academicJournals

Vol. 12(28), pp. 2351-2357, 13 July, 2017
DOI: 10.5897/AJAR2017.12264
Article Number: 41B412365238
ISSN 1991-637X

http://www.academicjournals.org/AJAR

African Journal of Agricultural Research

Full Length Research Paper

Carcass yield, cuts and body components in lambs fed a pineapple by-product silage diet

Acaína K. S. Elias[1], Kaliandra S. Alves[1], Luis Rennan S. Oliveira[1], Darley O. Cutrim[2], Rafael Mezzomo[1], Vanessa P. Pontes[1], Waldjâneo O. Melo[3] and Daiany I. Gomes[1]*

[1]Department of Animal Science, University Federal Rural da Amazônia, Parauapebas, Brazil.
[2]Department of Animal Science, Federal Institute of Tocantins, Pedro Afonso, Brazil.
[3]Department of Animal Science, University Federal Rural da Amazônia, Paragominas, Brazil.

Received 24 February, 2017; Accepted 12 June, 2017

The effect of pineapple by-product silage as a substitute for elephant grass on carcass yield, commercial cuts and non-carcass components was evaluated in 25 castrated male Santa Inês feedlot finishing lambs. The lambs had an initial body weight of 18.0±3.4 kg, and they were fed four pineapple by-product silage concentrations (0, 25, 50, 75 and 100%) distributed in a completely randomized design with five treatments and five repetitions. Lambs were slaughtered at a body weight of 30 kg. The hot carcass weight and hot carcass yield were recorded and chilled at 4°C for 24 h. The quantitative parameters of the carcass, the wholesale cuts expressed in kg and percentage, and non-carcass components were determined. Carcasses were divided into seven commercial cuts. The hot and cold carcass yields significantly increased when elephant grass was replaced with pineapple by-product silage in the diets. The weight of the false rib and loin cuts increased linearly when pineapple by-product silage was added to the diets (P< 0.05). No significant differences were observed in the weights of the other cuts (P>0.05). The average weights of the non-carcass components were not affected by the addition of pineapple by-product silage, except for gastrointestinal tract (GIT) content, which decreased linearly, and omental-mesenteric, perirenal and internal fat depots, which increased linearly with the addition of pineapple by-product silage to the diets. The use of pineapple by-product silage as a substitute for elephant grass in growing lamb diets is recommended because it did not negatively affect the carcass characteristics, commercial cut yields or non-carcass components.

Key words: Elephant grass, nutrition, sheep, small ruminant, pineapple.

INTRODUCTION

Pineapple (*Ananas comosus* L. Merril) is extensively produced in all tropical countries, particularly in Brazil, where pineapple production is expanding with 1.56 billion fruits produced in 2015 (IBGE, 2016). Although, much of pineapple production is destined for fresh consumption, processing for production of juices and other products

*Corresponding author. E-mail: Daiany.i.gomes@gmail.com. Tel/Fax: +55 94 99221-5041.

has achieved great importance. Azevêdo et al. (2011) estimated that 77.5% of the material produced on the farm consists of pineapple leaves, stems, crowns and discarded fruit. After pressing, the total fruit is comprised of 75 to 85 juice and 15 to 25 fruit pulp or meal. Thus, there is a large quantity of byproducts from the pineapple industry that can be used in ruminant feed.

Moreover, the seasonality in forage production has been one of the factors responsible for the reduced productivity of ruminant livestock in Brazil, which combined with frequent fluctuations in cereal prices and protein supplements used in animal feed, has raised interest in the use of alternative foods to reduce production costs (Bezerra et al., 2016; Luz et al., 2017). Among the reasons for the use of byproducts for feeding ruminants is the reduction in production costs and satisfactory food in the dry season.

In the lamb meat production system, quantitative carcass characteristics are essential to the production process as they are directly correlated with the product and help to produce better products that are more competitive in the current market (Lage et al., 2014). Additionally, carcass yield depends on relative cut weight among other factors. Thus, it is essential to understand the effects of nutrition on carcass composition. Besides that, the different cuts that comprise the lamb carcass have different economic values and commercial quality.

