EFFECT OF SUPPLEMENTATION OF DRIED YEAST ("NEUTRAMIX-MDY") ON GROWTH PERFORMANCE OF PRE-RUMINANT CALVES

By
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THESIS

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DECLARATION

I hereby declare that this thesis entitled **"EFFECT OF SUPPLEMENTATION OF DRIED YEAST ("NEUTRAMIX-MDY") ON GROWTH PERFORMANCE OF PRE-RUMINANT CALVES"** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

Mannuthy,
13.09.02

Asitha. T.V

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CERTIFICATE

Certified that the thesis entitled **"EFFECT OF SUPPLEMENTATION OF DRIED YEAST ("NEUTRAMIX-MDY") ON GROWTH PERFORMANCE OF PRE-RUMINANT CALVES"** is a record of research work done independently by **Dr. Asitha, T.V.**, under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to her.

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ASITHA, T.V.

Dedicated to
The Lord Krishna

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Introduction

1. INTRODUCTION

The dairy sector in India has shown remarkable development in the past decade and India has now become the World's number one milk producing country with an output in 1999-2000 at 78 million tonnes (Roy, 2002). This increase in milk production from about 17 million tonnes in 1951 through 70.8 million tonnes in 1996 (Gandhi *et al.*, 1998) to 78 million tonnes in1999-2000, has been made possible by sustained improvement in cattle breeding policies adopted by the country to produce animals with improved production potential and growth rate. The present Indian cattle population has high potential for growth to attain early maturity and breedable body size under proper feeding and managemental regimes.

The special feature of our dairy industry is that it depends largely on agricultural by products and crop residues for animal feeding. Shortage of these feeds in quality is the most significant factor that adversely affects the animal productivity in our country and hence we are unable to exploit the benefits of breeding policies completely. Instead of searching for alternate feed resources, researchers have been continuously trying to find out suitable measures to harvest maximum efficiency from the feeds available locally. At this point growth promoting feed additives such as probiotics or direct fed microbials gain importance.

The growing concern over the use of antibiotics and other growth stimulants in animal feed on human health point of view has resulted in increased interest in evaluating the effect of direct fed microbials or probiotics, which are live microbial feed supplements which beneficially affect the host animal by improving its intestinal microbial balance.

Probiotics include yeast, fungal and bacterial cultures. Ruminant nutritionists and microbiologists have long been interested in manipulating the microbial ecosystem of the rumen to enhance productivity and they have suggested that yeast and fungi were effective in manipulating the rumen ecosystem to enhance animal performance. Most of the results regarding yeast supplementation are in adult cattle and the limited reference explaining results in calves are highly varying.

For this reason a trial was conducted to evaluate the effect of supplementation of yeast culture ("Neutramix-MDY") on growth rate, feed efficiency and digestibility of nutrients in pre-ruminant calves.

Review of Literature

2. REVIEW OF LITERATURE

2.1 Yeast culture supplementation and growth response

2.1.1 Young ruminants

Rittenhouse (1993) was able to accelerate growth rate of yearling steers by providing yeasacc[1026] along with grazed forage and corn diet. Sommart *et al.* (1993) found that the average daily gain was significantly higher in ruminants fed a straw based diet with higher protein level when supplied with yeast. Yadav *et al.* (1994c) observed that the daily body weight gain was higher in buffalo heifers received yeast culture and yeast culture + bypass protein than control animals (645, 712 and 553 grains, respectively) but the difference was significant only for the group fed yeast + bypass protein.

Strzetelski *et al.* (1995) reported from their studies on the effect of different strains of liquid yeast culture on growth performance of calves fed a basal ration comprised of whole milk, concentrate mixture and meadow hay that all strains of yeast culture improved weight gain. The highest body weight gain was obtained for the group fed *Saccharomyces cerevisiae* SK-1 strain. In a second study, Strzetelski *et al.* (1996) observed that the body weight gain in 7 to 80 day old calves increased considerably with addition of yeast culture, to a basal diet containing barley or triticale as a starch source.

Yadav *et al.* (1996) found that the live weight gain was non-significant in young buffaloes of 7.3 months of age and the same was significantly higher for pre-pubertal heifers (16 months of age) when both the age groups were given diets supplemented with yeast and protected protein.

Body weight gains of 476 g/day and 492 g/day were observed by Singh *et al.* (1998) in calves fed control and yeast supplemented diet. Malik and Sharma (1998) also observed an increase in body weight gain in calves fed a ration supplemented with a mixed probiotic containing *Saccharomyces cerevisiae* and *Lactobacillus acidophilus.* The values were 376.5 g/day and 466.2 g/day for control and treatment group respectively. The final body weight was 14.31% higher in probiotic supplemented group (76.7 ± 3 Vs. 67.1 ± 4.8).

However, in experiments conducted by Adams *et al.* (1981) in steers to determine the effect of yeast culture, sodium bicarbonate and monensin on growth performance, the mean final weight and average daily gain were similar for all treatment groups compared with that of control. Similarly, Windschitl (1991) found that the initial and final body weights of calves were unaffected by addition of a probiotic (Frastrack TM) containing yeast to their ration. Also there was no significant effect on total gain and average daily gain.

Cole *et al.* (1992) studied the effect of supplementation of yeast culture in stressed steer calves, steers and lambs in four different experimental trials. According to their observations, daily gain in body weight was not influenced by the supplementation in steer calves and lambs. Steers challenged with

Infectious Bovine Rhinotracheitis Virus (IBRV) were fed with yeast supplemented diet post inoculation and they tended to loose less weight than the control animals.

No significant difference was observed by Mutsvangwa *et al.* (1992) in the live weight gains of bulls calves fed a ration supplemented with yeast culture. Quigley *et al.* (1992) also obtained similar non-significant effects on body weight gain when young calves were given sodium bicarbonate and yeast culture along with calf starter in two different experimental trials.

Mir and Mir (1994a) compared the effect of dietary supplementation of yeast culture and lasalocid individually and in combination on growth performance of steers and observed that yeast culture addition resulted in consistent but non-significant increase in average daily gain and final body weight. In another trial, Mir and Mir (1994b) found that yeast culture supplementation did not improve average daily gain significantly in steers fed three different types of diets (75% alfalfa + 24% rolled barley, 94% corn silage + 4% soyabean meal and 25% alfalfa hay + 74% rolled barley). The average daily gain of corn silage + soyabean meal diet group supplemented with yeast tended to be lower than the control steers. Yadav *et al.* (1994d) also observed a higher but non-significant gain in body weight in baffalo calves given yeast culture and yeast culture + bypass protein.

Probiotics like *Saccharomyces cerevisiae*, Lactic acid bacilli and *Bacillus cereus* did not improve live weight gain in German and Argentine

Holstein calves (Daenicke *et al.*, 1999; Monti and Tarabla, 1999). Cabrera *et al.* (2000) also reported a non-significant difference in growth performance in grazing steers fed diet supplemented with yeast culture. Pandey and Agrawal (2001) studied the effect of yeast culture on body weight gain in crossbred calves and reported that there was a non-significant increase in average daily gain in yeast fed animals (350.65 ± 21.75 and 368.36 ± 18.4 for control and treatment respectively).

2.1.2 Adult ruminants

Robinson (1997) conducted trials in pre-partum and post partum cows using diets with and without yeast culture and found that yeast supplemented cows lost less body condition pre-partum which was consistent with numerically higher live weight gain. Soltan *et al.* (1998) determined the effect of supplementation of Cel-con (*Saccharomyces cerevisiae* culture) on body weight in bulls. They observed that dietary Cel-con supplementation significantly increased body weight after 6 weeks of feeding.

On the contrary, Arambel and Kent (1990) reported that there was no significant difference in mean body weight when lactating cows were fed a diet with and without supplemented yeast. Kellems *et al.* (1990) also observed almost similar results in lactating cows fed yeast, fungus and their combination. Alikhani *et al.* (1992) and Piva *et al.* (1993) also obtained similar results in lactating ruminants. Huhtanen and Hissa (1996) and El-Hassan *et al.*

(1996) observed that inclusion of yeast culture to the diet had no significant effect on live weight gain in bulls.

Hadjipanayiotou *et al.* (1997) reported a greater body weight loss in dairy goats and ewes fed diets supplemented with yeast culture.

2.1.3 Other species

Onifade *et al.* (1999) found that addition of yeast culture to the basal diet of rabbits linearly increased the body weight and body weight gain. The highest values were obtained in rabbits fed yeast culture at the rate of 3 g/day.

Inclusion of live yeast culture in the ration of commercial broilers did not produce any significant effect on live weight gain (Yadav *et al.*, 1994a). No significant difference was observed by Kamra *et al.* (1996) in live weight gain of New Zealand white rabbits given diets supplemented with live yeast culture. Quintero *et al.* (1996) reported that the difference in live weight and daily gain was not significant between pigs supplemented with a mixed probiotic containing *Streptococcus faecium, Lactobacillus acidophilus* and *Saccharomyces cerevisiae* and unsupplemented control group.

2.2 Yeast culture supplementation and dry matter intake

2.2.1 Young ruminants

Adams *et al.* (1981) studied the effect of yeast culture, sodium bicarbonate and monensin in ruminally cannulated steers fed a basal diet with 50 per cent concentrate and 50 per cent roughage. They observed that the dry matter intake (DMI) was higher in yeast and sodium bicarbonate fed steers. In another study, Mutsvangwa *et al.* (1992) determined the effect of yeast culture on DMI in crossbred bull calves and observed that the DMI during the trial period was 5.32 ± 0.29 and 5.55 ± 0.28 kg/day, for the control and the treatment group respectively. Malik and Sharma (1998) reported that the DMI was significantly higher in crossbred calves fed a mixed probiotic containing yeast and almost similar results were reported by Pandey and Agrawal (2001) in calves fed yeast culture alone.

