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LICURI BAGASSE (*SYAGRUS CORONATA*) IN RATIONS FOR BROILERS

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ABSTRACT: The objective of this research was to evaluate the performance of broilers fed with different levels of licuri bagasse inclusion in the initial (1-21 days), growth (22-35 days), and finishing (36-42 days) phases. For this was used completely randomized design with three hundred birds with a day age what were submitted the diets based on corn and soybean containing levels of inclusion of the licuri bagasse (4, 8, 12 and 16%) and a reference diet (without the inclusion of the bagasse). Daily weight gain, total weight gain, daily feed intake and feed conversion were evaluated. The inclusion of increasing licuri bagasse levels interfered positively in the of birds' performance, providing higher rates for the levels with 8; 12 and 16% inclusion of the bran, within the studied variables.

Keywords: Alternative food, feed conversion, feed intake.

BAGAÇO DE LICURI (SYAGRUS CORONATA) EM RAÇÕES PARA FRANGOS DE CORTE

RESUMO*: O objetivo desta pesquisa foi avaliar o desempenho de frangos de corte alimentados com diferentes níveis de inclusão de bagaço de licuri nas fases inicial (1-21 dias), crescimento (22-35 dias) e terminação (36-42 dias). Para isso foi utilizado um delineamento inteiramente casualizado com trezentas aves com um dia de idade as quais foram submetidas a dietas à base de milho e soja contendo níveis de inclusão do bagaço de licuri (4, 8, 12 e 16%) e uma dieta referência (sem a inclusão do bagaço). Foram avaliados o ganho de peso diário, o ganho de peso total, o consumo diário de ração e a conversão alimentar. A inclusão de níveis crescentes de bagaço de licuri interferiu positivamente no desempenho das aves,*

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proporcionando maiores taxas para os níveis com 8; 12 e 16% de inclusão do farelo, dentro das variáveis estudadas.

***Palavras-chave**: Alimento alternativo, conversão alimentar, consumo de ração.*

INTRODUCTION

Ration is the item that costs the most among the production costs of poultry farming, totaling about 70%. It is a very significant factor for producers and researchers working with food and animal nutrition.

Corn and soybean are the most widely used vegetable ingredients in poultry feed, especially for their nutritional values (ALVES-CAMPOS et al., 2017). These products, however, are becoming increasingly expensive and scarce, especially in the Northeastern semi-arid region. It represents one of the main limiting factors for local poultry production. That way, the high demand for these foods causes big variations in production costs that are imposed by the market and the different regions of the country (SANTOS and GRANGEIRO 2012). As a result, the search to identify alternative products to be used in broiler production is increased. However, it is necessary to have information about ingredients' chemical composition to produce rations with adequate nutritional levels to meet the animals' requirements in order to allow maximum productivity (MELLO et al., 2009).

In the past few years there has been a great demand for alternative foods that do not affect the animals' productive performance. Among these alternative foods are the licuri (*Syagrus coronata*), a typical palm tree of the northeastern semi-arid region, very resistant to long periods of drought, about 6 to 10 meters high, easily found in northern Bahia. The licuri clusters have an average of 1 357 fruits, which have average lengths and diameters of 2.0 and 1.4 cm, respectively. According to Crepaldi et al. (2001), the fruit's lipid content (49.2%) and protein (11.5%) of the almond and the total carbohydrate content (13.2%) of the pulp, energy value (635.9 kcal.100g^{-1}). The licuri bagasse has an average concentration of 20% of crude protein and 11% of lipids. The licuri bagasse has been used to feed non-ruminants in the northeastern semi-arid region, especially in the north of Bahia (Brazil), where there is abundance of the palm tree (MELO et al., 2016).

The objective of this research was to evaluate the performance of broilers fed with different levels of licuri bagasse inclusion in the initial, growth, and finishing phases.

MATERIAL AND METHODS

The experiment was conducted in the poultry sector of the Federal Institute of Education, Science and Technology - Baiano, Campus Senhor do Bonfim, Bahia, Brazil, march to April 2016. A total of 300 one day old Cobb broilers were distributed in a completely randomized experimental design, on whatthe treatment factor was the inclusion of licuri bagasse with different levels (0; 4; 8; 12 and 16%), six replicates and 10 birds per experimental unit. The birds were sheltered on wood shavings in an experimental warehouse, 30 boxes were used with an area of 1m^2.

