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Summary

Seven ruminally cannulated steers were used to evaluate fiber digestibility and rumen pH for diets containing 35 or 88% wet corn gluten feed (WCGF) or 35% wet distillers grains with solubles (WDGS). These diets were top-dressed with or without a direct-fed microbial (DFM). Interactions were observed for DM and NDF digestibility. Feeding 88% WCGF decreased DM digestibility, but NDF digestibility increased especially with the DFM. Rumen pH was greatest for steers fed 88% WCGF and lowest for steers fed 35% WCGF.

Introduction

Increased ADG and decreased F:G associated with feeding wet corn gluten feed (WCGF) and wet distillers grains plus solubles (WDGS) in finishing diets up to 50% of the diet (*2008 Nebraska Beef Report*, pp. 33-34; *2008 Nebraska Beef Report*, pp. 35-36) may be due to improved rumen pH from WCGF, high fat from WDGS, or high fiber digestibility from both WCGF and WDGS. Feed digestibility has improved in some cases when DFM is fed (Weinberg et al., *Journal of Dairy Science 90*: 4754-4762). The objectives of the current study were to evaluate three diets of 35% WCGF, 35% WDGS, and 88% WCGF with or without a DFM to determine effects on nutrient digestibility and rumen pH.

Procedure

Seven ruminally cannulated steers (BW = 796 lb) were used in a 6 x 6 unbalanced Latin square to evaluate effects of feeding WCGF or WDGS in diets and top-dressing a DFM on nutrient digestion, intake, and rumen pH. Treatments were arranged in a 3 x 2 factorial design with diets containing 35% WCGF (35WCGF), 35% WDGS (35WDGS), or 88% WCGF (88WCGF; DM basis; Table 1). The three diets were top-dressed at feeding with or without the DFM consisting of 1 x 10^9 CFUs of *Lactobacillus buchneri* strain 40788 (Lallemand Animal Nutrition North American, Milwaukee, Wisc.). All diets contained 7% alfalfa hay and 5% dry supplement with dry rolled corn (DRC) as the remainder of the diets.

Table 1. Composition of dietary treatments (DM basis)[1].

Ingredient	35WDGS	35WCGF	88WCGF
WDGS[2]	35	—	—
WCGF[2]	—	35	88
DRC[2]	53	53	—
Alfalfa hay	7	7	7
Dry supplement[3]	5	5	5
Diet DM%	54.1	75.7	62.2
Diet NDF%	23.8	24.5	38.4

[1]35WDGS = 35% WDGS; 35WCGF = 35% WCGF; 88WCGF = 88% WCGF.
[2]WDGS = wet distillers grains plus solubles; WCGF = wet corn gluten feed (Sweet Bran); DRC = dry rolled corn.
[3]All diets were formulated to contain a minimum of 0.65% Ca, 0.60% K, 320mg/steer daily Rumensin®, 90mg/steer daily Tylan®, and 140mg/steer daily thiamine.

Periods were 21 days in length, including a 12-day adaptation period followed by a 9-day collection period. Steers were individually fed in pens once daily at 0800 hr. Daily feed refusals were collected. Wireless pH probes were submersed in the rumen from day 13 through day 21. Ruminal pH measurements included average, minimum, and maximum pH; magnitude of pH change; pH variance; time spent below pH 5.6; and area of pH below 5.6 (time below x magnitude below). Chromic oxide (7.5g/dose) was used as an indigestible marker for estimating fecal output and was dosed intraruminally at 0800 hr and 1800 hr daily from day 13 to day 20, with two doses given at 0800 hr on day 13. Fecal grab samples were collected three times daily at 0800 hr, 1300 hr, and 1800 hr on day 17 through day 21 and composited by weight daily. Fecal samples, WDGS, and WCGF were freeze dried. Alfalfa, DRC, and feed refusals were oven dried at 60°C for 48 hours. A period composite was made from equal dried weights of daily fecal samples for nutrient digestibility calculations.

Intake and digestibility data were analyzed as a 3 x 2 factorial treatment arrangement and Latin square experimental design using the MIXED procedure of SAS. Interaction between diet type and DFM addition were tested. If no significant interaction was observed, then main effects of either diet type or DFM supplementation were presented. If a significant interaction was observed, then the simple effects of DFM supplementation within diet type were presented. Period was included in the model as a fixed effect and steer was a random effect. Ruminal pH data were analyzed as a repeated measure with a Cholesky covariance structure.

Results

No significant interactions between diet and DFM resulted for DM or NDF intake ($P \geq 0.97$, Table 2). Feeding 35WCGF resulted in the greatest ($P < 0.01$) DMI, which was 3.4 lb greater than feeding 35WDGS ($P < 0.01$). Because steers fed 88WCGF had the greatest diet concentration of NDF, intake of NDF was the greatest ($P < 0.01$) for this diet (8.0 lb). 35WCGF and 35WDGS had similar

Table 2. Effects of diet[1] and DFM on nutrient intake and digestibility.

