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Production performance of lactating dairy cows at pasture fed concentrate supplemented with licuri oil[1]

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ABSTRACT - The objective of this study was to determine the optimal level of licuri oil to use in the concentrate of lactating dairy cows on pasture, through growth performance, feed conversion and cost of the supplementation. A total of 16 dairy cows, Holstein × Zebu crossbreed, were kept on Tanzania grass pasture. Cows were divided into four Latin squares, 4 × 4, formed by four experimental periods of 21 days, divided into 17 days for adaptation and four days for data collection. Cows received three kg of concentrate per day at the time of milking, and the treatments consisted of four diets containing licuri oil at levels of 0.0, 1.5, 3.0, and 4.5% of the concentrated dry matter. There was a linear increase in the daily milk yield, corrected to 3.5% fat, and an improvement in the feed conversion of the dry matter and neutral detergent fiber with the inclusion of the licuri oil. The optimal level of licuri oil was 1.5% of the concentrated DM for dairy cows on pasture, whose level has the best profit sale of milk, with positive results in the corrected daily milk production and conversion of the feed nutrients.

Key Words: licuri, lipids, milk

Introduction

Brazil is the sixth largest milk producer and has great potential to become the largest exporter of dairy products. To enter into international trade, however, it is necessary to produce milk of high quality and low cost.

The search for strategies that can improve animal performance has been an on-going effort, and the use of energy or protein supplements is common in Brazil (Silva et al., 2011; Silva et al., 2010; Borja et al., 2010) and involves biological, economic and environmental aspects.

In early lactation, cows do not consume enough food to meet their energy requirements, and the mobilization of body tissues, particularly fat deposits, results in reductions in weight and body condition (NRC, 2001) as well as reduced fertility and milk production. However, the response in milk production of dairy cows to supplemental fat sources is highly variable, from -4.4 to 9.6 kg/day of milk/kg of lipid added to the diet (Abughazaleh, 2008). This considerable variation in the response to supplementation has been attributed to the physiological states of the cows, the type of roughage basal diet, the total amount of energy consumed by the animal under the supplementation and the amount and composition of the lipid source used (Fernandes et al. 2009).

Regionally available lipid sources should be studied to provide alternatives in the supplement, concerning both the efficiency and economic aspects. However, grass is considered the cattle food source that has the highest benefit/cost ratio, and the use of concentrate should aim to achieve goals that cannot otherwise be achieved through the exclusive use of pasture (Santos et al., 2009).

Licuri oil is extracted from the fruits of licurizeiro and can be an alternative nutritional source for animals in the Brazilian Northeast. It is obtained from the fruit of the palm (*Syagrus coronata*[Martius]Beccari) native to the semiarid region of Northeast Brazil (Jesus, 2010). However, the use of this oil as a feed is not well described, and its use is largely restricted to the manufacture of cosmetics. Thus, the aim of this study was to find the optimal level of licuri oil, 0.0, 1.5, 3.0, or 4.5%, to include it as a percentage of the dry matter in the concentrate of dairy cows on pasture through the evaluation of the production performance, feed conversion and cost of supplementation.

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Material and Methods

The experiment was conducted between June and September 2007, at the Fazenda Experimental of Universidade Federal da Bahia (12° 23' 57.51" S, 38° 52' 44.66" W), São Gonçalo dos Campos, Bahia, which is located 108 km from Salvador, in the north-central region of Bahia and the micro-region of Feira de Santana (Recôncavo).

