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Using Buffered Enzymes to Improve the Digestibility of Distiller's Grains

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Summary

Fifty-four individually fed crossbred steers (584 ± 1 lb) were used to determine the effects of treating WDG with an enzyme, or buffered enzyme on animal performance. Commodity wet distiller's grains (**WDG**; minimum 85% corn-based; **CON**) was treated with 10 % limestone + enzyme (**BUFF**), and enzyme without buffer (**ENZ**). The treated WDG products were bagged in agricultural bags and fed at 30% of diet DM to steers consuming growing diets. The BUFF treatment reduced dry matter intake compared to ENZ ($P = 0.01$) and numerically reduced dry matter intake relative to UNT ($P = 0.11$). No other differences in animal performance were observed ($P > 0.30$). More information is needed before the use of buffered enzymes will become a viable option to improve the digestibility of WDG.

Introduction

Wet distiller's grains (**WDG**) have become an important feed commodity in the Texas High Plains Region. However, WDG available in this region may have a lower energy value compared to WDG available in the Northern Plains. Research from our laboratory suggest that WDG from the Northern Plains has an energy value similar to steam-flaked corn whereas WDG produced in the Texas High Plains reduces feed efficiency in a steam-flaked corn-based diet. Metabolism data suggests the addition of WDG into steam-flaked corn-based diets reduces ruminal digestibility of the diet. Therefore, improving the ruminal digestibility of WDG may improve its feeding value and maintain the competitive advantage of feeding steam-flaked corn-based diets in the Texas High Plains Region. We have previously reported that treating WDG with a buffered enzyme improves the digestibility of WDG in vitro and in situ. However, no animal performance data are currently available. Therefore, the objective of this project was to evaluate the effects of WDG that has been treated with an enzyme, or buffered enzyme on animal performance.

Experimental Procedures

Fifty-four crossbred steers ruminally and duodenally cannulated steers (584 ± 1 lb) were used to determine the effects of treating WDG with an enzyme, or buffered enzyme on animal performance. Steers were purchased by a commercial order buyer and were received at the research feedlot (BW = 450 lb). Upon receipt, they were individually identified with a unique ear

tag, weighed, vaccinated against viral pathogens (Titanium 5; AgriLabs, St. Joseph, MO) and clostridial bacteria (Vision 7 with SPUR; Merck Animal Health), treated for internal parasites (Safe-Guard, Merck Animal Health) and external parasites (UltraSabor, Merck Animal Health). Steers were also dehorned and castrated as necessary. Steers then went through a 45-day adaptation period to resolve health issues. Steers were then trained to a Calan Broadbent Feeding System (American Calan Inc., Northwood, NH). Upon initiation of the 84-day growing exp., steers were implanted with 36-mg of zeranol (Ralgro; Merck Animal Health). After steers were trained to the feeding system, they were limit fed a complete starter feed (RAMP, Cargill Corn Milling, Blair, NE) at 1.75% of their mean BW. Steers were weighed for three consecutive days and were blocked by BW and randomly assigned to one of three treatments.

Treatments included diets with WDG that was treated using three strategies: 1) untreated WDGS (**UNT**); 2) WDGS treated with a commercial enzyme provided by Biozyme Inc. (St. Joseph, MO) added at a rate of 0.227 ml / kg (1 L / US ton) diluted into water and added at a volume of 80 ml / kg (73 L / US ton, DM-basis; **ENZ**); 3) WDGS buffered with 10% (DM-basis) limestone followed by addition of ENZ (**BUFF**). After sample preparation, the three WDG products were bagged in agricultural bags and sealed for 10 days prior to trial initiation. All diets (Table 1) contained 29% steam-flaked corn, 18% alfalfa hay, 18% cottonseed hulls, and 5% supplement. The supplement provided a dietary inclusion of 0.3% salt, 60 mg/kg Fe, 40 mg/kg Zn, 30 mg/kg Mg, 25 mg/kg Mn, 10 mg/kg Cu, 1 mg/kg I, 0.15 mg/kg Co, 0.1 mg/kg Se, 1.5 IU/g vitamin A, 0.15 IU/g vitamin D, 8.81 IU/kg vitamin E, 44 mg/kg monensin, and 9.9 mg/kg tylosin. Wet distiller's grains was added at 27% of all diets. Limestone was included at 3% of the UNT and ENZ diet during mixing so that calcium was equilibrated across diets. An equivalent amount of limestone was added to BUFF prior to adding the enzyme as described above.

