; Block 2 = 17.210 ± 1.450 kg; Block 3 = 19.210 ± 0.670 kg; Block 4 = 20.800 ± 0.355 kg; Block 5 = 21.580 ± 0.850 kg). Data were tabulated and submitted for ANOVA and regression analysis with the aid of the statistical package SAEG (UNIVERSIDADE FEDERAL DE VIÇOSA-UFV, 2007). Differences were considered significant at $P \leq 0.05$ unless otherwise noted.

RESULTS AND DISCUSSION

Dry matter intake decreased linearly with the replacement of Tifton 85 hay with CBH (Table 2). The reductions in CPI and NDFI may be related to the decreased DMI because the diet had similar NDF and CP concentrations. The reduction in the TDNI can be attributed to the lower concentration of energy in the diets with the CBH inclusion and also the reduction in the DMI. The reduction in nutrient intake for animals consuming CBH may explain the decreases observed for body weight at slaughter, empty body weight, hot carcass weight and cold carcass weight, given the direct implication of these parameters on animal performance and that they are the natural markers of nutrient intake.

The carcass weights are consistent with the ranges proposed by Zapata et al. (2001) for the lamb carcasses, especially for crossbred animals. The authors stated that the average carcass weight should be approximately 15 kg. The hot carcass yield, biological yield and commercial yield were not affected by replacement. The hot and commercial carcass yields are also in agreement with the yields presented by these authors and corroborate the findings by Vieira et al. (2010), who analyzed crossbred sheep fed a detoxified castor bean meal and obtained an average commercial yield of 42.84%.

The chilling losses was not affected by replacement, but we observed high average values (3,81%). The rate of chilling losses should be approximately 2.5%; however, it may range from 1 to 7%, based on the uniformity of the fat cover, sex, weight, temperature and humidity in the cold chamber (MARTINS et al., 2000). In this study, the high average values for the chilling losses is closely related to the small fat layer observed (1.47 mm), as the fat has a protective function of avoiding water loss by the carcass. Gerrard and Grant (2006) stated that the body's development of adipose tissue occurs after the peak of muscle growth. Pinheiro et al. (2007) observed higher subcutaneous fat in adult sheep compared with lambs. Santos et al. (2001) said that with advancing age and therefore increase the weight, the amount of fat in the

Table 2 – Dry matter intake, total digestible nutrients intake, crude protein intake, neutral detergent fiber intake and carcass characteristics of sheep fed castor bean hulls in replacement of Tifton 85 hay.

Item	Level of replacement of Tifton 85 hay by castor bean hulls (%)				CV	Effect		R^2
	0	33	66	100		L	Q	
DMI (kg/day)	1.027	1.020	0.948	0.917	11.07	*[1]	NS	0.92
TDNI (kg/day)	0.64	0.63	0.60	0.52	17.17	*[2]	NS	0.83
CPI (kg/day)	0.145	0.144	0.133	0.127	11.05	*[3]	NS	0.93
NDFI (kg/day)	0.381	0.380	0.340	0.332	11.20	*[4]	NS	0.84
SW (kg)	32.84	31.59	30.37	28.67	5.32	***[5]	NS	0.99
EBW (kg)	30.93	29.54	28.18	26.80	5.58	***[6]	NS	0.99
HCW (kg)	15.13	14.29	13.58	12.78	6.69	***[7]	NS	0.99
CCW (kg)	14.57	13.70	13.13	12.27	6.69	***[8]	NS	0.99
HCY (%)	46.01	45.05	44.72	44.63	3.09	NS	NS	-
BY (%)	48.86	48.21	48.20	47.75	2.84	NS	NS	-
CY (%)	44.29	43.21	43.21	42.85	3.24	NS	NS	-
CL (%)	3.74	4.09	3.39	4.01	15.29	NS	NS	-
Fat (mm)	1.60	1.66	1.48	1.14	51.00	NS	NS	-
LMA (cm^2)	10.20	10.18	8.87	8.73	17.21	*[9]	NS	0.85

DMI = dry matter intake; TDNI = total digestible nutrients intake; CPI = crude protein intake; NDFI = neutral detergent fiber intake; SW = body weight at slaughter; EBW = empty body weight; HCW = hot carcass weight; CCW = cold carcass weight; HCY = hot carcass yield; BY = biological yield; CY = commercial yield; CL = chilling losses; LMA= longissimus muscle area; L = linear, Q = quadratic; R^2 = determination coefficient; Significance: NS, Not Significant, *, $P \leq 0.05$, ** $P \leq 0.01$, *** $P \leq 0.001$. [1] v =1.044-0.0012CH; [2] $\hat{Y}$= 0.663-0.0012CH; [3] $\hat{Y}$= 0.147-0.0002CH;[4] $\hat{Y}$= 0.389-0.0006CH; [5] $\hat{Y}$= 33.358 – 0.0412XCH; [6] $\hat{Y}$= 31.361 – 0.0413CH; [7] $\hat{Y}$= 15.367 – 0.0232CH; [8] $\hat{Y}$= 14.792 – 0.0224CH; [9] $\hat{Y}$= 10.455 – 0.0171CH. CH = % Castor bean hulls in replacement of Tifton 85 hay.

carcass increases. Hood and Thornton (1979) found that there is an increase in the number of fat cells in sheep Santa Ines in the growth phase between 28 and 45 kg body weight. In this study, the confinement time was pre-set at 70 d; therefore, the low amount of subcutaneous fat could be a consequence of the slaughter occurring before muscle growth has reached its plateau, namely before the adipose tissue started its development. This hypothesis is gaining more credence with the observation that there was no variation in the thickness of subcutaneous fat among treatments . Thus, the thinness of the fat may not have been due to the low energy intake but due to the chronology of body development.