The total area of the experiment was 8 hectares, made up of pastures of *Panicum maximum* cv. Tanzania I, divided into 10 paddocks of 8000 m^2, surrounded by electrified wire. All of the paddocks contained a trough for the supply of a mineral mixture and water. The pasture was managed in a rotational system, with four days of occupation and 36 days of rest, with an average forage supply of 10% of the body weight in dry matter (Table 1), through *put and take* system, in which regulating animals were used to maintain the desired supply. A reserved area of 3 ha was used for the staying of regulating animals. The monitoring of the pasture dry matter availability was performed using a square with 1-m^2 area, randomly released ten times in the paddock before the entry and exit of animals. The difference in the amount of forage before the entry and after the exit of the animals was used to determine the rate of grass growth, which was necessary in the calculation of the load adjustment. A total of 16 multiparous cows were used: lactating crossbred Holstein × Zebu cows with an average weight of 500±72 kg, between their 45th and 90th days of lactation, identified by ear rings, with an average production of 8 liters of milk/day. The cows were divided into four 4 × 4 Latin squares (four treatments × four periods × four animals in each treatment). The experiment was divided into four experimental periods of 21 days, with 17 days of adaptation and 4 of data collection.

Table 1 - Forage mass and offer contents given to lactating cows with licuri oil supplementation in the concentrate

Item	Experimental period			
	1st	2nd	3rd	4th
Forage mass (kg DM/ha)[1]	8987	7424	7448	6380
Forage offer (% DMLW)[2]	10.30	10.36	10.34	10.07

[1] Kilogram of dry matter per hectare.
[2] Dry matter live weight percentage.

The treatments were different levels (0.0, 1.5, 3.0, or 4.5%) of licuri oil in the dry matter (DM) of the concentrate, which also contained corn meal, soybean meal and urea (Tables 2 and 3). The supplements were balanced to meet the nutritional requirements of cows, according to the National Research Council (NRC, 2001). Three kg of concentrate supplement/cow/day were offered, divided into two meals a day (at 6 a.m. and 4 p.m.).

The animals were mechanically milked twice daily (at 6 a.m. and 4 p.m.), when they received the concentrate diet. In the last four days of each experimental period, the milk production was evaluated. The milk production was corrected to 3.5% fat (CMP) according to the following formula, as described by Leiva et al. (2000):

$CMP = (12.82*fatP) + (7.13*protP) + (0.323*MP)$,

where MP = the milk production, kg/day; fatP = the fat production, kg/day; and protP = the protein production, kg/day.

The fatty acid profile of the concentrates and extrusas was analyzed by gas chromatography in the Laboratório de Nutrição e Crescimento Animal, Escola Superior de Agricultura Luiz Queiroz - USP (Table 4).

Measurements of the body condition score (BCS) were conducted on the last day of the period of data collection by two observers, using a biological scale from 1 to 5, with subunits of 0.25 points. The score was evaluated by visual and tactile (palpation) of the animal. The score was attributed to the animals according to the amount of reserve tissue, especially muscle and fat in certain areas of the body that are associated with the following anatomic landmarks: the ribs, the spinous processes of the vertebral spine, the

Table 2 - Chemical composition of the extrusa and ingredients used in the concentrate for lactating cows subjected to licuri oil supplementation

Chemical composition	Ingredient			
	Corn meal	Soybean meal	Licuri oil	Extrusa
Dry matter (%)	88.80	88.55	100.00	33.76
Mineral matter (% DM)	0.35	6.18	0.00	9.80
Crude protein (% DM)	8.94	49.72	0.00	12.02
Ether extract (% DM)	1.10	2.10	100.00	1.51
Neutral detergent fiber (% DM)	19.77	11.29	0.00	73.77
Acid detergent fiber (% DM)	3.46	8.16	0.00	41.06
Lignin (% DM)	0.74	0.65	0.00	10.61
Cellulose (% DM)	2.71	7.51	0.00	30.45
Hemicellulose (% DM)	16.32	3.12	0.00	32.71
Non-fibrous carbohydrates (% DM)	69.83	30.71	0.00	2.89

Table 3 - Concentrate composition given to lactating cows subjected to licuri oil supplementation

