



Economic analysis of the finishing of lambs under confinement conditions using licuri cake (*Syagrus coronata* Mart. Becc.)

Análise econômica da terminação de cordeiros em condições de confinamento utilizando torta de licuri (Syagrus coronata(Mart.)Becc.)

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SUMMARY

The present study endeavors to determine the impact of the inclusion of licuri tart in the diet of finishing lambs, Santa Inês mestizos, by evaluating the economic parameters. For this purpose, a total of 44 lambs, including both uncastrated as well as vaccinated and wormed lambs, with an average age of six months and a mean body weight of 21.2 kg ± 2.7 kg, were employed. Initially, the lambs were fed on the diet which consisted of 40% Tifton-85 hay and 60% of a concentrated mixture, mainly composed of ground corn grain, soybean meal, mineral premix, being further followed by the inclusion of the licuri cake at four different levels (a) 0.0, (b) 8.0, (c) 16.0, and (d) 24% with respect to the dry matter. Principally, the soybean meal and milled corn were replaced by the licuri cake with these levels, thereby constituting four treatments and 11 replicates (11 lambs per treatment) in a completely randomized design. Further, for subjecting the lambs to the above mentioned four different levels of treatment, the lambs were confined for 70 days. The analysis of various economic parameters revealed that upon including the licuri cake up to the level of 24%, the operation cost decreases, which in turn results in higher profitability. However, its cost at the time of use will eventually determine its use for feeding lambs, because of the possible price variations of the ingredients used to formulate the diets along with the model of production of the rural property.

Key words: Byproducts, nutrition, sheep, oilcakes.

RESUMO

Objetivou-se determinar o impacto da inclusão de torta de licuri na dieta de cordeiros em terminação, mestiços de Santa Inês, com base na análise econômica. Utilizou-se 44 cordeiros, não-castrados, vacinados e vermifugados, com média de seis meses de idade e peso corporal médio de 21,2 kg ± 2,7 Kg. Os cordeiros foram alimentados com 40% feno de Tifton-85 e 60% de uma mistura concentrada composta por grão de milho moído, farelo de soja, premix mineral e inclusão de torta de licuri nos níveis 0; 8; 16 e 24% com base na matéria seca em substituição ao farelo de soja e grão de milho moído, com esses níveis constituindo os tratamentos, utilizando-se 11 cordeiros por tratamento em delineamento inteiramente casualizado. Os animais foram confinados por 70 dias. O menor custo operacional e consequente maior lucratividade quando se incluiu a torta de licuri até o nível de 24%. No entanto, a decisão de seu emprego na alimentação de cordeiros vai depender de seu custo no momento da utilização, considerando as possíveis variações de preços dos ingredientes utilizados para formulação das dietas e modelo de produção da propriedade rural.

Palavras-chave : Subprodutos, nutrição, ovinos, tortas oleaginosas.

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INTRODUCTION

The rising demand, tradition, the possibility of integration with other activities, as well as access to market niches and the aggregation of value have become the main structuring points due to which the interest in the sheep production chain has grown tremendously (Viana *et al.*, 2013). These aspects are evidently visible due to the acceleration in search of the rural producers for technological alternatives, which have the capability to improve the productivity and the quality of the herds so as to meet this internal demand.

Among the various possible ways, the sheep production in an intensive or semi-intensive way has been frequently identified, as one of the most promising possibilities as it utilizes lower cost rations such as some by-products or co-products from agro-industry. Typically, these by-products or co-products are being derived, from the production of oils utilized for various other purposes, being in the food and cosmetics industry or in the production of biofuels. Predominantly, the environmental and economic issues have led to the growth of interest in using agro-industrial by-products in ruminant feed (Rodrigues *et al.*, 2003; Azevedo *et al.*, 2012; Gonzaga Neto *et al.*, 2015; Medeiros *et al.*, 2015). Additionally, the use of by-products of biofuels as alternative sources of nutrition has been greatly driven, by the growing search for sustainable production, which basically includes environmental protection, social and economic inclusion (Morais *et al.*, 2015; Oliveira *et al.*, 2015; Silva *et al.*, 2015).

