Effect of Dietary Inclusion of Wet Distillers Grains on Feedlot Performance of Finishing Cattle and Energy Value Relative to Corn

Kyle J. Vander Pol
Galen E. Erickson
Terry J. Klopfenstein
Matt A. Greenquist
Thomas Robb [1]

Summary

An experiment evaluated the effects of six dietary inclusions of wet distillers grain plus solubles (WDGS) on feedlot performance and carcass characteristics of yearling steers, and also evaluated the energy value of WDGS relative to corn. Treatments consisted of 0, 10, 20, 30, 40, and 50% (DM basis) dietary inclusion of WDGS. Final BW, DMI, and ADG increased quadratically, while feed: gain decreased quadratically as WDGS inclusion increased from 0 to 50% of DM. No differences in carcass characteristics were observed among treatments. Energy value of WDGS relative to corn was above 100% for all inclusion levels and decreased (178 to 121%) as dietary WDGS inclusion increased, (10 to 50% of DM). Results indicate that WDGS can be used effectively in finishing diets, with optimum performance being observed at 30 to 40% dietary inclusion.

Introduction

As the U.S. ethanol industry continues to expand, the availability of by-products generated from milling processes will increase. It is estimated that in 2005, U.S. production of fuel grade ethanol may reach 4 billion gallons and will continue to grow. Therefore, it appears that there is a tremendous opportunity for cattle feeders to take advantage of and use these by-products in their current operations.

Along with the positive availability of distillers by-products, past research has indicated a higher energy value of feeding distillers by-products compared to dry-rolled corn when fed to cattle. However, the higher energy value appears to be inclusion level dependent and the response is variable. Therefore, knowing that the potential exists to use more wet distillers by-products in feedlot diets than what is currently being used opens up an avenue that many nutritionists, and ethanol companies are interested in.

The objective of this trial was to determine the effects of increasing dietary inclusion of wet distillers grains plus solubles (WDGS) on feedlot performance and carcass characteristics of finishing yearling steers, and to determine the energy value of WDGS relative to a high-moisture/dry-rolled corn combination as level of WDGS increases from 0 to 50% (DM basis) in 10% increments.

Procedure

A 126-day finishing trial used 288 crossbred yearling steers (BW = 773 ± 24 lb) with predominately British breed influences in a completely randomized design. Five days before the initiation of the trial, steers were limit fed a high fiber ration consisting of a 1:1 ratio (DM basis) of alfalfa hay and wet corn gluten feed at 2.0% of BW. Steers were weighed individually on day 0 and day 1, to obtain an accurate initial weight, and poured with Elector© (*Elanco Animal Health, Greenfield, IN)* on d 1. Steers were stratified by weight, and assigned randomly to pen (eight steers/pen). Pen was assigned randomly a dietary treatment and served as the experimental unit. In total there were six treatments and six replications/treatment, resulting in 36 pens.

The six dietary treatments (Table 1) consisted of a control (CON) with no WDGS, 10% WDGS (10DG), 20% WDGS (20DG), 30% WDGS (30DG), 40% WDGS (40DG), and 50% WDGS (50DG) all included in the ration as a percentage of DM. Alfalfa hay was included in all diets at 5.0% of DM, and high-moisture corn (HMC) and dry-rolled corn (DRC) were fed at a 1:1 ratio (DM basis). WDGS replaced this blend of HMC:DRC so all diets had a constant ratio of HMC to DRC. Dry matter determinations were conducted weekly on all ingredients by drying samples in a 60º C forced air oven for 48 hours. Diets were formulated to meet or exceed the NRC (1996) requirements for metabolizable protein, Ca, and K. Dietary adaptation consisted of a step-up procedure where alfalfa hay replaced corn starting at 45% of DM, and was reduced by 10%, with the step durations being 3, 4, 7, and 7 days, for steps 1, 2, 3, and 4, respectively. Steers were fed once daily at 0800 by means of a single axle truck equipped with a Roto-Mix® model 420 (*Roto-Mix®, Dodge City, Kan.*) mixer/delivery box.

Steers were implanted on day 28 with Revalor-S® (*Intervet, Millsboro, DE*). Dietary ingredients were sampled once weekly, analyzed for DM (AOAC,1965), frozen, composited by month, and analyzed for N and ash (AOAC, 1965).

Steers were slaughtered on day 127 at a commercial abattoir (*Tyson Fresh Meats, West Point, NE*). Hot carcass weight and liver scores were recorded on day of slaughter. Ribeye area and fat thickness were measured after a 24-hour chill. Further, marbling score and yield grade were called by a trained USDA grader. Final BW, ADG, and feed efficiency were calculated based on hot carcass weights adjusted to a common dressing percentage of 63. This was done to minimize error associated with gut fill, and to provide an accurate estimate of final weight.

The energy value of each level

(Continued on next page)

of WDGS (Table 2) was calculated using feed efficiency. The difference between each WDGS treatment and the CON was calculated, divided by the feed efficiency value of the CON treatment, as well as the percentage of WDGS in the corresponding diet to give an energy value of WDGS relative to the CON treatment (see Table 2).

