DAKOTA GOLD®-BRAND DRIED DISTILLER'S GRAINS WITH SOLUBLES IN FINISHING CATTLE DIETS: A PREHARVEST STRATEGY AGAINST ACID RESISTANT *ESCHERICHIA COLI* AND COLIFORMS?

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Summary

Trial 1. Finishing beef heifers (345 head) were used in a 153-day finishing trial to evaluate the effects of feeding six levels of Dakota Gold®-brand dried distiller's grains with solubles (DDGS): 0%, 15%, 30%, 45%, 60%, 75% (dry basis), on the number of acid resistant *E. coli* and coliforms. Fecal grab samples were taken on day 65 and day 100, 2 and 20 hours after feeding, and were analyzed for acid resistant *E. coli* and total coliforms, as well as pH and VFA. There was a significant linear increase in fecal pH with increased DDGS at both 2 and 20 hours postfeeding ($P<0.05$). Total coliforms and acid resistant *E. coli* at 2 and 20 hours postfeeding were not affected by dietary treatment ($P>0.05$). Total fecal VFAs were not affected by dietary treatment or hour sampled after feeding ($P>0.05$)

Trial 2. Trial 2 was conducted on ruminally fistulated Jersey steers (18 head) using three levels of DDGS (0%, 30%, 75%). Rumen and fecal grab samples were taken after 4-week adaptation periods on three occasions after every animal had been on each level of the diet and had been sampled. Fecal and rumen samples were taken 2, 4, 6, 8, 12,18, and 24 hours post-feeding. Both fecal and rumen pH were unaffected by dietary treatment, yet an hour effect was noted. Dietary treatment had no effect ($P>0.05$) on *E. coli* or total coliforms cultured from rumen fluid or feces.

(Key Words: *E. coli,* Finishing Cattle, Dakota Gold Brand Dried Distiller's Grains with Solubles.)

Introduction

Recent food safety research has focused on pre-harvest intervention to reduce *E. coli* contamination. Methods such as vaccination, competitive exclusion, and diet have been proposed as strategies to prevent *E. coli* from contaminating the food supply. Studies have used various fiber sources to reduce numbers of acid resistant *E. coli* shed in cattle feces prior to slaughter. Feeding a fiber source such as hay before slaughter has been proposed as a method to reduce prevalence of acid resistant *E. coli.*

Dakota Gold dried distillers grain with solubles (DDGS) is higher in fiber (43% NDF, DM basis), fat, and protein as compared to cereal grains. Also, DDGS undergoes heating, creating Maillard products that can inhibit the growth of pathogenic microorganisms. We hypothesized that the high fiber content plus the Maillard products could reduce rumen and fecal acid-resistant coliforms, including *E. coli*.

Experimental Procedures

Trial 1. Three hundred sixty-three crossbred heifers (average wt 729 lb) were fed diets with six levels of DDGS (0, 15, 30, 45, 60 and 75%, DM basis) throughout a 153-day finishing experiment. Diet compositions are shown in Table 1. Heifers

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were stratified by previous treatment and randomly allocated to the six diets (54 total pens with 9 pens per diet, 6-7 head per pen). Fecal samples were aseptically obtained from heifers on days 65 and 100 (nine animals per diet, 54 animals daily), at 2 hours and 20 hours postfeeding. Samples of feces were incubated for 15 minutes in a citric acid/sodium phosphate buffer solution at pH 2, 4, and 7 to ascertain total and acid-resistant coliforms and *E. coli*. The samples in the pH 2 and pH 4 buffers were neutralized with sterile 1 M NaOH and placed on ice. Serial dilutions were made with each sample in 0.1% sterile peptone water, plated onto Petrifilm™ plates, incubated for 24 hours at 99°F and enumerated.

Trial 2. Eighteen ruminally fistulated Jersey steers were used in a 3 × 3 Latin square experiment. Steers were fed diets containing 0%, 30%, or 75% Dakota Gold-brand dried distiller's grains for a 16-week period (Table 2). Rumen and feces samples were obtained aseptically from each steer after a four-week adaptation period for each level at 2, 4, 6, 8, 12, 18, and 24 hours postfeeding. The fecal and rumen samples were processed in the same manner as the fecal samples from study 1.

