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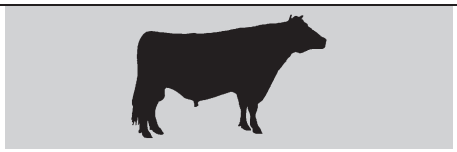

# Evaluation of Wagyu for residual feed intake: Optimizing feed efficiency, growth, and marbling in Wagyu cattle

**M. McGee,* C. M. Welch,* J. B. Hall,† PAS, W. Small,‡ and R. A. Hill*[1]**
*Department of Animal and Veterinary Science, University of Idaho, Moscow 83844;
†University of Idaho Nancy M. Cummings Research, Education, and Extension Center, Carmen, ID 83467; and ‡AB Genetics LLC, Boise, ID 83702

## ABSTRACT

*Ninety-two yearling Wagyu bulls were evaluated for residual feed intake (RFI) and other performance variables during a 70-d testing period. Bulls were fed a diet in which ingredients were formulated to match the nutritional equivalent of the diet fed to finishing Wagyu cattle. After RFI testing, bulls were classified into the following groups: efficient (RFI >0.5 SD below the mean; n = 32), marginal (RFI ± 0.5 SD of the mean; n = 34), and inefficient (RFI >0.5 SD above the mean; n = 26). Residual feed intake was positively correlated with DMI (r = 0.56; P < 0.01) but was not correlated (r = 0.01; P = 0.91) with ADG. Metabolic BW was not correlated (r = −0.10; P = 0.33) with RFI. Intramuscular fat percentage tended to be negatively correlated with RFI (r = −0.17; P = 0.11). Efficient, marginal, and inefficient groups showed differences in G:F (P < 0.01) and DMI (P < 0.01), but no differences were observed for metabolic BW or ADG (P = 0.71 and P = 0.96, respectively). Inefficient bulls had greater DMI (P < 0.01) than did efficient bulls. Marginal bulls also had greater DMI (P < 0.01) than did efficient bulls. All groups did not differ (P > 0.05) in ultrasound measures for rib fat, LM area, and intramuscular fat. No differences (P > 0.05) were observed between groups for the other performance variables tested. Observations from the current study suggest that Wagyu sires that are superior for both feed efficiency and marbling can be identified with assistance from RFI analysis.*

**Key words:** feed efficiency, marbling, residual feed intake, Wagyu

## INTRODUCTION

Production systems in the beef cattle industry aim to produce high-quality beef. To this end, enhanced product quality attributes of tenderness, juiciness, and flavor are highly favored by exclusive restaurants and the general consumers. Beef products from Japanese black cattle (Wagyu) are priced with a premium because of superior palatability, as well as exclusivity. Wagyu and Wagyu-influenced cattle have demonstrated superior marbling traits (Mir et al., 1999). Increased marbling has been associated with greater tenderness and reduced cooking loss (Mitsumoto et al., 1992). Wagyu cattle are typically fed costly high-grain finishing diets, which enhance their propensity to deposit intramuscular fat (**IMF**), improving quality grade scores. Although marbling is increased, the literature reports that Wagyu cattle show inferior red meat yield and feedlot performance when compared with other breeds (Mir et al., 1999; Ueda et al., 2007). Because of this trade-off between quantity and quality, it is important to maximize profits by identifying feed-efficient animals that also have high IMF and a desirable growth rate.

The incorporation of evaluation of residual feed intake (**RFI**) along with IMF, ADG, and feed intake measurements in identifying superior animals provides a possible approach to improve the profitability of Wagyu cattle. Residual feed intake is moderately heritable, with values ranging from 0.16 to 0.43 (Herd et al., 2003). Residual feed intake has been researched extensively in British and Continental breeds; however, only a few large scale evaluations of Wagyu or Wagyu-influenced cattle have been

[1] Corresponding author: rodhill@uidaho.edu

reported (Sasaki et al., 1982; Lejukole et al., 1993; Mukai et al., 1995; Oikawa et al., 2000; Shojo et al., 2005). The present study provides a quantitative phenotypic evaluation of yearling Wagyu bulls for RFI, ADG, DMI, and subcutaneous fat and IMF deposition.

## MATERIALS AND METHODS

### *Animal Acquisition and Acclimation*

Procedures involving the use of animals in this study were approved by the University of Idaho Animal Care and Use Committee. Ninety-two yearling Wagyu bulls (starting BW = 415 ± 55 kg; age = 474 ± 17 d) obtained from Snake River Farms (AgriBeef Co., Boise, ID) were transported to the University of Idaho Nancy M. Cummings Research Education and Extension Center (**NMCREEC**), Carmen. Prior to delivery, animals were fed a diet similar to the one used during the test period. After arrival, all animals were allotted a 14-d adaptation period before a 70-d postweaning RFI test to normalize intake as well as acclimation to the GrowSafe system (GrowSafe Systems Ltd., Airdrie, Alberta, Canada). The GrowSafe system at NMCREEC is composed of 4 (21.34 × 54.86 m) pens, with each pen containing 5 feeding nodes (GrowSafe bunks). The pens are located outside without cover. Bulls were randomly allocated to 1 of 3 pens of the GrowSafe feed-intake monitoring system. The 3 pens contained 30, 31, and 31 bulls at initiation of the adaptation period.

