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Effects of Fibrolytic Enzyme treated Alfalfa on Performance in Holstein Beef Cattle

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ABSTRACT

To examine the effect of fibrolytic enzymes on performance in feedlot cattle, 20 feedlot cattle with average 250 ± 20 Kg live weight were used in a completely randomized design with 4 treatment and 5 replicates in 21-d periods. Cattle were fed balanced TMR including %30 alfalfa hay and %70 Concentrate on DM basis and 9.5, 14.25 and 19 ml of fibrolytic enzyme were used per 10 Kg of alfalfa hay. Using moderate level of enzyme (14.25 $_{ml/10Kg}$ alfalfa) increased ADG and DMI 23.1 and 4.3 percent respectively compared to control. Dry matter intake also significantly increased ($p<0.05$) in 2nd and 3rd treatments (9.5 and 14.25 ml enzyme) comparing to control group. Feed conversion improved significantly ($p<0.05$) in treatments, containing 14.25 ml enzyme compared to other treatments. Results of this study showed that using 14.25 ml of fibrolytic enzyme per 10 Kg alfalfa hay were most effective in terms of improving daily gain and dry matter intake. Also it was indicated that level of applying had a certain limit and high level of enzyme (19 $_{ml/10Kg}$ hay), decreased feed conversion and average daily gain.

Keywords: Enzyme, digestibility, fibrolytic, performance and cattle.
Abbreviations*: ADF (acid detergent fibre); ADG (average daily gain); BW (Body weight); FCR (feed conversion ratio); NDF (neutral detergent fibre); ADF (acid detergent fibre); IU (International Unit).*

INTRODUCTION

Forage is the main part of ruminant's diets that contain high levels of fiber. Intake and digestibility of forages directly affect milk production, rumen function, and animal health. The cell wall components of forages represent a major source of energy for cattle. However, the efficiency of converting forages to meat is limited by digestibility of forage cell walls.

The use of exogenous fibrolytic enzyme products to improve feed utilization by ruminants has attracted growing attention. In ruminant applications, exogenous fibrolytic enzyme, must act synergistically with the endogenous enzymatic activities of the rumen microbes. Enzymes are used to improve the nutritive value of feeds for non-ruminant animals and as silage additives for ruminants. Research has demonstrated that supplementing dairy cow and feedlot cattle diets with fiber degrading enzymes has significant potential to improve feed utilization and animal performance. The primary objective of using feed enzyme additives in ruminant diets is to decrease the cost of producing meat or milk.

Presence of medium or high levels of fiber in feedlot cattle rations is one of several limiting factors for growth especially in finishing cattle. Therefore there is high interest and effort for maximizing the feed intake with increasing fiber digestion and get of more effective fiber with lower forage among researchers. Forages and its fiber digestibility decrease with plant maturity and there is several causes that lignification degree is the most important and effective cause [1]. Recent observations show that use of liquid fibrolytic enzyme in feed will increase enzyme

absorption and enzyme mix with feed and increase the stability against proteolysis [2, 3, and 4]. External enzymes affect on feed, before or after feeding to animal in rumen and small intestine [5]. Some of information indicated that external enzymes do their activity in rumen and reticulum [6 and 7]. Naturally fibrolytic enzyme is existing in the rumen and contains cellulose and xylanase [2]. Rumen bacteria and fungi produce this enzyme in the rumen. Advantage of adding fibrolytic enzyme , when is maximum that internal(natural) enzyme activity is lower than optimum level , for example when rumen pH is lower than natural level , internal enzyme activity will decrease [8]. When rumen pH is lower than 6.2, the growth of cellulose producer bacteria in rumen will stopped [9]. Therefore the ration that contain high levels of starch and sugars, will decreased the internal enzyme .Fibrolytic enzyme can obtain from fungi sources and can be as a supplement for natural enzyme [11]. The use of fibrolytic enzyme in feedlot cattle rations is commodious [2,10 and 11]. Several factors interfere on enzyme affect on animal such as forage type, levels of enzyme usage, ration cell wall, carbohydrate balance, and enzyme adding temperature, pH, feed moisture and ration type [12 and 13]. Fibrolytic enzyme can increase fiber digestibility and then increase feed passage rate and therefore cattle use more feed and increase feed intake [11]. Stokes [14] believe that fibrolytic enzyme hydrolyze the structural carbohydrates efficiently. When enzyme use with feed, it attack on plant fiber. The effect of enzyme in rumen is direct hydrolyze or synergistic affect among enzyme and rumen microorganisms, however external enzyme portion is less than natural rumen celluletic activity. The use of fibrolytic enzyme is a new subject and therefore proper methods of enzyme adding on feed, enzyme adding levels, type of enzyme and proper condition for adding enzyme is not known yet. The objective of this study was to examine the effect of use of fibrolytic enzyme on feedlot cattle performance, daily weight gain, feed intake and feed efficiency.

MATERIALS AND METHODS

Animals and diets:

20 Holstein feedlot cattle with average 250±20 kg live weight were used in this experiment. All of animals used similar diets and the diet composition is shown in table 1. The change from the previous all-forage diets to these high concentrate diets was made over a 2-weeks period, during which time the proportion of concentrate in the diet was increased approximately per day.

Fibrolytic enzyme (Biocellulase A20: Contain 80% cellulase and 20% xylanase) sprayed on alfalfa hay at the every evening and then fed to animals 24 hours latter.

At the end of experiment, all of cattle were weighted. Weigh were done at morning time, before daily feeding. BW measured as one of several performance indexes of cattle during the experiments period. Every cattle fed a TMR ration ad libium during the experiment. 12-14 h before feeding at per day, enzyme mixed with water and sprayed on feed at 3 levels (9.5, 14.25 and 19.5 $_{ml/10Kg\ hay}$).