Rationing was *ad libitum*, and the rations were isoprotein formulated based on total amino acids for all phases (initial, growth and finishing). The initial phase is from 1 to 21 days, the growth phase is from 22 to 35 days and the final phase (termination) is from 36 to 42 days (MALAVAZZI, 1982). The average weights in grams in the initial, growth and termination phases were 50 ± 6; 421.05 ± 73.08 and 794.64 ± 116.5 respectively.

The licuri bagasse was obtained by mechanical pressing of the almonds, where about 90% of the licuri oil is removed and the resulting fraction was found in the bagasse. After pressing, the bagasse was ground until reaching bran texture, which was used in the experimental rations. The diets supplied for the initial, growth, and finishing phases are in table 1; 2 and 3.

Table 1. Diets containing different levels of licuri bagasse inclusion in broiler diet for the initial phase (1-21 days).

Tabela 1*. Dietas contendo diferentes níveis de inclusão de bagaço de licuri na dieta de frangos de corte para a fase inicial (1-21 dias).*

	Levels (%)				
Ingredients	0	4	8%	12	16

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Corn (%)	60.88	57.40	55.00	51.00	49.00
Soybean meal (%)	36.20	35.00	33.63	32.55	31.10
Licuri bagasse (%)	0.00	4.00	8.00	12.00	16.00
Soybean oil (%)	0.00	0.00	0.00	0.11	1.21
Limestone (%)	1.20	1.85	1.62	1.70	0.84
Premix (%)	0.50	0.50	0.50	0.50	0.50
Calculated value					
Crude protein (%)	22.41	22.40	22.40	22.40	22.40
Ether extract (%)	2.66	2.93	3.24	3.60	5.01
Total Calcium (%)	0.59	0.84	0.76	0.79	0.46
Available phosphorus (%)	0.41	0.41	0.41	0.42	0.42
Digestible methionine (%)	0.40	0.39	0.37	0.36	0.34
Digestible lysine (%)	1.47	1.47	1.44	1.45	1.45
Digestible tryptophan (%)	0.27	0.26	0.25	0.24	0.23
Digestible threonine (%)	0.80	0.76	0.73	0.70	0.67

ME = 3050 KCalKg-1. Premix: Supplementation (vitamin and minerals provided per kilogram of feed). Initial phase: Calcium (min) 160.00 g; calcium (max) 200.00 g; phosphorus (min) 45.00 g; sodium (min) 40 g; iron (min) 600.00 mg; copper (min) 2 405 mg; zinc (min) 1,000,000 mg; manganese (min) 1 400.00 mg; iodine (min) 20.00 mg; selenium (min) 7.00 mg; cobalt (min) 4.00 mg; vitamin A (min) 260 000.00 Ul; vitamin D3 (min) 65,000.00 IU; vitamin E (min) 455.00 IU; vitamin K3 (min) 52.00 mg; folic acid (min) 13.00 mg; biotin (min) 1.50 mg; choline (min) 10.00 g; niacin (min) 650.00 mg; pantothenic acid (min) 390.00 mg; vitamin B1 (min) 39.00 mg; vitamin B2 (min) 195.00 mg; vitamin B6 (min) 52.00 mg; vitamin B12 (min) 390.00 mcg; lysine (min) 26.00 g; methionine (min) 9 800.00 mg; chlorohydroxyquinoline (min) 600.00 mg; narasin + nicarbazine 1,000,000 mg / 1,000,000 mg; 10.001.00 ftu. Growth Phase: Calcium (min) 160.00 g; calcium (max) 175.00 g; phosphorus (min) 35.00 g; sodium (min) 35.00 g; iron (min) 600.00 mg; copper (min) 2 672.00 mg; zinc (min) 1,000,000 mg; manganese (min) 1 400.00 mg; iodine (min) 20.00mg; selenium (min) 7.00 mg; cobalt (min) 4.00 mg; vitamin A (min) 250 000.00 Ul; vitamin D3 (min) 62 500.00 IU; vitamin E (min) 437.00 IU; vitamin K3 (min) 50.00 mg; folic acid (min) 12.00 mg; biotin (min) 1.50 mg; choline (min) 6,000.00 mg; niacin (min) 625.00 mg; pantothenic acid (min) 375.00 mg; vitamin B1 (min) 37.00 mg; vitamin B2 (min) 187.00 mg; vitamin B6 (min) 50.00 mg; vitamin B12 (min) 375.00 mcg; lysine (min) 21.00 g; methionine (min) 8,000.00 mg; chlorohydroxyquinoline 600.00 mg; salinomycin 1,320.00 mg; phytase (min) 10 001.00 ftu.

