EFFECT OF DIETARY SUPPLEMENTATION OF BAKER'S YEAST (*Saccharomyces cerevisiae*) ON THE PERFORMANCE OF BROILERS

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Thesis submitted in partial fulfilment of the requirement for the degree of

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DECLARATION

I hereby declare that this thesis, entitled **"EFFECT OF DIETARY SUPPLEMENTATION OF BAKER'S YEAST (*Saccharomyces cerevisiae*) ON THE PERFORMANCE OF BROILERS"** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

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CERTIFICATE

Certified that this thesis, entitled **"EFFECT OF DIETARY SUPPLEMENTATION OF BAKER'S YEAST (*Saccharomyces cerevisiae*) ON THE PERFORMANCE OF BROILERS"** is a record of research work done independently by **Shri. Renjith.P.M.**, under my guidance and supervision and it has not previously formed the basis for the award to me of any degree, diploma, fellowship or associateship to him.

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We, the undersigned members of the Advisory Committee of **Shri. Renjith. P.M.,** a candidate for the degree of Master of Veterinary Science in Poultry Science, agree that this thesis entitled **"EFFECT OF DIETARY SUPPLEMENTATION OF BAKER'S YEAST (*Saccharomyces cerevisiae*) ON THE PERFORMANCE OF BROILERS"** may be submitted by Shri. Renjith. P.M., in partial fulfillment of the requirement for the degree.

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CONTENTS

LIST OF TABLES

LIST OF FIGURES

Introduction

1. INTRODUCTION

The poultry industry in India has emerged as the most dynamic and rapidly growing segment under the agricultural sector and accounts for 100 billion rupees to the Gross National Product (GNP). The broiler production has recorded an explosive growth from 4 million in 1971 to 594 million in 2000 and egg production has increased from 5340 million in 1971 to 34,470 million in 2000 (Anon, 2003-2004).

Even though India ranks fifth position in egg production and nineteenth position in meat production in the world the per capita consumption is only 34 eggs and 826 g of meat (Anon, 2003-04). These levels are too low as compared to the world average of 147 eggs and 10.9 kg of poultry meat. The National Institute of Nutrition has recommended per capita consumption of 10.8 kg meat and 180 eggs per annum. i.e. 30 g meat and half an egg per person per day. Despite the impressive annual growth rate of 10 per cent in egg yield and 20 per cent in broiler production, a wide gap exists between the supply and demand of poultry meat and eggs in the country.

The urbanization of Indian population is expected to significantly change the food habit, i.e., a shift in diet from carbohydrate to protein which is likely to increase the per capita consumption of egg and poultry meat consumption. The fast growing poultry industry with its improved high yielding genetic potential competes with human population, for high quality feed ingredients such as cereals and fish which are already in short supply in our country.

Major problem faced by poultry sector is the high cost of feed which accounts for 70 per cent of production cost. Hence the formulation of least cost rations is the main aim of the poultry producer to reduce the feeding cost. Inclusion of feedstuffs containing unidentified growth factors in rations to enhance growth rate and feed efficiency is an area of interest to poultry farmers.

The gastrointestinal tract of chicken is inhabited by more than 300 species of bacteria and in a healthy bird there is a delicate balance between the beneficial and harmful bacteria. The balance gets shifted in favour of harmful bacteria under conditions of stress like intensification of the industry and faster growth. To cope up with the stress conditions various biotechnological tools are used and probiotic is one such product of biotechnology that is being incorporated currently into poultry feeds. The probiotic organisms compete with pathogenic bacteria to utilize the nutrients in the gastrointestinal tract and deprive the pathogens of the essential nutrient. Apart from this, probiotics in broiler diet improve growth, feed efficiency and carcass quality and reduce the adverse effects of antibiotics.

Yeasts are abundant throughout the environment and can be found in cereal grains, grain by-products, silages, hays and are even present in the soil and water. They are unicellular fungi, known for their fermentation ability and production of enzymes like amylase, protease, lipase and cellulase as well as B vitamins. Yeasts are good source of proteins and amino acids and are rich in lysine. About 40 per cent of the weight of dried yeast consists of protein.

Very few species of yeast are used commercially and *Saccharomyces cerevisiae*, which is known as "baker's yeast", is one of the most commercialized species as probiotics. Baker's yeast is also able to assimilate carbon, nitrogen and sulphur sources and trace elements into palatable nutritious product. Yeast also facilitates growth of *Lactobacillus* in the gut. In addition, the presence of glutamic acid in the yeast culture increases the palatability of the feeds.

The mannan oligosaccharide derived from *Saccharomyces cerevisiae* contained protein which had high proportion of serine, threonine, aspartic and glutamic acids and methionine. The mannan oligosaccharide significantly reduces the *Escherichia coli* in chicken faeces. It is also rich in lysine.

Research with broilers at the Oklahoma Agricultural Experiment Station has shown that the phytase activity of live yeast cultures significantly increase the efficiency of utilization of phytin phosphorus in the feed ingredients of plant origin and thereby reducing the cost of phosphorus supplements in the feed.

Yeast cultures are complex fermented products containing the yeast and the media on which it was grown during fermentation. Yeast cultures are not fed as a source of live or viable yeast cells, but are used as a nutritional supplement to provide unidentified fermentation factors, which are recognized to stimulate bacterial growth in the digestive tract. The yeast cell has a carbohydrate shell around it called the cell wall. It consists of mostly beta-glucans and mannans. The yeast cell wall has unique ability to absorb or bind toxins, antivitamins, virus and pathogenic bacteria. The culture is dried to preserve the fermenting capacity of yeast. Since the use of antibiotic is banned in several countries as growth promoter, feeding of probiotics became popular.

Significant improvement in body weight, feed consumption, feed efficiency and livability in broilers was reported by Yadav *et al.* (1994) where as non significant effect in growth was reported by Lopez *et al.* (2002). In view of the inconsistent reports in the literature, the present study was planned to investigate the effect of feeding live baker's yeast on growth and nutrient utilization of broilers.

Review of Literature

2. REVIEW OF LITERATURE

The research findings about baker's yeast done by various workers are discussed briefly in this chapter.

Meteorological parameters

Data pertaining to the meteorological parameters of Mannuthy (Latitude 10°32"; Longitude 76°16" E; Altitude 22.25 m above MSL) for five years were summarized by Somanathan (1980). He reported the highest mean maximum temperature of 32.35°C during May and lowest during July (28.15°C). The lowest mean minimum temperature recorded was 23.28°C during May. The daily average per cent relative humidity varied between 75.68 during May and 86.52 during July. Climatograph of this locality fell within the hot and humid climate.

Body weight and weight gain

Thayer and Jackson (1975) conducted two feeding trials to determine the effect of live yeast culture on phosphorus utilization in rations for growing chickens up to 8 weeks of age. The live yeast culture produced a statistically significant increase in growth rate at inorganic phosphorus supplemented levels of zero and 20 per cent of the amount required to meet the NRC requirements.

Savage *et al.* (1985) conducted an experiment to evaluate the effects of feeding corn-soy rations with and with out live yeast culture in Large White turkey poults. The results of their study revealed that the addition of live yeast culture to the corn-soy diet had no effect on mean body weight of either sex.

Trammell (1988) studied the use of yeast culture in commercial broiler diets and found that the average body weight was improved significantly by adding yeast culture. The addition of 5-10 lbs of yeast culture per tonne of grower feed helped to maintain the advantage in body weight obtained from adding yeast culture to the starter diets. Broilers fed diets containing 5 lbs of yeast culture per ton had the higher finishing weights (1975.5 g) at seventh week. When the three week data for all chicks fed yeast culture were pooled and compared to the control chicks (1927.8 g at seventh week), the yeast culture fed chicks were heavier (1955.9 g) at seventh week. The differences were significant.

Savage (1990) evaluated the effect of feeding varying levels of yeast culture (0.25, 0.50, 1.0 and 2.0 per cent) to turkey poults from day old to 21 days of age. The results of the study did not reveal any significant difference in weight gains between treatments.

Savage and Bradley (1992) conducted an experiment to determine the influence of yeast culture on the performance of market turkeys. Significant differences in body weight gains were recorded for males between 2 weeks and 14 weeks of age. Although no statistical difference in weight gain between diets was observed in females up to 8 weeks, there was numerical improvement in weight gain. These results suggested that there may be differences between sexes by diet interaction.

Baidya *et al.* (1993) reported the efficiency of feeding antibiotics and probiotics in broilers using Aurofac-100 (Aureomycin), Biospur (*Lactobacillus*, alpha amylase), G-probiotic (Live yeast culture, *Lactobacillus*, *Streptococcus*, Betaglucanase, liver extract) and Bioboost forte (live yeast culture *Saccharomyces cerevisiae*). Results of the study revealed no significant difference between experimental groups.

Sims and Mitchell (1994) evaluated the effect of yeast culture on the performance of commercial turkey toms. There was significant interaction between protein levels and yeast culture on body weight at 26 and 54 days of age. They concluded that the addition of yeast culture to the diet significantly increased the body weight compared to those not receiving yeast cultures.

In a study to counteract deleterious effects of aflatoxin in broilers by the supplementation of *Saccharomyces cerevisiae* (yeast) at 0.1 and 0.2 per cent level, Devegowda *et al.* (1994) reported significant improvement in body weight gain and immune response.

Yadav *et al.* (1994) studied the effect of dietary supplementation of graded levels of live yeast culture (0, 0.2, 0.6 and 1.0 per cent) on the performance of commercial broilers. The final body weights in grams were 2007.0, 1809.2, 1885.4, and 1995.0 for 0, 0.2, 0.6 and 1.0 per cent inclusion levels of yeast respectively. A response to added baker's yeast live culture was not observed in average body weight of broilers.

Bhatt *et al.* (1995) reported that dietary supplementations of four strains of *Saccharomyces cerevisiae* in the diet of Starbro broilers resulted significantly higher gain in live weight in Y 3 strain of yeast compared to Y_1 and Yea-Sac 1026 strains of yeast during the starter phase. However, during the finisher phase the difference among different treatments was non-significant for different parameters. The overall data pertaining to growth showed significantly higher gains in live weight in Y3 strain and yeast isolation from the droppings of pigeon.

Sarkar *et al.* (1997) studied the effect of feeding yeast and antibiotic either singly or in combination as well by phase feeding of the same in the ration of broilers up to six weeks of age. They found that body weight gain did not differ significantly among treatments.

Onifade *et al.* (1999) compared the supplemental effects of yeast *Saccharomyces cerevisiae* and sub-therapeutic antibiotics in high fiber and low protein diets of broiler chicks. In the first experiment, yeast along with antibiotics was added and in the second experiment yeast and antibiotics were separately added to the diets. *Saccharomyces cerevisiae* and antibiotics increased body weight and body weight gain above the control in the first experiment. In the second experiment broilers fed with supplements had superior body weight and body weight gain compared to the control.

