The influence of grain source and dried corn distillers grains plus solubles oil concentration on finishing cattle performance and feeding behavior

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The objective of this experiment was to determine the effect of grain type (corn vs. barley) and oil concentration of dried corn distillers grains plus solubles (DDGS; moderate = 7.9 percent vs. low = 4.5 percent) on finishing performance, feeding behavior and carcass characteristics. Our data indicate that including a lower-fat DDGS, as compared with a moderate-fat DDGS, in a finishing diet may not influence finishing performance, feeding behavior or carcass measurements and that feeding barley-based diets resulted in decreased dry-matter intake and improved gain efficiency.

Summary

Eighty-one steers (944 ± 7.7 pounds of body weight) were used to determine the effect of grain type (corn vs. barley) and oil concentration of dried corn distillers grains plus solubles (DDGS; moderate = 7.9 percent vs. low = 4.5 percent) on finishing performance, feeding behavior and carcass characteristics. Steers were allotted by body weight to three pens. Within each pen, steers were assigned randomly to one of four dietary treatments (n = six or seven steers per treatment): 1) corn and moderate-fat DDGS, 2) corn and low-fat DDGS, 3) barley and moderate-fat DDGS and 4) barley and low-fat DDGS. Intake and feeding behavior traits were calculated from data generated via the Insentec feeding system. Steers were slaughtered with an average body weight of 1,473 ± 9.7 pounds and were marketed in two groups at 119 (n = 40) and 155 (n = 41) days. Final body weight and average daily gain were not affected ($P \geq 0.68$) by grain type or DDGS oil concentration. Dry-matter intake decreased ($P = 0.002$) and gain:feed increased ($P = 0.01$) in steers fed barley-based diets. Daily visits to the feeder decreased ($P = 0.05$), but time eating per visit increased ($P = 0.03$) in steers fed barley-based diets,

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compared with those fed corn-based diets. We found no effect ($P \geq 0.26$) of treatment on carcass traits: hot carcass weight; marbling; rib-eye area; 12th rib fat; and kidney, pelvic and heart fat. These data indicate steers fed barley-based diets had improved gain efficiency, having a greater gain:feed than steers fed corn-based diets. Oil concentration of DDGS had no effect on finishing performance. Steers fed barley-based diets spent more time eating per visit but visited the bunk less per day than those steers fed corn-based diets, which could account for the lower dry-matter intake in steers fed barley diets. Carcass traits were not affected by either grain type or oil concentration of DDGS. Our data indicate that including a lower-fat DDGS, as compared with a moderate-fat DDGS, in a finishing diet may not influence finishing performance, feeding behavior or carcass measurements, and that feeding barley-based diets resulted in decreased dry-matter intake and improved gain efficiency.

Introduction

Feed costs represent the largest direct cost in beef production. Utilizing different grain types can influence feed efficiency. Corn dried distiller grains plus solubles (DDGS) is a valuable feed product utilized in finishing diets (Klopfenstein et al., 2008) and may influence growth performance differently, depending on grain source and processing.

The ethanol industry is evolving and changing its production practices. This has resulted in changes in the nutrient composition of the final coproduct available as a feedstuff.

Decreasing fat in the diet has been shown to decrease average daily gain in finishing steers (Zinn, 1989). However, increasing oil concentration in the diet also can have a negative effect on digestibility of nonlipid energy sources (Jenkins, 1993), so DDGS with a lower oil concentration actually could provide beneficial affects to ruminants.

Therefore, research is needed to determine what affect DDGS oil concentration has on finishing cattle performance, feeding behavior and carcass quality when commonly fed feed grains are fed. We hypothesize that grain type and DDGS oil concentration will influence finishing performance and feeding behavior.

Our objectives were to determine the effects of grain source (corn vs. barley) and DDGS oil concentration (4.5 vs. 7.9 percent DM) on finishing performance, feeding behavior and carcass quality.

Experimental Procedures

All procedures with animals were approved by the North Dakota State University (NDSU) Animal Care and Use Committee. Eighty-one steers (944 ± 7.7 pounds of body weight) predominately of Angus, Simmental and Shorthorn breeding were used in a 2 x 2 factorial arrangement of treatments (grain type [rolled corn vs. barley] and DDGS oil concentration [moderate = 7.9 percent vs. low = 4.5 percent]; Tables 1 and 2).

