University of Nebraska - Lincoln
DigitalCommons@University of Nebraska - Lincoln

Nebraska Beef Cattle Reports | Animal Science Department

January 2001

Urinary Allantoin Excretion of Finishing Steers: Effects of Grain Adaptation and Wet Milling Byproduct Feeding

Ryan Mass
University of Nebraska-Lincoln

D. J. Jordon
University of Nebraska-Lincoln

Todd Milton
University of Nebraska-Lincoln

Terry J. Klopfenstein
University of Nebraska-Lincoln, tklopfenstein1@unl.edu

Rick Stock
Cargill Corn Milling, Blair, Nebraska

Follow this and additional works at: https://digitalcommons.unl.edu/animalscinbcr

Part of the Animal Sciences Commons

Mass, Ryan; Jordon, D. J.; Milton, Todd; Klopfenstein, Terry J.; and Stock, Rick, "Urinary Allantoin Excretion of Finishing Steers: Effects of Grain Adaptation and Wet Milling Byproduct Feeding" (2001). *Nebraska Beef Cattle Reports*. 310.
https://digitalcommons.unl.edu/animalscinbcr/310

This Article is brought to you for free and open access by the Animal Science Department at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Nebraska Beef Cattle Reports by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

Urinary Allantoin Excretion of Finishing Steers: Effects of Grain Adaptation and Wet Milling Byproduct Feeding

Ryan Mass
D.J. Jordon
Todd Milton
Terry Klopfenstein
Rick Stock[1]

Steep liquor and distillers solubles do not stimulate microbial crude protein supply, as measured by allantoin excretion. Rumen pH correlated with microbial crude protein supply.

Summary

A metabolism trial investigated microbial protein supply for finishing cattle. In Phase I, cattle were adapted to a dry-rolled corn diet. Urinary allantoin excretion was positively correlated with TDN supply. In Phase II, cattle were fed that diet or diets with a portion of the corn replaced by one of two levels of the corn wet milling byproducts steep liquor or distillers' solubles. Byproducts inclusion did not increase microbial crude protein supply, as measured by urinary allantoin excretion. Rumen pH also correlated with microbial crude protein supply.

Introduction

Corn wet milling plants often blend corn steep liquor (STEEP) and distillers' solubles (DS) together, making it impossible to differentiate if one or both ingredients cause a performance response. A possible explanation for a response may be stimulation of microbial crude protein supply (MCP) due to amino acids and peptides present in STEEP and/or DS. Urinary allantoin excretion is a non-invasive marker of MCP supply (see related beef report article). The objectives of our research were to: 1) make estimates of urinary allantoin excretion as a marker of MCP supply for beef cattle fed dry-rolled corn based finishing diets; and 2) test the hypothesis STEEP and/or DS stimulate MCP synthesis when they replace dry-rolled corn in finishing diets.

(Continued on next page)

Procedure

Five crossbred yearling steers (mean wt = 775 lbs.) were fitted with rumen cannulas according to the guidelines of the UNL Institutional Animal Care and Use Committee. Cattle were housed in 10' x 10' box stalls, fed every two hours via automatic feeders, and allowed ad libitum access to feed. The trial was conducted in two phases: a common grain adaptation phase (Phase I) and a 5 x 5 Latin square (Phase II). In Phase I, cattle were adapted to a dry-rolled corn based finishing diet by feeding diets consisting of 45, 35, 25, 15, and 7.5% alfalfa for 4, 4, 7, 7, and 7 days, respectively. Dry-rolled corn replaced alfalfa in those adaptation steps. In Phase II, each period of the 5 x 5 Latin square was 21 days. All diets contained 7.5% cobs as the roughage source and were balanced to 15.3% CP using urea (this is the CP concentration of the 15% STEEP treatment). Treatments were: 1) CONT = 92.5% dry-rolled corn plus dry supplement; 2) 7.5% STEEP; 3) 15.0% STEEP; 4) 7.5% DS; and 5) 15.0% DS. In treatments two through five, the byproducts replaced dry-rolled corn in the ration.

In Phase I, cattle were tethered continuously to facilitate urine collection by abdominal funnels attached to a vacuum pump. Although urine was collected continuously in Phase I, urine volume was measured and aliquots were saved for analysis on the last four days of each adaptation step only. In Phase II, cattle were allowed to move freely in their stalls on days 1 through 17 and were tethered for urine collection on days 18 through 21. Aliquots of urine were analyzed for allantoin. Daily dry matter intake was measured in both phases and rumen pH was measured every three hours during days 18-21 of each period of Phase II.

The following were estimated for each steer and grain adaptation step combination in Phase I: average daily dry matter intake and average daily allantoin excretion in the urine. The following estimates were made for each steer and period combination in Phase II: average daily dry matter intake, average daily rumen pH and average daily allantoin excretion in the urine.

Table 1. Dry matter intakes and urinary allantoin excretion of cattle during Phase I, the grain adaptation phase.

