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

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Table 3. Quantity fed and economic benefits of wet byproduct feeds in Nebraska from 1992-1999.

	1992	1993	1994	1995	1996	1997	1998	1999
Wet distillers grains								
Quantity (1,000 tons DM)	0	0	70.0	145.8	173.3	311.0	345.1	352.4
Benefit (\$1,000,000)	\$0.00	\$0.00	\$1.37	\$5.69	\$2.17	\$4.77	\$14.22	10.27
Wet corn gluten feed								
Quantity (1,000 tons DM)	30.2	233.3	233.3	581.2	446.9	752.7	825.1	825.1
Benefit (\$1,000,000)	\$0.56	\$7.09	\$9.00	\$26.55	\$15.66	\$38.21	\$22.46	\$20.30
Steep liquor								
Quantity (1,000 tons DM)	6.8	52.5	52.5	57.8	44.0	69.5	78.5	78.5
Benefit (\$1,000,000)	\$0.40	\$3.60	\$4.37	\$5.27	\$4.07	\$6.81	\$5.26	\$3.95
All byproduct feeds								
Quantity (1,000 tons DM)	37.0	285.8	355.8	784.8	664.2	1133.3	1248.7	1256.0
Benefit (\$1,000,000)	\$0.96	\$10.69	\$14.74	\$37.51	\$21.90	\$49.78	\$41.94	\$34.51

the net economic benefit of the wet byproduct feeding innovation. The bottom line indicates the average feed value of wet distillers grain was \$140 per ton, while the opportunity cost as dried feed was \$118 per ton, for an average net benefit of \$22 per ton. Delivered price averaged \$107, indicating an average gain of \$32 per ton to feeders, and a \$10 per ton loss to processors. Over the past two years processors have obtained a positive \$5.77/ton benefit. It appears processors sold wet grains lower than

the opportunity cost in order to establish the market during the first few years.

Conversely, corn gluten feed was marketed above the opportunity cost beginning in 1992. The benefit to the processors has been \$8.14 per ton and the benefit to producers has been \$25.72.

In Table 3 we summarize our estimates of the quantities of byproduct feeds fed in Nebraska, and the total net benefits generated according to the estimated values per ton as reported in Table 2. As of 1992, the amount of

byproducts fed was negligible, but by 1997 the amount fed had grown to over a million tons, with an estimated net benefit of nearly \$50 million. Currently, 30% of the benefits are from distillers grains from the dry milling industry and 70% from the wet milling industry which produces corn gluten feed and steep liquor.

¹Richard Perrin, professor, Agricultural Economics; Terry Klopfenstein, professor, Animal Science.

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

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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.

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.

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Summary

A metabolism trial investigated microbial protein supply for finishing

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

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

Item ^b	Steps ^a					SEM
	1	2	3	4	5	
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

^aCattle 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.

^bEach 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.

Item	Diets ^a					SEM
	CONT	7.5STEEP	15STEEP	7.5DS	15DS	
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

^aDry-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.

^bOrthogonal contrast for CONT vs. average of other four treatments ($P = .32$).

^cOrthogonal contrast for CONT vs. average of other four treatments ($P = .05$).

rumen pH and average daily allantoin excretion in the urine.

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

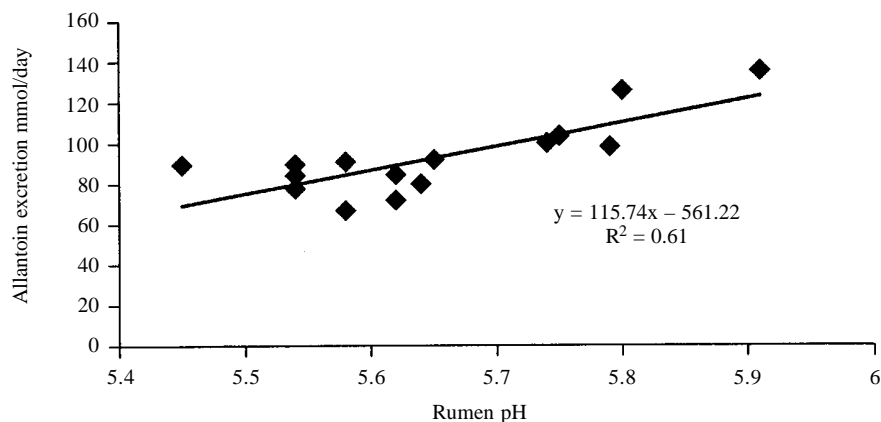


Figure 1. Urine allantoin excretion versus rumen pH of cattle fed various dry-rolled corn finishing diets (inclusion of wet-milling byproducts varies).

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.

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Programmed Gain Finishing Systems In Yearling Steers Fed Dry-rolled Corn Or Wet Corn Gluten Feed Finishing Diets

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Programming gain during the first 100 days of a 161-day finishing period resulted in reduced cumulative performance compared to ad libitum feeding.

Summary

One hundred sixty crossbred yearling steers were used in a completely randomized design to determine the response to a programmed gain finishing system in diets with and without wet corn gluten feed. Including a programmed gain phase in the finishing period reduced daily gain, hot carcass weight, fat thickness and marbling score in diets with and without wet corn gluten feed. Diets containing wet corn gluten feed increased daily gain, hot carcass weight and fat thickness compared with diets containing only dry-

rolled corn. Programming gain improved efficiency but reduced net return per animal and increased cost of gain versus ad libitum feeding.

Introduction

Improvements in feed efficiency have been demonstrated with feeding systems designed to control feed intake in feedlot cattle; however, daily gain may decrease, resulting in increased days on feed. There are many methods that can be used to control feed intake, one of which is an approach referred to as programmed gain. Programmed feeding techniques are systems in which the net energy equations are used to calculate the amount of feed required to achieve a predetermined rate of gain. Based on the diet being fed, a programmed rate of gain is selected and the amount of feed required to achieve the programmed rate of gain can be calculated. The interest in programmed gain feeding systems has been increased by reports that similar daily gains, hot carcass weights and days on feed can be achieved with programmed

gain feeding systems when compared to ad libitum feeding. At the same time, reductions in the amount of feed consumed result in improvements in efficiency. However, two previous studies (1999 Nebraska Beef Report, pp 46-48; 2000 Nebraska Beef Report, pp 41-43) conducted at the University of Nebraska to determine the effects of programmed gain feeding strategies failed to observe a significant improvement in feed efficiency while both daily gains and hot carcass weights were lower as a result of using a programmed gain feeding system.

Both of the previously conducted studies included wet corn gluten feed in the finishing diet. The objective of this study was to determine if the response to a programmed gain feeding system differed in finishing diets with and without wet corn gluten feed.

Procedure

One hundred sixty crossbred yearling steers (643 lb) were stratified by weight

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