Effect of residual feed intake, gender, and breed composition on blood urea nitrogen concentration in an Angus-Brahman multi-breed herd

R. O. Myer and M. A. Elzo, University of Florida

Abstract

Blood urea N can be used as an indicator of N use and excretion by an animal. The objective of this research was to assess the effect of residual feed intake (RFI) and post weaning growth rate on blood plasma concentration of urea N (PUN) in 188 bulls, heifers, and steers (mean = 296.5 kg, SD = 37.3 kg) ranging from 100% Angus to 100% Brahman. Calves were assigned to pens in a GrowSafe feeding facility by sire group and sex, and self-fed a total mixed ration (corn, cottonseed hulls, chopped grass hay, cottonseed meal, molasses, and mineral-vitamin supplement; 90% DM, 14% CP, 1.5 mcal/kg DM NEm, and 0.9 mcal/kg DM NEg). The pre-trial adjustment period lasted 21 d. Individual daily feed intake was collected during the 70 d feeding trial; BW were recorded every 2 wk. Blood (jugular) was drawn on d 0 and d 56 for PUN. Residual feed intake (RFI) was computed as the difference between actual and expected intakes. The RFI groups were high (RFI > mean + 0.5 SD), medium (RFI between ± 0.5 SD), and low (RFI < mean – 0.5 SD; SD = 2.0 kg DM/d). Data (PUN) were analyzed using a mixed model. Fixed effects were sex of calf, RFI group, and Brahman fraction of calf; daily feed intake and mean exit velocity were covariates. Random effects were sire and residual. Overall ADG was 1.25 ± 0.26 kg/d. Brahman had higher d 0 and d 56 PUN concentrations than Angus (P < 0.01). Sex affected both d 0 and d 56 PUN (P < 0.01) concentrations with bulls having the lowest and heifers the highest. Day 0 PUN concentration was negatively associated with ADG (P < 0.01). Only d 56 PUN concentration was related to RFI (P =0.02), indicating that more feed efficient animals also had lower PUN.

Key Words: Beef Cattle, Blood Urea, Feed Efficiency

Introduction

Digestibility of diet crude protein and feed efficiency has been found to be moderately positively related in growing beef cattle (Nkrumah et al., 2006). The relationship of utilization of absorbed protein and N to feed efficiency has not been investigated using the advanced feed intake technology now available such as the GrowSafe system. Analyzing blood urea N (BUN) concentration is a useful indicator of protein status within a group of animals, and can be used to predict N utilization and excretion (Kohn et al, 2005). We hypothesize that feed efficient beef cattle will also be more efficient in the utilization of absorbed protein resulting in less N loss to the environment.

Objective

Determine the effect of residual feed intake (RFI) on blood plasma concentration of urea N in growing bulls, heifers, and steers ranging from 100% Angus to 100% Brahman.

Methods

Weaned beef cattle (n = 188; 7 to 8 mo of age; mean BW = 296.5 kg, SD = 37.3 kg) were evaluated in a 70 d feed intake study. There were 11 bulls, 93 heifers and 84 steers from 6 breed groups: Angus (A; n = 25), Brahman (B; n = 28), ¾ A ¼ B (n = 36), Brangus (5/8 A 3/8 B; n = 31), ½ A ½ B (n = 43), and ¼ A ¾ B (n = 25). After weaning (August or early September), the calves grazed on bahiagrass (*Paspalum notatum*) and received a preconditioning diet for 3 to 6 wk in preparation for their feed intake trial at the Feed Efficiency Facility at UF North Florida Research and Education Center in Marianna. This facility is equipped with GrowSafe technology to measure individual feed intake in cattle housed in groups. The calves were assigned to pens of either heifers or steers, or bulls and steers by sire, body weight and breed group. After assignment, the calves were self-fed a total mixed ration (corn, cottonseed hulls, chopped grass hay, cottonseed meal, molasses, and mineral-vitamin supplement; 90% DM, 14% CP, 1.5 mcal/kg DM NEm, and 0.9 mcal/kg DM NEg). The pre-trial adjustment period lasted 21 d. Individual daily feed intake was collected during the 70 d feeding trial; BW were recorded every 2 wk. Blood (jugular) was drawn on d 0 and d 56 into heparin containing tubes; plasma was separated and analyzed for urea N (PUN; Coulombe and Favrean, 1963).

Residual feed intake (RFI) was computed as the difference between actual and expected intakes. Expected feed intake was estimated as a linear regression of average daily feed intake on ADG and metabolic mid-weight. The RFI groups were high (RFI > mean + 0.5 SD), medium (RFI between ± 0.5 SD), and low (RFI < mean - 0.5 SD; SD = 2.0 kg DM/d).

