EFFECT OF SUPPLEMENTATION OF PROBIOTICS AND RUMEN BUFFER ON PERFORMANCE OF LACTATING BUFFALOES

T H E S I S

Submitted
In partial fulfillment of the requirements for the Degree of

MASTER OF VETERINARY SCIENCE
IN
ANIMAL NUTRITION

BY
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Enrolment No:-V/12/175

Mumbai Veterinary College, Mumbai

MAHARASHTRA ANIMAL AND FISHERY SCIENCES
UNIVERSITY, NAGPUR – 440 001,
(INDIA)

DECLARATION OF THE STUDENT

I hereby declare that the experimental research work and interpretation of the thesis entitled **"EFFECT OF SUPPLEMENTATION OF PROBIOTICS AND RUMEN BUFFER ON PERFORMANCE OF LACTATING BUFFALOES"** or part thereof has not been submitted for any other degree or diploma of any university, not the data have been derived from any thesis or publications of any university or scientific organization. The sources of material used and all assistance received during the course of investigation have been duly acknowledged.

Date:
Place: Mumbai

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Appendix – C (i)

DECLARATION OF ADVISORY COMMITTEE

Mr. DHARMENDR KUMAR VERMA has satisfactorily prosecuted his course of research for a period of not less than one semester and that the thesis entitled **"EFFECT OF SUPPLEMENTATION OF PROBIOTICS AND RUMEN BUFFER ON PERFORMANCE OF LACTATING BUFFALOE**S" submitted by him is the result of research work is sufficient to warrant its presentation to the examination in subject of **Animal Nutrition** for the award of **Master of Veterinary Science** degree by the Maharashtra Animal and Fishery Sciences University Nagpur.

We also certify that the thesis or part of thereof has not been previously submitted by him for a degree of any other university.

Place: Mumbai
Date

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3	Dr. S. D. Ingole	Professor, Department of Veterinary Physiology	
4	Dr. A. H. Kodape	Associate Professor, Department of Livestock Production and Management	

Appendix – C (ii)

CERTIFICATE

This is to certify that the thesis entitled "**EFFECT OF SUPPLEMENTATION OF PROBIOTICS AND RUMEN BUFFER ON PERFORMANCE OF LACTATING BUFFALOES**" submitted by **Mr. DHARMENDR KUMAR VERMA** to the Maharashtra Animal Sciences University, Nagpur, in partial fulfillment of the requirement for the degree of **Master of Veterinary Science (M.V.Sc)** has been approved by the Student's Advisory Committee after examination in collaboration with the External Examiner.

Name & signature of External Examiner	**Signature & seal of HOD**	**Signature of guide/advisor**

ADVISORY COMMITTEE

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Dean /Associate Dean.
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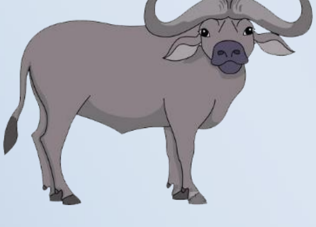
Dedicated to

My Beloved Brothers

Acknowledgement



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"A Journey Is Easier When You Travel Together." I would like to dedicate my thesis to my beloved late brother **Jitendra Kumar Verma.** The beautiful moments of the lives we have cherished together makes me drive through the difficult times, lits a smile on my face & encourages me to move forward. With your blessings, my brother, I was able to complete my research and see it through the end. I miss you my brother.

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Date:

Place: Mumbai *Dharmendr Kumar Verma*

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ABBREVIATIONS

DMB	Dry matter basis	ECM	Energy corrected milk
DMI	Dry matter intake	Kg	Kilogram
CP	Crude protein	P	Level of significance
CF	Crude fibre	DFI	Daily feed intake
EE	Ether extract	FCR	Feed conversion ratio
TA	Total ash	G	Gram
NFE	Nitrogen free extract	Ca	Calcium
DCP	Digestible crude protein	P	Phosphorus
TDN	Total digestible nutrient	Mg	Milligram
FCM	Fat corrected milk	MT	Milliosn tonne
SCC	Somatic cell count	CM	Corn meal
SNF	Solids not fat	w/v	Weight / volume
DAHD & F	Department of Animal Husbandry , Dairying & Fisheries	CFM	Concentrate feed mixture
SC	*Sacchromyces cerevisiae*	CFU	Colony forming unit
TS	Total solids	HF	Holstein Friesian
OM	Organic matter	TMR	Total mixed ration
DFM	Direct fed microbial	PED	Pediococcus acidilactici 19839
CRD	Complete randomized design	BM	Beneficial microorganisms
YC	Yeast culture	BAC	Bacillus subtillis 15541
EHY	Enzymatically hydrolysed yeast	P169	Propionibacteria

Introduction

1. INTRODUCTION

Livestock plays an integral role in sustaining livelihood, nutritional and environmental security and growth of Indian Agriculture. The giant strides made in the livestock sector in the past decades are the major reason for positive growth rates recorded in agricultural sector. India has achieved horizontal growth in terms of animal population, there is an urgent need of growth in terms of enhancing productivity of livestock.

India possesses 108.70 million buffaloes accounting for 57 percent of total population in the world (DAHD and F, 2012) but their productivity is quite low due to shortage of feeds and fodders. The most important scope for improving buffalo milk production still lies in improvement of feeding strategies and utilization efficiencies of dairy animals through dietary manipulation with the use of various feed additives in the ration.

The bovine population of India is highest in the world. Considering global milk production, India rank first in milk production and largest consumer of the milk in the world. India produces around 50 to 60 million tonnes of milk per year and contributes 9.5 % of the world milk production. Milk production of our country during the period 1991-92 to 2017-18, has increased from 55.6 million tonnes to 176.3 million tonnes as compared to 165.4 million tonnes for the year 2016-17 showing a growth of 6.65 %. In India the per capita availability of milk was 178 gram per day during year 1991-92 which has increased to 375 gram per day in 2017-18 *visa-vis* the world estimated average intake of 294 grams per day during 2017 (DAHD and F, 2018). This indicates sustained improvement in the availability of milk and its products for growing population.

Shortage of feed resources in India has been documented by different organizations but several locally available feed resources used for feeding milch animals are not taken into consideration. These include industrial by-products, horticulture and vegetable wastes, local grasses, tree leaves, aquatic plants, weeds and other non-conventional feed resources. The available feed resources are not fed in right proportion as per the requirement of animals, leading to imbalance of nutrients in the ration. The compounded cattle feed manufactured by various agencies in different sectors does not usually meet the specific requirement of animals, which includes species, breed, stage of lactation, physiological stage of animals, quality of basal roughages etc. In view of this, it has not been possible to fully exploit the genetic potential of lactating animals. Despite shortage, milk production and the productive life of dairy animals can be improved substantially if the available feed and fodder resources are utilized judiciously.

In dairy farming, feed is the most important factor which accounts for about 60-65% of the total cost of rearing. In order to get maximum profitability, the feed must be balanced nutritionally and also be economical. The economy of feed is not only assessed by the apparent cost per kg of feed but also by the cost of feed required to produce a kg of milk. For achieving maximum profitability in dairy farming there is need to adopt the scientific feeding strategies for dairy animals. In such situations various feed additives like probiotics, enzymes, buffering agents and herbs can be used for improving health status and production performance of the farm animals.

Knowledge of ruminal biotechnology has made it possible to manage rumen microbial ecosystems and rates of rumen fermentation. Ruminal biotechnology applies the available knowledge of fore-stomach fermentation and uses it for improving the nutritive value and quality of feeds, and also to enhance absorption of nutrients in the intestinal tract.

Methods for manipulating ruminal fermentation by biotechnology involve use of rumen modifying substances, introduction of genetically modified organisms in rumen, implementing molecular techniques and rumen defaunation. Rumen modifier is a product that alters the rumen environment and thereby alters the fermentation process and products of fermentation (Moran, 2005). Various kinds of feed additives like enzymes, protease inhibitors, buffering agents, enzymes, bacterial and fungal additives like yeast and yeast cultures are the examples of rumen modifying substances. Among various feed additives, supplementation of yeast culture has shown encouraging results in lactating ruminants in terms of milk yield and its quality.

Probiotics like yeast (*Saccharomyces cerevisiae*), and bacteria (*Bacillus subtilis, Bacillus pumilus* and *Bacillus amyloliquifaciens*) are widely utilized to improve livestock productivity, and the underlying mechanisms for such enhancement, have attracted increasing attention during recent years. Yeast cells are known to be a rich source of vitamins, enzymes and yeast is also found to stimulate cellulolytic bacteria in the rumen, improve fibre digestion and flow of microbial protein from the rumen. Hence, yeast supplementation has been shown to improve the growth rate and feed conversion efficiency. In some studies, yeast supplementation has resulted in increasing milk production and milk fat percentage in lactating cows (Ayad *et al.*, 2013). Supplementation of probiotic in lactating ruminant animals resulted in increased dry matter intake, nutrient digestibility, body weight gain, milk yield and its composition. *Bacillus subtilis* (probiotic bacteria) is a rod-shaped gram positive bacteria that is commonly observed in the soil and the gut of humans and animals. Bacterial spores like *bacillus subtillis, bacillus pumilus and bacillus amyloliquefaciens* increases milk production and milk components yield, decreases somatic cell count and promotes growth of total rumen bacteria, proteolytic and amylolytic bacteria (Luan *et al*. 2015).

Yeast (*S. cerevisiae*) is metabolically active in the rumen and the small intestine after ingestion. Yeast has an ability to scavenge oxygen from the rumen making ecosystem more beneficial for growth and activity of the rumen anaerobic microbes. It also has the ability to increase cellulolytic activity in the rumen and increases nutrient digestibility, especially for rich fibre diets. *S. cerevisiae* have also been shown to maintain the rumen pH and limit acidosis risks through regulating both of lactate producing and lactate utilizing bacteria. *S. cerevisiae* is a rich source of nutrients like peptides, vitamins, organic acids and cofactors which may be required by the rumen bacteria. Yeast also reduces the concentration of acetate or the acetate: propionate ratio in the rumen of ruminant animals (Newbold *et al*.1996).

The lactating buffaloes are usually fed on high concentrate or high energy rations for getting more milk production. Such ration contain readily fermentable starch or low fibre diet, which results in increased volatile fatty acid production in the rumen and may result in acidosis. The reduction in rumen pH results in drastic reduction in dry matter intake, increase in propionate production, depression in milk yield and its fat percentage.

In cities like Mumbai, several buffalo farms are located where in concentrate based ration are fed, as green roughages are not cultivated in cities due to lack of cultivable lands. Similarly, feeding of dry roughages is also limited due to high cost involved in transportation of dry roughages from adjacent states of Maharashtra. Under concentrate based feeding regime, animals are very prone for conditions like acidosis. The supplementation of buffers in such animals may help in stabilization of pH and rumen environment, which will result in better microbial fermentation and improvement in overall utilization of nutrients.

Buffers in dairy rations are compounds that neutralizes excess acid production within the animal digestive system and thus help in restoring rumen pH to its normal level. Buffers are a combination of weak acid and its salt, which resists changes in pH or hydrogen ion concentration. Buffers increase ability to overcome the harmful effects of too much acid production and helps in maintaining rumen microbial fermentation process.

The effect of dietary yeast supplementation on milk yield and milk composition is varied. It has been hypothesized that combined supplementation of substances like buffering agent with probiotic can help in exploiting the beneficial effects of probiotics. This type of combine supplementation may prove beneficial in supporting and working out complete action of yeast. Moreover, concept of combine supplementation of yeast and rumen buffering agents may have potential to give new dimensions to animal feed industry as well as to the field of animal nutrition research.

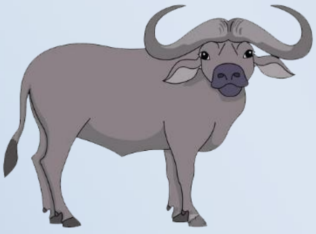
Keeping this view in mind it was decided to study and evaluate the effect of probiotic and rumen buffering agent in lactating buffaloes with following objectives:

1. To study the effect of supplementation of probiotics and rumen buffer on milk yield and its composition in lactating buffaloes

2. To study the effect of supplementation of probiotic and rumen buffer on feed intake and efficiency of feed utilization in lactating buffaloes

3. To study the economics of milk production

Review of Literature



2. REVIEW OF LITERATURE

Buffaloes are ruminant animals. Microbial digestion is unique feature observed in ruminants by virtue of which ruminants can digest coarse roughage and less digestible feed stuff. The feed eaten by ruminants are mainly of plant origin. The buffaloes are efficient in converting cellulose and other fibrous materials into high quality milk and meat.

Indian buffaloes are important source of milk supply today and yield nearly three times as much milk as cows. More than half of the total milk produced (55%) in the country was contributed by the 47.22 million milch buffaloes, whereas the 57.0 million cows contribute only 45% of the total milk yield. Indian Buffaloes are water buffaloes. There are about 10 indigenous standard breeds of buffaloes, which are well known for their milking qualities. However, lack of knowledge of dairy farmers regarding scientific feeding and shortage of feed resources limits the milk yield of buffaloes.

The shortage of feed resources necessitate us to use alternate feed resources. The use of feed additives which help in maximum utilization of available feed resources is need of the day. Now a days various feed additives like probiotics, yeast culture, enzymes, buffers, neutralizers are being used in ruminant ration for improving microbial digestion of feedstuffs and stabilization of rumen pH. Among most of the feed additives probiotics, yeast culture and buffers have shown promising result in ruminant animals.

Probiotics, when used as feed additive should remain active in the gastro-intestinal tract or remain metabolically active so that its beneficial effects get some time for expression. El Hassan *et al*. (1993) reported from both, *in vitro* and *in vivo* experiments that the yeast cells did not survive in the rumen however, they remained metabolically active for some time. Newbold *et al*. (1990) reported that yeast cells can remain metabolically active up to 6 hrs in the rumen. These studies indicated that the additive is effective only till it is fed. Therefore, a constant feeding of yeast cells to the ruminants appears to be essential to achieve any beneficial effect on the productivity of the animals.

The feeding of live yeast culture, *saccharomyces cerevisiae* improve the performance and microbiological balances of animal and thereby extract the nutrients to the maximum extent and get them deposited in end product (milk, meat and eggs) for human use which simultaneously reduce environmental pollution.

Role of live yeast products for ruminants are improving digestibility, dry matter intake, milk yield and its composition is well documented with previous research activities.

Other substances like buffering agents are also playing important role in maintaining rumen health by adjusting ruminal pH to its optimum. For getting desired animal responses it becomes necessary to examine and understand the effect of supplementation of live yeast, bacteria and buffering agent in lactating buffaloes.

With these facts, the present trial was undertaken to study the effects of supplementation of probiotics like yeast (*Saccharomyces cerevisiae*), bacteria (*Bacillus subtilis, Bacillus pumilus* and *Bacillus amyloliquifaciens*) and rumen buffer (sodium bicarbonate) on yield and composition of milk in lactating buffaloes. Hence, the latest work on use of microbial feed additives and rumen buffer in ruminants ration has been taken into consideration and efforts have been made to discuss various aspects of it in the present review. Therefore, references pertaining to the effect of supplementation of probiotics like yeast (*Saccharomyces cerevisiae*), and bacteria (*Bacillus subtilis, Bacillus pumilus* and *Bacillus amyloliquifaciens*) and rumen buffer (sodium bicarbonate) on milk yield and its composition, nutrient digestibility and feed efficiency were referred and presented.

2.1 Milk composition and milk yield

Kumar *et al*. (1992) evaluated the effect of supplementation of live yeast culture (*Saccharomyces cerevisiae* plus growth medium) on the performance of lactating buffaloes (*Bubalus bubalis*). Twenty buffaloes (Murrah breed) having an average daily milk yield of 8 to 10 litre and in their early lactation stage were divided into two equal groups. The control group was given a basal production diet consisting of 35 to 40 kg green berseem and concentrate mixture 0·5 kg/kg milk produced per day per animal and in the yeast supplemented group the above diet was supplemented with 10 g yeast culture *Saccharomyces cerevisiae* YC-1026 (5×10^9 c.f.u. per g). The feeding continued for 10 weeks and during this period milk samples collected at weekly intervals and milk yield recorded daily. During this period, average daily milk yield was increased by proportionately 0·135 and fat-corrected milk yield by 0·185 by inclusion of YC. Fat, protein, lactose and total solids in milk increased proportionately by 0·039, 0·051, 0·030 and 0·034, respectively. The corresponding proportional increases in the quantity of these constituents secreted in milk (kg/day) were 0·237, 0·200, 0·200 and 0·204.

Kobayashi (1995) conducted experiment on eight Holstein cows for a period of 30 weeks to study the effects of dietary yeast culture on milk production and composition, ruminal fermentation and blood parameters. The control diet consisted of 50% corn silage (early lactation, 3-15 weeks post parturition) or Italian ryegrass silage (mid lactation, 16-30 week post parturition) and 50% concentrate (DM basis). At 3-wk post parturition, cows were assigned in equal numbers to either 0 or 10 g/d of yeast culture, *Saccharomyces cerevisiae* plus growth medium. Milk production in early lactation (25.4 vs. 27.7 kg/d) and in mid lactation (19.3 vs. 21.4 kg/d) tended to increase following the supplementation of the dietary yeast culture. Milk fat production tended to decrease with the yeast culture supplement in both lactation periods, whereas milk protein production increased above the control by a mean of 5% in early lactation and a mean of 8% in mid lactation.

Park *et al.* (1996) studied effect of *saccharomyces cerevisiae* on 30 Holstein cows which were divided into three groups. Group I was control. The group II was treatment- 1, supplied or added 0.1% *S. cerevisiae* (2.2×10^{12} organisms/kg) and group III was Treatment-2 supplemented 0.05% *Lactobacillus acidophilus* (1.0×10^{12} organisms/kg) plus 0.05% *S. cerevisiae* Supplementing *S. cerevisiae* alone or with *L. acidophilus* increased daily milk yield of cows by 7 to 8% ($P<0.05$), but milk fat contents (3.76, 3.62 and 3.61% for control and treatments 1 and 2, respectively) were not significantly affected. Supplements alleviated the decrease in daily milk yield in the late phase of milk production without affecting milk fat content. Daily milk yield was different (P<0.05) between control and treatment groups from the fourth week of supplement feeding. After 7 weeks supplement feeding (week 9 of the experiment) daily milk yields for control and treatments 1 and 2, respectively, were 88.8, 93.5 and 95.5% of milk yield at the beginning. The effect of supplementing *L. acidophilus* plus *S. cerevisiae* appeared to be cumulative in alleviating the decrease in milk yield and this effect was sustained thereafter. Two weeks after stopping supplementation daily milk yield was maintained at 81.3 and 89.3% of the level at the beginning for treatments 1 and 2, respectively, compared with 75.4% for the control group.

Kung *et al*. (1997) conducted two lactation trials in Holstein cows in mid lactation, which were offered a diet with corn silage as the primary forage source. Half of the cows received a top-dressing based on corn that contained 10 g/d of the yeast and enzyme supplement. The supplement had no effect on milk production, milk composition, or dry matter intake. In a second lactation experiment, high producing cows in early lactation were fed 0, 10 and 20 g/d of the supplement. Cows fed the control diet produced 36.4 kg of milk/d, and milk production was 39.3 and 38.0 kg/d from cows fed 10 and 20 g of yeast/d. it is concluded that supplementation of yeast and enzyme in the diet of mid lactation cow does not effect on milk production, milk composition and dry matter intake but in early lactation dairy cows showed increased milk production and its composition.

Soder and Holden (1999) studied the effect of yeast culture *Saccharomyces cerevisiae* and enzymes on 36 multiparous and 12 primiparous Holstein cows with respect to dry matter intake and milk yield and its composition. The pre-partum diet comprised of a total mixed ration containing chopped grass hay, corn silage, and grain pellet. The postpartum diet comprised of a total mixed ration containing corn silage, legume silage, chopped legume hay, and grain pellet. Treatments consisted of 1) whey control, 10 g/d; 2) enzyme, 10 g/d, 3) yeast 15 g/d and 4) Biomate Yeast Plus® (20 g/d Chr.Hansen BioSystems, Inc., Milwaukee,WI).The additives utilized in present experiment were top-dressed at feeding time. The trial lasted for 13 weeks period. Least squares means for intake, milk yield, and milk composition were unaffected by treatment. Yeast cultures with or without enzyme had no direct effects on pre-partum or postpartum dry matter intake or milk yield and its composition of lactation.

Biricik and Yavuz (2001) studied effect of *Saccharomyces cerevisiae* on 6 Brown Swiss and 18 Holstein cows. The trial lasted for ten weeks. The cows were divided into two groups (control and treatment) having 12 cows each. *Saccharomyces cerevisiae* (10 g/cow) viable yeast culture was added daily to the feed of the treatment group. Milk and 4% fat-corrected milk production, and milk fat, milk protein and milk dry matter content, as well as blood chemistry results did not differ significantly between control and treated cows. It was concluded that the addition of *S. cerevisiae* viable yeast culture to the ration of dairy cows does not significantly affect milk production and composition.

El-Ghani (2004) conducted trial on a fifteen Zaraibi does in the first and second lactation, 12–24 months of age, and weighing in average 32.50 kg which were randomly divided into three equal groups. The control group (T_1) was fed a concentrate mixture and roughage (alfalfa and wheat straw), while the second (T_2) and third (T_3) groups were fed the same diet supplemented with 3 or 6 g of YC, respectively. The results of digestibility trials revealed that bucks fed YC had higher nutrient digestion coefficients than the control group. A similar trend was observed in feed intake. The lactating Zaraibi goats had higher ($P < 0.05$) milk yield, and contents of milk energy, protein, total solid and solid nonfat than the control goats. It is concluded that the inclusion of 6 g per day of YC in goats diets is recommended under field conditions.

Kumar and Reddy (2004) studied the effect of supplementation of yeast culture to roughage-based rations in 12 crossbred heifers. These heifers were divided into 3 equal groups viz. R1, R2, R3 and offered ration containing roughage concentrate ratio of 50:50, 60:40, 70:30, respectively for 45 days period. In second phase of 45 days, the above ration was supplemented with yeast culture (Yeasacc 1026) containing *Saccharomyces cerevisiae* @ 10 g/animal/day along with concentrate mixture. The dry matter intake was significantly ($P<0.01$) higher with R3 as compared to R1 and R2 irrespective of addition of yeast culture. The digestibility of DM, CP, EE and DCP content were significantly ($P<0.01$) depressed as the level of forage was increased. However, the CF digestibility was progressively increased as the roughage level was increased in the rations. The DM intake, digestibility of nutrients and DCP content were improved significantly ($P<0.05$) by dietary supplementation of yeast culture. Feed conversion efficiency was improved and cost/kg gain was reduced considerably by supplementing the diet with yeast culture.