Results and Discussion

Trial 1. Total VFA concentration in the feces was not affected ($P>0.05$) by dietary treatment or time sampled postfeeding (Figure 1). However, propionate levels were numerically higher at 20 hours post-feeding than at 2 hours postfeeding. Fecal pH was not affected by dietary treatment or sampling time ($P>0.05$), but increased linearly as DDGS increased (Figure 2). Diet did not affect either *E. coli* or total coliforms at pH 2, 4, or 7; however, more organisms were recovered at 2 hours post-feeding versus 20 hours postfeeding (Table 3). This suggests that dietary fiber may not be the diet component to be studied, since varying levels of DDGS had no significant effect on acid-resistant *E. coli* or total coliforms, fecal pH, or total VFAs. Sampling time had a significant effect, as *E. coli* and total coliforms were almost a half a $\log_{10}$ less at 20 hour postfeeding than at 2 hours postfeeding, demonstrating that results for an acid-resistance study can be affected by sampling time.

Trial 2. Neither fecal pH nor rumen pH were affected by dietary treatment, but pH increased with time after feeding ($P<0.05$; Figure 3). Fecal *E. coli* had a treatment by hour interaction ($P<0.05$). When pH 2 buffer was used to establish the presence of acid-resistance organisms, we found an effect of diet but this effect may have been related to unequal consumption in diets. Sampling time was again affected (Table 4), but, this could be related to differences of feed consumption. The first three time periods were sampled in succession and the cattle were not consuming as much because they may have been stressed by sampling. Neither rumen *E. coli* nor total coliforms were affected by dietary treatment or sampling time ($P>0.05$). The lower rumen pH could have killed many of the *E. coli* and total coliforms before reaching the hindgut, but the surviving organisms were acid tolerant and possibly grew in the neutral pH of the hindgut. The exact component of diet that affects acid-resistant *E. coli* and coliforms was not identified in this study.

Table 1. Diet Compositions (% of Dry Matter)

	Dried Distiller's Grains with Solubles[a]					
Item	0%	15%	30%	45%	60%	75%
DDGS[a]	-	15	30	45	60	75
Flaked corn	76.62	62.98	49.06	33.89	18.72	3.56
Ground corn	0.00	0.40	1.06	1.38	1.69	2.00
Alfalfa hay	10	10	10	10	10	10
Cane molasses	5	5	5	5	5	5
Dehulled soybean meal	3.01	1.43	0	0	0	0
Urea	1.21	1.06	0.79	0.67	0.55	0.43
Limestone	1.32	1.29	1.25	1.23	1.21	1.19
Salt	0.09	0.09	0.08	0.08	0.08	0.07
Medicated premix[b]	2.45	2.45	2.45	2.45	2.45	2.45
Vitamin/mineral premix[c]	0.09	0.09	0.08	0.08	0.08	0.07
Crude protein	14.0	14.1	15.0	16.6	18.1	19.7

[1]Dakota Gold-brand dried distillers grains with solubles.
[a]300 mg Monensin, 90 mg Tylosin and 0.5mg MGA.
[b]KSU Beef TM Mix.

Table 2. Diet Composition (Dry Basis, Trial 2)

	Dried Distillers Grains with Solubles[1]		
Item	0%	30%	75%
DDGS[a]	-	30	75
Flaked corn	76.62	49.06	3.56
Ground corn	0.00	1.06	2.00
Alfalfa hay	10	10	10
Cane molasses	5	5	5
Dehulled soybean meal	3.01	0	0
Urea	1.21	0.79	0.43
Limestone	1.32	1.25	1.19
Salt	0.09	0.08	0.07
Medicated premix[b]	2.45	2.45	2.45
Vitamin/mineral premix[c]	0.09	0.08	0.07

[1]Dakota Gold-brand dried distillers grains with solubles.
[a]KSU Beef TM Mix.

Table 3. Trial 1. Effects of Time After Feeding on Fecal *E. coli* and Coliforms

Item	2 Hours	20 Hours
Fecal E. coli	--Log_{10} CFU/G--	--Log_{10} CFU/g--
Buffer Treatment		
pH 2[1]	2.62	1.87
pH 4	5.90	5.48
pH 7	6.35	6.07
Fecal Total Coliforms	--Log_{10} CFU/g-	--Log_{10} CFU/g--
Buffer Treatment		
pH 2[1]	2.65	1.89
pH 4	5.98	5.64
pH 7	6.40	6.26

[1]Sampling time effect (P<0.05).