Cole *et al.* (1992) conducted four different trials to determine the effect of yeast culture on performance of feeder calves and lambs. In trial one and two steer calves were transported for a period of 28 and 18 hours and then their performances were assessed for 56 days and the DMI was found to be statistically non-significant. In the third trial,healthy steers were challenged with IBRV and then fed a control diet without yeast and a treatment diet with 0.75 per cent yeast culture. Calves fed yeast culture had significantly higher dry matter intake than controls after IBRV inoculation.

Mir and Mir (1994a) reported that the dry matter intake of steers fed alfalfa based diet supplemented with yeast culture and lasalocid was significantly different between control and treatment group. At the same time when yeast and lasalocid alone and in combination were supplemented with corn silage based and dry rolled barley based diets they observed a non-significant numerical increase in the DMI of steers under treatment groups.

Mir and Mir (1994b) conducted two experiments over two years sequentially with high forage and high grain diets with or without added yeast culture. They observed that the dry matter intake was exactly similar in both the experiments.

Plata *et al.* (1994) observed that the DMI was not affected by addition of *Saccharomyces cerevisiae* to the diets of Holstein steer. Chiquette (1995) also found that the dry matter consumption in steers remained unaffected by different dietary treatments such as control diet, control diet + 10 g head^{-1} day^{-1} of *Saccharomyces cerevisiae* + 3 g head^{-1} day^{-1} of *Aspergillus oryzae* fermentation extract.

2.2.2 Adult ruminants

Wohlt *et al.* (1991) conducted lactation experiments in primiparous Holstein cows beginning 30 days prior to their scheduled parturition date through week 18 of lactation. The decrease in dry matter intake normally associated with calving occurred in control and treatment groups, but the extent of reduction in intake was lesser in cows supplemented with yeast culture. After calving, increase in DMI tended to be greater in cows fed yeast compared with those fed the control diet, averaging 14.9 vs 13.8 kg/day ($P<0.002$).

Mpofu and Ndlovu (1994) from their in vivo experiment in sheep concluded that the dry matter intake in sheep fed diets supplemented with yeast, fungi and a combination of yeast and fungi was significantly higher than that of controls. The percentage increase in DMI over control animals were 6, 1 and 20 per cent with yeast, fungi and their combination, respectively.

Arambel and Kent (1990) found that the addition of yeast culture to the diets of lactating cows had no effect on dry matter intake. Piva *et al.* (1993) reported that the dry matter intake in mid lactation cows was unaffected by supplementation of yeast culture to the diet. Almost similar results were reported by Yoon and Stern (1996) in cows fed yeast, fungi and their combination

Hadjipanayiotou *et al.* (1997) reported that the dry matter consumption in dairy goats and ewes remained unaffected by addition of yeast culture to their diet. The extent of depression in dry matter intake pre-partum and the rate of increase in dry matter intake in post-partum in cows were not influenced by yeast culture supplementation (Robinson, 1997).

2.2.3 Other species

Onifade *et al.* (1999) observed a linear and significant increase in dry matter consumption in rabbits fed a diet supplemented with yeast at the rate of 1.5 g/kg and 3 g/kg of feed.

Yadav *et al.* (1994a) reported that the cumulative feed consumption in commercial broilers was unaffected by addition of yeast culture to their ration. Kamra *et al.* (1996) found that the addition of yeast culture to the diets of New Zealand white rabbits produced no significant effect on feed intake.

In contrary to the above response, Windschitl (1991) observed a slightly lower dry matter intake (P<0.14) in calves fed diet containing yeast. Quigley *et al.* (1992) conducted similar experiments in ruminally cannulated and intact calves and found that the DMI was lower in cannulated calves.

2.3 Feed efficiency

2.3.1 Young ruminants

Yadav *et al.* (1994b) observed that the feed efficiency value was better for Murrah buffalo calves fed yeast culture compared with that of control animals. Dietary supplementation of a mixed probiotic containing *Lactobacillus acidophilus* and *Saccharomyces cerevisiae* had resulted in a higher feed conversion efficiency in young calves. The values were 2.1 ± 0.3 and 1.7 ± 0.1 for control and supplemented group respectively (Malik and Sharma, 1998).

Adams *et al.* (1981) reported that the feed conversion efficiency was not influenced by addition of yeast culture to the diet of steers. Similar observations were made by Windschitl (1991) in Holstein heifer calves fed yeast culture along with hay and silage based diet.

Cole *et al.* (1992) studied the effect of yeast culture in stressed steer calves in two different experimental trials and reported that the feed to gain ratio was unaffected by yeast supplementation. Mutsvangwa *et al.* (1992) also observed that the efficiency of feed conversion did not differ between yeast supplemented and unsupplemented bull calves.

Quigley *et al.* (1992) reported that no significant differences in efficiency of gain were observed when calves were fed yeast culture and sodium bicarbonate. Inclusion of yeast culture and lasalocid alone and in combination did not produce any significantly different effect on feed to gain ratios in steers fed alfalfa silage or corn silage and dry rolled barley based diets (Mir and Mir, 1994a).

Yadav *et al.* (1994d) from their studies in buffalo heifers observed that the feed efficiency was non-significantly improved by feeding yeast and yeast + protected protein, whereas, Singh *et al.* (1998) observed similar feed to gain ratio in control and yeast fed animals. A feed to gain ratio of 9.07 ± 0.25 and 8.91 ± 0.35 were observed in control and yeast supplemented calves which was statistically non significant (Pandey and Agrawal, 2001).

2.3.2 Adult ruminants

Soltan *et al.* (1998) observed that Cel-con (*Saccheromyces cerevisiae* culture) markedly improved feed conversion efficiency in bulls.

2.3.3 Other species

Onifade *et al.* (1999) reported that the feed conversion efficiency was higher for rabbits fed yeast culture at the rate of 3 g and 1.5g/kg feed, the highest significant values for feed efficiency being obtained with 3g yeast/kg diet.

2.4 Yeast culture supplementation and nutrient digestibility

2.4.1 Young ruminants

Kumar *et al.* (1994) studied the influence of yeast on rumen degradability by *in sacco* methods in buffalo calves. They observed that supplementation of yeast culture resulted in an increase in *in sacco* dry matter disappearance. Plata *et al.* (1994) conducted experiments in six groups of steers using rations with three different levels of oat straw (40%, 60% and 80%) and the three treatment groups were supplemented with *Saccharomyces cerevisiae* (Yea-Sacc[1026]). They observed that there was no significant interaction between oat straw level in the ration and addition of yeast culture, since the addition improved neutral detergent fibre (NDF) digestion in all the three treatment groups.

Pandey and Agrawal (2001) reported that the dry matter (DM), NDF and acid detergent fibre (ADF) digestibilities were significantly higher in calves of three to seven months of age fed a diet supplemented with Biovet Yc containing *Lactobacillus sporegenes* and *Saccharomyces cerevisiae*. The crude protein digestibility was numerically higher but was non-significant.

Windschitl (1991) found that there was no statistical difference with regard to total tract digestibility of DM, OM, protein and fibre when calves were fed a basal ration supplemented with a probiotic containing yeast. When brome grass hay was included in the basal diet, a numerical increase in ADF digestibility was observed. Almost similar observations were reported by Mutsvangwa *et al.* (1992) in apparent digestibility of OM, DM, CP and NDF in bull calves of three months of age during the experimental study.

Effect of addition of live yeast culture (*Saccharomyces cerevisiae*) on DM, CP, ADF and NDF digestibility in steers fed high grain and high forage diet was studied by Mir and Mir (1994b) and they opined that there was no significant difference between digestibility values among control and treatment groups.

Moloney and Drennan (1994) reported that DM, OM, ADF and NDF digestibility were unaffected by dietary inclusion of yeast culture in steers. They observed an interaction between yeast and diet type with respect to crude protein digestibility. Yeast culture did not affect crude protein digestibility when included in a low fibre high protein diet but decreased crude protein digestibility when included in high fibre low protein diet. Singh *et al.* (1998) also reported that there was no significant effect of yeast culture on nutrient digestibility in calves. Cabrera *et al.* (2000) from their studies in growing steers grazing tropical pasture supplemented with *Saccharomyces cerevisiae* reported that the supplementation did not improve total tract ADF and NDF digestibility.

2.4.2 Adult ruminants

Wiedmeier *et al.* (1987) conducted trials in lactating dairy cows and observed that yeast culture alone and in combination with fungal cultures increased digestibility of DM, crude protein (CP) and hemicellulose significantly while the ADF digestibility values remained unaffected. Mpofu and Ndlovu (1994) conducted *in vitro* experiments with rumen liquor from cannulated steers and *in vivo* experiments in sheep to determine the effect of *Saccharomyces cerevisiae* and white rot fungi alone and in combination. In *in vitro* experiments, NDF digestibility values were significantly higher for yeast and fungi alone and in combination, highest values for NDF digestibility being obtained with combined treatment. In *in vivo* experiments in sheep also the NDF digestibility values were higher with the microbial supplements. Yoon and Stern (1996) found that yeast culture (*Saccharomyces cerevisiae*) when included in the diets of lactating cows improved apparent ruminal organic matter (OM) digestion by 18.6 per cent and ruminal true OM digestion by 12.1 per cent compared with that of the unsupplemented group. Ruminal crude protein digestion was higher for yeast fed cows but NDF, ADF, cellulose and hemicellulose digestion were similar for the control and the treatment group.

Adams *et al.* (1981) from their trials in lambs reported that addition of yeast culture to the ration had no significant effect on digestibility of DM, OM, CP and ADF.

