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Effect of Wet and Dry Distillers Grains Plus Solubles and Supplemental Fat Level on Performance of Yearling Finishing Cattle

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Summary

Two finishing trials were conducted to compare the addition of fat from either wet or dry distillers byproducts (WDGS; DDGS) to that provided from one of two commercially available fat sources (corn oil, Trial 1; tallow, Trial 2). In Trial 1, feed conversion and ADG decreased linearly as level of corn oil increased, while feed conversion and ADG were improved numerically as the level of WDGS increased in the diet. In Trial 2, no differences in performance were observed comparing cattle fed dry distillers grains plus solubles to cattle fed diets containing tallow. WDGS provided 12 and 17% more net energy for gain when fed at 20 and 40% of the diet compared to a dry rolled/high moisture corn mix.

Introduction

Ethanol production in the United States has expanded over the past few decades. A recent USDA report indicated that U.S. ethanol production has grown from just a few million gallons in the mid-1970s to over 1.8 billion gallons in 2002. 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. About 2/3 of the grain being milled is recovered as ethanol or carbon dioxide (i.e, the starch); the other 1/3 is referred to as distillers byproducts. Therefore, nutrients within distillers byproducts are concentrated three-fold compared to the cereal grain from which it was produced.

In past research trials, distillers byproducts have shown a higher energy value than dry-rolled corn (1994 Nebraska Beef Report, pp. 38-40; 1996 Nebraska Beef Report, pp. 63-64). However, at this point it is unclear why the energy value of distillers byproducts is higher. Possibilities include: higher fat and protein content of distillers byproducts, less subacute acidosis, or overall increased energy utilization.

The objectives of these research trials were to determine if the additional energy provided from distillers byproducts when replacing corn in finishing diets is related to the higher fat content of the byproducts or their ability to minimize subacute acidosis.

Procedure

Trial 1

Sixty crossbred yearling heifers (765 lb) were individually fed one of six treatment diets in a 2 x 3 factorial design. Factors consisted of two sources of additional fat and level of fat (Table 1). Supplemental fat was provided at 0, 2.5, or 5% of diet DM from either corn oil or wet distillers grain plus solubles (WDGS) (0, 20, or 40% of diet DM). Alfalfa hay was included in all diets at 7.5% of diet DM, and high-moisture corn and dry-rolled corn were fed at a 1:1 ratio (DM-basis). Dietary treatments consisted of 0% WDGS (0DG), 20% WDGS (20DG), 40% WDGS (40DG), 0% corn oil (0FAT), 2.5% corn oil (2.5FAT), or 5% corn oil (5FAT). The 20DG and 2.5FAT diets as well as the 40DG and 5FAT diets were formulated to contain the same amount of ether extract (EE), as well as to ensure that all diets met or exceeded the metabolizable protein requirements of the heifers. Initial weights were based on a 5-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, DM offered increased 0.50 lb/day from 12 lb/day DM (1.6% BW) until ad libitum intakes were achieved (~21 days). Heifers were weighed every 28 days, and were implanted on day 28 with Synovex-Plus®. Heifers were slaughtered on day 113 at a commercial packing plant (IBP, West Point, NE), and livers were scored and hot carcass weights were recorded. Fat thickness, ribeye area, USDA called yield grade and marbling score were recorded after a 24- hour chill. Performance was

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calculated based on hot carcass weights adjusted to a common dressing percentage (62% for heifers). Net energy for gain (NE_g) for the diets and ingredients were calculated based on animal performance inputs (Owens et al., 2002, in J. Anim. Sci. 80(Suppl.1):273 (Abstr.).

Corn distillers grains and distillers solubles were produced at a commercial ethanol plant (Abengoa Bioenergy, York, NE). Distillers grains and distillers solubles were brought in separately and fed at a 65:35 ratio (DM basis) to provide a constant ratio.