The study of non-carcass components can be used as an indirect nutritional assessment in lamb production. The weight of non-carcass components usually corresponds to the animal weight gain, but often to a lower extent. Thus, knowledge of the sources of variation in body organs can help develop strategies to evaluate the effects of nutrition on growth and to optimize the use of alternative foods in ruminant diets (Costa et al., 2013; Cutrim et al., 2016).

Therefore, the aim of the present study was to evaluate the effect of pineapple by-product silage as a substitute for elephant grass on carcass characteristics, commercial cuts and non-carcass components in feedlot lambs.

MATERIALS AND METHODS

The Brazilian Committee for Care and Experimentation approved all procedures involving animals in this study (number 003/2014).

Study location, experimental animals and diet

This study was conducted in the Laboratory of Animal Nutrition in the Department of Animal Science at the Federal Rural University of Amazonia in Parauapebas, State of Pará, Brazil. In total, 25 individuals of various breeds were used in the study with a predominance of Santa Inês individuals. The individuals were castrated males with a mean initial body weight of 18.0±3.4 kg and an average age of four months. Prior to the study, the animals were marked, vaccinated (against ectoparasites and endoparasites) and given vitamins A, D and E. The animals were kept in individual dirt pens (2.0 x 2.5 m) and had free access to feed and water. The experimental period lasted 76 days with a 14-day adaptation period.

Five diets were formulated to meet maintenance requirements and a 200 g/day weight gain (NRC, 2007). The forage to concentrate ratio was 70:30 with elephant grass (*Pennisetum purpureum* Schum.) and pineapple by-product silage as forage on a dry matter basis. The pineapple by-product silage replaced the elephant grass in the following concentrations: 0, 25, 50, 75 and 100% on a dry matter basis. The concentrate consisted of maize meal, soybean meal, dried molasses, urea, limestone and a complete mineral mixture (8.0 g/kg of DM) (Table 1). Experimental diets were fed *ad libitum* to achieve a refusal rate of 10% (based on dry matter) of that offered. Feed was provided as total mixed ration daily at 8:00 a.m. and 3:00 p.m. The animals had access to water *ad libitum* throughout the experiment.

The pineapple by-product silage was composed of skin, crown and bagasse resulting from fruit processing for pulp production. The skin and crown were triturated in a sieveless (different particle size) stationary disintegrator upon silage preparation and ensiled in cement shackles. The compaction of silage was carried out manually and closed with canvas silos. The silos were opened 30 days after storage immediately before the silage was fed to the animals. The chemistry composition of pineapple by-product silage, proportion of each dietary ingredient and chemical composition of the feeds is shown in Table 1.

The elephant grass (*P. purpureum* Schum) was provenient from an area already established located next to the feedlot where the experiment was undertaken. It has a small slope and every cut was fertilized with 80 kg of nitrogen and 30 kg of potassium chloride per hectare. The elephant grass had a mean age of approximately 70 days and was cut by machine (particle size of 1.5 cm), to produce surface silos. The silo was opened for use 100 days after ensiling, which had the smell and color of a regular silage.

Slaughter and quantitative carcass's measurements

At the end of 76 days, animals were weighed (BW) and fasted for 18 h with free access to water. The animals were then weighed again for determination of body weight at slaughter (BWS) and to assess the weight loss resulting from the imposed fasting (LF), which was calculated as follows: LF (%) = (BW – BWS)/BWS x 100. At slaughter, animals were anesthetised by stunning in the atlanto-occipital region followed by bleeding by sectioning the carotid and jugular veins. Blood was collected in a polyethylene container and weighed per normative instruction No. 0.3 of 01/13/2000 (Technical Regulation of Methods for Humane Slaughtering of Livestock).

After slaughter, the gastrointestinal tract (GIT) content was removed for determination of empty body weight (EBW) to calculate hot carcass yield (HCY) with the following equation:

HCY (%) = hot carcass weight (HCW) / EBW x 100

The HCW was recorded after skinning, evisceration and removal of the head, paws and genitals. After chilling the carcasses for 24 h at 4°C, the cold carcass weight (CCW) was recorded. Chilling loss (CL) was calculated with the following equation:

CL (%) = (HCW – CCW) / HCW x 100

The cold carcass yield was calculated with the following equation:

CCY (%) = (CCW/ BWS) x 100

The carcasses were split in half, and both sides were divided into

Table 1. Chemical composition of experimental diets (dry matter basis).