Saha *et al.* (1999 a) conducted an experiment to study the effect of baker's yeast supplementation on growth, feed efficiency and carcass quality of broilers. The body weight gain in grams at eighth week of age was 1285, 1325 and 1355 respectively for 0, 0.35 and 0.5 per cent yeast levels. Diets supplemented with different levels of baker's yeast did not show any effect on average body weight of broilers.

Saha *et al.* (1999 b) studied the effect of live yeast supplementation on the growth and nutrient utilization in commercial broilers in deep litter system of rearing. Baker's yeast (0.25 per cent) was added to the concentrate mixture. The final body weight at eighth week of age was 1267.5 and 1417.55 g and average body weight gain was 1225.25 and 1375.25 g respectively for control and experimental groups. However, the improvement in the growth rate consequent to supplementation of baker's yeast was non-significant.

Kumprechtova *et al.* (2000) conducted a comparative feeding trial with broiler chickens to study the effect of continual applications of a probiotic (control-without probiotic, and treatments-100 g of probiotic and 200 g of probiotic per 100 kg of feed) containing the Sc-47 strain of the yeast *Saccharomyces cerevisiae* to feed mixtures of standard formulation and to feed mixtures with two different levels of crude protein. The live weight of broilers at 21 days of age was not significantly influenced by the levels of probiotic while it was higher than in control by 1.80 per cent and 1.38 per cent, respectively, in the first and second treatments at 42 days of age. Positive results of both levels of probiotic were observed with feed mixtures having a lower level of crude protein.

Singh and Prasad (2000) studied the effect of live yeast supplementation on growth and nutrient utilization in caged broilers. Broiler chicks were randomly divided into five groups and reared on feed without baker's yeast (control) and four feed mixtures with 0.1, 0.2, 0.3 and 0.4 per cent baker's yeast. The final body weights at fifth week were 1.221, 1.261, 1.220, 1.220 and1.228 kg and the average weight gain at five weeks were 1.175, 1.217, 1.179, 1.177 and 1.245 kg for control, 0.1, 0.2, 0.3 and 0.4 per cent levels of baker's yeast in diet respectively. Better growth rate was observed in experimental groups though not significant.

An experiment was conducted to evaluate the performance of broiler chicken supplemented with marine yeast or *Saccharomyces cerevisiae* through drinking water to negative control (feed without antibiotic growth promoter), positive control (feed with antibiotic growth promoter) and reference commercial probiotics (Kompiang., 2002). Results of this study revealed that the effects of probiotic on bird performance were better than that of negative control.

Lopez *et al.* (2002) determined the probiotic activity in the soluble fraction of a hydrolysed enzymatic product of *Saccharomyces cerevisiae* yeast. The group fed the yeast showed differences in the productive indicators, compared to the control (without the hydrolysed product). Live body weight was increased by 16 and 19 per cent for the groups treated with the completely hydrolysed product and its soluble fraction. Gain in body weight was 17 and 20 per cent respectively.

Soliman *et al.* (2003) studied the effect of marjoram, bacitracin and active yeast as feed additives on the performance and the microbial content of the broiler's intestinal tract. The results of this study indicated that all additives improved live body weight and weight gain at three weeks insignificantly. The combination of yeast and bacitracin gave the best final body weight gain at six weeks of age (1609 g).

Teixeira *et al.* (2003) determined the effects of probiotics on the performance of broiler chicks fed diets containing bone and meat meal with different levels of bacterial contamination. Four rations were formulated, one with bicalcic phosphate without meat meal (control) and the other three contained meat meal with high, medium and low level of bacterial contamination. The rations fed to broilers were those without probiotics; with a probiotic containing *Lactobacillus acidophilus*, *Streptococcus faecium* and *Saccharomyces cerevisiae* at a dose of 10 g per ton of feed; and with a probiotic containing *E.faecium*, *L.acidophilus*, *L.plantarum* and *Lactobacillus* species at the dose of 3×10^{10} cfu per g added to water. Results revealed no significant effects on weight gain of broilers.

Abd El Wahed *et al.* (2003) conducted an experiment to evaluate the effect of replacing soybean meal with graded levels of dried yeast on growth of Dandarawi and Montazah chicks. Four experimental diets were formulated in which dried yeast replaced soybean meal at levels of 0, 2, 4, and 6 per cent for each strain. The chicks fed graded levels of dried yeast substituted for soybean meal had highly significant differences for live body weight gain except at 12 weeks of age (168, 511, 1039, 606 and 292 g respectively during the periods 0-4, 0-8, 0-16, 8-16 and 12-16 weeks of age). As the level of dried yeast increased, live weight significantly increased. Chicks fed the control diet had lower live body weight gain than those fed graded levels of dried yeast.

Feed intake

Thayer *et al.* (1978) conducted studies to determine the effect of live yeast culture on the utilization of both available and total dietary phosphorus in turkeys. Addition of live yeast culture to the turkey breeder rations recorded significant difference in feed intake between the control and experimental rations.

Cantor *et al.* (1983) reported the effects of yeast culture on feed palatability in turkeys. Yeast culture was included at 2.5 per cent to the basal diet. Results of this study revealed that there was no significant difference among treatment for feed intake, but poults showed a significant preference for the diets containing yeast culture.

Baidya *et al.* (1993) reported the efficiency of feeding different antibiotics and probiotics in broilers using Aurofac-100 (Aureomycin), Biospur (*Lactobacillus*, alpha amylase), G-probiotic (Live yeast culture, *Lactobacillus*, *Streptococcus*, Betaglucanase, liver extract) and Bioboost forte (live yeast culture -*Saccharomyces cerevisiae*). The data on feed intake could not bring forth any significant difference among the various experimental groups compared to control.

Yadav *et al.* (1994) studied the effect of dietary supplementation of graded levels of live yeast culture (0, 0.2, 0.6 and 1.0 per cent) on the performance of commercial broilers. The feed consumption per bird in grams at eight weeks of age was 4595.5, 4322.9, 4296.9 and 4448.9 for 0, 0.2, 0.6 and 1.0 per cent dietary levels of yeast respectively. A response to added live baker's yeast culture was not observed in case of cumulative feed consumption of broilers.

Sarkar *et al.* (1997) found that feeding yeasts and antibiotics singly or in combination as well as by phase feeding did not improve feed intake in broilers up to six weeks of age.

Saha *et al.* (1999a) studied the effect of baker's yeast supplementation on growth, feed efficiency and carcass quality of broilers. The feed consumption in grams at eighth week of age was 3276, 3246 and 3495 g respectively for 0, 0.35 and 0.5 per cent yeast levels. Diets supplemented with different levels of baker's yeast did not show any significant effect on cumulative feed consumption of broilers.

Saha *et al.* (1999b) studied the effect of live yeast supplementation on the growth and nutrient utilization in commercial broilers in deep litter system. The total feed consumption of birds in control (3580.25 g) and groups supplemented with baker's yeast at 0.25 per cent (3622.56 g) did not differ significantly.

Kumprechtova *et al.* (2000) conducted a comparative feeding trial with broiler chickens to study the effect of continual applications of a probiotic (control-without probiotic, and treatments-100 g and 200 g of probiotic per 100 kg of feed) containing the Sc-47 strain of the yeast *Saccharomyces cerevisiae* to broiler feed mixtures of standard formulation and to feed mixtures with two different levels of crude protein. Results of the study revealed that the consumption of feed was reduced by both levels of probiotic in comparison with control.

Singh and Prasad (2000) studied the effect of live yeast supplementation on the growth and nutrient utilization in caged broilers. Broiler chicks were randomly divided into five groups and reared on feed without baker's yeast (control) and groups with 0.1, 0.2, 0.3 and 0.4 per cent baker's yeast. The mean feed intake per bird at five weeks of age was 2.39, 2.50, 2.50, 2.51 and 2.62 kg for control, 0.1, 0.2, 0.3 and 0.4 per cent baker's yeast respectively. The total feed consumption of birds in control and yeast feeding groups did not differ significantly.

An experiment was conducted to evaluate the effect of marine yeast and *Saccharomyces cerevisiae* as probiotic supplements on poultry performance (Kompiang, 2002). Evaluation was conducted by comparing the performance of broiler chicken supplemented with marine yeast or *Saccharomyces cerevisiae* which were given through drinking water to negative control (feed without antibiotic growth promoter), positive control (feed with antibiotic growth promoter), and reference commercial probiotic. Feed consumption was measured weekly during the trial. The effects of probiotic on bird performance were better than that of negative control.

Lopez *et al.* (2002) investigated whether probiotic activity is present or not in the soluble fraction of a hydrolysed enzyamatic product of *Saccharomyces cerevisiae* yeast. Feed intake was increased by 9 and 8 per cent for the groups treated with the completely hydrolysed product and its soluble fraction compared to the control.

Soliman *et al.* (2003) studied the effect of marjoram, bacitracin and active yeast as feed additives on the performance and the microbial content of the broiler's intestinal tract. Diets were fed without supplementation (control) or supplemented with active dried yeast at 4 g / kg diet; bacitracin methyline disalicylate (220 mg/kg diet) ; a combination of 4 g yeast + 220 mg bacitracin/kg diet or marjoram at1.5 per cent of the diet. During the first three weeks of age, the combination of bacitracin and yeast enhanced the appetite of birds, where feed intake values were insignificantly increased in yeast and bacitracin fed group when compared to the control group.

Teixeira *et al.* (2003) conducted a trial to determine the effects of probiotics on the performance of broiler chicks fed diets containing bone and meat meal with different levels of bacterial contamination. Four rations were given, one with bicalcic phosphate without meat meal (control) and the other three contained meat meal with high, medium and low level of bacterial contamination. These rations were fed to broilers: without probiotics; with a probiotic containing *Lactobacillus acidophilus, Streptococcus faecium* and *Saccharomyces cerevisiae* at a dose of 10 g per ton of feed; and with a probiotic containing E.*faecium, L.acidophilus, L.plantarum* and *Lactobacillus* species. Results revealed no significant effects on feed intake of broilers.

Onyango *et al.* (2004) evaluated the efficacy of *Escherichia coli*-derived phytase preparations on the performance and nutrient utilization of broiler chicken. Diets were fed with adequate phosphorus, very low phosphorus, low phosphorus and low phosphorus diet plus phytase preparations produced in different yeast production systems like in *Pichia pastoris*, *Schizosaccharomyces pombe*, and in *Saccharomyces cerevisiae*. Results revealed that feed intake among three phytase preparations did not differ significantly.

Feed conversion ratio

Thayer and Jackson (1975) conducted two feeding trials to determine the effect of a live yeast culture on phosphorus utilization in rations for growing chickens up to 8 weeks of age. There was no statistically significant difference in feed conversion in both trials.

Cantor *et al.* (1983) reported the effects of yeast culture on feed palatability in turkeys. The results indicated that turkey poults have the ability to distinguish between a corn-soy diet with and without 2.5 per cent yeast culture. After feeding the diets for one week, the poults showed a significant preference for the diets containing yeast culture. There were no significant differences for feed conversion among the treatments.

