Feeding of 60% Dried Distillers Grains in Finishing Rations Results in Acceptable Lamb Performance and Carcass Quality

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Dried distillers grains, replacing barley and soybean meal in up to 60% of the ration, maintained lamb performance and had no negative effect on lamb carcass traits when compared to a barley based ration.

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Introduction

Coproducts from the ethanol industry are increasingly available in the northern Great Plains as the ethanol industry continues to expand. Dried distillers grain (**DDG**), one such coproduct, is an excellent source of energy and protein for beef cattle and sheep (Lardy, 2003). North Dakota, Minnesota, and South Dakota annually produced about 900,000 tons of DDG, approximately 80% of which are fed to ruminants. Historically, research in beef cattle backgrounding and finishing diets report that DDG can be fed as a source of supplemental protein and/or energy, with optimum inclusion levels at approximately 20% of the diet dry matter (Lardy, 2003). However, DDG are high in potassium, phosphorus, and sulfur, and care must be used when feeding DDG at the upper limits of the recommendation. Additionally, as DDG prices stabilize and become cheaper as more product becomes available, some producers are interested in the maximum inclusion levels of DDG in finishing rations. . To prevent polioencephalomalacia in sheep, current recommendations are to keep dietary concentrations of sulfur below 0.3% DM when animals are fed concentrate diets, or 0.5% DM when fed high-forage diets (NRC, 2007). When feeding greater than 20% of the diet as DDG, dietary sulfur concentrations usually will exceed 0.3% DM. However, recent research results in cattle indicate that as much as 50% of the ration (DM basis) may contain DDG when 150 mg/hd/d supplemental thiamin is provided (Huls et al., 2008). Little research has evaluated the inclusion of dried distillers grains as a replacement for concentrate in lamb finishing rations.

Schauer et al. (2005, 2006) and Huls et al. (2006) reported that DDG can be included at levels up to 22.5% of a finishing ration with no negative affect on lamb performance or carcass traits. In fact, the supplemental energy and protein supplied by DDG, when compared to either barley or corn based diets, may in fact increase performance (Schauer et al., 2006). While it is widely accepted that DDG are an excellent source of protein and energy, the unique problems of feeding feedstuffs high in phosphorus and sulfur to sheep warrant additional research. Maintaining a calcium to phosphorus ratio of 2:1 or greater for the prevention of urinary calculi may become difficult as the level of DDG included in lamb finishing rations increases. This study was designed to evaluate how lambs respond to increasing levels of DDG in a finishing ration, specifically when sulfur concentrations become toxic, while providing supplemental thiamin to prevent polioencephalomalacia.

Procedures

A randomized complete design was used to evaluate the influence of DDG in lamb finishing diets. Two-hundred forty western white-faced Rambouillet wether and ewe lambs (69.8 ± 1.3 lbs initial BW) were stratified by weight and sex and assigned randomly to 16 pens (15 lambs/pen). Pens were then assigned to one of four diets; 0% replacement of barley with DDG (**Control**), 20% DDG in ration replacing barley (**20%**), 40% DDG in ration replacing barley (**40%**), or 60% DDG in ration replacing barley (**60%**; Table 1). Lambs were fed a finishing diet for 111 days. Diets were balanced to at

least meet crude protein, energy, and copper requirements (NRC, 2007); however, they were not kept isocaloric or isonitrogenous as level of DDG inclusion increased (Table 1). Thiamin was included at 142 mg/hd/d (DM basis) in all rations for the prevention of polioencephalomalacia. The control diet consisted of 76.5% barley and 12.5% alfalfa hay. Rations were formulated as to maintain a Ca:P ratio of 2:1 or greater and sulfur was evaluated (Table 1). Rations were mixed and ground through a grinder-mixer and provided ad-libitum via bulk feeders. Lambs were weighed on day 0, 32, 56, 83, and 111. Initial and final weights were an average of two-day weights. Following the 111 day finishing period, lambs were harvested and carcass data collected at Iowa Lamb Corp, Hawarden, IA. Feedlot performance and carcass trait data were analyzed as a randomized complete design using the GLM procedure of SAS (SAS Inst. Inc., Cary, NY). The model included treatment. Contrast statements included 1) Control vs DDG inclusion; 2) linear effect of DDG inclusion; 3) quadratic effect of DDG inclusion; and 4) cubic effect of DDG inclusion.

Results

The effects of treatments on feedlot performance and carcass traits are shown in Table 2. Final weight, ADG, Feed:Gain, Gain:Feed, mortality, hot carcass weight (**HCW**), leg score, conformation score, fat depth, body wall thickness, ribeye area, quality grade, yield grade, and % boneless closely trimmed retail cuts (**% BCTRC**) were not affected by treatment ($P \geq 0.15$). Intake increased in a linear manner ($P < 0.001$) as level of DDG inclusion increased. Additionally, flank streaking increased ($P = 0.09$) in a cubic relationship to the control as level of DDG inclusion increased.