Concerning the performance aspects, the economic analysis of investments has been highlighted as an important evaluation tool as it possibly affirms the viability of a project, apart from allowing the classification among the projects or evaluating the alternatives of action, thereby picking the more attractive among

the several presented (Rodrigues *et al.*, 2003; Santos, 2010). Santos *et al.* (2009) have also drawn attention towards the necessity of a good cost analysis system, as a basic and essential tool, required for the administration of any enterprise, especially in agribusiness. In such systems, the costs and revenues can constantly vary due to which the analysis becomes more complex and need to be analyzed differently from other types of business.

In the present investigation, mainly the nutritional composition of the licuri tortilla have urged the identification of its potential in ruminant feed (Ribeiro *et al.*, 2008). But studies evaluating the economic viability of the use of licuri cake as an ingredient in the finishing diet of confined lambs are scarce in the literature. Therefore, the study involving the economic analysis of the concentrate levels in the finishing diet of confined lambs is of paramount importance (Barros *et al.*, 2005). Thus, the present work makes an attempt to evaluate the effects of the inclusion of licuri cake on lambs in finishing from the perspective of economic analysis.

MATERIAL AND METHODS

Local

For carrying out the experiment, the Experimental Farm of the School of Veterinary Medicine and Animal Science of the Federal University of Bahia, located at km 174 of BR 101 highway, in the municipality of São Gonçalo dos Campos (BA), was employed, with the experiment being carried out for a period of 88 days between August (2012) to November (2012).

Animals and Experimental Management

In the present work, all the experiments were carried out with the approval of the

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ethics committee of the School of Veterinary Medicine and Animal Science of the Federal University of Bahia, with the registration of approval under protocol n^o. 02/2014. For the experiment, a total of 44 lambs including both crossbred as well as vaccinated and vermifuge crossbred lambs, with an average age of six months and mean initial weight of 21.2 ± 2.7 kg, were utilized. Further, the distribution of these lambs was carried out in a completely randomized design, comprising of four treatments and 11 replicates. Prior to the experiment, identification of all the animals was followed, by the treatment of all the lambs against (i) internal parasites and external parasites with ivermectin, Ivomec® Merial, (trematodes, nematodes, and mites), (ii) vaccination with the polyvalent vaccine, Poli-star® Valeé, (clostridia), and (iii) treatment for coccidiosis with sulfaquinoxaline. In total, the experiment lasted for 88 days, out of which 18 days were for adaptation and the remaining 70 days for sample collection. Further, for housing animals, a fully covered area, being equipped with individual slatted and suspended floor bays along with individual feeders and drinking fountains, was utilized. The housed lambs were further offered diets in two equal daily fractions, (i) at 9:00 am and (ii) at 4:00 p.m, with the diet being provided in the form of a complete mixture (roughage:concentrate ratio established at 40:60), thereby minimizing selection by the animals. Moreover, to determine the consumption

and the adjustment of the food provided, the leftovers were being weighed, on a daily basis, with the leftover being estimated to be approximately 15%. On the other hand, the water was being given to the lambs as often as necessary.

Experimental Diets

The diet upon which the lambs were fed included Tifton-85 hay and a concentrated mixture, composed of milled corn grain, soybean meal, mineral premix and inclusion of licuri cake. Further, in partial substitution to the soybean meal and the ground corn grain, the treatment based on the dry matter consisted of levels, (a) 0.0 %, (b) 8.0 %, (c) 16.0 %, and (d) 24.0%. However, before offering to the lambs, the roughage source {Tifton-85 hay (*Cynodon* sp.)}, was being crushed into particles of approximately 5.0 cm, and the concentrated ingredients were mixed, in an automatic feed mixer. Subsequently, both the crushed hay and the homogeneous mixture of the concentrated ingredients, at the time of the tender, were mixed. Eventually, the licuri cake, before homogenization, was milled to break the clods and facilitate homogenization with the other ingredients of the concentrate. Additionally, the diets were being formulated to be isonitrogenated (16.0% CP) and isoenergetically (64% TDN) to nutritional requirements for lambs, with an average weight gain of 200g/day (NRC, 2007) (see Table 1).