An experiment was conducted to evaluate the effects of feeding nutritionally balanced corn-soy rations with and with out live yeast culture in Large White turkey poults. The addition of live yeast culture to the corn-soy diet had no significant effect on feed conversion ratio (Savage *et al.*, 1985).

Trammell (1988) studied the use of yeast culture in commercial broiler diets. Feed efficiency was improved numerically by adding yeast culture to the starter diet at all levels. When the three week data for chicks fed yeast culture were pooled and compared to the control chicks (1.421 and 1.404 respectively for control and yeast fed broilers) yeast culture fed chicks had a significantly higher feed efficiency. At seven weeks of age the feed efficiency was 1.954 and 1.956 respectively for control and yeast fed groups.

Savage (1990) evaluated the supplementation of yeast culture in diets for turkey poults. He concluded that feeding poult with 0.25 per cent yeast culture was beneficial. The mean feed conversion ratios were not different among the treatments. But there was a trend of improved feed efficiency for the poults fed the 0.25 per cent and the 1.0 per cent yeast culture diets. He reported a 6.2 per cent improvement in feed efficiency.

Savage and Bradley (1992) determined the influence of yeast culture on the performance of turkeys. The feed conversion ratio revealed that both males and females had improved feed efficiencies between two and eight weeks.

Baidya *et al.* (1993) reported the efficiency of feeding different antibiotics and probiotics in broilers. The study was conducted using Aurofac-100 (aureomycin), Biospur (*Lactobacillus*, alpha amylase), G-probiotic (Live yeast culture, *Lactobacillus, Streptococcus*, Betaglucanase, liver extract) and Bioboost forte (live yeast culture *Saccharomyces cerevisiae*). The data on feed efficiency could not bring forth any significant difference among the various experimental groups compared to control.

Sims and Mitchell (1994) evaluated the effect of yeast culture on the performance of commercial tom turkeys. It was found that turkeys on high protein diets receiving yeast culture had better feed efficiency than those birds on the high protein diet with out yeast culture. In the low protein diet, feed efficiency was similar with and with out yeast culture.

Yadav *et al.* (1994) studied the effect of dietary supplementation of graded levels of live yeast culture (0, 0.2, 0.6 and 1.0 per cent) on the performance of commercial broilers. The feed conversion ratio was 2.2, 2.3, 2.2 and 2.2 for 0, 0.2, 0.6 and 1.0 per cent dietary levels of yeast respectively. The response to added live baker's yeast culture was not significant in the case of feed efficiency.

Bhatt *et al.* (1995) reported that dietary supplementation of four strains of *Saccharomyces cerevisiae* in the diet of Starbro broilers showed significantly higher feed efficiency ratio in Y3 strain of yeast as compared to other treatments during the starter phase. However during the finisher phase, the differences among treatments were non-significant for different parameters. The overall performance showed significantly higher feed efficiency in Y3 strain and yeast isolation from the droppings of pigeon.

Feed conversion ratios did not differ significantly among treatment groups when yeasts and antibiotics are fed either singly or in combination by phase feeding in the diet of broilers up to six weeks of age (Sarkar *et al.*, 1997).

Two experiments were conducted to compare the supplemental effects of yeast *Saccharomyces cerevisiae* and sub-therapeutic antibiotics in high fiber and low protein diets of broiler chicks. In first experiment yeast along with antibiotics were added and in the second experiment yeast and antibiotics were separately added to the diet. *Saccharomyces cerevisiae* and antibiotics improved feed conversion ratio above the control in the first experiment. In the second experiment broilers fed with supplements had superior feed conversion ratio compared to the negative control. Yeast stimulated better feed conversion ratio (Onifade *et al.*, 1999).

Saha *et al.* (1999a) conducted an experiment to study the effect of baker's yeast supplementation on growth, feed efficiency and carcass quality of broilers. Diets supplemented with different levels of baker's yeast (*0, 0.35* and *0.5* per cent) did not show any significant effect on overall feed efficiency in broilers (2.55, 2.45 and 2.58 for baker's yeast levels of 0, 0.35 and 0.5 per cent respectively).

Saha *et al.* (1999b) studied the effect of live yeast supplementation on the growth and nutrient utilization in commercial broilers in deep litter system of rearing. The feed conversion ratio at eighth week of age was 2.78 and 2.63 respectively for control and experimental groups. Baker's yeast added at 0.25 per cent level to the concentrate mixture showed significant response to the feed conversion ratio of broilers.

Kumprechtova *et al.* (2000) conducted a comparative feeding trial with broiler chickens to study the effect of continued applications of a probiotic (control-without probiotic, and treatments-100 g of probiotic per 100 kg feed and 200 g of probiotic per 100 kg of feed) containing the Sc-47 strain of the yeast *Saccharomyces cerevisiae* to feed mixtures of standard formulation and to feed mixtures with two different levels of crude protein. The effect of both levels of probiotic on feed consumption per one kg of weight gain was more pronounced when it was applied to feeds with a lower crude protein level.

Singh and Prasad (2000) studied the effect of baker's yeast supplementation (0.1, 0.2, 0.3 and 0.4 per cent baker's yeast) on the growth and nutrient utilization in caged broilers. The feed conversion ratio was 2.04, 2.06, 2.12, 2.14 and 2.10 for control, 0.1, 0.2, 0.3 and 0.4 per cent baker's yeast, respectively. Difference in feed conversion ratio between control and experimental groups were found non-significant.

Lopez *et al.* (2002) determined the probiotic activity in the soluble fraction of a hydrolysed enzymatic product of *Saccharomyces cerevisiae* yeast. The group fed the product showed differences in the productive indicators, compared to the control (without the hydrolysed product). Feed conversion was increased by 7 and 10 per cent for the groups fed with the completely hydrolysed product and its soluble fraction.

Soliman *et al.* (2003) studied the effect of marjoram, bacitracin and active yeast as feed additives on the performance and the microbial status of the intestinal tract. The results of this study indicated that the best feed conversion values were 1.87 for bacitracin fed group followed by group fed combination of yeast and bacitracin (1.90), marjoram (1.96), yeast (2.16) and control (2.16). The results were non-significant.

Teixeira *et al.* (2003) conducted a trial to determine the effects of probiotics on the performance of broiler chicks fed diets containing bone and meat meal with different levels of bacterial contamination. Four rations were formulated, one with bicalcic phosphate without meat meal (control) and the other three contained meat meal with high, medium and low level of bacterial contamination. The rations fed to broilers were those without probiotics; with a probiotic containing *Lactobacillus acidophilus, Streptococcus faecium* and *Saccharomyces cerevisiae* at a dose of 10 g per ton of feed; and with a probiotic containing *E.faecium, L.acidophilus, L.plantarum* and *Lactobacillus* species. Results revealed no significant effects on feed conversion of broilers.

Abd El Wahed *et al.* (2003) conducted an experiment to evaluate the effect of replacing soybean meal with graded levels of dried yeast on growth of Dandarawi and Montazah chicks. Four experimental diets were formulated in which dried yeast replaced soybean meal at levels of 0, 2, 4, and 6 per cent for each strain. There were significant strain differences present and regardless of the strain, 2 per cent dried yeast supplementation significantly improved feed efficiency during the periods as compared to the control.

Onyango *et al.* (2004) studied the efficacy of *Escherichia coli*-derived phytase preparations on the performance and nutrient utilization of broiler chicken. Diets were fed with adequate phosphorus, very low phosphorus, low phosphorus and low phosphorus diet plus phytase preparations produced in different yeast production systems like in *Pichia pastoris*, Schizosaccharomyces pombe, and *Saccharomyces cerevisiae*. Feed efficiency did not differ among the three treatments.

Processing yields and losses

Savage *et al.* (1985) reported the effects of feeding nutritionally balanced corn-soy rations with and with out live yeast culture to Large Whiteturkey poults. There was significant difference in eviscerated yields at various ages but the difference between sexes and dietary treatments were statistically non-significant. The carcass fat (per cent) was lower in females than that of males but the difference between control and yeast supplemented groups were non-significant.

Baidya *et al.* (1993) reported the efficiency of feeding different antibiotics and probiotics in broilers. The study was conducted using Aurofac-100 (aureomycin), Biospur (*Lactobacillus*, alpha amylase), G-probiotic (Live yeast culture, *Lactobacillus, Streptococcus*, Betaglucanase, liver extract) and Bioboost forte (live yeast culture *Saccharomyces cerevisiae*). The data on different slaughter parameters like per cent edible meat, eviscerated yield, giblet yield and the ratio of different vital organs to per cent live weight did not show significant differences among various treatments suggesting that feeding of different growth promoters had no remarkable effect on different slaughter characteristics.

Sims and Mitchell (1994) evaluated the effect of yeast culture on the performance of commercial turkey toms. There were no significant effects on carcass characteristics, although breast yield per cent did favour those birds receiving yeast culture.

Yadav *et al.* (1994) studied the effect of dietary supplementation of graded levels of live yeast culture (0, 0.2, 0.6 and 1.0 per cent) on performance of commercial broilers. The effect of dietary supplementation on carcass quality characteristics showed that the processing losses (fasting loss, blood loss, defeathering loss and evisceration losses), dressing per cent, individual yield of drumstick and thighs, wings, neck, back and breast were not significantly affected by the graded levels of yeast supplementation.

Bhatt *et al.* (1995) reported that dietary supplementations of four strains of *Saccharomyces cerevisiae* in the diet of Starbro broilers recorded statistically non-significant difference in processing yields among various treatments.

Sarkar *et al.* (1997) reported that eviscerated carcass and giblet yields did not show significant differences when yeasts and antibiotics are fed either singly or in combination as well by phase feeding. Different cut up parts and weight of different vital organs to per cent live weight also did not show any significant difference.

Two experiments were conducted to compare the supplemental effects of yeast *Saccharomyces cerevisiae* and sub-therapeutic antibiotics in high fiber and low protein diets of broiler chicks. In the first experiment yeast along with antibiotics were added and in the second experiment yeast and antibiotics were separately added to the diet. *Saccharomyces cerevisiae* and antibiotics increased carcass and breast weights above the control in the first experiment. Yeast caused a lower deposition of abdominal fat. But in the second experiment broilers fed with supplements had statistically similar carcass data compared to control (Onifade *et al.*, 1999).

Saha *et al.* (1999 a) conducted an experiment to study the effect of baker's yeast supplementation on growth, feed efficiency and carcass quality of broilers. Diets supplied with different levels of baker's yeast (0, 0.35 and 0.5 per cent) did not show any significant effect on dressing per cent, giblet yield, and cut up yields of broilers among different treatments.

Kumprechtova *et al.* (2000) conducted a comparative feeding trial with broiler chickens to study the effect of continual applications of a probiotic (control-without probiotic, and treatments-100 g and 200 g of probiotic per 100 kg of feed) containing the Sc-47 strain of the yeast *Saccharomyces cerevisiae* to feed mixtures of standard formulation and to feed mixtures with two different levels of crude protein. Slaughter yield was not significantly influenced by applications of the probiotic.

