January 2005

Degradable Intake Protein In Finishing Diets Containing Dried Distillers Grains

Kyle J. Vander Pol
University of Nebraska-Lincoln

Galen E. Erickson
University of Nebraska-Lincoln, gerickson4@unl.edu

Terry J. Klopfenstein
University of Nebraska-Lincoln, tklopfenstein1@unl.edu

Degradable Intake Protein In Finishing Diets Containing Dried Distillers Grains

Kyle J. Vander Pol
Galen E. Erickson
Terry J. Klopfenstein[1]

Summary

An experiment evaluated the effects of finishing diets containing dried distillers grains supplemented with degradable intake protein on performance and carcass characteristics of yearling heifers. Diets contained 10% or 20% dried distillers grains (DDG) with or without 0.80 or 0.63% urea. Degradable intake protein balances were -192 (10% DDG no urea), 58 (10% DDG + urea), -111 (20% DDG), and 81 (20% DDG + urea) grams/day. No response in performance or carcass characteristics were observed among treatments. The results indicate sufficient amounts of urea were recycled to the rumen to meet the degradable intake protein requirement. Therefore, supplemental degradable intake protein is not necessary in finishing diets containing dried distillers grains at 10% or 20% of diet DM.

Introduction

A recent USDA report indicated U.S. ethanol production grew from a few million gallons in the mid-1970s to over 3.3 billion gallons projected in 2004. Corn dry milling is the primary mechanism for producing fuel ethanol, however, ethanol can be produced from the dry milling of other cereal grains (sorghum, wheat, etc.) or from wet milling corn. Approximately two-thirds of the grain being milled is recovered as ethanol or carbon dioxide, the other one-third is referred to as distillers by-products. Therefore, nutrients within distillers by-products are concentrated three-fold compared to the cereal grain from which it was produced.

Distillers grains are well utilized in feedlot diets, however, diets being formulated to contain a fixed amount of dried distillers grains (DDG) often indicate a deficiency in degradable intake protein (DIP). Past research with growing heifers concluded supplemental DIP in high forage diets containing fixed amounts of DDG was not necessary (*2004 Nebraska Beef Report*, pp. 20-21).

The objective of this research trial was to determine if supplemental DIP is necessary for performance optimization of heifers consuming finishing diets containing DDG.

Procedure

Fifty-eight crossbred yearling heifers (844 lb) were individually fed one of four diets in a 2 x 2 factorial arrangement of treatments. Factors consisted of two levels of DDG (10% and 20% of DM) and presence or absence of urea (Table 1). Supplemental urea was provided at 0%, 0.8% (10% DDG diet), or 0.63% (20% DDG diet) of diet DM. Bromegrass hay and molasses were included in all diets at 5% of diet DM, while dry supplement was included in all diets at 4% of DM. Dry-rolled corn made up the balance of the diets. Rumensin® and Tylan® were fed at a rate of 320 and 90 mg/head/day, respectively. Dietary treatments (Table 1) consisted of 10% DDG (10DG), 20% DDG (20DG), or 10% DDG with urea (10DG+U), and 20% DDG with urea (20DG+U). All diets were evaluated using the NRC, 1996 computer model to determine both DIP and metabolizable protein (MP) balances. All diets were sufficient in MP (Table 1), while the 10DG and 20DG diets were deficient in DIP (Table 1). Initial weights were based on a five-day limit fed weight, where heifers were fed a 50% alfalfa hay:50% wet corn gluten feed diet (DM basis) at 2% of body weight, with weights taken for three consecutive days. Dietary adaptation consisted of limit feeding, whereby DM offered increased 0.50 lb/day from 12 lb/day DM (1.4% BW) until ad libitum intakes were achieved (~21 days). Heifers were implanted on day 26 with Revalor-H®, and were weighed on days 26-28, 70-72, and 100 (final live weight). An aliquot (20 ml) of blood was collected on days 28, 72, and 100, via jugular venipuncture into vacutainers, for subsequent blood urea nitrogen analysis, using the automated procedure outlined by Marsh et. al (1965). Heifers were slaughtered on day 100 at a commercial packing plant (Tyson Fresh Meats, West Point, Nebraska)

Table 1. Ingredient composition for finishing diets containing dried distillers grains with or without supplemental urea (values presented as a percentage of dietary DM)[a].

