Effect of Pyramid Enzyme on the Performance of Finishing Cattle Fed Sorghum-based Diets

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Abstract
In some regions of the Ogallala Aquifer, irrigation water is being withdrawn in amounts that exceed the natural recharge rate, resulting in declining water levels. Substituting sorghum for corn and other crops with high water demand is a practical strategy for decreasing water use. Sorghum generally is regarded as being inferior to corn, limiting its use in beef feedlots. The objective of this study was to evaluate the effect of supplementing Pyramid PowerGrower Ruminant (Pyramid Feeds, Scott City, KS) as an additive to improve sorghum use in feedlot cattle. This enzyme was incorporated into the diet at 1.5 lb/ton (86% dry matter basis). Cattle were fed diets consisting of ground sorghum, sorghum-based distillers grains, corn silage, and the enzyme supplement for a period of 148 days. Digestibility of diet components was estimated using acid detergent insoluble ash as an internal marker. There were small, but non-significant, improvements in performance and diet digestion with enzyme supplementation.

Introduction
The Great Plains region produces a majority of slaughter cattle in the U.S. Within eight states (South Dakota, Wyoming, Colorado, Kansas, Nebraska, New Mexico, Oklahoma, and Texas) in the Great Plains region spanning 173,746 mi^2 is the Ogallala Aquifer. The Ogallala Aquifer provides 30% of irrigated water and 70% of the groundwater in the U.S. Irrigation in the High Plains has contributed to significant groundwater depletion, as water is being withdrawn from the aquifer at a rate exceeding its natural recharge rate. With ongoing depletion, water conservation efforts have become more prominent. One option to reduce water usage is to cultivate sorghum, which can be grown in semiarid regions and withstands extended periods of drought. Compared to corn, grain sorghum has a lower water requirement throughout the growing period. Sorghum is the fifth most produced cereal grain globally. Sorghum has been found to be less ruminally digestible than corn and has been less desirable for feedlot use. Sorghum is characterized by an extensive starch-protein matrix that can adversely affect the nutritive value and digestibility of the grain. The use of exogenous enzymes that target disruption of this matrix may be a practical means of improving digestibility and animal performance. There is limited research utilizing exogenous enzymes to increase sorghum digestibility within sorghum-based finishing diets.

Experimental Procedures

From January to June 2025, a randomized complete block design experiment was conducted at the Southeast Research and Extension Center (Mound Valley, KS). Crossbred yearling steers (n = 280; body weight = 974 ± 33.5 lb) were transported to the research center. Upon initiation of the experiment, steers were weighed and identified using visual ear tags and radio frequency identification ear tags. Animals were vaccinated for viral and clostridial pathogens, treated for internal and external parasites, and implanted with a long-acting steroidal implant. Steers were randomly allocated to treatment blocks based on the order of processing. Steers were housed in 36 earth-surfaced feedlot pens measuring 50 × 100 ft and were fed one of two treatment diets. They were randomly allocated to 18 blocks. The treatments were a control diet with no added enzyme, or a diet supplemented with Pyramid PowerGrower Ruminant (Pyramid Feeds, Scott City, KS) as an additive to improve sorghum utilization in feedlot cattle (Table 1). This enzyme was incorporated into the diet at 1.5 lb/ton (86% dry matter basis). Cattle were fed diets consisting of ground sorghum, sorghum-based distillers grains, corn silage, and the enzyme supplement for a period of 148 days. Cattle were fed once daily in the morning, *ad libitum*. Daily feed bunk scores were taken, and ingredient dry matter samples were determined weekly. Rejected feed samples were taken every Monday and Thursday to determine actual dry matter intake values for each 3- or 4-day interval.

