Evaluation of Wet Distillers Composite for Finishing Ruminants[1]

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ABSTRACT: Two trials evaluated the effect of a composite of feed ingredients formulated to be similar in nutrient composition to wet distillers byproducts on finishing performance of sheep and cattle. Trial 1 used 60 crossbred lambs (31 kg) assigned to one of four treatments: dry-rolled corn (DRC) control, dried distillers grains plus solubles, wet corn gluten feed (WCGF), and wet distillers grains composite (COMP1). The COMP1 consisted (DM basis) of 47.5% WCGF, 11.9% condensed distillers solubles, 30.5% corn gluten meal, 9.7% tallow, and .4% dicalcium phosphate and was fed at 40% of the diet DM. Lambs fed the COMP1 diet were 27% more efficient ($P < .10$) than lambs fed WCGF and 12% more efficient ($P > .10$) than lambs fed DRC. In Trial 2, 60 yearling crossbred steers (272 kg) were assigned to one of five treatments: DRC control, WCGF, wet distillers grains composite (COMP2), COMP2 minus tallow (–FAT), or COMP2 minus corn gluten meal (–CGM). The COMP2 consisted (DM basis) of 65.7% WCGF, 26.3% corn gluten meal, and 8.0% tallow and was fed at 40% of the diet DM. Steers fed COMP2 were more efficient ($P < .10$) than steers fed DRC or WCGF, and the steers fed –FAT and –CGM were intermediate to these three dietary treatments. A composite diet of WCGF, condensed distillers solubles, corn gluten meal, and tallow, formulated to be similar in nutrient composition to wet distillers byproducts, may improve feed efficiency compared with WCGF or DRC.

Key Words: Distillers Grains, Gluten Feed, Corn, Fat, Protein, Cattle

J. Anim. Sci. 1997. 75:44–50

Introduction

Demand for ethanol and corn sweeteners is on the rise and is predicted to increase in the future (Anonymous, 1996). This trend will result in an abundance of byproducts that are potential economical alternatives to corn. Wet distillers grains and wet corn gluten feed (**WCGF**) are currently used as sources of protein and energy in feedlot diets. Previous research indicates that corn wet distillers grains plus thin stillage are higher in NE_g than corn grain (Larson et al., 1993; Ham et al., 1994); however, WCGF is similar in NE_g content to corn (Ham et al., 1995). Potential differences between wet distillers grains and WCGF include lipid content, level of degradable and escape protein, and NDF level. Distillers byproducts are higher in NDF (Ham et al., 1994) and escape protein (Firkins et al., 1984) than WCGF. Additionally, distillers byproducts have a higher concentration of lipid (NRC, 1984) than WCGF. Our hypothesis was that a composite of feedstuffs could be formulated using WCGF, degradable and escape protein sources, and tallow that would provide improvements in efficiency of finishing cattle similar to those provided by distillers byproducts. Therefore, two finishing trials evaluated the effect of a composite of feedstuffs, formulated to be similar in nutrient composition to wet distillers grains plus thin stillage, on finishing performance of sheep and cattle.

Materials and Methods

Trial 1

A 60-d finishing trial used 60 crossbred lambs (BW = 31 ± 7 kg) in a randomized complete block design. Lambs were blocked by weight (blocks were 28 ± 3, 30 ± 2, and 35 ± 4 kg) and assigned randomly within block to one of four treatments: 1) dry-rolled corn (**DRC**) control, 2) dried distillers grains plus solubles (**DDGS**), 3) WCGF (Minnesota Corn Processors, Columbus, NE), and 4) wet distillers byproducts composite (**COMP1**). The COMP1 consisted (Table 1) of 47.5% WCGF, 30.5% corn gluten meal, 11.9% condensed distillers solubles, 9.7% tallow, and .4% dicalcium phosphate (DM basis) and was formulated

[1]Published with the approval of the director as paper no. 11420, journal ser., Nebraska Agric. Res. Div.

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Received February 20, 1996.

Accepted September 10, 1996.

