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Post-Weaning Feed Intake and Performance of Bulls Developed in an Automated Feed Intake Management System

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Abstract

Two years of feed intake and performance data on spring born growing bulls (n = 77) developed in an automated feed intake system were analyzed and compared to predicted data from the BRANDS feed formulation software program (Iowa State University, Ames, IA). Each year bulls were weaned in the fall and they entered the Kansas State University Intake facility where they were fed a total mixed ration and the intake data were recorded by the Insentec feed intake system for 64 and 72 days for years one and two, respectively. A strong correlation ($P < 0.01$) for predicted and actual dry matter intake (DMI) was observed both years, with a weaker correlation ($r = 0.36$, $P = 0.03$) between the predicted and observed average daily gain (ADG) during the 2021–2022 test period. In year 2, a strong positive correlation ($r = 0.73$) was observed between actual and predicted ADG, suggesting that dietary differences may impact the accuracy with which gain is modeled. Feed intake trends over time were positive for both sets of bulls, but consumption increased at an increasing rate in 2022–2023. Ultimately, data indicated that DMI increases over time with advancing days on test during development in an individually fed intake system, and the day-to-day variation within the data set implies that animal intake is greatly impacted by factors such as individual behavior, management, and weather. The BRANDS formulation program appears to predict DMI more accurately than ADG.

Introduction

Post-weaning feed intake and its relationship to average daily gain (ADG) is critical given the significant impact feed costs have on developing virgin bulls. In typical production systems, bulls upon weaning are often managed in pen settings in which the overall intake of the contemporary group is measured, yet significant variation on an individual animal basis may occur. While systems exist allowing for individual feed consumption data to be recorded, much of the previous work in this area with growing beef cattle has been with steers. Likewise, performance of growing cattle can be predicted from nutrient requirements if feed intake is measured and dietary composition is known, and research evaluating this with pre- and peri-pubertal bulls post-weaning is limited. Our objectives were to: 1) report observed intake and performance data; 2) compare expected and observed dry matter intake (DMI) and ADG using modeled nutrient requirement equations; and 3) evaluate the change in individual DMI over time of weaned beef bull calves fed in an automated feed intake management system.

Experimental Procedures

Feed intake and performance data from purebred Angus, Hereford, and Simmental bull calves across two calf crops [birth years 2021 (n = 40) and 2022 (n = 37)] were utilized for this analysis. All calves were born at the Kansas State University Purebred Beef Unit in the spring and raised at their dam's side grazing native Flint Hills range until weaning in September each year. At weaning, bulls initially had access to native prairie hay and a commercial creep feed for *ad libitum* consumption for approximately 2 weeks before being transitioned to a total mixed ration which was subsequently fed for 5–6 weeks. Following the weaning and diet transition period, bulls entered the Kansas State University Feed Intake Facility in mid-November each year. Intake test periods were November 11, 2021, through February 2, 2022 (83 days) and November 19, 2022, through January 30, 2023 (72 days) for years one and two, respectively. During the 2021–2022 test year, feed intake data were recorded for 64 days. During the study at the Feed Intake Facility, bulls were managed as a common group in earthen partially covered pens and fed in Insentec bunk module units allowing for individual feed intake data to be recorded. Ingredient composition of diets fed differed between years (Table 1). Bulls were individually weighed without feed or water restriction at the beginning and end of the test period to calculate ADG, with feed to gain ratio (F:G) subsequently calculated for each bull from average individual DMI.

Projected DMI and ADG were calculated for each group of bulls by year on an individual basis using the Growing Bull module of the Excel-based Beef Ration and Nutrition Decision Software (BRANDS) formulation program (Iowa State University, Ames, IA) used by K-State Research and Extension. Intake and performance equations incorporated into BRANDS are from the Nutrient Requirements of Beef Cattle 7th and 8th editions. Using actual initial and ending body weight (BW) for each bull, actual DMI of individual feedstuffs based on diet composition, and assumed average feedstuff composition values, projected DMI and ADG were retrospectively calculated to determine the accuracy of the program in predicting performance. In the 2021–2022 test year, two different diets were fed, but only diet 1 was used in the analysis as it was fed for the majority of the total days. All data were analyzed using SAS (SAS Institute Inc., Cary, NC) and the correlation procedures were used to evaluate the relationship between observed and projected DMI and ADG. *P*-values less than or equal to 0.05 were declared significant.

