Abstract W36

Evaluation of post-weaning phenotypic residual feed intake in an Angus-Brahman multibreed herd of beef cattle

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SUMMARY

Phenotypic residual feed intake (RFI) was evaluated in a group of 200 bull, heifer, and steer calves of breed compositions ranging from 100% Angus (A) to 100% Brahman (B). Calves were born in Gainesville, FL (December 2005 to March 2006) and moved to a ***GrowSafe automated feeding facility*** in Marianna, FL, in September 2006. Calves were randomly allocated to 10 pens of 20 calves each by sire group (1 = A, 2 = ¾ A ¼ B, 3 = Brangus, 4 = ½ A ½ B, 5 = ¼ A ¾ B, and 6 = B) and sex (bull, heifer, and steer). Calves were fed concentrate (DM = 91.2%, CP = 17.3%, DIP = 11.3%, NEm = 1.7 mcal/kg, and NEg = 1.2 mcal/kg) during the 21-d adjustment and the ***70-d trial*** periods. Individual daily feed intake and weekly weights were obtained. Phenotypic RFI was computed as the difference between the actual and the expected feed intakes (function of average daily gain and metabolic mid-weight). Phenotypic RFI was analyzed using a mixed linear model. Fixed effects were pen, age of dam, sex of calf, initial age, initial weight, Brahman fraction of calf, and heterozygosity of calf. Random effects were sire and residual. ***Important effects were: sex (P < 0.002; Males had lower RFI than females), initial weight (P < 0.02), and Brahman fraction (P < 0.02; Brahman had lower RFI than Angus).*** Calves were assigned to 3 RFI groups: high (RFI > mean + 0.5 SD), low (RFI < mean - 0.5 SD), and medium (RFI between mean ± 0.5 SD; SD = 2.1 kg). ***High and medium RFI group estimates were higher (P < 0.001) for daily feed intake and feed conversion ratio, and lower (P < 0.001) for average daily gain and final weight than those of the low RFI group.***

INTRODUCTION

Considerable attention has been given to feed efficiency in beef cattle in recent years, particularly with the development of automatic feeding systems that permit real-time feed and water intake data collection. A ubiquitous way of evaluating animals for feed efficiency is residual feed intake (RFI; Koch et al., 1963). The RFI is computed as the difference between actual feed intake and expected feed intake (function of average daily gain and metabolic mid-weight). Two of the most commonly represented breeds in the Southern region of the US are Angus (A) and Brahman (B). These breed exist either as purebred or as crossbreds of various fractions. Thus, it is important to evaluate the efficiency of feed utilization in animals that span the range from 100% A to 100% B.

The objective of this research was to evaluate post-weaning phenotypic RFI and post-weaning growth in bulls, heifers, and steers in an Angus-Brahman multibreed herd of beef cattle.

MATERIALS AND METHODS

Animals and preweaning management and nutrition. Animals were from the Angus-Brahman multibreed herd of the University of Florida (UF). There were 200 calves (bulls = 11, heifers = 94, steers = 95) from 6 breed groups (1 = Angus, 2 = ¾ A ¼ B, 3 = Brangus, 4 = ½ A ½ B, 5 = ¼ A ¾ B, and 6 = Brahman). Calves were produced by a diallel mating 21 sires and 200 dams of all six breed groups. Table 1 shows numbers of calves per breed-group-of-sire x breed-group-of-dam combination. Cows were synchronized in March 2005 with a progesterone-releasing device (CIDR®, Pfizer Animal Health) for 7 d, followed by an injection of $PGF_{2\alpha}$ (5 ml of LUTALYSE®, Pfizer Animal Health), artificially inseminated twice, then assigned to a cleanup sire group for a period of 60 d. There was one cleanup sire group per breed group of sire, for a total of six breeding groups. Calves were born from December 2005 to March 2006, kept at the UF Beef Research Unit (BRU) until weaning (August 2006), and moved to the Marianna GrowSafe automated feeding facility in September 2006. Calves were pre-conditioned at the BRU for 29 d using concentrate (1.6 kg to 3.6 kg; 488 Pellet, Medicated Weaning Ration, Lakeland Animal Nutrition, Lakeland, Florida; and soy hull pellets), hay, pasture, and free choice mineral (UF University Special Hi-Cu Mineral, University of Florida, Animal Science Department, Gainesville).

