EFFECT OF DIFFERENT LEVELS OF YEAST CULTURE ON DIGESTIBILITY, NITROGEN BALANCE AND RUMINAL CHARACTERISTICS IN BUFFALO BULLS

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ABSTRACT

The study was planned to examine the effect of different levels of yeast culture on feed intake, nutrient digestibility, nitrogen balance and ruminal characteristics in *Nili Ravi* buffalo bulls. The Nili Ravi buffaloes occupy primary and key space in Pakistani Livestock herd and contribute major quantity of milk supply. The cheaper and easily available sources of nutrients can play pivotal role in its improvement. Four ruminally cannulated *Nili Ravi* buffalo bulls were distributed in a 4×4 Latin Square Design. Four diets containing 50% berseem and 50% wheat straw were formulated. Control diet (C) was without yeast culture. However, low (LYC), medium (MYC) and high yeast culture (HYC) diets contained 5, 10 and 15 g yeast culture per animal diet respectively on daily basis. The experiment lasted for forty days. First seven days were given as adaptation period followed by a collection period of three days.

The results showed that dry matter (DM) and crude protein (CP) intakes were similar in buffalo bulls fed varying levels of yeast culture. Dry matter, CP, NDF and ADF digestibilities were higher in buffalo bulls fed various levels of yeast culture compared to control diet. Highest dry matter, CP, NDF and ADF digestibilites were observed in MYC. Nitrogen intake was higher in buffalo bulls fed varying levels of yeast culture than control. Highest nitrogen balance was observed in MYC diet. Highest Ruminal NH_3-N was observed in control and lowest ruminal NH_3-N was observed in MYC. Ruminal pH was higher in bulls fed MYC and HYC diets. These results indicate that yeast culture has positive effects on digestibility, nitrogen balance, ruminal pH and ruminal NH_3-N concentration. So, yeast culture could be a useful tool to improve the performance of the animals.

Keywords: yeast supplementation, buffalo bulls, *Bubalus bubalis*, digestibility, nitrogen metabolism

INTRODUCTION

One of the major causes of low ruminant productivity in Pakistan is inadequate protein and energy availability. Ruminants are getting 40 and 75% of their crude protein and energy requirements, respectively. The area under fodder cultivation is squeezing due to preferred cultivation of cash crops. Low protein, poor digestibility, palatability, high neutral detergent fiber content and seasonal scarcity of fodders are the main causes for poor quality of fodders (Khan *et al*., 2006). There is

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need for supplementation of certain substances for efficient utilization of existing feed resources.

Animal nutritionists have used many techniques like supplementation of feed additives to improve the animal performance. These additives include antibiotics, prebiotics, probiotics, enzymes, vitamins and minerals (Saegusa *et al*., 2004). Dietary yeast culture (YC) has been extensively used for the manipulation of rumen fermentation since the 1950s (Beeson and Perry, 1952). Use of probiotics in ruminant's diet is gaining more importance due to ban on antibiotics by European Union.

The products containing *Saccharomyces cerevisiae* (*S. cerevisiae*) vary widely in effectiveness because of viability of yeast cells and the differences in strain. Supplementation of yeast in the ruminant rations may improve milk production, feed intake (Williams *et al.*, 1991), digestion, weight gain, ruminal pH value (Jouany *et al.*, 1998). Yeast products have been used extensively in animal nutrition to improve animal performance and manipulate rumen fermentation. Various *S. cerevisiae* based products of yeast have showed impact on nutrient digestibility, dry matter (DM) intake and rumen pH (Lehloenya *et al.*, 2008). Several rumen parameters such as volatile fatty acids (VFA) concentration, total tract nutrient digestion and pH are also influenced by yeast thus, adding yeast to the ruminant rations seems to influence the rumen fermentation and improves rumen ecosystem (Denev, 2006). The study was planned to examine the effect of different levels of yeast culture on feed intake, nutrient digestibility, nitrogen balance and ruminal characteristics in *Nili Ravi* buffalo bulls.

MATERIALS AND METHODS

Four ruminally cannulated *Nili Ravi* buffalo bulls were used in 4×4 Latin Square Design to evaluate the effect of different levels of yeast culture on feed intake, nutrient digestibility, nitrogen balance and ruminal characteristics (pH and ammonia-N). Adjustment period of seven days followed by collection period of three days was used in each treatment. Animals were housed on a concrete floor in separate pens.

Berseem sown in the field area was harvested on daily basis. The fodder was chopped to a suitable particle size. Animals were fed at 2% of their body weight on DM basis. The diet consisted of a mixture of 50% wheat straw and 50% berseem. The chemical composition of ingredients and their percent contribution are given in Table 1 and 2, respectively. Yeast culture was added at 0, 5, 10 and 15 g in per animal diet respectively on daily basis. Experiment was lasted for 40 days. Fresh water was ensured round the clock during the experiment.