Ingredient (% DM)	Level of licuri oil (% DM)			
	0.00	1.50	3.00	4.50
Corn meal	79.70	77.60	75.93	74.24
Soybean meal	14.63	15.00	15.30	15.60
Licurioil	0.00	1.50	3.00	4.50
Urea:ammonium sulfate (9:1)	3.00	3.00	3.00	3.00
Mineral-vitamin mixture[1]	2.67	2.80	2.77	2.66
Nutritional fraction				
Dry matter (%)	88.90	88.90	89.10	89.30
Mineral matter (% DM)	3.85	4.00	3.98	3.88
Crude protein (% DM)	22.80	22.80	22.80	22.79
Ether extract (% DM)	1.18	2.67	4.14	5.64
Neutral detergent fiber (% DM)	17.41	17.04	16.74	16.44
Acid detergent fiber (% DM)	3.95	3.91	3.88	3.84
Lignin (% DM)	0.68	0.67	0.66	0.65
Cellulose (% DM)	3.26	3.23	3.21	3.18
Hemicellulose (% DM)	13.46	13.13	12.87	12.60
Non fibrous carbohydrates (% DM)	60.15	58.79	57.72	56.63
Metabolizable energy (Mcal/kg)[2]	3.34	3.42	3.50	3.60
Total digestible nutrients (% DM)[2]	81.71	83.73	85.63	87.77

[1] Guarantee levels (per kg of product): calcium – 200.00 g; phosphorous – 60.00 g; magnesium – 20.00 g; sulfur – 20.00 g; sodium – 70.00 g; potassium – 35.00 g; copper – 700.00 mg; iodine – 40.00 mg; cobalt – 15.00 mg; iron – 700.00 mg; manganese – 1,600.00 mg; zinc – 2,500.00 mg; selenium – 19.00 mg; chromium – 10.00 mg; fluoride (max.) – 600,00 mg; vitamin A – 200,000.00 U.I.; vitamin E – 1,500.00 U.I.; vitamin D3 – 50,000.00 U.I.
[2] Estimated according to the NRC (NRC, 2001).

Table 4 - Concentrates and extrusa fatty acid profile, as a percentage of the total fatty acids

Fatty acids	Licuri oil level (% DM)				Extrusa
	0.00	1.50	3.00	4.50	
C6:0	0.00	0.03	0.05	0.08	0.00
C8:0	0.00	0.45	0.52	0.54	0.00
C10:0	0.03	0.37	0.71	1.14	0.93
C12:0	1.65	3.96	9.48	15.54	2.21
C14:0	0.52	3.23	5.88	6.90	2.85
C15:0	0.04	0.03	0.05	0.05	0.31
C16:0	34.02	23.92	19.54	15.80	5.47
C16:1 *n*-9	0.05	0.07	0.07	0.09	0.00
C18:0	7.38	6.95	5.20	4.69	9.43
C18:1 *t*-6	0.13	0.17	0.03	0.02	0.00
C18:1 *c*-9	29.97	33.04	29.29	26.47	4.47
C18:1 *c*-11	1.57	1.33	1.44	2.41	1.89
C18:1 *c*-12	0.80	0.89	1.04	1.26	1.27
C18:1 *c*-13	0.38	0.51	0.70	2.03	0.31
C18:2 *n*-6	21.97	22.70	22.91	19.38	4.70
C18:3 *n*-6	0.86	0.54	0.38	0.26	40.58
C18:3 *n*-3	0.44	0.39	0.37	0.29	17.05
CLA[1]	0.00	1.25	2.11	2.77	8.31
C20:3	0.19	0.20	0.25	0.28	0.22

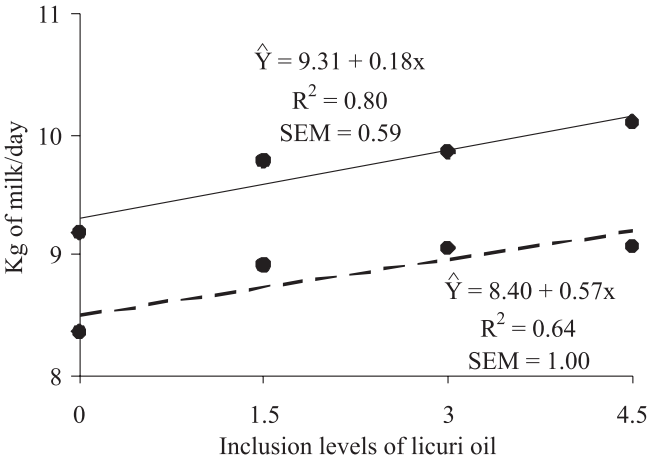
[1] Conjugated linoleic acid.

transverse processes of the vertebral spine,the tip of the ileum, the base of the tail, the sacrum, and the lumbar vertebrae (Maciel, 2006).