Discussion

Dried distillers grains replacing up to 60% of the ration in a barley and alfalfa based finishing ration had no affect on lamb performance. However, intake did increase linearly as level of DDG inclusion increased. One possibility for the increase in intake was increased palatability of the ration, possibly due to increased fat concentration of the ration. Although intake increased, a significant increase in ADG was not observed. However, a numerical increase in ADG of approximately 6% was observed for all

Table 1. Dietary ingredient and nutrient composition of control and dried distillers grain diets

	Diets[a]			
Item	Control	20%	40%	60%
	%, DM basis			
Ingredient				
Barley	76.50	61.48	41.48	21.48
Dried distillers grain	---	20.00	40.00	60.00
Alfalfa	12.50	12.50	12.50	12.50
Soybean Meal	5.00	---	---	---
Ammonium Chloride	0.50	0.50	0.50	0.50
Trace mineral[b]	5.00	5.00	5.00	5.00
CTC[c]	0.50	0.50	0.50	0.50
Nutrient Concentration				
CP, %	19.80	20.10	25.10	27.20
TDN, %	79.10	81.60	84.00	84.60
$NE_{maintenance}$, Mcal/lb	0.85	0.88	0.92	0.92
NE_{gain}, Mcal/lb	0.57	0.59	0.61	0.61
Crude Fat, %	2.50	4.03	6.69	8.34
Acid Detergent Fiber, %	10.20	9.72	10.90	12.50
Sulfur, %[e]	0.22	0.32	0.47	0.55
Calcium, %	2.14	1.77	1.17	1.38
Phosphorus, %	0.48	0.55	0.66	0.67
Copper, ppm	12.00	10.00	11.00	10.00
Zinc, ppm	73.00	75.00	86.00	63.00
Thiamin, mg/hd/d	142.00	142.00	142.00	142.00

[a]Control = 0% replacement of barley with dried distillers grains; 20% = 20% dried distillers grain in ration replacing barley; 40% = 40% dried distillers grain in ration replacing barley; 60% = 60% dried distillers grain in ration replacing barley.

[b]Trace mineral: 0.12 % S, 0.31% P, 1.2% K, 1.45% Mg, 17.47% Ca, 2.82% Na, 509 ppm Fe, 375 ppm Mn, 50 ppm Cu, 715 ppm Zn, 5 ppm Se, 891 mg/lb Thiamine, 43.25 KIU/lb Vitamin A, 4.3 KIU/lb vitamin D3, 4320 IU/lb Vitamin E, 430 mg/lb Bovatec®.

[c]CTC (4G) was formulated to provide 48 g/ton chlortetracycline.

[e]Sulfur may be toxic at 0.30% of diet.

DDG treatments when compared to the control. Other researchers suggest that DDG can be an effective replacement of concentrate with no affect of livestock performance compared to control rations. Erickson et al. (1989) provided up to 28% of a finishing ration as DDG and observed no negative affects on performance. Similarly, Schauer et al. (2005) replaced up to 15% of the total ration and Huls et al. (2006) replaced up to 22.9% of the ration with DDG and found no difference in lamb performance or carcass traits. However, Schauer et al. (2006) reported an increase in performance from increasing levels of DDG at levels up to 22.5% of the ration. In both the Schauer et al. (2006) trial and the current trial, CP levels of the DDG rations are in excess of the requirements for lambs (NRC, 2007). In the control rations, CP may be limiting as corn and/or barley CP concentrations are substantially lower than DDG crude protein concentrations. Future research is needed to determine if adequate performance can be maintained while utilizing lower quality forages than alfalfa with DDG replacing a portion of the concentrate in the diet. Additionally, continued quantification of CP requirements is needed. In the current trial and in Schauer et al. (2006) the control ration was balanced for the CP requirements based on current literature, but marginal increases in ADG were observed as dietary CP increased with increasing levels of DDG.

The majority of carcass traits were not affected by increasing levels of DDG in the ration. These results are supported in research conducted by Schauer et al. (2005, 2006) and by Huls et al. (2006). In the current trial only marginal increases in flank streaking were observed, potentially the result of increased energy density in the rations with higher levels of DDG inclusion .

