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Wet Corn Gluten Feed and Alfalfa Hay Levels in Dry-Rolled Corn Finishing Diets

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Summary

One hundred ninety-two yearling steers were fed 132 days (June to October) to determine if roughage levels could be reduced in dry-rolled corn finishing diets containing wet corn gluten feed (WCGF) and to evaluate the effects on N volatilization. Finishing diets contained either 0 or 35% WCGF and 0, 3.75, or 7.5% alfalfa hay. Intake, ADG, and carcass weight increased as level of alfalfa hay increased, or when WCGF was fed. Feed conversions of cattle fed 35% WCGF were improved 4.4% compared to conversions of cattle fed no WCGF at 0% alfalfa hay. Within 35% WCGF diets, efficiency decreased as alfalfa hay inclusion increased. Nitrogen loss from pens with cattle fed 0 and 35% WCGF was not different, averaging nearly 80%. These data suggest alfalfa hay can be decreased from conventional levels when diets contain WCGF.

Introduction

Roughages such as alfalfa hay (AH) are used to control acidosis in finishing diets. Typically, finishing diets contain 5-10% roughage (DM basis). However, due to their cost per unit of energy and high potential for shrink, roughages are burdensome in finishing diets. Due to a reduced starch load and the positive attributes of feeding WCGF relative to acidosis, conventional levels of roughage may not be necessary when WCGF is included in finishing diets.

Feeding corn bran has reduced N volatilization during the winter/spring (i.e., November to May) feeding months by increasing OM excretion onto the pen surface (2002 Nebraska Beef Report, pp. 54-57; 2003 Nebraska Beef Report, pp. 54-58). However, decreasing diet digestibility with corn bran may also depress animal performance. The combination of steep liquor and corn bran in WCGF may allow performance to be maintained while helping to reduce N loss by increasing OM excretion onto the pen surface. The objectives of this research were to determine 1) if WCGF can be effectively utilized as an energy source and reduce the need for conventional levels of roughage in dry-rolled corn based diets due to acidosis control, and 2) if feeding WCGF will increase OM excretion onto the pen surface and widen the C:N ratio of manure thereby increasing manure N and reducing N volatilization losses.

Table 1. Composition of finishing diets (% DM basis).

	0% WCGF			35% WCGF		
AH level, % DM	0	3.75	7.5	0	3.75	7.5
Dry-rolled corn	87.0	83.25	79.5	52.0	48.25	44.5
Wet corn gluten feed[a]	—	—	—	35.0	35.0	35.0
Alfalfa hay	—	3.75	7.5	—	3.75	7.5
Molasses	5.0	5.0	5.0	5.0	5.0	5.0
Tallow	3.0	3.0	3.0	3.0	3.0	3.0
Supplement[b]	5.0	5.0	5.0	5.0	5.0	5.0
Urea	1.23	1.12	1.01	0.21	0.11	—
Nutrient Composition[c]						
CP, %	13.1	13.1	13.1	13.5	13.5	13.5
Ca. %	0.70	0.70	0.70	0.70	0.70	0.70
P, %	0.38	0.38	0.38	0.49	0.49	0.48

[a]Wet corn gluten feed from ADM, Columbus, NE.
[b]Supplement provided 28 g/ton Rumensin and 10 g/ton Tylan (90% air-dry basis).
[c]Crude protein and P were analyzed (after trial), Ca was calculated based on formulation; all are expressed as a percentage of diet DM.

Procedure

Feedlot Experiment

One-hundred ninety two yearling steers (initial BW = 774 $\pm$ 24 lb) were fed 132 days from June to October 2002. Steers were weighed initially on two consecutive days after being limit fed (2% BW) for 5 days to minimize gut fill differences. Cattle were stratified by weight and assigned randomly to 1 of 24 pens (2 x 3 factorial treatment structure; 4 pens/ treatment). Adaptation to finishing diets consisted of a 23-day step-up period where dry-rolled corn progressively replaced AH. Cattle were implanted on day 1 with Synovex-C and re-implanted on day 30 with Revalor-S.

Finishing diets contained either 0 or 35% WCGF (ADM, Columbus, NE) and 0, 3.75, or 7.5% AH (Table 1). Experimental diets were formulated to meet or exceed metabolizable protein requirements (1996 NRC) and be iso-nitrogenous based

(Continued on next page)

upon the 35% WCGF and 7.5% AH treatment. Urea was used as the supplemental protein source to make diets equal in CP. Upon completion of the feeding trial, cattle were harvested at a commercial abattoir and carcass data were collected. Final weights were calculated from hot carcass weights using a common dressing percentage (63%).

Nutrient Balance

Mass balance for N was conducted as previously outlined (2002 Nebraska Beef Report, pp. 54-57; 2003 Nebraska Beef Report, pp. 54-58). Stocking density in all pens was maintained at 332 ft^2/steer. Throughout the feeding period, feed refusals were collected when necessary to accurately assess DMI. After cattle were removed from pens, manure was scraped and piled into one central pile within each pen. As the manure was being loaded out of pens, manure samples were taken. Manure was weighed on an as-is basis and hauled to the University of Nebraska compost yard.