Table 2. Diets containing different levels of licuri bagasse inclusion in broiler diet for the growing phase (22-35 days).

***Tabela 2**. Dietas contendo diferentes níveis de inclusão de bagaço de licuri na dieta de frangos de corte para a fase de crescimento (22-35 dias).*

	Levels (%)				
Ingredients	0	4	8	12	16
Corn (%)	67.00	63.92	60.14	56.01	53.40
Soybean meal (%)	29.62	28.58	27.36	26.19	25.00
Licuri bagasse (%)	0.00	4.00	8.00	12.00	16.00
Limestone (%)	1.66	2.00	1.50	1.20	0.02

Premix (%)	0.50	0.50	0.50	0.50	0.50
Calculated value					
Crude protein (%)	19.80	19.90	19.85	19.80	19.87
Ether extract (%)	2.77	3.06	4.80	6.62	8.14
Total Calcium (%)	0.75	0.88	0.69	0.58	0.13
Available phosphorus (%)	0.38	0.39	0.39	0.39	0.40
Digestible methionine (%)	0.36	0.35	0.33	0.31	0.30
Digestible lysine (%)	1.38	1.18	1.15	1.14	1.05
Digestible tryptophan (%)	0.23	0.23	0.22	0.20	0.20
Digestible threonine (%)	0.71	0.68	0.65	0.62	0.59

ME = 3150 KCalKg-1 Premix: Supplementation (vitamin and minerals provided per kg of feed). Initial phase: Calcium (min) 160.00 g; calcium (max) 200.00 g; phosphorus (min) 45.00 g; sodium (min) 40 g; iron (min) 600.00 mg; copper (min) 2 405 mg; zinc (min) 1,000,000 mg; manganese (min) 1 400.00 mg; iodine (min) 20.00 mg; selenium (min) 7.00 mg; cobalt (min) 4.00 mg; vitamin A (min) 260 000.00 Ul; vitamin D3 (min) 65,000.00 IU; vitamin E (min) 455.00 IU; vitamin K3 (min) 52.00 mg; folic acid (min) 13.00 mg; biotin (min) 1.50 mg; choline (min) 10.00 g; niacin (min) 650.00 mg; pantothenic acid (min) 390.00 mg; vitamin B1 (min) 39.00 mg; vitamin B2 (min) 195.00 mg; vitamin B6 (min) 52.00 mg; vitamin B12 (min) 390.00 mcg; lysine (min) 26.00 g; methionine (min) 9 800.00 mg; chlorohydroxyquinoline (min) 600.00 mg; narasin + nicarbazine 1,000,000 mg / 1,000,000 mg; 10.001.00 ftu. Growth Phase: Calcium (min) 160.00 g; calcium (max) 175.00 g; phosphorus (min) 35.00 g; sodium (min) 35.00 g; iron (min) 600.00 mg; copper (min) 2 672.00 mg; zinc (min) 1,000,000 mg; manganese (min) 1 400.00 mg; iodine (min) 20.00mg; selenium (min) 7.00 mg; cobalt (min) 4.00 mg; vitamin A (min) 250 000.00 Ul; vitamin D3 (min) 62 500.00 IU; vitamin E (min) 437.00 IU; vitamin K3 (min) 50.00 mg; folic acid (min) 12.00 mg; biotin (min) 1.50 mg; choline (min) 6,000.00 mg; niacin (min) 625.00 mg; pantothenic acid (min) 375.00 mg; vitamin B1 (min) 37.00 mg; vitamin B2 (min) 187.00 mg; vitamin B6 (min) 50.00 mg; vitamin B12 (min) 375.00 mcg; lysine (min) 21.00 g; methionine (min) 8,000.00 mg; chlorohydroxyquinoline 600.00 mg; salinomycin 1 320.00 mg; phytase (min) 10 001.00 ftu.