Nikkhah *et al*. (2004) studied the effects of different levels of yeast (*Saccharomyces cerevisiae* SC47) on lactation performance of 12 Holstein dairy cows. The cows were divided into 4 groups of 3 cows each. Ingredients of the basal diet were lucerne hay (23.65%), maize silage (17.2%) and concentrate (59.15%) on a dry matter basis. Experimental diets 1 to 4 contained 0, 3, 6 and 12 g of yeast/day, respectively. The rations were fed to cows as total mixed ration (TMR), and the yeast was top-dressed during the allotment of the ration. It was observed that dry matter intake and milk yield in cows were not affected by experimental diets, but milk composition including fat, solids not fat and percent total solid increased by feeding yeast culture ($P<0.05$). The concentration of milk lactose and protein were not affected by yeast culture ($P>0.05$). The averages of fat corrected milk yield at 4% fat with respect to rations 1-4 were 29.29, 27.25, 29.47 and 29.53 kg/day, respectively. The differences between milk yield averages were not significant.

Gujjar *et al.* (2006) conducted a trial for a period of 90 days on eighteen lactating buffaloes which were divided into three groups A, B and C, with six animals in each group. Animals of Group A were fed a concentrate ration with 2 ml of Biovet (lactic acid bacteria, yeast, actinomycetes and fermenting fungi) per kg of feed, while those of Group B were fed an experimental ration having probiotic 500 g in 100 kg of concentrate mixture. The Group C animals served as control group. The average daily milk yield was 7.60, 7.39 and 6.15 litres in groups A, B and C, respectively. The corresponding values for milk fat were 7.60, 7.39 and 6.15 percent. The daily feed intakes for concentrate mixture were 4.36, 4.38 and 4.41 kg, while fodder intakes were 35.28, 35.29 and 37.46 kg in respective groups. The values for feed efficiency per kg were 1.70, 1.75 and 2.14 on dry matter basis, 0.197, 0.203 and 0.251 on crude protein basis, while 1.05, 1.08 and 1.35 on TDN basis in

Groups A, B and C, respectively. It was also observed that under same feeding and management conditions, the lactating buffaloes supplemented with Biovet (Group A) produced more milk @ 1.45 litres per day, while Group B buffaloes supplemented with probiotic produced 1.22 litres more milk per day than Group C. There was a significant ($P<0.05$) difference in milk yield between groups A and C, and B and C, while these differences were not significant for average daily feed intake and feed efficiency on crude protein basis. The Biovet (BM-Technology) has favourable effect on milk yield and feed efficiency due to beneficial micro-organisms (BM) and combined function for increased digestibility of concentrate mixture and fodder in lactating buffaloes.

Ramirez *et al*. (2007) studied the effects of supplementation of diet with a commercial yeast (*Saccharomyces cerevisiae*) on yield and milk composition in water buffalo Multiparous water buffalo cows (n = 24) in second third of lactation were assigned into two treatments: 1) experimental group (n=12) fed with 100 g/day of commercial yeast cultures (*Saccharomyces cerevisiae*) and 2) Control group (n=12) without yeast, during two months. All buffalo cows grazed in same pastures during rain season (September-November; 2006). Milk production was measured twice weekly and milk composition was measured at half and at the end of trial. The addition of yeast doesn't increase significantly the yield and milk composition in water buffalo but it resulted in a difference of 0.57 Kg milk/animal/day between groups.

Bruno *et al.* (2008) studied the effects of feeding a yeast culture of *Saccharomyces cerevisiae* on lactation performance of cows during heat stress. Multiparous Holstein cows (n = 723) calved during the summer months from two dairy farms were randomly assigned to a diet containing no yeast culture (control; n=361) or 30g/d of a *S. cerevisiae* yeast culture (YC; n = 362) fed from 20 to 140 d in milk (DIM). Intake of DM was similar between diets, but cows fed YC produced 1.2 kg/d more milk, more milk true protein, solids-not-fat and lactose than that produced by control cows. However, energy corrected milk yield, and concentrations of true protein, solids-not-fat and lactose did not differ between treatments. Feeding a yeast culture of *S. cerevisiae* improved yields of milk and its components in heat-stressed multiparous Holstein cows.

Srinivas (2009) studied the effect of thermo tolerant probiotic (Levucell SC 20) on voluntary feed intake, rumen fermentation pattern, nutrient digestibility, milk production and its composition and on growth performance in Murrah buffaloes. The dry matter intake (kg/day) increased marginally in the probiotic supplemented group of lactating buffaloes as compared with the control. The average digestibility coefficients (%) of all nutrients were higher in lactating buffaloes fed probiotic supplemented diet as compared with the control. The DCP and TDN contents were higher in the probiotic supplemented group as compared with the control. The average milk yield, butter fat yield, 6% FCM, SNF per cent and total solids were higher in buffaloes fed diets supplemented with thermo tolerant probiotic as compared with the control, however, the differences between the two groups were not significant. The feed efficiency was improved and cost of feed per kg 6% FCM yield was decreased marginally (₹. 8.06 vs. ₹. 8.44) with probiotic supplementation in the diet of lactating buffaloes as compared to the control. Further supplementation of thermo tolerant probiotic (Levucell SC 20) in the diets of buffalo bull calves increased the growth rate, improved feed efficiency and decreased feed cost/ kg gain as compared to the control. However, it was observed that the recommended dose of probiotic (0.5 g /head/day) supplemented in the diet of lactating buffaloes may be little to demonstrate significant positive response on milk yield and milk composition.

Vibhute *et al.* (2011) studied effect of feeding probiotics on milk yield and its composition in lactating cows. Experiment was carried on sixteen multifarious cows, selected on the basis of average daily milk yield and stage of lactation. Cows were divided into four groups (four cows in each group) with parity within each group. These cows were fed 10, 15 and 20 g probiotics just before evening milk. The multi-strain probiotic used were containing four strains consist of bacteria and fungi viz. *Lactobacillus acidophilus, Saccharomyces cerevisiae, Saccharomyces boulardii* and *Propionibacterium frendenreichii.* It was found that, the use of probiotics proved to be effective in increasing milk production of lactating cows. Milk fat, milk protein and SNF content tended to be higher in cows supplemented with probiotics preparations. The appropriate level of 20 g probiotic per day per animal was found effective. The economic advantage of probiotics depends on its relative prices and on the levels of milk production of the cows.

Yalcin *et al.* (2011) determined the nutritive value of live yeast culture (Rumisacc, *Saccharomyces cerevisiae*) and also investigated its effects on milk yield, milk composition and some blood parameters in lactating cows. Six multiparous Holstein cows were allocated to two groups of three cows and assigned randomly to one of two diets in a cross-over experiment. Daily 50 g Rumisacc was top dressed at the 4 p.m. feeding for the treatment group. Rumisacc supplied a high protein and energy with high organic matter digestibility values (83.35%) determined by *in vitro* enzymatic analysis. Yeast culture supplementation significantly increased milk yield, tended to increase fat, protein and lactose yield of milk. Live yeast culture supplementation had non-significant effect on dry matter, milk quality characteristics and blood parameters. It was concluded that live yeast culture (Rumisacc, *Saccharomyces cerevisiae*) had high nutritive value and positive effects on milk yield and its composition.Ayad *et al.* (2013) evaluated the effect of supplementing *Saccharomyces cerevisiae* (BIOSAF® SC 47), on body condition score, milk production and its composition in peripartum dairy cows. The experiment was conducted during 14 days before parturition to 45 days postpartum (20 milking). Holstein cows (16 primiparous and 4 multiparous) were randomly divided into two groups (n=10); the groups were fed with same diet: One group received, *Saccharomyces cerevisiae.* The average milk production per cow (by about +25%, i.e. 4.8 l/day/cow), with a positive effect in milk fat content and stabilization of the BCS, with reduction of reserve mobilization after calving. Thus it was concluded that the addition of yeast culture in the diet of Holstein cows was beneficial in improving milk production and milk fat.

Raval *et al*. (2013) studied the effects of probiotics supplementation on nutrient utilization, production performance, feed conversion efficiency and economics of feeding in 14 lactating Kankrej cows which were divided into two dietary treatments 1.) T_1 (control: concentrate mixture + Green fodder + Dry fodder) and 2.) T_2, Probiotics supplementation (15 g/d/ animal probiotics containing

Saccharomyces cerevisiae; 1.5 × 10^8 cfu/g and bacteria, *Lactobacillus sporogens*; 5 × 10^7 cfu/g + T1) were fed. The results revealed that supplementing probiotics to lactating Kankrej cows significantly improved intake of DM, CP and TDN while DCP intake, water intake and feed conversion efficiency of nutrients like DM, CP, DCP and TDN in relation to milk yield and FCM remained statistically similar as compared to control. The average DM intake of experimental cows during digestion trial in treatment groups T1 and T2 were 10.03±0.04 and 10.27±0.04 kg/d and when expressed as kg/100 kg B.wt. it was 2.66±0.06 and 2.75±0.09 and in terms of g/kg $W^{0.75}$ was 117.15±2.03 and 120.69±3.02. The treatment group T_2 recorded significantly higher (P≤0.01) DM intake. The average CP and TDN intake of T_1 were 1012.03±1.53 and 6135.39±254.17g/d respectively which were significantly lower (P≤0.05) than T2 group having CP and TDN intake 1057.91±9.40 and 6919.64±262.35 g/d respectively, but the average DCP intake was 576.44±35.88 and 665.75±39.63 g/d, respectively, remained statistically (P≥0.05) similar. The average digestibility coefficient of OM, CP, CF and NFE in T1 and T2 were remain statistically (P≥0.05) similar except DM (65.21±1.88 and 70.89±1.76) and EE (46.92±2.78 and 59.78±3.47). The feed conversion efficiency of experimental Kankrej cows in treatment groups T_1 and T_2 in terms of intake of DM (kg/kg milk yield), CP (g/kg FCM), DCP (g/kg milk yield) and TDN (kg/kg FCM yield) respectively, were statistically (P≥0.05) similar. The results revealed that supplementing probiotics to lactating Kankrej cows significantly improved fat percent, 4% FCM while milk production and return as percent of feed cost were increased but remained statistically similar as compared to control.

Hossain *et al.* (2014) studied the effect of supplementing *Saccharomyces cerevisiae* on performance of ten multiparous cows. These cows were taken as control group before feeding probiotics and after feeding they were taken as treatment group. The cows were supplemented with 15g live yeast culture per head per day for a one month trial period. In the conducted experiment it was seen that there was significant (P<0.05) improvement in milk yield after supplementing probiotics (0.3 liter/ day/ animal which is 8.8% in average daily milk yield) to the crossbred dairy cows. It was observed that there was no significant improvement in butter fat percentage of milk (P>0.05) and acidity (%) between treatment and control group, but significant improvement (P<0.05) was found in protein content and solids-not-fat content of milk.

Maamouri *et al.* (2014) conducted trial on eight Holstein Friesian cows which were randomly divided into two groups of four animals on the basis of age, body weight, average milk yield, and lactation number. The first group was supplemented with 2.5 g/cow/day of probiotic yeast *Saccharomyces cerevisiae* (2.5x 10^{10} CFU/day) and the second group (control) was without the yeast. The study showed that supplementation with 2.5 g of yeast *Saccharomyces cerevisiae* per cow per day or 2.5×10^{10} CFU/day tended (P < 0.06) to increase milk production by 1.1 kg/cow. Further it was seen that there was a significant increase of fat (P < 0.01; 52.8 and 46.9 g/cow/day) and protein (P < 0.05; 41.7 and 38.7 g/cow/day) content both for treated and control group, respectively. It is concluded that supplementation of *Saccharomyces cerevisiae* at 2.5x 10^{10} CFU/day in the diet of dairy cows may have positive influence on milk fat and protein yield (g/cow/day).

Azzaz *et al.* (2015) evaluated the effect of yeast culture (*Saccharomyces cerevisiae*) supplementation either alone or in combination with *Propionibacterium freudenreichii* strain P169 on nutrient digestibility coefficients, blood metabolites, milk yield and milk composition of mid lactating buffaloes. Fifteen lactating buffaloes, 2 months after parturition, were randomly divided into three groups, 5 animals in each group, using complete random design. The experiment lasted for two months, buffaloes were fed dry matter according to 3% of their mean body weight. The experimental groups were fed on: (1) Control ration (consisted of 50% concentrate feed mixture (CFM), 30% corn silage, 10% dried sugar beet pulp and 10% rice straw), (2) Control ration+50 g Yeast Culture (YC)/head/day and (3) Control ration+50 g YC+4 g propionibacteria, P169, (YC+P169)/head/day. The supplementation of YC or YC+P169 improved (p<0.05) all nutrients digestibility but significantly decreased (p<0.05) blood plasma urea nitrogen of treated buffaloes. Milk and 4% fat corrected milk yields were significantly increased (p<0.05) while milk fatty acids were unaffected by YC or YC+P169 supplementation. In conclusion, rations supplementation with YC or YC+P169 had beneficial effects on the buffaloes productivity with no deleterious effects on animals health.

Bakr *et al.* (2015) investigate the effects of *Saccharomyces cerevisiae* feeding on rumen, blood and milk parameters together in high producing dairy cattle during the transition and early lactation period. Sixteen clinically healthy Holstein cows were divided into 2 groups: a control group of 6 cows and a probiotics-fed group of 10 cows. Milk production and milk fat percentage were higher, whereas milk protein percentage and somatic cell count were decreased in yeast-supplemented cows throughout the study. These results suggest that supplementation of *S. cerevisiae* to dairy cows rations during transition and early lactation period improves their health and milk production parameters.

Luan *et al.* (2015) evaluated the effects of a direct fed microbial -DFM (*Bacillus pumilus* 8G-134) on pre- and postpartum performance. In early lactation Forty-three multiparous Holstein cows were assigned to 2 treatments in a randomized complete block design; cows in the direct-fed microbial treatment (DFM, n=21) received 5.0×10^9 cfu/cow of *B. pumilus* in 28 g of a maltodextrin carrier, whereas cows in the control treatment (CON, n=22) received 28 g of maltodextrin carrier alone. Treatments were top-dressed on the total mixed ration daily. Treatments were applied from 21 d before expected calving date to 154 d after calving. Cows fed DFM had higher yields of milk, fat-corrected milk, energy-corrected milk, milk fat, and milk protein during the second week of lactation than CON; however, they found no differences between treatments on milk yield and milk components overall. Cows on DFM tended to have higher feed conversion and to have lower prevalence of subclinical ketosis (beta-hydroxybutyrate >1.2 mmol/L) on d 5 than cows fed CON. Dry matter intake, body weight, and body condition score were not affected by DFM supplementation. Milk production efficiencies (calculated based on fat-corrected milk and energy-corrected milk) were higher by 0.1 kg of milk per kilogram of dry matter intake in cows that received DFM compared with cows that received CON. Cows fed DFM tended to have higher feed conversion and evidence for greater immunity than CON.

Supplementation with *B. pumilus* 8G-134 may provide benefits for transition cow health and milk production efficiency as a probiotic for dairy cows.

Shreedhar *et al.* (2016) conducted experiment on Twenty-four HFxDeoni cross bred cows were divided into four groups (6 cows in each group) on the basis of average milk yield, parity and stage of lactation. T_0 (control group) cows were not supplemented with probiotic. T_1, T_2 and T_3 (treatment groups) cows were fed with 10, 15 and 20 g probiotics per day, respectively, just before morning milking. The multi strain probiotic contained *Saccharomyces cervisiae* and *Lactobacillus sporogenes.* The increased in milk yield was observed from 8.31, 8.26 and 8.48 lit. /day to 8.97, 9.64 and 9.68 lit. /day in T_1, T_2 and T_3 group (highly significant; $P<0.05$), respectively, compared to from 8.45 to 8.57 lit. /day in T_0 group. Milk yeild were significantly higher in cows (T_1, T_2 and T_3) supplemented with probiotics than T_0. The freezing point decreased in T_1, T_2 and T_3 groups indicating increase in the total solids of milk compared to T_0. There were minor changes in ash content of milk by feeding probiotics. Economically, supplementing the diet with probiotic earned more profit and feeding @ 15 g probiotic/day/animal was found more beneficial than feeding @ 10 and 20 g/day/cow.

Musa (2017) conducted trial on Twelve (12) Holstein Friesian crossbred lactating cows to compare the effects of sodium bicarnate (bicarb), multi-strain probiotics (probiotics) and their interaction on milk yield and milk composition. The cows were grouped in to four (4) with three (3) cows in each treatment group. They were fed according to treatment group viz: T_0 compounded feed (control), T_1 compounded feed + 120 g sodium bicarbonate, T_2 compounded feed + 10g probiotics and T_3 compounded feed + 100 g sodium bicarbonate + 5 g probiotics. The experiment lasted for a period of 21 days including 10 days adaptation period. The milk mean fat percent was significantly ($p>0.05$) higher in T_1 than T_0 followed by T_3 and T_2. Milk yield and lactose were also significantly increased ($p>0.05$) by inclusion of probiotics, inclusion of probiotics + bicarb than control group. However, milk acidity, protein percent, SNF and CLR was not significantly influenced by test ingredient. The results indicate interaction of bicarb + probiotics did not have any unique influence on milk yield or its composition as compared to individual test ingredients in different treatment.

Hansen *et al*. (2017) studied the effect of the dietary yeast supplement, *S. cerevisiae* (Yea-Sacc[1026]), on primiparous (PP) and multiparous (MP) Egyptian buffaloes in early to mid-lactation. Lactating buffaloes were fed either a basal total mixed ration (TMR, control; 4 PP and 8 MP) or the basal TMR plus 10 g Yea-Sacc[1026] per buffalo per day (yeast; 4 PP and 8 MP). Yeast treated MP buffaloes consumed more DM ($P \leq 0.041$) and CP than the untreated control group. Apparent digestibility of DM and OM were significantly greater at mid-lactation for treated versus control group ($P = 0.001$). Crude fibre digestibility was greater in MP than in PP buffaloes ($P = 0.049$), and yeast supplemented MP cows had a greater CF digestibility than control MP buffaloes at mid-lactation ($P = 0.010$). Milk yields, ECM, fat and protein yields increased for yeast treated MP buffaloes ($P \leq 0.039$). The study concluded that the response to yeast supplementation in buffalo cows is parity dependent. Multiparous buffaloes respond to yeast supplementation with an increased DM intake and CF digestibility without significant weight gains, allowing a greater ECM yield with less fat mobilization. Supplementing buffaloes with yeast culture may increase milk production in early lactation and results in a more persistent milk production during mid-lactation. Feed conversion and energy and nitrogen conversion efficiency may be increased with the use of yeast supplementation in Egyptian buffaloes.

Acharya and Dhital (2018) conducted trial on twenty crossbred cattle which were randomly divided into five treatment groups. Each group had four animals arranged in Complete Randomized Design (CRD). Among five treatment groups, treatment (T_1) was fed with 0.5 kg/MT of live yeast *Saccharomyces cerevisiae* (SC) incorporated feed, treatment (T_2) with 1 kg/MT *Saccharomyces cerevisiae* , treatment (T_3) with 1.5 kg/MT SC, treatment (T_4) with 2 kg/MT SC and treatment (T_5) as control without any live yeast inclusion in feed. Supplementation of the live yeast up to seventh day of the trial had statistically non-significant (P>0.05) effect on average milk yield per cattle between the treatments. Response of the yeast on mean milk yield per cattle between the treatments was found statistically different

($P<0.05$) on fourteenth day and twenty-eight day of the trial. On fourteenth day mean milk yield of control group (T_5) was significant lower when compared with highest dose rate inclusion T_4 only but remained non-significant with the rest of the lower dose rate treatments. With further supplementation of the yeast up to 28th day of the trial, results showed the statistically significant effect with lower dose rate T_2 as well with respect to control group besides T_4. Hence, the result of this experiment indicates that supplementation of live yeast for at least 14 days has role in the enhancement of milk production in crossbred dairy cattle with faster effect by dose rate of T_4 treatment.

2.2 Effect of rumen buffer

Buffer is a water based solution containing a mixture of either an acid and its conjugate base, or a base and its conjugate acid. The risk of acidosis is highest when large volumes of rapidly fermented concentrates are fed, the addition of buffer in dairy ration neutralize excess acid within the rumen or animal digestive system. Sodium bi-carbonate is a widely used as buffering agent in ruminant ration. The high yielding cows and buffaloes required more amount of nutrients which can be fulfilled by feeding more amount of concentrate. However, feeding of higher amount of concentrate may lead to acidosis in animals. Supplementation of buffers through diet may reduce chances of acidosis.

Erdmann *et al.* (1982) conducted two experiment to evaluate effect of supplementation of Sodium bicarbonate (1%) and Magnesium oxide (8%) in Holstein and jersey cows. In Experiment 1, twenty Holstein and four Jersey cows, intake and milk production were not affected by treatment through 12 wk postpartum. In digestion trials at 3, 6, 9, and 12 weeks postpartum, addition of magnesium oxide increased digestibility of dry matter by 1.8% units. Starch digestion was decreased 1.8% units by sodium bicarbonate whereas acid detergent fiber digestion increased 9 to 12% units with addition of either buffer. In Experiment 2, with four fistulated Holstein cows in a Latin square design, intake per unit body weight was increased 0.18% units by dietary sodium bicarbonate while milk production was unaffected. Dry matter and acid detergent fibre digestion were increased slightly by sodium bicarbonate. Milk fat percent increased 0.5 to 0.9% by addition of either buffer in both experiments and resulted in corresponding increases in fat-corrected milk.

Khorasani and Kennelly (2001) studied the effects of concentrate-to-forage ratio and buffer on rumen fermentation and production parameters, the effects were examined in four rumen-cannulated cows (240 ± 18 d in milk) fed a total mixed ration *ad libitum* in a 4 × 4 Latin square design. The treatments were a 50:50 concentrate to forage ratio with [1.2% of dry matter, (DM)] and without (0% of DM) buffer and a 75:25 concentrate to forage ratio with (1.2% of DM) and without (0% of DM) buffer. Rumen pH declined in response to increased concentrate but was not influenced by buffer. The milk fat concentration was lower for cows fed the high concentrate diet without buffer; however, the addition of buffer to the diet prevented the milk fat depression. Milk fat depression was associated with elevated trans-C18:1 fatty acids in milk, which provides additional support for an inhibitory effect of these fatty acids on mammary fat synthesis. We concluded that the potential of nutrition as a tool to alter milk composition is greater in later lactation as these animals are better able to cope with the negative effects of high grain diets, and the treatment response is greater than in early lactation.

