Bulgarian Journal of Veterinary Medicine (2007), **10**, No 2, 113–118

THE EFFECT OF FIBROLYTIC EXOGENOUS ENZYME ON FATTENING PERFORMANCE OF STEERS

F. BALCI[1], S. DIKMEN[1], H. GENCOGLU[2], A. ORMAN[1], I. I. TURKMEN[2] & H. BIRICIK[2]

[1]Department of Animal Science, [2]Department of Animal Nutrition and Nutritional Diseases, Faculty of Veterinary Medicine, Uludag University, Bursa, Turkey

Summary

Balci, F., S. Dikmen, H. Gencoglu, A. Orman, I. I. Turkmen & H. Biricik, 2007. The effect of fibrolytic exogenous enzyme on fattening performance of steers. *Bulg. J. Vet. Med.*, **10**, No 2, 113–118.

Sixteen Holstein steers, 9–12 months old with 362.0±17.0 and 363.6±16.0 kg initial body weight for steers in control and treatment groups, respectively, individually penned were used to investigate the effect of a fibrolytic enzyme (Promote N. E. T., Agribrands International, St. Louis, MO) on fattening performance. The animals were randomly allocated to: control (C) (n=8), or enzyme-treated (E) (n=8) groups. They were fed for a period of 80 days with normal ration (group C) or normal ration + 60 g/day fibrolytic enzyme (group E). Both groups were given wheat straw as roughage source. Health records were kept and all steers were healthy throughout the trial period. During the last week of the 80-day experimental period, for 3 consecutive days, rumen fluid samples with an amount of 0.5 L were obtained from 6 steers from each of control and treatment groups via the oesophageal tube, 3 hours after morning feeding. They were used for analysis of pH and *in vitro* dry matter (DM), organic matter (OM) and neutral detergent fibre (NDF) digestibility. During the fattening period liveweight gains of control and treatment groups were determined (986±70 and 1270±80 g, respectively) and the difference was found to be statistically significant ($P<0.05$). Roughage feed conversion rate (FCR) difference between groups was insignificant whereas concentrate feed FCR was statistically significant ($P<0.05$) and better for the treated group. Total FCR was also better in treated than in control steers ($P<0.05$). Rumen pH was found to be 6.19±0.13 and 6.20±0.07 for the control and treated groups, respectively ($P>0.05$). Wheat straw showed higher ($P<0.05$) *in vitro* DM, OM and NDF digestibility in the treated group compared to the control, whereas concentrate feed did not show the same differences ($P>0.05$). The results obtained from this study suggest that steers fed with Promote N.E.T. supplemented feed had better results of daily weight gain, total weight gain and feed conversion rate.

Key words: fattening performance, fibrolytic enzyme, Holstein steers

INTRODUCTION

In beef feedlot production, feed can make up to 75% of the cost of gain. Enzyme research and use has expanded into ruminant nutrition and recent improvements in manufacturing technology have decreased the cost of enzyme preparations for the feed industry. This may eventually promote obtaining products that could lower the cost of gain for growing and finishing cattle.

In recent years, newer enzyme preparations have been used in ruminant diets, at varying levels, on a broad range of forages and concentrates (Feng *et al.*, 1996; Lewis *et al.*, 1996; Beauchemin *et al.*, 1997;) with varying results.

Feeding of cattle under intensive conditions is based on grasses whose quantity and nutritional quality show seasonal variations which affect cattle performance. Therefore, various nutritional strategies to give more constant performance have been developed, such as supplementary feeding with energy and protein sources, and the use of complementary forages (Ramos *et al.*, 1998; Rojo *et al.*, 2000; Aranda *et al.*, 2001;). There is also a growing interest in the use of exogenous enzymes in ruminant nutrition, since it has been shown that they can improve the digestibility of the fibre fraction (Pinos *et al.*, 2002; Beauchemin *et al.*, 2000). However, research has been focused on the effect of fibrolytic enzymes on fattening performance of steers.

This experiment was conducted to study the effects of fibrolytic enzymes with cellulase and xylanase activities on the digestibility of forage and body weight gain of steers under intensive conditions.

MATERIALS AND METHODS

The steers consisted of 16 individually penned purebred Holstein steers (362 kg mean body weight) randomly assigned to either control (C) or enzyme-treated (E) groups with 8 steers in each group. The animals were at the age of 9–12 months, and with similar initial body mass (362.1 ± 17.0 and 363.6 ± 16.0 kg, for the groups C and E, respectively). Steers were treated against internal and external parasites and dosed i.m. once monthly (3 times during the 80-day experimental period) with the AD_3E vitamin product (Beforvel AD_3E, Vilsan, Turkey). The animals were fed *ad libitum* with wheat straw and concentrate mix and allowed to adapt to the respective diet for a 2-week period prior to start of the trial. All feedstuffs were analyzed initially for dry matter and nutrient levels and dry matter values were obtained weekly. Feed ingredients of concentrate mix are isis given in Table 1. Health records were kept and all steers were healthy during the trial period.