Table 1. Table showing the proportion and chemical composition of the ingredients and chemical composition of the experimental diets of lambs in finishing with licuri cake

Ingredients	Levels of licuri cake (% DM)			
	0%	8%	16%	24%
Groundcorn	40.31	35.55	30.79	26.03
Soybeanmeal	17.19	13.95	10.71	7.47
Licuri cake	0	8	16	24
Mineral supplement ¹	1.50	1.50	1.50	1.50
Urea + Ammonia Sulphate ²	1	1	1	1
Tifton-85 Hay	40	40	40	40

Chemical composition								
Analyticalfr actions	Ingredients				Levels of licuri cake (% DM)			
	Ground corn	Soybean meal	Licuri cake	Hay	0%	8%	16%	24%
DM (%)	88.05	89.06	87.15	91.18	89.77	89.67	89.56	89.46
MM ³	1.20	6.26	5.91	6.08	5.49	5.7	5.92	6.13
CP ³	6.73	49.75	24.24	5.1	16.1	16.11	16.12	16.13
EE ³	4.53	1.88	13.86	1.13	2.6	3.43	4.27	5.10
NDFap ³	13.1	16.82	48.31	75.23	38.26	40.96	43.66	46.35
ADF ³	5.00	11.78	30.63	38.05	19.26	21.09	22.92	24.75
PIND ⁴ (%CP)	21.28	11.07	13.69	38.63	25.93	25.66	25.38	25.1
PIAD ⁴ (%CP)	10.18	5.97	3.61	6.86	7.87	7.48	7.1	6.71
Lignin	1.22	0.85	11.99	5.36	3.12	3.93	4.74	5.55
Cellulose	3.78	8.97	18.63	32.69	16.14	17.16	18.18	19.2
Hemicellulose	8.1	5.05	17.68	37.18	19.01	19.87	20.74	21.6
NFC	74.44	25.29	7.68	12.46	37.55	33.8	30.03	26.29
TDN ⁵	87.67	73.73	76.17	41.85	64.75	64.29	63.82	63.35
CDM, g/d ⁶	-----	-----	-----	-----	1195.37	1102.28	877.22	658.26
FC (Kg/Kg) ⁶	-----	-----	-----	-----	6.34	5.51	5.76	6.98
TWG (Kg) ⁶	-----	-----	-----	-----	16.58	15.51	13.68	11.2

¹ Guarantee levels (per kg in active ingredients): calcium 120.0g; phosphorus 87.0g; sodium 147.0 g; sulfur 18.0 g; copper 590.0mg; cobalt 40.0mg; chromium 20.0mg; iron 1,800.0mg; 80.0mg iodine; manganese 1,300.0mg; selenium, 15.0mg; zinc 3,800.0mg; 300.0mg molybdenum; maximum fluoride 870.0mg; Solubility of phosphorus (P) in citric acid at 2% minimum - 95%; ² Mixture of urea and ammonium sulphate in a ratio of 9: 1; ³Data in relation to percentage of Dry Matter; ⁴ Protein insoluble in neutral detergent and Protein insoluble in acid detergent; ⁵Values estimated based on NRC equations (2001); ⁶Feed conversion data from Costa *et al.* (2016).

Chemical Analysis

With the aim of carrying out chemical analysis, the pre-drying of samples of ingredients in a forced ventilation oven at 55° C for 72 hours was followed, by the

subsequent crushing of the samples in Willy knife mills with a 1.0 mm sieve, with the crushed samples being stored in labeled plastic flasks. The crushed stored samples were then submitted for analysis using various methods such as (i) dry matter