2.3 Digestibility

Wohlt *et al*. (1998) conducted trial on Thirty-six multiparous Holstein cows which were fed a mixture of corn silage and concentrate [1:1; dry matter (DM) basis] and long hay (0.9kg/d) through week 18 of lactation. Beginning at 30 day pre-partum through week 4 of lactation, the total mixed rations of 18 of these cows were top-dressed daily with 10 g of Bio-mate® Yeast Plus® (Chr.Hansen’s, Inc., Milwaukee,WI). The other 18 cows served as controls. At week 5, both control and treated cows were divided into three groups and fed 0, 10, or 20 g/d of yeast. Yeast supplementation during early lactation significantly improved DM intake, milk yield, and the digestibility of crude protein and acid detergent fiber. Least squares means for DM intake, fat-corrected milk yield, crude protein digestibility, and acid detergent fiber digestibility for cows fed 0, 10, 20 g/d of yeast during week 5 to18 of lactation were 23.8, 24.7, and 25.0 kg/d; 37.7, 40.7 and 41.4 kg/d; 78.5, 80.8, and

79.5%; and 54.4, 60.2 and 56.8% respectively. Although numerical responses in DM intake and milk yield were greater for cows fed 20 g/d of yeast than for cows fed 10 g/d of yeast, the response was not significant.

Dutta and Kundu (2008) studied the effect of feeding probiotics culture in triple combination (*Saccharomyces cerevisiae*, *Lactobacillus plantarum* and *Enterococcus faecium*; ratio 6: 2: 2, total dose 10×10^9cfu/animal) in crossbred mid lactating cows, the effect was assessed in term of the lactation performance and nutrient utilization. Dry matter intake /100 kg body weight tended to increase due to inclusion of probiotics culture and significant between control (T_1) and treatment groups (T_2) in second, fourth and sixth fortnights. Crude protein intake (CPI)/100 kg body weight was not affected due to probiotics supplementation. Addition of probiotics increased milk yield (kg/day/animal) significantly from 10.16 kg in T_1 to 10.60 kg in T_2. Fat corrected milk (kg) yield was also increased significantly due to probiotics supplementation from 9.94 kg (T_1) to 10.34 kg/day (T_2). The milk production efficiency (kg milk/kg DMI) was higher in T_2 (0.90) than T_1 (0.88). Probiotics supplementation had no impact on milk fat percentage. Total milk solid, protein and milk ash per cent remained unaffected due to mixed culture supplementation. Digestible organic matter (DOM) intake and TDN intake per kg$W^{0.75}$ were significantly higher in T_2 over T_1. Digestible crude protein (DCP) intake/$W^{0.75}$ kg followed the same trend; 4.25 MJ extra ME and 2.24 MJ NE were consumed by probiotics supplemented animals at similar level of DMI in both the groups, which could be the reason for higher milk yield due to probiotics addition.

Khorasani and Kennelly (2001) studied the effects of concentrate-to-forage ratio and buffer on rumen fermentation and production parameters in four rumen-cannulated cows (240 ± 18 d in milk) fed a total mixed ration *ad libitum* in a 4 × 4 Latin square design. The treatments were a 50:50 concentrate to forage ratio with [1.2% of dry matter, (DM)] and without (0% of DM) buffer and a 75:25 concentrate to forage ratio with (1.2% of DM) and without (0% of DM) buffer. Rumen pH declined in response to increased concentrate but was not influenced by buffer. The milk fat concentration was lower for cows fed the high concentrate diet without buffer; however, the addition of buffer to the diet prevented the milk fat depression. Milk fat depression was associated with elevated trans-C18:1 fatty acids in milk, which provides additional support for an inhibitory effect of these fatty acids on mammary fat synthesis. It was concluded that the potential of nutrition as a tool to alter milk composition is greater in later lactation as these animals are better able to cope with the negative effects of high grain diets, and the treatment response is greater than in early lactation.

Clark *et al.* (2009) conducted trial to investigate the effects of sodium sesquicarbonate on dry matter intake, body weight, milk production and its composition during a 308-d lactation in a Forty six multiparous lactating cows. Diets contained alfalfa silage, corn silage, and concentrate. Composition of diets was changed twice during the 308- d lactation experiment. Diets fed during d 1 to 175 and d 176 to 245 were formulated to contain more rumen undegradable protein and fat, and less forage than that fed during d 246 to 308. Sodium sesquicarbonate did not affect yields of milk, 4% fat-corrected milk, and components in milk, or percentages of components in milk during the complete 308-d lactation or during d 1 to 175 or d 176 to 245. However, from d 246 to 308, cows fed sodium sesquicarbonate produced more milk, 4% fat-corrected milk, fat, protein, and solids-not-fat than did control cows. Milk composition was not altered. These data suggest that composition of the diet has a significant effect on the response to dietary buffers by lactating dairy cows.

2.4 Somatic cell count

The Somatic Cell Count (SCC) is a main parameter which decides milk quality. The SCC in the milk increases after calving when colostrum is produced before the cow settles into lactation, and tends to rise towards the end of lactation, most likely due to the concentrating effect of lower amounts of milk being produced. Somatic cell count in milk indicates mammary health. Low SCC present in milk indicates high quality milk with normal appearance i.e. no clots seen in milk. Various studies with probiotic and rumen buffer added in diet of lactating animals revealed and fluctuating results for changes in SCC.

Swartz *et al*. (1994) evaluated effect of supplementation of two *Saccharomyces cerevisiae* yeast cultures containing about 10^8 cfu/g viable yeast cells on milk production and its composition in 306 lactating Holstein cows in the first 120 d of lactation from seven farms of Pennsylvania. Cows were fed individually and grouped into three blocks based on lactation numbers 1, 2, and 3 or greater, and, within block, randomly assigned to one of three treatments for a 14-wk study. The three treatments were 1) control, 2) yeast culture fermented on ground corn- meal and corn gluten meal (5.3 x 10^{10} cfu /d per cow), and 3) yeast culture fermented on cornmeal and soybean meal (5.1 x 10^{10} cfu /d per cow). The three treatments were mixed with cornmeal and 114 g per cow was fed daily as a top-dressing. All obtainable cows were delegated to the experiment but the cow had a history of high SCC mammary health problems. The conclusion of the experiment demonstrate SCC did not differ among treatments and FCM tended to be higher for treatment than for the control cows.

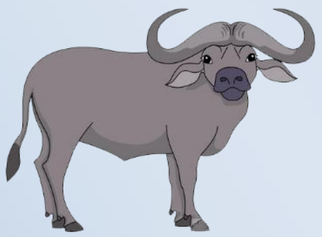
Dann *et al.* (2000) studied effect of supplementation of Yeast cultures (*Saccharomyces cerevisiae*) during pre-partum and post-partum period in 14 primigravid and 25 multigravid jersey cows. The selected cows were divided into two groups (control and treatment)1.control- fed total mixed rations prepartum and postpartum that were not supplemented with YC and 2. treatment - fed total mixed rations prepartum and postpartum that were supplemented with YC (60 g/d) The result of the experiment showed that cows supplemented with YC increased DMI more rapidly than non- supplemented cows, cows supplemented with YC reached peak milk production more quickly than did non- supplemented cows. Concentrations of fat, protein, lactose, total solids, and somatic cell count, were not significantly affected by YC.

Nocek *et al*. (2011) conducted trial on 150 multiparous cows were balanced to 1 of 3 treatments (2 pens/trt) according to previous lactation 305-d mature equivalent yield to evaluate supplementation of yeast culture and YC plus enzymatically hydrolyzed yeast (EHY) on production performance in dairy cattle which were randomly divided into 3 groups in which 1.control group: is non supplemented YC. 2. treatment group: control diet with added yeast culture (YC) 56 g/d and 3. treatment group: yeast culture + enzymatically hydrolysed yeast (YC+EHY) 28 g per day with control diet. Mean pen dry matter intake was similar across treatments. Treatment group with YC and YC+EHY produced more milk, fat-corrected milk, and energy-corrected milk than control group (1.4 and 1.6, 1.6 and 1.8, 1.7 and 1.9 kg, respectively). Treatments YC and YC+EHY did not differ. Milk fat and lactose percentages were not affected by treatment. Milk protein percentage was higher for cows supplemented with YC+EHY than for those on YC and control treatments (2.98, 2.93 and 2.91%, respectively) with control and YC-supplemented cows not being different from each other. Somatic cell count was higher for cows fed control and YC diets compared with YC+EHY, primarily during week 8 to 14 of trial. Supplementation of early lactation cows with YC improved milk production performance; furthermore, EHY supplementation improved milk protein percentage and reduce somatic cell count in milk i.e improve mammary gland health.

Degirmencioglu *et al*. (2013) carried out study to determine the effect of *Saccharomyces cerevisiae* (SC) addition on dry matter intake, milk yield, milk composition and somatic cell count in Anatolian water buffalo diets (AWB). The SC-treated groups (n = 5 buffalo /group) received 30.0 g of SC per buffalo per day. Compared to the control group, the SC-treated group consumed more total dry matter ($P<0.05$; 14.27 vs. 13.50 kg/day) and produced more milk/day ($P<0.01$; 7.13 vs. 6.22 kg/day). Dietary yeast inclusion significantly increased alfalfa dry matter intake during a 28-day lactation period ($P<0.01$; 10.41 vs. 9.81 kg/day) compared with the control diet. Yeast application significantly reduced the somatic cell count (SCC) in milk ($P<0.05$; 3.33 and 1.08 SCC (log 10/mL) for control and SC-treated groups, respectively). The fat (58.40 and 59.00 g/kg), non-fat solids (120.00 and 122.80 g/kg), protein (46.40 and 46.26. g/kg) and lactose components of milk (37.72 and 38.90 g/kg) were similar for both groups. The response of the AWB to supplemental yeast addition improved forage intake and daily milk production but did not affect milk composition. In conclusion, it has been thought that farmers with AWB can benefit from the use of yeast cultures in early lactation diets.

Anjum *et al.* (2018) evaluated the effects of dietary supplementation of rumen yeast (RY) in Nili-Ravi buffaloes, 16 buffaloes with 8 L average daily milk production were randomly divided into two groups, and investigated for a 60-day period. Group I (control) was offered maize silage *ad libitum* as sole forage plus 3 kg of concentrate/head per day (16% crude protein (CP) and 72% total digestible nutrients (TDN)), while group II was given the same diet as control supplemented with RY (14 g/head per day). Feed intake, nutrient digestibility, rumen fermentation and milk production of each animal were recorded. Average dry matter (DM) intake was not affected (P>0.05) in buffaloes with or without RY (14.7 and 14.3 kg/day, respectively). Digestibility of DM, CP, and ruminal pH were similar (P>0.05) between the groups, but the digestibility coefficients of neutral detergent fiber and acid detergent fiber were greater (P<0.05) for the animals that received RY. Milk production (9.60 vs. 9.15 L/day) and 4% fat corrected milk (FCM) (11.32 vs. 11.85 L/day) were significantly (P<0.05) greater in the buffaloes fed with RY than the control group. Milk composition was similar between the experimental groups, however, milk somatic cell count (SCC) was significantly (P<0.01) lower in RY supplemented buffaloes than the control animals. In conclusion, feeding RY had positive effects on milk production, fibre digestibility and SCC in buffaloes fed maize silage-concentrate based diet.

Materials & Methods



3. MATERIALS AND METHODS

The present experiment was carried out at M. S. Patel Buffalo Farm, Unit No.13, Aarey Colony, Goregaon, Mumbai-400065 and in the Department of Animal Nutrition, Mumbai Veterinary College, Parel, Mumbai 400012. The buffaloes in the early stage of lactation phase were used for this study. In this experiment, the effect of combined supplementation of probiotics and rumen buffer on performance of lactating buffaloes was evaluated in terms of milk yield and it composition, digestibility of nutrients and economics of milk production.

3.1 Experimental animals

Twelve Murrah buffaloes in early stage of lactation were used in this experiment. Animals were selected on the basis of breed, stage of lactation and daily milk yield. The selected buffaloes were divided into two groups of six each. The details of the buffaloes selected for the experiment are presented in Appendix-1

3.2 Plan and Design of Experiment

The selected buffaloes were divided into two groups viz. control (T_0) and treatment (T_1) of six each. The control group received concentrate mixture as per the practice of farm. Treatment groups received same concentrate mixture along with combined probiotics and rumen buffer (10 g) feed supplement. In control and treatment groups roughages feeding and all the management practices were same except dietary treatments.

During trial period , the observation pertaining to daily milk yield, weekly milk composition and feed intake were recorded for both (control and treatment) the groups. The milk composition was studied in terms of milk protein, fat, total solids and SNF at weekly interval. The weekly efficiency of feed utilization was also calculated in terms of DM, TDN and DCP intake per kg FCM yield. The somatic cell count of milk was determined at fortnightly interval. The economics of milk production was also studied.

During last week of the experiment, a digestion trial of seven days period was undertaken with total collection method to study the digestibility of various nutrients for both the groups. The experiment lasted for 13 weeks.

3.3 Experimental Feeds and Feeding Schedule

The experimental groups were randomly allotted to different feed treatments. The details of feed treatments allotted are given below.

T_0 (Control): Received standard concentrate mixture.

T_1 (Treatment): Fed as per group T_0 Plus supplemented with probiotics and rumen buffer @ 10g /head/per day.

Composition of Probiotics and Rumen Buffer

Live Yeast count (*Saccharomyces cerevisiae*)	Min 20×10^{12}	CFU/kg
Bacillus Spores	Min 3×10^{11}	CFU/kg
Buffer- Soda-bicarbonate	62.7	Percentage

The feed ingredients were purchased from local market in bulk quantities. The concentrate mixture was prepared as per BIS 1990 (Type-II) standards. It was compounded fresh everyday by hand mixing on the farm. The prepared concentrate mixture was soaked in water for 6-8 hours before feeding. The concentrate mixture allowance required per day was fed in two installments i.e. 1:30 AM and 2:00 PM just before milking. The animals were offered paddy straw for two times a day and paragrass once in a day as per practice of the farm.

Daily feed intake was recorded group wise for the both groups. The representative samples of concentrate mixtures, paddy straw, para grass, were collected at weekly interval, oven dried and stored for further analysis. At the end, representative pooled samples were analyzed for chemical composition. The chemical composition of concentrate mixture, roughage (paragrass and paddy straw) is presented in Table 1.

Table 3.1. Average chemical composition (% DMB) of concentrate mixture, paragrass and paddy straw

Nutrient %	Concentrate mixture (For all the groups)	Paragrass	Paddy straw
Moisture	8.86	63.65	7.57
Organic matter	94.27	88.78	87.13
Crude protein	15.96	7.89	3.25
Ether extract	4.26	2.85	1.23
Crude fibre	14.00	26.74	35.36
Nitrogen free extract	60.05	51.3	47.29
Total ash	5.73	11.22	12.87
Calcium	1.15	0.25	0.41
Phosphorus	0.41	0.21	0.18

3.4 Housing, Management and Health Care:

The animals were housed in well constructed shed with adequate ventilation, flooring and tying arrangements. Normal standards of hygiene, management, feeding practices, vaccination and deworming programs were followed for all the experimental buffaloes throughout the experimental period. Animals were let loose daily twice in an open paddock for watering and exercise.

Observations Recorded

The following observations were recorded during the entire experimental period of 13 weeks:

1. Milk samples from all experimental buffaloes were collected individually at weekly interval for estimation of fat, protein, SNF, total solids and lactose
2. Fortnightly milk somatic cell count

3. Digestibility for CP, CF, EE, and NFE
4. Week wise efficiency of feed utilization in terms of DM, DCP, and TDN intake per kg FCM yield
5. Daily milk production of individual animal at weekly interval
6. Average daily feed intake of concentrate mixture and roughages at weekly interval of individual animal from both the groups, offered as per the practice of farm
7. Economics of milk production

3.5 Digestibility Trial

In the last week of the experiment a digestibility trial of seven days duration was conducted by total collection method. Three animals from both groups were selected for the digestibility trial. The buffaloes were tied separately with sufficient space to avoid eating of feed/fodder of each other. During trial period daily intake of the concentrate mixture, paragrass and paddy straw was recorded individually. Total quantity of feces voided during 24 hours period by individual buffalo was recorded. Daily 1/200th part of feces voided by each buffalo was oven dried to constant weight for moisture estimation and the pooled dried samples for seven days were used for proximate analysis. Daily 1/400th part of total fecal matter was preserved animal wise for nitrogen estimation. Sulfuric acid (5% w/v) was used at the rate of 10 ml/50 g of fecal sample as a preservative and animal wise pooled samples were used for protein estimation.

3.6 Analysis of Feed, Fodders and Milk Samples

The representative samples of concentrate mixtures, dry roughages (paddy straw) and green fodder (paragrass) used for feeding of experimental buffaloes were collected at fortnightly interval throughout the experimental period, oven dried and the pooled samples were analyzed. The analysis for proximate principles and phosphorus was undertaken as per A.O.A.C. (2005) and calcium and phosphorus estimation was done as per Talapatra *et al*. (1940) in the laboratory of Department of Animal Nutrition, Mumbai Veterinary College, Parel, Mumbai - 400012.

The Composition of milk in relation to Total solids, Fat, Protein, Solids Not Fat (SNF) was studied at weekly interval with the help of Milkoscan (auto analyzer) available in the Department of Livestock Product Technology at Mumbai Veterinary College, Goregaon Campus Mumbai. The fat corrected (7%) milk yield was calculated by using following formula given by Raafat and Saleh (1962).

$$7\ \%\ FCM\ (Kg) = (0.265 \times \text{milk yield in kg}) + (10.5 \times \text{fat yield in kg})$$

Somatic cell count ($SCC \times 10^5$ / ml of milk) of milk was determined with the help of DeLaval optical cell counter by using stained cassette with a DNA specific fluorescent reagent.

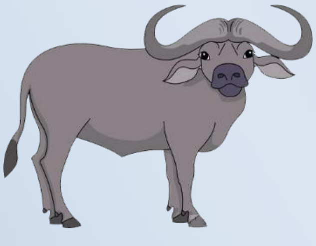
3.7 Economics:

Group wise average daily total feed cost per buffalo was calculated based on the average consumption of concentrate mixture, paragrass and paddy straw and supplements was calculated separately. Gross returns from sale of milk from both the experimental groups were calculated considering average daily milk production per animal over 13 weeks period and farm selling price of ₹65 per kg of milk. Daily gross profit per buffalo was worked out taking into account, average daily feeding expenses and milk production per buffalo and sale price of milk.

3.8 Statistical analysis

Observations of various parameters recorded during experimental period were tabulated and data were statistically analyzed as per Snedecor and Cochran (1994) by using Complete Randomized Design.

Results & Discussion



4. RESULTS AND DISCUSSION

The present experiment was conducted on Murrah buffaloes at M. S. Patel buffalo Farm, Unit No.13, Aarey Colony, Goregaon, Mumbai-65, and in the Department of Animal Nutrition, Mumbai Veterinary College, Parel, Mumbai 400012. This farm has standard housing, feeding and management practices with standard health care. In this experiment, the effect of supplementation of probiotics and rumen buffer on performance of lactating Murrah buffaloes in terms of milk yield and milk composition (milk protein, total solids, solids not fat, fat, lactose), feed intake, milk SCC and feed efficiency in terms of DM, DCP and TDN intake per kg FCM yield and economics of feeding was also worked out. The detail findings for the above parameters are presented here with.

4.1 Dry matter intake

The weekly average daily dry matter intake of two experimental groups of buffaloes is presented in Table 4.1. The same is presented graphically in Figure 4.1.

It was recognized from the information that the average daily dry matter intake (DMI) of buffaloes ranged from 15.2-15.84 kg. The average daily dry matter intake of buffaloes in control (T_0) and treatment groups (T_1) was 15.36 and 15.48 kg respectively, during 13 weeks period. It is observed from present study that buffaloes from the treatment group consumed on an average 0.78% additional dry matter (DM) during the course of the experiment than control group.

The experimental data for average DMI were subjected to statistical analysis by using paired t-test and result is presented in Table 4.1 and the result revealed that treatment group showed significant ($P< 0.01$) increases in average daily dry matter intake. This indicated that the supplementation of probiotics and rumen buffer has encouraging effect on DMI of the buffaloes.

The results of present study corroborated with Dutta and Kundu (2008) who reported that supplementation of probiotics culture in triple combination (*Saccharomyces cerevisiae*, *Lactobacillus plantarum and Enterococcus faecium*) ratio 6: 2: 2 to crossbred mid lactating cows significantly increases DMI.

Table 4.1 Weekly average daily dry matter intake (kg) of buffaloes from both the experimental groups

Weeks	Groups	
	Control (T_0)	**Treatment (T_1)**
1	15.20	15.34
2	15.28	15.49
3	15.28	15.57
4	15.33	15.60
5	15.38	15.54
6	15.46	15.77
7	15.43	15.84
8	15.32	15.77
9	15.39	15.66
10	15.41	15.66
11	15.46	15.71
12	15.32	15.64
13	15.38	15.48
Average ± SE	**15.36 ± 0.021**	**15.62 ± 0.038**

Significance $t_{24} = P < 0.01$

Wohlt *et al.* (1998) observed that Bio-mate® Yeast Plus® (Chr.Hansen's, Inc., Milwaukee, WI) supplementation during early lactation period significantly improved DMI in Holstein cows.

Similarly, Dann *et al.* (2000) and Degirmencioglu *et al.* (2013) also found that Yeast cultures (*Saccharomyces cerevisiae*) supplemented Jersey cows consumed significantly more DMI than non- supplemented group.