Table 1. Composition of wet distillers grains composites (% of DM)

Item	COMP1[a]	COMP2[a]
Wet corn gluten feed	47.5	65.7
Corn gluten meal	30.5	26.3
Tallow	9.7	8.0
Condensed distillers solubles	11.9	—
Dicalcium phosphate	.4	—
Nutrient composition		
Undegradable protein[b]	14.7	12.5
Degradable protein	16.8	15.4
Chloroform:methanol lipid[c]	16.1	13.1
NDF[d]	28.4	47.2
Crude protein[d]	31.5	27.9
Calcium[d]	.17	.09
Phosphorus[d]	.71	.68
Potassium[d]	.83	1.04

[a]COMP1 = composite for Trial 1; COMP2 = composite for Trial 2.
[b]Firkins et al., 1985.
[c]Larson et al., 1993.
[d]Based on tabular values (NRC, 1984).

to contain 16.8% degradable protein, 14.7% undegradable protein (based on 47% of the distillers byproducts protein escaping ruminal degradation; Firkins et al., 1985), .10% Ca, .71% P, and .44% K. All final diets contained 78.9% DRC or DRC plus corn byproducts (40% DM basis), 10% alfalfa hay, 6.1% molasses, and 5% dry supplement (DM basis; Table 2). Diets were formulated to contain a minimum of 12.5% CP, .7% Ca, .35% P, and .7% K and contained 28 mg of monensin (Elanco Animal Health, Indianapolis, IN) per kilogram of dietary DM. Supplemental protein for the control diet was supplied by soybean meal and urea.

Lambs were adapted to final diets in 21 d using four grain adaptation diets containing 45 (3 d), 35 (4 d), 25 (7 d), and 15% forage (7 d; DM basis). Corn byproducts or COMP1 were fed at 40% of the diet DM during the adaptation period and throughout the remainder of the trial. Lambs were allowed ad libitum access to feed and water. Orts were weighed each morning, mixed with the day's diet, and refed to the lambs. When orts seemed to deteriorate, they were removed, composited for the entire trial, and analyzed for DM content (60°C for 48 h in a forced-air oven). Lambs were housed individually in .9-m × .9-m pens in an environmentally controlled room (25°C). Initial and final weights were the average of weights taken on three consecutive days before feeding. Individual feeds were sampled weekly, composited, and analyzed for DM content (60°C for 48 h), Kjeldahl N (AOAC, 1975), NDF (Robertson and Van Soest, 1977), and lipid (chloroform-methanol extraction; Moore et al., 1986).

Net energy for gain of each diet was calculated using the procedures outlined by Larson et al. (1993) but using equations developed for lambs (NRC, 1985). These calculations include the NE_g of each grain adaptation diet as well as the final finishing diet. The net energy required for gain (**NE_gR**) was calculated using the equation $NE_gR = .276\ BW^{.75}(ADG)$, where NE_gR (Mcal/kg gain) is the net energy required for daily weight gain (ADG; NRC 1985). Maintenance net energy required (**NE_mR**, Mcal/d) was calculated by the equation $NE_mR = .056\ BW^{.75}$ (NRC, 1985). The NE content of the diet was assumed to fit the relationship: $NE_g = .877\ NE_m - .41$ (Zinn, 1989). By the process of iteration, the NE_g and NE_m contents (Mcal/kg) of the diets were calculated to fit the equation $DMI\ (kg/d) = (NE_gR/NE_g) + (NE_mR/NE_m)$. The NE_g content of the distillers byproducts was calculated by substitution, assuming basal ingredients possess the same energy value (NRC, 1984) across all diets.

Finishing performance and feed intakes were analyzed as a randomized complete block design according to the GLM procedures of SAS (1989). Individual lambs were used as the experimental unit and model effects included block and treatment. Least squares means were separated using the Least Significant Difference method when a significant ($P < .10$) treatment F-test was detected.