Table 3. Diets containing different levels of licuri bagasse inclusion in broiler diet for the finishing phase (36-42 days).

***Tabela 3**. Dietas contendo diferentes níveis de inclusão de bagaço de licuri na dieta de frangos de corte para a fase de terminação (36-42 dias).*

	Levels (%)				
Ingredients	0	4	8	12	16
Corn (%)	69.95	67.00	61.40	57.00	54.75
Soybean meal (%)	26.50	25.10	24.34	23.45	21.70
Licuri bagasse (%)	0.00	4.00	8.00	12.00	16.00
Limestone (%)	2.00	1.44	1.44	0.78	0.78
Premix (%)	0.50	0.50	0.50	0.50	0.50
Calculated value					
Crude protein (%)	18.57	18.51	18.52	18.80	18.41
Ether extract (%	2.83	4.01	6.47	6.62	9.03
Total Calcium (%)	0.87	0.66	0.66	0.58	0.42
Available phosphorus (%)	0.37	0.37	0.37	0.39	0.38

Digestible methionine (%)	0.34	0.34	0.34	0.31	0.27
Digestible lysine (%)	1.20	1.17	1.21	1.14	1.08
Digestible tryptophan (%)	0.22	0.21	0.20	0.20	0.18
Digestible threonine (%)	0.67	0.66	0.66	0.62	0.64

ME = 3150 KCalKg-1 Premix: Supplementation (vitamin and minerals provided per kg of feed). Initial phase: Calcium (min) 160.00 g; calcium (max) 200.00 g; phosphorus (min) 45.00 g; sodium (min) 40 g; iron (min) 600.00 mg; copper (min) 2 405 mg; zinc (min) 1,000,000 mg; manganese (min) 1 400.00 mg; iodine (min) 20.00 mg; selenium (min) 7.00 mg; cobalt (min) 4.00 mg; vitamin A (min) 260 000.00 Ul; vitamin D3 (min) 65,000.00 IU; vitamin E (min) 455.00 IU; vitamin K3 (min) 52.00 mg; folic acid (min) 13.00 mg; biotin (min) 1.50 mg; choline (min) 10.00 g; niacin (min) 650.00 mg; pantothenic acid (min) 390.00 mg; vitamin B1 (min) 39.00 mg; vitamin B2 (min) 195.00 mg; vitamin B6 (min) 52.00 mg; vitamin B12 (min) 390.00 mcg; lysine (min) 26.00 g; methionine (min) 9 800.00 mg; chlorohydroxyquinoline (min) 600.00 mg; narasin + nicarbazine 1,000,000 mg / 1,000,000 mg; 10.001.00 ftu. Growth Phase: Calcium (min) 160.00 g; calcium (max) 175.00 g; phosphorus (min) 35.00 g; sodium (min) 35.00 g; iron (min) 600.00 mg; copper (min) 2 672.00 mg; zinc (min) 1,000,000 mg; manganese (min) 1 400.00 mg; iodine (min) 20.00mg; selenium (min) 7.00 mg; cobalt (min) 4.00 mg; vitamin A (min) 250 000.00 Ul; vitamin D3 (min) 62 500.00 IU; vitamin E (min) 437.00 IU; vitamin K3 (min) 50.00 mg; folic acid (min) 12.00 mg; biotin (min) 1.50 mg; choline (min) 6,000.00 mg; niacin (min) 625.00 mg; pantothenic acid (min) 375.00 mg; vitamin B1 (min) 37.00 mg; vitamin B2 (min) 187.00 mg; vitamin B6 (min) 50.00 mg; vitamin B12 (min) 375.00 mcg; lysine (min) 21.00 g; methionine (min) 8,000.00 mg; chlorohydroxyquinoline 600.00 mg; salinomycin 1 320.00 mg; phytase (min) 10 001.00 ftu.

A pendular water tank and a pendular feeder were placed in all the boxes. The animals were weighed at the beginning and at the end of each phase and the leftovers of the diets were collected at the end of each phase, to obtain the data for the calculation of feed conversion (FC) = (Feed consumption / Weight gain), daily weight gain (GWG) g = (Final weight / number of days of experimentation)and daily feed consumption (DFC) = (total feed consumption / number of days of experimentation), calculations were performed using excel software spreadsheets. The average temperature of the experimental environment during the research was 34.13˚C ± 1.97 and the relative humidity of the air 40.32˚C ± 2.3.