Table 4. Trial 2. Fecal and Rumen *E. coli* and Total Coliforms

	Dried Distillers Grains with Solubles[1]			P-Value	
Item	0%	30%	75%	Linear	Quadratic
Fecal *E. coli*		Log_{10} CFU/g			
Buffer Treatment					
pH 2[2]	3.24	2.78	2.75	0.67	0.03
pH 4	5.57	5.22	5.62	0.14	0.40
pH 7	6.77	5.91	6.22	0.34	0.00
Fecal Total Coliforms		Log_{10} CFU/g			
Buffer Treatment					
pH 2[2]	3.38	2.86	2.79	0.55	0.02
pH 4	5.80	5.40	5.72	0.25	0.13
pH 7	6.90	6.05	6.35	0.14	0.00
Rumen *E. coli*		Log_{10} CFU/mL			
Buffer Treatment					
pH 2	1.80	1.35	1.41	0.18	0.16
pH 4	3.54	2.66	2.72	0.12	0.16
pH 7	4.02	3.14	3.16	0.09	0.10
Rumen Total Coliforms		Log_{10} CFU/mL			
Buffer Treatment					
pH 2	1.87	1.39	1.49	0.21	0.15
pH 4	3.64	2.83	2.98	0.11	0.15
pH 7	4.15	3.39	3.41	0.11	0.16

[1]Dakota Gold-brand dried distillers grains with solubles.
[2]Hour effect (P<0.05).

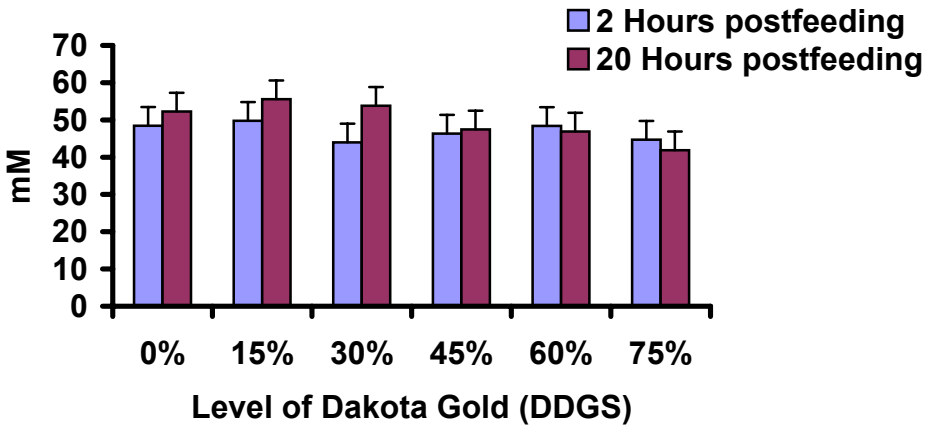
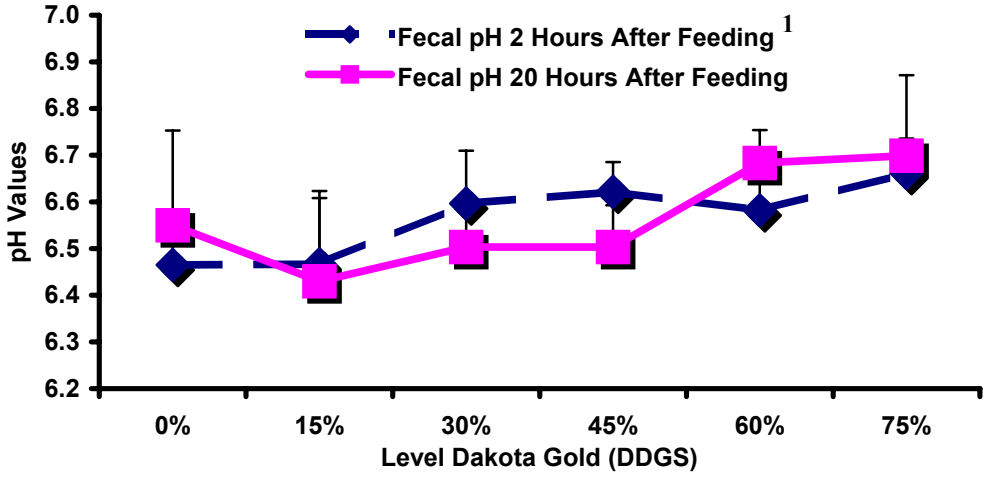
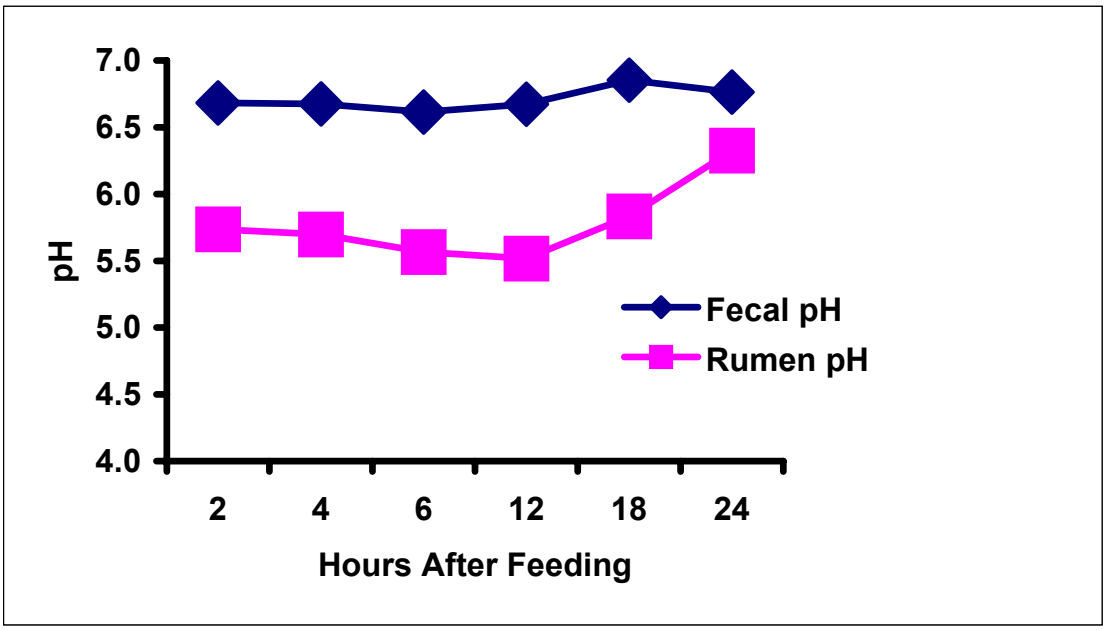