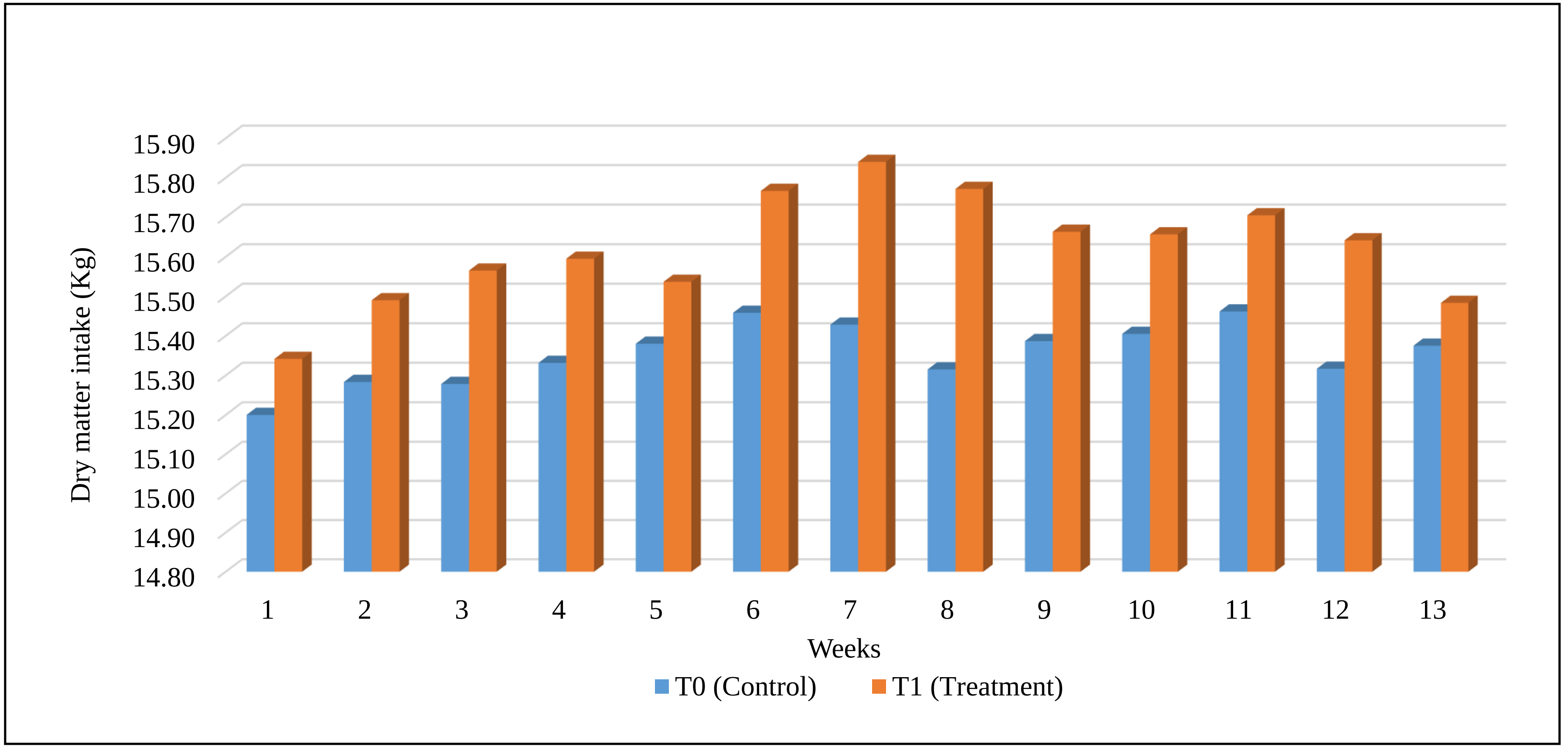


Fig 4.1 Week wise average daily dry matter intake (kg) of buffaloes from both the experimental groups

Opposing to the findings of present study, Alzahal *et al.* (2014) found that supplementation of direct-fed microbial (5.0×10^9 cfu/d of 3 strains of *Enterococcus faecium* and 2.0×10^9 cfu/d of *Saccharomyces cerevisiae*) (DFM) in diet had no effect on DMI of Holstein Friesian cows.

4.2 Milk yield

The weekly average daily milk yield of both experimental groups of buffaloes for 13 weeks duration is presented in Table 4.2. The same is presented graphically in Figure 4.2.

It was observed from the data that the average daily milk yield of buffaloes ranged from 9.24 to 10.06 kg. The average milk production in control (T_0) and treatment group (T_1) was 9.47 and 9.89 kg, respectively, during 13 weeks experimental period. It was revealed from present study, that the average daily milk production of the treatment group (4.43%) was higher than control group during the course of experiment. This indicated that combination of probiotics and rumen buffer had positive effect on milk production of buffaloes.

The experimental data for weekly average milk yield were subjected to statistical analysis by using paired t-test and result is presented in Table 4.2 and the result indicated that average daily milk yield of buffaloes from treatment group was significantly ($P < 0.01$) higher than control group receiving ration without yeast culture and rumen buffer. This indicating that the supplementation of probiotics and rumen buffer had beneficial effect on milk yield of the buffaloes.

Related findings are reported by Acharya and Dhital (2018) studied the effect of supplementation of different level of *Saccharomyces cerevisiae* (SC) and compare with control i.e. non supplemented group in crossbred cows and observed that supplementation of SC resulted in significant increase in milk yield than control group but there was no significant difference observed between treatment groups.

Anjum *et al.* (2018) observed highly significant (P<0.05) (9.60 vs. 9.15 L/day) increase in milk yield in Nili-Ravi buffaloes supplemented with rumen yeast.

Table 4.2 Weekly average daily milk yield (kg) of buffaloes from both the experimental groups

Weeks	Groups	
	Control (T_0)	**Treatment (T_1)**
1	9.39	9.64
2	9.49	9.80
3	9.48	9.91
4	9.54	9.93
5	9.56	9.98
6	9.57	10.06
7	9.43	10.03
8	9.24	9.97
9	9.50	9.75
10	9.62	9.99
11	9.25	9.91
12	9.38	9.82
13	9.64	9.81
Average ± SE	**9.47 ± 0.04**	**9.89 ± 0.03**

Significance t_{24} = P< 0.01

Yalcin *et al.* (2011) also reported significant increase in milk yield in lactating cows from treatment group supplemented with live yeast culture (Rumisacc *Saccharomyces cerevisiae).*

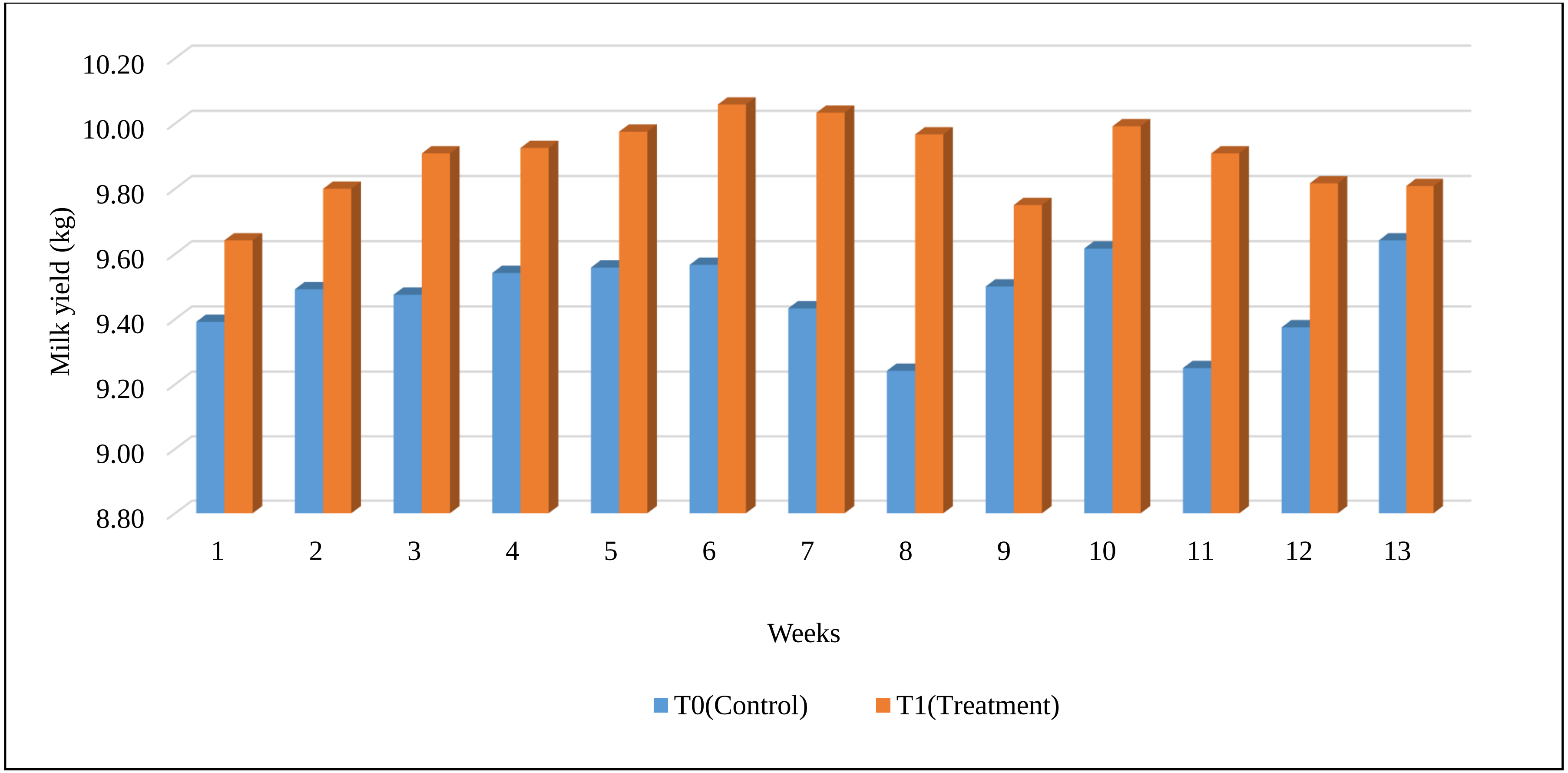


Fig 4.2 Week wise average daily milk yield (kg) of buffaloes from both the experimental groups

Contrary finding reported by Nikkhah *et al*. (2004) who observed that supplementation of different levels of *Saccharomyces cerevisiae* SC47 in lactating dairy cow had no effect on milk yield. Similar findings of non-significant changes in the milk yield after supplementation of 15 and 20 g yeast culture to the cows were reported by Soder and Holden (1999).

4.3 Fat corrected milk yield

The weekly average daily milk production data were corrected to 7% fat and the average daily FCM yield was calculated for both experimental group and it is presented in Table 4.3. The same is depicted graphically in Figure 4.3.

It was showed from the data that the average daily FCM yield of buffaloes fed experimental diet was ranged from 9.26 to 10.94 kg. During 13 weeks trial period. Average FCM yield in control (T_0) and treatment group (T_1) was 9.73 and 10.54 kg, respectively.

It is seen from present study that the average daily FCM yield of buffaloes from the treatment group was 8.32 % higher compare to buffaloes from control group, during the course of experiment. It showed advantageous effect of combination of probiotics and rumen buffer on FCM yield of buffaloes.

The experimental data for weekly average FCM were subjected to statistical analysis by using paired t-test and result is presented in Table 4.3. The result showed that buffaloes from treatment group showed significantly ($P < 0.01$) higher average FCM yield than buffaloes from control group. It showed positive effect of supplementation of yeast culture and buffer on FCM yield of buffaloes.

Result of present study are similar with Raval *et al.* (2013) who reported that *Saccharomyces cerevisiae*; 1.5×10^8 cfu/g and bacteria, *Lactobacillus sporogens*; 5×10^7 cfu/g supplementation in Kankrej cows linearly increased 4% fat-corrected milk than cows from control group.

Azzaz *et al.* (2015) also observed that yeast culture (*Saccharomyces cerevisiae*) alone or in combination with *Propionibacterium freudenreichii* strain

P169 had significantly increased (P< 0.05) 4% FCM yield in mid lactating buffaloes.

Table 4.3 Weekly average daily fat corrected milk yield (kg) of buffaloes from both the experimental groups.

Weeks	Groups	
	Control (T_0)	**Treatment (T_1)**
1	9.60	9.71
2	9.69	10.42
3	9.87	10.55
4	9.98	10.67
5	10.00	10.61
6	10.06	10.90
7	9.83	10.94
8	9.46	10.58
9	9.80	10.45
10	9.82	10.71
11	9.26	10.65
12	9.44	10.34
13	9.71	10.45
Average ± SE	**9.73 ± 0.07**	**10.54 ± 0.08**

Significance t_{24} = P< 0.01

Contrary observations of present study results, Clark *et al.* (2009) concluded that supplementation of *Sodium sesquicarbonate* did not affect 4% fat-corrected milk in Holstein cow. Similarly, supplementation of 10 g yeast culture per day, showed non- significant change in FCM yield of cows was reported by Biricik and Yavuz (2001).

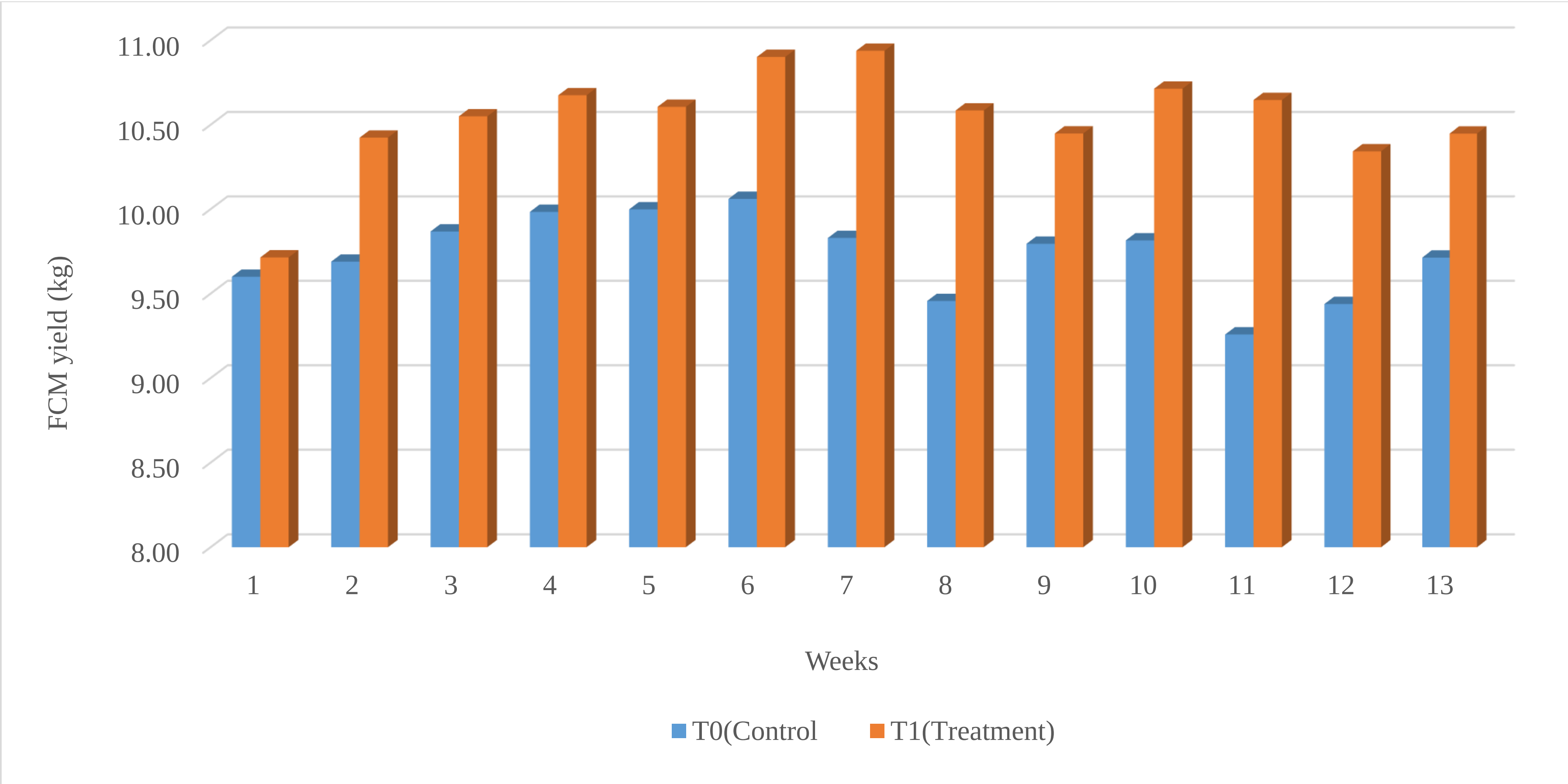


Fig 4.3 Week wise average daily FCM yield (kg) of buffaloes from both the experimental groups

The increase in milk yield and FCM yield observed in treatment group supplemented with probiotic and rumen buffer might be due to favorable condition provided by probiotics for multiplication and functioning of rumen microorganisms which in turn resulted in better digestion and utilization of feed nutrients for milk production. Similarly, the rumen buffer also might have helped in stabilization of rumen pH to normal there by creating conducive environment for rumen fermentation and nutrient utilization for milk production.

4.4 TDN intake

The weekly average daily TDN intake of both experimental groups of buffaloes is presented in Table 4.4.

It is observed from the data that the average daily TDN intake of experimental buffaloes ranged from 9.52-9.96 kg. The average daily TDN intake of control (T_0) and treatment group (T_1) was 9.62 and 9.82 kg, respectively, during, 13 weeks period. It was concluded from present study that the average daily TDN intake of treatment group was 2.07 % higher than control group during the course of experiment.

The experimental data for average TDN intake were subjected to statistical analysis by using paired t-test and result is presented in Table 4.4 and the result indicated that average daily TDN intake of treatment group was significantly ($P< 0.01$) higher than control group.

Result of present study are similar with Srinivas (2009) who reported higher TDN intake in lactating Murrah buffaloes supplemented with thermo tolerant probiotic (Levucell SC 20) than buffaloes from control group supplemented with no probiotic.

4.5 DCP intake

The average daily DCP intake of both experimental groups of buffaloes is presented in Table 4.5.

Table 4.4 Weekly average daily TDN intake (kg) of buffaloes from both the experimental groups

Weeks	Groups	
	Control (T_0)	**Treatment (T_1)**
1	9.52	9.66
2	9.57	9.74
3	9.57	9.78
4	9.60	9.80
5	9.63	9.77
6	9.68	9.91
7	9.66	9.96
8	9.59	9.91
9	9.64	9.85
10	9.65	9.84
11	9.68	9.87
12	9.59	9.83
13	9.63	9.73
Average ±SE	**9.62 ± 0.01**	**9.82 ± 0.02**

Significance t_{24} = P< 0.01

It was realized from the information that the average daily DCP intake of experimental buffaloes ranged from 1.17-1.23 kg. The average daily DCP intake of buffaloes from control (T_0) and treatment group (T_1) was 1.18 and 1.21 kg during 13 weeks period, respectively. It was seen from present study that the average daily DCP intake of buffaloes from treatment group was 2.54 % higher than control group during the course of experiment.

The experimental data for average DCP intake were subjected to statistical analysis by using paired t-test and result is presented in Table 4.5 and the result showed that average daily DCP intake of buffaloes from treatment group was significantly (P<0.01) higher than buffaloes from control group.

Table 4.5 Weekly average daily DCP intake (kg) of buffaloes from both the experimental groups.

Weeks	Groups	
	Control (T_0)	**Treatment (T_1)**
1	1.17	1.20
2	1.17	1.20
3	1.17	1.21
4	1.18	1.21
5	1.18	1.21
6	1.19	1.22
7	1.19	1.23
8	1.18	1.23
9	1.18	1.22
10	1.18	1.22
11	1.19	1.22
12	1.18	1.22
13	1.18	1.20
Average ± SE	**1.18 ± .002**	**1.21 ± .003**

Significance t_{24} = P< 0.01

Dutta and Kundu (2008) concluded that DCP intake per $kgW^{0.75}$ were significantly higher in mid lactating cows supplemented with triple combination *Saccharomyces cerevisiae, Lactobacillus plantarum and Enterococcus faecium* supplemented probiotic than control group.

4.6 Feed efficiency

The efficiency of feed utilization by buffaloes on different feed treatments was calculated in terms of DM, TDN, DCP required per kg of FCM produced.

4.6.1 Dry matter intake (kg) / kg FCM yield

The week wise average daily dry matter intake/ kg FCM yield of buffaloes from both the experimental groups is presented in Table 4.6. The same is presented graphically in Figure 4.4.

Table 4.6 Weekly average dry matter intake (kg) / kg FCM yield of buffaloes from both the experimental groups

Weeks	Groups	
	Control (T_0)	**Treatment (T_1)**
1	1.58	1.58
2	1.58	1.49
3	1.55	1.48
4	1.54	1.46
5	1.54	1.46
6	1.54	1.45
7	1.57	1.45
8	1.62	1.49
9	1.57	1.50
10	1.57	1.46
11	1.67	1.48
12	1.62	1.51
13	1.58	1.48
Average ± SE	**1.58 ± 0.01**	**1.48 ± 0.01**

Significance t_{24} = P< 0.01

It is seen from the data that the average daily dry matter intake/ kg FCM yield of buffaloes ranged from 1.45- 1.67 kg. The values for control (T_0) and treatment groups (T_1) were 1.58 and 1.48 kg, respectively, during 13 weeks period. It was observed from present study that the average daily dry matter intake/ kg FCM yield of treatment group was less than control group during the course of experiment. It was indicated that supplementation of combination of probiotics and rumen buffer in treatment group increased the efficiency of utilization of DM compared to those buffaloes from control group.

The experimental data for average daily dry matter intake (kg) / kg FCM yield were subjected to statistical analysis by using paired t-test and findings are presented in Table 4.6 and the result showed that buffaloes from treatment group required significantly ($P< 0.01$) lower average daily dry matter/kg FCM yield than buffaloes from control group.

4.6.2 TDN intake (kg) / kg FCM yield

The average daily TDN intake (kg) / kg FCM yield of both experimental groups of buffaloes is presented in Table 4.7. The same is presented graphically in Figure 4.4.

It was recognized from the information that the average daily TDN intake / kg FCM yield of experimental buffaloes ranged from 0.91-1.05 kg. The average daily TDN intake per kg FCM yield in control (T_0) and treatment group (T_1) was 0.99 and 0.93 kg, respectively, during 13 weeks experimental period. It was seen from present study that the average daily TDN intake/ kg FCM yield of treatment group was less than control group during the course of experiment.

The experimental data for weekly average daily TDN intake / kg FCM yield were subjected to statistical analysis by using paired t-test and result is presented in Table 4.7 and the result revealed that buffaloes from treatment group required lower average daily TDN/kg FCM yield than buffaloes from control group. The result showed better efficiency in terms of TDN intake.

Table 4.7 Weekly average TDN intake (kg) / kg FCM yield of buffaloes from both the experimental groups

Weeks	Groups	
	Control (T_0)	**Treatment (T_1)**
1	0.99	0.99
2	0.99	0.93
3	0.97	0.93
4	0.96	0.92
5	0.96	0.92
6	0.96	0.91
7	0.98	0.91
8	1.01	0.94
9	0.98	0.94
10	0.98	0.92
11	1.05	0.93
12	1.02	0.95
13	0.99	0.93
Average ±SE	**0.99 ± 0.01**	**0.93 ± 0.01**

Significance t_{24} = P< 0.01

4.6.3. DCP intake (kg) / kg FCM yield

The average daily DCP intake/ kg FCM yield of both experimental groups of buffaloes is presented in Table 4.8. The same is presented graphically in Figure 4.4.