The data were analyzed for normality by the Shapiro-Wilk's test; to homoscedasticity by the Hartley's test; and the independence of was by graphic analysis. Subsequently, they were submitted to analysis of variance through the F-test ($p \leq 0.05$). Statistically significant, the levels of licuri bagasse inclusion were evaluated by polynomial regression models ($p \leq 0.05$). The selection of the model was based on the low residue, low p-value, and high R^2 and R^2 adj (Version 5.6 Build 89).

RESULTS

There was a quadratic influence ($P<0.05$) on the zootechnical performance of broilers fed with different levels of inclusion of licuri bagasse in the initial phase. It was observed that the treatment with 12% of bagasse inclusion presented satisfactory results for feed conversion and weight gain (table 4).

Table 4. Average values of zootechnical performance of broilers fed different levels of licuri bagasse inclusion in the initial phase (1-21 days).

Tabela 4. Valores médios de desempenho zootécnico de frangos de corte alimentados com diferentes níveis de inclusão de bagaço de licuri na fase inicial (1-21 dias).

Variables	Levels of licuri bagasse inclusion (%)					R^2	Regression	CV (%)
	0	4	8	12	16			
FC ($g.g^{-1}$)	1.96	1.84	1.71	1.55	2.05	0.67	$y = 0.0054x^2 - 0.0893x + 2.0235$	8.76
WG (g)	388.29	420.03	421.05	534.45	439.53	0.49	$y = 0.0301x^2 + 0.7391x + 17.974$	8.29
FI (g)	762.30	775.53	722.61	828.66	897.96	0.85	$y = 0.0577x^2 – 0.5363x + 36.733$	7.28

FC= Feed conversion; WG = Weight gain; FI = Feed intake

There were no significant differences (P>0.05) in daily feed intake (P=0.14; F=1.85) and feed conversion rates (P=0.20; F=1.61) (table 5) at the growth phase.

Table 5. Average values of zootechnical performance of broilers fed different levels of licuri bagasse inclusion in the growth phase (22-35 days).

Tabela 5. Valores médios de desempenho zootécnico de frangos de corte alimentados com diferentes níveis de inclusão de bagaço de licuri na fase de crescimento (22-35 dias).

Variables	Levels of licuri bagasse inclusion					Regression	CV (%)
	0%	4%	8%	12%	16%		
FC ($g.g^{-1}$)	1.46	1.60	1.33	1.33	1.37	-	15.44
WG (g)	814.80	640.64	794.64	874.58	717.08	$y = -0.0287x^2 + 0.4393x + 54.829$	8.95
FI (g)	1652.00	1627.50	1487.50	1627.50	1373.26	-	13.16

FC= Feed conversion; WG = Weight gain; FI = Feed intake

There was a significant difference (P<0.05) in the weight gain variable among thetreatments levels. The most important values were observed in the inclusion of 12% of the licuri bagasse in the diet.

No significant differences (P=0.14; F=1.85) were observed in the daily feed intake of birds in the finishing phase using different levels of inclusion of licuri bagasse in their feed. There was a significant difference between the treatments used for the variables, feed conversion and weight gain. The most expressive values were found for the treatment with 12% inclusion of bagasse in the diet. The performance results of broilers fed with different levels of inclusion of licuri bagasse in the diet are shown in Table 6.

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Table 6. Average values of zootechnical performance of broilers fed different levels of licuri bagasse inclusion in the finishing phase (36-42 days).

Tabela 6. Valores médios de desempenho zootécnico de frangos de corte alimentados com diferentes níveis de inclusão de bagaço de licuri na fase de terminação (36-42 dias).

