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Nutritional and productive performance of goats kids fed diets with detoxified castor meal

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ABSTRACT

This study aimed to evaluate the inclusion of detoxified castor meal in the diet of growing goats by the nutritional and productive performance. The study included 36 crossbred Boer goats kids (Boer × Anglo Nubian), with average initial weight of 20 kg ± 3.2 kg, in a completely randomized design with four treatments (diets with inclusion levels of detoxified castor meal of 0, 100, 200 and 300 g per kg dry matter) and nine repetitions. The castor meal was detoxified using calcium oxide in the proportion of 40 g of CaO for each kg of castor meal. Intake, digestibility, performance and metabolic characteristics were evaluated. At the end of the experiment, the animals were slaughtered and eviscerated, and after removal of the head, leather and feet, the carcass weights were measured to obtain the hot carcass weight. From the left half of the carcass, five anatomical regions and sections were individually weighed. The inclusion of detoxified castor meal linearly decreased ($P < 0.05$) the intakes and digestibility of dry matter, crude protein, and metabolizable energy. There was also a linear reduction ($P < 0.05$) of ingested and retained nitrogen, however, the excretion of nitrogen was not affected ($P > 0.05$) by the inclusion of detoxified castor meal. The serum urea levels decreased linearly, and the microbial efficiency increased ($P < 0.05$). The inclusion of detoxified castor meal reduced the performance of the goats, the cold carcass weight and the yields of commercial cuts ($P < 0.05$). Thus, the inclusion of detoxified castor meal in the diets of growing beef goats causes a reduction in digestibility, intake and in the production performance of the animals.

1. Introduction

Castor bean is an oilseed from the Euphorbia family that adapts to areas with rainfall between 750 and 1500 mm (Souza et al., 2013). The main product arising out of this culture is castor oil, which is used mainly by the ricin industry for the

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production of many products, including lubricants, medicines and plastic. In the oil extraction process, castor bean meal is produced. This is a by-product used as organic fertilizer, but it has nutritional characteristics to be used as a protein source for animal feed and can replace the use of soybean meal, reducing costs and enabling improvement of the productive efficiency of the herd.

According to Carrera et al. (2012), castor bean meal has in its chemical composition 350–480 g crude protein (CP) per kg of dry matter. However, the presence of toxic substances such as ricin, ricinine and allergenic compounds (CB-1A) preclude its use in animal feed when the detoxification process of the castor bean meal is not performed. In addition, the high fiber content (320–490 g/kg DM) and lignin (46–180 g/kg DM) in its composition (Gomes et al., 2011; Carrera et al., 2012; Cobianchi et al., 2012; Furtado et al., 2012; Gionbelli et al., 2014) may limit its consumption due to physical limitations related to these components.

There are various methods of detoxification, and the efficiencies of these were tested by Anandan et al. (2005). The use of CaO enables detoxification of castor bran in the field and without the need for special equipment and structures. This technique can enable the use of castor seed meal as an alternative to reduce feed costs.

While there is the possibility of using castor seed meal in ruminant feed, few works define its nutritional potential as a function of its detoxification and its chemical composition. In goats, these works are non-existent in the literature. Therefore, there is a need for studies covering the variables related to food and feed production performance.

The aim of this study was to evaluate the effect of inclusion of detoxified castor bean meal in the diet of growing goats kids by determining the nutritional and productive performance.

2. Material and methods

All animal procedures were conducted according to the regulations of the Ethics Committee on the Use of Animals of the School of Veterinary Medicine and Animal Science at the Federal University of Bahia, protocol 08/2013.

2.1. Experimental area and trial period

The experiment was conducted at the Experimental Farm of the Federal University of Bahia, located in São Gonçalo dos Campos, from April to July 2013.

2.2. Animals, experimental design and diets

The experiment used 36 crossbred Boer goats kids (Boer × Anglo Nubian), castrated, with initial weight of 20 kg ± 3.2 kg and approximately 4 months old. These were distributed in a completely randomized design, with four treatments and nine repetitions.

Four levels of detoxified castor bean meal (0, 100, 200 and 300 g/kg dry matter) were used in place of concentrated soybean meal (Table 1), which corresponds to substitution of 0, 33, 66 and 100% of the total diet, respectively.

The forage:concentrate ratio of diets was 50:50 and animals were fed with total mixed ration at 09:00 am and 4:00 pm The leftovers were weighed daily and the amount of feed supplied was adjusted to allow for leftovers of up to 10% of the amount supplied. Water was supplied ad libitum.

The animals were housed in individual pens measuring approximately 1.0 m^2, housed in covered sheds and equipped with feeders and water throughout the trial period, which consisted of 92 days, 17 days of adaptation of the animals to the facilities and diets and 75 days of data collection. All the animals were identified, treated with anthelmintics and vaccinated before the start of the experiment.

The diets were formulated to be isonitrogenous and meet the nutritional requirements of growing goats, with an average daily gain of 200 g, according to the NRC (2007). We used Tifton 85 hay, ground into particles of approximately 4 cm, as a source of roughage. The concentrate was formulated with specific mineral supplements for goats, ground corn, soybean meal and detoxified castor bean meal at different levels.

2.3. Detoxification and measurement of ricin

The castor bean meal was detoxified with a calcium oxide (CaO) solution (40 g of CaO diluted in 700 ml of water for each kg of castor bean meal) as described by Anandan et al. (2005). After treatment, the material was covered overnight (12 h), and the next day, it was spread and dried in the sun and upturned every two hours for 48 h.

The protein present in the detoxified castor bean meal with CaO were extracted by the boiling method, using distilled water in the ratio of 1 g of meal/10 ml of water, followed by a boiling bath for 5 min. The extract was centrifuged for 5 min at 4100*g*, and the pellet was discarded.

The ricin was qualitatively assessed by separation of fractions A (36 kDa) and B (29 kDa) polyacrylamide gel at 12% under denaturing conditions (SDS-PAGE) (Laemmli, 1970). For processing, the gel was placed in solution with 0.1% Coomassie blue. The protein bands on the gel were visualized by staining with a 40% methanol solution containing 10% acetic acid. The molecular weights of the bands stained with ricin extracts were determined using known molecular weight markers (Sigma,

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