It was recognized from the information that the average daily DCP intake/ kg FCM yield of experimental buffaloes ranged from 0.112 to 0.128 kg. The corresponding values for control (T_0) and treatment group (T_1) were 0.121 and 0.115 kg, respectively, during 13 weeks experimental period. It was observed from

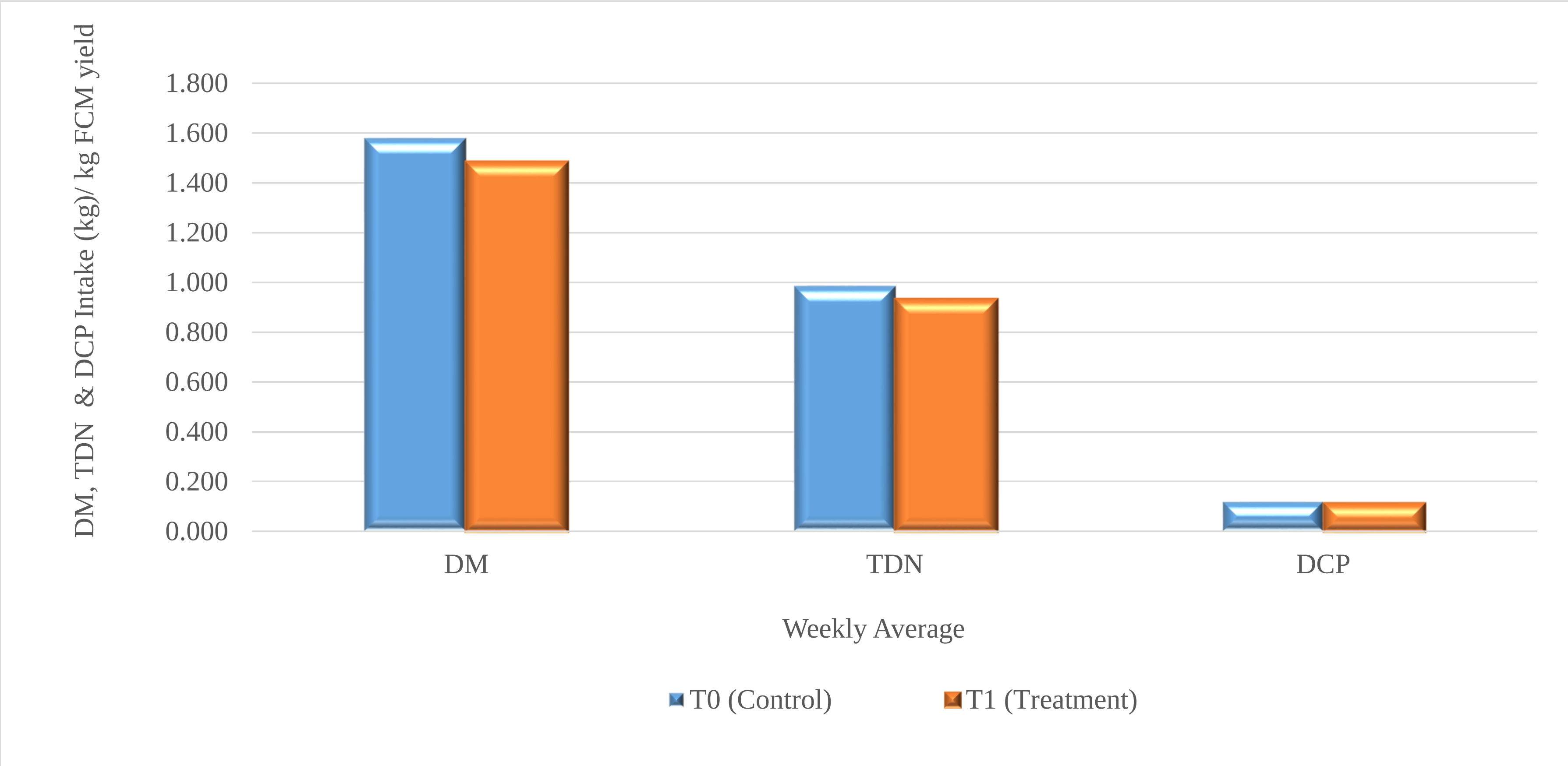


Fig 4.4 Fortnightly average DM, TDN and DCP intake (kg) / kg FCM yield of buffaloes from both the experimental groups

present study that the average DCP intake/ kg FCM yield of treatment group was less than control group during the course of experiment.

Table 4.8 Weekly average daily DCP intake (kg)/ kg FCM yield of buffaloes from both the experimental groups

Weeks	Groups	
	Control (T_0)	Treatment (T_1)
1	0.122	0.124
2	0.121	0.115
3	0.119	0.115
4	0.118	0.113
5	0.118	0.114
6	0.118	0.112
7	0.121	0.112
8	0.124	0.116
9	0.121	0.116
10	0.121	0.114
11	0.128	0.115
12	0.125	0.117
13	0.122	0.115
Average ±SE	**0.121±0.001**	**0.115±0.001**

Significance $t_{24} =$ P< 0.01

The experimental data for average daily DCP intake / kg FCM yield were subjected to statistical analysis by using paired t-test and result is presented in Table 4.8 and the result revealed that buffaloes from treatment group required significantly (P< 0.01) lower average daily DCP / kg FCM yield. Indicating better efficiency of utilization in terms of DCP required /kg FCM yield.

4.7. Milk composition

The milk samples from buffaloes of both the experimental groups were collected at weekly interval for analysis of milk composition. The detail result of milk composition are given below.

4.7.1 Milk fat

The weekly average daily milk fat percentage of two experimental groups of buffaloes is presented in Table 4.9. The same is presented graphically in Figure 4.5

It was observed from the data that the average daily milk fat percentage of buffaloes ranged from 6.99 to 7.86 %. The average daily milk fat of buffalo from control (T_0) and treatment groups (T_1) was 7.26 and 7.62 %, respectively, during 13 weeks experimental period. It was seen from present study that the average daily milk fat percentage of treatment group was 4.96 % higher than control group during the course of experiment.

The experimental data for average daily milk fat percentage were subjected to statistical analysis by using paired t-test and result is presented in Table 4.9. and it was revealed that average daily milk fat percentage of buffaloes from treatment group was significantly ($P< 0.01$) higher than the control group.

Finding of present study resembled with Musa (2017) who reported that supplementation of sodium bicarnate (bicarb) significantly increase mean fat percentage of milk in Holstein Friesian crossbred cows.

Maamouri *et al.* (2014) reported significant increase in milk fat in treatment group i.e supplemented with 2.5 g of yeast *Saccharomyces cerevisiae* per cow per day as compare to control group.

Bakr *et al.* (2015) also reported significant increase in milk fat percentage in treatment group supplemented with *Sacchromyces cerevisiae.*

Table 4.9 Weekly average milk fat (%) of buffaloes from both the experimental groups

Weeks	Groups	
	Control (T_0)	Treatment (T_1)
1	7.22	7.07
2	7.21	7.61
3	7.40	7.63
4	7.44	7.72
5	7.45	7.61
6	7.50	7.80
7	7.40	7.86
8	7.20	7.59
9	7.30	7.69
10	7.19	7.69
11	6.99	7.71
12	7.06	7.51
13	7.07	7.62
Average ± SE	**7.26 ± 0.05**	**7.62 ± 0.05**

Significance t_{24} = P< 0.01

Contrary to finding of present study Degirmencioglu *et al*. (2013) reported that the supplementation of *Saccharomyces cerevisiae* in Anatolian water buffalo diets (AWB) had non- significant effect on milk fat % (58.40 and 59.00 g/kg).

The increase in milk fat percentage observed in treatment group might be due to better ruminal fermentation and digestion of crude fibre which resulted in increased production of acetic acid in rumen which acts as precursor of milk fat.

4.7.2. Milk protein

The week wise average daily milk protein percentage of two trial groups of buffaloes is presented in Table 4.10. The same is presented graphically in Figure 4.6.

It was observed from the data that the average daily milk protein percentage of experimental buffaloes ranged from 3.02-3.52 %. The average milk protein percentage of control (T_0) and treatment group (T_1) was 3.16 and 3.41 %, respectively, during 13 weeks experimental period. It was concluded from present study that the average daily milk protein percentage of treatment group was 7.91% higher than control group during the course of experiment.

The experimental data for average daily milk protein percentage were subjected to statistical analysis by using paired t-test and result is presented in Table 4.10. and the result showed significant ($P< 0.01$) increase in average daily milk protein percentage in buffaloes from treatment groups than buffaloes from control group.

Finding of present study are in agreement with Maamouri *et al.* (2014) who reported significant ($P < 0.05$; 41.7 and 38.7 g/cow/day) increase in milk protein percentage in Holstein Friesian cow (supplemented 2.5 g/cow/day of probiotic yeast *Saccharomyces cerevisiae* (2.5x 10^{10} CFU/day) from than control cows without supplementation.

El-Ghani (2004) reported significant increase in milk protein percentage in goat after supplementation of diet with 3 or 6 g of YC.

Nocek *et al.* (2011) also reported improved milk protein percentage (2.98 and 2.91%) after supplementation of yeast culture (YC-56g/d) + enzymatically hydrolysed yeast (28g/d) (YC+EHY) in early lactating cows.

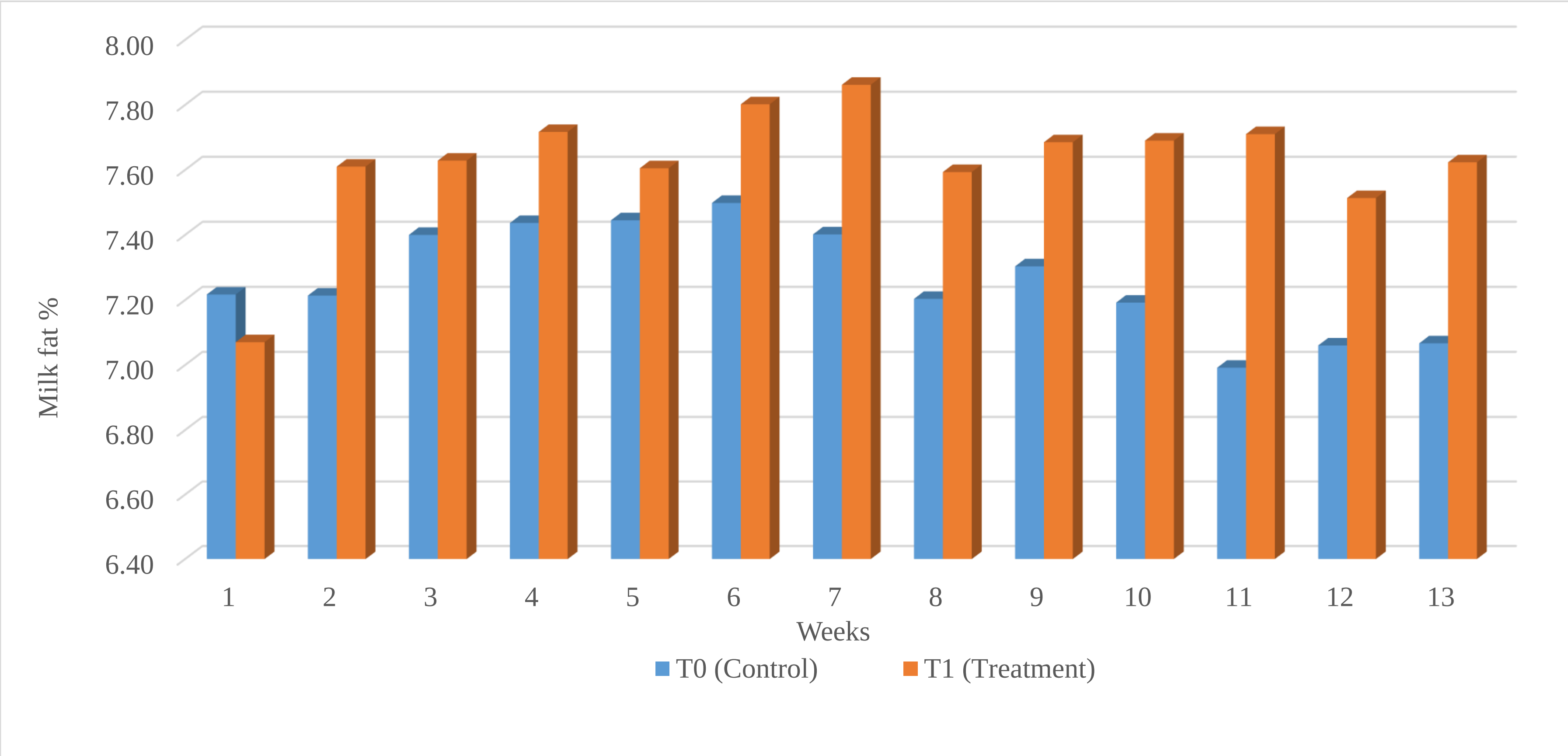


Fig 4.5 Week wise avearge daily milk fat % of buffalloes from both the experimental groups

Table 4.10 Week wise average milk protein (%) of buffaloes from both the experimental groups

Weeks	Groups	
	Control (T_0)	**Treatment (T_1)**
1	3.12	3.02
2	3.21	3.44
3	3.03	3.52
4	3.19	3.42
5	3.21	3.49
6	3.16	3.45
7	3.16	3.47
8	3.10	3.41
9	3.26	3.46
10	3.08	3.49
11	3.17	3.26
12	3.20	3.49
13	3.14	3.42
Average ±SE	**3.16 ± 0.02**	**3.41 ± 0.04**

Significance $t_{24} = P < 0.01$

Contrary to findings of present experiment, Biricik and Yavuz (2001) observed non- significant change in milk protein percentage in lactating Brown Swiss and Holstein cows from treatment group supplemented with 10g/d *Saccharomyces cerevisiae.*

4.7.3 Solids not fat

The week wise average milk solids not fat (SNF) percentage of buffaloes from both the experimental groups is presented in Table 4.11. The same is presented graphically in Figure 4.7.

Table 4.11 Week wise average milk SNF (%) of buffaloes from both the experimental groups

Weeks	Groups	
	Control (T_0)	**Treatment (T_1)**
1	8.54	8.70
2	8.52	8.79
3	8.67	8.89
4	8.78	9.45
5	8.58	9.21
6	8.60	9.29
7	8.41	9.21
8	8.63	9.27
9	8.46	9.14
10	8.65	8.79
11	8.69	9.27
12	8.47	9.13
13	8.53	9.08
Average ±SE	**8.58 ± 0.03**	**9.09 ± 0.06**

Significance t_{24} = P< 0.01

It was seen from the information that the average milk solids not fat percentage of experimental buffaloes ranged from 8.41-9.45 %. The average SNF percentage of control (T_0) and treatment groups (T_1) was 8.58 and 9.09 % respectively, during 13 weeks experimental period. It was concluded from present study that the average daily milk solids not fat percentage of treatment group was 5.94% higher than control group during the course of experiment.

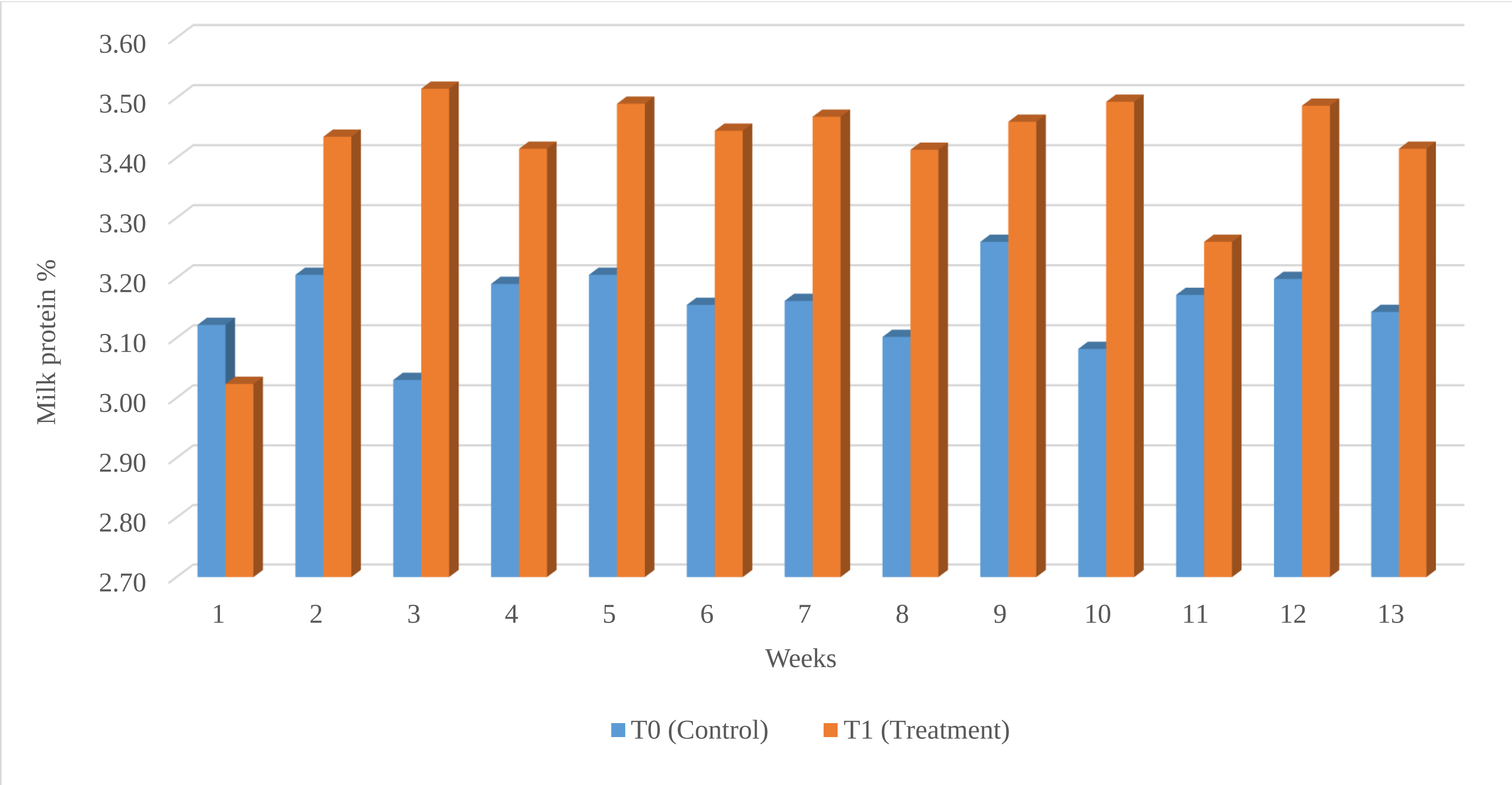


Fig 4.6 Week wise average milk protein % of buffaloes from both the experimental groups

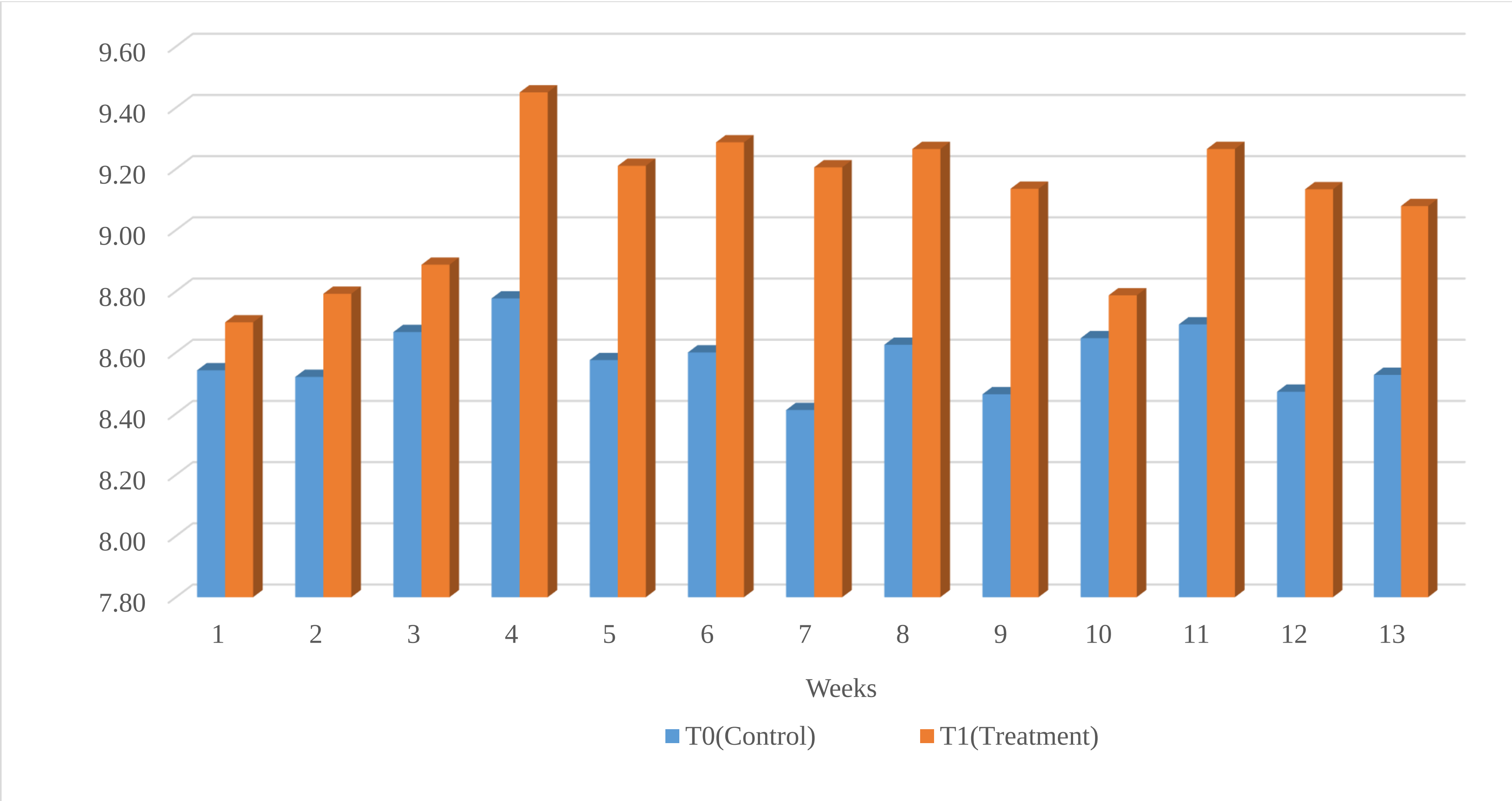


Fig 4.7 Week wise average daily milk SNF % of buffaloes from both the experimental groups

The experimental data for average daily milk solids not fat percentage were subjected to statistical analysis by using paired t-test and result is presented in Table 4.11 and the result showed that average milk solids not fat percentage of treatment group was significantly ($P < 0.01$) higher than control group.