Variables	Levels of licuri bagasse inclusion					Regression	CV (%)
	0%	4%	8%	12%	16%		
FC ($g.g^{-1}$)	1.87	1.52	1.51	1.31	1.47	$y = 0.60037x^2 - 0.0845x + 1.8566$	20.90
WG (g)	366.66	461.65	469.00	661.64	503.58	$y = -0.2046x^2 + 4.9658x + 50.2730$	28.43
FI (g)	473.69	481.32	489.93	600.25	494.55	-	25.35

FC= Feed conversion; WG = Weight gain; FI = Feed intake

DISCUSSION

The results indicated in Table 4 show that the inclusion of licuri bagasse in broiler rations up to 21 days of age is an excellent alternative and may reduce costs related to feeding this type of breed, obtaining good feed conversion (1.55) specially at the 12% level of bagasse. The values presented a satisfactory weight gain (534.45g / bird) at the 12% of licuri bagasse inclusion level. NRC (1994) emphasizes that food of oleaginous origin improves the palatability of the ration and can improve feed conversion.

Broiler chickens fed diets containing babassu bagasse showed values close to the values found in the present study for daily weight gain and feed conversion, at the levels of 9 and 12% of the babassu bagasse, probably due to the composition close to the licuri bagasse composition (CARNEIRO et al., 2009). We can see in Table 4, the performance for weight gain (472.71 g / bird) defined by the equation y = -0.0301x2 + 0.7391x + 17.974 demonstrating superiority in this variable for the bagasse inclusion level of 12.27% in the feed. However, as the percentage of bagasse increases from this level, there is a decrease in the broilers' weight gain. The caprylic acid present in the licuri acts on glucose and lipid metabolism, therefore high dosages can lead to weight loss.

These results differ from those found by Silva et al. (2015), by replacing soybean meal with babassu bagasse in rations for broilers from 22 to 42 days of age.

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They did not observe differences between treatments levels. When coconut was used to replace corn and soybeans at 10 and 20%, found different results for feed conversion, which was around 2.00 (JÁCOME et al, 2000). Confronting these results with the results of this research, it can be inferred that there was better use of licuri bagasse in relation to feed conversion.

Possibly these results occurred due to the absence of essential amino acids in the coconut bagasse, which is not the case with the licuri bagasse used in this research (Thomas and Scott., 1962).In broilers that had their corn partially replaced by cassava bagasse, values close to 2.00 were observed for feed conversion and approximate values of the present research for weight gain, being considered good results for the species, corroborating with statements made on the quality of licuri bagasse for feeding these animals (NASCIMENTO et al., 2005).The variables, weight gain, feed conversion and feed intake did not show significant differences in broilers during the growth phase, when fed with increasing levels of babassu bagasse in the diet, similar results to those found in this research, which allows to infer that at this stage the use of alternative sources of food from oilseeds does not interfere with the zootechnical performance of the animals, as long as they are used in the correct dosages (SILVA et al., 2015).

The highestvalue for the daily gain of weight in the growth phase is for the levels 8 and 12% of inclusion of licuri bagasse in the diet, the best level (7.65%) of licuri bagasse inclusion by the is determined by the regression equation $y = -0.0287x^2 + 0.4393x + 54.829$, which corresponds to 56.51g/bird of weight gain.

Similar results were observed by Ferreira et al. (2015), using whole manioc rootworms for pullets from one to 42. They observed significant differences between treatments levels for the feed conversion variable. The inclusion of annatto seed residue (*Bixa orellana* L.) in proportions of 2.5; 5.0; 7.5; 10.0; 12.5 and 15%, increased feed consumption, weight gain, however and feed conversion in broilers (Silva et al., 2005). This fact did not occur in the present study (table 6) demonstrating a better use of licuri bagasse in relation to feed conversion and weight gain for chickens.

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The positive results observed in the variables weight gain and feed consumption may be related to the benefits of unsaturated fatty acids present in licuri (VIEIRA et al., 2020). These acids play an important role in intestinal health, in strengthening the immune system and consequently maximizing the animals' weight gain. Significant differences were not observed in the daily feed intake in broilers from 22 to 42 days old, fed with cashew nuts (FREITAS et al., 2006). Results like those found in this study (table 6). However, statistical differences were found for the variables weight gain and feed conversion, these results corroborate with the results found in the present study. Like licuri bagasse, cashew nuts have health-friendly fatty acids (46% total lipids, 60% oleic acid and 21% linoleic acid) that are able to improve broiler performance (LIMA & GONÇALVES, 1998).

CONCLUSION

Licuri bagasse can be used in the diet of broilers in up to 16% substitution for corn and soybeans, without prejudice to the animals' performance.

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