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Does sugar cane ensiled with calcium oxide affect intake, digestibility, performance, and microbial efficiency in beef cattle?

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ABSTRACT

Two trials were conducted to evaluate how calcium oxide (CaO) as an additive in sugar cane silage affects animal performance and diet digestibility. Experiment 1 included 35 crossbred steers (Holstein × Nellore) with an average body weight (BW) of 350 ± 18.3 kg, which were distributed across a randomized block design with five treatments and seven replicates. The five treatments consisted of sugar cane ensiled with four different levels of CaO (0, 5, 10, and 15 g/kg; fresh basis) and a standard diet of corn silage. The forage concentrate ratio was 50:50 and was formulated to be isonitrogenous (120 g/kg DM). The dry matter intake (DMI) was measured daily and individually. Indigestible acid detergent fiber (iADF) was used as an internal marker to estimate apparent nutrient digestibility. There was a quadratic positive effect (P=0.013) of the CaO levels on DMI (g DM/kg BW), organic matter (OM; P=0.032), and non-fiber carbohydrates (NFC; P=0.014) intake. The average daily gain (ADG) of steers that were fed corn silage diets was similar (P=0.11) to that of those fed sugar cane silage with 5 g/kg of CaO. There was a positive linear effect of the percentage of CaO on the apparent total digestibility of DM (P=0.012), OM (P=0.001), crude protein (CP; P=0.022) and neutral detergent fiber (aNDF; P=0.015) of the diets. In Experiment 2, four ruminally and abomasally cannulated Nellore steers (184 ± 10.2 kg BW) were used with a 4 × 4 Latin square design to evaluate the effect of CaO levels on apparent total and ruminal digestibility of nutrients, ruminal characteristics, and microbial efficiency. The four treatments were composed of the same sugar cane silage diets used in Experiment 1. The aNDF intake decreased linearly (P=0.032) as the percentage of CaO increased. There was a linear positive effect of the percentage of CaO on the apparent total digestibility of DM (P=0.036), OM (P=0.007), CP (P=0.042), and aNDF (P=0.025). There were no effects of CaO levels on the ruminal pH values (P=0.52), ammonia concentration (P=0.22), or microbial

Abbreviations: CaO, calcium oxide; DM, dry matter; OM, organic matter; CP, crude protein; NFC, non-fiber carbohydrates; ADF, acid detergent fiber expressed inclusive of residual ash; aNDF, neutral detergent fiber assayed with a heat stable amylase and expressed inclusive of residual ash; TDN, total digestible nutrients; BW, body weight; ADG, average daily gain; GE, gain efficiency; DP, dressing percentage; ALLA, urinary excretion of allantoin; UA, uric acid; Pabs, Purine absorbed; PD, Purine derivatives.

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efficiency (P=0.283). Adding CaO to sugar cane silage reduces the silage fiber. However, the addition of more than 5 g/kg CaO to sugar cane at ensiling does not improve silage intake and animal performance. Additionally, the use of 15 g/kg of CaO in sugar cane at ensiling decreases diet intake and growth of beef cattle.

1. Introduction

Freshly chopped sugar cane (*Saccharum spp.)* has been a traditional and important source of roughage for ruminants in Brazil. In addition, sugar cane has also been ensiled in recent years and has been used increasingly in diets fed to beef cattle (Santos et al., 2008; Amaral et al., 2009). However, sugar cane has a high population of epiphytic yeasts, which actively ferments sucrose to ethanol resulting in a high loss of dry matter (DM). This loss of highly digestible carbohydrate (sucrose) causes an accumulation of cell wall constituents and thus lowers the relative digestibility of total DM in the final ensiled product (Santos et al., 2009; Cavali et al., 2010).

Calcium oxide (CaO) has been evaluated as a silage additive to moderate yeast fermentations in sugar cane silage because it has antifungal properties (Santos et al., 2009). Addition of CaO can also improve the digestibility of sugar cane silage by hydrolysis of cell wall carbohydrates, but the effects of adding high levels of CaO to the diet of beef cattle are not well known. Studies of sugar cane silage with CaO (levels of 15 and 20 g/kg) in mini silos have demonstrated a marked reduction in the ethanol production with increasing the dry matter recovery (Santos et al., 2008; Cavali et al., 2010). However, high levels of alkaline additives may affect the smell, palatability and osmolality in the rumen and have a corresponding negative impact on intake and animal performance.

Effects of adding CaO to sugar cane silage on intake and digestibility of beef cattle have been inconsistent (Menezes et al., 2011a,b; Mariz et al., 2013). However, most of these studies evaluated levels of CaO up to 10 g/kg (fresh matter) at ensiling, and most studies have evaluated the silage only in cannulated animals that usually have lower DM intakes than intact feedlot animals. These data suggest that more evaluations are needed under practical conditions with feedlot cattle to verify if adding CaO to the sugar cane silage can significantly improve the animal performance.

The objectives of this study were to evaluate the effects of adding various amounts of CaO to sugar cane at ensiling to intact feedlot cattle under practical feeding conditions. The effects were measured in terms of the intake, digestibility, microbial efficiency, and performance in beef cattle.

2. Materials and methods

All procedures involving animals were approved by the Brazilian committee for animal care and experimentation.

2.1. Location and diets

The experiments were conducted at the Federal University of Viçosa, Brazil, between June and September of 2008. Sugar cane (RB867515) was harvested at 13 months of age and chopped into 1- to 2-cm segments. RB867515 is a medium-ripening cultivar, and the recommended cutting time for this cultivar is the middle to the end of the harvest period in South-Central Brazil.

The five treatments consisted of sugar cane ensiled with four CaO levels (0, 5, 10, and 15 g/kg; as fresh basis) and a control group of a standard corn silage. The experimental silages were made in bunker silos, which were opened at 60 days of ensiling.

The forage concentrate ratio was 50:50, and diets were formulated to be isonitrogenous (120 g/kg DM). Chemical composition of the ensiled sugar cane is presented in Table 1. The concentrate ingredients consisted of ground corn, soybean meal, urea, ammonium sulfate, and a mineral mixture. The ratios of the ingredients are given in Table 2. The same four sugar cane silages used in Experiment 1 were used for Experiment 2.

2.2. Experiment 1

2.2.1. Steers and sampling protocol

A total of 35 Nellore × Holstein crossbred steers (360 ± 20 kg BW) were distributed in 7 blocks to evaluate the intake and digestibility of nutrients as well as the performance of the steers in the feedlot. Steers were grouped based on initial BW and allotted randomly to one of five treatments, each with seven replicates. The steers were treated for internal and external parasites (Ivomec Gold, Merial Brazil) at the beginning of the experiment and housed in individual pens of approximately 10 m^2 with protected feeders and water. The experiment was conducted for 99 days (15 days for diet adaptation and 3 periods of 28 days for data collection).

Steers were individually fed *ad libitum* twice daily at 07:00 and 15:00 h. The diets were fed as a total mixed ration, in which previously mixed silage and concentrate were weighed before feeding. Orts were collected and weighed once daily,