Manure N was calculated by multiplying manure N concentration by pounds of manure removed (DM) from the pen surface. Soil core N was used to correct manure N for manure left in the pen or soil removed at cleaning. Runoff N was the N concentration of the runoff times pounds of water collected. The manure C:N ratio was calculated by taking amount of manure OM multiplied by 0.49 (assuming OM contains 49% C) and divided by amount of N in the manure.

Nitrogen excretion was determined by difference between N intake and N retention. Nitrogen intake was calculated using analyzed dietary N concentration multiplied by DMI and corrected for N content of feed refusals. Steer N retention was calculated according to the retained energy and protein equations established by the 1996 Beef Cattle NRC. Nitrogen excreted was calculated by subtracting N retention from N intake. Total N lost was calculated by subtracting manure N (corrected for soil N content) and runoff N from excreted N. Percentage of N lost was calculated as N lost divided by total N excretion. All N values were expressed on a lb/steer basis. Phosphorus intake, retention and excretion were calculated similar to N.

Statistical analyses were conducted using the Mixed procedures of SAS. Pen served as the experimental unit. Model effects were AH level, WCGF level and the interaction of the two. Simple effects are expressed when a significant interaction occurred, whereas main effects of AH and WCGF level are expressed when no interaction was observed.

Table 2. Effects of wet corn gluten feed and alfalfa hay on steer performance and carcass characteristics.

	WCGF level			AH level			
Item	0%	35%	*P*-value	0%	3.75%	7.5%	Linear[a]
Final wt., lb[b]	1288	1308	0.09	1279	1308	1308	0.04
DMI, lb/day	23.6	24.6	<0.01	23.1	24.4	24.8	<0.01
ADG, lb	3.90	4.03	0.10	3.81	4.04	4.05	0.03
Marbling score[c]	502	495	0.50	496	496	502	0.63
Ribeye area, sq. in.	13.6	14.3	<0.01	13.6	14.4	13.8	0.57
12th rib fat, in.	0.49	0.54	0.01	0.49	0.51	0.53	0.05
Liver abscesses, %	4.2	3.1	0.73	4.7	4.7	1.6	0.41

[a]*P*-value for linear effect of alfalfa hay level.
[b]Calculated as hot carcass weight ÷ 63% (common dressing percentage).
[c]450 = Slight^{50}, 500 = Small^{0}, 550 = Small^{50}, etc.

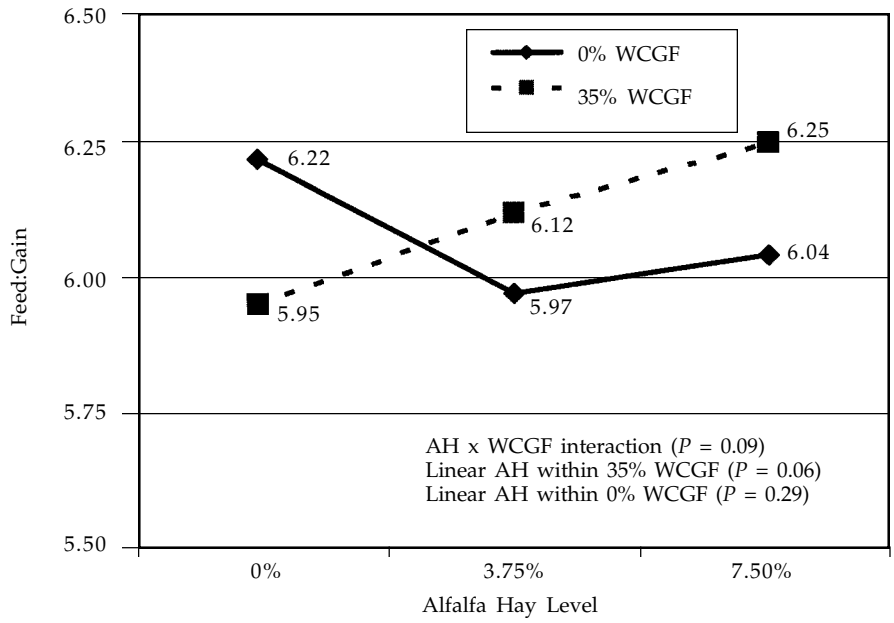

Figure 1. Interaction between alfalfa hay (AH) level and wet corn gluten feed (WCGF) inclusion on feed conversion of feedlot steers.

Results

Steers fed 35% WCGF had a higher DMI ($P < 0.01$) and ADG ($P = 0.10$) compared to those fed no WCGF (Table 2). Ribeye area and 12th rib fat thickness were also greater ($P < 0.01$) for steers fed WCGF. A linear effect ($P < 0.05$) of AH level was observed for DMI and ADG. An interaction occurred between AH level and WCGF inclusion for feed conversion (Figure 1). Feed conversions were not signifi-

Table 3. Effect of alfalfa hay level on N mass balance (values expressed as lb/steer over the entire feeding period).