Ingredient	Proportion of pineapple by-product silage[1]					
	0%	25%	50%	75%	100%	
Proportion of ingredients (%)						
Elephant grass	70.00	52.50	35.00	17.50	-	
Pineapple by-product silage	-	17.50	35.00	52.50	70.00	
Maize meal	22.86	23.13	23.39	23.66	23.90	
Soybean meal	4.70	4.41	4.12	3.83	3.56	
Molasses	0.74	0.76	0.79	0.81	0.84	
Urea	1.20	1.20	1.20	1.20	1.20	
Limestone	0.50	0.50	0.50	0.50	0.50	
Chemical composition (% DM)						**PBPS**
Dry matter	41.79	41.02	40.25	39.48	38.71	20.95
Organic matter	90.08	90.69	91.31	91.92	92.54	89.18
Ash	8.51	7.92	7.34	6.75	6.16	10.62
Crude protein	15.04	14.55	14.05	13.56	13.08	10.07
Ether extract	2.66	2.43	2.20	1.97	1.74	2.64
ADF	41.42	40.48	39.55	38.62	37.68	-
NDFap [2]	41.97	40.98	39.98	38.99	38.00	55.09
Hemicellulose	8.27	7.89	7.52	7.15	6.78	-
Lignin	4.77	5.37	5.97	6.57	7.17	-
TDN	80.52	82.77	82.26	85.24	86.65	-

[1]0% Pineapple by-product silage (PBPS) –100% elephant grass as roughage source 25% PBPS – 25% pineapple by-product silage + 75% elephant grass; 50% PBPS – 50% pineapple by-product silage + 50% elephant grass; 75% PBPS – 75% pineapple by-product silage + 25% elephant grass; 100% PBPS – 100% pineapple by-product silage as roughage source. [2] ADF = acid detergent fibre, NDFap = neutral detergent fibre corrected for ash and nitrogenous compounds.

the following seven anatomical regions: neck (seven cervical vertebrae; oblique incision between the seventh cervical and first thoracic vertebrae); shoulder (scapula, humerus, ulna, radio and carpal bone); true rib (first five thoracic vertebrae in addition to the upper half of the corresponding ribs); false ribs (last eight thoracic vertebrae in addition to the upper half of the corresponding ribs); flank (straight line from the dorsal end of the abdomen to the tip of the sternum); loin (six lumbar vertebrae perpendicular to the back between the thirteenth thoracic and last lumbar vertebrae); and leg (gluteal, femoral, and leg regions; tarsal bone, tibia, femur, ischium, pubis and ileum separated by a cross-sectional cut to the back between the last two lumbar vertebrae).

All cuts were weighed separately to calculate the yield based on the cut weight/CCW relationship expressed as a percentage. In addition, subcutaneous fat thickness (SFT) and loin eye area (LEA) were measured on the left half of the carcass. The SFT was measured using a calliper on the *longissimus dorsi* section between the last dorsal and first lumbar vertebrae as previously described by Osório and Osório (2005). The LEA was drawn on the exposed *longissimus dorsi* muscle using a transparent plastic film in the same region where the SFT was measured.

The non-carcass components, including organs (spleen, heart, liver, lungs and kidneys), by-products (blood, skin, paws, head, omental-mesenteric fat, perirenal fat and internal fat) and viscera (rumen-reticulum, omasum, abomasum, small intestines, and large intestines) were weighed. Then, the viscera were emptied, washed and weighed, separately.

Statistical analysis

The experimental design was completely randomized with five treatments (pineapple by-product silage concentrations of 0, 25, 50, 75 and 100%) and five repetitions per treatment. The initial animal weights were the covariates. Data were analyzed using Statistical Analysis System (SAS) software, and the following analyses were performed: analysis of variance using PROC GLM with orthogonal polynomial contrast to analyze linear, quadratic, and cubic effects by the diets and regression analysis using PROC REG at a 5% significance level.