Soliman *et al.* (2003) studied the effect of yeast as feed additives on the performance and the microbial content of the intestinal tract of broilers. Diets were fed without supplementation (control) or supplemented with active dried yeast at 4 g / kg diet. Carcass characteristics results showed that only gizzard, bursa and thymus values were affected significantly by the dietary treatments. All additives reduced gizzard values (2.77, 2.17, and 2.27 for control, yeast fed group and group fed combination of yeast and bacitracin respectively) as compared to the control group. Both bursa and thymus values were increased in yeast and bacitracin fed group which may indicate high immune response. Abdominal fat values were increased insignificantly in yeast and bacitracin group (1.36 per cent) compared to control (0.97 per cent).

Nutrient utilization

Thayer and Jackson (1975) conducted two feeding trials to determine the effect of a live yeast culture on phosphorus utilization in rations for growing chickens up to 8 weeks of age. They reported that live yeast culture at 2.5 per cent level in the feed increased the utilization of dietary phosphorus by the synthesis of phytase in the digestive tract. Values for ash, calcium and phosphorus in bone for the growing chickens fed rations supplemented with live yeast culture and those unsupplemented rations did not show statistically significant differences. It was recommended that inorganic phosphorus supplement levels in a soybean oil meal-corn ration may be reduced by some 40-60 per cent through the use of a live yeast culture.

A feeding trial of sixteen weeks duration was conducted in turkey breeder hens maintained in individual laying cages to determine the effect of live yeast culture on utilization of both available and total dietary phosphorus. The results indicated that the efficiency with which dietary phosphorus was utilized by turkey breeder hens was significantly increased by the addition of live yeast culture to the ration (Thayer *et al.*, 1978).

Yadav *et al.* (1994) studied the effect of dietary supplementation of graded levels of live yeast culture (0, 0.2, 0.6 and 1.0 per cent) on performance of commercial broilers. The added live baker's yeast culture in different grades showed positive nutrient balance per day per chick in grams in respect of protein/ nitrogen (16.0, 21.5, 20.4 and 21.3 for 0, 0.2, 0.6 and 1.0 per cent dietary levels of yeast respectively), calcium (1.1, 1.1, 1.1 and 1.1 for 0, 0.2, 0.6 and 1.0 per cent dietary levels of yeast respectively) and phosphorus (0.5, 0.5, 0.5 and 0.5 for 0, 0.2, 0.6 and 1.0 per cent dietary levels of yeast respectively) in all the treatment groups. But the differences were non-significant.

Bhatt *et al.* (1995) reported that dietary supplementations of four strains of *Saccharomyces cerevisiae* in the diet of Starbro broilers showed differences in digestibility of various nutrients at the end of starter phase which were non-significant except ether extract, acid detergent fiber and cellulose. The trend of data on digestibility seemed to be matching with that of growth. The retention of nitrogen was also significantly higher in treatments.

Saha *et al.* (1999a) conducted an experiment to study the effect of baker's yeast supplementation on growth, feed efficiency and carcass quality of broilers. Diets supplemented with different levels of baker's yeast (0, 0.35 and 0.5 per cent) did not show any effect on nutrient balance in respect to protein (18.5, 20.22 and 21.5), *calcium (1.20, 1.22 and 1.1) and phosphorus (0.50, 0.55 and 0.50)* levels.

Saha *et al.* (1999b) studied the effect of live yeast supplementation on the growth and nutrient utilization in commercial broilers under deep litter system of rearing. Baker's yeast was added at 0.25 per cent level. Except for the apparent digestibility of ether extract (76.22 and 78.85 per cent) the digestibility of other nutrients viz. organic matter (69.22 and 72.22 respectively) and crude protein (62.25 and 64.54 respectively) did not differ significantly between control and experimental groups. However, there was a general trend towards slightly better utilization of nutrients by the probiotic fed chicks and the retention of calcium (1.10 and 1.11 respectively) and phosphorus (0.61 and 0.65 respectively) for control and experimental groups as well.

Kumprechtova *et al.* (2000) conducted a comparative feeding trial with broiler chickens and reported the effect of continual applications of a probiotic (control-without probiotic, and treatments-100 g and 200 g of probiotic per 100 kg of feed) containing the Sc-47 strain of the yeast *Saccharomyces cerevisiae* to feed mixtures of standard formulation and to feed mixtures with two different levels of crude protein. Significantly higher nitrogen retention was obtained for feed mixtures with a lower crude protein level than those with a higher crude protein level. The coefficient of fiber digestibility increased only in the groups that received the probiotic in feeds with a higher crude protein level.

Singh and Prasad (2000) studied the effect of live yeast supplementation on the growth and nutrient utilization in caged broilers. Broiler chicks were randomly divided into five groups and reared on feed without baker's yeast (control) and four treatments with 0.1, 0.2, 0.3 and 0.4 per cent baker's yeast. The results pertaining to apparent digestibility of dry matter (64.6, 64.1, 68.0, 68.0 and 65.4 per cent respectively), organic matter (60.0, 56.0, 63.0, 66.0 and 61.2 per cent respectively), ether extract (62.5, 60.2, 63.5, 68.6 and 67.2 per cent respectively), calcium (1.29, 1.33, 1.42, 1.41 and 1.49 g respectively) and phosphorus (0.60, 0.62, 0.65, 0.63 and

0.69 g respectively) during last week of experiment showed slightly better utilization of these nutrients in broilers of experimental group but were non-significant.

Soliman *et al.* (2003) studied the effect of marjoram, bacitracin and active yeast as feed additives on the performance and the microbial content of the broiler's intestinal tract. Dietary treatments consist of control and diets supplemented with dried yeast (4 g / kg diet), marjoram (1.5 per cent), bacitracin (220 mg / kg diet) and yeast and bacitracin together (4 g / kg respectively). The results showed that digestibility coefficients of ether extract, crude fiber and crude protein were not affected significantly by any of the treatments, while the digestibility coefficients of dry matter, organic matter and nitrogen free extract were decreased significantly due to the additives. There were no significant differences between nitrogen balance values for yeast fed group and control group.

Serum cholesterol and serum protein

Bartov *et al.* (1974) reported plasma protein level of 3.54 ± 0.24 g/100 ml in male and 3.73 ± 0.36 g/100 ml in female broilers.

Sturkey (1976) reported that serum cholesterol of unsexed White leghorn chicks from one to 15 weeks of age as 116 to 134 mg per 100 ml and is influenced by species, age, sex, nutrition, health status, energy needs, climatic conditions and other factors. The total plasma or serum protein value was 4.0 and 5.24 for adult male chicken and female chicken respectively and can be affected by the state of dehydration, haemorrhage, and level of protein nutrition.

The effects of feeding mannan oligosaccharide (Bio-Moss, derived from *Saccharomyces cerevisiae*) at a level of zero to three grams per kg diet from one to 35 days on total serum protein, albumin, and globulin and on antibody response to Infectious Bronchitis, Infectious Bursal Disease, and New Castle Disease vaccines of meat and specific pathogen-free chickens were examined (Shafey *et al.*, 2001).

Serum globulin and total protein were influenced by dietary addition of Bio-Moss in specific pathogen-free chickens but not in meat chickens.

The effect of heat treatment on the reduction of cholesterol was studied in a hydrolysed enzymatic complex of *Saccharomyces cerevisiae* yeast cream (Garcia *et al.*, 2002). The heat treated and non treated hydrolysed enzymatic complexes were compared to a basal diet. The cholesterol levels in serum was determined at 21, 35 and 42 days of age and the high density lipoprotein (HDL) cholesterol, very low density lipoprotein (VLDL) + low density lipoprotein (LDL) cholesterol in serum also determined at 35 and 42 days of age. The cholesterol levels in serum at 21 days did not show differences among groups. However the cholesterol in serum decreased ($P<0.005$) in the heat treated product compared to the control and the naturally hydrolyzed product at 35 days (93.20 vs. 119.20 and 123.60 mg / dl) and 42 days (98.42 vs. 118.53 and 109.54 mg/dl). The HDL cholesterol concentration was similar among the groups at 35 days and lower at 42 days when compared to control. The results suggest that the heat treatment allows the hypocholesteraemic action of the hydrolyzed enzymatic complex of *Saccharomyces cerevisiae* yeast.

Soliman *et al.* (2003) studied the effect of marjoram, bacitracin and active yeast as feed additives on the performance and the microbial content of the broiler's intestinal tract. Dietary treatments consist of control and diets supplemented with dried yeast (4 g / kg diet), and yeast and bacitracin together (4 g / kg respectively). The total protein values were 3.57, 4.08, and 5.28 g / dl for control, yeast fed group and for group fed combination of yeast and bacitracin respectively. Cholesterol values were 125, 107 and 155 mg / dl for control, yeast fed group and for group fed combination of yeast and bacitracin respectively. The results of this study indicated a slight reduction in blood cholesterol due to yeast supplementation.

Livability

Trammell (1988) studied the use of yeast culture in commercial broiler diets. The average body weight was improved by adding yeast culture to the diet.

Mortality during the study was normal with most of the mortality being related to sudden death syndrome.

Savage (1990) studied the evaluation of yeast culture in diets for turkey poults. He concluded that feeding poults with diets containing 0.25per cent yeast culture could be beneficial. Although the diet had no significant effect on early poult mortality.

Savage and Bradley (1992) conducted an experiment to determine the influence of yeast culture on the performance of market turkeys. Bird mortality from day-old to 17 weeks did not reveal any significant difference between treatments within sex. When mortality primarily associated with the respiratory problem was tabulated separately, livability of yeast culture fed birds was better than controls. Mortality data for weeks 14 to 17 suggests that yeast culture fed males were able to withstand the respiratory challenge better than control birds.

Sims and Mitchell (1994) evaluated the effect of yeast culture on the performance of commercial turkey toms. The mortality of the birds was not significantly affected by treatments.

Bhatt *et al.* (1995) reported that dietary supplementations of four strains of *Saccharomyces cerevisiae* in the diet of Starbro broilers showed lower mortality per cent in comparison to controls.

An experiment was conducted to evaluate the effect of marine yeast and *Saccharomyces cerevisiae* as probiotic supplements on poultry performance (Kompiang, 2002). Evaluation was conducted by comparing the performance of broiler chicken supplemented with marine yeast or *Saccharomyces cerevisiae* which were given through drinking water to negative control (feed without antibiotic growth promoter), positive control (feed with antibiotic growth promoter), and reference commercial probiotic. Mortality was recorded during the trial. There was no significant difference in mortality among treatments.

Economics

Soliman *et al.* (2003) studied the effect of marjoram, bacitracin and active yeast as feed additives on the performance and the microbial content of the broiler's intestinal tract. Diets were fed without supplementation (control) or supplemented with active dried yeast at 4 g / kg diet; bacitracin methyline disalicylate (220 mg/kg diet); a combination of 4 g yeast + 220 mg/kg bacitracin/kg diet or marjoram at 1.5 per cent of the diet. In this study yeast scored the least economic efficiency and relative economic efficiency.