Data (PUN) were analyzed using a mixed model. Fixed effects were sex of calf, RFI group, and Brahman fraction of calf; daily feed intake was a covariate. Random effects were sire and residual.

Results

Residual feed intake (RFI) was used as the measure of feed efficiency as it is phenotypically independent of ADG and has become the preferred measure of efficiency of feed utilization (Koch et al., 1963; Archer et al., 1997). Residual feed intake is defined as the difference between actual and expected feed intake, therefore the lower the RFI, the better the feed efficiency.

Daily feed intake was used as a covariate for PUN statistical analysis as feed intake in itself can influence blood urea N concentration (Eggum, 1970).

Overall cattle performance and plasma urea concentrations are summarized in Table 1.

As expected, feed efficiency and average daily feed intake were affected by RFI grouping where as ADG was not affected (Figure 1).

Concentration of PUN measured at d 0 was not affected by RFI grouping, but was affected when measured at d 56 (Figure 2).

Sex and breed grouping affected PUN concentrations on both d 0 and d 56 (Figures 3 and 4).

Table 1. Summary of cattle performance and plasma urea concentrations during the 70 d test feeding period.

	Mean	S. D.
Avg. daily feed intake, kg	10.7	2.1
Feed efficiency, kg/kg	9.0	2.5
Average daily gain, kg	1.25	0.26
Residual feed intake	0	2.0
Plasma urea N, d0, mg/dL	7.5	2.9
Plasma urea N, d56, mg/dL	11.9	2.9

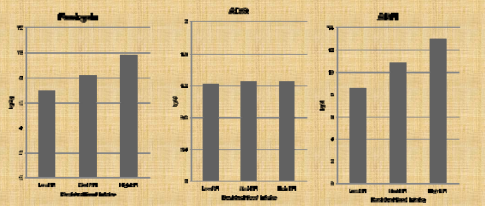

Figure 1. Residual feed intake grouping and feed efficiency, average daily gain and average daily feed intake during the 70 d test feeding period (SE = 0.2; P<0.01 for F:G and ADFI, and SE = 0.03 and P>0.10 for ADG; least square means).

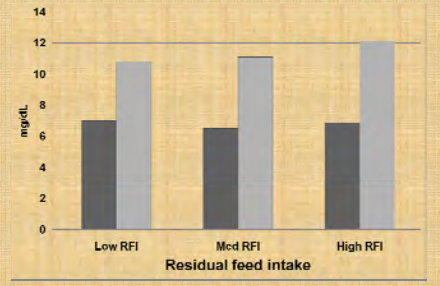

Figure 2. Residual feed intake grouping and plasma urea N concentration at start (d0; dark bars) and during (d56; gray bars) the 70 d test feeding period (SE = 0.2 and P>0.10 for d0, and SE = 0.3 and P = 0.02 for d56; least square means).

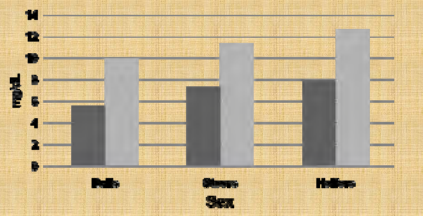

Figure 3. Sex and plasma urea N concentration at start (d0; dark bars) and during (d56; gray bars) the 70 d test feeding period (SE = 0.1 and P<0.01 for d0, and SE = 0.2 and P<0.01 for d56; least square means).

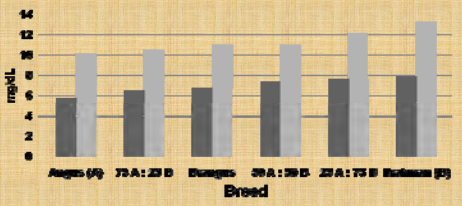

Figure 4. Breed group and plasma urea N concentration at start (d0; dark bars) and during (d56: gray bars) the 70 d test feeding period (SE= 0.6 and P<0.01 for both d0 and d56; least square means).

Conclusion

The results indicated that more feed efficient cattle also had lower blood urea N.

References

Archer et al. 1997. J. Anim. Sci. 75:2024-2032.
Coulombe and Favrean. 1963. Clin. Chem. 9:102-108.
Eggum. 1970. Br. J. Nutr. 24:983-988.
Koch et al. 1963. J. Anim. Sci. 22:486-494.
Kohn et al. 2005. J. Anim. Sci. 83:879-889.
Nkrumah et al. 2006. J. Anim. Sci. 84:145-153.