RESULTS AND DISCUSSION

The similar results for body weight slaughter (BWS), empty body weight (EBW), hot carcass weight (HCW), and cold carcass weight (CCW) among the treatments might have been associated with the relatively similar age of experimental lambs at slaughter. In addition, the results of carcass weight confirmed the data published by Cutrim et al. (2013) in which the final BW and daily weight gain were not affected by pineapple by-product silage feeding. Gowda et al. (2015) also verified the same daily weight gain in lambs fed a pineapple by-product

Table 2. Quantitative parameters of the carcass of feedlot sheep fed elephant grass and/or pineapple by-product silage.

Variables[1]	Proportion of pineapple by-product silage[2]					P Value[3]	
	0%	25%	50%	75%	100%	L	Q
BWS (kg)	27.71±1.61	28.85±1.68	31.31±1.82	25.85±1.68	26.31±1.71	0.845	0.792
EBW (kg)	22.15±1.41	23.71±1.51	26.04±1.65	22.90±1.63	23.14±1.64	0.167	0.887
HCW (kg)	12.05±0.68	12.88±0.73	14.39±0.81	12.16±0.77	12.73±0.80	0.115	0.907
CCW (kg)	11.70±0.65	12.54±0.70	14.08±0.79	11.85±0.74	12.48±0.78	0.086	0.924
HCY (%)[4]	43.44±0.95	44.23±0.97	46.14±1.01	46.92±1.15	48.69±1.19	0.001	0.472
CCY (%)[5]	42.16±0.87	43.02±0.89	45.13±0.93	45.71±1.06	47.70±1.10	0.001	0.416
CL (%)	54.32±9.88	54.09±9.84	55.73±10.14	53.04±10.79	55.81±11.35	0.110	0.867
LEA (cm^2)	11.51±0.74	12.16±0.78	12.65±0.81	13.29±0.95	11.14±0.80	0.709	0.128
SFT (mm)	1.12±0.33	1.80±0.52	1.90±0.55	1.00±0.32	1.38±0.45	0.869	0.444

[1]Body weight at slaughter (BWS), empty body weight (EBW), hot carcass weight (HCW), cold carcass wieght (CCW), hot carcass yield (HCY), cold carcass yield (CCY), chilling loss (CL%) loin eye area (LEA), subcutenea fat thickness (SFT). [2]In regression equations "x" means "proportion of by-product silage". [3]There was no cubic effect for the variables evaluated (P>0.05). [4]$Y_{HCY\ (\%)}$ = 43.2510 +0.0527x (r2=0.41). [5]$Y_{CCY\ (\%)}$ = 41.9978+0.0551x (r2=0.45).

silage diet, which, support desired growth rate and did not have any adverse effects on nutrient utilization and general health.

The hot carcass yield (HCY) and cold carcass yield (CCY) significantly increased when elephant grass was replaced with pineapple by-product silage in the diets (P<0.05). The equation indicated that for every 1% increase in pineapple by-product silage content, there was a 0.0527% increase in the HCY and a 0.0551% increase in the CCY. Even though the addition of pineapple by-product silage significantly affected the HCY and CCY, no significant differences were observed in the other items (P>0.05, Table 2). The linear increase in the HCY and CCY was likely caused by lower neutral detergent fibre corrected for ash and protein (NDFap) content after the addition of pineapple by-product silage to the diets (Table 1) because the HCW and CCW did not differ among the treatments (P>0.05; Table 2), and the GIT content decreased with the addition of pineapple by-product silage to the diets, as explained later (P<0.05, Table 4). The different organizational arrangements in the NDF fraction result in different degrees of substrate availability to rumen microorganisms, which may alter the digestion rate and, consequently, the rate of food passage through the rumen (Whetsell et al., 2004). Therefore, NDF constituents contribute significantly to the permanence of food along the GIT, which may affect carcass yield.

Moreover, NDF is a chemical fraction consisting mainly of cellulose, hemicellulose and lignin. These polymers have different physicochemical bond arrangements, which allow their composition to change, and can be found in different proportions in food, particularly in by-products (Costa et al., 2012).