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(DM) method 967.03, (ii) mineral matter (MM) method 942.05, (iii) crude protein (CP) method 981.10, (iv) ethereal extract (EE) method 920.29 (AOAC, 1990). Further, the methodology of Van Soest *et al.* (1991) with modifications proposed by the Ankon device manual of the Ankon Technology Corporation, was adopted for determining neutral detergent fiber (NDF) and acid detergent fiber (ADF). Additionally, the NDF was corrected, for ashes and protein, for which the neutral detergent boiling residue was muffled at 600 °C for 4.0 hours, and the protein insoluble in neutral detergent (PIND) content was subtracted, for determining the protein correction. Further, the non-fibrous carbohydrates (NFC) of the ingredients

were calculated, according to Mertens (1994), by considering the calculation for the corrected NDF value for ash and protein. On the other hand, the lignin on the ADF residue was calculated, according to method 973.18 (AOAC, 1998), by employing 72% sulfuric acid. Likewise, the content of protein insoluble in neutral detergent (PIND) and protein insoluble in acid detergent (PIAD) was obtained, according to the recommendations of Licitra *et al.* (1996). Lastly, the TDN contents highlighted in Table 1 were calculated, according to the digestibility estimation formulas given for each analytical fraction (NRC, 2001), in the following way:

$$\text{DNFC} = 0.98 (\% \text{ CNF}), \text{ DCP} = \% \text{ CP} \times [1 - (0.4 \times \text{PIAD} / \text{CP})]$$

$$\text{DE} = \% \text{ EE} - 1, \text{ DNDF} = 0.75 \times (\% \text{ NDFp} - \% \text{ Lignin}) \times [1 - (\% \text{ Lignin} / \% \text{ NDFp}) 0.667] - 7$$

where,

DNFC = Digestible Non-fibrous Carbohydrates;

DCP = Digestible Crude Protein;

EED = Digestible Ethereal Extract;

DNDF = Digestible Neutral Detergent Fiber;

NDFp = Neutral Detergent Fiber corrected for protein.

Following the estimation of the digestible analytical fractions, the TDN was estimated by using the equation given below:

$$\text{TDN} = \text{DCP} + (2.25 \times \text{DEE}) + \text{DNDF} + \text{DNFC}$$

where, TDN = Total Digestible Nutrients, estimated according to NRC (2001).

However, the equation shown below was employed for calculating the total digestible nutrient contents (TDN):

$$\text{TDN} (\%) = (\text{TDN intake} / \text{DM intake}) \times 100.$$

Economic Analysis

For analyzing the study economically, the performance of the animal was taken into consideration for calculating the financial return. Therefore, in view of obtaining the total feed costs, all the data were recorded in terms of prices (R\$), such as the price of (a) per kilogram of the ingredients of the diets, (b) per kilogram of marketed meat, (c) cost of the animals distribution in the treatments, (d) the products used for animal health, and (e) the labor required throughout the process (see Table 2).

Moreover, all the prices mentioned in Table 2, were obtained by carrying out the experiment in August 2012, in the Municipality of Feira de Santana/Ba. Subsequently, the costs of feed (CF) were calculated, by inserting the above values in the formula given below:

$$\text{CF} = [(\text{DMI}_i \times \text{Confinement period}) \times \text{CDex}]$$

where, DMI_i = individual Dry Matter Intake; Confinement period = 70 days; and CDex = cost of the experimental diet in R\$/kg.

Eventually, for calculating the Gross Income (GI), the carcass yields of each animal (kg) were multiplied by the market

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price (R\$ 9.50) paid for per kilogram of the carcass.

Table 2. Table presenting the total feed costs, in absolute values, (R\$/100 kg dry matter (DM)), for finishing lambs submitted to diets with licuri cake.

Ingredients	R\$/kg Ingredient DM	Cost of DM in R\$/100 kg of diet			
		Inclusion Level (% of DM)			
		0.00	8.00	16.00	24.00
Ground Corn Grain	0.74	29.83	26.31	22.78	19.26
Soybean meal	1.35	23.21	18.83	14.46	10.08
Licuri Cake	0.77	0.00	6.16	12.32	18.48
Mineral supplement	3.00	4.50	4.50	4.50	4.50
Urea	0.76	0.76	0.76	0.76	0.76
Tifton-85 Hay	0.76	30.40	30.40	30.40	30.40
Total/100Kg of diet		88.70	87.00	85.20	83.50

For calculating the operating cost (OC), the expenses of feed, vaccines, medicines, and labor, were added and further operating net revenue (ONR) was obtained, by subtracting the calculated OC from GR. Subsequently, by dividing the difference between GR and OC with the GR, followed by multiplication of the result with 100, the profitability assessment was evaluated. Further, the division of the ONR with the OC defines the cost-benefit ratio, used for comparing the values of the carcass weight. Moreover, by dividing the OC by the price per kilogram of the carcass, the leveling point was obtained. Overall, the analysis of the variables related to the economic cost of the experiment was carried out according to Nogueira, (2007).