	10DG	10DG+U	20DG	20DG+U
Dry-Rolled Corn	76.0	76.0	66.0	66.0
Dried Distillers Grains	10.0	10.0	20.0	20.0
Brome Hay	5.0	5.0	5.0	5.0
Molasses	5.0	5.0	5.0	5.0
Dry Supplement	4.0	4.0	4.0	4.0
Supplement [b]				
Fine Ground Corn	1.77	0.95	1.77	1.12
Limestone	1.34	1.34	1.32	1.32
Urea	—	0.80	—	0.63
Salt	0.30	0.30	0.30	0.30
Ammonium Sulfate	0.22	0.22	0.27	0.27
Tallow	0.15	0.15	0.15	0.15
Potassium Chloride	0.13	0.13	0.11	0.11
Mineral Premix	0.05	0.05	0.05	0.05
Rumensin™	0.018	0.018	0.018	0.018
Tylan™	0.01	0.01	0.01	0.01
Vitamin ADE	0.01	0.01	0.01	0.01
Diet Crude Protein, %	11.2	13.4	13.4	15.1
DIP Balance, g/day	-192	58	-111	81
MP Balance, g/day	268	277	367	367

[a]10 DG = 10% DDG no urea, 10DG+U = 10% DDG with urea, 20DG = 20% DDG no urea, 20DG+U = 20% DDG with urea.
[b] Values presented as a percentage of diet (DM basis).

Table 2. Performance measurements and carcass characteristics for finishing diets containing dried distillers grains with or without supplemental urea[a].

	10DG	10DG+U	20DG	20DG+U	SE
Performance Parameters					
Initial BW, lb	844	842	846	845	15
Final BW, lb [b]	1192	1206	1196	1203	19
DMI, lb	24.5	24.9	23.9	24.6	0.5
ADG, lb	3.51	3.68	3.55	3.60	0.11
Feed:Gain	7.02	6.79	6.82	6.95	0.20
Carcass Characteristics					
Hot Carcass Weight, lb	744	753	747	752	12
12th Rib Fat Thickness, in	0.45	0.43	0.40	0.45	0.03
Ribeye Area, in^2	12.7	12.4	12.5	12.3	0.1
Marbling Score [c]	536	522	548	536	16

[a]10 DG = 10% DDG no urea, 10DG+U = 10% DDG with urea, 20DG = 20% DDG no urea, 20DG+U = 20% DDG with urea.
[b]Calculated from carcass weight, adjusted to a 62% common dressing percentage.
[c]Where 400 = Slight 0, 500 = Small 0.

where livers were scored for abscesses and hot carcass weights were recorded. Fat thickness, ribeye area, USDA called yield grade, and marbling score were recorded after a 72-hour chill. Performance was calculated based on hot carcass weights adjusted to a common dressing percentage (62%).

Heifer was the experimental unit, and data from each individual were analyzed using the mixed procedures of SAS for performance, carcass, and blood variables. Blood urea nitrogen was analyzed as a repeated measurement over time, using the mixed procedures of SAS, with heifer as a random effect. Treatments containing 10% DDG were replicated 15 times, while treatments containing 20% DDG were replicated 14 times.

Corn distillers dried grains were procured from a commercial ethanol plant (Abengoa Bioenergy, York, Nebraska) as one lot, delivered all at one time, and utilized as needed.