Assessment of carcass cut yields is essential to complement calculations of animal performance during growth and to estimate the commercial value of carcasses (Oliveira et al., 2013). The LEA is used to estimate the amount of muscle in the carcass due to its high correlation with muscle content. Ttherefore, the absence of alteration in the LEA can be considered positive when working with diets containing by-product, because the cost with feeding is reduced without altering the performance of the animals (Pinto et al., 2011).

Subcutaneous fat thickness measured above the *longissimus dorsi* muscle is highly correlated with total carcass fat percentage. There is no standard for minimum fat cover thickness in lamb carcasses. Thus, there is no standard value for carcass classification regarding low or excess fat deposited in Brazil. However, according to the classification of Silva Sobrinho (2001), carcasses in the present study had low fat content (1 to 2 mm in thickness).

The weight of the false rib and loin cuts increased linearly when elephant grass was replaced with pineapple by-product silage in the diets (P<0.05, Table 3). No significant differences were observed in the weights of the other cuts (P>0.05). The results observed in the false rib cut may be associated with dietary energy density, which increased with the replacement of pineapple by-product silage (Tables 1 and 3). Because fat accumulates at a faster rate in the rib (Prado et al., 2015), the increase in dietary energy density may have further accelerated the process of fat deposition in this cut, thereby making the false rib cut to gain weight with the addition of pineapple by-product silage (P<0.05). The same results were observed for absolute loin weight (P<0.05, Table 3). The loin cut has a significant amount of fat in its composition. Therefore, the increase in dietary energy density may also explain the gain in absolute loin weight,

Table 3. Wholesale cuts expressed in kg and percentage of feedlot sheep fed pineapple by-product silage.

Variables	Proportion of pineapple by-product silage [1]					P Value[2]	
	0%	25%	50%	75%	100%	L	Q
Weight of retail cuts (kg)							
Neck	1.17±0.08	1.15±0.08	1.35±0.09	1.08±0.08	1.18±0.09	0.377	0.757
Shoulder	2.18±0.13	2.36±0.14	2.58±0.15	2.20±0.15	2.35±0.16	0.128	0.994
True rib	1.32±0.09	1.42±0.10	1.52±0.11	1.41±0.11	1.42±0.11	0.108	0.831
False rib[3]	1.57±0.10	1.76±0.11	1.99±0.13	1.68±0.12	1.83±0.13	0.016	0.918
Flank	0.71±0.07	0.62±0.06	0.87±0.09	0.60±0.07	0.73±0.08	0.295	0.538
Loin[4]	0.84±0.05	1.00±0.06	1.08±0.07	0.95±0.07	0.99±0.07	0.015	0.644
Leg	3.86±0.22	4.14±0.23	4.50±0.26	3.82±0.24	3.87±0.25	0.384	0.643
Relative share of each commercial cut (%)							
Neck	9.93±0.40	9.28±0.38	9.61±0.39	8.98±0.41	9.62±0.44	0.383	0.402
Shoulder	18.71±0.37	18.92±0.38	18.27±0.36	18.71±0.42	18.780.42	0.609	0.949
True rib	11.26±0.35	11.25±0.35	10.83±0.34	11.80±0.42	11.29±0.40	0.645	0.640
False rib[5]	13.41±0.39	13.86±0.40	14.15±0.41	14.21±0.46	14.50±0.47	0.031	0.807
Flank (%)	6.01±0.41	4.88±0.33	6.15±0.42	4.99±0.38	5.64±0.43	0.920	0.254
Loin	7.19±0.23	7.92±0.26	7.66±0.25	8.02±0.29	7.92±0.29	0.053	0.420
Leg[6]	32.93±0.47	33.07±0.47	31.98±0.45	32.37±0.51	31.30±0.50	0.006	0.234

[1]In regression equations "x" means "proportion of by-product silage". [2]There was no cubic effect for the variables evaluated (P>0.05). [3]y= 1.6735 + 0.0019x (r^2 = 0.03). [4]y=0.9184 + 0.0011x (r^2 = 0.41). [5]y= 13.5183 + 00103x (r^2 = 0.14). [6]y = 33.1152 – 0.0159x (r^2 = 0.19).

which may cause a more rapid fat deposition (Carvalho et al., 2014).

