



# Relationships between restricted residual feed intake of Brahman bulls measured in confinement and under different stocking intensities on Coastal bermudagrass pastures

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## ABSTRACT

Efficiency of animal production is an important component of the beef industry. The research objectives of this 2-yr study were to (1) estimate residual feed intake (RFI) of yearling Brahman (*Bos indicus*) bulls grazing Coastal bermudagrass [*Cynodon dactylon* (L.) Pers.] using DMI measured with *n*-alkanes; (2) compare RFI under grazing (RFI<sub>g</sub>) with RFI determined in confinement under restricted feed intake at 2.8% of BW (RRFI<sub>c</sub>); and (3) assess the relationships of carcass traits and gastrointestinal tract anatomy to RFI<sub>g</sub>. Bulls RRFI<sub>c</sub>-phenotyped as efficient (*n*-RFI) and inefficient (*p*-RFI) in both 2009 and 2010 were assigned to 2 replicate pastures at either low or high stocking intensity (STK) for 60 d. In 2009 there was no

difference ( $P > 0.3$ ) between *n*-RRFI<sub>c</sub> and *p*-RRFI<sub>c</sub> for initial or final BW, ADG, DMI, or feed-to-gain ratio. There was an interaction of RFI<sub>g</sub> × STK ( $P = 0.043$ ) for ADG in which *p*-RFI<sub>g</sub> bulls on low STK had the greatest gain. The *p*-RFI<sub>g</sub> bulls had the greatest DMI regardless of STK ( $P < 0.01$ ). In 2009 differences were found for carcass traits and gastrointestinal tract, and *p*-RFI<sub>g</sub> bulls on low STK had the greatest DMI and heaviest gastrointestinal tract. In 2010 *p*-RRFI<sub>c</sub> bulls had the heaviest initial BW ( $P = 0.048$ ), final BW ( $P = 0.084$ ), and metabolic BW ( $P = 0.054$ ), and the greatest DMI ( $P < 0.01$ ). From confinement to pasture, 37.5% of bulls on pasture maintained the same RRFI<sub>c</sub> rank in 2009, and 56.3% of bulls on pasture remained in the same RRFI<sub>c</sub> rank in 2010.

**Key words:** *Bos indicus*, bermudagrass, residual feed intake, stocking rate, pasture

## INTRODUCTION

Beef producers and scientists have long sought opportunities and management strategies to enhance efficiency of growth and reproduction from both biological and economic perspectives. Intake of feedstuffs and the conversion of concentrate rations or forages into positive activity functions such as growth, grazing behavior, estrus, and carcass fat have been the focus of nutrition and reproductive objectives. Feed or forage efficiency for growing cattle can be estimated by several approaches of which feed-to-gain ratio (**F:G**) and residual feed intake (**RFI**) are more commonly implemented (Koch et al., 1963). In the past years, several authors (Archer et al., 1999; Herd et al., 2003; Arthur et al., 2004, 2005) have evaluated animal breeding as an approach to improve beef cattle feed efficiency, and others (Basarab et al., 2013; Tedeschi et al.,

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2015) have emphasized the importance to reduce the contribution of greenhouse gas emissions of ruminants to the environment.

However, the measurement and documentation of F:G and RFI in confinement presents minor challenges compared with that of measuring intake on pasture (Lippke, 2002). This 2-yr study used yearling Brahman bulls in confinement under restricted feed intake at 2.8% of BW to quantify RFI (**RRFIc**). The objectives of this study were to (a) measure intake on Coastal bermudagrass pastures using n-alkane as a marker; (b) use RRFIc rankings to compare RFI rankings on grass pasture (**RFI<sub>g</sub>**) for efficient (negative, **n-RFI**) and inefficient (positive, **p-RFI**) bulls; and (c) evaluate RRFIc ranking on carcass traits and body composition of bulls slaughtered directly off pasture.