Statistical Analysis

The results obtained from the economic analysis of the experiment were analyzed statistically, by subjecting the results to the analysis of variance (ANOVA), and regression up to 5.0 % of probability, using the SASversão 9 program.

RESULTS AND DISCUSSION

The various analysis, being carried out in the present study, revealed that even though the roughage:concentrate ratio (40:60) did not vary among diets, the acquisition costs of each concentrate ingredient influenced

the feed costs with the inclusion of licuri cake levels (see Table 2). Upon transforming these costs into percentage values for each ingredient, a decrease in the contribution of the soybean meal and corn grain in the cost of the diet, as well as an increase in the contribution of the hay and the licuri cake in these costs, with the increase of the level of inclusion of licuri cake, was observed (see Table 3 and Figure 1). Moreover, while mentioning the chemical composition of the experimental diets of lambs in finishing with licuri cake levels, the licuri cake was also included in Table 1.

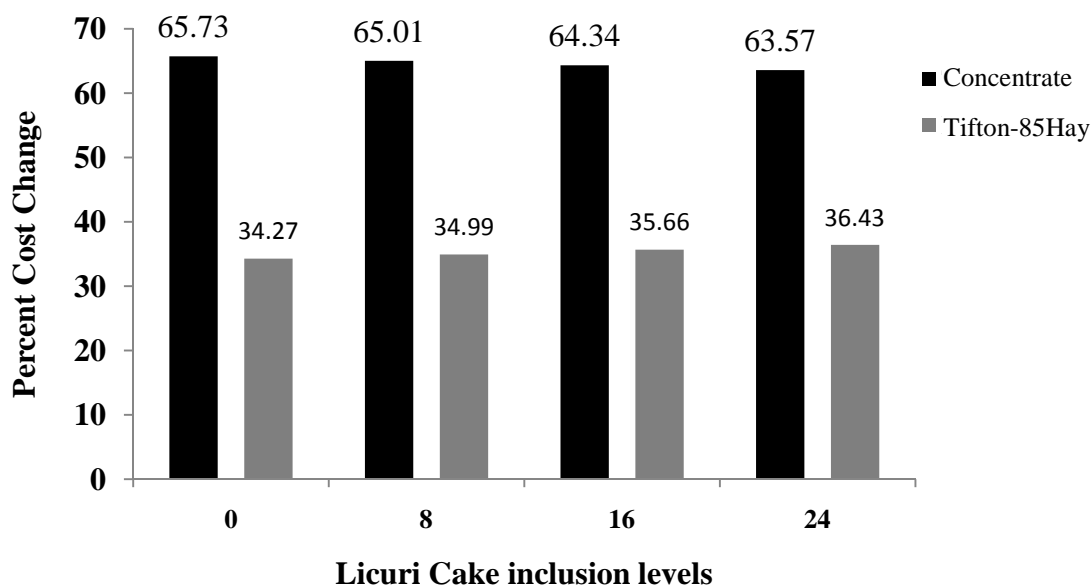


Figure 1. Percentage of the share of roughage and concentrate, in reais, on feed costs in finishing lambs fed diets with licuri cake.

Table 3. Table depicting the feeding costs, in percentages, of finishing lambs submitted to diets with different levels of inclusion of licuri cake.

Ingredients	Licuri cake inclusion levels (% of DM)			
	0.00	8.00	16.00	24.00
	Cost sharing in% / Ingredient			
Grounded corn grain	33.63	30.24	26.74	23.07
Soybean meal	26.17	21.64	16.97	12.07
Licuri Cake	0.00	6.95	14.16	21.69
Mineral supplement	5.07	5.17	5.28	5.39
Urea	0.86	0.87	0.89	0.91
Total concentrate	65.73	65.01	64.34	63.57
Tifton-85 Hay	34.27	34.94	35.68	36.41
Total	100	100	100	100

Taking into consideration the evidenced costs, one can observe that upon replacing the soybean meal and grounded corn grain with the licuri cake in the sheep diet, the concentrate's share of feed costs decreased (see Table 4). Moreover, this decrease can

be explicated by the lower acquisition cost per kg of DM of the licuri cake (R\$ 0.77), in comparison to the soybean meal (R\$ 1.35), even with the purchase price of ground corn being R\$ 0.74/kg MS.