Lal *et al.* (1987) carried out two different experiments in rams and bulls to assess the effect of unwashed dried yeast sludge on digestibility of nutrients. The digestibility of DM, OM, CF and NFE were unaffected by the treatment, but crude protein digestibility was significantly higher and ether extract digestibility was significantly lower in treatment group compared with control. Harrison *et al.* (1988) reported that addition of yeast culture to the diet of lactating cows did not affect apparent digestibility of DM, NDF, ADF, hemicellulose and starch. Arambel and Kent (1990) also had similar observations in lactating cows fed yeast culture.

Chademana and Offer (1990) observed that yeast culture had no significant effect on overall diet digestibility in sheep. In a lactation study Wohlt *et al.* (1991) observed that the digestibility of DM, NDF, ADF and hemicellulose were not influenced by supplementation of yeast culture at the rate of 10 g/day. At the same time crude protein and cellulose digestibility tended to be improved by yeast supplementation. The values for crude protein digestibility were 73.8 per cent and 75.4 per cent, respectively for control and treatment group. Chiquette (1995) found that the digestibility of DM, OM, ADF and NDF were similar when sheep were given a diet supplemented with direct fed microbials such as yeast, fungi and their combinations.

Degradation of DM, NDF and ADF of hay suspended in rumen of lactating cows using nylon bags was unaffected by introduction of yeast culture. But a non-significant trend towards lower degradation of NDF and

ADF during the first 12 hours of incubation and a greater degradation from 48 hours was observed with yeast culture diet (Enjalbert *et al.*, 1999).

2.4.5 Other species

Kamra *et al.* (1996) opined that induction of yeast culture to the diets of New Zealand White rabbits produced no significant difference in digestibility values of DM, NDF, ADF, cellulose and hemicellulose. At the same time crude protein digestibility was improved by feeding a mixed culture of yeast and Lactobacillus.

2.5 Haematology

2.5.1 Young ruminants

A reduction in plasma glucose level (69.4 ± 2.6) was observed in Holstein heifer calves fed a diet containing mixed probiotic with yeast as against those fed a control diet without probiotics (76.6 ± 2.6) (Windschtl, 1991).

Quigley *et al.* (1992) studied the effect of sodium bicarbonate and yeast culture on blood metabolites in *ad libitum* fed and limit fed calves. In limit fed calves they observed an increase in blood glucose when bicarbonate was fed, whereas the concentration declined with yeast and control diet, the values obtained being 4.28, 4.68 and 4.08 mM for control, bicarbonate fed and yeast fed calves.

2.5.2 Adult ruminants

Kar *et al.* (1994) found that the blood glucose level was significantly lower in lactating buffaloes fed yeast (581.8 mg/l) and yeast + bypass protein (605.2 mg/l) than in the control groups (627.5 mg/l), whereas plasma protein levels were marginally but not significantly higher in treatment groups compared with the control.

Piva *et al.* (1993) reported that addition of yeast culture to the diet of midlactation cows had no significant effect on blood plasma components such as total plasma protein, plasma glucose, Ca and P. The values for control and treatment groups were 3.95 and 4.2 mmol/l plasma glucose, 83.8 and 87.3 g/l for plasma protein, 2.1 and 2.78 mmol/l for plasma calcium and 1.74 and 1.67 for plasma phosphorus. Blood glucose level in buffalo calves was not influenced by supplemental feeding of yeast culture or yeast culture and bypass protein (Yadav *et al.*, 1994b). But the level of total plasma protein was significantly higher (66.2 g/l) in calves fed yeast culture than in control (62.4 g/l).

Materials and Methods

3. MATERIALS AND METHODS

The present study was conducted at the University Livestock Farm, of Kerala Agricultural University located at Mannuthy.

3.1 Animals

Twelve calves of one week to one-month of age were selected from the University Livestock Farm. These animals were housed in individual calf pens with separate feeding and watering facility. All the animals were maintained under identical feeding and management conditions. The animals were divided into two groups, the control and the treatment group, as uniformly as possible with regard to age, sex and body weight. Animals were dewormed one week before the beginning of the experiment and regular monthly deworming was practiced up to the end of the experimental period. The duration of the experiment was five months.

3.2 Experimental ration

The calves of the two groups were allotted to the control and treatment diet. The control ration comprised of calf starter, green grass and milk. Calf starter was compounded in the farm and the ingredient composition is given in Table 1. Measured quantity of calf starter and green grass were provided at the beginning of the experiment. Milk was fed at the rate of $1/10^{th}$ of body weight during the first month and the rate of feeding was reduced gradually according to the intake of solid feed by the animal. Milk feeding was stopped completely when the animal attained three months of age. The treatment group was fed with control ration supplemented with dried yeast, "Neutramix-MDY"[a] @20g/day/ calf. The samples of calf starter and green grass used for feeding were analyzed regularly for chemical composition during the course of the experiment.

3.3 Methods

Calves were fed required quantity of milk at 8 AM and 3.30 PM. Calf starter was fed in the morning immediately after milk feeding. "Neutramix-MDY" was mixed daily with calf starter given to the experimental group. At the beginning of the experiment, grass was fed once daily and towards the middle of the experiment, feeding frequency was increased to twice daily. Individual records of daily intake of calf starter, milk and green grass were maintained throughout the experimental period. The left over portion of calf starter and grass were weighed everyday and their moisture contents were analyzed. Drinking water was made available *ad libitum* at all times. Body weights were recorded at fortnightly intervals. The feed offered was revised every fifteen days to ensure that the animal's requirements were met.

3.4 Digestibility coefficient

Two digestibility trials were conducted during the 11th and 20th weeks of the experiment with collection periods of five days each. Representative

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a "Neutramix-MDY" – Product of Burns Philip India samples of calf starter, grass and "Neutramix-MDY" were taken everyday during the trial for analysis. The balance of feed and grass samples were also collected from individual pens and their moisture contents were determined everyday. At the end of collection period the feed samples collected daily were pooled and sub-samples were taken for analysis. Manual collection of dung was done as and when it was voided. All precautions were taken to collect the dung quantitatively uncontaminated by urine, feed residue or dirt.

The dung collected each day was weighed and representative samples were taken at the rate of 10% of voided quantity after mixing it thoroughly. The samples were taken in double lined polythene bags and stored in a deep freezer. The process of collection, weighing and sampling of dung were continued for five days. At the end of collection period the dung samples stored in deep freezer were taken out and the samples collected each day from each animal were pooled and mixed thoroughly. From that sub-samples were taken for analysis. The feed samples (calf starter and green grass) were analyzed for dry matter, crude protein, crude fibre, ether extract, total ash, acid insoluble ash, calcium, inorganic phosphorus, acid detergent fibre, acid detergent lignin (A.O.A.C.,1990) and neutral detergent fibre (VanSoest and Wine, 1967). Similarly dung samples were analyzed for dry matter, crude protein, total ash, acid insoluble ash, acid detergent fibre and neutral detergent fibre. "Neutramix-MDY" was analyzed for dry matter, crude protein, ether extract, total ash, acid insoluble ash, calcium and inorganic phosphorus. Data obtained from digestion trial were used for the calculation of digestibility co-efficient of dry matter, crude protein, neutral detergent fibre and acid detergent fibre.

3.5 Haematological studies

Blood samples were collected at the beginning and at monthly intervals. Sterile test tubes containing sodium fluoride as anticoagulant were used for blood collection and plasma was separated immediately after each collection. About 3 ml of whole blood was kept aside from each tube for blood glucose estimation (Folin and Wu, 1920). Plasma was then analyzed for levels of calcium (Clark and Collip, 1925), inorganic phosphorus by modified metol method using kits supplied by Qualigens diagnostics and plasma protein by Biuret Method (Gornall *et al.*,1949).

3.6 Statistical analysis

The data obtained were subjected to statistical analysis using the standard statistical procedures by Snedecor and Cochran (1980).

Table 1. Ingredient composition of calf starter

Ingredient	Percentage composition
Soya bean meal	40
Wheat bran	22
Yellow maize	30
Unsalted dried fish	6
Mineral mixture	2

To each 100 kg of the above mixture common salt @ 0.5 kg and Vitamin A, B2, D3 (Indomix – manufactured by Nicholas Pirmal India Limited containing 40,000 IU of Vitamin A, 20 mg of Vitamin B_2 and 5,000 IU of Vitamin D_3 per gram) @ 20 g per kg were added.

Results

4. RESULTS

The results obtained in the present study are described under the following topics.

4.1 Chemical composition

The average chemical composition of calf starter, green grass and dried yeast ("Neutramix–MDY") are presented in Table 2. Representative samples of milk fed to calves were analyzed for fat, total solids and solids not fat, the values being 3.50 ± 0.04, 11.90 ± 0.11and 8.40 ± 0.13 per cent respectively.

4.2 Body weights

The mean fortnightly body weights of calves are presented in Table 3 and Fig.1. Data were analyzed statistically by covariance analysis and are presented in Table 4. The average final body weights were 72.5 ± 3.26 and 76.2 ± 4.22 kg respectively, for the animals of control and treatment group.

4.3 Average daily gain

Summarized data on body weight, total gain and average daily gain of animals of control and treatment group are listed in Table 5. Data on average daily gain of calves are presented in Fig.2.

4.4 Dry matter intake

The average monthly dry matter intake is presented in Table 6 and Fig.3. Summarized data on total dry matter consumption and average daily dry matter consumption are presented in Table 7.

4.5 Feed to gain ratio

The feed to gain ratios of the calves were 4.94 and 4.60 for the control and experimental group respectively, and is given in Table 7.

4.6 Digestibility coefficients

Data on chemical composition of dung sample collected during the digestibility trials are presented in Table 8. Digestibility coefficients of dry matter, crude protein, neutral detergent fibre and acid detergent fibre of the two digestibility trials are set out in Table 9 and shown in Fig.4 and 5.