Animals' weights were measured on the last day of the data collection period, using a weighting tape for dairy breeds of cattle. The calculation of the feed conversion was done by the division of the intake daily values of each nutritional fraction for each period for milk production. The supplementation costs were calculated considering the price of each ingredient at the market in Feira de Santana, Bahia, during the first half of 2007. The cost evaluation of the lipid supplementation was performed by adding the cost of the ingredients of each treatment multiplied by the consumption of each of the diet components (on natural matter). The cost of the concentrates was obtained by multiplying the percentage of each ingredient by its cost. The gross margin from the milk sale was calculated by deducting the cost of the supplementation during this period from the price paid for the milk produced during the experiment. Data were subjected to analysis of variance and regression, using the GLM procedure (General Linear Models) of the SAS 9.1.2® statistical program (2004), adopting a significance level of 5%. In the analysis of the food costs, statistical comparisons were not used because they referred to the total group of animals.

Results and Discussion

The linear increase ($P<0.05$) in the daily milk yield (Figure 1) was the result of a higher intake of concentrate by the cows, as stimulated by the increased levels of licuri oil that, even without considering the increase in the intake of the total DM, provided a better digestibility of the DM and EE. It is likely that a higher intake of the concentrate provided an increased production of propionic acid, which is a precursor of glucose and may, in turn, be related to the synthesis of lactose, which is responsible for the increase in the volume of milk produced.



SEM = standard error of the mean.

Figure 1 - Daily milk production (---) and milk production corrected for 3.5% fat (——) of lactating cows on pasture fed a licuri oil-supplemented concentrate.

The milk yield corrected to 3.5% fat also increased with the addition of the licuri oil in the concentrate because this parameter accounts for the milk constituents, which were higher after the supplementation. The milk yield corrected to 3.5% was also influenced by the increase in the daily milk yield, which ranged from 8.36 to 9.07 liters with the addition of the licuri oil, which was an 8.5% increase over the baseline. However, contradictory results are found in the literature regarding lipid supplementation, from reports of no improvement in milk production (Whitlock et al., 2003; López, 2001; Simas et al., 1997; Wu et al., 1993), to results of observed reductions (Eifert et al., 2006) and Abel-Caines et al., 1997), and a situation that encourages research with various lipid supplements and validates the use of licuri oil when the milk is sent to the dairy industry and may provide better yield. The feed conversion of the DM (Table 5) improved linearly (P<0.05), with 0.06 kg DM/kg of milk produced for each 1% increase in the oil level in the concentrate. The same trend was observed for the CAPB and CAFDN, which improved by 0.1 kg CP/kg and 0.06 kg NDF/kg of the milk produced, respectively, which are significant results when assessing how much of the feed given to the animals is converted into product (milk).

The optimal conversion of the feed dry matter can be described as a result of the increase in the dry matter digestibility of the diet of the animals after the addition of licuri oil in the concentrate. This increase in the dry matter digestibility was mainly due to a higher intake of the concentrate, a situation that provided the highest daily production of milk and, therefore, a better feed conversion of the dry matter. There was a decrease in the feed conversion of the crude protein that demonstrated a linear effect (P<0.05). This may have occurred due to an efficient action of the rumen microorganisms to minimize the action of lauric acid, which prevented the inhibitory effect of the ether extract on the digestibility of the crude protein, thus, positive effects on the development of the rumen microflora and protein digestibility were observed, resulting in an improved protein metabolism and a better feed conversion. The increase in milk production and improved feed conversion of the crude protein provided with the licuri oil, as compared with other oils more commonly used for lactating cows (soybean and corn), may be considered positive for animal production. However, different results were reported by Santos et al. (2009) in postpartum cows fed diets with soybean oil: no difference in the feed conversion of the crude protein of the nutrients was found, as there was no variation in the nutrient intake or milk production.