The steers were allotted into three pens (light, medium and heavy pens; n = 27 per pen) and housed at the NDSU Beef Cattle Research Complex. Within each pen, steers were assigned randomly to one of four experimental treatment diets (n = six or seven steers per treatment within pen; n = 20 or 21 per treatment): 1) corn with moderate-fat DDGS, 2) corn with low-fat DDGS, 3) barley with moderate-fat DDGS, and 4) barley with low-fat DDGS.

Diets were formulated to meet or exceed recommendations for dietary intake protein (DIP), metabolizable protein (MP), vitamins and minerals (NRC, 1996). Diets were offered for ad libitum intake. Steers were adapted to experimental diets by transitioning to the final diet during a 21-day period. Intake

Table 1. Diet composition.

	Treatment			
	Rolled Corn		Rolled Barley	
Dietary Component, % of DM	Low-fat DDGS	Moderate-fat DDGS	Low-fat DDGS	Moderate-fat DDGS
Rolled corn	50	50	-	-
Barley	-	-	50	50
DDGS	25	25	25	25
Corn silage	20	20	20	20
Limestone	2	2	2	2
Urea	0.15	0.15	-	-
Salt	0.05	0.05	0.05	0.05
Vitamin premix[1]	0.01	0.01	0.01	0.01
Mineral premix[2]	0.05	0.05	0.05	0.05
Rumensin[3]	0.02	0.02	0.02	0.02
Tylan[4]	0.01	0.01	0.01	0.01
Fine-ground corn	2.71	2.71	2.86	2.86

[1]Contained 48,510 kilo International Units per kilogram (kIU/kg) vitamin A and 4,630.5 kIU/kg vitamin D.
[2]Contained 3.62 percent calcium, 2.56 percent copper,16 percent zinc, 6.5 percent iron, 4 percent manganese, 1.050 milligrams per kilogram (mg/kg) iodine and 250 mg/kg cobalt.
[3]Contained 176.4 grams (g) monensin/kg premix.
[4]Contained 88.2 g tylosin/kg premix.

Table 2. Analyzed nutrient concentration of diets (DM basis).

Dietary Component, % of DM	Treatment			
	Rolled Corn		Rolled Barley	
	Low-fat DDGS	Moderate-fat DDGS	Low-fat DDGS	Moderate-fat DDGS
Crude protein	13.7	14.0	14.8	14.8
Neutral detergent fiber	29.8	31.8	32.6	34.7
Acid detergent fiber	11.9	12.5	13.3	14.1
Ether extract	3.49	4.18	2.40	3.11
Calcium	1.09	1.16	1.15	1.07
Phosphorus	0.46	0.46	0.50	0.48
Starch	43.6	42.1	37.1	37.5

and feeding behavior traits were calculated from data generated via the Insentec feeding system.

Steers were slaughtered with an average body weight of 1,473 ± 9.7 pounds and were marketed in two groups at 119 (n = 40) and 155 (n = 41) days. Data were analyzed as a completely randomized block (days to slaughter) design using the generalized linear means mixed procedure of SAS with a 2 x 2 factorial arrangement of treatments. Data were considered significant when $P \leq 0.05$ and a tendency was considered when $0.05 < P \leq 0.10$.

Results and Discussion

Initial and final body weight did not differ between grain types or DDGS oil concentration (Table 3). We found no difference in average daily gain between grain types or DDGS oil concentration. Dry-matter intake decreased ($P = 0.002$) in steers fed barley, as compared with corn; however, we found no differences in dry-matter intake between DDGS oil concentrations. Barley-fed steers had increased ($P = 0.01$) gain:feed, compared with corn-fed steers, and we found no differences between DDGS oil concentrations.

No differences were observed in hot carcass weight; marbling score; rib-eye area; 12th rib fat; or kidney, pelvic and heart fat among steers fed different grain types or oil concentration of DDGS. We found a decrease ($P = 0.05$) in visits to the bunk per day in steers fed barley, compared with those fed corn, but no differences were found between DDGS oil concentrations (Table 4).

Time eating per visit increased ($P = 0.03$) in barley-fed steers. We observed a tendency ($P = 0.06$) for time eating per visit with DDGS oil concentrations to increase in low-oil-concentration DDGS. We found a tendency ($P = 0.09$) for a decrease in eating rate per visit for steers fed moderate-oil-concentration DDGS. We also observed a tendency ($P = 0.06$) for a decrease in eating rate per meal in barley-fed steers. No differences were found in eating rate per meal between oil concentrations of DDGS.

