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Evaluation of 2 sugarcane molasses feeding strategies on measures of growth and reproductive performance of replacement beef heifers

Paulo G. M. A. Martins,[1] PAS, Philipe Moriel,[2] PAS, João M. B. Vendramini, PAS, and John D. Arthington, PAS
Institute of Food and Agricultural Sciences—Range Cattle Research and Education Center, University of Florida, Ona 33865

ABSTRACT

Our objectives were to compare the effects of 2 sugarcane molasses feeding strategies on growth (Exp. 1 and 2), reproductive performance (Exp. 1), and forage intake (Exp. 2) of replacement beef heifers. In Exp. 1 and 2, treatments consisted of cottonseed meal manually mixed with molasses in a slurry form (SLU), or cottonseed meal and molasses provided in separate bunks (SEP). In Exp. 1, 48 Brangus-crossbred heifers ($BW = 236 \pm 4$ kg; age $= 335 \pm 5$ d) were randomly assigned to 1 of 12 bahiagrass pastures (4 heifers per pasture; 6 pastures per treatment). Each pasture received 31.8 kg of molasses and 6.4 kg of cottonseed meal (as fed) twice weekly from d 0 to 70. In Exp. 2, Braford heifers were randomly assigned into 1 of 16 drylot pens to evaluate the daily hay DMI of heifers offered SEP or SLU supplementation twice weekly from d 0 to 21. Effects of treatment and treatment × day were not detected for BW and ADG of heifers in Exp. 1 and 2 ($P \geq 0.27$). In Exp. 1, overall pregnancy rates were similar ($P = 0.55$), but puberty achievement tended to be greater for SLU versus SEP heifers ($P = 0.10$). In Exp. 2, G:F and hay DMI did not differ between treatments ($P \geq 0.21$). Therefore, cottonseed meal and sugarcane molasses can be offered separately rather than in a slurry form without affecting growth, forage intake, and reproductive performance of grazing replacement beef heifers during breeding season.

Key words: cottonseed meal, heifer, sugarcane molasses, supplementation, puberty

INTRODUCTION

Sugarcane (*Saccharum officinarum*) molasses is a by-product of the sugarcane industry typically used as an energy source for grazing beef cattle (Pate and Kunkle, 1989; Kunkle et al., 1994). In the Gulf Coast region of United States, the use of molasses-based supplements is common, particularly during the fall and winter seasons because of the low nutritional composition of warm-season grasses (Pate, 1983; Kunkle et al., 1994). The popularity of molasses is associated with its self-limiting intake characteristics and reduced labor and feeding costs required for its implementation in beef cattle operations (Whitlow et al., 1976). Commercially available molasses-based liquid supplements usually rely on NPN to increase CP concentrations (Pate et al., 1995). However, adding cottonseed meal (**CSM**) to a sugarcane molasses–urea mixture improved growth performance of younger cows compared with an isonitrogenous, isocaloric molasses–urea supplement (Pate et al., 1990).

Currently, the mixing of dry feeds with molasses in a beef cattle operation is performed manually or through relatively expensive equipment that are not widely spread among cow-calf operations. Providing sugarcane mo-

[1] Current address: Federal University of Jequitinhonha and Mucuri Valleys, Department of Animal Sciences, Diamantina, Minas Gerais, Brazil.
[2] Corresponding author: pmoriel@ncsu.edu or philipemoriel@yahoo.com.br

Table 1. Nutrient composition of feedstuffs (Exp. 1 and 2)[1]

	Exp. 1[2]		Exp. 2[3]
Item	Bahiagrass pasture	Limpograss hay	Stargrass hay
DM, %	91.0	93.1	91.4
CP, % of DM	5.10	7.69	13.01
IVOMD,[4] % of OM	32.7	38.7	48.8

[1]Values represent an average of composited pasture and hay samples collected during Exp. 1 and 2.

[2]Hand-plucked samples of pastures were collected once monthly from d 0 to 70, whereas limpograss hay samples were collected twice during the breeding season.

[3]Samples of hay offered were collected once weekly.