Trial 2

A finishing trial using 60 yearling crossbred steers (BW = 272 ± 42 kg) was conducted from July 11 to December 17, 1994. Steers were stratified by previous experimental gain, measured during a growth trial evaluating protein sources, and assigned randomly to one of five treatments. Blocks were .38 ± .13, .38 ± .13, .35 ± .13, and .28 ± .10 kg/d previous gain. Treatments consisted of a 1) DRC control, 2) WCGF, 3) wet distillers grains composite (**COMP2**), 4) wet distillers grains composite minus tallow (−FAT), and 5) wet distillers grains composite minus corn gluten meal (−CGM). The COMP2 was formulated (Table 1) based on the following assumptions: minimum of 12.5% degradable protein, 12.5% undegradable protein (assuming that wet distillers grains plus thin stillage contains 25% CP [Larson et al., 1993] and that the CP was 50% degradable [Aines et al., 1987]), 13.1% chloroform:methanol lipid (Larson et al., 1993), and 32.7% NDF (Larson et al., 1993). Based on these assumptions, the COMP2 contained 65.7% WCGF, 26.3% corn gluten meal, and 8.0% tallow (DM basis). The COMP2 contained additional CP (27.9%), degradable protein (15.4%), and NDF (47.2%). The composite diet was altered to formulate the treatments −FAT and −CGM by removing tallow or corn gluten meal, respectively, and replacing these ingredients with WCGF (DM basis). The control diet contained 79.1% DRC, 5.0% corn silage, 5.0% alfalfa hay, 5.9% molasses-based urea liquor supplement, and 5% dry supplement (Table 3). All other diets contained 45.0% DRC, 40% corn byproducts, 5% corn silage, 5% alfalfa hay, and 5.0% dry supplement. Diets were formulated (DM basis) to contain a minimum of 7.2% ruminally degradable N (TDN × .081; Shain et al., 1995) and a minimum of 12.0% CP, .7% Ca, .3% P, and .65% K and contained 28 mg of monensin per kilogram of dietary DM and 11 mg of tylosin per kilogram of dietary DM (Elanco Animal Health). Cattle were individually fed using Calan gates. Cattle had ad libitum access to feed with fresh feed placed in the bunk daily throughout the experiment. Orts were weighed every 3 d to calculate DMI.

Net energy for gain of each diet was calculated using the procedures outlined by Larson et al. (1993). These calculations include the NE_g of each grain adaptation diet as well as the final finishing diet. The net energy required for gain (NE_gR) was calculated using the equation $NE_gR = .0557\ BW^{.75}(ADG^{1.097})$, where NE_gR (Mcal/kg gain) is the net energy required for daily weight gain (ADG; NRC, 1984). Maintenance net energy required (NE_mR, Mcal/d) was calculated by the equation $NE_mR = .077\ BW^{.75}$ (NRC, 1984). The NE content of the diet was assumed to fit the relationship: $NE_g = .877\ NE_m - .41$ (derived from NRC, 1984; Zinn, 1989). By the process of iteration, the NE_g and NE_m contents (Mcal/kg) of the diets were calculated to fit the equation DMI (kg/d) = $(NE_gR/NE_g) + (NE_mR/NE_m)$. The NE_g content of the distillers byproducts was calculated by substitution as previously described in Trial 1.

Steers were adapted to the final diets in 21 d using four grain adaptation diets containing 45 (3 d), 35 (4 d), 25 (7 d), and 15% forage (7 d; DM basis). Corn byproducts or COMP2 were included at 40% of diet DM during the grain adaptation and throughout the trial. Forage was a mixture of alfalfa hay and corn silage with corn silage assigned the value of 50% forage. Individual feeds were sampled weekly, composited, and analyzed for DM, N, NDF, and lipid contents as described in Trial 1. Cattle were implanted with Compudose (Elanco Animal Health) at the onset of the trial and reimplanted with Finaplex-S (Hoechst Roussel, Somerset, NJ) on d 60. Steers were housed in covered pens with 15 cattle per pen. Initial weights were based on an average of three consecutive day weights taken before feeding. Cattle were slaughtered at the IBP plant, West Point, NE and grades were determined by the USDA grader. Hot carcass weight adjusted to 62% dressing percentage was used to calculate final weight. Hot carcass weight and liver abscess score were recorded at slaughter. Livers were

Table 2. Composition of lamb diets for Trial 1

	Treatment[a], % of diet DM			
Item	Control	DDGS	WCGF	COMP1
Dry-rolled corn	78.9	38.9	38.9	38.9
Alfalfa	10.0	10.0	10.0	10.0
Molasses[b]	6.1	6.1	6.1	6.1
Dried distillers grains plus solubles	—	40.0	—	—
Wet corn gluten feed	—	—	40.0	—
Composite	—	—	—	40.0
Dry supplement	5.0	5.0	5.0	5.0
Finely ground corn	—	3.3	3.5	3.1
Soybean meal	2.9	—	—	—
Urea	.5	—	—	—
Limestone	1.2	1.3	1.3	1.3
Potassium chloride	.2	.2	—	.2
NaCl	.2	.2	.2	.2
Trace mineral premix[c]	.01	.01	.01	.01
Vitamin premix[d]	.01	.01	.01	.01
Monensin premix[e]	.02	.02	.02	.02
Nutrient composition				
Crude protein[f]	12.5	17.3	13.0	18.7
Lipid[f]	3.7	6.2	3.1	6.2
NDF[f]	11.7	26.0	26.4	26.0
Calcium[g]	.70	.70	.70	.75
Phosphorus[g]	.35	.47	.52	.47
Potassium[g]	.70	.70	1.04	.87
Dry matter	88.1	88.8	62.5	70.1

