Performance and Carcass Traits of Yearling Steers Fed Barley- based Finishing Diets with Increasing Levels of Dried Distillers Grains

V.L Anderson, B R. Ilse, and J.P. Schoonmaker
NDSU Carrington Research Extension Center

Abstract
One hundred-thirty heavy yearling steers (980 lbs. ±14.5 pounds) were used to determine the effects of increasing levels of dry distillers grains in barley-based finishing diets on feedlot performance, carcass traits and carcass value. Steers were blocked by weight into four groups, and randomized within block to treatment diets. Diets were based on dry-rolled barley with 0, 12, 24, and 36% dry distillers grains. Dry matter intake increased linearly (P <0.01) with level of distillers grains during the first two months on feed and overall tended to show a linear response (P =0.09). Gains improved with distillers grains in the diet (P <0.01) and a linear increase was observed with increasing level of distillers grains (P <0.01). At the end of the 90-day study, steers in the 24% treatment were heavier (P <0.01) than the 0 and 12% with 36% intermediate. No differences in feed efficiency were observed. Carcass traits reflected the increased rate of gain with higher dressing percent (P <0.01), fat content (P <0.01), marbling scores (P <0.01), internal fat (KPH, P <0.01), and a higher percentage of Choice carcasses. The use of distillers grains with barley increased carcass value above the control by $30.83 for 12% distillers grains, $83.34 for 24% distillers grains, and $70.98 for 36% distillers grains due primarily to higher percentage USDA Choice carcasses, but also to greater carcass weight. From this data, it appears that barley fed with dry distillers grains at 24% of the diet provides for excellent growth of yearling cattle, improved carcass quality traits and greater net return.

Key words: DDGS, barley, feedlot, carcass.

Introduction
Barley is used throughout the world in many different livestock rations. North Dakota produces more barley than any other state in the U.S. Six-rowed and two-rowed barley are both high in starch, low in fat, and contain modest amounts of crude fiber and crude protein. Both the starch and protein components of barley are rapidly fermented in the rumen. Maximum performance of feeder cattle on barley-based diets may only be achieved with the supplementation of rumen-undegradable (escape or by-pass) protein. Dried distillers grains plus solubles (DDGS) contain 10 to 15% fat (oil), 40 to 45% NDF, 30 to 35% CP, and 5% ash (NRC, 1996). Distillers grains can be fed wet or dry and are slowly fermented in the rumen due to a high proportion of rumen-undegradable protein. There has been little research feeding barley and DDGS together.

Because DDGS is a fiber-based feed, it may stabilize rumen pH and reduce the potential for acidosis when used at modest levels of the diet compared to high levels of cereal grains. The objective of this trial was to determine the optimum level of dry distillers grains in barley-based diets to maximize cattle performance and producer profit.

Materials and Methods
One hundred-thirty crossbred heavy feeder steers (Avg. wt. 980 pounds ± 14.5 pounds) were allotted to four weight blocks based on an initial weight and then randomly to one of four barley-based diets within each block (4 pens per treatment, 8 or 9 head per pen) to determine the optimum level of DDGS inclusion to maximize cattle performance. Diets were formulated with DDGS included at 0, 12, 24, and 36% of the diet DM (Table 1). Canola meal was used as the

protein supplement in the 0% DDGS diet. Calves were fed totally-mixed rations once daily to appetite based on morning bunk readings, with feed intake recorded daily. Feed intake, gain, and feed efficiency were summarized for each of the three weigh periods and overall for the 90-day finishing period.