## MATERIALS AND METHODS

The Institutional Animal Care and Use Committee of Texas A&M University approved all procedures before the commencement of the trials (IACUC AUP 2008–207 and AUP 2010–53). These confinement and pasture studies were conducted at the Texas A&M AgriLife Research and Extension Center at Overton, Texas, in the Pineywoods vegetation zone in east Texas (32°16'N, 94°59'W). This site had an average rainfall of 100 cm

and mean temperature of 30.2°C during the summers of 2009 and 2010.

### *Confinement Period to Establish RFI*

Purebred Brahman bulls, from a reproductive physiology research herd established in 1975 at Texas A&M AgriLife Research–Overton, were used in these experiments. The primary research objectives for this Brahman herd have been focused on interrelationships of age and BW at onset of sexual maturity for both females and males (R. Randel, 2016, Texas A&M AgriLife Research, Overton, personal communication). All the spring-born bull calves from this research herd were used in 2009 (n = 42) and 2010 (n = 33). Bulls were weaned in October and backgrounded on Coastal bermudagrass pastures and hay plus 1 kg/d of 14% CP ration of cracked corn and soybean meal until time of the confinement period for assessing RFI. In addition to research targeted at sexual maturity attributes, yearling bull growth and development, and efficiency of use of roughage-based rations of about 60% TDN and 12% CP (Table 1) have also been a major emphasis of the reproductive physiology program for bulls. The roughage-based ration was used to avoid founding from high-grain rations and to mimic nutritive value of warm-season perennial grass pastures. The proto-

col of assessing RFI in confinement was initiated in 2007 and incorporated a 2-phase, 2-period, switchback design with the use of Calan gates (American Calan, Northwood, NH) to measure individual DMI. From February 26, 2007, to May 3, 2007 (period 1, 66 d), and from May 14, 2007, to July 16, 2007 (period 2, 63 d), half of the bulls in the first period had ad libitum access to the diet and half received a restricted daily ration. In period 2, bulls were switched from ad libitum to restricted and restricted to ad libitum levels of intake. The pelleted, complete ration used in 2007 was fed twice daily at 0800 and 1700 h with weekly BW measurements and adjustments in diet amount according to orts. With the forage-based ration, a 2.8% BW daily ration represented 98 to 102% of daily intake when fed twice daily. There was no significant difference in DMI between ad libitum and restricted (2.8% BW) ration for bulls in the 2 periods of 2007 experiments (R. Randel, 2016, Texas A&M AgriLife Research, Overton, personal communication). The resultant, restricted daily ration to meet reproduction and growth objectives similar to pasture development was set at 2.8% BW. Thus, we refer to the confinement RFI as restricted RFI (**RRFIc**).

The restricted ration of 2.8% BW was used to measure RRFIc of yearling bulls in 2008, 2009, and 2010. The 15-mo-old bulls assessed for RRFIc in 2008 were used to define methodology of supplementing alkane via corn gluten feed (**CGF**) pellets to estimate DMI on Coastal bermudagrass pastures (Aguiar et al., 2013). In both 2009 (May 14, 2009, to July 23, 2009) and 2010 (May 24, 2010, to August 2, 2010) of our experiments, bulls in confinement (70 d) were fed a daily ration (Table 1) with controlled feed intake at 2.8% BW. Bulls were weighed weekly, and ration intake was adjusted weekly for each bull. For each year, DMI, metabolic mid-BW, and ADG measurements were used to calculate RFI as described in the statistical analysis section.

**Table 1. Calculated chemical composition of diet used to quantify residual feed intake in the 2009 and 2010 confinements<sup>1</sup>**

Item	Value
Dietary component, %, as-fed basis	
Cottonseed hulls	45.0
Corn, ground	40.0
Premix (protein, mineral, vitamin)	15.0
Chemical composition, DM basis	
TDN, %	60.0
ME, Mcal/kg	2.35
DE, Mcal/kg	2.86
CP, %	12.5

<sup>1</sup>Estimated DM of 91% as fed.

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