4.7 Hematological parameters

The blood parameters such as plasma calcium, phosphorus, protein and blood glucose recorded at monthly intervals are set out in Table 10 and the data on blood glucose level of the experimental animals are shown in Fig.6.

Table 2. Percentage chemical composition of calf starter, grass and "Neutramix-MDY" fed to calves

Items	Calf starter	Grass	Neutramix-MDY
Dry matter	90.40 ± 0.65	16.08 ± 1.49	90.60 ± 0.02
Crude protein	26.29 ± 0.84	14.73 ± 0.36	37.65 ± 1.76
Crude fibre	8.34 ± 0.25	26.09 ± 0.75	--
Ether extract	3.47 ± 0.12	3.02 ± 0.12	2.62 ± 033
Total ash	11.52 ± 0.42	10.67 ± 0.42	12.49 ± 0.28
Nitrogen free extract	50.77 ± 1.25	29.87 ± 0.89	--
Acid insoluble ash	5.28 ± 0.34	2.47 ± 0.30	0.58 ± 0.04
Calcium	0.72 ± 0.02	0.45 ± 0.01	5.68 ± 0.27
Phosphorus	0.64 ± 0.01	0.31 ± 0.09	1.29 ± 0.08
Neutral detergent fibre	34.30 ± 2.37	68.56 ± 0.82	--
Acid detergent fibre	16.18 ± 1.16	37.48 ± 1.80	--
Acid detergent lignin	2.42 ± 0.61	5.53 ± 0.46	--

Table 3. Average fortnightly body weights (kg) of experimental animals

Fortnight	Control	Treatment
0	37.6 ± 0.42	35.1 ± 2.16
1	39.8 ± 3.10	38.6 ± 2.12
2	43.6 ± 3.10	42.0 ± 1.79
3	45.7 ± 3.25	44.6 ± 2.14
4	52.0 ± 3.20	50.4 ± 2.40
5	58.4 ± 3.20	57.7 ± 2.62
6	58.4 ± 3.20	57.8 ± 2.81
7	61.9 ± 3.08	60.0 ± 1.96
8	64.5 ± 3.09	64.3 ± 3.44
9	69.7 ± 3.34	70.6 ± 4.02
10	72.5 ± 3.26	76.2 ±4.22

Fig.1. Fortnightly body weights of experimental animals

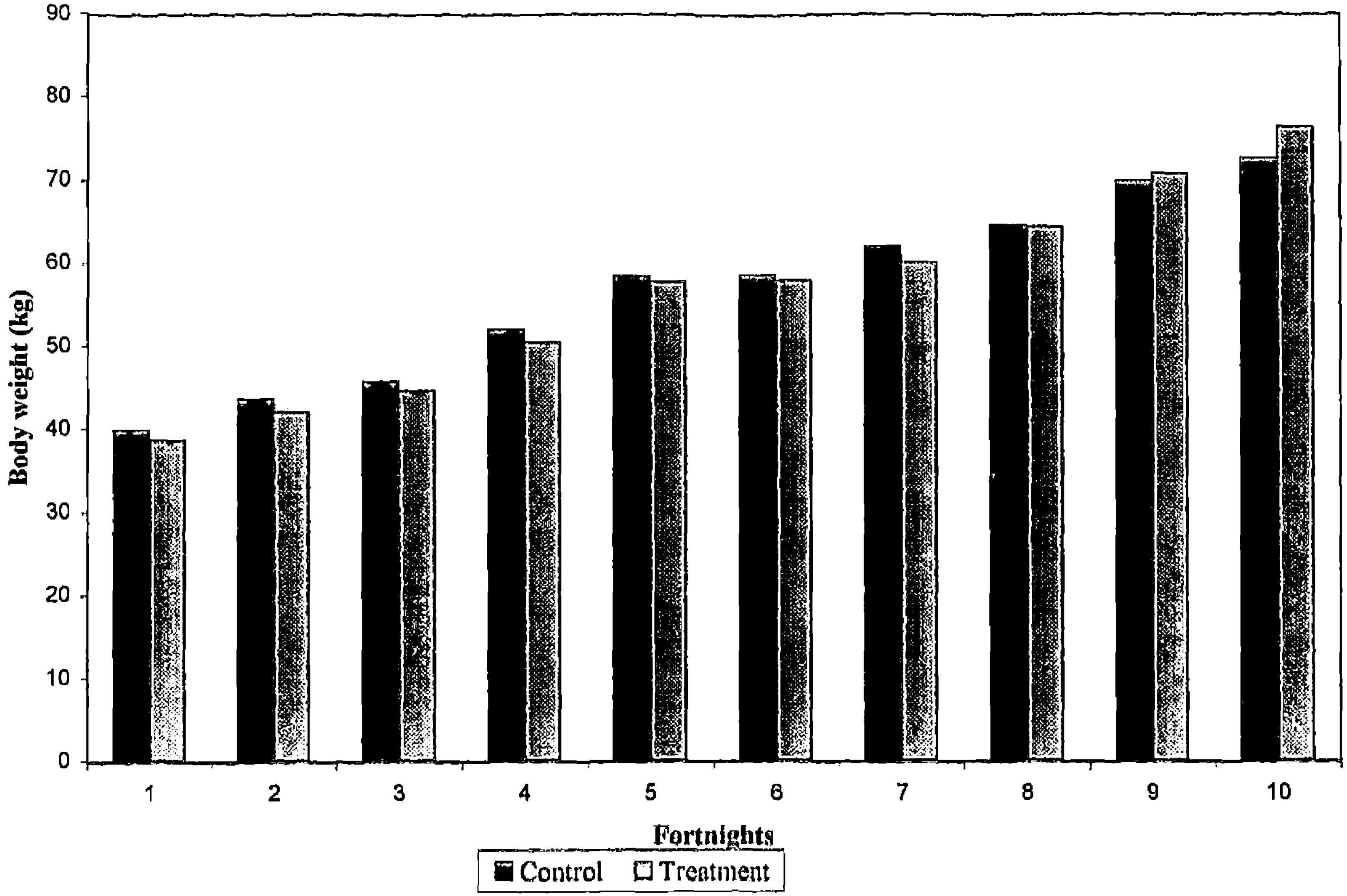


Table 4. Analysis of covariance of body weights of experimental animals recorded at fortnightly intervals

Fortnights	Mean sum of squares			Probability
	Groups	Covariate	Error	
1	0.278	398.461	15.776	—
2	0.112	430.830	1.573	—
3	0.184	424.474	7.025	—
4	0.690	350.441	18.058	—
5	0.952	322.048	22.154	—
6	0.852	295.705	24.735	—
7	3.498	393.621	34.223	—
8	12.039	340.395	55.298	—
9	72.497	358.128	67.603	0.3274

Table 5. Summarized data on body weight, total gain and average daily gain of experimental animals

Parameters	Control	Treatment	F value
Initial body weight (kg)	36.62 ± 2.30	35.08 ± 2.16	0.24 (N S)
Final body weight (kg)	72.5 ± 3.26	76.2 ± 4.22	0.43 (N S)
Total gain (kg)	35.83 ± 2.78	41.12 ± 3.76	1.28 (N S)
Average daily gain (g)	247 ± 0.01	284 ± 0.02	0.34 (NS)

NS-Non significant (P>0.05)

Fig.2. Average daily body weight gain of experimental animals

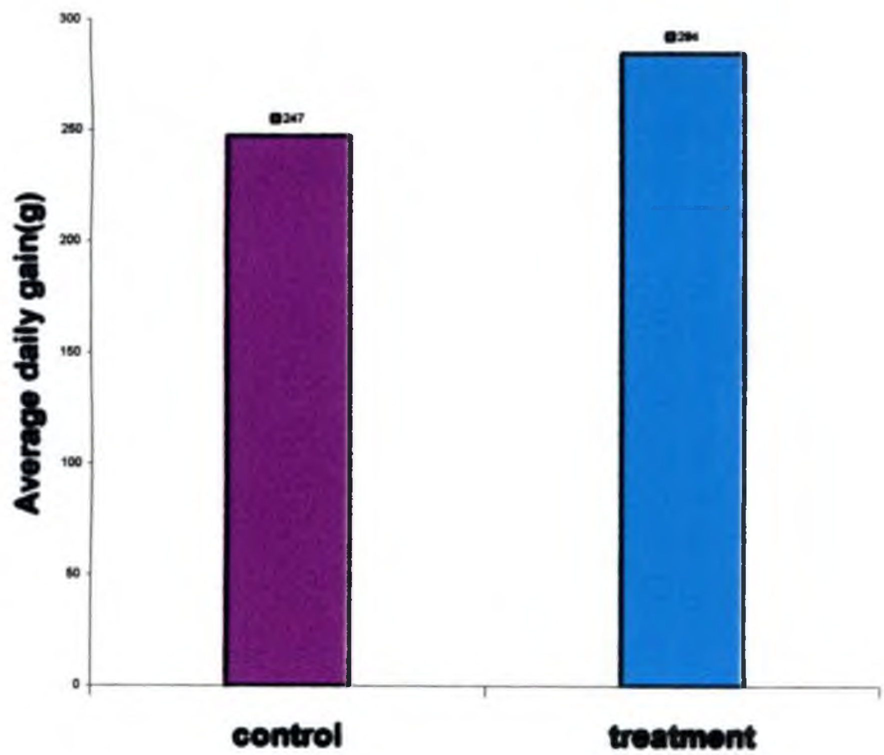


Table 6. Average monthly dry matter intake of experimental animals

Month	Dry matter intake (kg)		F value
	Control	Treatment	
1	12.00 ± 0.40	11.61 ± 0.89	0.17 (NS)
2	18.12 ± 0.61	17.48 ± 0.78	0.42 (NS)
3	30.84 ± 0.74	30.79 ± 0.89	0.001(NS)
4	49.93 ± 1.77	51.06 ± 1.82	0.20 (NS)
5	61.98 ± 1.61	62.16 ± 1.57	0.006 (NS)