Digestibility was determined using total collection method. During collection period, complete collection of urine and feces was made. The feces of each animal was collected daily, weighed, thoroughly mixed and 20% of it was sampled and dried at 55°C. At the end of each collection period, dried fecal samples were composited and 10% of the composited samples were taken for analysis. The urine excreted by each animal was acidified with 50% H_2SO_4 (v/v) and 10% of it was sampled and preserved at -20°C. At the end of each collection period, preserved urine samples were composited after thawing, and 10% of the composited sample was used for analysis (Sarwar *et al*., 2004).

Table 1. Chemical composition of ingredients fed to buffalo bulls.

Ingredient	DM (%)	CP (%)	TDN (%)	NDF (%)
Berseem	22.78	18.90	60	44.8
Wheat straw	92.76	2.60	43	81

DM, CP, TDN and NDF stand for dry matter, crude protein, total digestible nutrients and neutral detergent fiber, respectively.

Table 2. Chemical composition of ration fed to buffalo bulls.

Ingredient	Parts	DM Contribution (%)	CP Contribution (%)	TDN Contribution (%)	NDF Contribution (%)
Berseem	50	11.39	9.45	30	22.4
Wheat straw	50	46.38	1.30	21.5	40.55
Total	100	57.76	10.75	51.5	62.95

DM, CP, TDN and NDF stand for dry matter, crude protein, total digestible nutrients and neutral detergent fiber, respectively.

Ruminal samples were taken from the rumen at 3, 6, 9 and 12 h after morning feeding for determination of pH and NH_3-N. Thereafter each sample was squeezed through four layers of cheesecloth and about 50 ml of the liquid was acidified with 3 ml of 6 N HCl to terminate the fermentation, then sample was frozen. Ruminal NH_3-N was steam distilled using kjeldahl equipment and was titrated against sulphuric acid (Giri *et al*., 2005). Ruminal pH was measured immediately after sampling using a portable pH meter (Hanna HI 8314, Hanna industries, Romania). Nitrogen balance was determined by the difference of nitrogen consumed and the sum of fecal nitrogen plus urinary nitrogen excreted. The DM and CP contents of feed and feces were determined by using methods described by AOAC (2000). Neutral detergent fiber with sodium sulphite and Acid detergent fiber with residual ash were determined by methods described by Van-Soest *et al.* (1991).

Statistical analysis

The data was subjected to Analysis of Variance using Latin Square Design and treatment means were compared by using Duncan's new Multiple Range (Steel *et al*., 1997).

RESULTS

Nutrient intake

Dry matter and crude protein intake were similar (P>0.05) in buffalo bulls fed varying levels of yeast culture (Table 3). Non-significant difference was found between treatments and control group.

Nutrient digestibility

Dry matter, CP, NDF and ADF digestibilities were higher in treatments as compare to control diet (Table 4). Highest dry matter, CP, NDF and ADF digestibilites were observed in MYC.

Nitrogen balance

Nitrogen intake was similar (P>0.05) in buffalo bulls fed varying levels of yeast culture. Fecal nitrogen was significantly different (P<0.05) across animals (Table 5). Lowest fecal nitrogen was observed in HYC. Fecal nitrogen decreased with the addition of the yeast culture. Urinary nitrogen was also different (P<0.05) across all treatments. Lowest urinary nitrogen was observed in MYC. Highest urinary nitrogen was observed in control diet. Highest nitrogen balance was observed in MYC.

Ruminal characteristics

Ruminal NH_3-N was different across different treatments. Ruminal NH_3-N was higher in control and LYC as compare to MYC and HYC.

Table 3. Influence of yeast culture supplementation on nutrients intake in buffalo bulls.

Parameters (g/d)	Diets				SE
	C	LYC	MYC	HYC	
Dry matter	11.6	11.59	11.63	11.55	0.580
Crude protein	1.24	1.23	1.25	1.22	0.006
Neutral detergent fiber	7.3	7.29	7.32	7.27	0.036
Acid detergent fiber	4.29	4.28	4.3	4.27	0.021

Control diet contained 0 g yeast culture while LYC, MYC and HYC diets contained 5, 10 and 15 g yeast culture in per animal diet on daily basis, respectively.
SE = Standard error

Table 4. Influence of yeast culture supplementation on digestibility of nutrients in buffalo bulls.

Parameters (g/d)	Diets				SE
	C	LYC	MYC	HYC	
Dry matter	45.75^{c}	47.25^{c}	55.94^{a}	50.71^{b}	0.94
Crude protein	55.94^{b}	65.10^{a}	65.71^{a}	66.34^{a}	0.69
Neutral detergent fiber	40.85^{c}	42.01^{c}	51.56^{a}	45.55^{b}	0.387
Acid detergent fiber	40.86^{c}	42.03^{c}	51.52^{a}	45.47^{b}	0.378

Control diet contained 0 g yeast culture while LYC, MYC and HYC diets contained 5, 10 and 15 g yeast culture in per animal diet on daily basis, respectively.
Means in a row followed by same superscript are not significantly different (P>0.05).
SE = Standard error

Highest Ruminal NH_3-N was observed in control and lowest Ruminal NH_3-N was observed in MYC. On overall basis Ruminal NH_3-N decreased with increasing levels of yeast culture (Table 6).