### *Feeding and Management Practices*

Bulls were provided a diet (PerforMix Nutrition Systems, Nampa, ID) formulated to match the nutritional equivalent of the diet fed to finishing Wagyu cattle containing (on an as-fed basis) alfalfa hay early bloom, 21%; corn grain cracked, 56%; dried distillers grains, 13%; and a proprietary liquid supplement, Rumax FL10, 10% (PerforMix Nutrition Systems). Nutrient analysis of the diet is provided in Table 1. During the test period, the diet remained consistent, with samples taken daily for DM as well as weekly composite samples for proximate analysis performed by a commercial laboratory (SDK Laboratories, Hutchinson, KS). Feed was mixed daily and provided in a single feeding to all animals to facilitate ad libitum intake each morning between 0800 and 1000 h. At the beginning of the 70-d RFI test period, bulls were weighed on 2 consecutive days and again at the completion of the 70-d RFI test period. Within the test period, bulls were weighed every 2 wk.

### *Ultrasound Measurements*

An independent technician performed ultrasound measurements for rib fat (**RF**) thickness, IMF, and LM area recorded on d 0 and 70 without hair removal between the 12th and 13th ribs. Ultrasound images were captured by an Aloka 500ssd Scanner (Hitachi Aloka Medical Ltd., Wallingford, CT).

**Table 1. Nutrient analysis of ration (DM basis)**

| Analysis | Unit of measure | Value |
|---|---|---|
| DM | % | 87.1 |
| CP | % | 15.2 |
| $NE_m$ | Mcal/cwt[1] | 84.4 |
| $NE_g$ | Mcal/cwt | 57.4 |
| Forage DM | % | 22.0 |
| ADF | % | 11.1 |
| NDF | % | 19.9 |
| Fat | % | 4.3 |
| Calcium | % | 0.7 |
| Phosphorus | % | 0.5 |
| Magnesium | % | 0.2 |
| Sulfur | % | 0.2 |
| Salt | % | 0.7 |
| Vitamin A | IU/kg | 782.8 |
| Vitamin D | IU/kg | 78.3 |
| Vitamin E | IU/kg | 1.3 |
| Zinc | mg/kg | 59.8 |
| Copper | mg/kg | 20.5 |
| Selenium | mg/kg | 0.4 |

[1]cwt = hundred weight.

### *Statistical Analysis*

Analyses were conducted using SAS (SAS Institute Inc., Cary, NC). Residual feed intake was calculated as the difference between actual and predicted feed intake by regressing DMI on mid-test $BW^{0.75}$ and ADG (Koch et al., 1963) with the addition of RF thickness (Basarab et al., 2003) to the model. Thus, the final model for predicting RFI was

$$\text{DMI} = -0.2851 - 0.1134(\text{ADG}) + 0.1076(\text{BW}^{0.75}) - 0.5505(\text{RF thickness}).$$

Correlations were calculated among growth efficiency, performance, and ultrasound measurements via the CORR procedures of SAS (SAS Institute Inc.).

After RFI test, bulls were classified into the following groups: efficient (RFI >0.5 SD below the mean; n = 32), marginal (RFI ± 0.5 SD of the mean; n = 34), and inefficient (RFI >0.5 SD above the mean; n = 26). Least squares means were compared using the Studentized *t*-test.

## RESULTS AND DISCUSSION

Mean performance values for all bulls were DMI, 10.35 kg/d; ADG, 1.39 kg/d; G:F, 0.13 kg/kg; $BW^{0.75}$, 102.96 kg; LM area, 86.46 $cm^2$; and IMF, 6.26% (Table 2). Residual feed intake was not correlated with ADG (r = 0.01; $P = 0.91$; Figure 1A). A positive correlation was observed between RFI and DMI (r = 0.56; $P < 0.0001$; Figure 1B). Residual feed intake tended to be negatively correlated with IMF (r = −0.17; $P = 0.11$) in our test population (Table 3 and Figure 1C). As expected, RFI was not correlated with RF thickness ($P = 0.80$; Figure 1D), because RF thickness was included in the model to estimate RFI (Nkrumah et al., 2004; Baker et al., 2006; Ahola et al., 2011). Average daily gain and IMF were correlated (r = −0.34; $P < 0.01$; Figure 1E). Longissimus muscle area and IMF were negatively correlated (r =