Trial 2

Two hundred thirty-four crossbred yearling steers (775 lb) were utilized in 2 x 2 plus 1 experimental design. Factors consisted of source; dry distillers grains plus solubles (DDGS) and tallow, and level of fat source; zero, medium, and high. Dietary treatments (Table 1) consisted of zero tallow/zero DDGS (CON), 20% DDGS (20DG), 1.3% tallow (1.3TAL), 40% DDGS (40DG), and 2.6% tallow, with tallow or DDGS replacing corn. Wet corn gluten feed (WCGF; Sweet Bran®, Cargill Corn Milling, Blair, NE) a product of the corn wet-milling industry was included in all diets at 20% of diet DM to minimize subacute acidosis. The 20DG and 1.3TAL diets as well as the 40DG and 2.6TAL diets were formulated to provide the same amount of fat. Steers were weighed for two consecutive days prior to the initiation of the trial following a 5-d limit feeding period. Steers were stratified by weight and assigned randomly to pen (9-10 steers/pen; 9 steers rep 1, 10 steers rep 2-4), pen was then assigned randomly to treatment, with a total of 24 pens (4 pens for the TAL and DG diets and 8 pens for the CON diet). Steers were adapted to the finishing diet utilizing four diets where corn silage replaced high-moisture corn or DDGS at levels decreasing by 10% for 3, 4, 7, and 7 days, respectively. Steers were implanted with Revelor-S® on day 21 and slaughtered on day 118 at IBP (West Point, NE) on which hot carcass weights and liver abscess scores were recorded. Fat thickness, ribeye area and USDA called marbling score were taken after a 24 hour chill. Performance was calculated based on hot carcass weights adjusted to a common dressing percentage of 63, since this trial utilized steers.

The NE_g values for the diets, as well as, the DDGS were calculated similar to that in Trial 1. Corn DDGS were produced at a commercial ethanol plant (Abengoa Bioenergy, York, Neb.) and were received at the research facility on an as-needed basis.

Table 1. Diets for wet and dry distillers byproducts finishing trials (values presented as a percentage of dietary DM).

Trial 1

	0DG	0FAT	20DG	2.5FAT	40DG	5FAT
High-Moisture Corn	43.75	43.75	33.75	42.5	23.75	41.25
Dry-Rolled Corn	43.75	43.75	33.75	42.5	23.75	41.25
Distillers Grains	——	——	13.0	——	26.0	——
Distillers Solubles	——	——	7.0	——	14.0	——
Corn Oil	——	——	——	2.5	——	5.0
Alfalfa Hay	7.5	7.5	7.5	7.5	7.5	7.5
Dry Supplement	5.0	5.0	5.0	5.0	5.0	5.0
Total Lipid [a]	3.98	3.98	6.39	6.37	8.80	8.76

[a]Ether extract analysis, calculated from individual ingredient analysis and the corresponding inclusion rate in the diet.

Trial 2

	CON	20DG	1.3TAL	40DG	2.6TAL
High-Moisture Corn	67.0	47.0	65.7	27.0	64.4
Wet Corn Gluten Feed	20.0	20.0	20.0	20.0	20.0
Dry Distillers Grains/Solubles	——	20.0	——	40.0	——
Tallow	——	——	1.3	——	2.6
Corn Silage	10.0	10.0	10.0	10.0	10.0
Dry Supplement	3.0	3.0	3.0	3.0	3.0
Total Lipid [a]	3.50	4.25	4.74	5.00	5.98

[a]Ether extract analysis, calculated from individual ingredient analysis and the corresponding inclusion rate in the diet.

Results

Trial 1

No significant differences ($P > 0.10$) were observed for the interaction or main effects for dry matter intake (DMI) (Table 2). Dry matter intake tended ($P = 0.13$) to decrease linearly as fat provided from WDGS or corn oil in the diet increased. A significant source x level interaction was observed for both ADG and feed:gain. Average daily gain decreased linearly and feed:gain increased linearly as the amount of corn oil in the diet increased, with heifers on the 5FAT treatment having the lowest ADG and highest feed:gain than heifers on any other treatment. For dietary NE_g concentrations, there was a tendency for a source by level interaction to be significant ($P = 0.16$), with dietary NE_g concentration tending to decrease linearly as the amount of corn oil in the diet increased.