Research conflicts in regard to the effects on gain efficiency when different grain types are fed in finishing diets. These differences could be due to a number of variables, such as diet composition, grain source (field by field, state and region variety) or grain variety. Differences in dry-matter intake appear to be the driving influence behind the improved efficiency observed in this study.

Intake can be affected by roughage source and inclusion level in the diet and grain processing and, therefore, differences in each experiment's diets could affect intake. Our results were in agreement with the data suggesting that feeding barley improves gain efficiency, as compared with feeding corn.

Bremer et al. (2015) studied the effect of increasing distillers products with a reduced oil concentration on cattle performance to determine if the oil concentration affects average daily gain. Their results indicated an increase in average daily gain with increasing reduced-oil wet distillers grains plus solubles (7.9 percent fat) similar to normal-oil wet distillers grains plus solubles. Similar to our results, they also reported no differences in growth performance when feeding reduced-oil-concentration (7.9 percent fat) wet distillers grains plus solubles, compared with a normal wet distillers grains plus solubles (11.3 percent fat).

Steers fed barley-based diets spent more time eating per visit but visited the bunk less per day than those steers fed corn-based diets, which could account for the lower dry-matter intake in steers fed barley diets.

Steers fed moderate-oil-concentration DDGS tended to spend less time at the bunk per visit, which could be associated with changes in ruminal fermentation and digestion. More research is needed to better understand the effects that changes in feeding behavior induced by feeding different feeds have on growth performance.

In conclusion, utilizing barley, in comparison with corn, in finishing cattle diets decreased dry-matter intake, increased gain:feed and altered feeding behavior in cattle consuming a 90 percent concentrate diet without affecting carcass mass or quality. Utilizing a lower-oil-concentration DDGS did not significantly impact performance or carcass quality.

We found a tendency for oil concentration of DDGS to alter

feeding behavior; however, this did not seem to influence performance. Therefore, utilizing DDGS with a lower oil concentration in finishing diets likely will not greatly affect performance or carcass quality of finishing cattle.

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Table 3. Effects of grain source and oil level of dried distillers grains plus solubles on feeding behavior in finishing cattle.

	Treatment							
	Rolled Corn		Rolled Barley					
Item	Low-fat DDGS	Mod-fat DDGS	Low-fat DDGS	Mod-fat DDGS	SEM[a]	Grain	DDGS	Grain*DDGS
Initial weight, lb.	937	939	952	937	15.6	0.74	0.66	0.57
Final weight, lb.	1,464	1,482	1,479	1,462	19.4	0.89	0.94	0.34
Average daily gain, lb./day	3.95	4.06	4.01	3.97	0.088	0.79	0.68	0.41
Dry matter intake, lb.	26.7	26.2	24.9	24.9	0.49	0.002	0.85	0.75
Gain:feed	0.149	0.154	0.161	0.159	0.0034	0.01	0.62	0.24
Hot carcass weight, lb.	904	908	897	897	13.9	0.52	0.82	0.85
Marbling score[b]	508	477	475	483	26.8	0.62	0.67	0.46
Rib-eye area, in.^{2}	13.7	14.2	13.8	13.6	0.05	0.55	0.59	0.26
12th rib fat, in.	0.539	0.500	0.504	0.528	0.0164	0.96	0.86	0.45
Kidney, pelvic, and heart fat, %	1.84	1.82	1.83	1.79	0.042	0.56	0.53	0.84

[a]Standard error of the mean (n = 20).
[b]400 to 499 = small, 500 – 599 = modest.

Table4. Effects of grain source and oil level of dried distillers grains plus solubles on feeding behavior in finishing cattle.

	Treatment							
	Rolled Corn		Rolled Barley					
Item	Low-fat DDGS	Mod-fat DDGS	Low-fat DDGS	Mod-fat DDGS	SEM[a]	Grain	DDGS	Grain*DDGS
Events, per day								
Visits	27.1	28.6	23.1	26.2	1.6	0.05	0.16	0.60
Meals	7.35	7.62	7.61	7.55	0.257	0.71	0.68	0.53
Time eating, min.								
Per visit	3.46	3.18	4.21	3.55	0.248	0.03	0.06	0.44
Per meal	12.67	11.30	11.68	11.88	0.561	0.71	0.29	0.17
Eating rate, lb.								
Per visit	1.03	0.99	0.20	1.00	0.069	0.17	0.09	0.20
Per meal	3.73	3.53	3.37	3.35	0.146	0.06	0.42	0.53
Per min	0.300	0.313	0.298	0.287	0.0104	0.17	0.95	0.25

[a]Standard error of the mean (n = 20).