Figure 1. Total VFAs For Varying Levels Of Dakota Gold DDGS For 2 and 20 Hours Postfeeding (Trial 1).



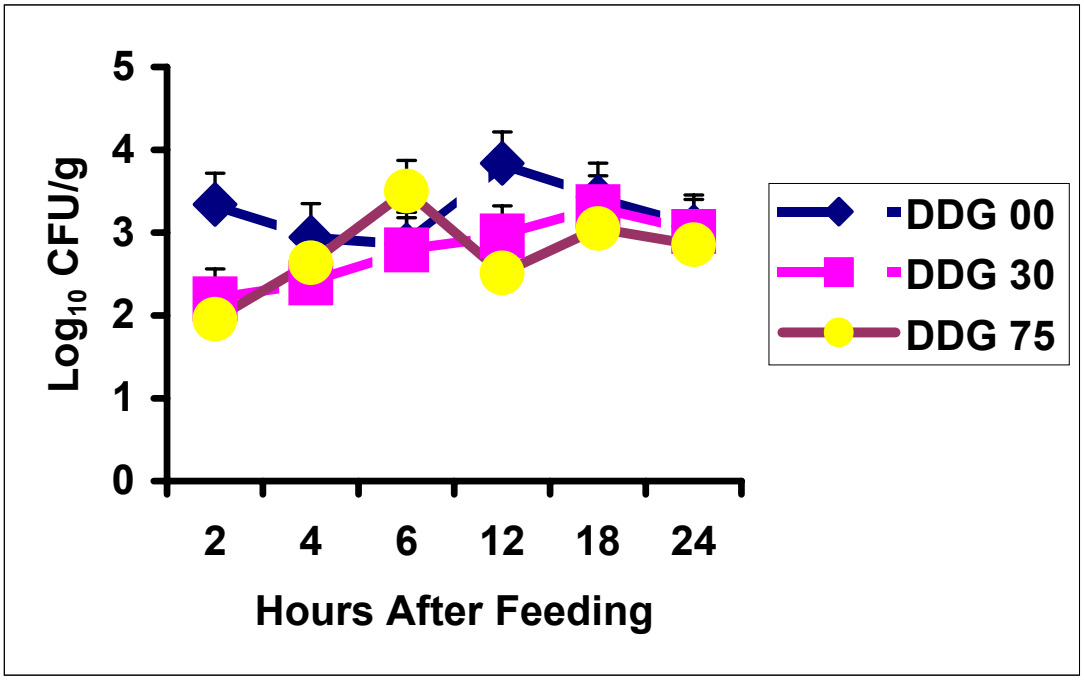
[1]Linear Effect (P< 0.05) of % DDGS.

Figure 2. Fecal pH at 2 and 20 Hours After Feeding Heifers Varying Levels of Dakota Gold Dried Distiller's Grains With Solubles (Trial 1).



[1]Hour effect, quadratic with regards to diet (P<0.05) SEM= .073
[2]Hour effect, quadratic with regards to diet and time (P<0.05) SEM = .077

Figure 3. Fecal[1] and Rumen[2] pH over a 24 Hour Period (Trial 2).



Quadratic effect (P<0.05)

Figure 4. Acid-Resistant Fecal *E. coli* (Trial 2).