No significant differences were observed for the main effects or interaction on 12th rib fat thickness, ribeye area, yield grade, or liver abscess score (Table 2). Because no significant differences were observed for 12th rib fat thickness and yield grade values, it appears that heifers were equally finished. However, there was a significant difference ($P = 0.03$) observed for

Table 2. Performance measurements and carcass characteristics for wet distillers byproducts finishing trial.

	Treatment[a]									Main Effects			Simple Effects	
Item	0F	2.5F	5F	0DG	20DG	40DG	SE	Cov[b]	Int.[c]	S[d]	Lev. lin.[e]	Lev. quad.[f]	DG lin[g]	Fat lin[h]
DMI, lb/day	20.0	20.0	18.0	19.8	20.0	19.6	0.9	NS [k]	NS	NS	.13	NS	—	—
ADG, lb	3.04	3.01	2.49	3.04	3.04	3.19	0.18	NS	.09	—	—	—	NS	.04
F:G, lb/lb	6.52	6.59	7.25	6.58	6.52	6.15	0.28	.05	.10	—	—	—	NS	.10
Diet NE_g [j] Mcal/cwt	63.8	64.1	59.7	63.1	64.7	67.4	2.3	NS	.16	—	—	—	NS	.20
Carcass Wt, lb	693	691	647	680	693	689	20	< .01	NS	NS	NS	NS	—	—
Marbling score [j]	524	519	496	547	536	538	16	.08	NS	.03	.15	NS	—	—
Ribeye area, in^2	11.8	11.6	11.3	11.8	11.7	11.5	0.3	NS	NS	NS	NS	NS	—	—
Fat thickness, in	0.54	0.69	0.47	0.44	0.59	0.60	0.06	.03	NS	NS	NS	.13	—	—

[a]0F = 0% corn oil diet, 2.5F = 2.5% corn oil diet, 5F = 5% corn oil diet, 0DG = 0% WDGS diet, 20DG = 20% WDGS diet, and 40DG = 40% WDGS diet.
[b]Covariate P-Value.
[c]Source x Level Interaction P-Value.
[d]Main effect of Source P-Value.
[e]Contrast for the presence of a linear effect of Level P-Value.
[f]Contrast for the presence of a quadratic effect of Level P-Value.
[g]Linear effect of wet distillers grains plus solubles P-Value.
[h]Linear effect of corn oil P-Value.
[i]Mcal/cwt, based on cattle performance (NRC, 1996).
[j]400 = Slight 0, 500 = Small 0.
[k]NS, P-Value > 0.20.

Table 3. Performance measurements for dry distillers byproducts finishing trial.

	Treatment [a]						Simple Effects	
Item	CON	1.3TAL	2.6TAL	20DG	40DG	SE	DG lin[b]	Tal lin [c]
Initial BW, lb	774	774	774	776	775	2	NS [f]	NS
Final BW, lb [d]	1358	1350	1370	1359	1375	12	NS	NS
DMI, lb/day	27.0	26.6	27.0	27.1	27.0	0.4	NS	NS
ADG, lb/day	4.94	4.87	5.05	4.94	5.08	0.10	NS	NS
F:G, lbs/lb	5.51	5.56	5.41	5.54	5.36	0.05	0.20	NS
Diet NE_g, Mcal/cwt [e]	64.84	64.79	66.08	64.49	66.77	0.12	NS	0.18

[a]CON = control diet, 1.3TAL = 1.3% tallow diet, 2.6TAL = 2.6% tallow diet, 20DG = 20% DDGS diet, 40DG = 40% DG diet.
[b]Linear effect of dry distillers grains plus solubles P-Value.
[c]Linear effect of tallow P-Value.
[d]Calculated from carcass weight, adjusted to a 63% common yield.
[e]Mcal/cwt, based on cattle performance (NRC, 1996).
[f]NS, P-Value > 0.20.

the main effect of source on marbling score, with heifers on the corn oil treatments having significantly lower marbling scores than heifers on the WDGS treatments.