[a]DDGS = dried distillers grains plus solubles; WCGF = wet corn gluten feed; COMP1 = wet corn gluten feed, corn gluten meal, condensed solubles, tallow, and dicalcium phosphate.
[b]Contained 1.5% salt, DM basis.
[c]10% Mg, 6% Zn, 4.5% Fe, 2% Mn, .5% Cu, .3% I, and .05% Co.
[d]15,000 IU of vitamin A, 3,000 IU of vitamin D, and 3.7 IU of vitamin E/g premix.
[e]132 g Monensin/kg premix.
[f]Based on values for individual feed ingredients determined in our laboratory.
[g]Based on tabular values (NRC, 1984).

scored by a modification of Elanco Products Company (1974) procedure using the following system: 0 = healthy; 1 = one to four small abscesses; 2 = one to four medium abscesses; 3 = one or more large abscesses; and 4 = adherence of abscess to diaphragm and digestive tract. Fat thickness measured at the 12th rib, quality grade, and yield grade were recorded after carcasses were chilled for 48 h.

Analysis of variance procedures for a randomized complete block design were performed using the GLM procedures of SAS (1989). Steer was used as the experimental unit. Model effects were treatment and block. Duncan's multiple range test was used to separate treatment means when a significant ($P < .10$) treatment F-test was detected.

Results

Trial 1. Dry matter intake was not different among lambs (Table 4) fed the different dietary treatments ($P > .10$). Lambs fed WCGF gained slower ($P < .10$) than lambs fed DRC control, DDGS, or COMP1. Lambs fed the COMP1 diet were 27% more efficient ($P < .10$) than lambs fed WCGF. Although the difference in feed efficiency between the control and COMP1 was not statistically significant, a 12% advantage was obtained with the COMP1 diet.

Trial 2. Steers fed COMP2 or –FAT diets consumed less dry matter ($P < .10$) than steers fed the DRC control diet (Table 5), and steers fed WCGF or –CGM diets were intermediate. Daily gains were not different ($P > .10$) among treatments. Steers fed the COMP2 diet were 10% more efficient ($P < .10$) than steers fed WCGF or DRC control diets. Steers fed –FAT or –CGM were 7% more efficient than steers fed WCGF or DRC control, but the differences were not significant ($P > .10$). Liver abscess score, quality grade, yield grade, and fat depth measured at the 12th rib were not different ($P > .10$) among treatments (data not shown).

Table 3. Composition of final steer diets for Trial 2

	Treatment[a], % of diet DM				
Item	Control	WCGF	COMP2	–FAT	–CGM
Dry-rolled corn	79.1	45.0	45.0	45.0	45.0
Alfalfa hay	5.0	5.0	5.0	5.0	5.0
Corn silage	5.0	5.0	5.0	5.0	5.0
Molasses supplement[b]	5.9	—	—	—	—
Wet corn gluten feed	—	40.0	—	—	—
Composite	—	—	40.0	40.0	40.0
Dry supplement	5.0	5.0	5.0	5.0	5.0
Finely ground corn	2.89	2.89	3.02	3.02	2.83
Limestone	1.44	1.44	1.51	1.51	1.51
Tallow	.10	.10	.10	.10	.10
Urea	—	—	—	—	.19
Potassium chloride	.20	.20	—	—	—
NaCl	.30	.30	.30	.30	.30
Trace mineral premix[c]	.02	.02	.02	.02	.02
Vitamin premix[d]	.02	.02	.02	.02	.02
Monensin premix[e]	.02	.02	.02	.02	.02
Tylosin premix[f]	.01	.01	.01	.01	.01
Nutrient composition					
Crude protein[g]	12.4	12.4	17.1	17.7	12.4
Degradable protein[h]	7.2	8.0	9.0	9.4	8.1
Undegradable protein[h]	5.2	4.4	8.2	8.3	4.3
Lipid[g]	6.4	6.2	8.4	5.4	8.6
NDF[g]	12.2	33.3	28.1	30.9	33.4
Dry matter[g]	79.0	57.8	64.5	62.7	59.4

[a]WCGF = wet corn gluten feed; COMP2 = wet corn gluten feed, corn gluten meal, and tallow; –FAT = composite minus tallow; –CGM = composite minus corn gluten meal.

