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SHORT COMMUNICATION

Effect of Fibrolytic Enzymes Produced from an Improved Mutant of *Chaetomium thermophile* DG-76 on the Performance of Beetal-Dwarf Crossbred Goat

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A B S T R A C T

This study was conducted to assess the performance and economical benefits of use of enzyme supplementation in an intensive feeding system in Beetal x Dwarf (crossbred) male goats. The fibrolytic enzyme produced from *Chaetomium thermophile* (DG-76), contained 5.8±0.1 U/ml, 8.3±0.2 U/ml, 6.2±0.2 U/ml, 170±2.2 U/ml and 2.2±0.02 mg/ml of filter paper (FP)-ase, CMC-ase, β-glucosidase, xylanase and extra cellular protein, respectively. The enzyme was mixed @ 1% v/w in total mixed ration (TMR) containing 15.14% CP, 20.75% ADF and 35.24% NDF which was offered for 60-d to two similar groups of 10 in each male goats weighing Control 33.42±1.1 kg and fibrolytic enzyme supplemented (FES) group 34.02±1.13 kg. There was a significant improvement (P=0.0001) in weight gain in enzyme supplemented than control group (5.01 vs 4.1 kg). Average daily live weight gain (ADLWG) was found to be 83.49 g in FES compared with 68.33 g in control and was statistically significant (P=0.0001). There was a non-significant (P=0.2875) decrease of 3.75% in feed intake in control group compared with FES, however, the feed conversion ratio (FCR) varied significantly (P=0.0008) and was 15.08% lower in FES than the control. Overall the enzyme supplementation resulted in 31.25% increase in net profit compared with the control group.

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INTRODUCTION

In current scenario of feed and forage scarcity, alternate and economical feeding strategies are required to be exploited extensively for sustainable livestock production (Khanum *et al.,* 2007). Fibrous crop residues in this background, offer economical livestock production systems however, being highly lignified the crop residues are less digestible and growth rate often decline upon their use in feeding of animals. Earlier workers worldwide reported a variable response of cellulases and xylanases on the digestibility and productive parameters in livestock (Giraldo *et al*., 2008; Bernard *et al*., 2010).

Yang and Xie (2010) reported that rational combination of enzyme products with specific fibrous forage should be considered in the design of a compound enzyme product for enhancing the cell wall degradation of fibrous crop residues. Most of the work done on the use of fibrolytic enzymes is from mesophilic organisms and market available enzymes are mostly non specified which might pose reduction in enzyme activity during the poor storage conditions, like those prevalent in Pakistan (Giraldo *et al*., 2008; Yang and Yue, 2012). Jo-Anne *et al.* (2012) pointed out that the application of exogenous fibrolytic enzyme preparations to forage requires the chemical characterization of the target forage to enable selection of enzymes that are (a) most suitable to degrade the cell wall components of the candidate forage and (b) effective under field conditions. The literature survey showed nil report on the use of *Cheatomium thermophile* fibrolytic enzymes (Latif *et al*., 1995) in ruminants. This study was planned to determine the effect of exogenous fibrolytic enzymes produced from *C. thermophile* on the performance of male goats.

MATERIALS AND METHODS

The enzyme was produced at National Institute of Biotechnology and Genetic Engineering (NIBGE) Faisalabad, Pakistan employing an improved mutant derivative of the fungus *Cheatomium thermophile DG-76* using wheat straw as carbon source. The obtained supernatant was evaporated to half the volume at 50°C and stored in the refrigerator until use. The enzyme was characterized by conducting enzyme assays for cellulases like endo-glucanase (CMC-ase), exo-glucanase (FP-ase), β-glucosidase and xylanase (Latif *et al.,* 1995).

Twenty similar Beetal x Dwarf; 50:50 castrated male goats (11 month±20d) were randomly divided into two groups as control (33.42±1.1 kg) and second the fibrolytic enzyme supplemented (FES) group (34.02 ±1.13 kg). The animals were offered twice a TMR (Table 1), at 07.00 am and 04.00 p.m. and refusal were collected daily prior to the morning feeding. All other managemental conditions remained same for both the groups and the results of 60 day experimental period have been presented.

Composite TMR samples were subjected to standard analytical methods after AOAC, 1990 and Van Soest *et al*. (1991). Treatment effects on random samples (in triplicate) were compared by the Duncan's multiple range test using Mstat-C software. P=0.001 was considered statistically significant.

RESULTS

The enzyme contained 5.8±0.1 U/ml of FP-ase, 8.3±0.2 U/ml of CMC-ase, 6.2±0.2 U/ml of β-glucosidase, 170±2.2 U/ml of xylanase and 2.2±0.02 mg/ml of extracellular protein. The enzymes were found stable during storage in the feed storage conditions as minor decrease (0- 3.41%) in the individual enzyme activities were noted during the 60-d feeding trial. The analysis of TMR has been provided in Table 1.