With respect to cuts expressed as a percentage, the leg cut decreased linearly with the addition of pineapple by-product silage to the experimental diets (P<0.05), which may be associated with possible differences in tissue growth, especially in muscle and fat tissues. Conversely, the false rib cut showed the same pattern observed for the absolute cut weight by increasing linearly with the addition of pineapple by-product silage (P<0.05). No significant differences were observed in the other cuts when expressed as percentages (P>0.05, Table 3).

Higher pineapple by-product silage contents resulted in greater dietary energy density (Table 1), and caused by TDN increase in diets. It is possible that fat tissue increased with the addition of pineapple by-product silage even though leg is known for its high muscle mass and low fat content (Stanisz et al., 2015). The weight gain in other carcass parts due to increased fat deposition resulted in a lower relative share of leg with the addition of pineapple by-product silage.

Therefore, the addition of pineapple by-product silage may not have changed the amount of muscle tissue deposited but instead caused changes in fat deposition, which is supported by the evidence mentioned earlier. In addition, the increase in omental-mesenteric, internal, and perirenal fat depots with the pineapple by-product silage inclusion (Table 4) supports the hypothesis proposed.

The average weights of the non-carcass components were not affected (P>0.05) (Table 4) by the addition of pineapple by-product silage, except for GIT content, which decreased linearly with pineapple by-product silage addition to the diets (P<0.05), and omental-mesenteric, perirenal, and internal fat depots (Table 4), which increased linearly with the addition of pineapple by-product silage to the experimental diets (P<0.05). The changes observed in the GIT content may be associated with the pineapple by-product silage fibre fraction. Because pineapple by-product silage is a source of fibre with a lower degree of lignification than forage, pineapple by-product silage has a smaller particle size than the average forage particle size and higher specific gravity, and the combination of these factors directly affects the retention time in the rumen. Regarding the non-carcass components that were affected by the diet (Table 4), there was greater fat deposition in the viscera of experimental animals.

The greater proportions of the components in the carcass result in higher maintenance requirements due to the higher metabolic activity of adipose tissue (Rufino et al., 2013). Moreover, food energy is wasted because omental-mesenteric, internal, and perirenal fat depots are not used for human consumption (Costa et al., 2011). The influence of diet on these results indicated that

Table 4. Non-carcass components of feedlot sheep fed pineapple by-product silage.

Variables (kg)	Proportion of pineapple by-product silage[1]					P Value[2]	
	0%	25%	50%	75%	100%	L	Q
Heart	0.13±0.01	0.12±0.01	0.13±0.01	0.12±0.01	1.18±0.08	0.811	0.561
Liver	0.39±0.03	0.39±0.03	0.44±0.04	0.42±0.04	0.41±0.04	0.185	0.864
Lungs	0.27±0.02	0.27±0.02	0.32±0.03	0.45±0.04	0.31±0.03	0.406	0.963
Kidneys	0.09±0.01	0.07±0.00	0.08±0.01	0.07±0.01	0.07±0.01	0.536	0.239
Blood	1.17±0.10	1.21±0.10	1.31±0.11	1.12±0.10	1.09±0.10	0.963	0.622
Skin	1.77±0.14	1.94±0.15	1.81±0.14	1.94±0.17	1.79±0.15	0.457	0.915
Paws	0.82±0.08	0.73±0.07	0.88±0.09	0.77±0.09	0.76±0.08	0.913	0.852
Head	1.56±0.07	1.63±0.08	1.61±0.08	1.51±0.08	1.52±0.08	0.986	0.905
GIT[3]	1.83±0.11	1.75±0.11	1.86±0.11	1.62±0.11	1.59±0.11	0.252	0.873
Content GIT[4]	5.56±0.40	5.14±0.37	5.27±0.38	2.95±0.24	3.18±0.26	0.001	0.507
Mes+omen fat[5]	0.55±0.07	0.92±0.12	1.00±0.14	0.89±0.14	1.16±0.18	0.001	0.538
Perirenal fat[6]	0.23±0.03	0.34±0.05	0.49±0.07	0.45±0.08	0.50±0.08	0.009	0.920
Internal fat[7]	0.08±0.02	0.16±0.05	0.23±0.07	0.20±0.07	0.21±0.07	0.035	0.629
Rumen+reticulum	0.69±0.07	0.73±0.07	0.81±0.08	0.55±0.06	0.61±0.07	0.444	0.529
Omasum	0.08±0.01	0.07±0.01	0.07±0.01	0.06±0.01	0.07±0.01	0.292	0.210
Abomasum	0.14±0.01	0.15±0.01	0.16±0.01	0.14±0.01	0.14±0.01	0.742	0.754
Small intestine	0.55±0.08	0.43±0.06	0.48±0.06	0.53±0.08	0.47±0.07	0.650	0.634
Large intestine	1.34±0.17	1.19±0.15	1.14±0.14	1.00±0.14	0.88±0.12	0.416	0.777