Results and Discussion

Initial BW was approximately 800 lb, and the ending BW were 1,080 lb and 1,063 lb for years 1 and 2, respectively (Table 2). Actual DMI for both years was slightly lower than predicted, with a greater standard deviation for 2022 (SD = 3.7) compared to 2021 (SD = 2.1; Table 2). Actual ADG for both years was notably greater than predicted (Table 2). Feed conversion was similar across the years. In 2021–2022, a strong positive correlation (r = 0.78, P < 0.01) was observed between actual and predicted DMI (Table 3). Likewise, there was a highly correlated (r = 0.84, significant (P < 0.01) relationship for observed and predicted DMI for 2022–2023 (Table 2). There was a moderate positive correlation (r = 0.36) between observed and predicted ADG in 2021–2022. There was also a strong relationship (r = 0.73, P < 0.01) between the observed and predicted ADG in year 2 (Table 3.). This difference in the relationships between actual and predicted ADG across years is likely related to how the BRANDS program handles metabolizable protein balance differences with different

diets. The 2021–2022 bulls showed more deviance in the average group daily DMI from the best fit line (Figure 1), which is credited to variation in behavioral feeding patterns, inclement weather, or management. At day 50, the steep drop in intake is likely related to the change in diets that took place three days prior. The difference in the slopes of the DMI lines suggest the patterns of consumption over time were not uniform across different groups of bulls fed different diets. The 2022–2023 bulls (Figure 2) increased in DMI more gradually over time and the group daily DMI had less variance from the trend line, making for a more consistent feed intake pattern while on test. Individual feed intake, when measured on animals managed together in a group setting, appears to be greatly variable and this variation is undetected in pen-managed situations.

Implications

Data support that DMI increases over time as days of the test period increase for growing bulls in an individually fed intake system, and although significant day-to-day variation exists, the BRANDS formulation program appears to more accurately predict DMI than ADG.

Acknowledgments

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Table 1. Ingredient composition of diets by year, percent dry matter basis

Item	2021–2022[1]	2021–2022[2]	2022–2023
Corn silage	43.50	35.70	60.00
Wet corn gluten feed	21.75	25.00	25.00
Steam flaked corn	---	---	7.98
Dry rolled corn	23.00	10.00	---
Brome hay	9.46	22.15	---
Supplement	2.29	2.15	1.74
Omega 3 fatty acid supplement	---	5.00	5.28

[1]Fed from November 11 to December 29, 2021.
[2]Fed from December 30, 2021, to February 2, 2022.

Table 2. Actual and predicted bull performance means by year

	2021–2022			2022–2023		
Item	Actual	SD[1]	Predicted	Actual	SD	Predicted
Initial BW,[2] lb	800	107	---	805	119	---
Ending BW, lb	1080	118	---	1063	158	---
DMI,[2] lb/day	18.5	2.1	21.1	20.1	3.7	21.1
ADG,[2] lb	3.33	.57	1.66	3.59	0.89	2.32
F:G[2]	5.71	1.20	---	5.9	1.48	---

[1] Standard deviation.
[2] BW = body weight. DMI = dry matter intake. ADG = average daily gain. F:G = feed to gain ratio.

Table 3. Correlation coefficients for actual and predicted intake and gain of bulls by year

	2021–2022				2022–2023			
Item	Actual	Predicted	*r*	*P*-value	Actual	Predicted	*r*	*P*-value
DMI,[1] lb/day	18.5	21.1	0.78	< 0.01	20.1	21.1	0.84	< 0.01
ADG,[1] lb	3.33	1.66	0.36	0.03	3.59	2.32	0.73	< 0.01

[1] DMI = dry matter intake; ADG = average daily gain.