The neutral detergent fiber improved the feed conversion linearly (P<0.05): each 1% increment of the licuri oil in the concentrate resulted in a drop of 0.06 percentage units. These results may be related to the changes in the forage-to-concentrate ratio with the increased intake of the concentrate and stimulated by the oil levels in the supplements, as it provided a better dry matter digestibility. Consequently, the possible change in the acetate-to-propionate ratio, with a possible greater production of propionic acid would, thus, increase the milk production and reduce the total consumption of the neutral detergent fiber.

Table 5 - Feeding conversion of concentrate nutrients and body condition score (BCS) of lactating cows on pasture fed concentrate supplemented with licuri oil

Item	Licuri oil level (% DM)				SEM	Regression equation	R^2	P[1]
	0.00	1.50	3.00	4.50				
Dry matter	1.68	1.52	1.37	1.42	0.11	$\hat{Y} = 1.63 - 0.06x$	0.47	0.03
Crude protein	0.22	0.19	0.17	0.16	0.04	$\hat{Y} = 0.21 - 0.01x$	0.76	0.02
Ether extract	0.02	0.02	0.02	0.02	0.003	$\hat{Y} = 0.02$	-	0.10
Neutral detergent fiber	1.14	1.02	0.89	0.85	0.08	$\hat{Y} = 1.12 - 0.06x$	0.60	0.01
Non-fibrous carbohydrates	0.17	0.16	0.17	0.17	0.03	$\hat{Y} = 0.16$	-	0.10
Body condition score	3.00	3.00	3.25	3.25	0.32	$\hat{Y} = 3.12$	-	0.10

[1]P<0.05; R^2 = coeficiente de determinação; SEM = standard error of the mean.

No changes were observed (P>0.05) in the body condition score of the cows fed licuri oil in the concentrate, with averages between 3.00 and 3.25, respectively, for the levels of 0,0% to 4.5% licuri oil. This finding can be interpreted as a confirmation that the animals' nutritional requirements were met, not considering that the animals used their stored reserves to produce the milk; the animals used in the experiment were Holstein × Zebu crossbreed, with production levels of approximately 8 kg of milk per day, which is typical for the small farms in the region.

It was observed that the net energy used for both maintenance and milk production did not vary with the addition of the licuri oil; therefore, the use of a metabolizable energy in the form of fatty acids builds animal fat and strengthens the reserves of the animal. It can be inferred that the metabolic fate of the available energy would lead to the maintenance of the body condition score and that licuri oil can result in amore rapid return to estrus and a shortening of the days to the first estrus postpartum.

The general change in animal weight, which was -1 to 8 kg during the experiment, can be an indication that all of the animals were in a condition of positive energy balance during the experiment; thus, the main goal was met, with an increased energy density of the rations when lipid supplementation was used. This supplementation on pasture had a positive effect on the milk production, body score and the digestibility of nutrients, as has also been reported by Padre et al. (2006) in cattle on pasture.

The cost of the supplementation increased with the addition of the licuri oil due to its cost of approximately R$ 1.50 per liter (Table 6). The costs of the concentrate supplementation/animal/day and total (84 days) were higher for the 4.5% oil diet, followed by the diets with 3.0%, 1.5% and without oil (Table 7). When considering the price of the milk, approximately R$ 0.65/L, it was observed that the gross margin was higher for the milk produced by the cows fed the concentrate with 1.5% oil due to the increase in milk production. Despite the fact that the cost of each ration was raised by the addition of the oil, under the local conditions of the region that produces licuri, such diet may be an attractive alternative for lactating cows.