Abd El Wahed *et al.* (2003) conducted an experiment to evaluate the effect of replacing soybean meal with graded levels of dried yeast on growth of Dandarawi and Montazah chicks. Four experimental diets were formulated in which dried yeast replaced soybean meal at levels of 0, 2, 4, and 6 per cent for each strain. The economic efficiency values of the groups fed 0, 2, 4, 6 per cent dried yeast substituted for soybean meal favours the substitution of soybean meal by 2 per cent of yeast.

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Materials and Methods

3. MATERIALS AND METHODS

An experiment was conducted at the Centre for Advanced Studies in Poultry Science, College of Veterinary and Animal Sciences, Mannuthy to study the effect of feeding live baker's yeast on growth and nutrient utilization of broilers. The study was conducted for a period of eight weeks from November 2003 to January 2004.

One hundred and forty four, day-old straight-run commercial broiler chicks (Ven cob) procured from a commercial hatchery formed the experimental subjects. The chicks were wing banded, vaccinated against Ranikhet Disease and weighed individually. The birds were allotted randomly to three treatment groups with four replicates of twelve birds each as detailed below.

Treatment	Number of replications	Type of ration	Baker's yeast (g/100 Kg)
T1	4	Control diet without baker's yeast	0
T2	4	Control diet with baker's yeast	300
T3	4	Control diet with baker's yeast	600

The allotment of chicks to the different treatment groups and replicates was made in such a way that the weights of the chicks with in a group as well as between groups were reasonably similar. The chicks were reared under deep litter system of rearing. The experimental shed was cleaned and disinfected one week before the commencement of the experiment. Litter materials were spread to a thickness of 6 cm in each pen. For each chick a floor space of 925 sq. cm was allotted. Feeders, waterers and other equipments were cleaned, disinfected and sun dried before use.

The chicks were brooded for a period of four weeks of age. Thereafter light was provided to enhance feed intake during night hours. Chicks were reared under standard managemental conditions up to eight weeks of age. They were protected against Ranikhet Disease and Infectious Bursal Disease. The birds were provided with feed and water *ad libitum* throughout the experimental period.

Broiler starter diets were fed up to six weeks of age and then switched over to broiler finisher diets till the end of eight weeks of age. Both the rations were formulated as per BIS (1992) specification of nutrients for broiler chicken.

Feed ingredients used in the formulation of the experimental rations were yellow maize, de-oiled rice bran, soybean meal, gingelly oil cake and unsalted dried fish. The feed ingredients were procured from University Poultry Farm, Mannuthy.

The ingredient composition of the three different starter and finisher rations is presented in Tables 1 and 2 respectively. The proximate analysis of the ration was carried out according to the procedure described by AOAC (1990). The chemical composition of diets is presented in Table 3.

The performance of the birds was recorded for a period of eight weeks. The following observations were recorded during the experimental period.

1) Meteorological parameters

Temperature and humidity inside the experimental house were recorded daily to assess the influence of the microenvironment on the performance of broilers. The wet and dry bulb thermometer readings were taken at 8 A.M. and 2 P.M. daily. The maximum and minimum temperatures were recorded at 8 A.M. on all days throughout the experimental period. From these data weekly mean maximum and minimum temperatures and per cent relative humidity were arrived at.

2) Body weight

The body weight of individual birds was recorded at fortnightly intervals from day old to study the pattern of body weight gain under different dietary treatments.

3) Feed intake

Feed intake of the birds was recorded replicate wise at weekly intervals. From these data, the average feed intake per bird per day was calculated for various treatment groups.

4) Feed conversion ratio

Feed conversion ratio (kg of feed consumed/kg body weight gain) was calculated at fortnightly intervals in each treatment groups based on the data on body weight gain and feed intake.

5) Metabolism trial

At the end of the experiment, a three-day metabolism trial was conducted using two birds from each replicate selected randomly and housed in individual metabolism cages with facilities for feeding, watering and excreta collection. Feed and water were provided *ad libitum*. Excreta samples were collected over 24 hour period for three consecutive days using total collection method as described by Summers *et al.* (1976). The droppings were weighed and samples were taken and stored in airtight containers in a deep freezer for analysis. The total amount of feed consumed and excreta voided were also recorded.

6) Chemical analysis

The chemical compositions of experimental rations were determined as per the standard procedures (AOAC, 1990). The nitrogen content of the excreta samples were determined in fresh material as per the procedure described by AOAC (1990). Then the excreta samples were dried in the oven at 100°C overnight and ground prior to the estimation of calcium and phosphorus content.

From the data obtained on the total intake and outgo of nutrients during the metabolism trial, N retention and availability of Ca and P were calculated.

7) Serum cholesterol and total protein

At the end of eight weeks, blood samples were collected from two birds in each replicate by severing the jugular vein for the estimation of serum cholesterol and total protein. The serum cholesterol was estimated colorimetrically using spectronic 1001_{plus} spectrophotometer (Milton Roy Co., USA) by Cholesterol oxidase Peroxidase method utilizing the kit supplied by M/s Agappe Diagnostics, F-4, Shailesh Industrial Complex, Valiv Post, Vasai (E), Thane, Maharashtra – 401 208, India. The serum total protein was estimated by Direct Biuret method using the kit supplied by M/s Agappe Diagnostics.

8) Processing yields and losses

At the end of eighth week, two birds from each replicate was randomly selected and sacrificed to study the processing yields and losses (BIS, 1973). The birds were fasted overnight and killed by modified Kosher's method. The jugular vein was severed and the birds were allowed to bleed for two minutes. The birds were weighed before and after bleeding to find out the weight of blood. Thereafter they were scalded and defeathered by using mechanical feather pluckers. The pin feathers were removed using pinning knife. Singeing was done using blowlamp to remove hair like structures. The birds were weighed again to find out the weight of the feathers. Head and legs were removed and weighed and evisceration was done. The eviscerated weight was recorded. The gizzard was sliced and the inner lining and the contents inside were removed. The gall bladder was removed carefully from the liver. The weight of giblets, i.e. the weight of liver, heart and gizzard was recorded. Ready-to-cook yield was calculated by adding eviscerated weight and weight of giblets.

9) Livability

The mortality of birds from different treatment groups was recorded and the livability was worked out. Post mortem examination was conducted in each case to find out the cause of death.

10) Economics

Cost of feed for different dietary treatments was calculated from cost of ingredients including cost of live yeast culture and from per cent ingredient composition. Cost of feed/kg live weight gain for different dietary treatments was calculated based on body weight attained and recurring expenditure at six and eight weeks of age.

11) Statistical Analysis

Data collected on various parameters were statistically analyzed by Completely Randomised Design (CRD) method as described by Snedecor and Cochran (1968).

Table 1. *Per cent ingredient composition of experimental diets (Starter)*

Ingredients	Control diet	Experimental diets	
	T1	T2	T3
Maize	46.50	46.50	46.50
De-oiled rice bran	7.00	7.00	7.00
Soya bean meal	32.00	32.00	32.00
Gingely oil cake	4.00	4.00	4.00
Unsalted dried fish	8.50	8.50	8.50
Mineral mixture[1]	1.75	1.75	1.75
Salt	0.25	0.25	0.25
Total	100	100	100
Added per 100 Kg feed			
Baker's yeast[2], g	-	300	600
Vitamin mixture[3], g	10	10	10
D.L.Methionine, g	100	100	100
Choline chloride, g	120	120	120
Lysine hydrochloride, g	140	140	140
Coccidiostat[4], g	50	50	50
Toxin binder[5], g	250	250	250

Note: [1] *Mineral Mixture composition*

Calcium 32 %, Phosphorus 6%, Magnesium 1000 ppm, Cobalt 60 ppm, Zinc 2600 ppm, Iron 0.1 %, Iodine 100 ppm, Copper 100 ppm, Manganese 2700 ppm.

[2] Baker's yeast (Provisacc®, Vetcare, Bangalore).

Each gram contains 5×10^9 *live yeast cells*

[3]Vitamin mixture composition (INDOMIX + INDOMIX BE):

Each gram contains: Vitamin A - 41250 IU, Vitamin D_3 - 6000 IU, Vitamin E - 20 mg, Vitamin K - 5 mg, Vitamin B_1 - 2 mg, Vitamin B_2 - 25 mg, Vitamin B_6 - 4 mg, Vitamin B_{12} - 20 µg, Niacin - 30 mg, Calcium *pantothenate - 20 mg.*

[4]Coccidiostat composition (Macromycin 12% w/w):

Each gram contains: Salinomycin sodium 12%

[5]Toxin binder composition (Alusil Premix™):

Each gram contains: SIO_2*: 400-500* mg, Al_2O_3*: 320-400* mg, Fe_2O_3*: 3-10* mg, MgO: 5-20 mg, CaO: 30-50 mg, Na_2O: 25-45 mg, K_2O: 5-10 mg.

Table 2. Per cent ingredient composition of experimental diets (finisher)

Ingredients	Control diet	Experimental diets	
	T1	T2	T3
Maize	56.00	56.00	56.00
De-oiled rice bran	6.00	6.00	6.00
Soya bean meal	23.00	23.00	23.00
Gingelly oil cake	3.00	3.00	3.00
Unsalted dried fish	10.00	10.00	10.00
Mineral mixture[1]	1.75	1.75	1.75
Salt	0.25	0.25	0.25
Total	100.0	100.0	100.0
Added per 100 Kg feed			
Baker's yeast[2], g	-	300	600
Vitamin mixture[3], g	10	10	10
D.L.Methionine, g	50	50	50
Choline chloride, g	100	100	100
Lysine hydrochloride, g	100	100	100
Coccidiostat[4], g	50	50	50
Toxin binder[5], g	250	250	250

Note: [1] Mineral Mixture composition

Calcium 32 %, Phosphorus 6%, Magnesium 1000 ppm, Cobalt 60 ppm, Zinc 2600 ppm, Iron 0.1 %, Iodine 100 ppm, Copper 100 ppm, Manganese 2700 ppm.

[2] Baker's yeast (Provisacc®, Vetcare, Bangalore).

Each gram contains 5×10^9 live yeast cells

[3]Vitamin mixture composition (INDOMIX + INDOMIX BE):

Each gram contains: Vitamin A - 41250 IU, Vitamin D_3 - 6000 IU, Vitamin E - 20 mg, Vitamin K - 5 mg, Vitamin B_1 - 2 mg, Vitamin B_2 - 25 mg, Vitamin B_6 - 4 mg, Vitamin B_{12} - 20 µg, Niacin - 30 mg, Calcium pantothenate - 20 mg.