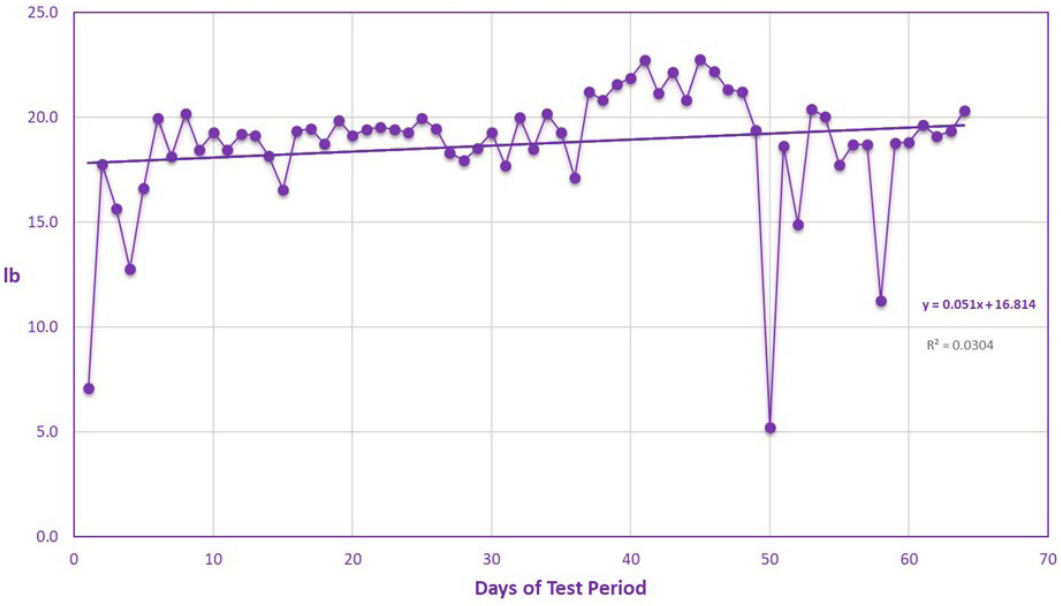

Figure 1. Average group daily dry matter intake for 2021–2022.

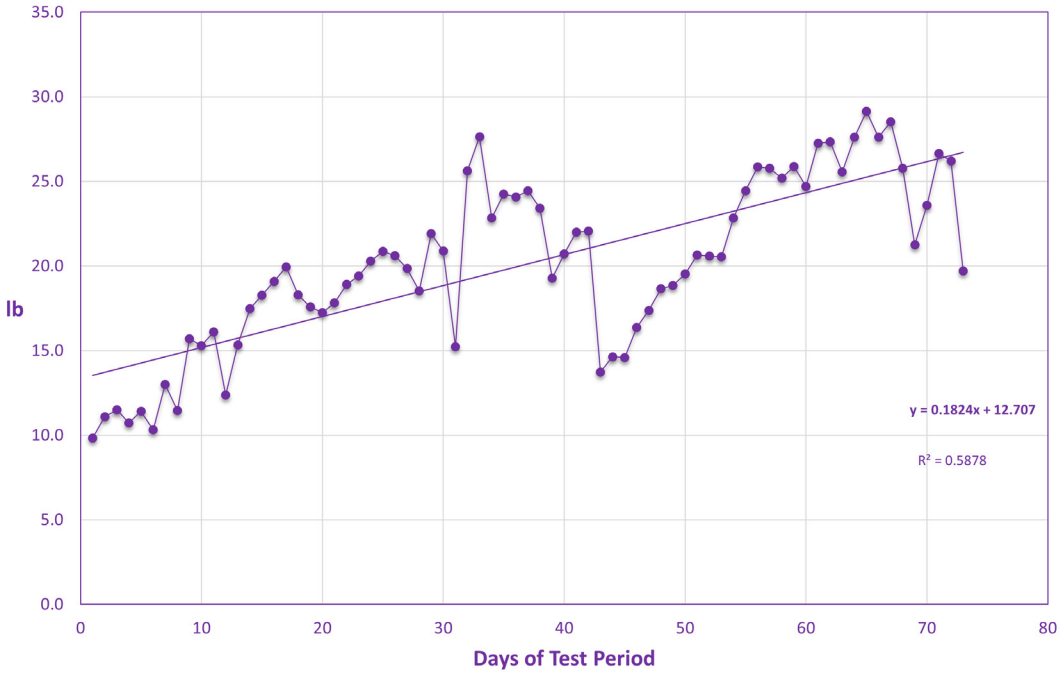

Figure 2. Average group daily dry matter intake for 2022–2023.