The 20DG, and 40DG diets provided 2.5% and 6.8% more NE_g than the 0DG diet, when calculated from animal performance. Net energy for gain values calculated from animal performance for WDGS in this trial were 73.1 and 75.9 Mcal/cwt when included at 20 and 40% of the diet, respectively, compared to that of the corn in the 0DG diet, which had an NE_g 65.3 Mcal/cwt, which is lower than the reported tabular value of 70 Mcal/cwt (NRC, 1996). This equated to the WDGS contributing 12 and 17% more energy than dry-rolled/high-moisture corn in this trial when fed to yearling heifers at 20 and 40% of the diet DM.

Within level of supplemental fat, all diets appeared to be similar in total lipid content (Table 1). Throughout the trial, distillers grains and distillers solubles were sampled and analyzed for lipid content, with the distillers grains samples averaging 9.5% total lipid (DM basis), and the distillers solubles averaging 29.5% total lipid (DM basis). The distillers solubles were the ingredient primarily responsible for the higher lipid content of the 20DG and 40DG diets. Past research (Zinn, 1994; in The Prof. Anim. Sci. 67:1038-1049) has suggested an upper limit of dietary lipid intake (0.73 g/lb of body weight), which was indeed surpassed for animals consuming the 40DG and 5FAT diets. However, performance was not affected negatively for cattle consuming the 40DG diet, while it was for cattle consuming the 5FAT diet. This may suggest that the fat within the WDGS product may be less available in the rumen compared to corn oil.

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Trial 2

No significant differences were observed for any performance parameter or carcass characteristic measurement (Table 3). All cattle gained very well (~4.98 lb/day), with cattle fed the 40DG or 2.6TAL diets having the highest ADG (5.08 and 5.05 lb). Feed conversion followed a similar response to ADG. Cattle fed the 40DG or 2.6TAL diets were the most efficient (5.36 and 5.41).

Net energy for gain, calculated from performance (Owens et al., 2002), indicated that DDGS when fed at 20% of the diet was 97.3% that of high-moisture corn, and when fed at 40% of the diet was 107.4% that of high-moisture corn. The overall diet NE_g values were 64.5 and 66.8 Mcal/cwt for the 20DG and 40DG diets respectively.

Within level of supplemental fat, diets appear to contain the same amount of total lipid (Table 1). Dry distillers grains plus solubles were sampled periodically throughout the trial and averaged 8.1% total lipid (DM basis) while the wet distillers grains and solubles mixture from trial 1 averaged 16.5% total lipid. Therefore, corn oil supplementation was higher in trial 1 because of the higher lipid content of the WDGS, where tallow supplementation in trial 2 was less, because of the lower lipid content of the DDGS compared to that of WDGS. Further, cattle did not surpass the total lipid intake threshold of 0.73 g/lb BW, in trial 2.

Results from Trial 1 indicate that feeding WDGS at 20 and 40% of the diet DM will increase ADG and feed conversion above a high-moisture/dry-rolled corn control. It appears that adding 5% supplemental corn oil to a feedlot finishing diet will have negative impacts on ADG and feed conversion. Wet distillers grains plus solubles in Trial 1 provided 12 and 17% more NE_g than a high-moisture/dry-rolled corn control when fed at 20 and 40% of the diet. Results from Trial 2 indicate that incorporating tallow in feedlot diets equal to that provided from DDGS results in similar performance of yearling finishing steers. Controlling acidosis by feeding WCGF at 20% of DM allowed tallow supplementation to produce similar results as feeding DDGS. Conclusions from Trial 2 indicate that part of the additional energy provided from DDGS is a result of subacute acidosis control.

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