Table 4. Table reveals the average costs of concentrate, roughage, and complete diet per kg of dry matter (DM) of lambs in finishing submitted to diets with licuri cake

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Variables	Licuri Cake inclusion levels(% DM)			
	0.00	8.00	16.00	24.00
Concentrate (R\$/Kg of DM)	0.59	0.57	0.55	0.53
Roughage (R\$/Kg of DM)	0.30	0.30	0.30	0.30
Complete Diet (R\$/Kg of DM)	0.89	0.87	0.85	0.83
Complete Diet (R\$/Animal/day) ¹	1.06	0.88	0.74	0.55

¹ Cost in R\$ per kg of DM x dry matter consumption per day.

Consequently, upon analyzing Table 4, one can evidently deduce that with higher inclusion of level of licuri cake, in the presence of soybean meal and milled corn grain, the total cost of the diets (R\$/kg of DM) reduces by 6.74%. However, with the highest level of inclusion of licuri cake, the complete diet (R\$/Animal/day) reduces by 30.19%, with the reduction being reflecting

the decrease in the consumption component. Additionally, according to Table 4, the decrease in the cost of total feed/animal/day also reflects in the linear decrease (P <0.001) of the operational cost. Similarly, the gross avenue also decreased linearly (P <0.001) with the inclusion of licuri cake in the diet (see Table 5).

Table 5. Table presenting the financial return through average values obtained with the sale of lambs slaughtered according to the diets with licuri cake.

Variables	Inclusion of LC (% DM basis)				SEM ¹	P-value	
	0.00	8.00	16.00	24.00		Linear ²	Quadratic ³
VPC ⁴	9.50	9.50	9.50	9.50	-	-	-
GR	157.5	150	137.18	110.58	4.000	0.0001	0.1830
OC	78.05	72.31	57.6	43.80	1.244	0.0001	0.1135
NOI	79.46	77.7	79.58	66.79	3.000	0.1936	0.3777
OP	50.24	50.88	57.56	59.43	1.022	0.0006	0.7659
B/C	1.02	1.10	1.38	1.53	0.054	0.0005	0.7564
LP	8.22	7.61	6.06	4.61	0.131	0.0001	0.1146

¹SEM = standard error of the mean; ²Similarity for linear effect; ³Significance for quadratic effect; ⁴Refer to the average value per carcass (Prices practiced in the region of Salvador-BA during the month of May 2011); VPC = value paid per carcass (R\$/kg); GR = Gross Revenue (total kg of carcass x R\$/ kg of carcass); NOI = net operating income; OC = operating cost in R\$, OP = operating profitability; B/C = benefit and cost ratio; LP = leveling point; NOI= GR-OC; OP = GR-OC / GR x100; B/C = NOI/OC; LP = OC/price per kg of carcass.

On the contrary, the parameters of financial return such as (a) operating profitability (OP), (b) relation cost-benefit (B/C), and (c) leveling point (LP), upon being analyzed showed a linear increase (P <0.001) with the increase of the licuri cake in the diet

(see Table 6). In the same context, in Figure 2, with the decrease in the cost of the feed, the factor that influences the operational cost to a large extent, the increase in the profitability has been witnessed.