[4]Coccidiostat composition (Macromycin 12% w/w):

Each gram contains: Salinomycin sodium 12%

[5]Toxin binder composition (Alusil Premix™):

Each gram contains: SIO_2: 400-500 mg, Al_2O_3: 320-400 mg, Fe_2O3: 3-10 mg, MgO: 5-20 mg, CaO: 30-50 mg, Na_2O: 25-45 mg, K_2O: 5-10 mg.

Table 3. Chemical composition of experimental rations*, %

Sl. No.	Nutrients	Starter			Finisher		
		T1	T2	T3	T1	T2	T3
1	Dry matter	88.63	87.86	88.19	88.08	88.16	87.98
2	Crude protein	23.56	23.19	23.08	20.97	20.26	20.84
3	Ether extract	3.41	2.86	2.43	3.16	3.09	3.23
4	Crude fibre	6.38	6.19	5.53	6.83	5.25	5.37
5	NFE	57.93	59.33	62.16	59.57	62.00	62.31
6	Total ash	8.72	8.43	6.8	9.473	9.40	8.25
7	Acid insoluble ash	3.23	3.27	3.38	4.88	3.62	2.88
8	Ca	1.38	1.26	1.31	1.23	1.29	1.31
9	Total P	0.89	0.89	0.68	0.77	0.78	0.99

* on dry matter basis

Results

4. RESULTS

The results of the experiment conducted to study the effect of dietary supplementation of baker's yeast at different levels on the performance of broilers are presented in this chapter.

Meteorological parameters

The data pertaining to microclimate viz., the mean maximum and minimum temperature (°C) and per cent relative humidity inside the experimental house during the period from November 2003 to January 2004 are presented in Table 4. During the experimental period, the mean maximum temperature ranged from 31.9 to 34.3°C while the mean minimum temperature ranged from 20.0 to 26.6°C. The per cent relative humidity varied from 63.7 to 78.1 at 8 a m and 43.7 to 58.3 at 2 p m.

Body weight

The data on mean body weight at fortnightly intervals as influenced by dietary supplementation of baker's yeast is given in Table 5 and graphically represented in Fig.1. The day old body weight of chicks among different treatment groups viz., T1, T2 and T3 were 46.42, 46.06 and 46.17 g respectively with an overall mean of 46.22 g. Statistical analysis of the data (Table 6) on day old body weight of chicks did not reveal any significant difference between treatment groups.

At second week of age, the mean body weight recorded for treatments T1, T2 and T3 were 403.94, 406.88 and 401.57 g respectively with an overall mean of 404.13 g. The statistical analysis of the data did not reveal any significant difference among treatments.

Table 4. Mean weekly meteorological parameters recorded in the experimental house during the period from November 2003 to January 2004

Weeks	Temperature (°C)		Relative humidity (%)	
	Maximum	Minimum	8 a.m.	2 p.m.
1	34.3	26.6	71.7	55.6
2	34.1	26.0	72.3	58.3
3	32.9	23.4	75.4	50.4
4	31.9	20.0	75.3	50.4
5	32.0	21.6	75.0	47.7
6	32.4	20.9	78.1	48.3
7	33.7	23.6	72.1	43.7
8	33.9	23.7	63.7	44.9
Overall mean	33.2	23.2	73.0	49.9

Table 5. Influence of dietary supplementation of baker's yeast on fortnightly body weight in broilers, g

Treatment	Age in weeks				
	0	2	4*	6	8
T1	46.42	403.94	1117.92[a]	1973.96	2584.27
T2	46.06	406.88	1199.48[b]	1931.57	2556.46
T3	46.17	401.57	1188.23[b]	1942.29	2495.73
Overall mean ± SE	46.22± 0.11	404.13± 1.54	1168.54± 25.52	1949.27± 12.73	2545.49± 26.14
CD			50.576		

*Means bearing the different superscripts within the same column differ significantly (P<0.05)

Table 6. Analysis of variance for fortnightly body weight of broilers as influenced by different dietary treatments.

Weeks	Source	d.f	SS	MSS	F
0	Treatment	2	3.314	1.657	0.163
	Error	141	1433.839	10.169	
2	Treatment	2	679.875	339.937	0.319
	Error	141	150185.9	1065.15	
4	Treatment	2	187565.6	93782.8	5.868*
	Error	141	2253228	15980.34	
6	Treatment	2	46644.79	23322.4	0.490
	Error	141	6714954	47623.78	
8	Treatment	2	196879.1	98439.55	0.697
	Error	141	19912197	141221.3	

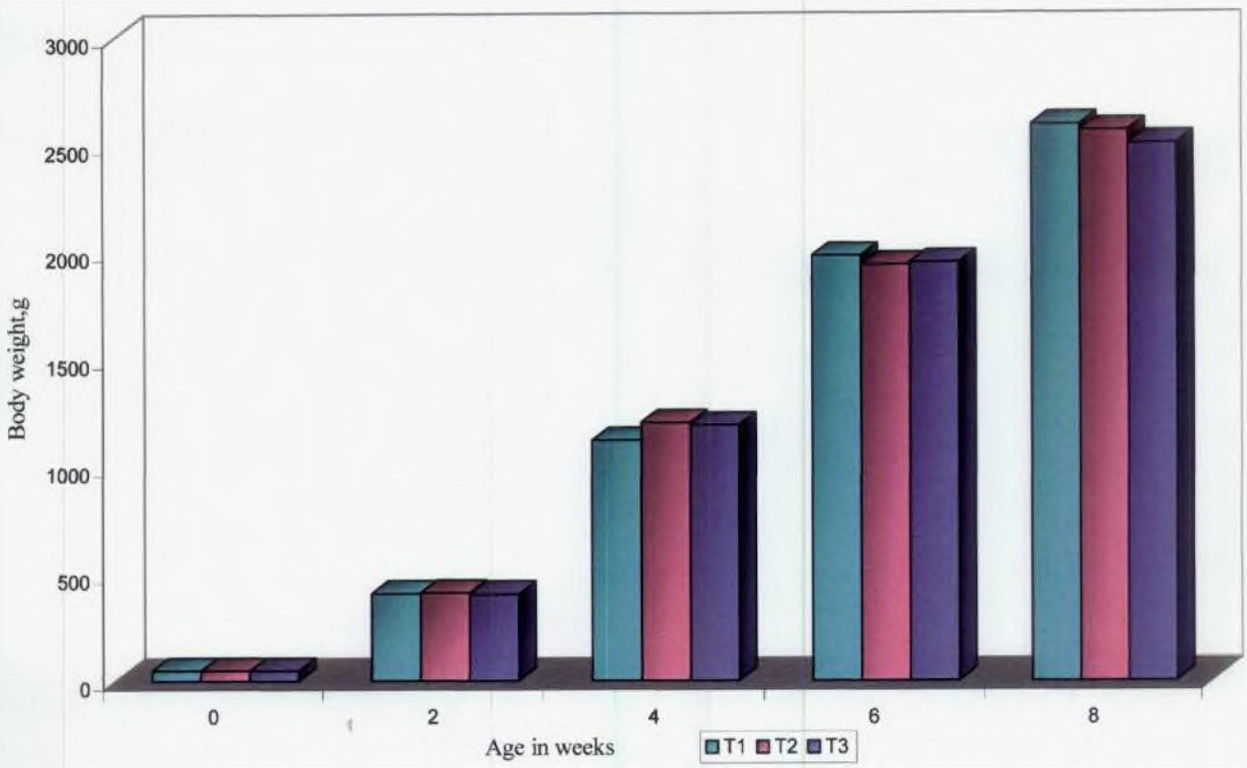

Fig. 1. Influence of dietary supplementation of baker's yeast on fortnightly body weight in broilers, g

At fourth week of age the mean body weights recorded for treatments T1, T2 and T3 were 1117.92, 1199.48 and 1188.23 g respectively with an overall mean of 1168.54 g. Statistical analysis of the data on body weight at fourth week of age revealed significant differences among treatments ($P<0.05$). The birds fed diet containing baker's yeast at 0.3 per cent (T2) and 0.6 per cent (T3) levels had significantly higher body weight than that of birds fed control diet (T1).

The mean body weight recorded at sixth week of age for treatments T1, T2 and T3 were 1973.96, 1931.57 and 1942.29 g respectively with an overall mean of 1949.27 g. Statistical analysis of the data did not reveal any significant difference between treatments. Numerically higher body weight (1973.96 g) was recorded in the group fed with standard broiler ration (T1).

At eighth week of age, the mean body weights recorded for treatments T1, T2 and T3 were 2584.27, 2556.46 and 2495.73 g respectively with an overall mean of 2545.49 g. Statistical analysis of the data on eighth week body weight did not reveal any significant difference among different treatment groups. The highest body weight of 2584.27 g was recorded with group fed with standard broiler ration (T1).

Body weight gain

The mean fortnightly body weight gain of broilers fed different experimental rations from zero to eight weeks of age is presented in Table 7 and graphically represented in fig 2. The analysis of variance of data on body weight gain at fortnightly intervals is presented in Table 8.

At second week of age, the mean fortnightly weight gain among the different treatment groups viz., T1, T2 and T3 were 357.52, 360.82 and 355.40 g respectively with an overall mean of 357.91 g. Statistical analysis of the data on body weight gain during second week of age did not reveal any significant difference between treatment groups.

At fourth week of age, the mean fortnightly body weight gain recorded for the three treatment groups viz., T1, T2 and T3 were 713.98, 792.60 and 786.67 g respectively with an overall mean of 764.42 g. Statistical analysis of the data revealed significant differences between treatment groups ($P<0.01$). The highest body weight gain was recorded for group fed with 0.3 per cent baker's yeast (T2) and was statistically similar to T3. The lowest gain was recorded for the control group without baker's yeast (T1).

The body weight gain recorded at sixth week of age was significantly ($P<0.01$) different between treatments. The birds fed with standard broiler ration (T1) recorded significantly higher body weight gain (856.04 g) than T2 and T3. The mean maximum body weight gain (780.73 g) was recorded during this period.

The body weight gain recorded at eighth week of age for treatments T1, T2 and T3 were 610.31, 624.90 and 553.44 g respectively with an overall mean of 596.22 g. Statistical analysis of the data on eighth week body weight gain of broilers during eighth week of age did not reveal any significant difference between treatment groups.

The cumulative weight gain (Table 7, fig. 3) recorded up to six weeks of age for treatment groups T1, T2 and T3 were 1927.54, 1885.51 and 1896.13 g with an overall mean of 1903.06 g. The cumulative weight gain up to eight weeks of age recorded for T1, T2 and T3 were 2537.86, 2510.40 and 2449.57 g respectively with an overall mean of 2499.28 g. Statistical analysis of the cumulative weight gain up to six weeks and eight weeks of age did not reveal any significant difference between treatment groups (Table 8).