As shown in Table 2, the enzyme supplemented group resulted in better weight gain (5.01 kg in FES vs 4.1 kg in control) compared with the control. Similarly average daily live weight gain (ADLWG) was found as 83.49 g in FES compared with 68.33 g in control. The gain in weight represented a 22.19% increase over the control. There was a non-significant (P=0.28) decrease in feed intake in control group compared with FES group, however, the FCR varied significantly (P=0.0001) and was 15.08 % lower in enzyme supplemented than the control. Considering per animal feed expenditure and sale of the male goats as per available estimate, the total feeding expenses come around 6.49% higher for FES group while the sale can earn revenue of Rs. 1537.5 vs Rs.1878.75 per animal for control and FES groups respectively (Table 2). This net profit represents a better gain of 31.25% in enzyme supplemented than control group.

Table 1: Formulation and chemical analysis of total mixed ration (TMR)

Feed ingredients	Total Mixed Ration	
	Control	FES
Whole rice (broken)	10	10
Cottonseed meal	12	12
Oats	12	12
Grames (kala channa)	25	25
Mungbean straw (chunni)	20	20
Linseed whole	5	5
Wheat straw	13	13
Di- Calcium Phosphate	1	1
Salt	0.5	0.5
Mineral mix. #	0.5	0.5
Enzyme	0	1
Dist. Water	1	0
Total	100	100
Price per kg (Rs.)∞	18.89	19.39
Chemical composition* (%)		
Dry matter	88.58±2.1	
Crude proteins	15.14±0.62	
ADF	20.75±0.79	
NDF	35.24±1.1	
EE	4.31±0.15	
Ash	7.3±0.4	

∞=Price of enzyme Rs. 50/liter; *=determined on 100%DM basis. #Mineral mixture contained g per kg: Vit. A, 0.8; Vit. D3, 0.16; Vit. E, 0.38; Vit. B1, 1.0; Vit. B2, 1.25; Vit. B12, 0.001; Vit. B3, 6.25; Copper Sulphate (Cu), 0.25; Magnesium Sulphate (Mg), 25; Calcium Chloride (Ca), 0.23; Zinc Sulphate (Zn), 2.17; Manganese Sulphate (Mn), 10; Potassium Iodide (I2), 0.5; Sodium Selenite (Se), 0.01; D.C.P (P), 150; Sodium Chloride, 120; Vit. D6, 4.

Table 2: Weight gain, ADLWG and FCR in control and enzyme supplemented groups

Parameters	Feeding Groups		
	Control group (Mean±SD)	FES group (Mean±SD)	Significance
Weight gain (kg)	4.1±0.53[b]	5.01±0.25[a] (22.19%)	(P=0.001)
ADLWG (g)	68.33±8.82[b]	83.49±4.12[a] (22.19%)	(P=0.001)
Feed intake (kg)	29.89±0.86[a]	31.01±0.76[a] (3.75%)	(P=0.2875)
FCR (Kg)	7.29±0.04[b]	6.19±0.01[a] (15.08%)	(P=0.0008)
Cost economics*			
Feeding expenses (Rs.)	564.62	601.28	per animal basis
Sale Revenue (Rs.)	1537.5	1878.75	per animal basis
Net profit (Rs.)	973.3	1277.47	per animal basis

± shows s.d among the values. Values with different superscripts in rows differ significantly. *Calculation based on Rs. 375/kg live weight rate and feed prices as per Table-2.

DISCUSSION

In this study there was a positive response in terms of production parameters in enzyme supplemented than control group. This improvement may be due to better digestion and utilization of fiber fractions in the rumen and the results are in line with previous workers like Krueger and Adesogan (2008) who reported that application of multienzyme cocktails reduced the lag phase and improved efficiency of fermentation of mature Bermuda grass in rumen. In fact the rate of enzyme application depends on the type of forage being used, the type of producing organism and the situation specific cost economics of supplementation (Giraldo *et al*., 2008; Yang and Xie, 2010). This study is also a representative of common practices in the mutton production where shepherds graze the goat and sheep in field after harvest and feed on crop residues extensively.

With enzyme supplementation there was better economic return than control. This increase in net profit was mainly due to better weight gain and in line to our findings, Bala *et al.* (2009) using Beetal-sannen crossbred goats concluded that apart from increased digestibility, fortification of concentrate supplement with cellulase and xylanases enzymes improved FCM yield in the last quarter of lactation in goats, and improved body weights by 5%. When a major fraction of the diet contains fiber the use of relevant exogenous enzymes help attain better gains as evident in this study.

Conclusion: Fibrolytic enzymes produced from *Chaetomium thermophile DG-76* have a beneficial effect on the performance of Beetal-Dwarf crossbred male goats in intensive crop residue based feeding systems.

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