Steers were fed once daily at levels adequate to ensure ad-libitum intake. When wet, stale, or excessive feed remained in the bunk, orts were weighed, and a subsample was collected for DM determination. Orts were subtracted from the feed delivered on a DM basis to calculate DMI. Steam-flaked corn and WDGS samples were collected three times per week and all other dietary ingredients were collected weekly for DM analysis. Ingredient DM was updated weekly for ration formulation. A composite sample was made for each ingredient using DM samples collected over the duration of the study and sent to a commercial laboratory (Servi-Tech Laboratories, Amarillo, TX) for nutrient analysis. At the end of the 84-day feeding period, steers were again fed RAMP at 1.75% of their mean BW for seven days and weighed for three consecutive days and averaged to calculate final BW.

Results and Discussion

The nutrient profiles of the treated WDG are shown in Table 2. Consistent with our previous laboratory-scale work, the addition of enzyme reduced the fiber content of the WDG; neutral detergent fiber (NDF) was reduced 31% and acid detergent fiber was reduced 26% compared to the original WDG product. The addition of buffer further reduced the NDF content by an additional 7% (36% reduction compared to the original sample) and reduced ADF by an additional 4% (29% reduction compared to the original sample). We have previously reported a

6.6% and 20.6% reduction in NDF content from the addition of enzyme and buffered enzyme, respectively, to WDG. Additionally, we previously observed that enzyme alone did not significantly reduce ADF content whereas the addition of a buffered enzyme reduced ADF content by 11%. In the current study, we appear to have achieved a larger total reduction in fiber content, and a larger impact of the enzyme without the addition of buffer compared to our previous lab-scale work. This could be because the entire product was mixed at one time prior to initiating the trial. Therefore, over the course of the 84-day study, the enzyme had more time to degrade fiber compared to our laboratory work (14-28 days). The importance of time in fiber degradation by the enzyme is not well understood. While the reduction in NDF content of the WDG was large, the corresponding reduction to dietary NDF and ADF content were relatively small (5-8%) because WDG made up only 27% of the diet (Table 1).

Animal performance data are shown in Table 3. The buffered enzyme treatment reduced DMI compared to ENZ ($P = 0.01$) and numerically reduced DMI relative to UNT ($P = 0.11$). The reason for the reduction in DMI is unclear. No other differences in animal performance were observed ($P > 0.30$). We expected an improvement in ADG and/or feed efficiency with the BUFF treatment and expected that the ENZ treatment may also improve performance. Previous research from our laboratory suggested BUFF improves the rumen digestibility of WDG. We anticipated that a 30% inclusion rate would result in an improvement in animal performance; we failed to detect any difference.

There are several possible reasons that we did not detect any differences in ADG or G:F. In our previous research, we added the same amount of enzyme (1 L / US ton), but mixed it in more water to create samples (240 L / US ton in previous research vs. 73 L / US ton in the current study). We used less water in the current study in an effort to make mixing of large batches more manageable. The previous rate of water application would have required 6000 liters (1,585 gallons) of water for a 25 ton load of WDG. We added 1825 liters (482 gallons) per 25 ton load. We would not expect the amount of water used to deliver the enzyme to affect the results. However, we cannot discount this difference in our failure to observe performance differences. Another possibility is the enzyme was managed differently. Previously we mixed the lab-scale batches of treated WDG upon receipt of the enzyme. In the current study, the enzyme was stored in a cooler at 5 degrees Celsius for approximately 3 months prior to application. The shelf-life of the enzyme is not known. It is also possible that a greater amount of enzyme is required to elicit an effect in the animal compared to laboratory-scale studies. Dose responses to enzyme have not been evaluated. The fact that we observed a reduction in fiber content greater than we have observed previously does not support an issue with the enzyme.

A more likely explanation for the lack of response is the fact that we used a high forage diet. We chose to conduct this study in individually fed steers fed growing diets for 84-days as a means of reducing costs and quantity of enzyme required to conduct the work. A pen-scale project would have required much more enzyme and a longer period of time. However, the fiber reduction may have been more meaningful in a finishing diet because total dietary fiber levels are lower.

