

Effect of exogenous fibrolytic enzymes supplementation on growth and nutrient utilization in Murrah buffalo calves

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ABSTRACT

The present experiment was conducted to study the effect of supplementing exogenous fibrolytic enzymes (cellulase 4050 µM glucose/g/h and xylanase 8600 µM xylose/g/min mixed equally w/w) at 2 levels @ 1.5 and 3.0 g mixture/kg DM of TMR on the growth performance and nutrient utilization in buffalo calves. Female Murrah buffalo calves (18) were randomly divided into 3 groups (8–10 month of age; 149.44, 151.08 and 151.62 kg BW; 6 each) and fed concentrate, wheat straw and green maize fodder in 40: 45:15 proportions (DM basis) in control group and the same ration as fed to control group plus 1.5 g enzyme mixture/kg DM of TMR (group 1) and 3.0 g enzyme mixture/kg DM (group 2) for 120 days. Average body weight gain in group 1 was 96.10 kg, which was higher than group 2 (83.20 kg) and control group (83.08 kg). Average daily gain was also higher in group 1 (800.79 g/d) over the group 2 (693.33 g/d) and control group (692.35 g/d). DMI was higher in group 1 (4.37 kg/d) as compared to control (4.24 kg/d) and group 2 (4.24 kg/d). The digestibility coefficient of NDF, cellulose and hemicellulose were higher in group 1 over the group 2 and control group. It could be concluded that supplementation of exogenous fibrolytic enzymes @ 1.5 g mixture/kg DM improved the growth rate in Murrah buffalo calves.

Key words: Buffalo calves, Fibrolytic enzymes, Growth, Nutrient utilization

In India ruminant feeding system relies mainly on fibrous crop residues. In crop residues the lignocellulose component is the potential source of energy, but the utilization of such residues by ruminants as feedstuffs is limited due to lack of lignolytic activity of the rumen microbial population (Singh and Osting 1993). Enzymes can improve fiber digestion and utilization when incorporated in the diets of ruminants (Tricarico *et al.* 2002, Shojaeian and Thakur 2007, Bala *et al.* 2009). Chandra Shekhar *et al.* (2010) reported that use of enzymes in animal feeding improved production efficiency and minimize nutrients wastage. Fibrolytic enzymes can increase the availability of storage polysaccharides and proteins by breaking down specific bonds in feedstuffs not usually degraded by endogenous enzymes, thus releasing more nutrients (Beauchemin *et al.* 2001). Keeping this in view, the effect of supplementing exogenous fibrolytic enzymes on the growth performance and nutrient utilization in Murrah buffalo calves was investigated.

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MATERIALS AND METHODS

Female Murrah buffalo calves (18), 8 to 10 month-old, were randomly divided into 3 groups of 6 each and fed concentrate mixture, wheat straw and green maize fodder in 40:45:15 proportions (on DM basis) in control group and the same ration as fed to control group plus 1.5 g enzyme mixture (cellulase 4050 µM glucose/g/h and xylanase 8600 µM xylose/g/min mixed equally w/w)/kg DM of TMR (group 1) and the same enzyme mixture @3.0 g/kg DM (group 2) for 120 days. Cellulase and xylanase enzymes were procured commercially. The activities of cellulase and xylanase enzymes were estimated by measuring the rate of release of reducing sugars from pure substrates by colorimetric method using dinitrosalicylic acid (Miller 1959).

Daily feed intake and fortnightly body weights were recorded during the entire experimental period of 120 days. The calves were housed in a well ventilated byre having individual feeding manger and space for separate tying of individual calf and provided with fresh and clean tap water free choice 3 times daily. A 73- day digestibility trial was conducted under the same housing management at the end of growth trial. DM, OM, CP, EE, CF, NFE and total ash of feed, residue and faecal samples were analyzed (AOAC

2005), NDF and ADF were estimated (Goering and Van Soest 1970). Statistical analyses of the data were carried out by using analysis of variance as per Snedecor and Cochran (1986).

RESULTS AND DISCUSSION

The chemical composition of concentrate mixture, green maize, wheat straw and total mixed ration (TMR) fed to calves is presented in Table 1. DMI and TDNI (kg/day) was significantly ($P<0.05$) higher in enzymes supplemented group 1 over the group 2 and control group (Table 2). Lewis *et al.* (1999) reported an increase in DMI by 2.2 kg/cow/day when forages were treated with combination of cellulase and xylanase. TDN intake (kg/day) was significantly ($P<0.01$) higher in Sahiwal cows by 10.27% on supplementation of enzyme mixture (@1.5 g/kg DMI), along with 4% urea treated wheat straw (Shojaeian and Thakur 2007). The average daily and total body weight gain was higher ($P<0.05$) in calves supplemented with fibrolytic enzymes @1.5 g/kg DM supplemented group 1 (800.79 g/day and 96.10 kg) over that of enzymes added @ 3.0 g/kg DM group 2 (693.33 g/day 83.20 kg) and control group (692.35 g/day and 83.08 kg). Our results are similar to those of Pritchard *et al.* (1996), who reported linear improvements of intake and gain in steers fed treated grass hay by fibrolytic enzymes. Similar findings were obtained by Zinn and Salinas (1999) who observed improvement in DM intake and average daily gain in cattle supplemented with the enzymes. The feed conversion efficiency (DMI kg/kg gain) was improved by 11.13% in group1 than that of control and group 2, but it was statistically nonsignificant. The CP intake (kg/kg gain) was improved ($P<0.05$) by 18.07, 17.07% in group 1 over that of control and group 2, respectively.