[b]Molasses-urea based supplement containing 50.6% CP, .55% P, vitamins (78,925 IU of vitamin A/kg, 15,789 IU of vitamin D/kg, and 20 IU of vitamin E/kg), and trace minerals (.37% of supplement DM; 2.25% Fe, 1.0% Zn, .64% Mn, .20% Cu, .18% Mg, .16% Co, and .55% I).

[c]10% Mg, 6% Zn, 4.5% Fe, 2% Mn, .5% Cu, .3% I, and .05% Co.

[d]15,000 IU of vitamin A, 3,000 IU of vitamin D, and 3.7 IU of vitamin E/g premix.

[e]176 g monensin/kg premix.

[f]88 g tylosin/kg premix.

[g]Based on values for individual feed ingredients determined in our laboratory.

[h]Assuming the following values for protein degradability (% of CP): dry-rolled corn = 40%; alfalfa hay = 72%; corn silage = 75%; wet corn gluten feed = 80%; corn gluten meal = 40%.

Table 4. Effect of wet distillers grains composite on finishing lamb performance

	Treatment[a]				
Item	Control	WCGF	DDGS	COMP1	SEM
DM intake, kg/d	1.24	1.21	1.27	1.27	.35
Daily gain, kg	.28[b]	.24[c]	.31[b]	.32[b]	.04
Gain/feed	.226[b]	.198[c]	.224[b]	.252[b]	.020

[a]WCGF = wet corn gluten feed; DDGS = dried distillers grains plus solubles; COMP1= wet corn gluten feed, corn gluten meal, condensed solubles, tallow, and dicalcium phosphate.
[b,c]Means within a row with unlike superscripts differ ($P < .10$).

Discussion

Our results indicate that a composite of feeds can be formulated that improves efficiency compared with WCGF. The data reported from these two trials are in agreement with the performance values obtained by Larson et al. (1993) and Ham et al. (1994) from experiments that used corn wet distillers grains and thin stillage from a farm-scale alcohol plant. However, it is not clear how the relative proportions of the fiber, protein, and fat contributed to the increase in energy value observed with distillers byproducts. When comparing WCGF to COMP1 or COMP2, a 27 (Trial 1) or 10% (Trial 2) improvement in feed efficiency was observed. Wet distillers grains are higher in lipid than WCGF (15% vs 9%, respectively; Ham et al., 1995). Fat contains three times more NE_g than does corn (Zinn, 1989). Based on this observation, wet distillers grains should be higher in NE_g than corn. However, Larson et al. (1993) noted that the fat content of wet distillers grains mathematically could only account for 9% more energy than corn. These researchers reported that wet distillers grains contained 47% more energy than corn when fed to yearling steers. This indicates that the lipid fraction of the distillers byproducts may be responsible for a portion of the increase in efficiency but is not the only factor involved. The NE_g content of the corn byproducts and composites were calculated based on individual animal performance. In Trial 1, WCGF, COMP1, and DDGS contained 83, 122, and 112%, respectively, the relative NE_g value of corn. In Trial 2, WCGF, COMP2, –FAT, and –CGM contained 100, 123, 117, and 129%, respectively, the relative NE_g value of corn; however, these values may be inflated due to the large amount of individual animal variation within each treatment. When the energy values were calculated based on treatment means, WCGF, COMP2, –FAT, and –CGM contained 101, 120, 116, and 110%, respectively, the relative NE_g value of corn, which may be more realistic estimates.

It is difficult to separate the effects of removing the starch and replacing it with digestible fiber on animal performance. In the wet and dry milling processes, starch is removed to produce corn sweeteners and ethanol. Corn wet distillers grains contain 87% less starch than corn (Larson, 1992). Therefore, replacing corn with distillers byproducts may help control subacute acidosis. Farlin (1981) and Firkins et al. (1985) speculated that increased feed efficiency when wet corn distillers byproducts were fed may have been due in part to a reduction in subacute acidosis. High starch intake leads to increased production of ruminal organic acids that may result in subacute acidosis (Burrin and Britton, 1986). More recently, Stock et al. (1990) suggested that subacute acidosis could cause reductions in gain and efficiency. Feed intake has been used as an indicator of subacute acidosis (Britton and Stock, 1987); however, higher-energy diets may reduce intakes because of chemostatic intake regulation mechanisms. Dry matter intake for WCGF-fed animals was similar to that of the controls ($P < .10$) and COMP1 (Table 4) diets in Trial 1 and slightly higher than COMP2 (Table 5) in Trial 2.

