Effect of Dietary Supplementation with Yeast Cell Suspension (*Saccharomyces cerevisiae*) on Nutrient Utilisation and Growth Response in Crossbred Calves

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ABSTRACT : Twenty crossbred calves of 88 ± 5.5 kg initial live weight and 3-4 month of age were divided into two groups and fed wheat straw and concentrate to support a 500 g daily gain in body weight. Calves in the experimental group (YC) were given a daily dose of 10 ml yeast cell suspension (YC) containing live cells (5×10^9 cells/ml) of *Saccharomyces cerevisiae* ITCCF 2094. After a growth study of 122 days metabolism trials were conducted. The calves in the YC group recorded a daily weigt gain of 492 ± 27.8 g as compared to 476 ± 20.1 g in control group.

There were no significant differences in feed intake, nutrient digestibility, feed/gain ratio and nitrogen retention between the YC supplemented and control groups.

(**Key Words**: Growth, Yeast, *Saccharomyces cerevisiae*, Crossbred Calves)

INTRODUCTION

Supplementation of yeast cell suspension (YC) in the diet of ruminants has been of great interest during the last one decade. The yeast cells are known to be a source of vitamins, enzymes and some unidentified cofactors which are helpful in increasing the microbial activity in the rumen (Dawson et al., 1990, Williams et al., 1991). The beneficial effects of yeast supplementation reported so far include better growth rate, feed conversion efficiency and milk production (Dawson, 1993). Large variations in these responses have also been reported which might be due to types of animals, diets and yeast strains supplemented in the diets in various studies.

In the author's laboratory higher weight gain and improvement in feed conversion efficiency (FCE) were observed in YC supplemented crossbred calves fed concentrate and green berseem from birth to 91 days (Panda et al., 1995). However, during the summer season green fodder becomes scarce in most of the tropical countries and cattle are fed mainly on wheat straw based diets. The present study was conducted to study the effect of YC supplementation in concentrate and wheat straw fed crossbred calves.

MATERIALS AND METHODS

Twenty crossbred calves (inter se, *Bos indicus* × *Bos taurus*) were taken from the same herd being kept in the Animal Farms of Indian Veterinary Research Institute at the age of 1-2 days and reared in two groups of 10 animals each on milk, calf starter and green berseem. The animals of one group received a daily dose of live yeast cell suspension (10 ml of suspension containing 5×10^9 cells/ml) from day 1-2 after birth. The other group of 10 animals, which served as control did not receive the yeast culture (YC). They were weaned after 24 h of birth. This experiment was started when the age of animals was between 3-4 months. The calves were housed under hygienic conditions in experimental sheds with individual feeding facilities for each calf.

Yeast culture

Saccharomyces cerevisiae ITCCF 2094 was cultured in Roux culture bottles on YEPD agar, containing peptone 1%, dextrose 2%, yeast extract 0.3% and agar 15%. Thick growth obtained on the agar surface was washed in normal saline solution to obtain the yeast cell suspension. The desired concentration of yeast cells (5×10^9 cells/ml) was obtained by diluting the supension with normal saline and adjusting optical density at 640 nm.

Feeding and management

The calves were offered restricted amount of concentrate mixture and wheat straw to appetite by allowing 20-25% as refusals to meet energy and protein requirements as per NRC (1988). The concentrate mixture

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contained 30% crushed maize, 32% wheat bran, 35% groundnut cake, 2% mineral mixture and 1% common salt. Chemical composition of the concentrate mixture and wheat straw is given in table 1. Animals were fed once daily at 10:00 hrs. in the morning. First the concentrate was given which was consumed by the calves within half an hour thereafter weighed quantity of straw was offered. Water was available *ad libitum* at 11:00 and 16:00 hrs. Feed intake and residues left were recorded each day. The required quantity of yeast culture suspended in normal saline was given orally as a single dose in the morning individually to each of the calves of YC group. The calves received 5×10^{10} yeast cells/animal/day.

Table 1. Chemical composition of diet on DM basis (g/kg)

Items	Concentrate mixture	Wheat straw
Organic matter	928	878
Crude protein	225	32
Neutral detergent fibre	578	755
Acid detergent fibre	204	503
Cellulose	138	373
Hemicellulose	371	252
Ash	72	122

All the calves were weighed at the start of the experiment and thereafter at weekly intervals up to 122 days. A six days metabolism trial was conducted at the end of the growth study to determine the digestibility and balance of nutrients. The animals were conditioned in metabolism cages for two days before the collection period. The faeces and urine samples of 24 h were pooled and after proper mixing aliquotes of faeces (1/100 for nitrogen and 1/1500 for dry matter) were taken each day. Similarly an aliquot of urine (1/1000) was taken for nitrogen estimation and was pooled with dilute sulphuric acid. The 6 days pooled samples of individual animals, preserved in dilute sulphuric acid were used for nitrogen estimation and dry samples were used for other chemical components.

Sampling and chemical analyses

The feed offered, residue left and faeces voided were analysed for dry matter (DM) by dring at 100℃ for 24 h, for organic matter (OM) by ashing at 550℃ for 4 h and for crude protein (CP) by the kjeldahl technique (AOAC, 1980). Neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL), cellulose and hemicellulose were determined by the methods of Goering and Van Soest (1970).