NS-Non significant – (P>0.05)

Fig.3. Average monthly drymatter intake of experimental animals

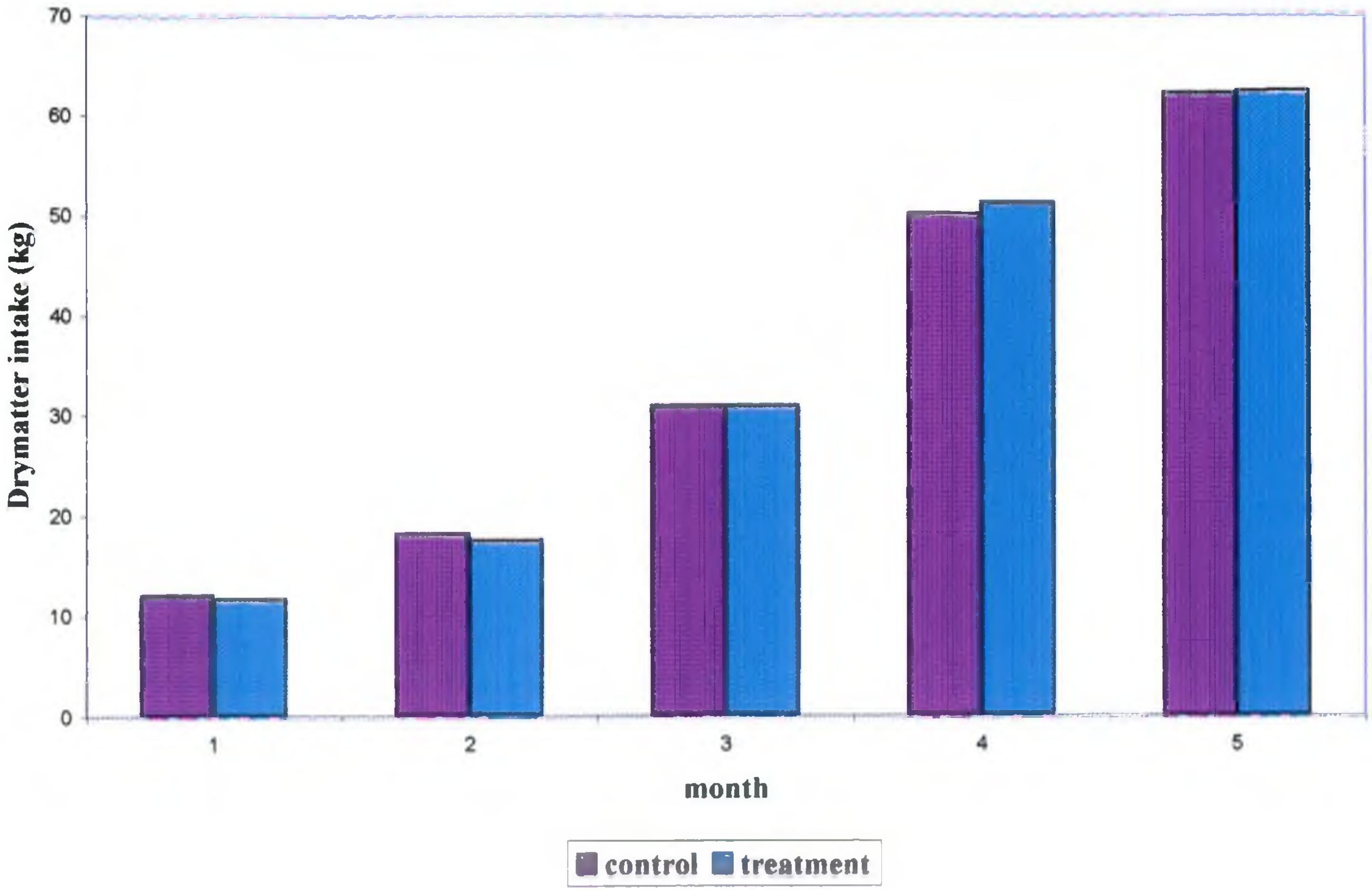


Table 7. Summarized data on total dry matter consumption and feed to gain ratio of calves fed the control and the experimental ration

Parameters	Control	Treatment	F value
Total dry matter consumed (kg/animal)	171.91 ± 4.93	173.10 ± 4.70	0.03 (NS)
Average daily dry matter consumed (kg/animal)	1.19 ± 0.03	1.18 ± 0.03	0.17 (NS)
Dry matter consumed/100 kg body weight (kg)	2.74 ± 0.10	2.63 ± 0.08	0.87 (NS)
Feed to gain ratio	4.94 ± 0.41	4.60 ± 0.44	0.81 (NS)

NS-Non significant - ($P>0.05$)

Table 8. Percentage chemical composition of dung samples of calves fed the control and the experimental ration in trial 1 and 2

Items	Dung First trial		Dung Second trial	
	Control	Treatment	Control	Treatment
Dry matter	23.68 ± 0.78	23.62 ± 1.02	22.93 ± 0.90	24.46 ± 0.61
Crude protein	18.09 ± 1.06	18.11 ± 0.81	17.22 ± 0.65	16.33 ± 0.51
Total ash	23.30 ± 0.86	21.93 ± 1.00	21.96 ± 0.23	23.32 ± 1.03
Acid insoluble ash	13.66 ± 0.74	12.15 ± 1.02	13.43 ± 0.77	15.13 ± 0.57
Neutral detergent fibre	58.40 ± 1.69	54.05 ± 1.87	58.77 ± 1.35	59.21 ± 0.80
Acid detergent fibre	36.05 ± 0.66	34.02 ± 1.27	37.63 ± 1.11	38.33 ± 0.61

Table 9. Average digestibility coefficients of nutrients of control and treatment ration in trial 1 and 2

Parameters	First trial		F value	Second trial		F value
	Control	Treatment		Control	Treatment	
Dry matter	76.15 ± 0.79	76.66 ± 1.03	0.15(NS)	71.08 ± 1.67	72.55 ± 2.87	0.05(NS)
Crude protein	75.87 ± 2.05	76.68 ± 1.14	0.12(NS)	79.42 ± 1.18	79.75 ± 0.81	0.01(NS)
Neutral detergent fibre	55.45 ± 2.59	58.06 ± 2.98	0.44(NS)	65.01 ± 1.88	61.66 ± 2.98	0.33(NS)
Acid detergent fibre	42.12 ± 3.60	48.96 ± 3.28	1.97(NS)	55.64 ± 4.39	52.85 ± 4.08	0.12(NS)

NS-Non significant - ($P>0.05$)

Table 10. Plasma calcium, phosphorus, protein and blood glucose levels of experimental animals

Months	Plasma calcium (mg/100ml)		Plasma phosphorus (mg/100ml)		Plasma protein (g/100ml)		Blood glucose (mg/100ml)	
	Control	Treatment	Control	Treatment	Control	Treatment	Control	Treatment
1	10.00 ± 0.72	11.50 ± 1.19	6.86 ± 0.29	5.97 ± 0.24	7.41 ± 0.27	7.62 ± 0.38	102.67 ± 4.18	97.60 ± 8.00
2	10.00 ± 0.20	9.00 ± 1.29	5.10 ± 0.20	6.03 ± 0.31	7.34 ± 0.51	9.11 ± 1.16	90.78 ± 5.65	95.68 ± 4.57
3	9.25 ± 0.48	9.25 ± 0.47	6.57 ± 0.33	6.86 ± 0.32	7.77 ± 0.48	6.47 ± 0.39	93.45 ± 2.59	94.57 ± 5.59
4	9.16 ± 0.92	9.33 ± 1.83	8.40 ± 0.40	7.85 ± 0.64	7.60 ± 0.36	7.17 ± 0.20	85.69 ± 3.19	76.46 ± 1.97
5	11.00 ± 0.60	10.0 ± 0.71	7.82 ± 0.25	8.05 ± 0.32	7.79 ± 0.28	7.72 ± 0.33	60.56 ± 2.55	62.75 ± 1.92

Fig.4. Average digestibility coefficients of nutrients of control and treatment rations in trial one