Similar finding were observed by Hossain *et al*. (2014) found that probiotics (*Saccharomyces cerevisiae*) supplementation had significant ($P<0.05$) increase SNF percentage of milk in multiparous cows.

Nikkhah *et al*. (2004) also observed significant increase in solids not fat percentage in milk of Holstein dairy cows supplemented with yeast (*Saccharomyces cerevisiae* SC47) than cows from control groups.

4.7.4 Total solids

The week wise average milk total solids percentage of two trial groups of buffaloes is presented in Table 4.12. The same is presented graphically in Figure 4.8.

It was recognized from the data that the average milk total solids percentage of experimental buffaloes ranged from 15.53-17.17 %. The average milk total solids percentage of buffaloes from control (T_0) and treatment groups (T_1) was 15.84 and 16.72 %, respectively, during 13 weeks period. It was concluded from present study that the average daily milk total solid percentage of treatment group was 5.55 % higher than control group during the course of experiment.

The experimental data for average daily milk total solids percentage were subjected to statistical analysis by using paired t-test and result is presented in Table 4.12 and the result revealed that average milk total solids percentage of buffaloes from treatment group was significantly ($P < 0.01$) higher than buffaloes from control group.

Shreedhar *et al.* (2016) reported that supplementation of multi strain probiotic containing *Saccharomyces cerevisiae* and *Lactobacillus sporogenes* leads to increase in total solids content of milk in HF X Deoni crossbred cows

Table 4.12 Week wise average milk total solids (%) of buffaloes from both the experimental groups

Weeks	Groups	
	Control (T_0)	**Treatment (T_1)**
1	15.76	15.77
2	15.73	16.40
3	16.07	16.52
4	16.21	17.17
5	16.02	16.82
6	16.10	17.09
7	15.81	17.07
8	15.83	16.86
9	15.77	16.82
10	15.84	16.48
11	15.68	16.98
12	15.53	16.65
13.	15.59	16.70
Average ±SE	**15.84 ± 0.06**	**16.72 ± 0.10**

Significance t_{24} = P< 0.01

Srinivas (2009) observed significant increase in total solids percentage of milk in treatment group Murrah buffaloes supplemented with thermo tolerant probiotic (Levucell SC 20) than buffaloes from control group.

4.7.5 Lactose

The week wise average milk lactose percentage of buffaloes from control and treatment groups is presented in Table 4.13. The same is presented graphically in Figure 4.9.

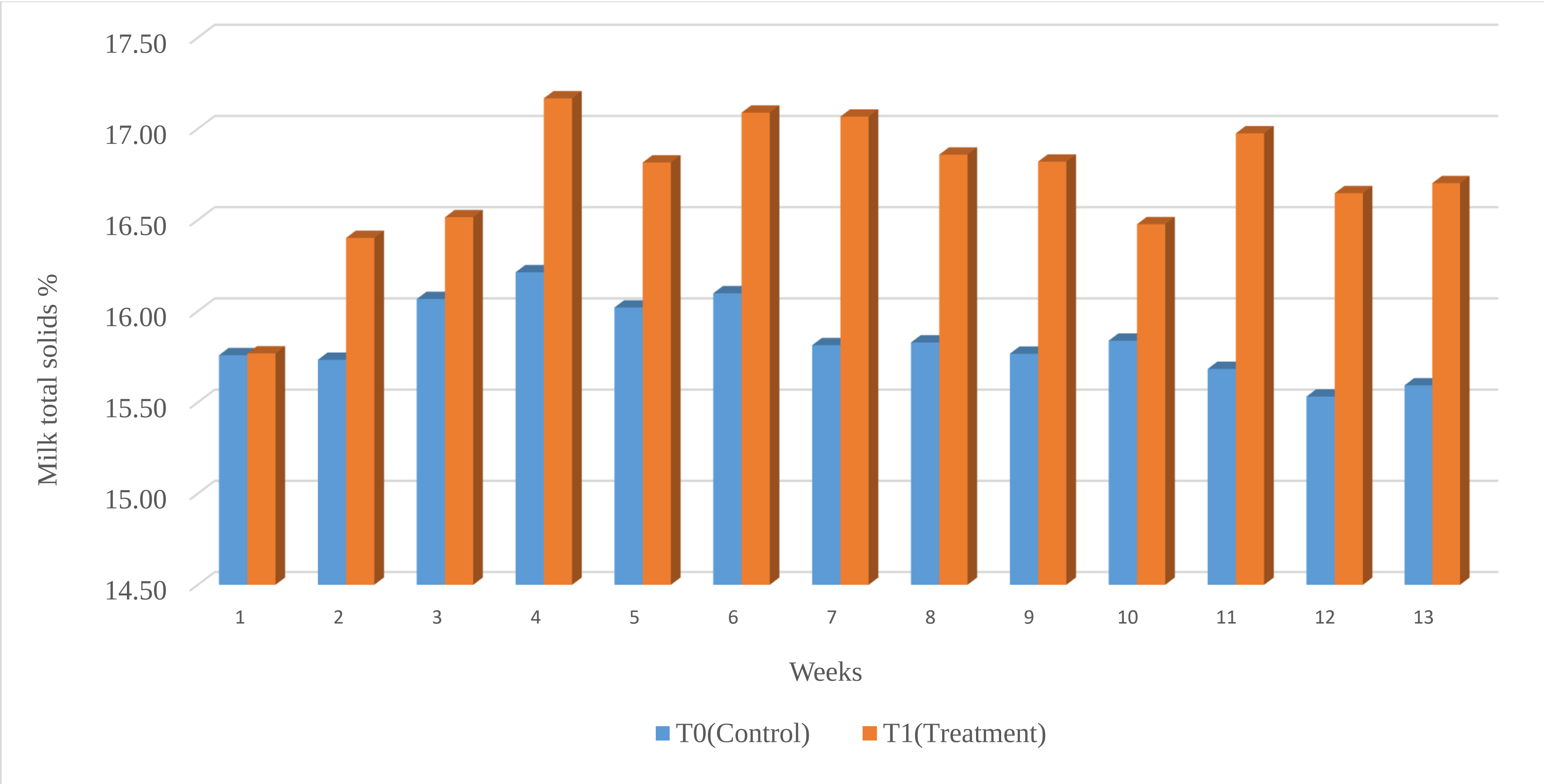


Fig 4.8 Week wise average milk total solids % of buffaloes from both the experimental groups

Table 4.13 Week wise average milk lactose % of buffaloes from both the experimental groups

Weeks	Groups	
	Control (T_0)	**Treatment (T_1)**
1	4.32	4.55
2	4.34	4.70
3	4.47	4.67
4	4.24	4.55
5	4.27	4.46
6	4.28	4.47
7	4.25	4.44
8	4.29	4.45
9	4.37	4.47
10	4.33	4.37
11	4.38	4.42
12	4.54	4.46
13	4.30	4.48
Average ±SE	**4.34 ± 0.02**	**4.50 ± 0.03**

Significance t_{24} = P< 0.01

It was observed from the information that the average milk lactose percentage of experimental buffaloes ranged from 4.24 - 4.70. The average milk lactose percentage of control (T_0) and treatment group (T_1) was 4.34 and 4.50, respectively, during 13 weeks experimental period. It was concluded from present study that the average milk lactose percentage of treatment group was 3.68% higher than control group during the course of experiment.

The experimental data for average milk lactose percentage were subjected to statistical analysis by using paired t-test and result is presented in Table 4.13. and the result revealed that average milk lactose percentage of treatment group was significantly ($P< 0.01$) higher than control group receiving no supplementation of probiotic and rumen buffer.

Bruno *et al.* (2008) supplemented *Saccharomyces cerevisiae* to lactating cows during heat stress and noticed significant increase in the milk lactose content of milk. Similar findings were reported Musa *et al.* (2017) who observed significant increase in milk lactose content in Holstein Friesian crossbred lactating cows supplemented with *Sacchromyces cerevisiae*.

In contrary to above findings Nikkhah *et al*. (2004) and Swartz *et al.* (1994) noticed non- significant change in lactose content of milk after supplementation of yeast culture.

4.8 Somatic Cell Count (SCC)

The fortnight wise average somatic cell count of milk of buffaloes from both the experimental groups is presented in Table 4.14. The same is presented graphically in Figure 10.

It was observed from data that the average somatic cell count (SCC $\times 10^5$ /ml of milk) of milk of buffaloes from control (T_0) and treatment groups (T_1) was 2.97 and 2.12 It was observed from present study that the average milk somatic cell count of treatment group was reduced by 28.62 % as compare to control group. This indicated positive effect of probiotic and buffer supplementation on udder or mammary health.

The experimental data for average milk somatic cell count were subjected to statistical analysis by using paired t-test and result is presented in Table 4.14 and the result revealed that the average milk somatic cell count of buffaloes from treatment group was significantly ($P < 0.05$) reduced than control group. Lower SCC credited to favorable role of probiotic and rumen buffer that are intermediating immune response for fighting mastitis infection of the udder.

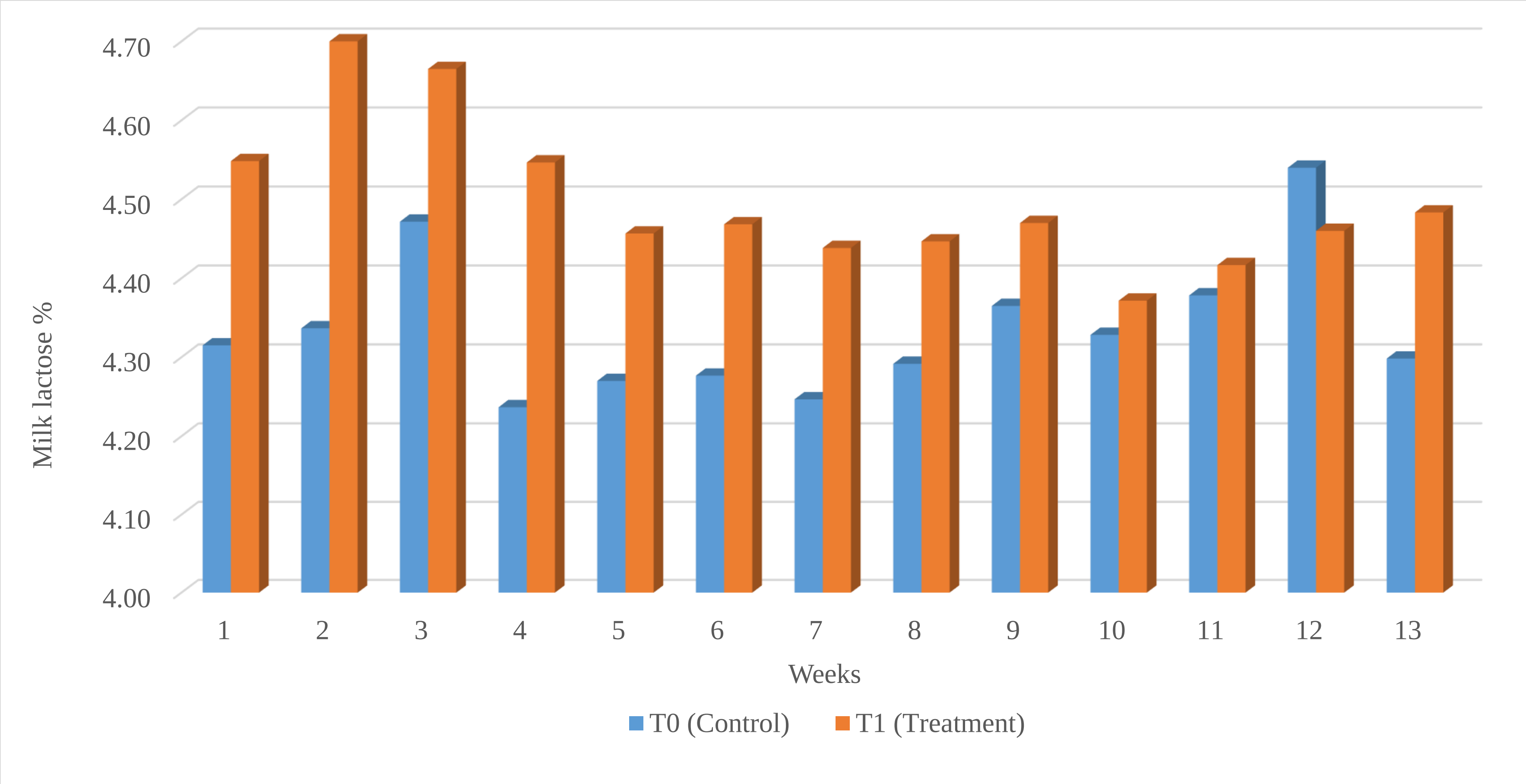


Fig 4.9 Week wise average milk lactose % of buffaloes from both the experimental groups

Table 4.14. Fortnightly average milk somatic cell count (SCC ×10^5 /ml of milk) of buffaloes from both the experimental groups

Fortnight	Groups	
	Control (T_0)	Treatment (T_1)
1	3.26	3.92
2	3.07	2.18
3	2.93	1.73
4	2.90	1.76
5	2.87	1.53
6	2.78	1.59
Average ±SE	**2.97 ± 0.07**	**2.12 ± 0.37**

Significance t_{10} = P< 0.05

Degirmencioglu *et al*. (2013) also reported that supplementation of *Saccharomyces cerevisiae* significantly lowers the somatic cell count (SCC) in milk (P<0.05; 3.33 and 1.08 SCC (log 10/mL) for control and SC-treated groups, respectively).

Contrary to findings of present result Swartz *et al*. (1994) found no significant effect on milk SCC after supplementation of *Saccharomyces cerevisiae* in Holestein cows.

4.9 Digestibility trial

At the end of trial, during last week (85-91 days) of the study a digestibility trial of seven days duration was carried out by total collection method on three animals from each group and the digestibility coefficients for different nutrients were calculated. The digestibility coefficients of dry matter, organic matter, crude protein, ether extract, crude fibre and NFE for the rations of control and treatment groups are presented in Table 4.15.

It is manifested from the table that average digestibility coefficient for dry matter of control group (T_0) and treatment group (T_1) was 60.71 and 62.27 %, respectively. Thus, the digestibility of DM in treatment group (T_1) was 1.56 units higher as compared to control group. This indicated beneficial effect of combined supplementation of probiotics and rumen buffer on the DM digestibility.

Table 4.15 Average digestibility coefficients, TDN and DCP contents of both the experimental rations

Nutrient	Groups	
	Control (T_0)	**Treatment (T_1)**
Dry matter	60.71	62.27
Organic matter	63.27	64.71
Crude protein	67.3	68.07
Ether extract	70.19	72.11
Crude fibre	65.29	65.46
Nitrogen free extract	71.96	72.74
TDN %	62.62	62.86
DCP%	7.69	7.77

The results of present study are in line with the finding of Ghazanfar *et al.* (2015) who found higher DM (dry matter) digestibility in cattle heifers after supplementation of *saccharomyces cerevisiae* (5g/animal/ day).

It is seen from the table that the average digestibility coefficients for organic matter of control (T_0) and treatment group (T_1) was 63.27 and 64.71 %, respectively. Thus indicating the beneficial effect of combined supplementation of probiotics and rumen buffer on digestibility of organic matter. The digestibility coefficient for organic matter in treatment group was higher than control by 1.44 units.

Dutta and Kundu (2008) also reported increased organic matter digestibility after supplementation or feeding of combined probiotics (*Saccharomyces*

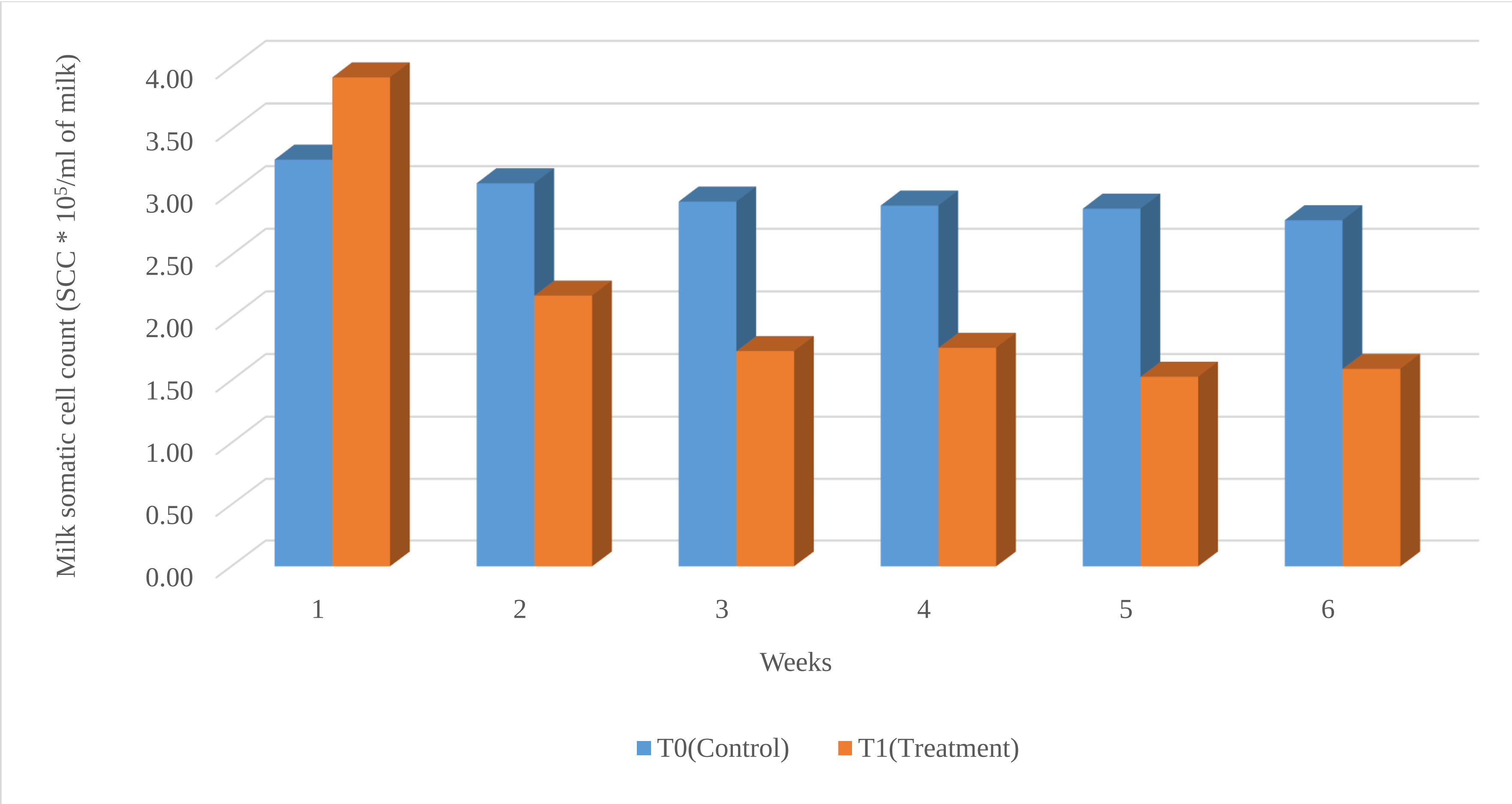


Fig 4.10 Fortnight wise average milk somatic cell count (SCC* 10^5/ml of milk) of buffaloes from both the experimental groups

cerevisiae, Lactobacillus plantarum and Enterococcus faecium.ratio 6: 2: 2) to crossbred cows.

The digestibility trial conducted during last week of experiment showed the average digestibility coefficient for crude protein was 67.3 % for control group and 68.07 % for treatment group. Thus, the digestibility coefficient of crude protein for treatment group was higher as compare to control group by 0.73 units.

Wohlt *et al*. (1998) also reported higher crude protein digestibility in Holstein cows after supplementation of yeast culture through diet.

The average digestibility coefficient for EE (ether extract) were 70.19% for control group and 72.11% for treatment group. It was seen that digestibility coefficient of treatment group was higher as compare to control groups by 1.92 units. Thus, indicating the positive effect of combined supplementation of probiotics and rumen buffer on digestibility of ether extract

It was also observed from the data of digestibility trial that the digestibility coefficient for crude fibre were 65.29 and 65.46% for control and treatment group, respectively. It was revealed that the digestibility coefficient of treatment group was higher as compare to control groups by 0.17 units. This showed beneficial effect of feed treatment on digestibility of crude fibre.

Further, it was observed from the Table 4.15 that the digestibility coefficient for NFE (Nitrogen free extract) were 71.96% for control group and 72.74 % for treatment group, respectively. The results indicated better digestibility coefficients of NFE for treatment group as compare to control group. This showed beneficial effect of feed treatment with respect to digestibility coefficient of NFE. The digestibility of NFE was higher by 0.78 units in treatment group as compare to control.

It is revealed from the Table 4.15, that average TDN content of rations for group T_0 and T_1 was 62.62 and 62.86%, respectively. The average TDN content of ration for group T_1 was 0.24 units higher than control group.

It is also seen from Table 4.15, that average DCP content of ration for group T_0 and T_1 was 7.61 and 7.77 %, respectively. The average DCP content of ration for group T_1 was higher than control ration by 0.16 units.

In agreement with finding of present study Dutta and Kundu (2008) also reported higher TDN and DCP values in diet of cows, supplemented with yeast culture (*Saccharomyces cerevisiae*).

The results of digestibility trial conducted during last week of experiment indicated that the digestibility of all nutrients was higher in group T_1 due to supplementation of combined probiotic and rumen buffer with diet and the same was reflected in higher TDN and DCP content of ration fed to treatment group (T_1) than control ration.

4.10 Economics

In dairy animal production system, profit mainly depends on input- output relationship, hence the economics of dairy production during the experiment was carried out by calculating daily returns per buffalo from both the experimental groups. The profit was worked out by considering mainly cost of feed and fodders and supplements like probiotic and rumen buffer and the amount received on the sale of milk. The input- output relationship for both the experimental groups is shown in Table 4.16.