Performance	No DFM 35WDGS	No DFM 35WCGF	No DFM 88WCGF	With DFM 35WDGS	With DFM 35WCGF	With DFM 88WCGF	Diet *P*-value	DFM *P*-value	Inter[2]
DM									
Intake, lb/day	18.4	21.7	20.6	19.6	23.1	21.9	< 0.01	0.04	0.99
Digestibility, %	79.2^{c}	79.4^{c}	73.7^{a}	77.7^{bc}	79.0^{c}	76.2^{b}	< 0.01	0.82	0.08
NDF									
Intake, lb/day	4.40	5.39	7.79	4.63	5.67	8.11	< 0.01	0.10	0.97
Digestibility, %	68.2^{ab}	68.1^{a}	69.0^{ab}	64.8^{a}	65.8^{a}	72.3^{b}	0.05	0.61	0.15

[1]35WDGS = 35% WDGS; 35WCGF = 35% WCGF; 88WCGF = 88% WCGF.
[2]Interaction for diet and DFM.
[abc]Means within the same row without a common superscript differ ($P \leq 0.10$).

Table 3. Main effects of diet and DFM on ruminal pH.

Item	Diet[1] 35WDGS	Diet[1] 35WCGF	Diet[1] 88WCGF	Diet[1] *P*-value	DFM[2] Neg	DFM[2] Pos	DFM[2] *P*-value	Inter[3]
Average pH	5.38^{b}	5.13^{a}	6.07^{c}	< 0.01	5.57	5.47	0.14	1.00
Maximum pH	6.00^{b}	5.76^{a}	6.60^{c}	< 0.01	6.14	6.10	0.66	0.57
Minimum pH	5.01^{b}	4.82^{a}	5.52^{c}	< 0.01	5.16^{b}	5.08^{a}	0.08	0.60
pH change	0.99	0.94	1.06	0.18	0.97	1.03	0.20	0.81
pH variance	0.04	0.05	0.05	0.75	0.04	0.05	0.23	0.42
Time < 5.6, min/day	1160^{b}	1261^{b}	125^{a}	< 0.01	816	881	0.49	0.98
Area <5.6, min/day[3]	453^{b}	672^{c}0^{a}	< 0.01	370	370	1.00	0.91	

[1]Main effects for diet; 35WDGS = 35% WDGS; 35WCGF = 35% WCGF; 88WCGF = 88% WCGF.
[2]Main effects for DFM; Neg = no DFM; Pos = with DFM.
[3]Interaction for diet and DFM.
[a,b,c]Means within the same main effect and the same row without a common superscript differ ($P \leq 0.01$).

diet NDF. Therefore, steers fed 35WCGF consumed more NDF (5.5 lb) due to greater DMI, compared to steers fed 35WDGS (4.5 lb). Top-dressing the diets with the DFM increased DMI ($P = 0.04$) and NDF intake ($P = 0.10$).

A significant interaction ($P = 0.08$) was observed between diet and DFM for DM digestibility. An interaction tendency ($P = 0.15$) resulted for NDF digestibility. Feeding 35WCGF or 35 WDGS resulted in greater DM digestibility regardless of DFM, compared to feeding 88WCGF ($P \leq 0.10$). However, feeding steers the 88WCGF diet with the DFM resulted in increased DM digestibility, compared to not feeding the DFM ($P = 0.06$). The numerically greatest NDF digestibility resulted from providing the DFM with the 88WCGF diet. Steers fed this combination had statistically greater ($P \leq 0.10$) NDF digestibility compared to steers fed the 35WCGF diet with or without the DFM as well as steers fed the 35WDGS with the DFM, likely due to greater fiber intakes. Steers fed 88WCGF had the greatest NDF digestibility, possibly due to little starch interference with fiber digestion, a higher proportion of fiber from WCGF in relation to poorly digested fiber from alfalfa hay, or higher rumen pH making for a more favorable environment for fiber digestion.

No significant interactions between diet and DFM resulted for any ruminal pH variables ($P \geq 0.42$), so only main effects of diet and DFM are reported (Table 3). Average, maximum, and minimum pH were significantly different ($P < 0.01$) for diets fed to steers. The greatest ruminal pH was observed in steers fed 88WCGF. Feeding 35WDGS resulted in intermediate values, and the lowest ruminal pH was recorded in steers fed 35WCGF. Minimum pH was statistically different ($P = 0.08$) for DFM, as a decrease was observed after providing the DFM to steers. No differences in pH change or pH variance resulted from diet treatment or DFM treatment. Time and area below pH 5.6 were statistically significant ($P < 0.01$) for dietary treatment. Steers fed 88WCGF had the lowest ($P < 0.01$) time (125 minutes/day) and area (0 minutes*pH units < 5.6/day) below pH 5.6. Additionally, steers fed 35WDGS had decreased area below pH 5.6 (453 minutes*pH units < 5.6/day) compared to steers fed 35WCGF (672 minutes/day[3], $P < 0.01$). No effects of DFM on time and area below pH 5.6 were observed. Therefore, feeding 88WCGF helped to alleviate any acidosis challenges, with increased average pH and very little time and area below pH 5.6.

In conclusion, steers had the greatest DMI when they were fed 35WCGF and the greatest NDF intake when fed 88WCGF. Digestibility of DM was the least for steers fed 88WCGF, suggesting corn in the diets improved DM digestibility for 35WCGF and 35WDGS. However, 88WCGF, which had no corn, resulted in the greatest NDF digestibility, especially when DFM was provided. Steers fed 88WCGF with no corn had the greatest pH values with the least amount of time spent experiencing subacute acidosis. Greater pH values were also observed for steers fed 35WDGS compared to 35WCGF, suggesting differences in how byproducts interact with the ruminal environment. Few ruminal pH effects resulted from feeding the DFM.

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