[1]In regression equations "x" means "proportion of by-product silage". [2]There was no cubic effect for the variables evaluated (P>0.05). [3]Gastrointestinal tract (GIT), [4]$Y_{Content\ GIT} = 5.8129 - 0.0273x$ ($r^2 = 0.57$). [5]Mes+omen = mesentery + omentum. $Y_{Mes+omen} = 0.6630 + 0.0049x$ ($r^2 = 0.14$). [6]$Y = 0.2679 + 0.0027x$ ($r^2 = 0.18$). [7]$Y = 0.1132 + 0.0013x$ ($r^2 = 0.11$).

energy was wasted upon deposition of omental-mesenteric, perirenal, and internal fat in the carcass. Thus, the addition of pineapple by-product silage likely resulted in premature carcass termination.

Therefore, use of pineapple by-product silage can be recommended for meat production in feedlot lambs as experimental animals prematurely reached the time of slaughter. Considering the market preference for young animals with carcass weights ranging from 12 to 14 kg, it is possible to produce animals for commercial slaughter by replacing elephant grass (*P. purpureum* Schum.) with pineapple by-product silage, which has low cost of production.

Conclusion

The pineapple byproduct silage alters some carcass quantitative characteristics, preserving desirable parameters for meat production. Therefore, pineapple byproduct silage can be used as a replacement for elephant grass silage at amounts of 100% without causing negative effects on carcass characteristics.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

ACKNOWLEDGEMENTS

The authors thank the Conselho Nacional de Pesquisa e Desenvolvimento Científico e Tecnológico (CNPq), Fundação de Amparo à Pesquisa do Estado do Pará (FAPESPA) and Universidade Federal Rural da Amazônia for financial support.

REFERENCES

Azevêdo JAG, Valadares Filho SC, Pina DS, Detman E, Valadares RFD, Pereira LGR, Souza NKP, Silva LFC (2011). Consumo, digestibilidade total, produção de proteína microbiana e balanço de nitrogênio em dietas com sub-produtos de frutas para ruminantes. Rev. Bras. Zootecn. 40:1052-1060.

Bezerra LS, Barbosa AM, Carvalho GGP, Simionato JI, Freitas Jr. JE, Araújo MLGML, Pereira L, Silva RR, Lacerda ECQ, Carvalho BMA (2016). Meat quality of lambs fed diets with peanut cake. Meat Sci. 121:88-95.

Carvalho JRR, Chizzoti ML, Ramos EM, Machado Neto OR, Lanna DPD, Lopes LS, Teixeira PD, Ladeira MM (2014). Qualitative characteristics of meat from young bulls fed different levels of crude glycerin. Meat Sci. 96:977-983.

Costa MRGF, Pereira ES, Silva AMA, Paulino PVR, Mizubutie IY, Pimentel PG, Pinto AP, Rocha JN (2013). Body composition and net energy and protein requirements of Morada Nova lambs. Small Rumin. Res. 114:206-213.

Costa RG, Medeiros GR, Duarte TF, Pedrosa NA, Voltolini TV, Madruga MS (2011). Salted goat and lamb meat: Typical regional product of the city of Petrolina, state of Pernambuco. Small Rumin. Res. 98:51-54.