Feed intake

The mean daily feed consumption (g/bird/day) during the experimental periods among different treatment groups are given in Table 9 and graphically

Table 7. Influence of dietary supplementation of baker's yeast on fortnightly and cumulative mean body weight gain in broilers, g

Treatment	Age in weeks				Cumulative weight gain	
	2	4*	6*	8	0-6 weeks	0-8 weeks
T1	357.52	713.98[a]	856.04[a]	610.31	1927.54	2537.86
T2	360.82	792.60[b]	732.09[b]	624.90	1885.51	2510.40
T3	355.40	786.67[b]	754.06[b]	553.44	1896.13	2449.57
Overall mean±SE	357.91± 1.57	764.42± 25.28	780.73± 38.19	596.22± 21.80	1903.06± 12.62	2499.28± 26.09
CD		44.122	57.051			

*Means bearing the different superscripts within the same column differ significantly (P<0.01)

Table 8. Analysis of variance for fortnightly and cumulative mean body weight gain in broilers as influenced by baker's yeast supplementation

Period / Age in weeks	Source	d.f	SS	MSS	F
0-2	Treatment	2	716.88	358.44	0.352
	Error	141	143438.4	1017.29	
3-4	Treatment	2	184009.9	92004.94	7.565**
	Error	141	1714887	12162.32	
5-6	Treatment	2	419976	209988	10.367**
	Error	141	2867122	20334.2	
7-8	Treatment	2	136859	68429.86	1.627
	Error	141	5929103	42050.37	
Cumulative 0-6 weeks	Treatment	2	45862.96	22931.48	0.482
	Error	141	6707308	47569.56	
Cumulative 0-8weeks	Treatment	2	196000.1	98000.06	0.695
	Error	141	19885979	141035.3	

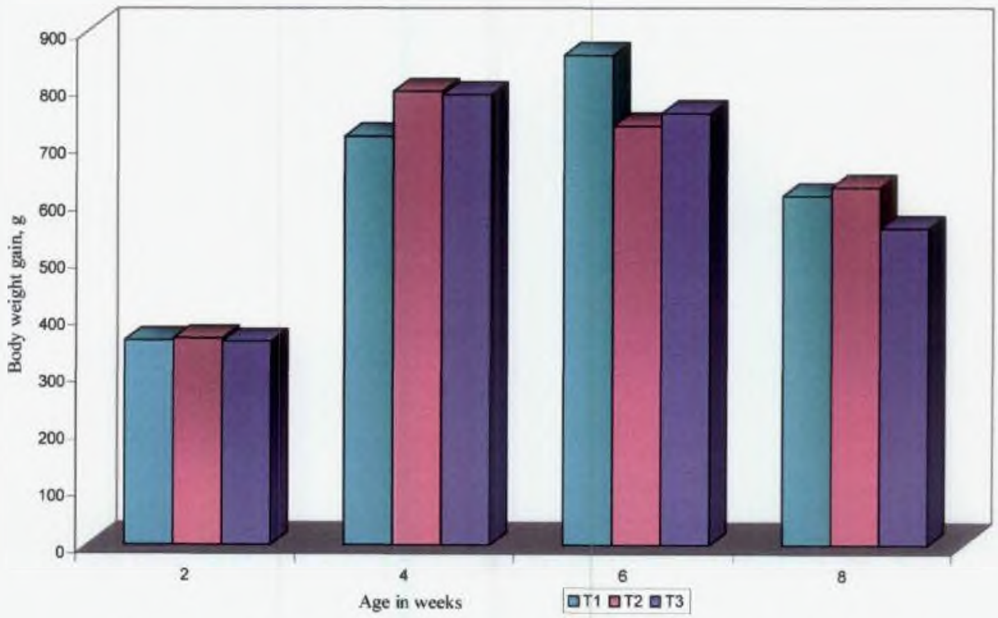

Fig. 2. Influence of dietary supplementation of baker's yeast on fortnightly body weight gain in broilers, g

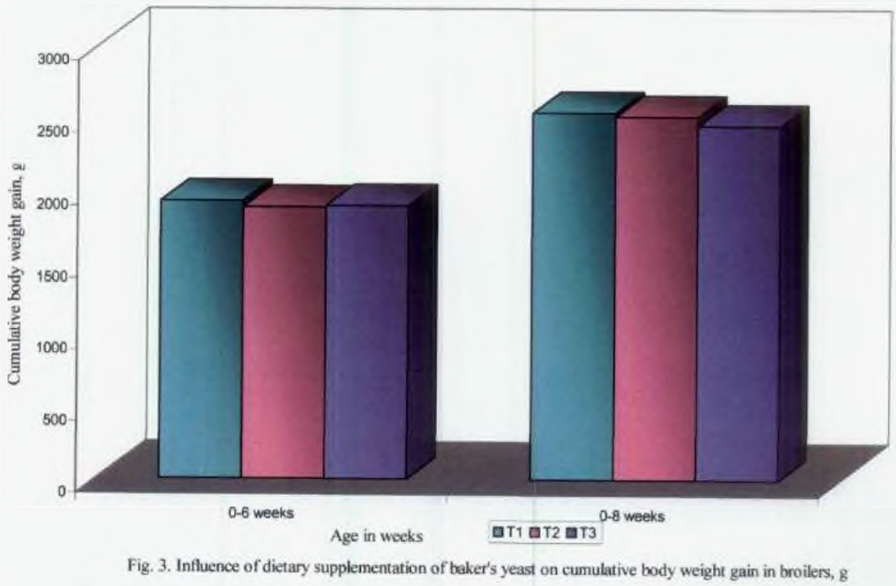

Fig. 3. Influence of dietary supplementation of baker's yeast on cumulative body weight gain in broilers, g

represented in fig 4 and fig. 5. Statistical analysis of the data is presented in Table 10.

The mean daily feed intake during the first week did not show any significant difference among treatment groups T1, T2 and T3 were 23.47, 23.10 and 22.71 g respectively. Statistical analysis of the data showed that the variation in feed intake due to different treatments were not significant.

Mean daily intake of birds during second week for treatments T1, T2 and T3 were 54.88, 56.12 and 54.75 g respectively with an overall mean of 55.25 g. Statistical analysis of the data did not reveal any significant difference between treatment groups. During third week the feed intake per bird per day for treatments T1, T2 and T3 were 85.34, 86.34 and 89.41 g with an overall mean of 87.03 g. The mean daily feed consumption per bird during fourth week for the three dietary treatments T1, T2 and T3 were 110.51, 116.99 and 117.95 g with an overall mean of 115.15 g. There was no statistically significant difference among treatments.

At fifth week, the feed consumption was 140.24, 134.41 and 136.47 g for the treatments T1, T2 and T3 respectively with an overall mean of 137.04 g. The statistical analysis of the data (Table 10) on feed intake during this period revealed significant difference between treatments. Birds fed with control diet showed significantly ($P<0.05$) higher feed intake than T2.

The mean daily feed consumption at sixth week of age was 157.86, 153.19 and 160.67 g for T1, T2 and T3 respectively. Statistical analysis of the data did not reveal any significant difference between treatment groups.

At seventh week of age, the mean daily feed intake among the different treatments, T1, T2 and T3 were 162.13, 149.67 and 153.68 g respectively with an overall mean of 155.16 g. Statistical analysis of the data revealed significant differences ($P<0.05$) among treatment groups. The highest feed consumption was recorded for the control group (T1) and it was statistically similar to T3. Broilers

Table 9. Influence of dietary supplementation of baker's yeast on mean daily feed consumption in broilers, g

Treatment	Age in weeks								Cumulative feed consumption	
	1	2	3	4	5*	6	7*	8*	0-6 weeks	0-8 weeks
T1	23.47	54.88	85.34	110.51	140.24^{a}	157.86	162.13^{a}	155.70^{a}	4006.04	6230.83
T2	23.10	56.12	86.34	116.99	134.41^{b}	153.19	149.67^{b}	145.60^{b}	3990.94	6057.81
T3	22.71	54.75	89.41	117.95	136.47^{ab}	160.67	153.68^{ab}	147.13^{b}	4073.65	6179.27
Overall mean ± SE	23.09 ±0.22	55.25 ±0.44	87.03 ±1.22	115.15 ±2.34	137.04 ±1.071	157.24 ±2.18	155.16 ±3.67	149.48 ±3.14	4023.54 ±25.43	6155.97 ±51.29
CD					4.4402		9.1710	6.8001		

*Means bearing the different superscripts within the same column differ significantly ($P<0.05$)

Table 10. Analysis of variance for mean daily feed intake in broilers as influenced by different treatments.

Weeks	Source	d.f	SS	MSS	F
1	Treatment	2	21.163	0.581	0.658
	Error	9	7.959	0.884	
2	Treatment	2	4.550	2.275	0.728
	Error	9	28.119	3.124	
3	Treatment	2	32.742	16.371	3.878
	Error	9	37.995	4.222	
4	Treatment	2	131.131	65.566	0.731
	Error	9	807.238	89.693	
5	Treatment	2	69.980	34.990	4.540*
	Error	9	69.358	7.706	
6	Treatment	2	114.519	57.260	1.074
	Error	9	479.719	53.302	
7	Treatment	2	323.456	161.728	4.919*
	Error	9	295.881	32.876	
8	Treatment	2	237.263	118.632	8.803*
	Error	9	121.280	13.476	
Cumulative 0-6 weeks	Treatment	2	15518.84	7759.418	0.940
	Error	9	74330.3	8258.922	
Cumulative 0-8 weeks	Treatment	2	63129.37	31564.68	1.672
	Error	9	169859.3	18873.25	

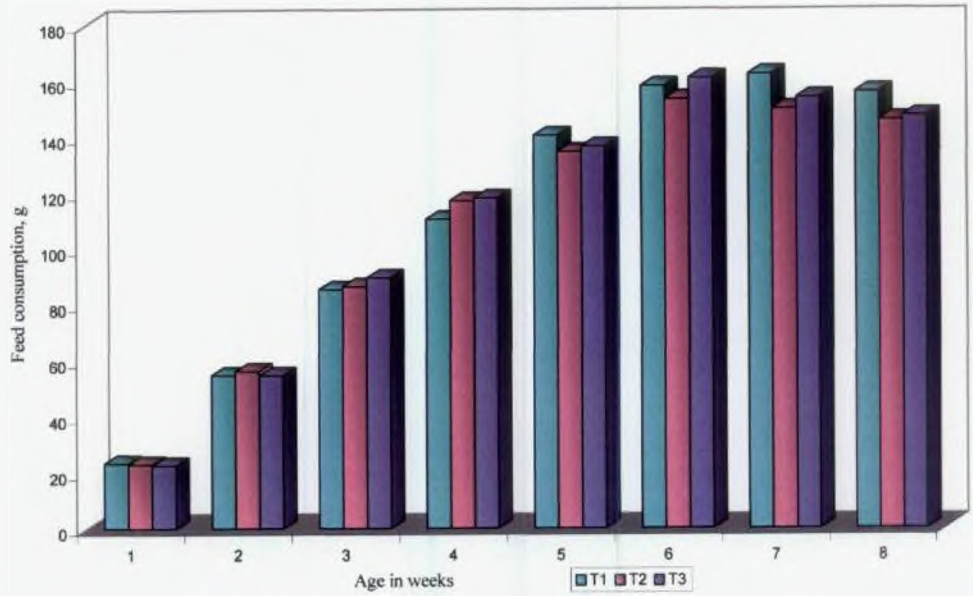

Fig. 4. Influence of dietary supplementation of baker's yeast on mean daily feed consumption in broilers, g