Table 1. Number of calves by breed group of sire x breed group of dam combination

Breed group of dam	Breed group of sire						
	Angus 4	¾ A ¼ B 3	Brangus 4	½ A ½ B 3	¼ A ¾ B 3	Brahman 4	All 21
Angus	17	5	5	3	4	8	42
¾ A ¼ B	11	3	9	4	6	6	39
Brangus	1	1	21	0	0	1	24
½ A ½ B	7	8	11	5	11	10	52
¼ A ¾ B	2	2	2	6	3	4	19
Brahman	0	0	0	0	0	24	24
All	38	19	48	18	24	53	200

Management, nutrition, and data collection at the feed efficiency facility. The UF-IFAS Feed Efficiency Facility (FEF) at the North Florida Research and Education Center (NFREC), Marianna, FL, consists of 24 pens (108 m^2/pen) each equipped with 2 GrowSafe feed nodes. Calves were randomly allocated to 10 pens of 20 calves each by sire group (1 = A, 2 = ¾ A ¼ B, 3 = Brangus, 4 = ½ A ½ B, 5 = ¼ A ¾ B, and 6 = B) and sex (bull, heifer, and steer). Animals were fed a concentrate diet composed (as-fed basis) of whole corn (38%), soybean hulls (18%), corn gluten feed (18%), cottonseed hulls (13.6%), and a protein, vitamin, and mineral supplement (14.3%). The concentrate has a DM = 91.2%, a CP = 17.3%, a DIP = 11.3%, a NEm = 1.7 mcal/kg, and a NEg = 1.2 mcal/kg. There was a pre-trial adjustment period of 21 d, followed by a trial period of 70 d. The GrowSafe software system recorded individual feed intake in real-time. Individual animal weights were obtained weekly.

Computation of residual feed intake. ***Residual feed intake was computed as the difference between actual feed intake and expected feed intake (Koch et al., 1963; Archer et al., 1997; Arthur et al., 2001) during the 70-d post-weaning feeding trial.*** Expected feed intake was a function of average daily gain and metabolic mid-weight. Average daily gain was computed as the regression of weight on days on test. Metabolic mid-weight was equal to estimated mid-weight (estimated initial weight plus average daily gain times 35 d) to the power of 0.75.

Statistical analysis. Phenotypic RFI was analyzed using a homoscedastic mixed linear model. Fixed effects were pen (1 to 10), age of dam (1 = 3 yr, 2 = 4 yr, and 3 = 5 yr and older), sex of calf (1 = bull, 2 = heifer, and 3 = steer), initial age of calf, initial weight of calf, Brahman fraction of calf, and probability of A and B alleles at 1 locus in the calf. Random effects were sire and residual. Sire and residual effects were assumed to have mean zero and uncorrelated. Subsequently, calves were assigned to 3 RFI groups (Nkrumah et al., 2004): high (calf RFI > mean + 0.5 SD), low (calf RFI < mean - 0.5 SD), and medium (calf RFI between mean ± 0.5 SD; SD = 2.1 kg).

The RFI class effect was included in the mixed linear model for daily feed intake (DFI), feed conversion ratio (FCR), post-weaning average daily gain (ADG), and final feeding trial weight (70 d; FW) to evaluate differences among calves in these 3 groups for each trait. The mixed model for these traits contained all the effects included in the model for RFI plus RFI group, and 1) final weight for DFI and FCR), 2) average daily feed intake for ADG, and 3) total feed intake (70 d) for FW.

Mixed model analyses were carried out using SAS Proc MIXED. Least squares means for high, medium, and low RFI calves for RFI, DFI, FCR, ADG, and FW were plotted against breed group of calf using Microsoft Excel.