Costa RG, Trevino IH, Medeiros GR, Medeiros AN, Pinto TF, Oliveira RL (2012). Effects of replacing corn with cactus pear (*Opuntia ficus indica Mill*) on the performance of Santa Inês lambs. Small Rumin. Res. 102:13-17.

Cutrim DO, Alves KS, Neiva JNM, Oliveira LRS, Mezzomo R, Elias AKS, Mata VJV, Santos RC, Gomes DI (2013). Replacement levels of elephant grass by moist pineapple by-product silage in diets of Santa Inês crossbred sheep: performance and digestibility. Trop Anim. Health Prod. 45:585-592.

Cutrim DO, Alves KS, Santos RC, Mata VJV, Oliveira LRS, Gomes DI, Mezzomo R (2016). Body composition and energy and protein nutritional requirements for weight gain in Santa Ines crossbred sheep. Trop Anim. Health Prod. 48:683-688.

Gowda NKS, Vallesha NC, Awachat VB, Anandan S, Pal DT, Prasad CS (2015) Study on evaluation of silage from pineapple (Ananas comosus) fruit residue as livestock feed Trop. Anim. Health. Prod. 47:557-561.

Instituto Brasileiro de Geografia e Estatística – IBGE (2016). Levantamento Sistemático da Produção Agrícola (http://www.sidra.ibge.gov.br) (verified 24 February 2016).

Lage JF, Paulino PVR, Pereira LGR, Duarte MS, Valadares Filho SC, Oliveira AS, Souza NKP, Lima JCM (2014). Carcass characteristics of feedlot lambs fed crude glycerin contaminated with high concentrations of crude fat. Meat Sci. 96:108-113.

Luz JB, Alves KS, Mezzomo R, Santos Neta ER, Gomes DI, Oliveira LRS, Silva, JC, Carvalho FFR (2017). Carcass characteristics and meat quality of lambs fed babassu cake (Orbignya speciosa) as a replacement for elephant grass silage. Trop. Anim. Health Prod. 49:113-119.

National Research Council (NRC) (2007). Nutrient Requirements of Sheep. 6th rev. ed. National Academy Press, Washington, DC, USA.

Oliveira PB, Lima PMT, Campeche A, Mendonc S, Laviola BG, McMauns C, Louvandini H, (2013). Growth and carcass characteristics of Santa Inês lambs fed diet supplemented with physic nut meal free of phorbol ester. Small Rumin. Res. 114:20-25.

Osório JCS, Osório MTM (2005). Produção de carne ovina: Técnicas de avaliação in vivo e na carcaça. 2nd ver. ed. Editora Universitária, Pelotas, RG, Brasil.

Pinto TF, Costa RG, Medeiros AN, Medeiros GR, Azevedo PS, Oliveira RL, Treviño IH, (2011). Use of cactus pear (*Opuntia ficusindica Mill*) replacing corn on carcass characteristics and non-carcass components in Santa Inês lambs. Rev. Bras. Zootecn. 40:1333-1338.

Prado IN, Passetti RAC, Rivaroli DC, Ornaghi MG, Souza KA, Carvalho CB, Perotto D, Moletta JL (2015). Carcass Composition and Cuts of Bulls and Steers Fed with Three Concentrate Levels in the Diets. Asian. Australas. J. Anim. Sci. 28:1309-1316.

Rufino LDA, Pereira OG, Ribeiro KG, Valadares Filho SC, Cavali J, Paulino PVR (2013). Effect of substitution of soybean meal for inactive dry yeast on diet digestibility, lamb's growth and meat quality. Small Ruminant Res. 111:56-62.

Silva Sobrinho AG (2001). Produção de cordeiros em pastagem. Simpósio Mineiro de Ovinocultura. Universidade Federal de Lavras pp. 63-97.

Stanisz M, Ludwiczak A, Pietrzak M, Slósarz P (2015). The quality of meat and edible by-products from kids with different inheritance of Boer goat. Small Rumin. Res. 125:81-87.

Whetsell MS, Prigge EC, Nestor EL (2004). Influence of mass of ruminal contents on voluntary intake and digesta passage in steers fed a forage and a concentrate diet. J. Anim. Sci. 82:1806-1817.