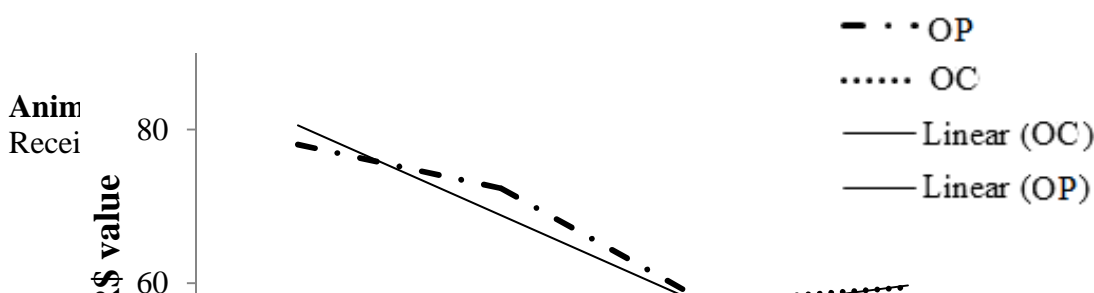




Figure 2. The figure displaying the operational cost and profitability (R\$) of finishing lambs submitted to diets with licuri cake.

Table 6: Table describing the operational cost and profitability of lambs submitted to diets with the licuri cake.

Variables	Licuri cake inclusion levels (% DM basis)			
	0.00	8.00	16.00	24.00
OC	78.05	72.31	57.60	43.80
OP	50.24	50.88	57.56	59.43

A close analysis of Table 1 and Table 4, draws attention towards the lower consumption of DM/animal/day, mainly reflected by the lower cost of the complete diet with the increase of the inclusion of licuri cake. This observation is found to be allied up with no difference in feed conversion between the levels of inclusion of licuricake tested (see Table 1) and at the lowest cost of the concentrate with an increase in the inclusion level (see Table 4). Apart from this, these aspects can also be witnessed in the linear decrease of the operational cost in the finishing of the animals, having a higher level of inclusion of licuri cake in their diet. Further, observation of a linear decrease in gross revenue, obtained from the sale of slaughtered animals, thereby indicates the difference in the lowering of gross revenue when diet without the inclusion of licuri cake, exhibiting a decrease in the range of

4.67 to 29.79%, is being compared with the diet with inclusion of licuri cake, showing a 24 % decrease. Thus, one can deduce that in the case of the diet with the inclusion of licuri cake presented lower gross revenue, in comparison to diet without the inclusion of licuri cake, owing to the lower weight of the cold carcass (see Table 1).

Essentially, the profitability, which mainly points out the proportion of gross revenue that constitutes a profit after covering the costs, showed an increase of 9.19% with the diet having the higher level of inclusion of licuri cake. The above increase in the profitability was observed due to two main reasons, (a) the lower price per kilogram of dry matter (see Table 4), and (b) lower consumption (see Table 1). Principally, profitability has been found to be coupled, with the revenue and cost composition, which in turn are found to be linked, with the reduction of the value of the diet with



the lower consumption of the same. Consequently, variations in each productive scenario and diet ingredient relationships, as observed by Carvalho *et al.* (2007), might exist. The authors also outline that with respect to the sale of the lamb carcass, the profitability decreased linearly ($P > 0.05$) with the increase in the volume of the diet (lower cost). Indeed, the increase in the volume of the diet increased the weight, which induces a reduction in carcass weight slaughter, thereby reducing revenue more sharply than reducing costs.

On the other hand, the benefit and cost ratio (net operating revenue minus operating cost) get significantly influenced by the operating cost. The analysis has revealed that the operational cost, for the aspects already mentioned, decreases by 56.12% for the diet with the highest level of inclusion of licuri cake, in comparison to the diet without the inclusion of licuri cake. As a result, the net operating revenue (gross revenue minus operating cost), showed a difference of 21.22%, thereby reflecting a greater benefit, being in the range of 40.20%, for the diet with a higher level of inclusion of licuri cake. In the same context, Table 5 unveils that in the diet with a higher level of inclusion of the licuri cake, the minimum quantity of the carcass required for maintaining equality between revenue and costs was 4.61 kg, which in turn refers to the occurrence of no losses. Contrastingly, at the 0% inclusion level of licuri cake, such leveling between revenue and costs would require 8.22 kg of the carcass. Therefore, these values are utilized as the leveling point, as it has been calculated by dividing the operational cost with the price per kilogram of the carcass. Thus, these values act as a financial indicator, thereby showing the amount of product's sale required for the full payment of the total costs (Agy *et al.*, 2012).