Additionally, Pires et al. (2006) found that when sheep were slaughtered at an average live weight of 30 kg after being fed on diets with increasing levels of ADF, the average fat cover thickness value was only 0.06 mm greater than that observed in this work. These authors also found a high average value of chilling losses of 3.12%. According Cardoso et al. (2006), diets with a high fiber concentration necessarily have low energy density and ruminal fill limit the intake, reducing animal performance.

Our results of fat cover thickness indicate that more research is needed with lambs without defined breed at different slaughter weights to determine the evolution of the fat cover In our experiment the animals had different energy intake, different slaughter weights and did not differ in fat cover thickness.

The LMA decreased linearly with the replacement of Tifton 85 hay with CBH. The LMA is among the largest muscles of the carcass from livestock species and its cross-sectional area is often used as a predictor of muscularity (GERRAR; GRANT, 2006; YÁÑEZ et al., 2006). Therefore, its linear decline is consistent with decreased body weight. The LMA, according to Zapata et al. (2001), correlates positively with the animal's age. This finding justifies the median values found in this work (10.2 cm² to 8.7 cm²) because the average age of the animals used in this experiment was approximately 7 ± 1.4 months.

Weights of all meat cuts decreased linearly with the replacement of Tifton 85 hay with CBH (Table 3), which was also accompanied by decreased energy intake according to the replacement percentages. Energy is the most limiting nutritional component in sheep production and the deficit in energy intake results in reduced animal performance, with reflections on the productive indices, such as carcass yield and its cuts (PIOLA JUNIOR et al. 2009; EZEQUIEL et al., 2006). Alves et al. (2003) and Gonzaga Neto et al. (2006) also reported the importance of energy intake in sheep meat production.

With the exception of the neck, for which a quadratic effect was observed with a minimum yield of 9.84% at 56.9% replacement, there was no effect of CBH substitution on the cut yields (Table 4). These data agree with the law of anatomical harmony that states that in carcasses of similar weight and fat quantities, almost all body parts are present in similar proportions, as long as genotype is uniform (BOCCARD; DUMONT, 1960).

Despite the decrease observed for the weights of cuts, the results obtained from our work, especially the yield data, can be considered satisfactory. The most prized lamb carcass cuts come from the leg, shoulder and loin;

Table 3 – Weight of commercial cuts of sheep fed castor bean hulls in replacement of Tifton 85 hay.

Item (kg)	Level of replacement of Tifton 85 hay by castor bean hulls (%)				CV	Effect		R^2
	0	33	66	100		L	Q	
Neck	0.81	0.73	0.62	0.68	13.79	**[1]	NS	0.63
Shoulder	1.46	1.30	1.26	1.17	8.97	***[2]	NS	0.94
TR	0.49	0.49	0.45	0.39	19.23	*[3]	NS	0.88
FR	0.75	0.71	0.65	0.62	9.96	***[4]	NS	0.99
Sawcut	0.80	0.80	0.74	0.68	13.38	*[5]	NS	0.86
Loin	0.60	0.56	0.56	0.48	9.07	***[6]	NS	0.87
Leg	2.38	2.31	2.19	2.07	7.54	**[7]	NS	0.99

TR = true ribs, FR = false ribs; L = linear, Q = quadratic; R^2 = determination coefficient; Significance: NS, Not Significant, *, P <0.05, ** P <0.01, *** P <0001. [1] $\hat{Y}$= 0.8142 – 0.0015CH; [2] $\hat{Y}$= 1.4458 – 0.0027CH; [3] $\hat{Y}$= 0.5184 – 0.0013CH; [4] $\hat{Y}$= 0.7701 – 0.0013CH; [5] $\hat{Y}$ = 0.8266 – 0.0012CH; [6] $\hat{Y}$= 0.6122 – 0.0011CH; [7] $\hat{Y}$= 2.433 – 0.0032CH. CH = % Castor bean hulls in replacement of Tifton 85 hay thus, the greater their percentage of the carcass, the greater its value will be. Zundt et al. (2003) indicated that the proper conformation includes the proportional development of the different anatomical regions belonging to it. Thus the best conformations are achieved when the parts of greatest commercial value are well pronounced. In our study, the percentage of premium cuts of carcass remained at approximately 60%, which could add more value to the final product. Moreover, the low yield of little valued cuts such as the neck and sawcut, keep the meat within the requirements of the consumer market.