The fiber in corn byproducts has been characterized as being highly and readily digested (DeHaan, 1983). Ham et al. (1994) reported that corn byproducts may cause a shift in organic matter digestion to the small intestine, when compared with a DRC control. A number of authors have reported that this shift in site of organic matter digestion from the rumen to the lower gut may result in more efficient energy utilization by reducing losses associated with fermentation (Blaxter, 1962; Ørskov et al., 1969; Black and Tribe, 1973). In the study previously mentioned, Ham et al. (1994) observed that total tract NDF digestibility tended to be 5% higher for WCGF than wet distillers grains. This could be explained by wet distillers grains having a smaller particle size and subsequent faster rate of ruminal passage. Wet corn gluten feed has a larger particle size, which may cause it to have a slower rate of passage and to be more completely digested in the rumen, contributing to its higher total tract digestibility. The composite diets used in our studies combined WCGF, corn gluten meal, and tallow to simulate wet distillers grains. The composites may have had a greater particle size than wet distillers grains due to WCGF being used as the fiber fraction, resulting in the composite being more completely digested. In Trial 2, there was no difference in gains among the treatments; however, the steers fed the COMP2 diet were more efficient than steers fed WCGF diets ($P < .10$).

Table 5. Effect of wet distillers grains composite on finishing steer performance

	Treatment[a]					
Item	DRC	WCGF	COMP2	–FAT	–CGM	SEM
DM intake, kg/d	9.75[b]	9.48[bc]	9.05[c]	9.08[c]	9.43[bc]	.54
Daily gain, kg	1.33	1.30	1.35	1.32	1.33	.13
Gain/feed	.136[b]	.136[b]	.149[c]	.146[bc]	.146[bc]	.023

[a]DRC = dry-rolled corn; WCGF = wet corn gluten feed; COMP2 = wet corn gluten feed, corn gluten meal, and tallow; –FAT = composite minus tallow; –CGM = composite minus corn gluten meal.

[b,c]Means within a row with unlike superscripts differ (*P* < .10).

The effect of fat in DRC finishing diets is unclear. Krehbiel et al. (1995b) reported that, with individually fed steers, gain/feed decreased as level of fat increased in DRC finishing diets. In two feedlot studies, gain/feed was improved in DRC finishing diets when 2 or 4% tallow was fed (Krehbiel, 1995a). Shain et al. (1993) reported that as vegetable fat increased, rate of fiber digestion in growing diets declined. Fat in excess of 2 to 3% of dietary DM has been reported to inhibit fibrolytic bacteria (Palmquist, 1988). Diets used in our trials containing distillers byproducts averaged 6% lipid. Jenkins et al. (1989) reported that ruminal fermentation of fiber was reduced when corn oil was added to diets but total tract digestibility was unaffected. One possible explanation could involve compensatory hindgut fermentation of fiber. Hindgut fermentation was not measured in our trials, but fat levels in our diet did not seem to reduce the digestibility of the fiber in the diets, as observed by the high feed efficiency, and may have enhanced performance due to the energy density of the diet.

Wet distillers byproducts are higher in escape protein than WCGF (47% vs 26%, respectively; Firkins et al., 1984). During the wet milling process, most of the gluten protein is separated and sold as corn gluten meal. Corn gluten meal is a relatively insoluble protein, thus corn gluten feed protein would be expected to be more soluble than the protein of distillers byproducts. Also, because corn is steeped in dilute acid in the wet-milling process, some solubilization of protein and hemicellulose may occur (Firkins et al., 1984). Firkins et al. (1985) noted that large-framed steer calves gained faster and more efficiently when fed dried distillers grains plus solubles due to a greater amount of amino acids being presented to the small intestine. McCoy et al. (1995) added escape protein to diets containing WCGF (40% of diet DM) and observed that adding escape protein to WCGF diets increased metabolizable protein intake and consequently improved daily gain, indicating that WCGF may be deficient in metabolizable protein. However, in our study all diets were formulated to meet or exceed metabolizable protein requirements (NRC, 1984) of the animals. Therefore, improvements in animal performance were attributed to increased energy utilization.

Implications

It is feasible to formulate a composite feed that is similar in nutrient content to wet distillers grains that will elicit similar improvements in feed efficiency compared to corn. However, it is not clear what level of fat, fiber, or escape protein or how the interactions of these ingredients contribute to the increases in feeding value observed with distillers byproducts.

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