[4]IVOMD = in vitro OM disappearance.

lasses and natural protein feed sources separately could further decrease labor and feed costs, but it might also lead to an asynchrony between energy and protein release in the rumen. In theory, synchronous nutrient availability should increase the efficiency of nutrient utilization, leading to greater production of microbial products, nutrient supply to the animal, and enhanced animal performance (Hall and Huntington, 2008). Hence, we hypothesized that the growth and reproductive performance of replacement beef heifers would be impaired if sugarcane molasses is offered separately from cottonseed meal rather than in a homogenous slurry form. Therefore, our objectives were to evaluate growth, puberty, and pregnancy rates of beef heifers fed cottonseed meal that was offered separately or mixed with sugarcane molasses.

MATERIALS AND METHODS

The 2 experiments described herein were conducted at the University of Florida, Institute of Food and Agricultural Sciences, Range Cattle Research and Education Center, Ona, Florida (27°23′N and 81°56′W) from October 2012 to March 2013 (Exp. 1) and November to December 2012 (Exp. 2). Heifers used in these experiments were cared for by acceptable practices as outlined in the *Guide for the Care and Use of Agricultural Animals in Research and Teaching* (FASS, 2010).

Exp. 1

Brangus-crossbred heifers (n = 48; initial BW = 236 ± 4 kg; initial age = 335 ± 5 d) were randomly assigned to 1 of 12 bahiagrass (*Paspalum notatum* Flueggé) pastures (1.2 ha per pasture; 4 heifers per pasture). In each pasture, 31.8 kg (as fed; 72% DM) of sugarcane molasses (Westway Feed Products LLC, Clewiston, FL; 5.8% CP and 74.3% TDN of DM) and 6.4 kg (as fed; 92% DM) of cottonseed meal (46.1% CP and 75.0% TDN of DM) were delivered twice weekly (Tuesdays and Fridays) at 0800 h for 70 d (d 0 to 70). Supplements were formulated to meet the requirements of developing beef heifers according to the NRC (2000). Treatments were randomly assigned to pastures (6 pastures per treatment) and consisted of (1) cottonseed meal manually mixed with sugarcane molasses in a slurry form (**SLU**) and (2) cottonseed meal provided separately in a concrete bunk and molasses provided in a plastic tank (**SEP**). Cows had free-choice access to a salt-based trace mineral mix (Cattle Select Essential Range, Lakeland Animal Nutrition, Lakeland, FL; 14% Ca, 9% P, 24% NaCl, 0.20% K, 0.30%, Mg, 0.20% S, 0.005% Co, 0.15% Cu, 0.02% I, 0.05% Mn, 0.004% Se, 0.30% Zn, 0.08% F, and 82 IU/g of vitamin A) and water during the experiment. Nutritional compositions of pasture and hay are shown in Table 1.

Individual heifer BW was obtained on d 0, 35, and 70, after 16 h of feed and water withdrawal. Blood samples were collected via jugular venipuncture into sodium-heparin–containing tubes (Vacutainer, Becton Dickinson, Franklin Lakes, NJ) twice monthly on d 0, 8, 35, 43, 62, and 70. Blood samples were immediately placed on ice after collection and then centrifuged at 1,200 × g for 25 min at 4°C. Plasma was stored frozen at −20°C until laboratory analysis. Blood samples were used to determine plasma progesterone concentrations using a Coat-A-Count solid-phase ^{125}I RIA kit (DPC Diagnostic Products Inc., Los Angeles, CA). Standard plasma samples, containing high and low plasma concentrations of progesterone, were analyzed in quadruplicate in each assay to determine the intra- and interassay CV (7.0 and 8.1%, respectively). Heifers were considered pubertal if 2 consecutive blood samples had plasma progesterone concentrations ≥1.5 ng/mL (Cooke and Arthington, 2009); then puberty attainment was declared on the first day of high plasma progesterone concentration. On d 70, heifers were combined into 2 groups and exposed to bulls, which were rotated weekly for 84 d (d 71 to 155; 1:24 bull-to-heifer ratio). Heifers had free-choice access to long-stem limpograss (*Hemarthria altissima*) hay during the breeding season and complete trace mineral mix (same as described above). Pregnancy status of heifers was determined by rectal palpation 45 d after bull removal and confirmed at calving.

Hand-plucked samples of pastures were collected once monthly from d 0 to 70, whereas limpograss hay samples were collected twice during the breeding season for nutritional composition analyses. All forage samples were dried at 60°C in a forced-air oven for 72 h and ground in a Wiley mill (Model 4, Thomas-Wiley Laboratory Mill, Thomas Scientific, Swedesboro, NJ) to pass a 2-mm stainless steel