Fecal samples and feed were collected to determine nutrient content and digestibility by using acid detergent insoluble ash as an internal marker. Digestibility was calculated with this equation:

$$\text{Digestibility }\% = 100 - \left[100 \times \frac{\text{Marker concentration in feed}}{\text{Marker concentration in feces}} \times \frac{\text{Nutrient concentration in feed}}{\text{Nutrient concentration in feces}}\right]$$

After a period of 148 days on feed, the steers were shipped to Tyson Foods in Holcomb, Kansas, for carcass data collection. On the day of harvest, hot carcass weight and incidence of liver abscesses were recorded. After a refrigeration period of 96 hours, camera imaging was used to acquire carcass measurements, including ribeye area, 12th rib subcutaneous fat, marbling score, percent kidney, pelvic, and heart fat, and U.S. Department of Agriculture quality and yield grades.

Data were analyzed using the GLIMMIX procedure of the Statistical Analysis System (SAS 9.4, Cary, NC). Treatment was the fixed effect, experimental unit was the feedlot pen, and random effect was block. Initial body weight was used as a covariate in the statistical models. Statistical tendencies were determined at $0.05 < P < 0.10$, and statistical significance was declared at $P \leq 0.05$.

Results and Discussion

There were subtle, but nonsignificant, differences between the performance measurements, carcass characteristics, and nutrient digestibility between the two treatment groups ($P > 0.10$). Performance data are shown in Table 2, carcass data in Table 3, and nutrient digestibility in Table 4. Despite dry matter digestibility not having a statistical difference, there was 2% higher digestibility in the enzyme treatment compared to the control treatment. Considering that there were nonsignificant differences in nutrient digestibility, it is expected that there would be no detectable differences in average daily gain (ADG) or feed:gain. The final body weight in the enzyme group

(1,354.5 lb) was numerically greater than the control group (1,343.9 lb), which was not statistically significant, and this numerical difference could be attributed to a 3-lb heavier body weight at the initiation of the study. Taking into account that there were no detectable differences between ADG, feed:gain, or final body weight, it follows that there were not significant differences between carcass characteristics. Quality grade is strongly impacted by marbling score and based on there being no statistical differences between marbling scores between treatments (568 vs. 552), it is consistent with expectations that there would be no treatment effects on quality grades. Within the control group, there was a numerically higher percentage of prime and premium choice cattle compared to the enzyme treatment (64.5% compared to 61.2%). Differences in yield grade were not expected, considering carcass characteristics did not have a significant effect.

Implications

Feeding Pyramid PowerGrower Ruminant (Pyramid feeds, Scott City, KS) resulted in modest but nonsignificant improvements in cattle performance, nutrient digestibility, and carcass characteristics.

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Table 1. Composition and nutrient analysis of finishing diets (% of dry matter)

Item	Control diet	Enzyme diet[1]
Ground sorghum	59.62	59.62
Sorghum-based DDGS[2]	25.00	25.00
Corn silage	12.00	12.00
Supplement[1,3]	3.38	3.38
Nutrient composition, analyzed		
Starch, %	43.20	43.20
Crude protein, %	18.85	18.85
Neutral detergent fiber, %	19.44	19.44

[1] Enzyme supplement includes Pyramid Powergrow Ruminant (Pyramid Feeds, Scott City, Kansas) in lieu of ground corn at a rate of 1.5 lb/ton of feed (86% dry matter basis). Enzyme blend consisted of the following components: 5,000 HCU/g beta mannanase; 1,200 SKB/g fungal amylase; 600 BAU/g bacterial amylase; 250 XU/g xylanase; 500 HUT/g fungal protease; 800 PC/g neutral protease; and 1,100 CU/g cellulase (values were determined from product specification document provided by Pyramid Feeds).
[2] Distillers dried grains with solubles.
[3] Supplement was formulated to provide on a dry matter basis; 1,000 IU/lb vitamin A; 7 IU/lb vitamin E; 10 ppm copper; 40 ppm zinc; 0.50 ppm iodine; 0.10 ppm cobalt; 0.10 ppm selenium; 40 ppm manganese; 30 g/ton Rumensin; 6 g/ton Tylan; and 300 mg/ton Optaflexx was fed the last 33 days on feed.

