Effects of Supplement Type on Performance, Reproductive, and Physiological Responses of Brahman-Crossbred Heifers

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OFFERING A CITRUS PULP-BASED SUPPLEMENT TO HEIFERS IMPROVED ENERGY STATUS AND CONSEQUENT BODY WEIGHT GAIN WITHOUT IMPACTING REPRODUCTIVE PERFORMANCE COMPARED TO SUPPLEMENTS BASED ON LIQUID MOLASSES.

SUMMARY
The objective of the current study was to evaluate the effects of supplement type on performance, reproductive, and physiological responses of grazing yearling beef heifers. Sixty Brahman x British crossbred heifers were stratified by initial body weight (BW) and age, and randomly allocated to 12 pens (five heifers/pen). Pens were randomly assigned to one of two treatments: 1) molasses-based supplement offered three times/wk or 2) citrus pulp-based supplement offered three times/wk.

Heifers offered a citrus pulp-based supplement had greater BW gain and blood concentrations of glucose, insulin, and insulin-like growth factor I (IGF-I) compared to heifers offered a molasses-based supplement. Reproductive performance and concentrations of blood progesterone did not differ between treatments. Heifers offered molasses-based supplements had greater blood urea nitrogen concentrations. In this study, supplementing grazing yearling heifers with citrus pulp-based supplements increased BW gain without impacting reproductive performance compared to a molasses-based supplement.

INTRODUCTION
Energy supplementation is essential for most grazing cow-calf operations in Florida since the perennial grasses grown in the state usually lack in energy content (Moore et al., 1991), and energy is the primary nutritional consideration for optimum reproductive performance of beef females (Schillo et al., 1992). Molasses and citrus pulp are options for supplementation. Although both feedstuffs are by-products with similar energy content, they differ in physical form and carbohydrate profile, which may impact supplement intake behavior (Arthington et al., 2004), forage intake, diet digestibility, energy utilization, and consequent animal performance. Molasses is classified as a liquid supplement, but contains around 75% of dry matter content (NRC, 2001) and has sucrose as the main constituent of its carbohydrate profile (Pate, 1983). Citrus pulp is classified as a dry supplement, containing around 85% of dry matter content (NRC, 2001) and pectin is its major carbohydrate (Arthington et al., 2002). The objective of the experiments was to investigate the effects of supplement type on performance and reproductive efficiency of Brahman-crossbred heifers.

MATERIALS AND METHODS
Sixty Brahman x British crossbred heifers were utilized in this experiment. For the sampling phase (d 0 to d 45), heifers were stratified by initial BW and age, and randomly allocated to 12 pens (five heifers/pen). Pens were randomly assigned to one of two treatments: 1) molasses-based supplement (ML), or 2) citrus pulp-based supplement (CT). Each pen consisted of 3.2 ac of bahiagrass (Paspalum notatum). For the breeding phase (d 46 to d 107), heifers were reallocated by treatment into two bahiagrass pastures and exposed to Angus bulls for 60 d. A complete mineral mix and water were offered ad libitum throughout the experiment. Stargrass (Cynodon nlemfuensis) hay was offered when pasture availability was limited. Treatments consisted of two energy supplements, fed three times/wk (Monday, Wednesday, and Friday) at a rate of 6.1 and 5.9 lb/heifer daily for ML and CT, respectively. Supplements were formulated to provide 3.53 and 0.96 lb/d/heifer of total digestible nutrients and crude protein, respectively. Cottonseed meal was included as protein source in both treatments.

Shrunk BWs were obtained before the start and at the end of the experiment to estimate heifer BW gain. Blood samples were collected weekly (on Wednesdays) throughout the entire experiment to determine onset of puberty using blood progesterone (P4) concentrations. Heifers were considered pubertal if blood P4 concentration was greater than 1.5 ng/mL for two consecutive wk. During the sampling phase, in addition to the weekly collections, blood samples were obtained once a day during four consecutive days, every other week, starting at 4 h after supplements were offered for determination of glucose, blood urea nitrogen (BUN), insulin, IGF-I, growth hormone (GH), and P4 concentrations. During the breeding phase, heifers were exposed to mature Angus bulls (d 46 to d 107). Each group was exposed to two bulls at the same time and bulls were rotated weekly between groups to account for potential effect of bull. Heifer pregnancy status was verified by presence of fetus using transrectal ultrasonography 70 d after the end of the experiment.