Average ruminal pH was different across different treatments. Highest ruminal pH was observed in MYC and HYC as compared to control and LYC. Lowest ruminal pH was observed in control group. Average ruminal pH increased with addition of different levels of yeast culture (Table 6).

DISCUSSION

Nutrient intake

Yeast culture had no effect on nutrient intake. Results of present study are supported by findings of Enjalbert *et al.* (1999) who reported that addition of yeast did not improve the dry matter intake in cows fed different levels of yeast culture. Jouany *et al*. (1998) also reported the same results. But in contrary to these findings several researchers (Wohlt *et al*., 1991; Beauchemin *et al*.,

Table 5. Influence of yeast culture supplementation on ruminal pH and NH3-N in buffalo bulls.

Parameters (g/d)	**Diets**				**SE**
	C	**LYC**	**MYC**	**HYC**	
Ruminal pH	6.46^{c}	6.55^{b}	6.65^{a}	6.65^{a}	0.033
Ruminal NH_3-N g/dl	0.022^{a}	0.022^{a}	0.18^{b}	0.20^{b}	0.010

Control diet contained 0 g yeast culture while LYC, MYC and HYC diets contained 5, 10 and 15 g yeast culture in per animal diet on daily basis, respectively.

Means in a row followed by same superscript are not significantly different (P>0.05).

SE = Standard error

Table 6. Nitrogen balance of bulls fed different levels of yeast culture in buffalo bulls.

Parameters (g/d)	**Diets**				**SE**
	C	**LYC**	**MYC**	**HYC**	
Nitrogen intake	191.2	194.15	198.5	189	10.32
Urinary Nitrogen	78.02^{a}	69^{b}	69.26^{b}	67.0^{b}	6.66
Fecal Nitrogen	77.65^{a}	69.26^{b}	72.49^{b}	66.94^{b}	5.42
Nitrogen Balance	35.55^{b}	55.89^{a}	61.00^{a}	55.06^{a}	3.29

Control diet contained 0 g yeast culture while LYC, MYC and HYC diets contained 5, 10 and 15 g yeast culture in per animal diet on daily basis, respectively.

Means in a row followed by same superscript are not significantly different (P>0.05).

SE = Standard error

2003; Mikulec *et al*., 2010) reported the addition of yeast in ruminant diets increased the dry matter intake. Possible reason of thia this increased dry matter intake might be increased digestibility.

Nutrient digestibility

Higher Nutrient digestibility observed in animals fed different levels of yeast culture might be attributed to the inclusion of yeast which might have increased the number of beneficial microbes as a result of which breakdown of bonds between different feed nutrients was increased. Results of the present study are in accordance with the findings of other researchers (Rusek and Bilik 2011; Adangale *et al*., 2011; Sawsan *et al*., 2012) who reported the same effect of yeast culture supplementation in ruminants. Higher CP digestibility might be due to increased number of beneficial microbes which break down the molecules in the rumen and as a result nitrogen utilization in the rumen is increased due to which CP digestibility is also increased. Haddad and Goussous (2005) also reported similar results when yeast culture was fed to animals at various levels. But in contrary to these findings, other researchers (Blauwiekel *et al*., 1995; Putnam *et al*., 1997; Carro *et al*., 1992) reported that yeast has non-significant effect on nutrient digestibility. Possible reason of this might be no increase in the number of rumen microflora.

Nitrogen balance

Lower fecal and urinary nitrogen observed in different treatments of yeast culture might be related to better CP digestibility. Sawsan *et al*. (2012) reported same results when 0.1% and 0.2% yeast culture was added in ration. Within yeast treatments, nitrogen balance increased due to better digestibility and increased utilization of ruminal NH_3-N. These results were also reported by Tang *et al*. (2008). Contrary to these, other workers (Aleksander *et al*., 2006; Lehloenya *et al*., 2008) reported that yeast addition had non-significant effect on nitrogen balance.

Ruminal characteristics

Lower ruminal NH_3-N in bulls fed different levels of yeast culture might be due to the increased utilization of N in the rumen. Doto and Liu (2011) also reported similar results when yeast culture was added in the ration. Our findings were not in concordance with Polsit *et al*. (2011) who described that addition of yeast had non-significant effect on ruminal NH_3-N. Higher ruminal pH might be due to lower levels of ruminal NH_3-N. The results of present study were supported by findings of Dolezal *et al*. (2010) who observed higher ruminal pH when yeast culture was supplemented in ruminant rations. Lynch and Martin (2002) also reported similar results when yeast culture was fed to the animals.

It is evident from the results that yeast culture has positive effects on digestibility, nitrogen balance, ruminal pH and ruminal NH_3-N concentration without altering the intake. So, yeast culture could be a useful tool to improve the performance of the *Nili Ravi* buffaloes.

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