Table 1. Barley-based finishing rations with increasing dried distillers grains

	Ration Treatment			
	0% DDGS	12% DDGS	24% DDGS	36% DDGS
Ingredient	Dry matter basis, %			
Barley, dry-rolled	76.96	68.4	52.28	44.4
Dry dist grains w/solubles	0	12.07	24.04	36.06
Corn Silage	16.43	16.71	16.86	16.77
Canola meal	3.98	0	0	0
Ground limestone	0.78	0.94	0.95	0.94
Rumensin, Vit, Min supplement	1.95	1.88	1.9	1.89
Nutrients				
Crude protein, %	13.5	13.9	15.4	16.9
Metabolizable protein ratio	92	106	123	140
Degradable protein ratio	144	135	133	131
NEg, Mcal/lb	61	61	62	62

Growing diets (40% roughage) were fed upon arrival and cattle transitioned to the finishing diets within two weeks (15% roughage, 62 Mcal/lb). All diets were formulated to contain equal amounts of energy with increasing protein provided in the DDGS treatments (Table 1). Feed samples were taken weekly and composited for analysis of DM and CP. Barley was dry rolled using an 8-grooves-per-inch, single-stage, 24-inch Roskamp roller mill. Steers were housed and fed at the Carrington Research Extension Center feedlot in open drylot pens during the summer of 2006. Steers were vaccinated against IBR, BVD, PI3, BRSV and clostridia (7-way) four weeks prior to the initiation of the trial. All steers were implanted with Synovex Plus (200 mg trenbolone acetate, 24 mg estradiol) at the initiation of the trial. Rations included supplemental calcium carbonate to achieve a 1.5 to 1 Ca to P ratio with Rumensin® included at 300 mg per head daily. Cattle were marketed at a commercial slaughter plant when it was estimated that 60% would grade low choice or higher. Carcass traits and USDA Yield and Quality Grades were quantified by qualified individuals after a 24-hour chill.

All animals in this study were managed according to best management practices and the project was approved by the NDSU Institutional Animal Care and Use Committee.

Blood samples were taken by veinipuncture from six steers in each treatment group prior to slaughter. Whole blood was centrifuged and serum was decanted, frozen and submitted to a commercial laboratory for analysis of blood urea nitrogen (BUN). BUN is an indicator of nitrogen recirculating in the bloodstream and high protein diets are thought to potentially increase BUN levels.

Statistical Analysis

Data were analyzed using SAS Mixed Procedures (SAS Institute, Crary, NC). Blocks were considered replicates and pen was the experimental unit. *P* values are provided so the reader

can make their own value determination of significance with a reminder that these coefficients are merely indicators of the effectiveness of experimental treatments on respective variables.

Steers feeding at bunk.

Results and Discussion

Feedlot performance

During the first two months on the treatment diets, dry matter intake (DMI) increased with any amount of distillers grains in the diet ($P < 0.01$) and a significant linear effect ($P < 0.01$) was observed with increasing distillers grains in the diets. However, during the final feeding period of the 90-day trial, no significant differences were observed resulting in a tendency ($P = 0.14$) for improved DMI with any level of distillers grains and some indication of a linear response ($P = 0.09$) from level of distillers grains (Table 2). Average daily gains (ADG) responded positively to distillers grains as well with increased ADG ($P < 0.01$) from any amount of distillers grains in the diet and a linear effect ($P < 0.01$) observed for increasing distillers grains level (Table 2). Feed efficiency did not differ ($P > 0.10$) and is reported in Table 2 as both feed (DM) per unit gain and gain per unit feed (DM). Serum BUN levels were similar ($P = 0.27$) with means of 15.0, 13.9, 15.9, and 18.3 mg/dl for 0, 12, 24, and 35% DDGS, respectively. The normal range for BUN in cattle is 20-30 mg/dl.

Table 2. Effects of barley-based finishing diets with increasing levels of distillers grain on finishing steer weight gain, feed intake, and feed efficiency.