Item	0% AH	3.75% AH	7.5% AH	SEM	Linear[a]
N intake[a]	65.6	69.3	70.4	0.7	<0.01
N retention[ab]	9.6	10.2	10.2	0.2	<0.05
N excretion[ac]	56.1	59.1	60.2	0.6	<0.01
DM wt. removed	736	814	772	123	0.83
OM wt. removed	143	179	183	16.2	<0.10
Manure N[d]	7.7	9.9	11.5	1.9	0.16
Runoff N	2.60	2.12	2.45	0.22	0.65
N lost[e]	45.8	47.1	46.2	1.8	0.88
N loss, %[f]	81.9	79.8	76.6	3.0	0.23
Manure C:N ratio	8.7	9.1	9.3	0.2	0.05

[a]*P*-value for linear effect of alfalfa hay level.
[b]Calculated using NRC (1996) net protein and net energy equations.
[c]Calculated as N intake — N retention.
[d]Corrected for soil N concentration before and after trial.
[e]Calculated as N excretion — manure N — runoff N.
[f]Calculated as N lost ÷ N excretion.

Table 4. Effect of wet corn gluten feed level on N mass balance (values expressed as lb/steer over the entire feeding period).

Item	0% WCGF	35% WCGF	SEM	*P*-value
N intake	65.9	71.0	0.6	<0.01
N retention[a]	9.8	10.2	0.1	0.10
N excretion[b]	56.1	60.8	0.5	<0.01
DM wt. removed	656	893	100	0.11
OM wt. removed	132	204	13	<0.01
Manure N[c]	8.6	10.8	1.5	0.33
Runoff N	3.05	1.73	0.18	<0.01
N lost[d]	44.4	48.3	1.5	0.08
N loss, %[e]	79.2	79.6	2.5	0.92
Manure C:N ratio	8.8	9.3	0.2	0.02

[a]Calculated using NRC (1996) net protein and net energy equations.
[b]Calculated as N intake — N retention.
[c]Corrected for soil N concentration before and after trial.
[d]Calculated as N excretion — manure N — runoff N.
[e]Calculated as N lost ÷ N excretion.

cantly different ($P > 0.2$) across AH inclusion levels when 0% WCGF was fed; however, feed conversions improved ($P = 0.06$) as AH was removed in diets containing 35% WCGF. This observation suggests AH had less value when diets contained WCGF. Furthermore, feed conversions of steers fed WCGF and 0% AH were improved 4.4% compared to conversions of steers fed no WCGF and 0% AH ($P = 0.10$).

Interactions between AH and WCGF were not observed for feedlot N mass balance; therefore, only main effects of AH and WCGF are shown (Tables 3 and 4, respectively). As level of alfalfa hay increased, N intake, N retention and N excretion increased linearly ($P < 0.05$). Steers fed WCGF consumed and excreted more N ($P < 0.01$) than those fed no WCGF. Amount of N lost (lb/steer) was greater when steers were fed WCGF ($P = 0.08$), but because WCGF fed steers excreted more N, there was no difference in the percentage N loss. When expressed as a percentage of N excretion, loss of N from pens where steers were fed 0 and 35% WCGF was not different, averaging 79.2 and 79.6%, respectively. More manure DM ($P = 0.11$) and OM ($P < 0.01$) were removed from pens with cattle consuming WCGF. The higher OM excretion from steers fed 35% WCGF translated into an elevated manure C:N ratio ($P = 0.02$) as compared to steers fed no WCGF; however, only a numerical increase was observed in the amount of N in manure (8.6 vs. 10.8 lb/steer for 0 and 35% WCGF diets, respectively). Runoff N was greater from pens where cattle were fed no WCGF ($P < 0.01$) compared to those pens where cattle were fed 35% WCGF.

Substituting 35% WCGF in place of dry-rolled corn resulted in a 0.11% increase in dietary P concentration (DM basis). The combination of a higher DMI for WCGF fed steers and greater P concentration in WCGF diets translated into a 4 lb/steer difference in P intake over the 132 day feeding period and a subsequent 3.9 lb/steer increase (42%) in P excretion (data not shown).

These data suggest AH has less value when diets contain WCGF, and can be reduced from conventional levels. Presumably, this effect is due to reduction in ruminal starch load and subsequent reduced ruminal acidosis when dry-rolled corn is partially replaced with WCGF. Previous research has provided evidence that feeding WCGF reduces the severity of acidosis compared with cattle consuming dry-rolled corn (1995 Nebraska Beef Report, pp. 34-36). However, the response to lower AH may change if corn is processed differently.

Loss of N from open feedlots is higher during the summer months than those of the winter/spring months (2003 Nebraska Beef Report, pp. 54-58); therefore, the additional OM excretion from feeding WCGF may not reduce N loss during the summer feeding months. Feeding WCGF will increase the amount of manure removed from pens. Evaluating the effects of feeding WCGF on N losses during the winter/spring months is warranted.

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