The digestibility coefficients of DM, OM, CP, CF, EE, NFE and ADF were similar in control group, groups 1 and 2 (Table 4). However, NDF, cellulose and hemicellulose digestibility coefficients were higher ($P<0.05$) in group 1

Table 1. Chemical composition of feed ingredients and total mixed ration used during the digestibility trial (% DM basis)

Parameters	Concentrate mixture	Green maize	Wheat straw	TMR
DM	91.68	21.00	92.00	82.05
OM	91.33	89.82	91.80	91.08
CP	20.46	8.26	2.11	12.13
EE	4.23	1.67	1.52	2.51
CF	8.01	29.11	42.91	26.69
NFE	58.63	50.68	45.26	49.86
Total ash	8.67	10.18	8.20	8.81
NDF	43.49	57.74	78.53	61.04
ADF	13.50	31.78	52.74	33.78
Hemicellulose	29.99	25.96	25.79	27.39
Cellulose	8.67	27.77	42.47	26.69
ADL	4.59	5.81	10.37	7.32

Table 2. Growth rate, intake and feed conversion ratio in calves fed experimental diets during feeding trial

Attributes	Control	Group1	Group2
Initial body weight (kg)	149.44 ±10.90	151.08 ±11.03	151.62 ±12.32
Final body weight (kg)	232.52 ± 12.22	247.18 ±13.31	234.82 ±12.39
Total body weight gain (kg)	83.08 ^a ± 1.86	96.10 ^b ± 2.66	83.20 ^a ±1.02
Average daily body weight gain (g)	692.35 ^a ±15.53	800.79 ^b ±22.17	693.33 ^a ±8.49
<i>Intake</i>			
DM (kg/d)	4.24 ^a ± 0.32	4.37 ^b ± 0.22	4.24 ^a ±0.22
CP (g/d)	458.16 ± 32.90	449.78 ± 25.01	454.17 ±23.89
TDN (kg/d)	2.09 ^a ± 0.15	2.31 ^b ±0.13	2.08 ^a ±0.11
<i>Feed conversion ratio (kg/kg gain)</i>			
DM intake	6.47 ± 0.36	5.75 ± 0.21	6.47 ±0.29
CP intake	0.699 ^{ac} ± 0.051	0.592 ^b ± 0.033	0.693 ^c ±0.046
TDN intake	3.18 ± 0.18	3.05 ± 0.11	3.18 ±0.14

^{a, b, c}Means having different superscripts in the same row differ significantly ($P<0.05$).

over those of group 2 and control group. The improved digestibility of NDF, cellulose and hemicellulose may be attributed to the better utilization of lignocellulosic material of the wheat straw and maize fodder by exogenous fibrolytic enzyme supplementation. Fibrolytic enzymes are typically cellulases that degrade cellulose or xylanases that act on hemicellulose (Beauchemin *et al.* 1995). Our results are in agreement with finding of Bowman *et al.* (2002) who reported that the digestibility coefficient of DM, NDF and ADF increased over the control when enzymes (cellulase and xylanase) were added to the entire concentrate. Shojaeian and Thakur (2007) observed that DM, OM, NFE, NDF, ADF and cellulose digestibility of ammoniated wheat straw based TMR was improved significantly ($P<0.01$) in Sahiwal cattle on supplementation of enzyme mixture of cellulase and xylanase @ 1.5 g/kg DMI. Improvement in DM and fibre digestion (NDF) when enzymes applied to forages plus barley diet immediately before feeding in ruminants, suggesting that fibrolytic enzymes applied at feeding can improve digestion in ruminants (Feng *et al.* 1996). Enhanced digestibility of DM, ADF and NDF of TMR indicated that the enzymes were partly resistant to proteolysis in the rumen and remained active in the intestine.

Our results indicated that exogenous fibrolytic enzyme supplementation @ 1.5 g/kg DMI, increased growth performance and nutrient utilization of Murrah buffalo calves due to improved dietary fibre digestion.

Table 3. Nutrient intake and digestibility coefficients (%) of nutrients in different groups during digestibility trial

Parameters	Control	Group 1	Group 2
Nutrient intake			
DM (kg/day)	5.26±0.32	5.24±0.24	4.99±0.27
DM (g/kg w ^{0.75})	92.16±2.78	87.35±1.53	86.64±2.96
CP (g/d)	567±34.04	540.33±39.04	536.67±28.10
CP kg w ^{0.75} (g/d)	9.93±5.91	9.01±0.39	9.31±0.30
TDN (kg/d)	2.59±0.16	2.77±0.13	2.45±0.13
TDN per kg w ^{0.75} (g/d)	45.23±1.23	46.28±0.81	42.52±1.45
Digestibility coefficients (%)			
DM	53.21±0.71	56.52±1.92	53.30±0.38
OM	55.20±0.53	58.50±1.83	56.45±0.65
CP	52.00±0.48	55.35±2.22	53.26±0.94
EE	74.21±0.34	75.72±1.35	74.19±1.26
CF	49.68±1.43	54.21±2.85	52.14±1.96
NFE	49.07±1.40	52.27±1.94	48.64±1.16
NDF	47.45 ^{ab} ±0.99	52.49 ^c ±1.71	48.66 ^b ±0.90
ADF	44.79±1.56	49.25±2.03	46.78±1.14
Cellulose	45.14 ^a ±1.27	51.11 ^b ±2.16	45.66 ^a ±1.26
Hemicellulose	49.20 ^a ±1.55	56.35 ^b ±1.66	50.71 ^a ±1.90

a, b, c Means having different superscripts in the same row differ significantly (P<0.05).

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