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Water Intake in Growing Beef Cattle

Abstract

Water is an essential part of livestock and human diets and is often thought of as an inexpensive, readily available renewable natural resource. However, the amount of competition between humans, wildlife, feed production, and livestock for high-quality water is increasing, not only from the effects of drought but from the pressure of a growing global population (Nardone et al., 2010). With limited resources available for production agriculture, there is a need to identify and select for efficient animals that can produce more product with fewer inputs. Although some work has been done in dairy cattle, very little data is available on individual animal water intake in modern beef cattle (Brew et al., 2011). The majority of the water intake data available in growing beef cattle is derived from dividing the total amount of water drunk in a pen divided by the number of animals in that pen (Sexson et al., 2010; Mader and Davis, 2004). Data derived from groups are not generally useful for the purposes of genetic evaluation, which aims to quantify individual animal variation in a trait for selection. However, in order to practice selection on a large scale, parameters for collecting phenotypic data must be established. The objectives of this study were to measure daily water intake on a large number of beef steers and to estimate the number of test days necessary to collect accurate water intake phenotypes.

Keywords

water intake, beef cattle, test length

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Water Intake in Growing Beef Cattle

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Introduction

Water is an essential part of livestock and human diets and is often thought of as an inexpensive, readily available renewable natural resource. However, the amount of competition between humans, wildlife, feed production, and livestock for high-quality water is increasing, not only from the effects of drought but from the pressure of a growing global population (Nardone et al., 2010). With limited resources available for production agriculture, there is a need to identify and select for efficient animals that can produce more product with fewer inputs. Although some work has been done in dairy cattle, very little data is available on individual animal water intake in modern beef cattle (Brew et al., 2011). The majority of the water intake data available in growing beef cattle is derived from dividing the total amount of water drunk in a pen divided by the number of animals in that pen (Sexson et al., 2010; Mader and Davis, 2004). Data derived from groups are not generally useful for the purposes of genetic evaluation, which aims to quantify individual animal variation in a trait for selection. However, in order to practice selection on a large scale, parameters for collecting phenotypic data must be established. The objectives of this study were to measure daily water intake on a large number of beef steers and to estimate the number of test days necessary to collect accurate water intake phenotypes.

Key words: water intake, beef cattle, test length

Experimental Procedures

Feed and water intake was measured on 459 crossbred steers using an Insentec system at the Oklahoma State University Willard Sparks Beef Research Unit. Steers were fed in four groups during a three-year period (group 1 from May to August 2014, group 2 from November 2014 to March 2015, group 3 from May to August 2015, and group 4 June to October 2016). Steers were individually weighed every 14 days and gain was calculated using a regression of full body weight over time to account for differences in fill. Individual daily feed and water intake records were collected over a 70-day period in accordance with test length guidelines for feed intake and gain published by the Beef Improvement Federation (2010). Within each group, steers were blocked by weight

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(low and high) at the beginning of the study and randomly assigned to one of four pens containing approximately 30 steers per pen. Each pen provided 2007.47 ft² of shade and included an Insentec system containing six feed bunks and 1 water bunk. Steers were fed a growing diet throughout the study that consisted of 15% cracked corn, 51.36% wet corn sweet bran, 28.44% prairie hay, and 5.20% supplement on a dry matter basis. The mean dry matter was ~73.5% and mean gross energy of composited samples was ~128,270.3 cal/oz on a dry matter basis (data on group 1-3 only). Groups 1-3 steers were managed using a standard slick bunk feed call procedure and group 4 was offered *ad libitum* feed intake. All groups had *ad libitum* access to water. Intake records were filtered for reasonableness using parameters for feed and water bunk starting weight, ending weight, and duration. Records collected on weigh dates, days where equipment malfunctioned, or other days where *ad libitum* water access was compromised were treated as missing data points to maintain data quality. Average intakes for each animal were computed for increasingly large test durations (7, 14, 21, 28, 35, 42, 49, 56, 63, or 70 days) with a minimum of 3 days of intake per week to determine the optimum test duration for water intake in this dataset. Water intake was adjusted for differences in body size by reporting it as a percent of mid-test body weight. A general linear model with group as a fixed effect was fit in SAS (SAS Inst. Inc., Cary, NC; version 9.4) to determine whether intakes were significantly different between groups. Phenotypic correlations were generated using SAS 9.4 for each shortened test period as compared to the full 70-day test. Depending on the desired stringency of data collection, minimum test duration can be determined when both the Pearson and Spearman correlations were above 0.90, 0.95, or 0.99 for water intake.

Results and Discussion

The average intake across all groups was approximately 88.77 lb/day, which was approximately 9.334% of their body weight. Cattle that were fed during the summer months had a significant ($P < 0.0001$) increase in water intake when compared to cattle fed during the winter (10.03% of body weight vs. 6.90% of body weight, respectively). Cattle fed during the summer months that were managed on the slick bunk procedure had lower water intakes ($P < 0.0008$) than cattle that had access to *ad libitum* feed during the summer months (9.67% of body weight vs. 10.76% of body weight, respectively). However, with only one group at a larger initial body weight representing *ad libitum* intake, it is not clear how much of this difference might be due to differences in feed regimen, differences in genetic potential for water intake, or changing metabolic water requirements as body weight increases. Mader and Davis (2004) reported daily water intakes of 7.89% of mid-test body weight per day (~10 gallons) for finishing steers based on pen water intake data extrapolated to individual animals during the summer with similar temperature humidity index measures, which were lower than our estimates for the same time of year (groups 1, 3, and 4). Brew et al. (2011) reported daily water intake of 7.92 gallons (66.10 lb) per day during the winter using a GrowSafe system to collect individual water intakes. This result was consistent with our intakes collected during the same season (group 2).

Our results indicate that minimum test durations for collection of water intake phenotypes should be 35, 49, or 56 days if the desired phenotypic correlation is either 0.90, 0.95, or 0.99, respectively. While no other minimum test duration recommendations exist for water intake, the minimum test duration for water intake in our data is similar

to the minimum test duration for feed intake as reported by the Beef Improvement Federation (35-42 days; 2010). These data suggest that water and feed intake can be collected simultaneously, which would allow concurrent collection of both phenotypes without significantly extending test duration.

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Table 1. Daily water intake for beef cattle (n = 459) during a three year period

Group ²	Water intake (% mid-test body weight/day) ¹					Daily water intake (gal)			
	N	Mean	STD ³	Min	Max	Mean	STD ³	Min	Max
1	118	10.79 ^a	1.97	5.84	16.45	10.70	2.12	5.68	17.51
2	115	6.90 ^b	1.13	4.46	11.89	7.21	1.44	3.69	11.53
3	117	8.55 ^c	1.42	5.95	13.18	9.47	1.75	6.27	15.64
4	106	10.76 ^a	2.86	7.67	22.92	12.98	3.43	8.47	26.79
All	456	9.34	2.58	4.46	22.92	10.66	2.37	6.27	26.79

¹Daily water intake as a percent of mid test body weight (lb).

²Daily water intakes were taken for group 1 summer 2014, group 2 winter 2014, group 3 summer 2015, group 4 summer 2016, and all is the average of the four groups.

³Standard deviation.

^{abcd}Means within a column that do not have common superscripts differ (P<0.05).