Implications

Consistent with previous research, this project suggests that the addition of enzyme or buffered enzyme reduces the fiber content of WDG. However, no corresponding improvement in animal performance was observed. Further research in finishing diets with a lower dietary fiber content is warranted before negating the potential benefits of using buffered enzymes to improve the digestibility of WDG.

Table 1. Diets and nutrients profiles (% DM-basis) containing wet distiller's grains (WDG) treated with an enzyme with our without a buffer fed to growing steers.

Item	Control[1]	Enzyme	Buffered Enzyme
Wet distiller's grains	27.0	27.0	30.0
Limestone	3.0	3.0	0.0
Steam-flaked corn	29.0	29.0	29.0
Alfalfa hay	18.0	18.0	18.0
Cottonseed hulls	18.0	18.0	18.0
Supplement[2]	5.0	5.0	5.0
Nutrient Composition, % DM			
CP	15.9	15.1	16.2
NDF	35.8	32.9	33.1
ADF	24.3	22.8	23.0
Crude fat	4.47	4.47	4.82
Ca	1.67	1.67	1.62
P	0.35	0.34	0.35
K	1.01	1.00	1.01
S	0.28	0.27	0.28

Control = untreated WDG; 2) Enzyme = WDG treated with a commercial enzyme provided by Biozyme Inc. (St. Joseph, MO) added at a rate of 0.227 ml / kg (1 L / US ton) diluted into water and added at a volume of 80 ml / kg (73 L / US ton, DM-basis); 3) Buffered Enzyme = WDG buffered with 10% (DM-basis) limestone followed by addition of Enzyme.

[2]Provided a dietary inclusion of 0.3% salt, 60 mg/kg Fe, 40 mg/kg Zn, 30 mg/kg Mg, 25 mg/kg Mn, 10 mg/kg Cu, 1 mg/kg I, 0.15 mg/kg Co, 0.1 mg/kg Se, 1.5 IU/g vitamin A, 0.15 IU/g vitamin D, 8.81 IU/kg vitamin E, 44 mg/kg monensin, and 9.9 mg/kg tylosin.

Table 2. Nutrient profile of treated wet distiller's grains (WDG) fed to growing steers.

Item	Control[1]	Enzyme	Buffered Enzyme
CP	35.1	32.1	32.6
NDF	35.7	24.7	22.9
ADF	21.2	15.6	15.0
Crude fat	11.4	11.4	11.4
Ca	0.11	0.11	3.99
P	0.87	0.81	0.77
K	1.07	1.02	0.96
S	0.58	0.54	0.53

Control = untreated WDG; 2) Enzyme = WDG treated with a commercial enzyme provided by Biozyme Inc. (St. Joseph, MO) added at a rate of 0.227 ml / kg (1 L / US ton) diluted into water and added at a volume of 80 ml / kg (73 L / US ton, DM-basis); 3) Buffered Enzyme = WDG buffered with 10% (DM-basis) limestone followed by addition of Enzyme.

Table 3. Performance of steers consuming diets containing wet distiller's grains treated with an enzyme or buffered enzyme.

Item	Control[1]	Enzyme	Buffered Enzyme	SEM	*P*-value
Initial BW, lb	584	584	584	1	0.99
Final BW, lb	868	873	854	9	0.32
ADG, lb	3.39	3.44	3.22	0.11	0.32
DMI, lb[2]	19.6[ab]	20.3[a]	18.5[b]	0.5	0.04
G:F	0.173	0.169	0.174	0.004	0.66
F:G	5.78	5.92	5.75	-	-

[1]Control = untreated WDGS; 2) Enzyme = WDGS treated with a commercial enzyme provided by Biozyme Inc. (St. Joseph, MO) added at a rate of 0.227 ml / kg (1 L / US ton) diluted into water and added at a volume of 80 ml / kg (73 L / US ton, DM-basis); 3) Buffered Enzyme = WDGS buffered with 10% (DM-basis) limestone followed by addition of Enzyme.

[2]Control > Buffered Enzyme ($P = 0.11$).