Table 2. The influence of dried distillers grains on feedlot lamb performance and carcass characteristics

Item	Treatment[a]					*P*-value[c]				
	Control	20%	40%	60%	SEM[b]	*P*-value	Linear	Quad-ratic	Cubic	Con. Vs. DDG
Initial Wt (lbs)	68.00	70.00	71.00	70.00	1.30	0.55	0.47	0.22	0.97	0.22
Final Wt (lbs)	132.00	137.00	137.00	137.00	2.00	0.27	0.15	0.25	0.49	0.06
ADG (lbs/day)	0.58	0.62	0.61	0.62	0.02	0.21	0.11	0.41	0.25	0.05
Intake (lbs/hd/d)	3.69	3.91	4.03	4.20	0.07	0.001	< 0.001	0.71	0.64	< 0.001
F:G	6.38	6.31	6.66	6.75	0.20	0.38	0.13	0.72	0.48	0.41
G:F	0.16	0.16	0.15	0.15	0.005	0.53	0.20	1.00	0.51	0.39
Mortality	0.75	0.25	0.25	0	0.30	0.38	0.12	0.68	0.58	0.12
HCW (lbs)	66.00	69.00	69.00	68.00	1.00	0.27	0.19	0.16	0.56	0.06
Leg score	10.30	10.50	10.50	10.50	0.30	0.89	0.56	0.66	0.84	0.45
Conformation score	10.30	10.30	10.50	10.50	0.27	0.83	0.42	1.00	0.67	0.60
Fat Depth (in)	0.29	0.32	0.30	0.32	0.02	0.57	0.36	0.69	0.33	0.24
Body Wall Thick (in)	0.96	0.98	1.01	1.02	0.03	0.47	0.13	0.87	0.82	0.22
Ribeye Area (in^2)	2.32	2.38	2.35	2.39	0.05	0.72	0.43	0.83	0.44	0.35
Flank Streaking	324.00	357.00	342.00	345.00	8.00	0.08	0.19	0.09	0.09	0.02
Quality Grade	10.30	10.80	10.80	11.00	0.20	0.15	0.04	0.57	0.45	0.04
Yield Grade	3.26	3.57	3.42	3.55	0.18	0.63	0.39	0.65	0.39	0.26
%BCTRC[d]	45.10	44.90	44.90	44.80	0.21	0.76	0.35	0.70	0.79	0.31

[a]Control = 0% replacement of barley with dried distillers grains; 20% = 20% dried distillers grain in ration replacing barley; 40% = 40% dried distillers grain in ration replacing barley; 60% = 60% dried distillers grain in ration replacing barley.

[b]Standard Error of Mean; n = 4 .

[c]*P*-value for Control vs DDG treatments and linear, quadratic, and cubic affect of dried distillers grains inclusion.

In the current trial supplemental thiamin was provided to aid in the prevention of sulfur toxicity, hopefully preventing the incidence of polioencephalomalacia. Current research suggests that sulfur toxicity in concentrate rations fed to lambs is 0.3% DM, and 0.5% DM in lamb fed high-forage diets (NRC, 2007). As concentrate levels increase in lamb diets, ruminal pH decreases and excessive production of rumen sulfide can result (Gould, 1998). While decreases in ruminal pH have not been found to decrease the microbial production of thiamin (Alves de Oliveira et al., 1996), the ruminants main source of thiamin, the decreases in pH have been found to increase the bacteria that produce thiaminase – a compound that in turn destroys the thiamin that is already present, inducing a thiamin deficiency and subsequently polioencephalomalacia (Morgan and Lawson, 1974; Boyd and Walton, 1977, Thomas et al., 1987). In rations containing greater than 0.3% sulfur, the combination of increasing dietary sulfur concentration, increased ruminal sulfide production, and increasing thiaminase production can result in an increase in polioencephalomalacia (Gould, 1998). Sulfur toxicity may additionally result in decreased intake and performance as well as health problems associated with sulfur binding to copper, resulting in copper deficiencies. One potential remedy for excessive dietary sulfur is to include supplemental thiamin in the ration (NRC, 2007). Recent beef cattle research has had mixed results with supplemental thiamin. Huls et al. (2008) successfully fed 50% of the diet as modified distillers grains plus solubles while supplementing with 150 mg/hd/d thiamin, noting no change in performance when compared to control diets. However, a 50% DDG with solubles treatment had to be discontinued by Buckner et al. (2007) when multiple steers exhibited signs of polioencephalomalacia, even though they were providing 150 mg/hd/d supplemental thiamin. In our trial, no increases in mortality or morbidity were observed, indicating that the lambs on increasing levels of DDG had no deleterious effects from increasing dietary sulfur concentrations. Additional research is needed to further quantify the supplemental thiamin needs of lambs fed high DDG rations.

Implications

The expansion of the ethanol industry in the region may result in an increase in the availability of dried distillers grains. Maximizing the use of dried distillers grains may become economically feasible for lamb feeders when prices become favorable. When appropriately priced relative to corn and/or barley, dried distillers grains and supplemental thiamin can effectively replace up to 60% of a lamb finishing ration with no negative effects on feedlot performance or carcass traits.

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