However, the gross margin was lower for each of the diets with 4.5% of additional oil and the best for the inclusion of oil at 1.5%; results that can stimulate the production of the oil in the region. The oil extraction is usually performed by associations of producers in this region; thus, positive reports on its use may promote its

Table 6 - Cost composition of the licuri oil concentrate

Ingredient	Cost (R$)/kg of NM[1]	Costs per kg of the ingredients at the different levels of licuri oil (% DM)			
		0.00	1.50	3.00	4.50
Corn meal	0.58	0.46	0.45	0.44	0.43
Soybean meal	0.72	0.11	0.11	0.11	0.11
Licuri oil	1.50	0.00	0.02	0.04	0.06
Urea:ammonium sulfate (9:1)	0.70	0.02	0.02	0.02	0.02
Mineral-vitamin mixture[1]	2.60	0.07	0.07	0.07	0.07
			Cost of the kg of concentrate costs		
Supplements	-	0.65	0.67	0.68	0.69

[1] Costs per kg of natural matter.

Table 7 - Assessment of the costs and revenue of supplementation, as based on milk production and the levels of licuri oil in the concentrate dry matter

Items	Licuri oil level (% DM)			
	0.00	1.50	3.00	4.50
Consumption of concentrate/animal/day	1.84	1.93	2.26	2.44
Cost of the concentrate supplement/kg	0.65	0.67	0.68	0.69
Cost of supplement/animal/day (R$)	1.20	1.29	1.59	1.68
Days of supplementation	84.00	84.00	84.00	84.00
Supplementation total cost (R$/84 days)	100.46	108.30	129.26	141.42
Average daily milk production (kg/animal)	8.36	8.91	9.06	9.07
Total production (kg/animal)	702.24	748.44	761.04	761.88
Price received per kg of milk (R$)	0.65	0.65	0.65	0.65
Price received/total production (R$)	456.46	486.49	494.68	495.22
Gross margin from the milk sale (R$/animal)	355.99	378.18	365.42	353.80
Feed cost per kg of milk produced	0.14	0.14	0.17	0.18
Milk production/ha/84 days of the experiment	87.78	93.55	95.13	95.23

competitiveness with other oils on the market such as soybean oil that are not typical of the semiarid region.

According to Benedetti (2002), a program of milk production on pasture should allow dairy farmers to use, with maximum efficiency, the available resources of the farm. In addition, the cheapest feed it can produce to offer the dairy herd is intensively managed grazing land, whose cost is 2.0 to 5.2 times less than other foods – a situation that reduces the cost of production and promotes more competitive products in the dairy chain.

Conclusions

The 1.5% level of licuri oil in the diet of dairy cows on pasture as DM of the concentrate level results in a better gross margin from the sale of the milk, with increases in the daily and corrected milk production, feed conversion and increased dry matter intake, crude protein and neutral detergent fiber. Supplementation of grazing dairy cattle is a technology that allows the correction of unbalanced diets and the improvement of milk production. Despite the effect of grazing by concentrate replacement, an increase in the level of production per animal unit was found with the diet consisting of Tanzania grass and a concentrate containing licuri oil; Therefore, this the meet met the nutritional requirements of the animals and has positive effects on animal performance.

References

ABEL-CAINES, S.F.; GRANT, R.J.; HADDAD, S.G. Whole cottonseeds or a combination of soybean and soybeans hulls in the diets of lactating dairy cows. **Journal of Dairy Science**, v.80, n.7, p.1353-1367, 1997.

ABUGHAZALEH, A.A. Effect of fish oil and sunflower oil supplementation on milk conjugated linoleic acid content for grazing dairy cows. **Animal Feed Science and Technology**, v.141, p.220-232, 2008.

BENEDETTI, E. **Produção de leite a pasto**: bases práticas. Salvador: SEAGRI, 2002. 176p.

BORJA, M.S.; OLIVEIRA, R.L.; RIBEIRO, C.V.M.R. et al. Effects of feeding licury (Syagruscoronate) caketo growing goats. **Asian-Australian Journal Animal Science**, v.23, n.11, p.1436-1444, 2010.

EIFERT, E.C.; LANA, R.P.; LANNA, D.P.D. et al. Consumo, produção e composição do leite de vacas alimentadas com óleo de soja e diferentes fontes de carboidratos na dieta. **Revista Brasileira de Zootecnia**, v.35, n.11, p.211-218, 2006.

