Effects of Supplement Type and Feeding Frequency on Performance and Physiological Responses of Yearling Brahman-Crossbred Steers

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Feeding a citrus pulp-based supplement daily improved steer performance compared to the same supplement fed three times/wk, or compared to an iso-caloric and iso-nitrogenous supplement based on liquid molasses also fed three times/wk.

SUMMARY

The objective of the current study was to evaluate the effects of supplement type and feeding frequency on performance, voluntary forage intake, and physiological responses of yearling beef steers. Twenty-four Brahman x British steers were stratified by initial body weight (BW) and randomly allocated to 12 pens (two steers/pen). Pens were randomly assigned to one of three treatments: 1) molasses-based supplement offered three times/wk (ML), 2) citrus pulp-based supplement offered three times/wk (CT), or 3) citrus pulp-based supplement offered daily (CD). Forage intake did not differ between treatments, however, CD-fed steers had a decreased oscillation in daily forage intake compared to CT and ML. Steers offered a CD had greater BW gain compared to steers offered CT and ML, however, these results were not reflected by the blood hormones and metabolites usually associated with animal performance. In this study, daily supplementation of yearling steers with citrus pulp-based supplements increased BW gain without impacting forage intake compared to the same supplement offered three times/wk, or compared to an iso-caloric and iso-nitrogenous supplement based on liquid molasses also fed three times/wk.

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). The frequency at which supplements are offered depends on the supplement type and also on the management system of the operation. Citrus pulp and molasses, which originate respectively from the citrus and sugar industry, are viable alternatives for energy supplementation in Florida. Molasses, despite its high dry matter (DM) content (approximately 75%), is classified as a liquid feed, whereas citrus pulp is commonly processed and fed as dry pellets. Differences in physical form between citrus pulp and molasses may lead to differences in intake behavior (Arthington et al. 2004). Molasses and citrus pulp also differ in their carbohydrate profile. Although both are low-starch energy feedstuffs, sucrose is the main carbohydrate of molasses (Pate, 1983), whereas pectin is the main carbohydrate of citrus pulp (Arthington et al., 2002). Pectin and sucrose are fermented differently in the rumen (NRC, 2001), which may potentially impact forage intake, diet digestibility, energy utilization, and consequent animal performance. The objective of this experiment was to investigate the effects of supplement type and feeding frequency on performance, plasma metabolites and hormones, and voluntary forage intake of yearling steers.

MATERIALS AND METHODS

Twenty-four Brahman x British crossbred yearling steers were utilized in this experiment. Steers were stratified by initial BW, and randomly allocated to 12 pens (two steers/pen). Pens were randomly assigned to one of three treatments: 1) molasses-based supplement fed 3 times/wk (ML), 2) citrus pulp-based supplement fed 3 times/wk (CT), or 3) citrus pulp-based supplement fed daily (CD). Limpograss (Hemarthria altissima) hay was coarsely ground and offered in amounts to ensure ad libitum intake throughout the study. Steers also had free access to a complete mineral mix and water. Treatments were fed at a daily rate of 5.9 lb for CT- and CD-fed steers and 6.1 lb for ML-fed steers. Supplements were formulated to provide 3.53 and 0.96 lb/d of total digestible nutrients and crude protein, respectively. Cottonseed meal was included as protein source in all treatments.

Shrunk BWs were obtained before the start and at the end of the experiment to estimate steer BW gain. During the first 3 wk of the study (d 1 to d 21), blood samples were collected immediately prior and 4, 8, 24, 32, and 48 h after the first supplement feeding of the week (d 1, 8, and 15) for determination of glucose, blood urea nitrogen (BUN), insulin, insulin-like growth factor I (IGF-I) and growth hormone (GH) concentrations. For the second part of the study (d 22 to d 40), forage dry matter intake (DMI) was recorded daily. Hay refusal was collected and weighed before hay and supplement feeding.

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. Steer and pen were classified as random variables. Pen was considered the experimental unit. Means were separated using the PDFF option, and significance was set at P<0.05.

RESULTS

The majority of beef cattle operations offer molasses slurries once to 3 times/wk; therefore we did not include a treatment with the molasses-based supplement fed daily. Supplement intake behavior was observed for all treatments. Steers fed ML consumed the whole amount of supplement by approximately 48 h after feeding. Steers fed CT consumed their offer by 24 to 36 h, whereas CD-fed steers consumed their offer within 4 h.