							Contrast	
	0% DDGS	12% DDGS	24% DDGS	36% DDGS	Std Err	P Value	Distillers vs. No distillers	Linear
No. Head	32	33	32	33				
No Pens	4	4	4	4				
Avg. weight, lbs.								
15-Jun	983.6	977.2	992.5	967.7	14.5	0.56	0.76	0.57
13-Jul	1068.9	1065.8	1104.5	1077	12	0.1	0.33	0.25
10-Aug	1176.1	1188.9	1248.6	1196.6	13.7	0.01	0.03	0.05
13-Sep	1297.4[a]	1293.0[a]	1358.4[b]	1311.1[ab]	15.5	0.02	0.2	0.13
Dry Matter Intake, lbs./hd/day								
Period 1	22.91[a]	24.00[ab]	26.63[c]	25.6[bc]	0.58	0.01	0.01	0.01
Period 2	22.13[a]	22.68[a]	25.89[b]	23.65[ab]	0.42	0.01	0.01	0.01
Period 3	29.54	27.97	31.5	29.43	1.91	0.64	0.97	0.72
Overall	24.75	24.96	27.92	26.24	0.88	0.09	0.14	0.09
Avg Daily Gain, lb								
Period 1	2.864[a]	2.996[a]	3.816[b]	3.698[b]	0.21	0.01	0.01	0.01
Period 2	3.827[a]	4.395[ac]	5.145[bc]	4.272[ac]	0.18	0.01	0.01	0.01
Period 3	4.529[a]	3.720[b]	4.173[ab]	4.227[ab]	0.21	0.05	0.04	0.62
Overall	3.683[a]	3.722[a]	4.34[b]	4.04[ab]	0.12	0.01	0.01	0.01
DM per gain								
Period 1	8.59	8.27	7.07	7.16	0.91	0.57	0.32	0.21
Period 2	5.87	5.24	5.06	5.6	0.3	0.28	0.13	0.47
Period 3	6.57	7.53	7.73	7.07	0.59	0.54	0.23	0.54
Overall	6.54	6.5	6.23	6.31	0.26	0.82	0.55	0.43
Gain per feed								
Period 1	0.125	0.126	0.144	0.146	0.016	0.69	0.48	0.28
Period 2	0.172	0.193	0.199	0.181	0.01	0.31	0.14	0.49
Period 3	0.155	0.134	0.134	0.144	0.011	0.48	0.18	0.51
Overall	0.154	0.154	0.161	0.159	0.006	0.81	0.57	0.44

[a,b,c] Values with different superscripts are significantly different P<.05.

Carcass traits and value

All the carcass traits measured except ribeye area responded positively to any level of DDGS and linearly increasing levels of DDGS. Ribeye area exhibited a quadratic response. Marbling

scores improved with DDGS leading to a greater percent Choice or better carcasses for treatments with DDGS. Carcass value was calculated using a constant price for each of the feeds and a $12 price differential from USDA Choice to Select grades. The increased percent Choice was the primary reason for the increased carcass value. After subtracting the value of the feed consumed during the trial period, the increase in value for carcasses from the respective treatments above the control treatment was $30.83 for 12% distillers grains, $83.34 for 24% distillers grains, and $70.98 for 36% distillers grains. In this scenario, barley was valued at $3.00 per 48-pound bushel, canola meal at $160 per ton, and dry distillers grains at $140 per ton.

Table 3. Carcass data from steers fed barley with increasing levels of dry distillers grain.

	Treatment						Contrast	
	0% DDGS	12% DDGS	24% DDGS	36% DDGS	St. Err	P Value	Dist vs. No Dist	Linear
Hot Carcass Wt., lbs.	754.5[a]	759.6[a]	806.4[b]	781.3[ab]	11.1	0.01	0.01	0.01
Dr. Percent	60.92[a]	61.54[ab]	62.18[abc]	62.49[c]	0.03	0.01	0.01	0.01
REA, Sq in.	13.41[ab]	13.12[ab]	13.65[ab]	12.94[b]	0.17	0.03	0.41	0.27
Fat Thickness, in	0.36[a]	0.44[ab]	0.49[ab]	0.52[b]	0.03	0.01	0.01	0.01
Marbling Score*	389[a]	426[ab]	432[ab]	446[b]	16.25	0.09	0.02	0.02
Yield Grade	2.91[a]	3.11[ab]	3.23[b]	3.30[b]	0.07	0.01	0.01	0.01
KPH, %	2.25[a]	2.31[ab]	2.38[ab]	2.48[b]	0.05	0.01	0.01	0.01
Percent USDA Choice	31	53	66	69				