The rump, thoracic and leg perimeters decreased linearly with the replacement of Tifton 85 hay by CBH; however, no other measurements were influenced (Table 5).

Lamb body development occurs in the following sequence: bone, muscle and fat (GERRARD; GRANT, 2006). Thus, after birth, it is expected that the animal develops early bone structure and sequentially has an increase in muscle mass. Finally, the animal should have a surface finish related to the fat deposited. The morphological results of this study showed that the linear measurements did not vary with energy intake; however, perimeter measurements, which are dependent on muscle development, linearly decreased, showing the direct influence of energy intake. Araújo Filho et al. (2007)

Table 4 – Yield of commercial cuts of sheep fed on castor bean hulls in replacement of Tifton 85 hay.

Item (%)	Level of replacement of Tifton 85 hay by castor bean hulls (%)				CV	Effect		R^2
	0	33	66	100		L	Q	
Neck	11.08	10.61	9.26	11.17	12.74	NS	*[1]	0.63
Shoulder	20.03	18.96	19.09	19.26	5.49	NS	NS	-
TR	6.76	7.05	6.71	6.51	15.80	NS	NS	-
FR	10.23	10.21	9.77	10.19	7.64	NS	NS	-
Sawcut	10.96	11.66	11.03	11.20	10.12	NS	NS	-
Loin	8.24	8.12	8.31	7.79	8.12	NS	NS	-
Leg	32.86	33.54	32.95	34.02	5.19	NS	NS	-

TR = true ribs, FR = false ribs; L = linear, Q = quadratic; R^2 = determination coefficient; Significance: NS, Not Significant, *, P <0.05, ** P <0.01, *** P <0001. [1] $\hat{Y}$= 11.456 – 0.0569CH + 0,0005CH². CH = % Castor bean hulls in replacement of Tifton 85 hay.

Table 5 – Carcass measurements of sheep fed castor bean hulls in replacement of Tifton 85 hay.

Item	Level of replacement of Tifton 85 hay by castor bean hulls (%)				CV	Effect		R^2
	0	33	66	100		L	Q	
Rump width (cm)	15.22	15.00	14.73	14.51	6.15	NS	NS	-
Thorax width (cm)	21.62	21.53	20.98	20.75	6.36	NS	NS	-
Rump perimeter (cm)	58.97	57.88	57.35	56.00	3.34	**[1]	NS	0.98
Internal length (cm)	61.36	61.27	60.97	59.23	4.06	NS	NS	-
Leg length (cm)	41.77	41.42	42.24	40.77	3.03	NS	NS	-
Thorax depth (cm)	26.52	26.50	26.51	25.80	3.34	NS	NS	-
Thoracic perimeter (cm)	68.02	67.84	67.32	65.43	2.79	*[2]	NS	0.81
Leg perimeter (cm)	32.78	31.74	31.55	30.98	4.35	*[3]	NS	0.92
LCI	0.36	0.36	0.35	0.36	6.27	NS	NS	-
CCI (kg/cm)	0.24	0.22	0.22	0.21	6.16	***[4]	NS	0.97

LCI = leg compactness index, CCI = carcass compactness index, L = linear, Q = quadratic; R^2 = determination coefficient; Significance: NS, Not Significant, *, *P* <0.05, ** *P* <0.01, *** *P* <0001. [1] $\hat{Y}$= 59.437 – 0.0284CH; [2] $\hat{Y}$= 68.921 – 0.0249CH; [3] $\hat{Y}$= 32.773 – 0.0168CH; [4] $\hat{Y}$= 0.2385 – 0.0003CH. CH = % Castor bean hulls in replacement of Tifton 85 hay.

reported that diets with greater energy levels tend to foster greater tissue deposition, increasing morphometric measures of carcass. These authors observed greater thoracic perimeter (67.33 cm) for animals fed diets containing 2.94 MCal ME/kg DM when compared to animals fed diets containing 2.50 Mcal ME/kg DM (65.42 cm).

The lack of an effect of Tifton 85 hay replacement with CBH on the longitudinal measurements could be explained by the fact that the animals were only subjected to the experimental diet when they were approximately 7 ± 1.4 months age. As bone development is early compared to other tissues, there was no influence of diet on measurements that depend directly on bone development.

The LCI was not influenced by the dietary substitution, but there was a linear decrease for the CCI (Table 5). Carcass compactness index depends on the cold carcass weight, which also decreased linearly with the substitution. The CCI values obtained (0.24 – 0.21) are very close to those obtained by Medeiros et al. (2009) when they subjected Morada Nova sheep to different levels of concentrate and thus different energy levels. These authors obtained the same effect by this substitution, i.e., greater levels of carcass compactness (0.24) for animals provided greater energy intake, and lower CCI (0.22) for animals fed diets with lower energy density.

CONCLUSIONS

The replacement of Tifton 85 hay with CBH in sheep diets negatively influences body weight at slaughter, hot and cold carcass weight, the weights of all commercial cuts and morphometric measurements. Despite the observed results, factors such as the availability and prices of hay and CBH can justify the choice of alternative ingredients because the likely reduction in costs may offset losses related to the carcass weight and commercial cuts.

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