Mean BW gain was greater (P<0.05) for CD compared to ML, and tended to be greater (P=0.13) for CD compared to CT (0.66, 0.40, and 0.22 lb/d for CD, CT, and ML, respectively; SEM=0.11). Similar to our previous experience with heifers (Cooke et al., 2006), feeding steers with citrus pulp-
based supplements at the same frequency of molasses-based supplements numerically increased BW gain. However, differences in BW gain became significant if supplementation frequency increased. Our findings concur with previous reports indicating inferior BW gain for animals fed molasses compared to animals fed other energy sources (Pate, 1983; Royes et al., 2001). Feeding citrus pulp-based supplements daily tended to increase BW gains compared to the same supplement fed 3 times/wk. To our knowledge, no studies evaluating supplementation frequency with citrus pulp-based supplements have been reported.

Mean forage DMI did not differ (P=0.16) among treatments (1.50, 1.29, and 1.36 % BW for ML, CT, and CD, respectively; SEM=0.07; Figure 1). A day effect and also a treatment x day interaction were detected (P<0.01). Forage DMI was less (P<0.01) for CT and ML during the days that these supplements were fed (0.99 and 1.56 for CT compared to 1.41 and 1.59 % BW for ML during feeding days and non-feeding days, respectively; SEM=0.08). A day effect was not detected for CD-fed steers (P=0.35). In addition, forage DMI for steers fed CT was less (P<0.01) compared to steers fed ML during feeding days only (0.99 compared to 1.41 % BW, respectively, SEM=0.08). Feeding citrus pulp-based supplements daily instead of three times/wk did not affect overall forage DMI, but decreased the oscillation in forage intake. This effect is likely due to the regular daily supplement intake of steers fed CD.

Mean concentration of BUN tended to be greater (P=0.06) for CD compared to ML (3.55 vs 1.97 mg/dL, respectively; SEM=0.53), but did not differ (P=0.42) for CD compared to CT (2.92 mg/dL for CT) and CT compared to ML (P=0.23). Mean plasma glucose concentrations were decreased (P<0.05) for CD compared to CT and ML (66.05, 76.24, and 76.55 mg/dL, respectively; SEM=3.02) but did not differ (P=0.94) for CT compared to ML. Mean plasma insulin concentrations were greater (P<0.05) for CT compared to CD and ML (0.60, 0.46, and 0.43 ng/mL, respectively; SEM=0.04) but did not differ (P=0.63) between CD compared to ML. No differences were observed for plasma IGF-I between treatments; however, a treatment x period interaction was observed (P<0.01). Steers fed CD had the greatest increase in plasma IGF-I concentration from the beginning to the end of the experiment (Figure 2). Mean plasma GH concentrations did not differ (P=0.98) among treatments.

In conclusion, data from this experiment imply that feeding a citrus pulp-based supplement daily improved steer performance compared to the same supplement fed 3 times/wk, or compared to an iso-caloric and iso-nitrogenous supplement based on liquid molasses also fed 3 times/wk. However, these results were not reflected by the blood hormones and metabolites usually associated with animal performance. We also observed that steers fed supplements every day had a decreased oscillation in daily forage intake compared to those fed supplements 3 times/wk. Further, this oscillation was greater for steers supplemented 3 times/wk with a citrus-pulp based supplement compared to steers fed molasses-based supplement at the same frequency.

**Literature Cited**


Cooke et al. 2006. J. Anim. Sci. 84 (Suppl. 2):8 (Abstr.)


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Figure 1. Forage DMI of steers supplemented 3 times/wk with citrus pulp- (CT) or molasses-based supplement (ML), or daily with citrus pulp-based supplement (CD). Days at which supplements were offered are underlined. No significant differences (P=0.16) were observed (1.50, 1.29, and 1.36 % for ML, CT, and CD, respectively; SEM = 0.07). Day effect and treatment x day interaction were detected (P<0.01).

Figure 2. Plasma insulin-like growth factor I (IGF-I) concentrations, pooled within period, of steers supplemented three times/wk with citrus pulp- (CT) or molasses-based supplement (ML), or daily with citrus pulp-based supplement (CD). Treatment x period interaction was detected (P<0.01), and values within period with different subscripts differ (P<0.05).