It is observed from the Table that, the cost per kg concentrate mixture was ₹.25 for both the experimental groups. The cost of combined supplementation product of probiotics and rumen buffer was ₹ 3.0 per buffalo from treatment group.

The corresponding total cost of feeding per buffalo was ₹.368.5 and ₹.370.6 in control and treatment group, respectively, indicating the feeding cost was slightly higher in buffaloes from treatment group than control buffaloes.

Table 4.16 Input- Output relationship

Particulars	Group	
	T_0	T_1
Intake (kg/day/animal)		
Concentrate	10.4	10.4
Paddy straw	5.7	5.8
Para grass	8.6	8.8
Rumicell g/ day/ animal	0	10.0
Cost (₹ /kg)		
Concentrate	25	25
Paddy straw	13	13
Para grass	4.0	4.0
Rumicell (₹ /kg)	0	300
Total feed cost (₹ /day)/animal		
Concentrate	260.0	260.0
Paddy straw	74.1	75.4
Para grass	34.4	35.2
Rumicell cost (₹/day/animal)		3.0
Total feed cost (₹)	368.5	370.6
Miscellaneous cost* (₹ /day)	50	50
Total expenses (₹ /day)	418.5	420.6
Average daily milk production (₹ /buffalo)	9.47	9.89
Total cost of milk production (₹/kg)	44.19	42.53
Average daily FCM Production (kg/buffalo)	9.73	10.53
Total cost of FCM production (₹ /kg)	43.01	39.94
Daily income from milk sale** (₹)	615.55	642.85
Daily profit through sale of milk (₹ /buffalo)	197.05	222.25
Extra profit over control (₹ /buffalo)	--	25.20

The total cost per kg milk production was ₹.44.19 and ₹.42.53 for control and treatment group, respectively, indicating slightly lower cost per kg milk produced for the treatment group supplemented with a combination of probiotics and rumen buffer. When the cost was considered on the basis of daily fat corrected milk production, the treatment group cost (₹.39.94) was slightly lower than the control group cost (₹.43.01).

The farm sale price of milk ₹.65 per kg. The total income earned from the sale of milk was ₹.615.55 and ₹.642.85 for control and treatment group, respectively. The corresponding values for profit realized per buffalo were ₹.197.05 and ₹. 222.25. Thus, group receiving probiotics and rumen buffer recorded more profit over control group by ₹. 25.20.

Thus, it is seen that combine supplementation of probiotics and rumen buffer in lactating buffalo was cost effective.

4.11 Overall performance

The overall performance of buffaloes from both (control and treatment) the groups is presented in Table 4.17. It is observed from the Table that the average values for DMI (dry matter intake) were significantly higher in treatment group as compare to control group. Similarly, the nutrient intake in terms of TDN and DCP was significantly higher in treatment group. Also, there was a positive impact on the nutrient digestibility in animals when they were supplemented with a combination of probiotics and rumen buffer which was also reflected in higher TDN and DCP content of ration provided to treatment group. The Table also revealed that there was a significant increase in the absolute milk yield and 7% FCM yield in the buffaloes from treatment group when compare to the buffaloes from control group.

When the efficiency of feed utilization was compared between treatment group and control, in relation to DM, TDN and DCP intake per kg FCM yield, a significant increase was found in the former group than the latter.

The milk composition in terms of milk fat, protein, SNF, lactose and total solid % was significantly better in treatment group than in control. The milk SCC of buffaloes from treatment was significantly reduced in treatment group indicating positive effect of supplementation on udder health.

Table 4.17 Overall performance of buffaloes from both the experimental groups

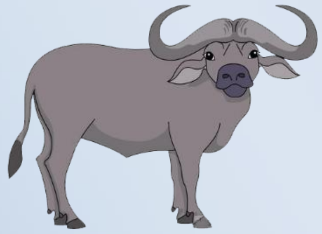
Parameters	Control	Treatment	Significance
Dry matter intake (kg)	15.36 ± 0.021	15.62 ± 0.038	**
Milk yield (kg)	9.47 ± 0.04	9.89± 0.03	**
FCM yield (kg)	9.73 ± 0.07	10.54 ± 0.08	**
TDN%	62.62	62.86	
TDN intake (kg)	9.62 ± 0.01	9.82 ± 0.02	**
DCP %	7.69	7.77	
DCP intake (kg)	1.18 ± 0.002	1.21 ± 0.003	**
Feed efficiency			
DM intake (kg)/kg FCM yield	1.58 ± 0.01	1.48± 0.01	**
TDN intake (kg) / kg FCM	0.99 ± 0.01	0.93± 0.01	**
DCP intake (kg) / kg FCM	0.121 ± 0.001	0.115 ± 0.001	**
Milk composition			
Fat (%)	7.26 ± 0.05	7.62 ± 0.05	**
Protein (%)	3.16 ± 0.02	3.41 ± 0.04	**
Total solids (%)	15.84 ± 0.06	16.72± 0.10	**
S.N.F. (%)	8.58 ± 0.03	9.09 ± 0.06	**
Lactose %	4.34 ± 0.02	4.50 ± 0.03	**
SCC (somatic cell count) (×10^5 /ml of milk)	2.97± 0.07	2.12 ± 0.37	*

*** Significant at 5% level**

****Significant at 1% level**

Thus, from overall findings of the present study, it can be concluded that combined supplementation of probiotics and rumen buffer @ 10 g/day/buffalo is beneficial for improving production performance of buffaloes in terms of milk production, its composition, nutrient intake, feed efficiency with positive impact on mammary health by reducing somatic cell count. Such combine supplementation is also cost effective. Thus, it can be inferred that for enhanced production performance and for higher profit margin use of such combined supplementation is beneficial.

Summary & Conclusions



5. SUMMARY AND CONCLUSIONS

The present experiment was carried out at M. S. Patel buffalo Farm, located Unit No.13, Aarey Colony, Goregaon, Mumbai-65, and in the Department of Animal Nutrition, Mumbai Veterinary College Parel, Mumbai 400012. This trial was conducted to study the effect of supplementation of probiotics like yeast culture (*Saccharomyces cerevisiae*), and bacteria (*Bacillus subtilis, Bacillus pumilus* and *Bacillus amyloliquifaciens*) and rumen buffer (soda bicarbonate) on performance of lactating buffaloes. The study was carried out to evaluate the effect of probiotics and rumen buffer on milk production, milk composition, SCC (somatic cell count) and nutrient digestibility and also studied the efficiency of feed utilization in the form of DM, DCP and TDN intake (kg)/ kg FCM yield.

In this experiment, 12 Murrah buffaloes were selected and divided into two groups, each containing 6 animals. The buffaloes were selected on the basis of breed, health condition, phase of lactation, and milk yield. Among two groups first group was considered as control (T_0) and received standard concentrate mixture and roughages as per the routine practice of the farm. The second group was considered as treatment (T_1) group and received same standard concentrate mixture and roughages along with supplement containing probiotics and rumen buffer @ 10 g /day /animal. The experiment was conducted for 91 days period.

During the experimental period daily milk yield, weekly feed intake, weekly milk composition and fortnightly somatic cell count (SCC) were recorded for both the experimental groups (control and treatment).

Different parameters like milk fat, protein, total solids, SNF and lactose were estimated to determine the milk composition. On weekly basis efficiency of feed utilization in the form of DM, TDN, DCP intake/ kg FCM yield was calculated and recorded.

During last 7 days (13th week) of the experimental period the digestibility trial was carried out by total collection method involving three buffaloes from each group to study the digestibility of various nutrients.

The week wise average daily DMI intake of buffaloes from control (T_0) and buffaloes from treatment (T_1) group was 15.36 and 15.48 kg, respectively, the statistical analysis of the data showed that the buffaloes from treatment group had significantly ($P< 0.01$) higher average daily dry matter intake as compared to control, which demonstrated the positive effect of treatment mixture containing probiotics and rumen buffer.

The week wise average daily milk yield of buffaloes from both the groups (control and treatment) was 9.47 and 9.89 kg per day, respectively. It is noticed that the average milk yield of buffaloes from treatment group was significantly ($P< 0.01$) higher as compared to the control, which demonstrated the positive effect of supplementation.

The buffaloes from control (T_0) and treatment (T_1) groups showed an average daily 7% FCM yield of 9.73 and 10.54 kg, respectively. Thus indicating that the average FCM yield of buffaloes belonging to the treatment group was significantly ($P< 0.01$) better than the buffaloes belonging to control.

The week wise average daily TDN intake of 9.62 and 9.82 kg was observed in the animals concerned with T_0 and T_1 groups, respectively. Thus it can be noted, from the data that the average TDN intake of buffaloes from treatment group was significantly ($P< 0.01$) better than the control, when they were supplemented with the combination of probiotics and rumen buffer.

The week wise average daily DCP intake of buffaloes from the groups T_0 and T_1 was 1.18 and 1.21 kg, respectively. When the statistical analysis was applied it was interpreted that the average DCP intake of buffaloes from group T_1 was significantly ($P< 0.01$) higher than control (T_0) group.

The efficiency of feed utilization by the buffaloes from both the groups was estimated in terms of DM, TDN and DCP required (kg) per kg of FCM yield produced. A value of 1.58, 1.48 kg and 0.99, 0.93 kg was seen as an average DM and TDN required per kg FCM yield for the buffaloes under the groups T_0 and T_1, respectively. It was observed that the feed treatment had significant ($P< 0.01$) effect on the efficiency of utilization when considered in relation to DM and TDN required per kg FCM.

In terms of DCP required per kg FCM, the group T_0 and T_1 showed 0.121 and 0.115 kg of average efficiency, respectively. As a result significant ($P< 0.01$) effect was in treatment groups with respect to DCP utilization for each kg FCM production.

The week wise average milk fat percentage was 7.26 and 7.62 % in the groups T_0 and $T_{1,}$ respectively. Thus, milk fat was increased in the treatment group indicating a significant effect ($P< 0.01$) of combine supplementation of probiotics and rumen buffer.

The groups T_0 and T_1 showed 3.16 and 3.41 %, 15.84 and 16.72 % of average weekly milk protein and total solids percentages respectively. Thus, revealing that the treatment group had significant ($P< 0.01$) effect on both these parameters.

The average milk SNF percentage on weekly basis was 8.58 and 9.09 % for the groups T_0 and $T_{1,}$ respectively. From statistical point of view, the treatment groups had significant effects ($P< 0.01$) on average milk SNF percentage.

The weekly average milk lactose percentages were 4.34 and 4.50 % for the groups T_0 and $T_{1,}$ respectively. A significant ($P< 0.01$) positive effect was seen due to the treatment on average milk lactose percentage.

The fortnightly average somatic cell count per unit of milk was 2.97 and 2.12 for the groups T_0 and $T_{1,}$ respectively. Thus, a significant ($P < 0.05$) decrease was seen in SCC in the treatment group indicating a prominent role of combination of probiotics and rumen buffer in maintaining udder health.

During the concluding stages of the research, a digestibility trial was conducted which revealed that the average digestibility coefficients for DM was 60.71 and 62.27 % for T_0 and T_1 group, respectively. Similarly, the average digestibility coefficients OM were 63.27 (T_0) and 64.71 (T_1).

The average digestibility coefficient values recorded for both T_0 and T_1 groups were CP- 67.30 and 68.07%, EE- 70.19 and 72.11%, CF- 65.29 and 65.46% and NFE- 71.96 and 72.74%. Thus, it can be noted from the data that the treatment groups showed a positive effect on the digestibility coefficient of all the nutrients when compared with the control. The higher digestibility of all the nutrients was also reflected in higher TDN and DCP percentage of treatment ration as compared to control ration. The TDN and DCP % of control and treatment ration were TDN- 62.62 and 62.86% and DCP- 7.69 and 7.77%, respectively.

The economics of the trial was also carried out in order to assess the profitability of supplementation of probiotics and rumen buffer in lactating buffaloes. Daily profits of ₹ 197.05 and ₹ 222.25 were recorded for the group T_0 and T_1, respectively, through the sale of milk. Thus, an extra profit of ₹ 25.20 was earned daily in treatment group over the control group which indicated the cost effectiveness of combined supplementation of probiotics and rumen buffer in treatment groups over control.

Thus, from overall findings of the present study, it can be concluded that combined supplementation of probiotics like yeast (*Saccharomyces cerevisiae*), bacteria (*Bacillus subtilis*, *Bacillus pumilus* and *Bacillus amyloliquifaciens*) and rumen buffer @ 10 g/day/buffalo is beneficial for improving production performance of buffaloes in terms of milk production, its composition, nutrient intake, feed efficiency with positive effect on udder health by reducing milk somatic cell count. Such combine supplementation is also cost effective. Thus, it can be inferred that for enhanced production performance in lactating buffaloes and for higher profit margin use of combined supplementation of probiotics and rumen buffer is beneficial.

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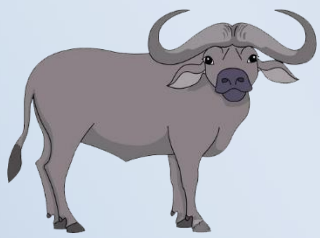

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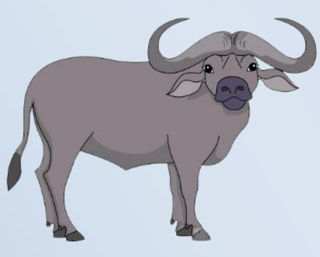
Appendix



APPENDIX

Appendix – 1 Details of buffaloes used in experimental groups

Group: T_0 (Control)				
Sr. No.	**Buffalo No.**	**Breed**	**Average milk yield (kg)**	**Days of lactation**
1	I.	Murrah	8.85	42 days
2	II.	Murrah	10.45	45 days
3	III.	Murrah	9.80	36 days
4	IV.	Murrah	8.65	40 days
5	V.	Murrah	9.25	47 days
6	VI.	Murrah	9.70	45 days
Average			9.45	

T_1 (Treatment)				
Sr. No.	**Buffalo No.**	**Breed**	**Average milk yield (kg)**	**Days of lactation**
1	I.	Murrah	10.15	45 days
2	II.	Murrah	9.55	43 days
3	III.	Murrah	8.70	40 days
4	IV.	Murrah	9.55	38 days
5	V.	Murrah	9.30	48 days
6	VI.	Murrah	9.55	50 days
Average			9.47	

Appendix 2. Weekly average daily dry matter intake (DMI) (kg) of buffaloes from both the experimental groups

T_0 (Control)													
Weeks													
Buffalo No.	1	2	3	4	5	6	7	8	9	10	11	12	13
I.	15.10	15.25	15.20	15.40	15.32	15.50	15.65	15.25	15.40	15.34	15.40	15.25	15.48
II.	15.30	15.20	14.95	15.30	15.45	15.35	15.40	15.15	15.30	15.60	15.65	15.45	15.40
III.	14.90	15.10	15.25	15.20	15.40	15.40	15.16	15.25	15.16	15.27	15.45	15.00	15.32
IV.	15.25	15.15	15.37	15.28	15.45	15.65	15.48	15.45	15.36	15.42	15.50	15.35	15.28
V.	15.45	15.32	15.45	15.35	15.28	15.55	15.43	15.47	15.65	15.52	15.35	15.50	15.52
VI.	15.20	15.68	15.45	15.46	15.38	15.30	15.45	15.32	15.45	15.28	15.42	15.35	15.25
Average	**15.20**	**15.28**	**15.28**	**15.33**	**15.38**	**15.46**	**15.43**	**15.32**	**15.39**	**15.41**	**15.46**	**15.32**	**15.38**

T_1 (Treatment)													
Weeks													
Buffalo No.	1	2	3	4	5	6	7	8	9	10	11	12	13
I.	15.2	15.45	15.70	15.74	16.1	16.15	16.45	16.24	16.14	15.76	15.46	15.76	15.46
II.	15.25	15.34	15.40	15.45	15.52	16.10	15.74	15.65	15.44	15.42	15.38	15.68	15.45
III.	15.25	15.40	15.60	15.67	15.38	15.30	15.42	15.65	15.46	15.54	15.56	15.62	15.36
IV.	15.40	15.45	15.60	15.75	15.35	15.65	15.62	15.54	15.67	16.12	15.93	15.65	15.48
V.	15.60	15.70	15.63	15.54	15.45	15.64	15.76	15.9	15.85	15.56	16.14	15.76	15.68
VI.	15.35	15.60	15.46	15.42	15.42	15.76	16.05	15.65	15.42	15.54	15.76	15.38	15.47
Average	**15.34**	**15.49**	**15.57**	**15.60**	**15.54**	**15.77**	**15.84**	**15.77**	**15.66**	**15.66**	**15.71**	**15.64**	**15.48**

Appendix. 3. Weekly average daily milk yield (kg) of buffaloes from both the experimental groups

Control (T_0)													
Weeks													
Buffalo No.	1	2	3	4	5	6	7	8	9	10	11	12	13
I.	8.75	8.80	9.10	9.00	9.20	9.10	9.35	9.40	9.45	8.65	8.3	9.25	8.95
II.	10.3	10.50	10.20	10.50	10.15	10.65	10.45	10.75	10.35	10.40	9.95	10.25	10.40
III.	9.95	10.30	9.85	9.85	10.15	9.65	9.85	7.60	9.85	10.25	9.95	9.45	10.10
IV.	8.45	8.50	8.60	8.60	8.80	8.65	8.15	8.75	8.35	8.65	8.65	8.55	8.85
V.	9.15	9.20	9.3	9.45	8.90	9.40	9.00	9.50	9.40	9.50	8.95	9.10	9.20
VI.	9.75	9.65	9.80	9.85	10.15	9.95	9.80	9.45	9.60	10.25	9.70	9.65	10.35
Average	9.39	9.49	9.48	9.54	9.56	9.57	9.43	9.24	9.50	9.62	9.25	9.38	9.64

Treatment (T_1)													
Weeks													
Buffalo No.	1	2	3	4	5	6	7	8	9	10	11	12	13
I.	10.4	10.85	11.50	11.15	10.95	11.20	10.95	11.00	10.60	10.80	10.75	10.35	10.50
II.	9.70	9.95	9.65	9.75	10.10	9.95	9.90	9.65	9.35	9.65	9.60	9.65	9.55
III.	8.85	8.95	9.25	9.20	9.35	9.25	9.15	9.10	9.15	9.35	9.15	9.00	9.25
IV.	9.65	9.60	9.20	9.40	9.80	10.15	9.85	9.95	9.75	9.90	10.15	9.75	9.70
V.	9.45	9.85	9.60	9.95	9.70	9.60	10.10	9.65	9.70	9.85	9.65	9.95	9.85
VI.	9.80	9.60	10.25	10.10	9.95	10.20	10.25	10.45	9.95	10.40	10.15	10.20	10.00
Average	**9.64**	**9.80**	**9.91**	**9.93**	**9.98**	**10.06**	**10.03**	**9.97**	**9.75**	**9.99**	**9.91**	**9.82**	**9.81**

Appendix. 4. Weekly average daily FCM (kg) of buffaloes from both the experimental group

Control (T_0)													
Weeks													
Buffalo No.	1	2	3	4	5	6	7	8	9	10	11	12	13
I.	9.03	8.71	9.24	9.19	9.54	9.33	9.51	9.70	9.70	8.69	8.32	9.42	9.09
II.	10.46	10.75	11.39	11.77	11.06	11.71	11.49	11.60	11.07	11.46	10.85	10.95	11.16
III.	10.32	10.30	9.90	10.21	10.31	10.00	10.11	7.49	9.48	9.97	9.65	9.05	9.73
IV.	8.80	9.53	9.56	9.38	9.68	9.97	9.05	9.36	8.99	8.97	8.01	8.95	9.22
V.	9.34	9.25	9.56	9.55	9.13	9.35	8.76	8.95	9.70	9.45	8.82	8.67	8.67
VI.	9.65	9.60	9.55	9.81	10.28	10.00	10.06	9.65	9.84	10.36	9.90	9.60	10.40
Average	**9.60**	**9.69**	**9.87**	**9.98**	**10.00**	**10.06**	**9.83**	**9.46**	**9.80**	**9.82**	**9.26**	**9.44**	**9.71**

Treatment (T_1)													
Weeks													
Buffalo No.	1	2	3	4	5	6	7	8	9	10	11	12	13
I.	10.31	11.36	11.91	12.17	11.55	12.09	11.78	11.40	11.29	11.31	11.40	10.81	11.03
II.	10.16	10.83	10.22	10.41	10.67	10.33	10.79	10.11	10.10	10.30	10.43	10.19	10.11
III.	8.71	9.66	9.95	9.66	9.96	10.07	9.96	9.64	9.94	9.90	9.77	9.49	9.87
IV.	9.89	10.47	10.12	10.54	10.67	11.59	11.04	10.60	10.52	10.57	11.14	10.61	10.58
V.	9.41	10.41	10.16	10.31	10.36	10.76	10.91	10.49	10.25	10.99	10.31	10.49	10.66
VI.	9.80	9.81	10.94	10.97	10.42	10.57	11.15	11.27	10.60	11.22	10.82	10.47	10.44
Average	**9.71**	**10.42**	**10.55**	**10.67**	**10.61**	**10.90**	**10.94**	**10.58**	**10.45**	**10.71**	**10.65**	**10.34**	**10.45**

Appendix. 5. Weekly average milk fat % of buffaloes from both the experimental groups

Control (T_0)													
Weeks													
Buffalo No.	1	2	3	4	5	6	7	8	9	10	11	12	13
I.	7.30	6.9	7.15	7.20	7.35	7.24	7.16	7.30	7.25	7.04	7.02	7.17	7.15
II.	7.15	7.23	8.11	8.15	7.85	7.95	7.95	7.75	7.66	7.97	7.86	7.65	7.70
III.	7.35	7.00	7.05	7.35	7.15	7.35	7.25	6.86	6.64	6.74	6.71	6.6	6.65
IV.	7.40	8.15	8.06	7.86	7.95	8.45	8.05	7.66	7.73	7.35	6.30	7.44	7.40
V.	7.20	7.05	7.27	7.10	7.25	6.95	6.75	6.45	7.30	6.95	6.86	6.55	6.45
VI.	6.90	6.95	6.76	6.96	7.12	7.05	7.25	7.20	7.24	7.10	7.20	6.95	7.05
Average	**7.22**	**7.21**	**7.40**	**7.44**	**7.45**	**7.50**	**7.40**	**7.20**	**7.30**	**7.19**	**6.99**	**7.06**	**7.07**