	Steps[a]					
Item[b]	1	2	3	4	5	SEM
DMI, lb/day	17.4	18.0	19.1	16.7	17.8	1.6
Allantoin, mmol/day	55.7	51.6	58.6	62.0	89.6	7.5

[a]Cattle were adapted to a dry-rolled corn based finishing diet in five steps: 45, 35, 25, 15, and 7.5% alfalfa for 4, 7, 7, 7, and 7 days, respectively.
[b]Each number is the mean of all five animals, except for Step 5 (one animal went off feed because of a blown rumen cannula).

Table 2. Dry matter intakes, daily rumen pH, and urinary allantoin excretion of cattle during Phase II.

	Diets[a]					
Item	CONT	7.5STEEP	15STEEP	7.5DS	15DS	SEM
DMI, lb/day	17.6	18.7	16.7	18.7	19.1	1.8
Rumen pH[b]	5.75	5.65	5.58	5.68	5.60	.10
Allantoin, mmol/day[c]	105.5	94.5	93.1	87.6	82.7	6.6

[a]Dry-rolled corn finishing diet (CONT) balanced to 15.3% CP with urea (if needed). In all other treatments, by-product (STEEP = steep liquor; DS = distillers' solubles) replaced dry-rolled corn at the percentage of DM indicated.
[b]Orthogonal contrast for CONT vs. average of other four treatments (P = .32).
[c]Orthogonal contrast for CONT vs. average of other four treatments (P = .05).

Results

Dry matter intake and urinary allantoin excretion data for Phase I are shown in Table 1. Because grain adaptation step is confounded with time, no test of statistical difference can be made. However, the data serve as a useful observation of the trend allantoin excretion follows as cattle are adapted to a dry-rolled corn finishing diet. As alfalfa hay is replaced in the diet by dry-rolled corn, the total amount of allantoin excretion increases. This is intuitively correct because the total DMI remained relatively constant while the amount of dry-rolled corn increased. Therefore, the amount of TDN available for rumen fermentation increased, resulting in a greater amount of MCP supply. These data are the only known estimates of urinary allantoin excretion by cattle during a grain adaptation period.

Data for Phase II are shown in Table 2. There were no differences in DMI. Average daily rumen pH was numerically lower for the average of the wet milling byproducts versus the control (P = .30). The power of the test of rumen pH was compromised because there was a failure to obtain rumen pH data on two of the five periods in the Latin square. From these data, one could only speculate as to the possible cause of reduced rumen pH by wet milling byproducts; however, the pH of those feed ingredients may provide an explanation of the trend. The pH of the steep liquor and distillers' solubles fed in this trial were 4.22 and 4.96, respectively. Previous research with the byproducts shows they contain lactic acid and a significant amount of acetate, propionate and butyrate. These acids would certainly lower the pH of the feedstuffs.

Allantoin excretion was lower (P = .05) for the average of the wet milling byproducts versus the control. These data refute our hypothesis that one or both of these byproducts may stimulate MCP supply. Rumen pH was correlated (r^2 = .61) with allantoin excretion (Figure 1). This is in agreement with the 1996 NRC Model of Nutrient Requirements for Beef Cattle. In the research cited in the NRC, bacterial cultures were grown in vitro and pH was manipulated, resulting in lower MCP as pH declined. The data provide support for the concept

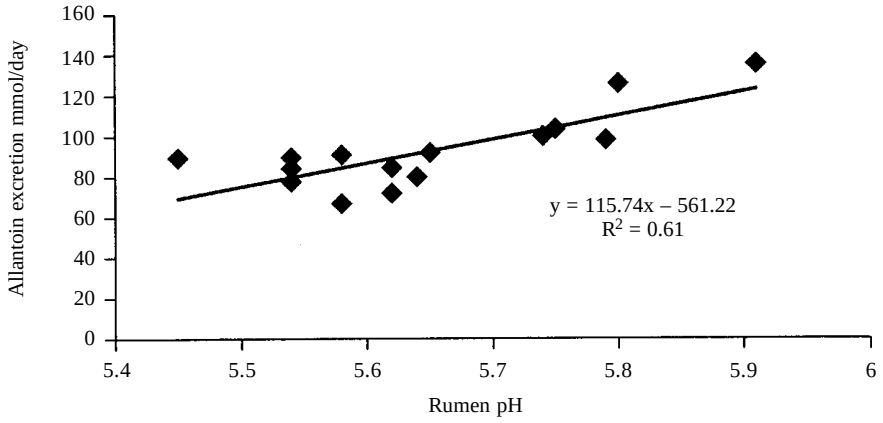

Figure 1. Urine allantoin excretion versus rumen pH of cattle fed various dry-rolled corn finishing diets (inclusion of wet-milling byproducts varies).

of pH sensitivity of rumen microbes in practical feeding conditions.

We conclude that steep liquor and distillers' solubles do not stimulate MCP supply. When averaged together, these byproducts reduced MCP supply, probably because of a trend toward lower rumen pH. The performance response of finishing cattle fed the wet milling byproducts steep liquor and distillers' solubles cannot be explained by increased MCP supply.

---

[1]Ryan Mass, graduate student; D.J. Jordon, technician; Todd Milton and Terry Klopfenstein, assistant professor and professor; UNL animal science, Lincoln. Rick Stock, Cargill Corn Milling, Blair, NE.