In the beginning, the analysis of these financial parameters, illustrate that the lower operating cost upon replacing the

soybean meal and ground corn grain with the licuri cake enables the use of this co-product at the levels studied in the present work. However, for carrying out more appropriate analysis in order to make a judgment regarding the effective use of this co-product, it is highly imperative to point towards the smaller and linearly significant gross revenue (see Table 5), observed for the higher levels of inclusion of licuri cake owing to lower weight gain and consequent carcass gain. Further, with the help of a projection calculated using the economic analysis model, reported by Nogueira (2007), it has been manifested that the animals who were being offered diet having 24% of inclusion of licuri cake took 132 days to achieve the same weight gain (projecting the same gain average of the evaluated period) as the animals who were fed upon the diet without inclusion of 70-day licuri cake. Even though the above projection highlights the difference in weight gained by animals fed upon diet with and without the inclusion of the licuri cake, it should be taken into account only on the demand of the market, concerning various characteristics of carcasses such as (i) carcass weight, (ii) size, and (iii) subcutaneous fat cover, thereby envisioning that the carcasses were not penalized, by the sudden rise of the price. Therefore, one can probably affirm that the inclusion of the same licuri, which do not favor the same weight of carcass, did not exert harmful effects on the characteristics of the carcass, which in turn reinforces that even lighter carcasses were being accepted by the slaughterhouse.

Thus, with respect to the prices of the ingredients evidenced in the diets used in the present work, the above results aid in ascertaining the advantage of the diet without licuri cake, if the producer is being focussed on the earlier finishing of the animals, as it allows to explore a greater number of production cycles. On the contrary, if one aims to achieve greater



profitability on a timely basis, then a diet with the inclusion of licuri cake has been proven to be satisfactory. These observations, therefore, serves as a decisive factor, which assists the producer in making decisions regarding the use of the by product at the market cost of the concentrates at the time of use. These aspects, as indicated previously, also highlight that others can exert a significant impact on the termination of more lots in the same time period when fed upon a diet having no inclusion of licuri cake, only if there is an availability of space in the property for the confinement of lambs for the whole year. Additionally, the price per kilogram of the licuri cake, obtained in the present study as a value being similar to the kilogram of ground corn grain but differing significantly to the kilogram value of the soybean meal (see Table 2), demonstrates a point ratio which may vary in function acquisition at the time of actual use in a particular property.

Apart from the above considerations, it is also very essential to take into account that cake, used in the present study, were obtained from the extraction of oil used for the cosmetics industry as well as from the oil utilized for human consumption, but production being on a smaller scale as compared to the production of the biodiesel program. This may show influence in some studies, particularly, the study to increase the yield of this palm, which is about 2000 kg coconuts/ha/ year, in spite of the plausible increase in the production scale of licuri cake, thereby causing a reduction in per kilogram cost of the byproduct. However, at present, the production of licuri can be still identified as extractivist since some studies, reported in the literature, have described about the plantation and cultivation of this palm. Further, Souza *et al.* (2014) have outlined that economically the feasibility of confinement for finishing lambs possess several impediments, as well as also states

that the extension of the confinement period increases production costs to an extent that it reduces the profitability. However, minimization of the diet cost is possible, only if the use of by products in the diet would promote the compatibility of the nutritional level by considering the genetic potential of the animal, thereby meeting the demands of the market. Therefore, upon considering these variables, as being allied up with the financial, economic, management, one can achieve success in the enterprise by promoting the activity so as to make it economically viable.

Overall, in the present scenario, the major emphasis is not only on the production alone, as the practicability of the system has begun to strive for the maximum economic return, thereby making the activity profitable. Additionally, maximizing the control of the production costs is highly crucial, as it is directly related to the profit margin of the activity.

CONCLUSION

In a nutshell, the lower operational cost indicated by the values of the diet ingredients leads to highest profitability and the best benefit/cost ratio with the higher inclusion level of licuri cake (24%). Consequently, according to these context, the use of this cake in diets for finishing lambs at the levels studied, in the present work, can be recommended. However, the economic viability will still depend on (i) the value of sorting the ingredients at the time of use, and (ii) the objectives of the production system taken into consideration.



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