Treatments were: control (C) – normal ration and enzyme treated (E) normal ration + 60 g/day fibrolytic enzyme [Promote – Natural Energy Technology (N.E.T.), Agribrands Int., St. Louis, MO, USA]. The product is an enzyme with cellulase and xylanase activities produced by *Trichoderma longibrachiatum* fermentation extract. For the treatment group 60 g/day Promote N.E.T was mixed to the concentrate feed which was daily offered to consume for steers, providing xylanase and cellulase. Enzyme activity, measured as micromoles of reducing sugars from cellulose per minute (pH 5.0, temperature 40°C) was 1200 ACU g^{-1} for cellulase. The animals were fed for a period of 80 days. Steers were weighed every 14 days for 2 consecutive days with 12-h fasting period.

In 3 consecutive days during the last week of the 80-day experimental period rumen fluid samples from 6 steers of group C and 6 steers of group E with an amount of 0.5 L, were collected via an oesophageal tube, 3 h after morning feeding and retained for analysis. The values of rumen fluid pH were determined using a hand pH meter (Inolab pH, serial no: 00200018, pH-Electrode SenTix 41, D-82362, Weiheim, Germany) just after the collection of samples. Later on, all samples were subjected to *in vitro* digestibility

Table 1. Feed ingredient composition of concentrate mix (DM basis)

Item	Control group (%)	Enzyme-treated group (%)
Corn	51.2	49.90
Sun flower meal	30.4	30.22
Barley	14.4	14.32
Limestone	1.4	1.392
Dicalcium phosphate	1.4	1.392
Salt	0.8	0.796
Vit-Min Premix*	0.2	0.198
Promote N.E.T.	–	0.60

* Vit-Min Premix (Kavimix VM, Kartal Kimya A.S., Gebze, Turkey): vitamin A 12 000 000 IU, vitamin D_3 3 000 000 IU, vitamin E 30 g, Mn 50 g, Fe 50 g, Zn 50 g, Cu 10 g, I 0.8 g, Co 0.1 g, Se 0.15 g and antioxidant 10 g per kg of premix.

determination as described by Tilley & Terry (1963) and using standard procedures (AOAC, 1990). Dry matter (DM) analysis of samples was performed according to AOAC method no. 962.09. *In vitro* organic matter (OM) digestibility was determined by 48-h incubation (incubated at a constant temperature of 38 °C) in buffered rumen fluid (DOM46), and by using gas production incubations, after washing over a filter. For both methods of Tilley & Terry (1963), rumen fluid from six steers was used. Contents of neutral detergent fibre (NDF) were analyzed with a heat-stable α-amylase as suggested by Van Soest *et al.* (1991).

Data were statistically analyzed with the Student t-test using Minitab statistical software.

RESULTS AND DISCUSSION

Fattening performance, liveweight gain and feed conversion rate (FCR)

The data obtained in our trial on steers are given in Table 2. Total liveweight gain was 20 kg higher for the treatment group ($P<0.05$) that is very important from economic point of view for fattening. During fattening period daily liveweight gain of control and treatment groups were determined 986±70 and 1270±80 g, respectively and the difference was found to be statistically significant ($P<0.05$). Roughage FCR was found to be not significant ($P>0.05$) whereas concentrate feed FCR was statistically significant ($P<0.05$) and better for the enzyme-treated group. Total FCR was also better for treated steers compared to controls ($P<0.05$).

Rumen pH, in vitro DM, OM and NDF digestibility

The effects of Promote N.E.T. on rumen pH and *in vitro* DM, OM and NDF digestibility are given in the Table 3.

Rumen pH was found to be 6.19±0.13 and 6.20 ±0.07 in the control and the enzyme-treated groups, respectively ($P>0.05$). Therefore, the use of Promote N.E.T. did not effect rumen pH, and individual fatty acid fermatation in steers, including NH_3-N total (Beauchemin *et al.*, 1998). Similar results were also reported by Krause *et al.* (1998). Beauchemin *et al.*(1997) reported that fibrolytic enzymes were much more effective in intestinal digestibility.