Treatment (T_1)													
Weeks													
Buffalo No.	1	2	3	4	5	6	7	8	9	10	11	12	13
I.	6.92	7.45	7.34	7.87	7.52	7.76	7.72	7.35	7.62	7.45	7.58	7.42	7.48
II.	7.45	7.84	7.56	7.64	7.54	7.36	7.86	7.45	7.76	7.64	7.82	7.53	7.56
III.	6.85	7.76	7.72	7.48	7.62	7.84	7.84	7.56	7.82	7.56	7.65	7.52	7.64
IV.	7.24	7.86	7.95	8.15	7.85	8.35	8.15	7.62	7.75	7.64	7.93	7.84	7.86
V.	6.96	7.54	7.56	7.34	7.65	8.15	7.76	7.83	7.54	8.10	7.65	7.52	7.78
VI.	7.00	7.21	7.64	7.82	7.45	7.35	7.84	7.75	7.62	7.75	7.63	7.25	7.42
Average	**7.07**	**7.61**	**7.63**	**7.72**	**7.61**	**7.80**	**7.86**	**7.59**	**7.69**	**7.69**	**7.71**	**7.51**	**7.62**

Appendix. 6. Weekly average milk protein % of buffaloes from both the experimental groups

Control (T_0)													
Weeks													
Buffalo No.	1	2	3	4	5	6	7	8	9	10	11	12	13
I.	2.92	3.27	2.93	3.18	2.95	3.01	2.95	3.15	3.47	2.96	2.98	2.92	3.16
II.	3.07	3.34	3.09	3.56	3.42	3.12	3.21	3.13	3.16	3.32	2.98	3.46	3.24
III.	3.14	3.07	3.12	3.15	3.18	3.25	3.18	3.36	3.54	3.15	3.23	3.15	3.18
IV.	3.10	3.01	3.12	3.15	3.26	3.20	3.22	2.97	3.31	3.24	3.88	3.36	3.27
V.	3.50	3.70	3.05	2.98	2.97	3.35	3.05	2.85	3.14	2.97	3.02	3.10	2.96
VI.	3.00	2.84	2.87	3.12	3.45	3.00	3.36	3.15	2.94	2.85	2.94	3.20	3.05
Average	**3.12**	**3.21**	**3.03**	**3.19**	**3.21**	**3.16**	**3.16**	**3.10**	**3.26**	**3.08**	**3.17**	**3.20**	**3.14**

Treatment (T_1)													
Weeks													
Buffalo No.	1	2	3	4	5	6	7	8	9	10	11	12	13
I.	2.91	3.46	3.62	3.32	3.45	3.56	3.76	3.25	3.44	3.76	3.42	3.54	3.32
II.	2.85	2.96	3.34	3.45	3.27	2.97	3.47	3.72	3.68	3.46	3.65	3.54	3.36
III.	2.94	3.42	3.27	3.35	3.64	3.76	3.56	3.26	3.65	3.75	3.08	3.45	3.28
IV.	3.05	3.54	3.85	3.47	3.54	3.65	3.48	3.46	3.32	3.58	3.15	3.27	3.64
V.	3.32	3.65	3.47	3.25	3.20	3.58	3.46	3.67	3.42	3.35	3.19	3.36	3.47
VI.	3.07	3.58	3.54	3.65	3.84	3.15	3.08	3.12	3.25	3.06	3.07	3.76	3.42
Average	**3.02**	**3.44**	**3.52**	**3.42**	**3.49**	**3.45**	**3.47**	**3.41**	**3.46**	**3.49**	**3.26**	**3.49**	**3.42**

Appendix. 7. Weekly average milk SNF% of buffaloes from both the experimental groups

Control (T_0)													
Weeks													
Buffalo No.	1	2	3	4	5	6	7	8	9	10	11	12	13
I.	8.36	8.45	8.67	8.86	8.24	8.46	8.35	8.76	8.48	8.84	8.57	8.56	8.62
II.	8.45	8.46	8.72	9.15	8.45	8.34	8.47	8.42	8.48	8.32	8.46	8.05	8.24
III.	8.56	8.50	8.65	8.45	8.82	9.10	8.43	8.84	8.42	8.74	8.92	8.34	8.76
IV.	8.52	8.28	8.42	8.81	8.54	8.83	8.26	8.73	8.43	8.96	8.81	8.62	8.54
V.	8.60	8.98	8.92	8.74	8.86	8.35	8.48	8.61	8.54	8.68	8.45	8.67	8.36
VI.	8.76	8.45	8.62	8.65	8.54	8.52	8.48	8.39	8.43	8.34	8.94	8.59	8.64
Average	**8.54**	**8.52**	**8.67**	**8.78**	**8.58**	**8.60**	**8.41**	**8.63**	**8.46**	**8.65**	**8.69**	**8.47**	**8.53**

Treatment (T_1)													
Weeks													
Buffalo No.	1	2	3	4	5	6	7	8	9	10	11	12	13
I.	8.34	8.74	8.95	9.43	8.96	9.34	9.56	9.34	8.84	8.76	9.46	9.34	9.26
II.	8.45	8.18	8.36	8.46	8.84	9.25	9.47	8.83	9.46	8.59	9.34	8.93	9.12
III.	8.76	9.24	8.96	9.12	9.65	9.54	9.24	9.62	8.76	8.49	8.92	9.36	9.14
IV.	8.39	8.85	9.12	8.78	9.43	9.10	8.86	9.58	9.24	8.82	9.32	8.91	8.95
V.	9.70	8.77	8.59	9.24	9.23	9.56	9.34	8.95	9.53	8.67	9.58	9.14	9.16
VI.	8.55	8.97	9.34	8.96	9.15	8.93	8.76	9.27	8.98	9.39	8.97	9.12	8.84
Average	**8.70**	**8.79**	**8.89**	**9.45**	**9.21**	**9.29**	**9.21**	**9.27**	**9.14**	**8.79**	**9.27**	**9.13**	**9.08**

Appendix. 8. Weekly average milk total solids % of buffaloes from both the experimental groups

Control (T_0)													
Weeks													
Buffalo No.	1	2	3	4	5	6	7	8	9	10	11	12	13
I.	15.66	15.35	15.82	16.06	15.59	15.70	15.51	16.06	15.73	15.88	15.59	15.73	15.77
II.	15.60	15.69	16.83	17.30	16.30	16.29	16.42	16.17	16.14	16.29	16.32	15.70	15.94
III.	15.91	15.50	15.70	15.80	15.97	16.45	15.68	15.70	15.06	15.48	15.63	14.94	15.41
IV.	15.92	16.43	16.48	16.67	16.49	17.28	16.31	16.39	16.16	16.31	15.11	16.06	15.94
V.	15.80	16.03	16.19	15.84	16.11	15.30	15.23	15.06	15.84	15.63	15.31	15.22	14.81
VI.	15.66	15.40	15.38	15.61	15.66	15.57	15.73	15.59	15.67	15.44	16.14	15.54	15.69
Average	**15.76**	**15.73**	**16.07**	**16.21**	**16.02**	**16.10**	**15.81**	**15.83**	**15.77**	**15.84**	**15.68**	**15.53**	**15.59**

Treatment (T_1)													
Weeks													
Buffalo No.	1	2	3	4	5	6	7	8	9	10	11	12	13
I.	15.26	16.19	16.29	17.30	16.48	17.10	17.28	16.69	16.46	16.21	17.04	16.76	16.74
II.	15.90	16.02	15.92	16.10	16.38	16.61	17.33	16.28	17.22	16.23	17.16	16.46	16.68
III.	15.61	17.00	16.68	16.60	17.27	17.38	17.08	17.18	16.58	16.05	16.57	16.88	16.78
IV.	15.63	16.71	17.07	16.93	17.28	17.45	17.01	17.20	16.99	16.46	17.25	16.75	16.81
V.	16.66	16.31	16.15	16.58	16.88	17.71	17.10	16.78	17.07	16.77	17.23	16.66	16.94
VI.	15.55	16.18	16.98	16.78	16.60	16.28	16.60	17.02	16.60	17.14	16.60	16.37	16.26
Average	**15.77**	**16.40**	**16.52**	**17.17**	**16.82**	**17.09**	**17.07**	**16.86**	**16.82**	**16.48**	**16.98**	**16.65**	**16.70**

Appendix. 9. Weekly average milk Lactose % of buffaloes from both the experimental groups

Control (T_0)													
Weeks													
Buffalo No.	1	2	3	4	5	6	7	8	9	10	11	12	13
I.	4.21	4.21	4.42	4.12	4.35	4.16	4.12	4.09	4.32	4.25	4.46	4.76	4.40
II.	4.32	4.32	4.53	4.46	4.18	4.08	4.35	4.46	4.43	4.56	4.34	4.45	4.28
III.	4.36	4.54	4.68	4.04	4.07	4.21	4.25	4.36	4.25	4.18	4.28	4.76	4.36
IV.	4.38	4.51	4.55	4.24	4.19	4.45	4.16	4.32	4.46	4.28	4.2	4.26	4.20
V.	4.36	4.18	4.27	4.21	4.56	4.42	4.24	4.25	4.34	4.47	4.56	4.42	4.18
VI.	4.26	4.26	4.38	4.35	4.27	4.34	4.36	4.27	4.39	4.23	4.43	4.59	4.37
Average	**4.32**	**4.34**	**4.47**	**4.24**	**4.27**	**4.28**	**4.25**	**4.29**	**4.37**	**4.33**	**4.38**	**4.54**	**4.30**

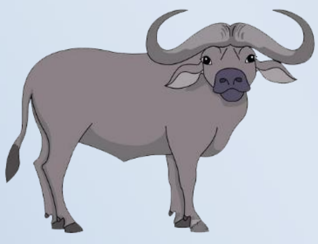
Treatment (T_1)													
Weeks													
Buffalo No.	1	2	3	4	5	6	7	8	9	10	11	12	13
I.	4.48	4.56	4.47	4.54	4.65	4.34	4.57	4.46	4.28	4.39	4.67	4.58	4.52
II.	4.44	4.75	4.84	4.56	4.36	4.65	4.45	4.24	4.76	4.56	4.38	4.48	4.45
III.	4.52	4.87	4.90	4.64	4.62	4.62	4.54	4.48	4.62	4.24	4.36	4.18	4.56
IV.	4.49	4.69	4.44	4.37	4.27	4.48	4.37	4.72	4.24	4.54	4.27	4.54	4.38
V.	4.80	4.67	4.63	4.78	4.63	4.65	4.35	4.24	4.58	4.36	4.56	4.42	4.57
VI.	4.56	4.66	4.71	4.39	4.21	4.07	4.35	4.54	4.34	4.14	4.26	4.56	4.42
Average	**4.55**	**4.70**	**4.67**	**4.55**	**4.46**	**4.47**	**4.44**	**4.45**	**4.47**	**4.37**	**4.42**	**4.46**	**4.48**

Appendix. 10. Fortnight wise average milk somatic cell count (SCC* 10^5/ml of milk) of buffaloes from both the experimental groups

Control (T_0)						
Fortnight						
Buffalo No.	1	2	3	4	5	6
I.	2.86	2.54	2.65	2.56	2.43	2.35
II.	3.67	3.45	3.37	3.48	3.3	3.36
III.	2.86	3.24	3.07	2.95	3.14	2.93
IV.	1.87	2.14	1.74	1.65	1.47	1.75
V.	5.35	4.54	4.25	3.95	3.86	3.63
VI.	2.96	2.53	2.48	2.78	3.02	2.65
Average	**3.26**	**3.07**	**2.93**	**2.90**	**2.87**	**2.78**

Treatment (T_1)						
Fortnight						
Buffalo No.	1	2	3	4	5	6
I.	8.24	4.26	3.86	3.14	2.96	2.64
II.	1.75	1.46	1.12	1.15	0.98	1.34
III.	1.56	1.18	0.77	0.52	0.45	0.65
IV.	3.77	1.31	0.83	1.45	1.67	1.42
V.	1.76	1.72	2.05	1.35	0.96	1.45
VI.	6.43	3.13	1.77	2.95	2.15	2.05
Average	**3.92**	**2.18**	**1.73**	**1.76**	**1.53**	**1.59**

Abstract



THESIS ABSTRACT

a)	Title of the thesis (in Capital letters)	**:**	"EFFECT OF SUPPLEMENTATION OF PROBIOTICS AND RUMEN BUFFER ON PERFORMANCE OF LACTATING BUFFALOES."
b)	Full name of student	**:**	Dharmendr Kumar Verma
c)	Name and address of Major Advisor	**:**	DR. G.M. GADEGAONKAR Assistant Professor, Department of Animal Nutrition, Mumbai Veterinary College, Parel, Mumbai – 400 012
d)	Degree to be awarded	**:**	M. V. Sc.
e)	Year of award of degree	**:**	2019
f)	Major subject	**:**	Animal Nutrition
g)	Total number of pages in the thesis	**:**	
h)	Number of words in the abstract	**:**	306
i)	Signature of Student	**:**	
j)	Signature, Name and address of forwarding authority (HOD / SH)	**:**	
k)	Signature of the Associate Dean	**:**	

ABSTRACT

The study involved 12 Murrah buffalo selected on the basis of breed, lactation stage and milk yield, which were divided into two groups of six each *viz*. Control (T_0) and Treatment group (T_1). The buffaloes from group T_0 received standard concentrate mixture and roughages as per the routine practice of the farm. Whereas group T_1 received same ration as that of group T_0 along with supplement containing probiotics like yeast (*Saccharomyces cerevisiae*), bacteria (*Bacillus subtilis, Bacillus pumilus* and *Bacillus amyloliquifaciens*) and rumen buffer@10 g /day /animal. The experiment lasted for 91 days. The average daily milk yield and FCM yield, DMI, TDN and DCP intake of buffaloes from treatment group (T_1) was significantly ($P< 0.01$) higher than control group. The efficiency of feed utilization in terms of DM, TDN and DCP required per kg of FCM yield produced was significantly ($P< 0.01$) better in group T_1 than control group.

The average milk fat, protein, total solids, SNF and lactose percentage of group T_1 was significantly ($P< 0.01$) higher than control. The average somatic cell count of milk of buffaloes form group T_1 was significantly ($P< 0.05$) lower than control group. The digestibility coefficients for all the nutrients were higher in treatment group than control group which was also reflected in higher TDN and DCP % of the ration provided to supplemented group. The economics of the study showed an extra profit of ₹ 25.20 in supplemented group over control group. Thus, it can be concluded that combined supplementation of probiotics and rumen buffer @ 10 g per day per buffalo is beneficial for improving performance of buffaloes in terms of milk yield, its composition, nutrient intake, feed efficiency and digestibility of nutrients. The supplementation also helps in reducing somatic cell count of milk showing positive effect on udder health and such supplementation is also cost effective.

प्रबंध सारांश

1)	प्रबंधाचे नाव	:	"दुधाळ म्हशींच्या आहारात मिश्र पूरकांचा (जैविके आणि कोटी पोट सामू प्रतीरोधी) समावेश करून त्याचा म्हशींच्या उत्पादन क्षमतेवर होणारा परिणाम अभ्यासणे"
2)	विद्यार्थ्यांचे संपूर्ण नाव	:	धर्मेंद्र कुमार वर्मा
3)	मार्गदर्शकाचे नाव आणि पत्ता	:	डॉ. जी एम गादेगावकर, सहाय्यक प्राध्यापक,पशुपोषणशास्त्र विभाग, मुंबई पशुवैद्यकीय महाविद्यालय, परळ, मुंबई - 0१२
4)	प्रदान केली जाणारी पदवी	:	एम. व्ही. एस्सी. (पशुपोषणशास्त्र)
5)	पदवी पुरस्काराचे वर्ष	:	२०१९
6)	मुख्यविषय	:	पशुपोषणशास्त्र
7)	प्रबंधातील पानांची एकूण संख्या	:	
8)	सारांशाचे एकुण शब्द	:	438
9)	विद्यार्थ्यांची सही	:	
10)	प्रबंध पाठवणाऱ्या अधिकाऱ्याचे संपूर्ण नाव पत्ता व सही	:	
11)	सहयोगी अधिष्ठता सही मुंबई पशुवैद्यकीय महाविद्यालय, परळ, मुंबई-४०००१२.	:	

सारांश

सदर प्रयोगा मध्ये म्हशींच्या आहारात मिश्र पुरके (जैविके आणि कोटी पोट सामू प्रतीरोधी) ह्यांचा अवलंब केल्यास म्हशींच्या दुग्धोत्पादानावर, दुधातील घटकांवर, खाद्य खाण्यच्या प्रमाणावर, खाद्याच्या उपयुक्ततेवर होणारा परिणाम अभ्यासण्यात आला. तसेच ह्याचा आर्थिक बाबींवर होणारा परिणाम देखील अभ्यासण्यात आला. ह्या प्रयोगाकरिता १२ दुधाल म्हशींची त्यांचा दुग्धोत्पादनानुसार, वेताच्या काळानुसार आणि जाती नुसार निवड करून दोन समान गटात विभागणी करण्यात आली व त्यांना गट ट० (नियंत्रण गट) व ट१(परीक्षण गट) असे संम्भोद्ण्यात आले. गट ट० मधील म्हशींना तबेल्या मधील प्रचलीत खाद्य (आंबोण व चारा) नेहेमी प्रमाणे देण्यात आले तर ट१ मधील म्हशींना ट० प्रमाणे खाद्य देण्यात आले व त्याव्यतिरिक्त मिश्र पुरके (जैविके- साक्रोमासीस सेर्विसे, बसिलास सबटीलीस, बसिलास पुमुलास, बसिलास अमाय्लो लुकोफेसींस आणि कोटी पोट सामू प्रतीरोधी) १० ग्रॅम प्रती म्हैस प्रती दिन ह्या प्रमाणात देण्यात आले. हा प्रयोग ९१ दिवसांसाठी राबवण्यात आला. गट ट१ मधील म्हशींचे सरासरी आठवडी दैनंदिन शुष्क पदार्थ, एकूण पचनीय घटक व पचनीय कच्ची प्रथिने ग्रहण करन्याचे प्रमाण गट ट० मधील म्हशींच्या मानाने अधिक होते व हा फरक सांखिकी दृष्ट्या ($P<0.01$) महत्वाचा आढळून आला. सरासरी दुग्धोत्पादन व स्निग्ध सुधारीत दुग्धोत्पादान गट ट१ मध्ये (परीक्षण गट) गट ट० पेक्षा अधिक आढळून आले व ही वाढ सांखिकी दृष्ट्या ($P<0.01$) अधिक दिसून आली.

सरासरी शुष्क पदार्थ, एकूण पचनीय घटक व पचनीय कच्ची प्रथिने ह्यांचे प्रती किलो स्निग्ध सुधारीत दुग्धोत्पादानासाठी लागणारे प्रमाण परीक्षण (ट१) गटामध्ये नियंत्रण (ट०) गटापेक्षा कमी आढळून आले व हा फरक देखील सांखिकी

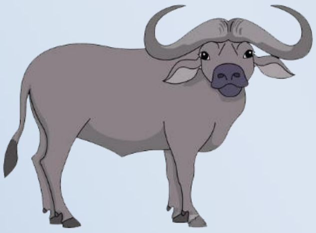
दृष्ट्या (P<0.01) महत्वाचा आढळून आला. यावरून असे दिसून आले की प्रती किलो स्निग्ध सुधारीत दुध उत्पादनासाठी वरील सर्व बाबींची उपयुक्तता गट ट१ मध्ये (परीक्षण गट) अधिक दिसून आली.

सरासरी दुग्ध मेद, प्रथिने, एकूण घन पदार्थ, मेद विरहीत घन पदार्थ, दुग्ध शर्करा हयांचे शेकडा प्रमाण गट ट१ मध्ये गट ट० पेक्षा सांखिकी दृष्ट्या (P<0.01) अधिक आढळून आले. दुधातील सरासरी सोमेटिक पेशींचे प्रमाण गट ट१ (परीक्षण गट) मधील म्हशींच्या दुधात गट ट० पेक्षा कमी आढळून आले व हा फरक सांखिकी दृष्ट्या (P<0.05) महत्वाचा दिसून आला.

सर्व अन्न पोषण मुल्यांची पाचकता परीक्षण खाद्यामध्ये अधिक आढळून आली व त्यामुळे परीक्षण खाद्यातील एकूण पचनीय पदार्थ व पचनीय कच्ची प्रथिने हयांचे शेकडा प्रमाण अधिक दिसून आले. आर्थिक दृष्ट्या विचार करीता असे दिसून आले की वरील प्रमाणे मिश्र पुरके (जैविके आणि कोटी पोट सामू प्रतीरोधी) हयांचा आहारात वापर केल्याने गट ट१ मधील म्हशीन (परीक्षण गट)मध्ये नियंत्रण गटातील म्हशीनपेक्षा रु २५.२० एवढा अधिक नफा मिळाला.

वरील सर्व बाबींचा विचार करीता असा निष्कर्ष काढण्यात आला की मिश्र पुरके (जैविके आणि कोटी पोट सामू प्रतीरोधी) हयांचा आहारात प्रती दिन प्रती म्हैस १० ग्रॅम एवढ्या प्रमाणात अवलंब केल्यासं म्हशींच्या दुग्धोत्पादनावर, दुधातील घटकांवर, खाद्य व खाद्य घटक खाण्याच्या प्रमाणा वर, खादयाच्या उपयुक्ततेवर, खाद्य पाचकतेवर अनुकूल परिणाम होतो. तसेच दुधातील सोमेटिक पेशींचे प्रमाण कमी करून कास निरोगी ठेवण्यास मदत होते. पूरकांचा असा केलेला अवलंब आर्थिक दृष्ट्या किफायतशीर दिसून येतो.

Vita



Vita

The author of this manuscript Dr. Dharmendr Kumar Verma was born on 20th May 1991 in Jamunipur dist- Ambedkar nagar (Uttar Pradesh). He finished his lower and Higher education from J. D. J. B. inter college Dhanwari Khemapur Ambedkar Nagar Uttar Pradesh and secured 64.44 % in S. S. C and 56% in H. S. C.

To club his passion for animals he joined College of Veterinary and Animal Sciences, Parbhani under Maharashtra Animal and Fishery Sciences University, Nagpur in 2012 and after undergoing the five year study and training course he graduated as a veterinarian with B.V.Sc. & A.H. degree with 79.83% in the year 2017. Due to his interest in Animal Nutrition he perceived admission in the Department of Animal Nutrition of Mumbai Veterinary College in 2017.

He is sincere, active and involves in various extracurricular activities. Besides academics his other interest includes playing cricket, reading books, update new knowledge, etc.

Two worthful years resulted in the submission of the present thesis successfully. As part of his training in the Department of Animal Nutrition he assisted various research works. As an all-rounder student he participated in National Service Scheme & Animal camps.

He considers himself as a good all-rounder of Veterinary Profession with futuristic vision, especially in the field of Nutrition of animals in the upcoming years.