Table 1. Ingredients and composition of diet

Diet ingredients	(%)
Alfalfa hay	30
Barley grain	53.08
Wheat bran	15
Salt (NaCl)	0.5
DCP	0.42
Mineral and vitamin Premix	1
Composition (DM basis)	
ME(Mcal/kg)	2.786
NE(Mcal/kg)	1.709
NEg(Mcal/kg)	1.209
CP %	13.5
NDF %	23.52
ADF%	13.6
Lignin%	3.2
Ca%	0.56
P%	0.32

Data:

Animals were weighted at beginning time of experiment and subsequently were weighted at the end of per weeks and then daily weight gains were estimated. Another data was daily feed intake. It then compared with ADG and FCR obtained.

Experimental design:

The experimental design in this study was completely randomized design with 4 treatment and 5 replicates.

Experimental duration:

Total experimental duration was 84 days that contain four periods. Every period contain 21 days.

Statistical Analysis:
At the end of experiment, all of data about daily weight gain, feed intake and feed efficiency, collected and analyzed with GLM method and SAS software and then means were compared with Duncken methods at 0.05. The following model was used:

$Yij=\mu+Xi+cov+\Sigma ij$

Where Y= any observation, μ= total mean, Xi= treatment affect, cov=initial body weight covariance, and Σ ij=effects of experiments error.

RESULTS

Average daily weight gains in this study were 51.8, 55, 67.4 and 48.8 kg respectively (Table 2). The effects of enzyme supplementation on animal performance differed with enzyme levels (Table 2). The highest daily weight gain, obtained at medium level of enzyme use. Statistical researches represent that there were significant differences among the medium enzyme level group (14.25ml), with another groups in daily weight gain ($P<.05$).

Table 2- The performance of cattle during experiment

	Enzyme level ($_{ml/10Kg\ hay}$)			
	0	9.5	14.25	19.5
Initial weight (kg)	251.4	250.6	248.8	239.2
Final weight (kg)	303.2	305.6	316.2	288
Feed intake (kg/day)	5.65	5.94	5.9	5.76
Daily weight gain (g)	616	651	801	583
FCR	9.23	9.08	7.36	9.93
Total weight gain (kg)	51.8	55	67.4	48.8

Some earlier studies with ruminants also reported improvements in ADG and FCR as a beneficial effect of enzyme supplements [15, 16 and 17]. The results of this study has shown that medium level of enzyme(14.25ml), is the best usage level and positively affects on beef cattle performance. Daily weight gain process at first 2 weeks of experiments were lower than later weeks, especially at first weeks of experiment, the lowest daily weight gain observed. There were no significant differences among group in feed intake (Table2).

Table 2 shows the feed conversion ratio among treatments. The best feed conversion ratio observed at medium enzyme level (14.25 $_{ml/10Kg}$ feed). In this level, animals fed average 2 kg lower feed and this was a considerable thrift in feed intake. This difference was significant statistically. In an experiment, adding of fibrolytic enzyme on feed didn't have any effects on animal performance [18]. At initial experiments period (First 21 days), there was no difference among treatments and differences was observed after first section of experiments. The worst feed conversion ratio, observed in cattle that fed highest enzyme levels.

The best feed efficiency observed in third treatment (14.25 $_{ml/10Kg}$ hay). The greatest differences between third treatment and another's treatments, observed at 8^{th} weeks of experiment.

DISCUSSION

Daily weight gain at first weeks of experiment was lower than other weeks, due to adaptation period to new situation and new ration and use of enzyme. After 2 weeks of experiment, all of cattle adapted to high concentrate ration and DWG increased gradually. Somewhat of obtained weight gain due to an increment of feed digestibility that cause to better fiber utilization and result to higher efficiency and prepare more energy for animal [19].

Higher daily weight gain and similarly feed intake at this period indicate the affects of fibrolytic enzyme on nutrients digestibility. Most of research on ruminant enzymes has focused on fibrolytic enzymes to improve fibre digestibility, because increasing fibre digestibility can increase the intake of digestible energy by the animal. Increasing in feed digestibility, provide more DE for cattle. However in this experiment, nutrients digestibility, did not measured directly, but more weight gain in mid enzyme level treatment, is a good index of digestibility. At an experiment on dairy cow, usage of fibrolytic enzyme with barley grain, due to an increasing in milk yield [2]. Therefore maybe one reason of more daily weight gain in cattle that fed medium enzyme level is the effect of enzyme on barley

digestibility. The difference in feed conversion rate among different group agreed with weight gain and feed intake in animals. The improvement in feed conversion rate at similar experiment [20] resulted both with more weight gain and less feed intake, but in present study, the improvement in FCR only due to more weight gain. The FCR at first two weeks of experiment was high and the main reason of this was that animals didn't adapt to high concentrate diets. After 2 weeks of experiment, the differences among treatments, observed. The worst FCR observed in cattle that fed diets that contain most enzyme level. The use of high enzyme level cause to an increasing in passage rate of digesta from gut [2] and then digesta will not used completely and the feed efficiency decreased and FCR increased. Enzyme supplements may provide a useful means of altering ruminal digestion and subsequent animal performance. Further work is necessary to elucidate the mechanism by which treatment of alfalfa based diets mixed with high concentrate fibrolytic enzyme activities, enhanced the conversion of feed to meat.

As a result, less feed is required to produce 1 kg of live weight gain or alternatively, more weight gain results per kg of feed consumed by the animal.

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