Table 2. Effects of enzyme blend on performance of feedlot steers fed sorghum-based diets with or without added enzymes

Item	Control	Enzyme[1]	SEM[2]	*P*-value
Initial body weight, lb	973.0	975.8	7.90	0.81
Final body weight, lb	1,343.9	1,354.5	7.66	0.34
Dry matter intake, lb/day	25.55	25.63	0.254	0.83
Average daily gain, lb/day	2.50	2.57	0.052	0.34
Feed:gain	10.30	10.02	0.179	0.29

[1] Pyramid Powergrow Ruminant (Pyramid Feeds; Scott City, Kansas) included at the rate of 1.5 lb/ton of complete diet (86% dry matter basis). Enzyme blend consisted of the following components: 5,000 HCU/g beta mannanase; 1,200 SKB/g fungal amylase; 600 BAU/g bacterial amylase; 250 XU/g xylanase; 500 HUT/g fungal protease; 800 PC/g neutral protease; and 1,100 CU/g cellulase (values were determined from product specification document provided by Pyramid Feeds).
[2] Standard error of the mean.

Table 3. Effects of an enzyme blend on carcass characteristics of feedlot steers fed sorghum-based diets with or without added enzyme

Item	Control	Enzyme[1]	SEM[2]	*P*-value
Hot carcass weight, lb	853.4	860.1	4.87	0.34
Marbling score[3]	568	552	12.3	0.32
12th rib fat thickness, in.	0.47	0.48	0.016	0.80
Ribeye area, in.^{2}	13.1	13.3	0.12	0.14
Kidney, pelvic, heart fat, %	1.84	1.82	0.015	0.47
Prime, %	24.3	22.9	4.18	0.79
Premium Choice, %	40.2	38.3	4.42	0.76
Low Choice, %	28.1	30.3	4.12	0.71
Select, %	6.4	8.1	1.97	0.51
Yield Grade 1, %	2.1	0.7	1.20	0.42
Yield Grade 2, %	37.4	40.0	4.18	0.66
Yield Grade 3. %	53.1	52.1	4.16	0.85
Yield Grade 4, %	7.4	6.5	1.79	0.70
Yield Grade 5, %	0.0	0.7	0.50	0.33
Abscessed livers, %	10.5	15.3	2.89	0.25

[1] Pyramid Powergrow Ruminant (Pyramid Feeds; Scott City, Kansas) included at the rate of 1.5 lb/ton of complete diet (86% dry matter basis). Enzyme blend consisted of the following components: 5,000 HCU/g beta mannanase; 1,200 SKB/g fungal amylase; 600 BAU/g bacterial amylase; 250 XU/g xylanase; 500 HUT/g fungal protease; 800 PC/g neutral protease; and 1,100 CU/g cellulase (values were determined from product specification document provided by Pyramid Feeds).
[2] Standard error of the mean.
[3] Slight amount of marbling, 300-399; small amount of marbling, 400-499; modest amount of marbling 500-599; moderate amount of marbling, 600-699.

Table 4. Effects of an enzyme blend on digestibility of diet components in feedlot steers fed sorghum-based diets with or without added enzymes

Digestibility, %[1]	Control	Enzyme[2]	SEM[3]	*P*-value
Dry matter	72.8	74.3	1.63	0.44
Organic matter	74.1	75.5	1.63	0.49
Starch	89.6	91.3	1.08	0.15
Protein	69.7	70.7	1.91	0.67
Neutral detergent fiber	64.4	65.1	1.95	0.77

[1] Samples were analyzed by SDK Laboratories (Huchinson, KS).
[2] Powergrow Ruminant (Pyramid Feeds; Scott City, Kansas) included at the rate of 1.5 lb per ton of complete diet (86% dry matter basis). Enzyme blend consisted of the following components: 5,000 HCU/gm beta mannanase; 1,200 SKB/gm of fungal amylase; 600 BAU/gm of bacterial amylase; 250 XU/gm of xylanase; 500 HUT/gm of fungal protease; 800 PC/gm of neutral protease; 1,100 CU/gm of cellulase (values were determined from product specification document provided by Pyramid Feeds).
[3] Standard error of the mean.