Statistical analyses

Data were analysed using unpaired method of student's "t"-test and the significance of difference between means was determined as per Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

The yeast cell suspension (YC) in normal saline was given orally to the animals. The calves developed affinity to YC feeding and consumed it readily. In present experiment the dose of yeast culture was similar as reported earlier (Mir and Mir 1994, Panda et al., 1995. Chiquette et al., 1995). The viability of yeast varies between 10^7-10^{10} cells/g product (Williams et al., 1991 and New bold et al., 1995) and in most of the published results the supplemental dose of yeast ranges between 0.5 to 1.0 percent of the diet. There was no effect of YC supplementation on dry matter intake (3.4 ± 0.21 and 3.2 ± 0.16 kg/d) in YC and control groups respectively (table 2). The animals in YC supplemented group and control group consumed 2.86 and 2.77 kg dry matter, 0.19 and 0.18 kg digestible crude protein and 1.90 and 1.81 kg total digestible nutrients per 100 kg of body weight. The animals in both the groups consumed 59-60% of DM in the form of concentrate and 40-41% from wheat straw. It appears that administration of YC did not affect the intake of nutrients on this dietary regimen as also

Table 2. Body weight gain and feed: gain ratio in calves fed with (YC) or without (control) yeast supplement

Items	YC	Control
Number of animals	10	10
Initial body weight (kg)	91.5 ± 9.5	85.0 ± 6.1
Final body weight (kg)	151.5 ±11.1	143.1 ± 6.5
Weight gain in 122 days (kg)	60.0 ± 3.4	58.1 ± 2.4
Weight gain (g/d)	491.8 ±27.81	476.2 ±20.1
Feed: gain	7.01± 0.42	6.82± 0.28
Dry matter intake (kg/d)		
Concentrate	2.03± 0.20	1.97± 0.13
Wheat Straw	1.40± 0.25	1.28± 0.14
Total	3.43± 0.21	3.25± 0.16
Concentrate (% DM intake)	59.2	60.6
Wheat straw (% DM intake)	40.8	39.4

reported by Erdman and Sharma (1989) in cows given a diet of 40% silage and 60% concentrate.

There were no differences in the digestibility of DM, CP, NDF, ADF, cellulose and hemicellulose between YC supplemented and control groups (table 3). Since the DMI and digestibility of nutrients were similar the plane of nutrition was also similar in both the groups as shown in nitrogen balance (table 3). Similar observations have been reported previously (Weidmeier et al., 1988). However, other workers have reported positive effect on the digestibility of nutrients with YC supplementation (Weidmeier et al., 1987) and this positive effect on the digestibility of nutrients has been attributed to stabilization of pH in the rumen due to utilisation of lactic acid by the yeast cells (Martin and Nisber, 1992). Williams et al. (1991) observed that greatest responses of yeast supplementation on animal productivity could be obtained on high concentrate diets. Such effects of yeast supplementation could not be observed in the present experiment. Williams and Newbold (1990) suggested that YC may alter the site of digestion and that total tract digestibility does not give an accurate representation of the effects of yeast in the rumen.

The body weight gain, feed conversion efficiency (FCE) and nitrogen retentions were similar in YC and control groups (table 2 and table 3). These results concur with the observations of Mutsavangwa et al. (1992), Mir and Mir (1994) and Rouzbehan et al. 1994 and contradict with those of Mcleod et al. (1991). The inconsistency in response of YC on the weight gain of the animals reported by different workers is difficult to explain as the response may depend on the specific yeast strain, type of diet given and physiological stage of the animals (Panda, 1994). It is also possible that yeast culture does not always have significant effects on ruminal fermentation (Mutsvangva et al., 1992). It is evident from the literature that yeast culture supplements do not have beneficial effects with all type of diets. In some studies minor changes in diet significantly alter the beneficial response of yeast culture. However, many of these studies are carried out under different management conditions and only few have common measure to evaluate the responses. Therefore it is not possible to define the dietary conditions under yeast provides the optimum benefits (Dawson, 1993). Wallace and Newbold (1993) concluded that yeast culture tended to increase body weight gain in cattle given a diet based on corn silage compared to grass silage.

In one of our previous studies (Panda et al., 1995) increase in average daily gain and higher digestibility of CP and improvement in feed conversion efficiency were observed in YC fed preruminant calves. The results of present study reveal that YC supplementation has no effect on nutrient utilisation and growth performance of calves fed wheat straw and concentrate diet.

Table 3. Digestibility of nutrients and nitrogen balance in calves fed with (YC) or without (control) yeast supplement

Items	YC	Control
Digestibility coefficients (%)		
Dry matter	66.9±1.3	68.3±1.0
Crude protein	49.9±2.7	47.9±1.8
Neutral detergent fibre	60.5±3.0	62.3±1.5
Acid detergent fibre	54.0±1.6	55.4±1.3
Cellulose	57.3±1.7	59.2±2.2
Hemicellulose	67.8±2.1	69.9±2.0
Nitrogen balance (g/d)		
Intake	96.6±1.5	95.5±1.7
Excreted in faeces	48.4±2.4	49.8±3.0
Excreted in urine	25.4±2.9	24.2±2.5
Balance	22.8±2.4	21.6±2.4

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