In vitro DM digestibility of wheat straw was higher (P<0.05) for enzyme-treated group than in controls, whereas concentrate feed did not show the same difference (P>0.05). There are several researches (Feng *et al.*, 1996; Lewis *et al.*, 1996; Lewis *et al.*, 1999; Rode *et al.*, 1999) reporting that fibrolytic enzymes increased the DM digestibility. Krause *et al.* (1998) also reported that DM digestibility of rations consisting of barley and straw, increased but the difference was not found to be statistically significant.

OM digestibility of wheat straw was found to be higher (P<0.05) for the enzyme-treated group whereas concentrate feed did not show the same difference (P>0.05). There are also other reports (Feng *et al.*, 1996; Lewis *et al.*, 1996; Lewis *et al.*, 1999; Rode *et al.*, 1999) evidencing that fibrolytic enzymes have increased the OM digestibility (Rode *et al.*, 1999).

NDF digestibility of wheat straw was higher (P<0.05) in the treated group than in controls (Table 3) whereas that of the concentrate was similar (P>0.05). Oba & Allen (1999) reviewed several studies and found greater NDF digestibility for grasses than legumes due to the fact that NDF filling effect in the rumen might be less for legumes because of greater parti-

Table 2. The effect of fibrolytic enzyme on the values of fattening performance and feed conversion rate (FCR) of Holstein steers (mean± SEM) at the end of the 80-days trial

Item	Control group	Enzyme-treated group
Initial body weight, kg	362.1 ± 17.0	363.6 ± 16.0
Final body weight, kg	431.1 ± 19.0	452.5 ± 19.0
Total liveweight gain, kg	69.0 ± 4.8	88.9 ± 5.8*
Daily liveweight gain, g	986.0 ± 70.0	1270.0 ± 80.0*
Concentrate FCR	9.43 ± 0.69	7.28 ± 0.52*
Roughage FCR	1.993 ± 0.15	1.660 ± 0.12
Total FCR	11.42 ± 0.83	8.94 ± 0.64*

* P<0.05 vs controls.

Table 3. The effect of fibrolytic enzyme on rumen pH and *in vitro* digestibility (mean values of all measurements ± SEM)

Item	n	Control group	Enzyme-treated group
Rumen pH	6	6.19 ± 0.13	6.20±0.07
DM concentrate	6	80.19±0.81	81.29±0.94
DM straw	6	25.06±0.34	29.22±2.22 *
NDF concentrate	6	57.08±1.00	59.68±1.47
NDF straw	6	35.72±0.73	38.29±1.51*
OM concentrate	6	57.06±1.00	59.68±1.47
OM straw	6	24.32±0.24	28.57±2.12*

* P<0.05 vs controls.

cle fragility and shorter rumen retention time compared with grass.

Previous studies have shown an increase on NDF and acid detergent fibre (ADF) digestibility with the use of fibrolytic enzymes (Feng *et al.*, 1996; Lewis *et al.*, 1996; Beauchemin *et al.*, 1997). In the current study the higher DM and OM digestibility values could result from the higher NDF digestibility. On the other hand, this increase should also be affected by the increase of other DM digestibility. However, fibrolytic enzymes (Beauchemin *et al.*, 1998) did not affect the N digestibility but increased the hemicellulose's and starch digestibility.

In the current study, there was no significant difference of the concentrate DM, OM and NDF digestibility between the treatment and control. It has been reported (Pinoz Rodriguez *et al.*, 2002) that the effect of an exogenous fibrolytic enzyme seems to be related to substrate (forage species) and rumen environment.

Beauchemin *et al.*, (1997) reported that the use of fibrolytic enzymes in steers fed with barley based diets resulted in higher fattening performance than in steers fed with corn based diets. This can be a result of higher celluloses content of barley.

CONCLUSIONS

The results obtained from this study suggested that steers fed with Promote N.E.T. supplemented feed, exhibited better daily weight gains, total weight gains and feed conversion rates. Therefore, there was a possible improvement in production traits with the supplementation of fibrolytic enzyme used in commercial steer's feed. On the other hand, fattening performance of steers can be affected by feed quality. Further research is needed to focus on the substrates themselves in combination with management practices which may also be important, as well as the feed source and the method of enzyme application. Much more research is necessary before exogenous enzymes should be made available to commercial beef cattle producers.

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Paper received 13.01.2007; accepted for publication 27.02.2007

Correspondence:

Dr. Faruk Balci
Department of Animal Science,
Faculty of Veterinary Medicine,
Uludag University,
16059 Bursa, Turkey
Telephone: +90 224 442 92 00
Fax: + 90 224 442 8025
e-mail: fbalci@uludag.edu.tr