Wet distillers grains plus solubles were produced at a commercial ethanol plant (*Abengoa Bioenergy, York, NE*), and delivered once weekly to the research facility. Based on information obtained from the ethanol plant, the ratio of distillers grains to distillers solubles was 65:35 (DM basis), and contained on average; 32.6% DM, 30.6% CP, and 12.0% crude fat.

Data were analyzed using the mixed procedures of SAS (*Version 9.1, SAS Inc., Cary, NC*) as a completely randomized design, with pen as the experimental unit. Orthogonal contrasts were used to test significance for the highest order polynomial.

Results

Performance and carcass variables are presented in Table 2. Carcass adjusted final body weight followed a significant ($P < 0.01$) quadratic increase as WDGS inclusion increased. Similarly, DMI increased quadratically ($P < 0.01$) as WDGS inclusion increased, with cattle on the 30DG treatment achieving the highest intake. Additionally, ADG increased quadratically (Figure 1) as WDGS inclusion increased from 0 to 50% of DM, with cattle fed the 30DG having the highest ADG. Feed conversion followed a significant ($P < 0.01$) quadratic decrease (Figure 1) as WDGS inclusion increased from 0 to 50% of the diet. However, optimum feed conversion was achieved when WDGS was incorporated into the diet at 40% of DM.

Calculated energy value of WDGS relative to HMC/DRC, resulted in energy values greater than 100% regardless of WDGS inclusion. The 10DG treatment yielded the highest energy value relative to corn, and the overall response was a significant

Table 1. Composition of dietary treatments and formulated nutrient analysis.[a]

Ingredient	CON	10DG	20DG	30DG	40DG	50DG
High-moisture corn	45.0	40.0	35.0	30.0	25.0	20.0
Dry-rolled corn	45.0	40.0	35.0	30.0	25.0	20.0
WDGS	—	10.0	20.0	30.0	40.0	50.0
Alfalfa hay	5.0	5.0	5.0	5.0	5.0	5.0
Dry supplement[b]	5.0	5.0	5.0	5.0	5.0	5.0
Fine ground corn	1.04	1.78	2.07	2.35	2.61	2.66
Limestone	1.45	1.55	1.57	1.55	1.53	1.51
Urea	1.29	0.66	0.44	0.21	—	—
Potassium chloride	0.45	0.42	0.39	0.36	0.33	0.31
Salt	0.30	0.30	0.30	0.30	0.30	0.30
Calcium sulfate	0.24	0.06	—	—	—	—
Tallow	0.13	0.13	0.13	0.13	0.13	0.13
Trace mineral premix[c]	0.05	0.05	0.05	0.05	0.05	0.05
Rumensin-80 premix[d]	0.016	0.016	0.016	0.016	0.016	0.016
Thiamine[e]	0.013	0.013	0.013	0.013	0.013	0.013
Vitamin A-D-E premix[f]	0.01	0.01	0.01	0.01	0.01	0.01
Tylan-40 premix[g]	0.009	0.009	0.009	0.009	0.009	0.009
Formulated Nutrient Analysis						
Crude protein, %	13.0	13.6	15.3	16.9	18.7	21.0
DIP balance, g/day	123	11	21	28	43	110
MP balance, g/day	37	171	301	431	560	693
Calcium, %	0.70	0.70	0.70	0.70	0.70	0.70
Phosphorus, %	0.29	0.34	0.39	0.44	0.49	0.54
Potassium, %	0.60	0.60	0.60	0.60	0.60	0.60
Sulfur, %	0.20	0.20	0.23	0.27	0.31	0.35
Ether Extract, %	4.17	5.02	5.85	6.68	7.51	8.33

[a]Values presented on a DM basis, dietary treatment levels (DM basis) of WDGS, CON = 0% WDGS, 10DG = 10% WDGS, 20DG = 20% WDGS, 30DG = 30% WDGS, 40 DG = 40% WDGS, 50DG = 50% WDGS.
[b]Supplement formulated to fed at 5% of diet DM.
[c]Premix contained 10% Mg, 6% Zn, 4.5% Fe, 2% Mn, 0.5% Cu, 0.3% I, 0.05% Co.
[d]Premix contained 80 g/lb^{-1} monensin.
[e]Premix contained 40 g/lb^{-1} thiamine.
[f]Premix contained 1500 IU vitamin A, 3000 IU vitamin D, 3.7 IU vitamin E per g.
[g]Premix contained 40 g/lb^{-1} tylosin.

