

**EFFECT OF A FIBROLYTIC ENZYME SUPPLEMENTATION ON GROWING BEEF STEERS**

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**ABSTRACT:** The objective of this study was to determine growth performance of growing beef steers when fed with a fibrolytic feed enzyme product in a completely randomized design. This growing beef study consisted of 60 group-penned Angus crossbred steers randomly assigned to treatments: control (C; no enzyme), low enzyme (LE), and high enzyme (HE). Five animals were placed in each pen, and 4 pens allocated to each treatment. All steers were adapted to C diet for a 2-week period prior to start of the trial. The growing ration contained 15% alfalfa hay, 43% corn silage, 30% barley grain, 7% soybean meal, and 5% feedlot supplement (DM basis), and was fed as a TMR. For the enzyme treatments, an experimental enzyme product from Alltech Inc. (Nicholasville, KY) was added to the C diet at dose rate of 1 or 2 g of the enzyme/kg DM TMR to the LE or HE treatment, respectively. The enzyme product was in powder form and contained endoglucanase and xylanase activities. All steers were fed once per day, and feed bunks read each afternoon and prior to morning feeding which was used to determine the amount of feed to deliver to each pen the following day. The experiment lasted for 84 d, and all steers were weighed on days 0, 28, 56, and 84. Intake of DM averaged 8.12 kg/d across the treatments, but supplementing the enzyme to the growing diet did not affect DMI regardless of dose rate ( $P = 0.83$ ). Body weight gain numerically increased with supplementing enzyme (101 and 99 kg for LE and HE, respectively) compared to C (96 kg), although supplementing the enzyme product failed to detect a significant effect ( $P = 0.67$ ). Average daily gain throughout the experiment was 1.13 kg/d on average for all treatments, and enzyme supplementation did not affect ADG ( $P = 0.95$ ). In addition, enzyme did not influence feed-to-gain ratio ( $P > 0.05$ ). Supplementing the fibrolytic feed enzyme in a beef growing diet at 1 and 2 g/kg DM TMR resulted in no effects on growing performance of beef steers.

**Key Words:** Growing beef steers, Fibrolytic feed enzyme, Feed-to-gain ratio.

**Introduction**

The use of feed enzyme additives in ruminant diets is gaining acceptance as a means of improving feed utilization and performance of domestic ruminants. The feed enzyme additives help bridge the gap between actual digestibility of the feed that occurs in vivo and the potential digestibility of the feed that would be possible if the conditions were ideal (Beauchemin et al., 2003). To ensure consistent results of feed enzyme products, however, product formulation and dose rate must be considered, as these are main factors that

affect the key enzymatic activities supplied (Beauchemin et al., 2003; Eun and Beauchemin, 2007b).

Identifying the key enzymatic activities needed for feed enzyme additives to be consistently effective in ruminants is challenging because the mechanisms whereby feed enzymes improve microbial digestion of feed are not well understood (Beauchemin et al., 2004). The key activities needed to improve forage fiber degradation for ruminants likely differ from those needed in industrial applications in which fibrolytic enzymes are commonly used (e.g., textile and food industries). With ruminants, the enzymes must act synergistically with the endogenous enzyme activities of the rumen microbes (Morgavi et al., 2000). In addition, for enzymes to improve forage degradation, the array of enzyme activities supplemented must be specific to the chemical composition of the targeted forage, due to the specificity of enzymes for their substrate (White et al., 1993). Thus, key enzymatic activities may differ among forages.

The objective of the current study was to evaluate the effects of a fibrolytic feed enzyme (FFE) product on growth performance of growing beef steers fed a corn silage-based TMR diet. The FFE product used in the current feeding study contained similar enzymatic activities to the enzyme product assessed by Ranilla et al. (2007), in which they reported its beneficial effect on in vitro degradation of grass hay. We expected a similar, positive effect of the FFE on corn silage-based diet of growing beef steers due to the fact that grass hay and corn silage have a similar cell wall structure.

**Materials and Methods**

*Enzyme product and its dose rate.* A developmental FFE product from Alltech Inc. (Nicholasville, KY) was used in this study. The FFE product was in powder form, and contained endoglucanase (EC 3.2.1.4) and xylanase (EC 3.2.1.8) activities, but no amylase (EC 3.2.1.1) and exoglucanase (EC 3.2.1.91) activities were detected. The FFE was applied at 0, 1, or 2 g of the enzyme/kg DM TMR to the control (C), low enzyme (LE), or high enzyme (HE) treatment, respectively. The FFE product was applied onto the corn silage followed by mixing with other ingredients of diet.

*Growing beef steer study.* The cattle used in this study were cared for according to the Live Animal Use in Research guidelines of Institutional Animal Care and Use Committee at Utah State University. The study was conducted at the Utah State University beef research farm for 84 days, and consisted of 60 group-penned Angus crossbred steers randomly assigned to treatments: C, LE, or HE treatment.