Results

Performance variables are presented in Table 2. Dry matter intake increased numerically with the addition of urea, however, no significant differences ($P > 0.10$) were detected for the interaction or main effects. Similarly, carcass adjusted final live weight was numerically higher for heifers receiving supplemental urea. Further, as with DMI and carcass adjusted BW, average daily gain (ADG) improved numerically when urea was incorporated into the diet, however, the response was not significant ($P > 0.35$). Feed:gain ratio were slightly different. The ratio was numerically improved by adding urea to the 10% DDG diet and was not impacted by adding urea to the 20% DDG diet. The urea x level interaction, however, was not significant ($P = 0.37$).

These data suggest sufficient recycling of nitrogen to the rumen to meet the DIP requirement occurred. Further, there was sufficient MP available to supply the needed urea for recycling. The numerical data for feed efficiency clearly show that recycling occurred on the 20% DDG treatment, however, the deficiency of DIP was less and the MP excess was greater than that for the 10% DDG treatment. The conservative application of these results may be to incorporate a small amount of urea into a 10% DDG diet; however, no added benefit of supplemental urea will occur when greater than 10% DDG is fed. In this experiment, DDG was used instead of wet distillers grains, primarily due to the relatively small amount of distillers grains needed in an individual feeding experiment. However, total protein and DIP are similar

(Continued on next page)

Table 3. Blood urea nitrogen values for heifers on finishing diets containing dried distillers grains with or without supplemental urea[a].

	10DG	10DG+U	20DG	20DG+U	SE	urea	level	urea*level
Day 28, mg/100 ml	9.2	10.9	11.6	14.1	0.58	< 0.01	< 0.01	0.49
Day 72, mg/100 ml	11.2	15.0	16.0	17.4	0.74	< 0.01	< 0.01	0.12
Day 100, mg/100 ml	14.1	16.1	17.5	18.5	0.67	0.03	< 0.01	0.44
Average, mg/100 ml [b]	11.5	14.0	14.9	16.7	0.52	< 0.01	< 0.01	0.48

[a]10 DG = 10% DDG no urea, 10DG+U = 10% DDG with urea, 20DG = 20% DDG no urea, 20DG+U = 20% DDG with urea.
[b]Average blood urea nitrogen for all time points.

between wet and dry distillers grains. Therefore, we could predict similar responses in diets containing wet distillers grains.

Carcass characteristics were similar between treatments (Table 2). The mean fat thickness was 0.43 inches, indicating heifers on all treatments were equally finished; however, heifers not supplemented with urea had numerically higher marbling scores than heifers supplemented with urea.

Blood urea nitrogen (BUN) values are presented in Table 3. Within each sampling date, as well as with the average of each heifer's BUN across all sampling dates, there were significant differences for the main effect of both level and urea. Interactions were not significant. Heifers receiving urea had significantly higher BUN values than heifers not supplemented with urea. Similarly, heifers fed the 20DG diets had significantly higher BUN values than heifers receiving the 10DG diets. Published data indicate that a minimum BUN value of about 7.0 mg/100 ml is necessary for optimum performance, with performance leveling off when BUN values exceed the minimum requirement (Marini and Van Amburgh, 2003, in Journal of Animal Science 81:545-552). The values observed in this trial all exceed the published minimum by at least 50%. Therefore, these data indicate excess metabolizable protein in the diets deficient in DIP was adequate enough to provide the additional DIP needed in the rumen and maintain performance.

Heifers on all treatments had significantly higher BUN values as time on feed increased. The higher circulating urea amounts later in the feeding period (Table 3) reflect the decreasing protein requirement of the finishing animal with time on feed.

In conclusion, providing supplemental urea to meet the DIP deficiency generated by diets containing either 10% or 20% DDG had no effect on performance or carcass characteristics of finishing heifers. Further, BUN values indicate adequate nitrogen was available for recycling in cattle receiving diets containing DDG to maintain performance similar to that of cattle supplemented with enough urea to meet the DIP requirement.

---

[1]Kyle J. Vander Pol, research technician; Galen E. Erickson, assistant professor; Terry J. Klopfenstein, professor, Animal Science, Lincoln.