[abc] Values with different superscripts are significantly different (P<0.05)

* Marbling score: 300 to 399 = Select; 400+ = Choice

Discussion

With increasing demand and price for corn for ethanol production, feeders are looking for other grains that are competitively priced. The increasing supply of distillers grains has stimulated interest in feeding higher levels than previously recommended. Extensive research has demonstrated the effectiveness of DDGS when used as a protein or energy feed in corn-based diets. Increased feed intake, gain, and efficiency were observed when DDGS was added to corn-based diets up to 15% of the diet DM, but a linear decrease in gain, intake, and efficiency was observed when DDGS was included up to 75% of the diet DM. Current recommendations are for a maximum of 20 to 25% DDGS in corn-based feedlot diets. Consideration must be given to the sulfur content of DDGS when included in formulations higher than 20-25%. The maximum level of dietary sulfur recommended in high grain diets by NRC (1996) is 0.4%. NRC (1996) also reports sulfur levels in DDGS at 0.4% but field reports have been verified at up to 1.4%. Sulfur content in corn grain and barley are similar at 0.14% according to NRC (1996). Sulfur toxicity causes polioencephalomalacia (PEM) which can be lethal. Thiamin treatment is usually effective for mild cases but death is often the end result in severe cases. High sulfate water can exacerbate the problem, especially if DDGS contain more than 0.4% sulfur.

Research conducted at the Carrington Center (Anderson and Schoonmaker, 2005) demonstrated that average daily gain and dry-matter intake increased linearly when modest amounts of wet and/or dry distillers grains (up to 14% of the diet DM in growing diets and 8% of diet DM in finishing diets) were added to barley-based diets. In this study, any combination of wet and/or dry-distillers grains appears to support improved DMI and ADG over the control diet

with barley and urea. Hot carcass weights reflected the improved gain but no other effects were observed on carcass traits. Pamp et al., (2004) also observed improved gain when barley-based diets were supplemented with rumen-undegradable protein sources of feather meal and blood meal.

This study was conducted with yearling cattle on feed for 90 days. Additional research is warranted to determine the response of weaned calves to diets with barley and distillers grains when fed to finish weight.

Implications

From this data, it appears that cattle fed barley-based diets may have greater feed intake and faster gains when distillers grains are added to the rations. Improved carcass quality traits and value were also observed. Feeding distillers grains at 24% of diet dry matter appears to be optimum of the treatments used in this study. The relative cost of DDGS or WDGS needs to be considered in formulating diets. Logistics considerations for distance from ethanol plant(s), cost of trucking, rate of use, and storage area are also important. According to this study, with current prices for feed commodities and carcass beef, greater profit can be achieved when DDGS is fed with barley. Wet distillers grains should provide as good or possibly greater performance. The growing feedlot industry in North Dakota is being confronted with a limited and high-priced corn supply, but a larger supply of distillers grains coupled with feed-barley may be a viable replacement. Animal performance and improved carcass value suggest these two feeds could be the foundation of a profitable feedlot industry in the Northern Plains.

Literature Cited

Anderson, V. L. and J. P. Schoonmaker. 2005. Effect of rumen-degradable and undegradable protein sources in barley-based growing and finishing diets. NDSU Beef Feedlot Report. Carrington Research Extension Center. Volume 28:16-22.

NRC. 1996. Nutrient Requirements of Beef Cattle. 7th Revised Edition. National Academy Press. Washington, D.C.

Pamp, Benjamin, Marc Bauer and Greg Lardy. 2004. The effect of rumen-degradable and undegradable protein supplementation on barley-based high-grain finishing diets on feedlot performance and carcass traits of beef steers. NDSU Beef Feedlot Report. Carrington Research Extension Center. Volume 27:20-23. ■