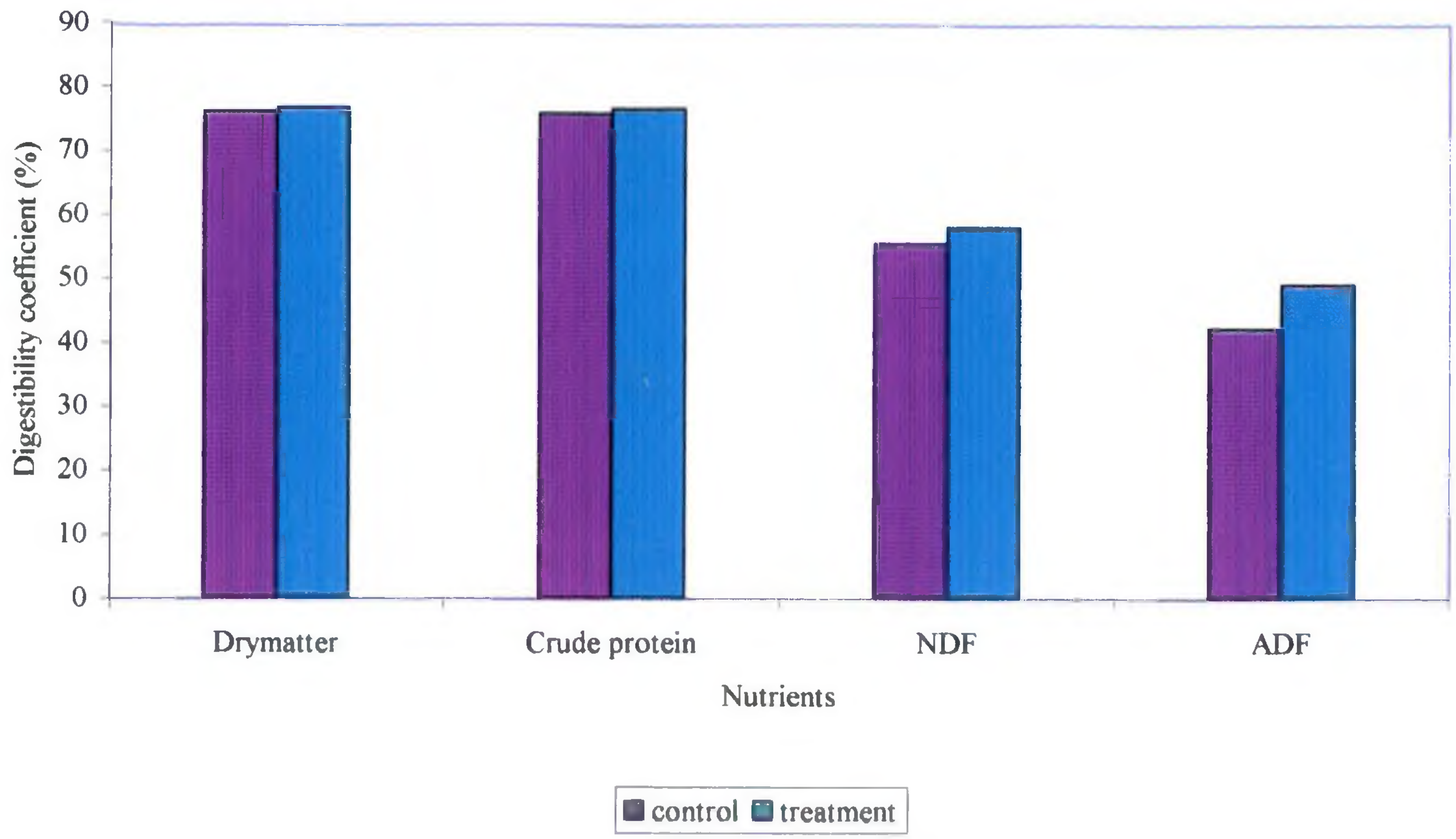


Fig.5. Average digestibility coefficients of nutrients of control and treatment ration in trial two

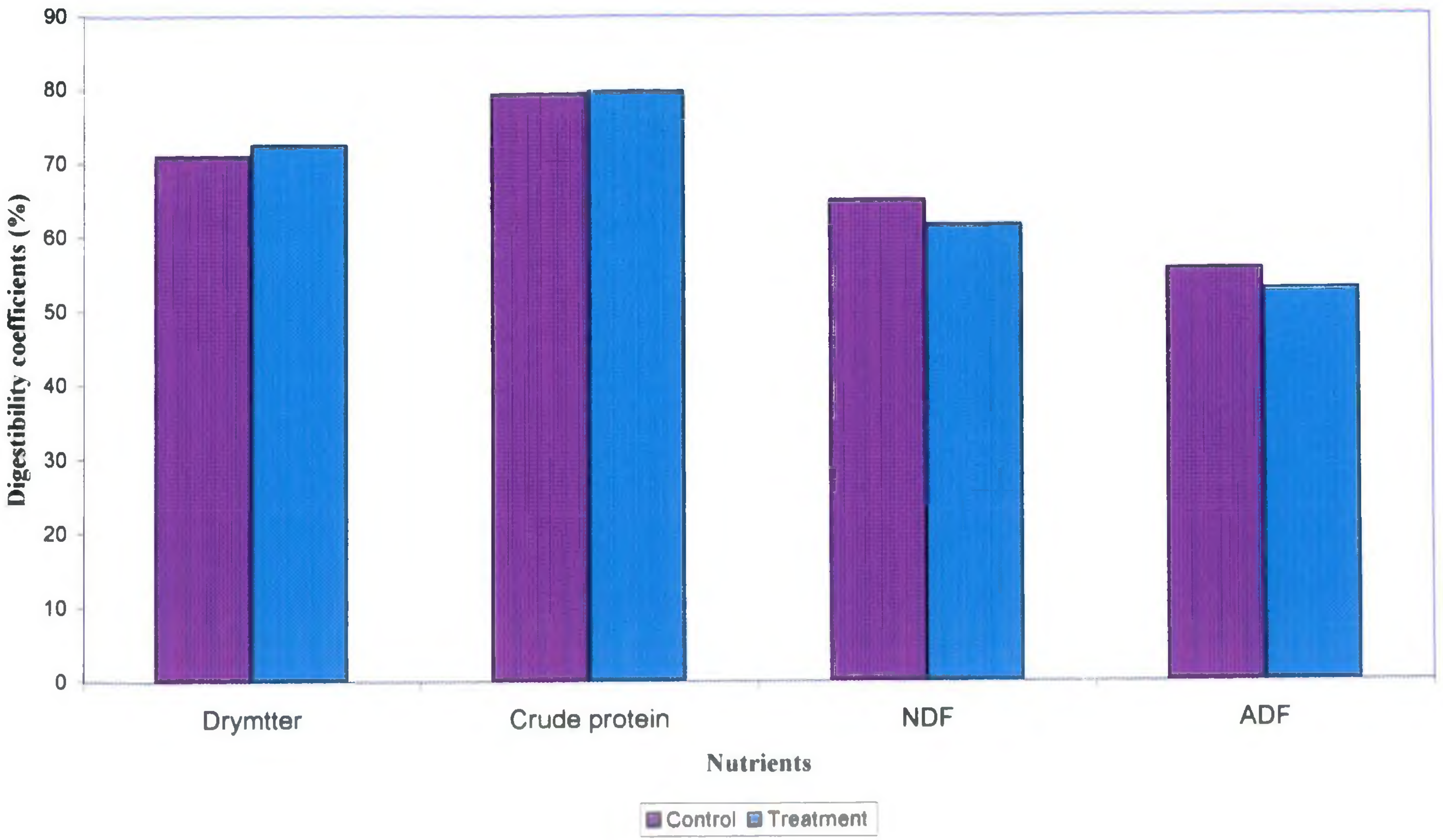
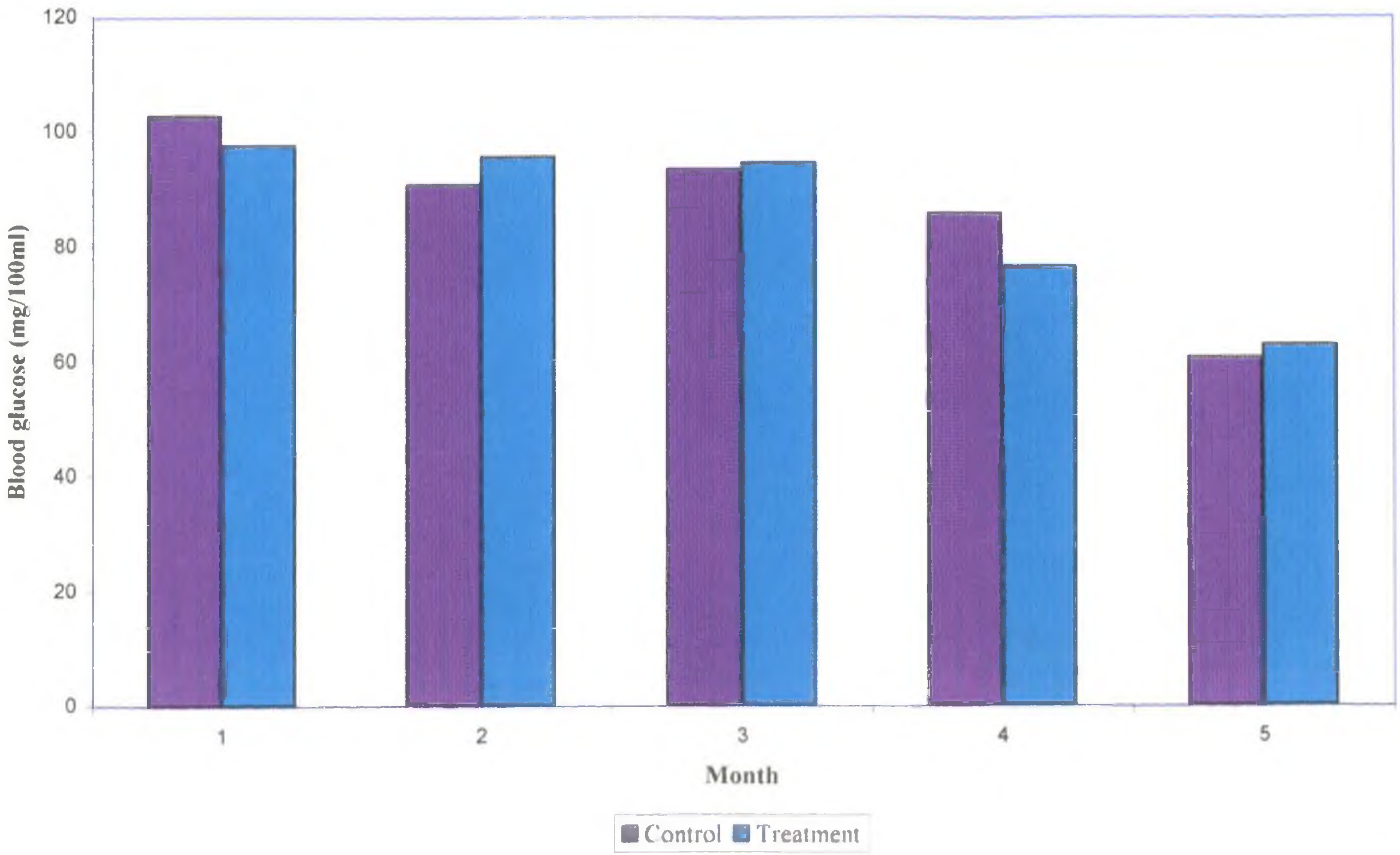