Five animals were placed in each pen. All steers were allowed to adapt to C diet for a 2-week period prior to start of the trial. Steers were fed a corn silage-based TMR diet (Table 1), and had free access to fresh water. All feedstuffs were analyzed initially for DM and nutrient concentrations according to AOAC (1995), and corn silage DM obtained weekly. Feed was mixed and delivered to the steers in a Rissler feed cart (Rissler Mfg, Mohnton, PA) which recorded amounts fed daily. All steers were fed once per day (0700) to appetite and feed bunks were read each afternoon and prior to morning feeding which was used to determine the amount of feed to deliver to each pen the following day. Feed samples were obtained weekly and composited by month for each treatment. The DM content of feed was determined by oven drying at 55°C. Mean DMI was calculated for each pen as the total amount of DM allocated daily divided by the number of cattle per pen on that particular day. Thus, intake accounted for any sick cattle removed from the pen during treatment. The assumption was that DMI was the same for all cattle within the pen. All steers were weighed on d 0, 28, 56, and 84. Body weight gain was determined by comparing the initial and final BW for individual animals. Feed-to-gain ratio (FGR) was calculated as kilograms of DMI divided by kilograms of BW gain.

**Table 1.** Diet composition and nutrient concentration

Item	% of DM
Ingredient	
Corn silage	43.0
Alfalfa hay	15.0
Barley grain, rolled	30.0
Soybean meal	7.0
Feedlot supplement <sup>1</sup>	5.0
Nutrient	
CP	12.2
Ca	0.81
P	0.29

<sup>1</sup>Composition (% of supplement DM): 5.0% NaCl, 0.24% Mg, 0.76% K, 200 ppm Cu, 400 ppm Mn, 650 ppm Zn, 2 ppm Se, 22 ppm I, 9 ppm Co, 121,000 IU/kg Vitamin A, 37,400 IU/kg Vitamin D, 55 IU/kg vitamin E, and 360 ppm Rumensin<sup>®</sup> (Elanco Animal Health, Indianapolis, IN).

*Statistical analysis.* All the data in this study were analyzed using the MIXED procedure of SAS (SAS Institute, Cary, NC) with a repeated measures treatment structure. Pen was the experimental unit with monthly data collection periods as repeated measures of treatments. Treatment and period were fixed effects and pen a random effect. The Kenward-Roger option was used to estimate denominator degrees of freedom. Least squares means are reported, and differences were considered significant at  $P < 0.05$ .

## Results

The BW at the start and end of the experiment were not affected by FFE supplementation (Table 2). Intake of DM averaged 8.12 kg/d across the treatments, but

supplementing the FFE to the growing diet did not affect DMI regardless of dose rate ( $P = 0.83$ ). Body weight gain numerically increased with supplementing FFE (101 and 99 kg for LE and HE, respectively) compared to C (96 kg), although supplementing the FFE product failed to detect a significant effect ( $P = 0.67$ ). Average daily gain throughout the experiment was 1.13 kg/d on average for all treatments, and FFE supplementation did not affect ADG ( $P = 0.95$ ). In addition, enzyme did not influence FGR ( $P = 0.98$ ).

**Table 2.** Performance of growing beef steers fed a corn silage-based TMR diet without or with a fibrolytic feed enzyme product

Item	Dietary treatment <sup>1</sup>			SE	<i>P</i>
	C	LE	HE		
Steers, n	20	20	20		
Initial BW, kg	290	289	282	7.3	0.33
Final BW, kg	385	386	382	5.3	0.69
BW gain, kg	96	101	99	4.7	0.67
ADG, kg	1.10	1.16	1.13	0.115	0.95
DMI, kg/d	8.12	8.09	8.16	0.064	0.83
Feed-to-gain ratio, kg/kg	8.42	8.50	8.25	0.906	0.98

<sup>1</sup>C = control diet without enzyme supplementation; LE = diet with low level of enzyme supplementation (1 g/kg TMR); HE = diet with high level of enzyme supplementation (2 g/kg TMR).

## Discussion

A similar feed enzyme product to the FFE used in this study showed some positive effects on in vitro degradation of grass hay, but not alfalfa hay (Ranilla et al., 2007). Due to the small proportion of alfalfa hay used in this study (15% of DM), the alfalfa hay may not affect the efficacy of the FFE used. The positive effect of the FFE on grass hay in the previous study may be caused by endoglucanase activity in the FFE, which has been suggested as a key enzymatic activity to improve corn and grass silage degradation (Wallace et al., 2001; Eun and Beauchemin, 2007a,b). Providing key enzymatic activities in feed enzyme products is one of the most important requirements for feed enzyme additives to have positive effects on feed digestion and resultant animal performance. Additionally, the array of feed enzyme activities supplemented must be specific to the chemical composition of the targeted forage, due to the specificity of enzymes for their substrate (White et al., 1993). In addition to the activity of endoglucanase, exoglucanase activity has been suggested as another key enzymatic activity to improve corn silage degradation (Eun and Beauchemin, 2007a,b). One of the main characteristics of exoglucanases is that they act on cellulose chains in a progressive manner. They progress along the polymer chain while releasing cellobiose in a recurrent fashion (Tomme et al., 1996; Reverbel-Leroy et al., 1997), resulting in thinning of crystalline cellulose (Boisset et al., 2000). Although the FFE used in this study contained endoglucanase activity, it had no exoglucanase activity. Therefore, no positive effects of the FFE supplementation on animal performance in this feeding study may be resulted from the lack of the

exoglucanase activity in the FFE product used, which may be important for the degradation of more recalcitrant fiber, such as the corn silage used in this study.

### Implications

In vitro bioassays that reflect the conditions of the rumen are a good alternative to feeding studies to identify ideal feed enzyme candidates for use in ruminant diets, but the results must be confirmed in vivo. Designing feed enzyme additives that deliver the key enzymatic activities is challenging in order for feed enzymes to have consistently positive effects on feed digestion by ruminants, and it may be better to provide all the key enzyme activities in feed enzyme products rather than providing a single, key enzyme activity.

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