



Cottonseed cake in substitution of soybean meal in diets for finishing lambs



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ABSTRACT

The objective of this study was to evaluate nutrient intake, diet digestibility, performance and carcass characteristics of Santa Inês crossbred lambs fed diets cottonseed cake in substitution of soybean meal. Forty Santa Inês × Dorper crossbred noncastrated rams with average initial weight of 20.9 ± 2.5 kg were distributed in a completely randomized design with four treatments and ten replicates. The diets were composed of Tifton 85 (*Cyndon dactylon* cv. Tifton-85) hay as roughage and cottonseed cake replacing 0, 33, 66 and 100% of soybean meal, in a roughage-to-concentrate ratio of 50:50. At the end of the experiment, the lambs were slaughtered and their carcasses were evaluated. Except for crude protein and ether extract, overall, the digestibility coefficients of the nutrients decreased linearly ($P < 0.05$) as the levels of cottonseed cake in the diets were elevated. The cottonseed cake levels in substitution of soybean meal also did not affect final body weight, daily weight gain and total weight gain of the lambs ($P > 0.05$). The qualitative and quantitative carcass characteristics did not differ ($P > 0.05$) among the levels of cottonseed cake in substitution of soybean meal. Although the hot and cold carcass yields decreased ($P < 0.05$) as the cottonseed cake increased its participation in the diet, these variables remained within the levels considered satisfactory. Cottonseed cake can replace up to 100% of soybean meal in the concentrate, which corresponds to 12% of the total diet for lambs, representing an important food alternative to substitute soybean meal.

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1. Introduction

Studies have proven that some byproducts from biodiesel production may contain satisfactory protein and energy levels, which meet the requirements of animals and which can replace commonly utilized ingredients, such as soybean meal (Abdalla et al., 2008; Ward et al., 2008; Nicory et al., 2015; Silva et al., 2015).

Cottonseed meal is a by-product already used in ruminant feeding. According to NRC (2001), soybean meal can be replaced by cottonseed meal in ruminant diets without major performance

losses, provided that the nutritional requirements are maintained. The great novelty of the present work is the use of cottonseed cake in total substitution of soybean meal, since the cake still little studied in concentrates for ruminants.

The cottonseed cake is a by-product from the biodiesel industry obtained through the extraction of the oil contained in the cottonseed, by pressing. One of the most remarkable characteristics of cakes obtained from biodiesel production is their chemical heterogeneity, which may vary according to the species and/or cultivar, the extraction methods used (chemical or mechanical), and the efficiency of processing (Oliveira et al., 2012).

The cottonseed cake has a high nutritional value, particularly in terms of protein (20–46%) (Ramachandran et al., 2006; Abdalla et al., 2008; Kanyinji and Sichangwa, 2014), ether extract (5.4–14.1)

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Table 1
Chemical composition of ingredients in experimental diets (%DM).

Nutritional component	Tifton-85 hay	Ground corn	Soybean meal	Cottonseed cake
Dry matter ^a	91.2	88.7	90.2	92.6
Organic matter	84.4	87.2	82.9	87.7
Crude protein	5.0	6.4	39.0	24.0
Ether extract	1.4	4.5	1.9	7.6
Neutral detergent fiber (NDF) ^b	72.2	12.0	15.6	44.3
Indigestible NDF	15.1	14.3	1.0	15.0
Acid detergent fiber	40.2	4.8	11.1	33.3
Cellulose	34.7	3.7	10.9	22.7
Hemicellulose	31.9	7.8	4.4	11.0
Lignin	5.5	0.5	0.3	10.6
Non-fibrous carbohydrates	14.7	75.6	36.2	19.2
Total digestible nutrients	56.2	87.2	78.7	65.0

^a %Of fresh matter.^b Corrected for ash and protein.

(Jabbar et al., 2006), and neutral detergent fiber (13.3–32.5) (Pousga et al., 2007) contents.