RESULTS AND DISCUSSION

Phenotypic RFI analysis. Important effects (Table 2) were sex (P < 0.002; Males had lower RFI (more efficient) than females), initial weight (P < 0.023; heavier calves had larger RFI (less efficient) than lighter calves), Brahman fraction (P < 0.02; Brahman had lower RFI (more efficient) than Angus), and direct heterosis (P < 0.07; crossbred calves tended to have higher RFI (less efficient) than straightbred calves).

The largest fraction of calves belonging to the low RFI group (most efficient) was that of Brahman, whereas Angus and Brangus had the largest fractions of calves in the high RFI group (least efficient).

Effect of phenotypic RFI on DFI, FCR, ADG, and FW. High and medium RFI group least squares estimates (Table 3) were higher (P < 0.0001) for daily feed intake (kg feed) and feed conversion ratio, and lower (P < 0.0001) for average daily gain and final weight than those of the low RFI group.

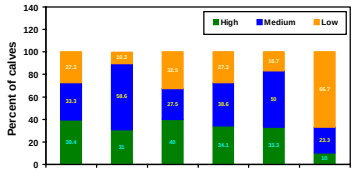
Table 2. Estimates of fixed effects for phenotypic RFI

Effect	Estimate	SE	P > |t|
Sex of calf (bull - steer)	-0.9 kg	0.4 kg	0.026
Sex of calf (heifer - steer)	0.4 kg	0.1 kg	0.005
Initial weight of calf	0.005 kg	0.002 kg	0.023
Breed of calf (Brahman – Angus)	-0.6 kg	0.3 kg	0.021
Heterosis of calf	0.6 kg	0.3 kg	0.073

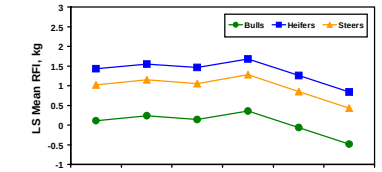
Table 3. Estimates of RFI group effect for DFI, FCR, ADG, and FW

Trait and Effect	Estimate	SE	P > |t|
DFI (High RFI – Low RFI)	2.1 kg	0.1 kg	< 0.0001
DFI (Medium RFI – Low RFI)	1.2 kg	0.1 kg	< 0.0001
FCR (High RFI – Low RFI)	1.7	0.2	< 0.0001
FCR (Medium RFI – Low RFI)	0.9	0.1	< 0.0001
ADG (High RFI – Low RFI)	-0.44 kg/d	0.05 kg/d	< 0.0001
ADG (Medium RFI – Low RFI)	-0.25 kg/d	0.04 kg/d	< 0.0001
FW (High RFI – Low RFI)	-28.5 kg	4.4 kg	< 0.0001
FW (Medium RFI – Low RFI)	-16.1 kg	3.3 kg	< 0.0001

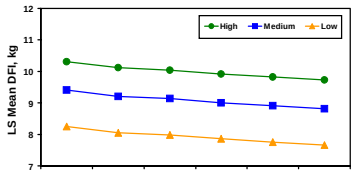
Residual Feed Intake



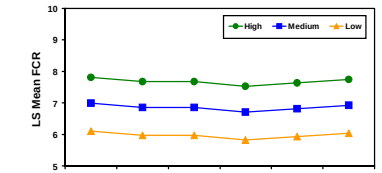
Residual Feed Intake



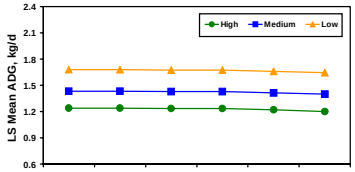
Daily Feed Intake



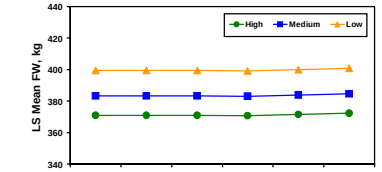
Feed Conversion Ratio



Average Daily Gain



Final Weight



FINAL REMARKS

Bulls were more efficient than steers which in turn were more efficient than heifers.
Brahman calves were more efficient than Angus, A x B crossbreds, and Brangus.
Low RFI calves were not only more efficient but they also grew faster than calves in the medium and high RFI groups.

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