FERNANDES, A.R.M.: SAMPAIO, A.A.M.; HENRIQUE, W. et al. Composição química e perfil de ácidos graxos da carne de bovinos de diferentes condições sexuais recebendo silagem de milho e concentrado ou cana-de-açúcar e concentrado contendo grão de girassol. **Revista Brasileira de Zootecnia**, v.38, p.705-712, 2009.

JESUS, I.B.; BAGALDO, A.R.; BARBOSA, L.P. et al. Levels of licuryoil ["Syagruscoronata" (Martius) Beccari] in crossbred Boerkids diet. **Revista Brasileira de Saúde e Produção Animal**, v.11, n.4, p.1163-1175, 2010.

LEIVA, E.; HALL, M.B.; VAN HORN, H.H. Performance of dairy cattle fed citrus pulp or corn products as sources of neutral detergent-soluble carbohydrates. **Journal of Dairy Science**, v.83, p.2866-2875, 2000.

LÓPEZ, S.E. **Suplementação com diferentes fontes de gordura para vacas Jersey de alta produção na fase inicial da lactação**. 2001. 223f. Tese (Doutorado em Produção Animal) - Programa de Pós-Graduação em Agronomia/Universidade Federal do Rio Grande do Sul, Porto Alegre.

MACIEL, A.B.B. **Proposta de avaliação da condição corporal em vacas holandesas e nelores**. 2006. 103f. Dissertação (Mestrado em Zootecnia) – Faculdade de Medicina Veterinária e Zootecnia - Universidade Estadual Paulista, Botucatu.

NATIONAL RESEARCH COUNCIL - NRC. **Nutrient requirements of dairy cattle**. 7.ed. Washinton, D.C.: National Academic Press, 2001. 381p.

PADRE, R.G.; ARICETTE, J.A.; MOREIRA, F.B. et al. Fatty acid profile, and chemical composition of *Longissimus* muscle of bovine steers and bulls finished in pasture system. **Meat Science**, v.74, p.242-248, 2006.

SANTOS, A.D.F.; TORRES, C.A.A.; RENNÓ, F.P. et al. Use of soybean oil for dairy cows during transition period: Intake, milk yield and compositionand composition. **Revista Brasileira de Zootecnia**, v.38, n.7, p.1363-1371, 2009.

SILVA, T.M.; OLIVEIRA, R.L.; BARBOSA, L.P. et al. Preliminary study on meat quality of goats fed levels of licury oil in the diet. **Asian-Australian Journal Animal Science**, v.24, n.8, p.1112-1119, 2011.

SILVA, T.M.; OLIVEIRA, R.L.; BARBOSA, L.P. et al. Body components of young crossbred Boer goats fed licury oil (Syagruscoronata) in the diet. **Arquivo Brasileiro de Medicina Veterinária e Zootecnia**, v.62, n.6, p.1448-1454, 2010.

SIMAS, J.M.; HUBER, J.T.; THEURER, C.B. et al. Influence of fat source and sorghum grain treatment on performance and digestibilities of high yielding dairy cows. **Journal of Dairy Science**, v.80, n.11, p.2907-2912, 1997.

STATISTICAL ANALYSES/STAT - SAS. **SAS user's guide**: statistics. Release 9.1.2 Cary: SAS, 2004. 1500p.

VAN SOEST, P.J.; MASON, V.C.The influence of Maillard reaction upon the nutritive value of fibrous feeds. **Animal Feed Science and Technology**, v.32, n.1, p.45-53, 1991.

WHITLOCK, L.A.; SCHINGOETHE, D.J.; HIPPEN, A.R. Milk production and composition from cows fed high oil or convertional corn at two forage concentrations. **Journal of Dairy Science**, v.86, p.2428-2437, 2003.

WU, Z.; HUBER, J.T.; SLEIMAN, F.T. Effect of three supplement fat sources on lactation and digestion in dairy cows. **Journal of Dairy Science**, v.76, n.11, p.3562-3570, 1993.