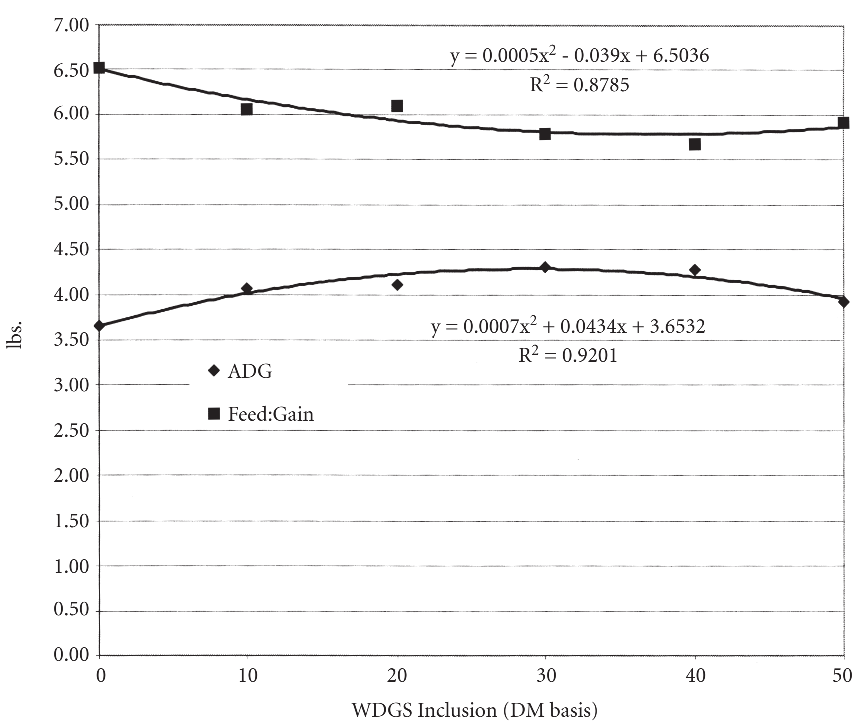

Figure 1. Graphical depiction of ADG and F:G relative to WDGS inclusion.

Table 2. Cattle performance when fed different levels of WDGS to finishing yearlings.[a]

WDGS level:	CON	10DG	20DG	30DG	40DG	50DG	SEM	Lin [b]	Quad [c]	Cubic [d]
Pens, n	6	6	6	6	6	6				
Steers, n	48	48	48	48	48	48				
Days on Feed	126	126	126	126	126	126				
Performance										
Initial BW, lb	774	772	772	772	774	772	0.7	0.60	0.52	0.81
Final BW [e], lb	1234	1285	1291	1313	1313	1267	12	0.01	< 0.01	0.43
DMI, lb/day	24.0	24.6	25.1	26.0	24.4	23.3	0.3	0.09	< 0.01	0.81
ADG, lb/day	3.65	4.07	4.11	4.31	4.27	3.92	0.09	0.01	< 0.01	0.45
Feed:Gain [f], lb/lb	6.52	6.06	6.10	5.78	5.68	5.92	0.02	< 0.01	< 0.01	0.43
Energy Value [g], %		178	138	144	137	121	7	0.81	< 0.01	<0.01
Carcass Characteristics										
HCW, lb	777	801	807	827	825	796	8	< 0.01	< 0.01	0.18
Liver Score [h]	0.23	0.24	0.23	0.29	0.31	0.33	0.11	0.40	0.87	0.90
12th Rib Fat, in	0.45	0.54	0.49	0.52	0.46	0.50	0.03	0.80	0.08	0.10
Ribeye Area, in^2	12.4	12.8	12.8	12.5	12.4	12.6	0.2	0.36	0.09	0.13
Marbling Score [i]	515	538	520	523	501	505	12	0.11	0.29	0.22
Yield Grade [j]	2.40	2.77	2.63	2.73	2.75	2.65	0.10	0.13	0.07	0.48

[a]Dietary treatment levels (DM basis) of WDGS, CON = 0% WDGS, 10DG = 10% WDGS, 20DG = 20% WDGS, 30DG = 30% WDGS, 40 DG = 40% WDGS, 50DG = 50% WDGS.
[b]Contrast for the linear effect of treatment P-Value.
[c]Contrast for the quadratic effect of treatment P-Value.
[d]Contrast for the cubic effect of treatment P-Value.
[e]Calculated from hot carcass weight, adjusted to a 63% common yield.
[f]Calculated as total gain over total dry matter intake.
[g]Calculated from feed efficiency relative to control, divided by WDGS inclusion.
[h] Where 1 = A-, 2 = A, 3 = A+.
[i]400 = Slight 0, 500 = Small 0.
[j]Called by U.S.D.A. grader.

($P < 0.01$) cubic decrease in energy value as WDGS inclusion increased from 10 to 50% of DM.

In terms of carcass characteristics, with the exception of HCW, there were no significant differences observed for any carcass characteristic. The observation of no difference in 12th fat thickness is a good indication all steers achieved similar feeding endpoints, regardless of treatment.

In summary, regardless of dietary inclusion, feeding WDGS in finishing diets generated higher energy values than a high-moisture/dry-rolled corn mixture. Because of the DMI response and maximum DMI observed at 30% WDGS, ADG increased as WDGS increased to 30%. However, ADG was similar for cattle fed either 30 or 40% WDGS. Therefore, for optimum (lowest) feed conversion, 40% WDGS should be used. Further, regardless of dietary inclusion, cattle fed WDGS achieved similar carcass characteristics as cattle not fed WDGS.

[1] Kyle J. Vander Pol, research technician; Galen E. Erickson, assistant professor; Terry J. Klopfenstein, professor; Matt A. Greenquist, research technician, Animal Science, Lincoln. Thomas Robb, Abengoa Bioenergy, York.