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Validation of an Intraruminal Continuous-Release Chromium Device to Determine Fecal Output in Grazing Cattle

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Story in Brief

In order to determine forage intake of grazing cattle, an accurate estimate of fecal output must be obtained. An intraruminal continuous-release chromium bolus[5] offers the opportunity to estimate fecal output with minimal labor and disruption of grazing behavior. Four steers grazing stockpiled bermudagrass pasture were used to validate the chromium release rate of these boluses. The manufacturer's reported released rate was .98 g of chromium per day. Boluses were administered 6 d prior to initiation of a 5-d total fecal collection period. Fecal collection bags were weighed, sub-sampled and emptied twice daily. Sub-samples were used to determine fecal dry matter concentration and chromium concentration. Based on chromium recovery data, mean release rate was .74 g per day, or 76% of the manufacturers reported release rate. Fecal output, fecal chromium concentration and chromium recovery varied among steers and days, but was similar among sampling periods. Validation of chromium release rate is necessary in order to obtain accurate fecal output and forage intake data.

(Key Words: Forage Intake, Grazing, Chromium, External Markers.)

Introduction

The production of ruminant animals relies heavily on grazed pastures as a feed resource. An accurate method to estimate fecal output and forage intake of grazing animals is essential in grazing livestock research. Total fecal collection provides an accurate estimate of fecal output, but is labor intensive and may influence grazing behavior. Daily pulse-dosing of external indigestible markers has been used to estimate fecal output, but requires frequent fecal sampling to account for diurnal variation (Prigge et al., 1981). Previously, Brandyberry et al. (1991) reported that intraruminal controlled release capsules (CRC) provided consistent fecal chromium concentration for cattle receiving a chopped alfalfa hay diet. These authors concluded that validation of CRC release rate from different capsule batches and in different forage types was necessary to insure accurate prediction of fecal output. Therefore, the objective of this study was to determine actual chromium release rate from CRC and to assess variability of chromium release among steers grazing low-quality bermudagrass pasture.

Materials and Methods

Four crossbred steers (677 lb ± 19) were used in a 5-d total fecal collection to determine chromium release from CRC. The manufacturer had conducted a trial for this batch of boluses using ruminally fistulated cattle grazing ryegrass, white clover pasture. The reported released rate was .98 g of chromium per day. In the current study, steers grazed stockpiled bermudagrass pastures at the Range Cattle Research Center, 15 miles west of Stillwater, OK. On the morning of December 2, 1997, the steers were administered the CRC. This allowed for a 6-d equilibration period. Steers were equipped with fecal collection bags on the morning of December 8, 1997, to begin the total fecal collection period. Collection bags were removed, weighed and emptied twice daily at approximately 8:00 a.m. and 4:00 p.m. for five consecutive days. Upon bag removal, feces was mixed by hand and a representative sub-sample was collected after mixing. Sub-samples were weighed, dried at 55° C for 48 to 72 h and re-weighed to determine dry matter concentration. The sub-samples were ground through a 2 mm screen and chromium concentration was measured by atomic absorption. Data were analyzed by General Linear Model Procedures with steer, day and period (a.m. or p.m.) included in the model as independent variables.

Results and Discussion

Mean chromium recovery was .74 g/d, or 55% of the manufacturer's reported release rate. This discrepancy could be due to overestimation of release rate by the manufacturer, slower release rate due to different forage type, or incomplete chromium recovery. Using a confidence coefficient of .95 (or an error rate of .05) the range of chromium release would be .87 to .61 g/d. Standard deviation and coefficient of variation for chromium recovery was .085 and 11%, respectively. In order to reduce coefficient of variation to 5%, five steers would be required.

Variability due to individual animals for fecal output, fecal chromium concentration and chromium recovery is shown in Table 1. As would be expected, higher fecal output appeared to be associated with lower fecal chromium concentration. Similarly, variability associated with each day of the fecal collection period is shown in Table 2. Fecal output was numerically higher, and fecal chromium concentration was greater ($P<.05$) on d 3, resulting in greater ($P<.05$) chromium recovery. The reason for both higher fecal output and chromium concentration for this day is unclear.

Fecal output per hour, fecal chromium concentration and chromium recovery per hour was similar for the a.m. and p.m. sampling periods (Table 3). Likewise, Brandyberry et al. (1991) concluded that accuracy of fecal output estimates was unaffected by time of day sampling and that one sample per day was adequate when using CRC.

Literature Cited

Brandyberry, S.D. et al. 1991. J. Anim. Sci. 69:4611.

Prigge, E.C. et al. 1981. J. Anim. Sci. 53:1629.

Table 1. Mean fecal output and chromium recovery by steer.

Steer	Fecal dry matter output, lb	Fecal chromium concentration, %	Chromium recovery, g/d
112	6.74[a]	.0257[c]	.79[a]
188	5.68[b]	.0274[b]	.71[b]
826	5.67[b]	.0292[a]	.75[ab]
951	5.69[b]	.0269[bc]	.70[b]
SEM	.19	.0005	.021

[a,b,c] Means within a column with different superscripts differ ($P<.05$).

Table 2. Mean fecal output and chromium recovery by day.

Day	Fecal dry matter output, lb	Fecal chromium concentration, %	Chromium recovery, g/d
1	5.94	.0261[b]	.70[b]
2	5.80	.0266[b]	.70[b]
3	6.38	.0300[a]	.86[a]
4	5.87	.0268[b]	.72[b]
5	5.73	.0268[b]	.70[b]
SEM	.097	.0006	.023

[a,b] Means within a column with different superscripts differ ($P<.05$).

Table 3. Mean fecal output and chromium recovery by sampling period.			
Sampling period	Fecal dry matter output, g/h	Fecal chromium concentration, %	Chromium recovery, g/h
AM	115.3	.027	.031
PM	110.9	.028	.030
SEM	1.4	.0006	.0006

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