Data were analyzed using the PROC MIXED procedure of SAS (SAS Inst., Inc., Cary, NC). The model statement contained the effects of treatment, time variables, and the consequent interactions. Heifer and pen were classified as random variables. Pen was considered the experimental unit. Means were separated using LSD, and significance was set at P<0.05.

RESULTS
Heifers fed ML required approximately a 48 h period to completely consume the supplement, whereas heifers fed CT consumed the whole amount of supplement 24 to 36 h after supplements were offered. This intake behavior was unexpected, since previous research by our group (Arthington et al., 2004) reported that heifers in similar conditions of management, consumed entire amounts of dry supplement within 2 to 3 h after feeding, whereas liquid supplement also was entirely consumed...
in approximately 48 h. Therefore, we concluded that intake behavior did not differ between treatments as expected, and the results obtained for heifer performance and reproductive efficiency in this experiment should be primarily attributed to the nutritional differences between CT and ML.

Heifers fed CT had greater (P<0.01) BW gain compared to heifers fed ML (Table 1), concurring with previous data reporting that animals fed molasses-based supplements usually have inferior BW gain compared to animals fed supplements based on other energy sources (Pate, 1983; Royes et al., 2001). However, the superiority in performance from CT-fed heifers was not reflected in reproductive efficiency. There were no treatment effects on pregnancy rate, puberty rate, and age at puberty (P=0.83, 0.81, 0.22, respectively; Table 1).

Heifers fed ML had greater mean BUN concentrations (P<0.05) compared to heifers fed CT (5.17 vs 4.17 mg/dL, respectively; SEM=0.24). Mean plasma glucose (83.3 vs 74.7 mg/dL for CT and ML, respectively; SEM=2.46), insulin (0.89 vs 0.75 ng/mL for CT and ML, respectively; SEM=0.04) and IGF-I (121.5 vs 108.9 ng/mL for CT and ML, respectively; SEM=4.10) concentrations were greater (P<0.05) for heifers fed CT compared to heifers fed ML. Both treatments had a decrease in P<sub>4</sub> concentration during feeding days (P<0.01; SEM=2.9); however, no differences were observed between treatments (89.5 and 90.3 % for CT and ML, respectively; P=0.66, SEM=4.1).

In conclusion, data from this experiment imply that offering a citrus pulp-based supplement to heifers improve energy status and consequent BW gain without impacting reproductive performance compared to supplements based on liquid molasses.

**LITERATURE CITED**


Table 1. Average daily gain (ADG) and reproductive performance of heifers offered citrus pulp- (CT) or molasses-based supplement (ML).

<table>
<thead>
<tr>
<th>Item</th>
<th>CT</th>
<th>ML</th>
<th>SEM&lt;sup&gt;a&lt;/sup&gt;</th>
<th>P =</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADG, lb/d&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.90</td>
<td>0.65</td>
<td>0.05</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Pregnancy rate, %&lt;sup&gt;c&lt;/sup&gt;</td>
<td>60.0</td>
<td>57.5</td>
<td>8.05</td>
<td>0.83</td>
</tr>
<tr>
<td>Puberty rate, %&lt;sup&gt;d,e&lt;/sup&gt;</td>
<td>80.0</td>
<td>76.6</td>
<td>9.94</td>
<td>0.81</td>
</tr>
<tr>
<td>Age at puberty (d)</td>
<td>379.4</td>
<td>368.5</td>
<td>6.02</td>
<td>0.22</td>
</tr>
</tbody>
</table>

<sup>a</sup>SEM=Standard error of the mean.

<sup>b</sup>Calculated using initial (d 6) and final (d 108) shrunk BW.

<sup>c</sup>Pregnant heifers/total heifers.

<sup>d</sup>Cycling heifers/total heifers.

<sup>e</sup>Puberty=plasma progesterone concentration greater than 1.5 ng/mL for two consecutive wk.