Our hypothesis is that cottonseed cake can replace up to 100% soybean meal in diets for lambs in feedlot. Thus, the aim of this study was to evaluate the nutritional and growth performance and carcass characteristics of feedlot lambs fed diets containing cottonseed cake replacing soybean meal.

2. Material and methods

The experiment was conducted on the Experimental Farm of São Gonçalo dos Campos, at the Federal University of Bahia (12°23'49.5"S, 38°52'43.5"W), from July to September 2011. The experimental site is characterized by average annual temperature of 26 °C, 85% relative humidity, and annual precipitation of approximately 1200 mm.

Forty Santa Inês × Dorper crossbred, noncastrated males with initial body weight of 20.9 ± 2.5 kg (mean ± SD) were distributed in a completely randomized design with ten replicates per treatment, and housed in individual pens with slatted floor provided with feeding and drinking troughs.

The diets, formulated based on the NRC (2007) for 4-month-old, late-maturing lambs at 0.3% of maturity weight, for an average

daily gain of 200 g and supplied as a complete mix, were composed of corn, soybean meal, mineral supplement, urea; and cottonseed cake (Table 1) substituting 0, 33, 66 and 100% of the soybean meal, corresponding to 0, 40, 80 and 120 g of cottonseed cake per kg of diet, respectively (Table 2). The roughage used was hay of Tifton 85 (*Cynodon* sp) grass, at a roughage-to-concentrate ratio of 50:50. Diets were iso-nitrogenous (14% crude protein on a dry matter basis) to meet the nutritional requirements of growing lambs. The experimental assay lasted 99 days, and was preceded by a 15-day adaptation period, during which vaccination, deworming, management, and diet adaptation procedures were performed. The animals were weighed after the 15 days of adaptation, and at the end of every 28-day period. Feed conversion was calculated as the ratio between intake and average daily gain (ADG) during the experiment. Lambs were fed twice daily, at 7:00 and 16:00 h. Feed and orts were weighted every day. The amount of feed was adjusted daily to allow between 10 and 20% as orts to ensure ad libitum intake conditions.

The individual intake of the lambs was assessed throughout the 84 days of experiment. Samples of the ingredients, diets provided, and orts were collected for analysis of dry matter (DM; Method 967.03—Association of Official Analytical Chemists (AOAC, 1990), organic matter (OM; Method 942.05—AOAC, 1990), crude protein

Table 2
Proportions and chemical composition of experimental diets.

Ingredient	Level of cottonseed cake in substitution of soybean meal (% of dietary DM)			
	0	33	66	100
Cottonseed cake	0.0	4.0	8.0	12.0
Minerals	1.5	1.5	1.5	1.5
Soybean meal	12.0	8.0	4.0	0.0
Ground corn	34.9	34.7	34.5	34.3
Urea	1.6	1.8	2.0	2.2
Tifton-85 hay	50.0	50.0	50.0	50.0
Item (% of dietary DM)	Chemical composition of experimental diets			
Dry matter ^a	87.4	87.3	87.2	87.1
Organic matter	82.6	82.6	82.6	82.6
Crude protein	13.7	13.7	13.6	13.6
Ether extract	2.5	2.7	2.9	3.1
Neutral detergent fiber (NDF) ^b	42.1	43.3	44.4	45.5
Indigestible NDF	22.9	23.8	24.7	25.5
Acid detergent fiber	9.8	10.4	11.1	11.7
Cellulose	19.9	20.4	20.9	21.3
Hemicellulose	19.2	19.5	19.7	20.0
Lignin	3.0	3.4	3.7	4.2
Non-fibrous carbohydrates	39.7	38.9	38.1	37.2
Total digestible nutrients	69.2	69.4	63.5	65.0
Gossypol content ^c	–	340	680	1020

^a g/kg Of fresh matter.^b Corrected for ash and protein.^c Parts per million (ppm).

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