Fig.6. Blood glucose levels of calves fed the control and the treatment diet



Discussion

5. DISCUSSION

5.1 Growth response

From the results presented in Tables 3 and 4, it could be seen that though there was no significant difference in the average fortnightly body weights of calves maintained on control and treatment ration till the end of the eighth fortnight, calves supplemented with yeast culture (@ 20 g/day) tended to show higher body weights than those fed the control ration during the last fortnight, the values recorded in the last fortnight being 72.5 and 76.2 kg (Table 3) for control and treatment group, respectively. The average cumulative gain of animals of control and treatment group was 35.83 and 41.12 kg (Table 5) respectively, during the course of the 145 day trial. Though the values were statistically non-significant, animals of the experimental group had higher numerical values for cumulative gain than that of the control animals. The data presented in Table 5 also reveal that the average daily gain was numerically higher for treatment group (284 g/day) than that of the control group (247 g/day), though not statistically significant.

The results obtained on final weight and average daily gain were in accordance with the results of Pandey and Agrawal (2001). Their study revealed non-significant increase in final body weight (kg) and average daily gain (g/day) in calves fed yeast culture (104.65 and 350.65) over the control animals (109.55 and 398.55). Almost similar responses were reported by Sommart *et al.* (1993) in heifers fed high protein diet, Mir and Mir (1994a) in steers fed yeast culture and lasalocid and Yadav *et al.* (1994d) in buffalo calves given yeast culture and bypass protein.

Non-significant effect on final body weight and average daily gain was observed in steers fed yeast culture, sodium bicarbonate and monensin by Adams *et al.* (1981). Windschitl (1991) also obtained similar results, but the average daily gain was 880g/day for the calves fed control and treatment diet. The above said average daily gain values irrespective of yeast supplementation, are much higher than that obtained in the present study. A live weight gain in bull calves with initial body weight of 133 kg at 3 months of age was 1.43 and 1.45 kg/day for control and yeast fed animals respectively, during the initial seven weeks of the experiment, the difference being statistically non-significant was observed by Mutsvangwa *et al.* (1992). Average daily gain of 330 and 335 g/day were observed in calves fed control and yeast supplemented diet by Quigley *et al.* (1992) is comparable with those of the present study.

Mir and Mir (1994b), Huhtanen and Hissa (1996) and Cabrera *et al.* (2000) also could not find any significant effect in growing steers fed yeast culture.

Many workers reported significantly higher values for average daily gain and mean body weight in animals fed yeast supplemented diets. Rittenhouse (1993) reported accelerated growth rate in grazing steers fed corn diet and Yea-Sacc1026. Higher body weight gain of 712 g/day was reported by Yadav *et al.* (1994c) in buffalo heifers fed yeast culture and bypass protein. In another study, Yadav *et al.* (1996) compared the effect of yeast culture among different age groups of buffaloes and observed that the body weight gain was non-significant at 3 to 7 months of age, whereas the same was significantly higher in pre-pubertal heifers of 16 months of age. Singh *et al.* (1998) observed significantly higher average daily gain of 492 g/day, while Malik and Sharma (1998) observed 466.2 g/day in calves fed yeast culture than that of the control animals.

The differences in average daily gain reported by different workers may be due to the differences in age, breed, climate, type of feed and other managemental factors. The lower average daily gain values obtained in the present study, irrespective of supplementation of yeast may be due to the monezial infestation diagnosed during the middle of the experiment. Two animals from control and two from treatment group were heavily infested and all animals were treated with Praziquental @ 5 mg/kg/day during the course of the experiment.

5.2 Dry matter consumption

The average monthly dry matter consumption of calves of the control and treatment group is presented in Table 6. Average daily dry matter consumption was 1.19 kg/day for control and 1.18 kg/day for treatment group (Table 7). The dry matter consumption/100 kg body weight was 2.74 and 2.63 kg respectively for control and experimental diet fed calves. The total dry matter consumption and average daily dry matter consumption were similar for the control and treatment group and addition of yeast culture had no effect on dry matter intake.

Cole *et al.* (1992) reported similar observations in stressed feeder calves and lambs fed yeast culture. Mir and Mir (1994 a) and Mir and Mir (1994b) observed that the dry matter intake in steers fed alfalfa silage based diet was unaffected by yeast culture supplementation. However they were able to observe a non-significant increase in dry matter intake when steers were given yeast along with dry rolled barley based diet. Arambel and Kent (1990), Plata *et al.* (1994) and Chiquette (1995) also observed similar results in steers fed yeast culture. In adult ruminants also the dry matter intake was unaffected when yeast was added to their diet (Piva *et al.*, 1993; Yoon and Stern, 1996).

A significantly higher dry matter intake was reported by Adams *et al.* (1981) in ruminally cannulated steers fed yeast culture. Mutsvangwa *et al.* (1992), Malik and Sharma (1998) and Pandey and Agrawal (2001) also observed significantly higher dry matter intake in crossbred calves fed diets supplemented with yeast culture.

Wohlt *et al.* (1991) and Mpofu and Ndlovu (1994) observed increase in dry matter intake in adult ruminants fed yeast culture supplemented diet.

In contrast to the above observations, Windschitl (1991) and Quigley *et al.* (1992) observed reduced dry matter intake in calves fed yeast culture.

5.3 Feed efficiency

The average feed to gain ratio obtained in the present study was 4.94 and 4.60 for the control and the yeast fed group respectively, and the values are presented in Table 7. The improvement in feed to gain ratio exhibited by the treatment group was non-significant when analyzed statistically.

Adams *et al.* (1981) reported similar responses in feed to gain ratio of steers fed yeast culture. The value expressed as kg feed/kg gain was 6.42 for control and 6.32 for yeast fed animals. Windschitl (1991) also observed that the feed efficiency was statistically non-significant in control and yeast fed groups. However, as in case of the present study, a consistent numerical difference was noted (5.24 in yeast fed animals as against 5.41 kg fed/kg gain in control animal) during the course of their study.

Mutsvangwa *et al.* (1992) and Quigley *et al.* (1992) also observed non-significant effects on feed efficiency in calves fed yeast culture. Mir and Mir (1994a) from studies in steers fed yeast and lasalocid concluded that yeast supplementation did not improve feed efficiency significantly, but lasalocid increased the same significantly.

Better feed efficiency was reported by Yadav *et al.* (1994d) in yeast fed Murrah baffalo calves. Malik and Sharma (1998) also got similar response in young calves fed yeast culture (2.1 Vs. 1.7).

5.4 Digestibility coefficients of nutrients

Data on the two digestibility trials conducted to assess the effect of yeast on digestibility of nutrients are presented in Table 9.

5.4.1 Dry matter

The dry matter digestibility of diet in the first trial was 76.15 and 76.66 per cent, respectively for control and treatment diets while the values were 71.08 and 72.55 per cent respectively, in the second trial. There was no significant difference in dry matter digestibility between the control and treatment diet in both the trials.

In agreement with the present study, Windschitl (1991) reported that the dry matter digestibility was not significantly influenced by the addition of yeast culture to the diet. The value obtained was 70.6 and 70.9 percent for control and treatment group, respectively. Mutsvangwa *et al.* (1992) also observed statistically non-significant results in calves fed yeast culture, but the dry matter digestibility tended to be higher for control diet, the values being 88 and 80 percent for control and treatment group respectively. Mir and Mir (1994b) from studies conducted in high forage fed steers reported that dry matter digestibility was not affected by addition of yeast culture to the high forage diet. Several other researchers (Moloney and Drennan, 1994, Singh *et al.* 1998 and Cabrera *et al.* 2000) also reported non-significant effects of yeast culture in growing ruminants.

However other workers have reported significant improvements in dry matter digestibility in ruminants. Kumar *et al.* (1994) reported that supplementation of yeast culture resulted in an increase in *in sacco* dry matter disappearance. Wiedmeier *et al.* (1987) reported significantly higher dry matter digestibility in lactating dairy cows.

The higher dry matter digestibility observed during the first trial than that of the second trial may be because of the high digestibility of milk, which formed a part of the diet during that period.

5.4.2 Crude protein

The crude protein digestibility obtained in the present study was 75.87 and 76.68 per cent respectively (Table 9) for control and treatment group, in first trial, but the same was 79.42 and 79.75 per cent in the second trial. In both the trials the values were statistically non-significant between the two groups. There was an increase in digestibility of crude protein during the second trial. Almost similar crude protein digestibilities were observed by Windschitl (1991) when calves were fed with yeast added diet. This is in general agreement with response reported by Mutsvangwa *et al.* (1992) in calves of 3 months of age and Mir and Mir (1994 b) in steers fed high forage diet. An interaction between yeast and diet type was reported by Moloney and Drennan (1994). They observed that yeast culture did not affect crude protein digestibility when included in a low fibre high protein diet, but decreased when included in high fibre low protein diet. Singh *et al.* (1998) also observed responses similar to the present study. A numerically higher but non-significant increase in crude protein digestibility was observed by Pandey and Agrawal (2001) in calves of 3 to 7 month age fed yeast culture.

5.4.3 Neutral detergent fibre

The digestibility co-efficient of neutral detergent fibre (NDF) was similar for both control and yeast supplemented diet during both the trials. The values were 55.45 and 58.06 per cent for control and treatment diet respectively, during the first trial and 65.01 and 61.66 per cent during the second trial and the values were statistically non-significant. However there was an increase in NDF digestibility in calves after 2½ months of age, which was indicated by about 10 percent increase in the control and 4 per cent increase in the treatment group observed during the second trial over the first.

Windschitl (1991) observed NDF digestibility values of 61.6 and 62.5 percent respectively, with control and yeast added diet fed to young calves. These values were very much similar to the values obtained during the second trial. Mutsvangwa *et al.* (1992) observed similar response in calves but the values were lower than the above said values (50.5 and 50.4 for control and experimental diet respectively). Mir and Mir (1994b) also reported similar NDF digestibility values for high forage and high grain diets supplemented with yeast culture. Neutral detergent fibre digestibility values obtained by Moloney and Drennan (1994) and Singh *et al.* (1998) in calves and Cabrera *et al.* (2000) in growing steers also were non-significant.

Plata *et al.* (1994) observed higher NDF digestibility for feeds with 3 different levels of oat straw supplemented with yeast culture. They had the opinion that there was no significant interaction between oat straw level in the ration and yeast culture addition with regard to NDF digestibility. Pandey and

Agrawal (2001) also observed a higher NDF digestibility in calves of 3 to 7 months of age. Significantly higher NDF digestibility was reported in lactating dairy cows by Wiedmeier *et al.* (1987) and in sheep by Mpofu and Ndlovu (1994).

5.4.4 Acid detergent fibre

The acid detergent fibre digestibility obtained in the present study was 42.12 and 48.96 per cent during the first trial and 55.64 and 52.85 per cent during the second trial for control and treatment diet, respectively. The values were statistically non-significant and as in case of NDF digestibility, the ADF digestibility also increased during the second trial.

This response is in agreement with observations of Windschitl (1991). He observed that the NDF digestibility was 60.00 and 61.00 per cent, for control and treatment diet respectively, in calves.

Similar response was reported by Mir and Mir (1994b) in growing steers fed alfalfa silage based diet. Moloney and Drennan (1994) and Cabrera *et al.* (2000) also reported that *Saccharomyces cerevisiae* had no effect on ADF digestibility in growing steers. Wiedmeier *et al.* (1987) reported that ADF digestibility remained unaffected when lactating cows were fed diet supplemented with yeast culture.

In contrast to the above response Pandey and Agrawal (2001) reported a significantly higher ADF digestibility in calves of 3 to 7 months of age (46.77 Vs 55.08) fed yeast supplemented diet.

5.5 Haematological parameters

5.5.1 Blood glucose

Blood glucose values of experimental animals varied from 60.56 to 102.67 mg/100 ml (Table 10). The data did not reveal any statistically significant difference between yeast fed group and its control. The values were higher during initial stages of the experiment, which gradually decreased with increasing age of the animals.

Yadav *et al.* (1994b) also observed similar non-significant effects of yeast supplementation in buffalo calves. Blood glucose concentrations of 95.68 and 51.88 mg/100 ml were reported in calves of one month and 10 to 11 months of age respectively by Prabha *et al.* (2000b).

Windschitl (1991) reported plasma glucose value of 69.4 mg% in calves of 4 to 7 months of age fed yeast containing probiotic, which was significantly lower than the control value of 76.6 mg%. Quigley *et al.* (1992) also observed a significant reduction in blood glucose level in limit fed calves given yeast culture. Significantly different values of 58.18 mg/100 ml in yeast fed Vs. 60.5 mg/100 ml in control, were reported by Kar *et al.* (1994) in lactating buffaloes. In agreement with the present study, Piva *et al.* (1994) observed non-significant effect of yeast supplementation in mid-lactation cows.

5.5.2 Plasma protein

Data on the monthly plasma protein are presented in Table 10. The values were non-significant and they varied from 7.34 to 7.77 g/100 ml in control and 6.47 to 9.11 g/100 ml in treatment group.

Sagathevan (1995) reported serum protein concentration ranging from 6.13 to 6.81 g/100 ml in calves of 6 to 9 months of age. Values varying from 7.2 to 9.1 g/100 ml were observed by Subramanian (1995) in calves of 5 to 7 months of age.

Piva *et al.* (1993) reported that the plasma total protein values were similar between control and yeast fed mid-lactation cows.

Yadav *et al.* (1994b) observed a statistically higher plasma protein level in calves fed yeast culture (66.2 g/l) than that of control animals (62.4 g/l).

5.5.3 Plasma calcium

The plasma calcium levels of the two groups remained similar throughout the study and the values varied from 9.0 to 11.5 mg/100 ml (Table 10). Concordant plasma calcium values of 11 to 13.6 mg/100 ml were reported by Kunjikutty (1969) in calves below one year of age. Prabha *et al.* (2000a) also obtained almost similar plasma calcium values in calves of 4 to 5 months of age.

The serum calcium concentration of 8.4 to 11.97 mg/100ml in buffalo bulls reported by Sirohi and Rai (1997) also agrees with the values obtained in the present study. Similar plasma calcium values were reported by Varghese (1998) in lactating cows of Kerala and Wilson (2001) in dairy heifers.

In agreement with the present study, Piva *et al.* (1993) reported non-significant effect of yeast culture on plasma calcium in mid-lactation cows.

5.5.4 Plasma phosphorus

The plasma phosphorus concentration in the experimental animals varied from 5.10 to 8.40 mg/100 ml. The dietary treatments had no effect on the plasma phosphorus concentration throughout the study. Kunjikutty (1969) reported similar serum phosphorus level of 3.5 to 7.3 mg/100 ml in calves below one year of age. The reported serum phosphorus levels of 8.45 mg/dl in lactating buffaloes (Lal *et al.*, 1994), 4.12 to 5.88 mg/dl in lactating dairy cows of Kerala (Varghese, 1998) and 5.71 to 8.48 in heifers (Wilson, 2001) are in accordance with the present study.

Summary

6. SUMMARY

A study was conducted to assess the effect of dried yeast ("Neutramix-MDY") supplementation on growth performance of pre-ruminant calves. Twelve calves of one week to one month of age were selected and distributed into two groups, as uniformly as possible with regard to age, sex and body weight and were randomly allotted to two dietary treatments. The control diet comprised of calf starter, green grass and milk. The treatment group received control diet supplemented with dried yeast ("Neutramix-MDY") @ 20g/day/calf.

The experiment was carried out for a period of 145 days and the animals were maintained under similar managemental conditions. Individual records of daily intake of calf starter, green grass and milk and fortnightly data on body weights were maintained throughout the experiment. Blood samples were collected at the beginning and at monthly intervals and levels of blood glucose, plasma protein, calcium and phosphorus were assessed. Two digestibility trials were conducted during the 11th and 20th weeks of the experiment with collection periods of five days each, to arrive at the digestibility coefficients of nutrients.

Animals maintained on control and treatment diet showed average daily weight gain of 247 and 284 g/day and final body weight of 72.5 and 76.2 kg respectively, during the experimental period. Although there was no significant difference between the control and treatment group, there was a numerical increase in daily gain and final body weight of animals fed treatment diet.

The average daily dry matter intake was 1.19 and 1.18 kg respectively, for animals of the control and treatment group.

The feed to gain ratio was 4.94 for the control and 4.60 for the treatment group and the same remained unaffected by dietary treatments.

The digestibility coefficients of dry matter, crude protein, acid detergent fibre and neutral detergent fibre were not significantly different between control and treatment group. However the crude protein, neutral detergent fibre and acid detergent fibre digestibility increased during the second digestibility trial.

Blood glucose level varied from 60.56 to 102.67 mg/100 ml in control and 62.75 to 97.60 mg/100 ml in treatment group, during the five month study. The values were non-significant between groups. Plasma protein (6.47 to 9.11 g/100 ml), calcium (9.0 to 11.5 mg/100 ml) and phosphorus (5.10 to 8.40 mg/100 ml) values also remained unaltered between the control and the treatment group.

From an overall assessment of the results obtained during the course of present investigation, it can be concluded that addition of yeast culture to the diets of pre-ruminant calves did not influence significantly their weight gain, dry matter intake, feed efficiency, nutrient digestibility and haematological parameters such as blood glucose, plasma protein, calcium and phosphorus.

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EFFECT OF SUPPLEMENTATION OF DRIED YEAST ("NEUTRAMIX-MDY") ON GROWTH PERFORMANCE OF PRE-RUMINANT CALVES

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ABSTRACT OF A THESIS

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ABSTRACT

An experiment was conducted to study the effect of dietary supplementation of dried yeast ("Neutramix-MDY") on growth performance of pre-ruminant calves. Twelve calves of one week to one month of age were distributed into two groups of six calves each, as uniformly as possible with regard to age, sex and body weight, with one group receiving the control diet (calf starter, grass and milk) and the other group receiving dried yeast ("Neutramix-MDY") @ 20g/day along with the control diet.

The final body weight (kg) and average daily gain (g/day) were 72.5 and 247 for control group and 76.2 and 284 for treatment group during the trial period. Though there was no statistically significant difference between the control and the treatment group, there was a numerical increase in both the parameters in treatment animals. The average feed to gain ratio was 4.94 and 4.60 for the control and treatment group respectively.

There was no improvement in dry matter, crude protein, acid detergent fibre and neutral detergent fibre digestibilities in yeast fed group over the control. Haematological parameters such as blood glucose, plasma protein, calcium and phosphorus were unaffected by the dietary treatment. The above results indicate that supplementation of yeast culture to the diets of pre-ruminant calves had no statistically significant effect on animal performance.