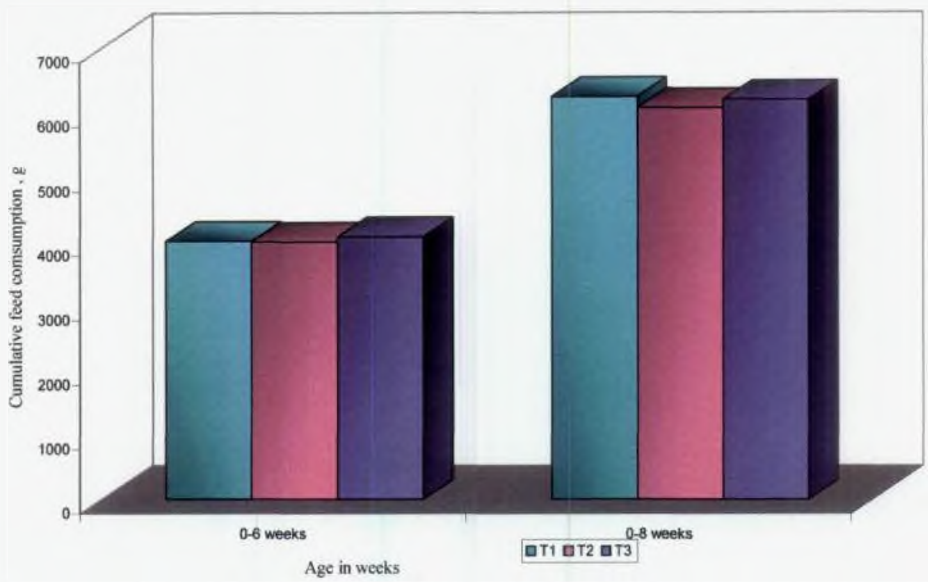

Fig. 5. Influence of dietary supplementation of baker's yeast on cumulative feed consumption in broilers, g

fed with 0.6 per cent baker's yeast (T3) recorded statistically similar feed consumption with T2 and T1.

At eighth week of age, mean daily feed intake per bird was 155.70, 145.60 and 147.13 g respectively for treatments T1, T2 and T3 with an overall mean of 149.48 g. Statistical analysis of the data revealed significant differences among treatment groups. The highest feed consumption was recorded for control (T1) and the lowest value was for group fed with 0.3 per cent baker's yeast (T2). T2 and T3 did not differ significantly.

The cumulative feed intake (Table 9, fig. 5) of broilers up to six weeks of age was 4006.04, 3990.94 and 4073.65 g respectively for treatments T1, T2 and T3 with an overall mean of 4023.54 g. Statistical analysis of the data did not reveal significant difference between the treatment groups. The cumulative feed intake of broilers up to eight weeks of age was 6230.83, 6057.81 and 6179.27 g respectively for treatments T1, T2 and T3 with an overall mean of 6155.97 g. There was no statistically significant difference between the treatments.

Feed conversion ratio

The mean feed efficiency recorded at fortnightly intervals in the five treatment groups are presented in Table 11 and its statistical analysis in Table 12. The graphical representations of the mean feed conversion ratio are shown in fig 6 and fig. 7. The feed conversion ratios during first fortnight for treatments T1, T2 and T3 were 1.54, 1.54 and 1.53 respectively with an overall mean of 1.54. Analysis of data on feed conversion ratio during the first fortnight did not reveal significant difference among treatment groups. During the second fortnight (three to four weeks of age) of the experiment, the feed conversion ratio recorded for T1, T2 and T3 were 1.92, 1.79 and 1.85 with an overall mean of 1.85. Statistical analysis of the data did not reveal any significant difference between treatment groups.

Table 11. Influence of dietary supplementation of baker's yeast on fortnightly feed conversion ratio (kg feed / kg gain) in broilers

Treatment	Age in weeks				Cumulative feed conversion ratio	
	2	4	6*	8	0-6 weeks	0-8 weeks
T1	1.54	1.92	2.44[a]	3.65	2.08	2.46
T2	1.54	1.79	2.77[b]	3.31	2.12	2.41
T3	1.53	1.85	2.77[b]	3.93	2.15	2.53
Overall mean ± SE	1.54±0.003	1.85±0.04	2.66±0.11	3.63±0.17	2.12±0.02	2.47±0.03
CD			0.2848			

*Means bearing the different superscripts within the same column differ significantly ($P<0.05$)

Table 12. Analysis of variance for fortnightly feed conversion ratio in broilers as influenced by baker's yeast supplementation.

Weeks	Source	d.f	SS	MSS	F
2	Treatment	2	0.00215	0.00011	0.050
	Error	9	0.01932	0.00215	
4	Treatment	2	0.03166	0.01583	2.062
	Error	9	0.06911	0.00768	
6	Treatment	2	0.28489	0.14244	6.027*
	Error	9	0.21270	0.02363	
8	Treatment	2	0.76606	0.38303	1.697
	Error	9	2.03092	0.22566	
Cumulative 0-6 weeks	Treatment	2	0.01044	0.00522	1.357
	Error	9	0.03461	0.00385	
Cumulative 0-8 weeks	Treatment	2	0.02688	0.01344	1.905
	Error	9	0.06348	0.00705	

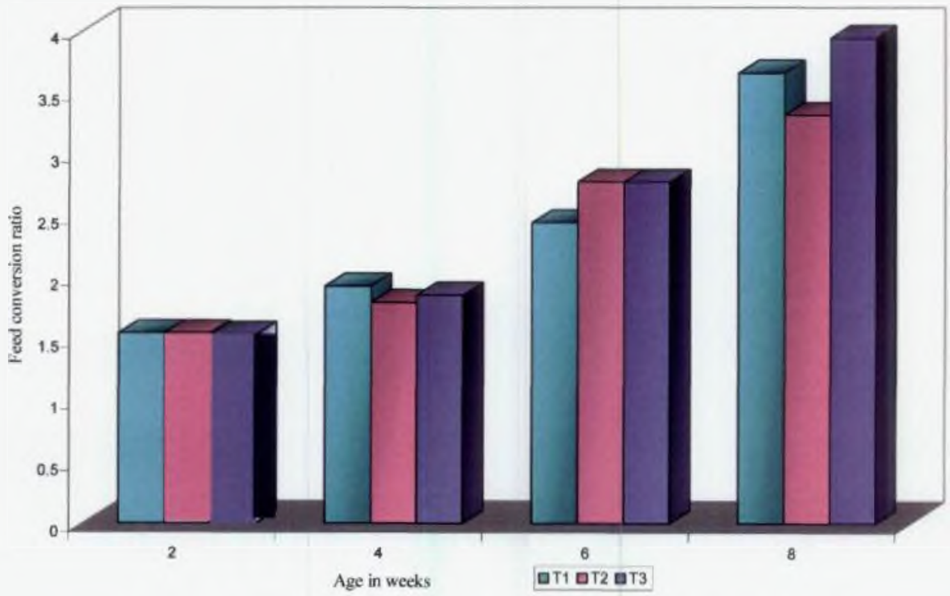

Fig. 6. Influence of baker's yeast on fortnightly feed conversion ratio (kg feed/kg gain) in broilers

Fig. 7. Inflence of baker's yeat on cumulative feed conversion ratio (kg feed/kg gain) in broilers

During the third fortnight, the feed conversion ratio recorded for T1, T2 and T3 were 2.44, 2.77 and 2.77 with an overall mean of 2.66. The statistical analysis of the data revealed significant difference between treatments and the highest efficiency was recorded for control group (T1) compared to the other treatments.

The feed conversion ratio obtained during fourth fortnight for treatments T1, T2 and T3 were 3.65, 3.31 and 3.93 respectively with an overall mean of 3.63. Statistical analysis of the data revealed no significant difference among treatment groups.

Cumulative feed conversion ratio up to six weeks of age for T1, T2 and T3 were 2.08, 2.12 and 2.15 respectively with an overall mean of 2.12. Statistical analysis of the data did not reveal any significant difference between treatment groups. Cumulative feed conversion ratio up to eight weeks of age for T1, T2 and T3 were 2.46, 2.41 and 2.53 with an overall mean of 2.47. Statistical analysis of the data did not reveal any significant difference between treatment groups.

Processing yields and losses

The mean per cent dressed yield, eviscerated yield, ready-to-cook yield, giblet yield, feather loss and blood loss recorded in broilers slaughtered at eight weeks of age as influenced by different dietary treatments are presented in Table 13 and graphically represented in Fig. 8. The statistical analysis of the data on processing yields and losses did not reveal any significant difference between dietary treatments (Table 14).

The percentage of eviscerated yield recorded for treatments T1 to T3 were 70.56, 70.86 and 71.15 respectively with an overall mean of 70.86. Statistical analysis of the data did not reveal any significant difference between treatment groups. The highest dressing percentage of 90.72 was recorded in the group fed with control diet followed by T2 with a dressing percentage of 90.68 and then by T3 with a dressing percentage of 89.94. The mean per cent giblet yields were

Table 13. Influence of dietary supplementation of baker's yeast on mean per cent processing yields and losses of broilers at eight weeks of age.

Treatment	Dressed yield (%)	Eviscerated yield (%)	Giblet yield (%)	Ready-to-cook (%)	Blood loss (%)	Feather loss (%)	Abdominal fat (%)
T1	90.72	70.56	3.73	74.29	3.22	6.05	2.02
T2	90.68	70.86	3.51	74.37	3.46	5.86	1.69
T3	89.94	71.15	3.44	74.59	3.19	6.87	1.77
Overall mean ± SE	90.45± 0.25	70.86± 0.17	3.56± 0.09	74.42± 0.09	3.29± 0.09	6.26± 0.31	1.83± 0.10

Table 14. Analysis of variance for mean processing yields and losses at eight weeks of age

Yields and losses	Source	d.f	SS	MSS	F
Dressed yield	Treatment	2	3.12095	1.56047	1.041
	Error	21	31.48748	1.49940	
Eviscerated Yield	Treatment	2	1.38786	0.69393	0.606
	Error	21	24.0274	1.14416	
Giblet yield	Treatment	2	0.36225	0.18112	1.445
	Error	21	2.63168	0.12531	
Ready-to-cook yield	Treatment	2	0.39236	0.19618	0.182
	Error	21	22.6846	1.08022	
Blood loss	Treatment	2	0.34532	0.17266	0.151
	Error	21	23.9854	1.14216	
Feather loss	Treatment	2	4.62583	2.31291	2.312
	Error	21	21.0132	1.00063	
Abdominal fat	Treatment	2	0.47868	0.23934	0.310
	Error	21	16.2127	0.772031	

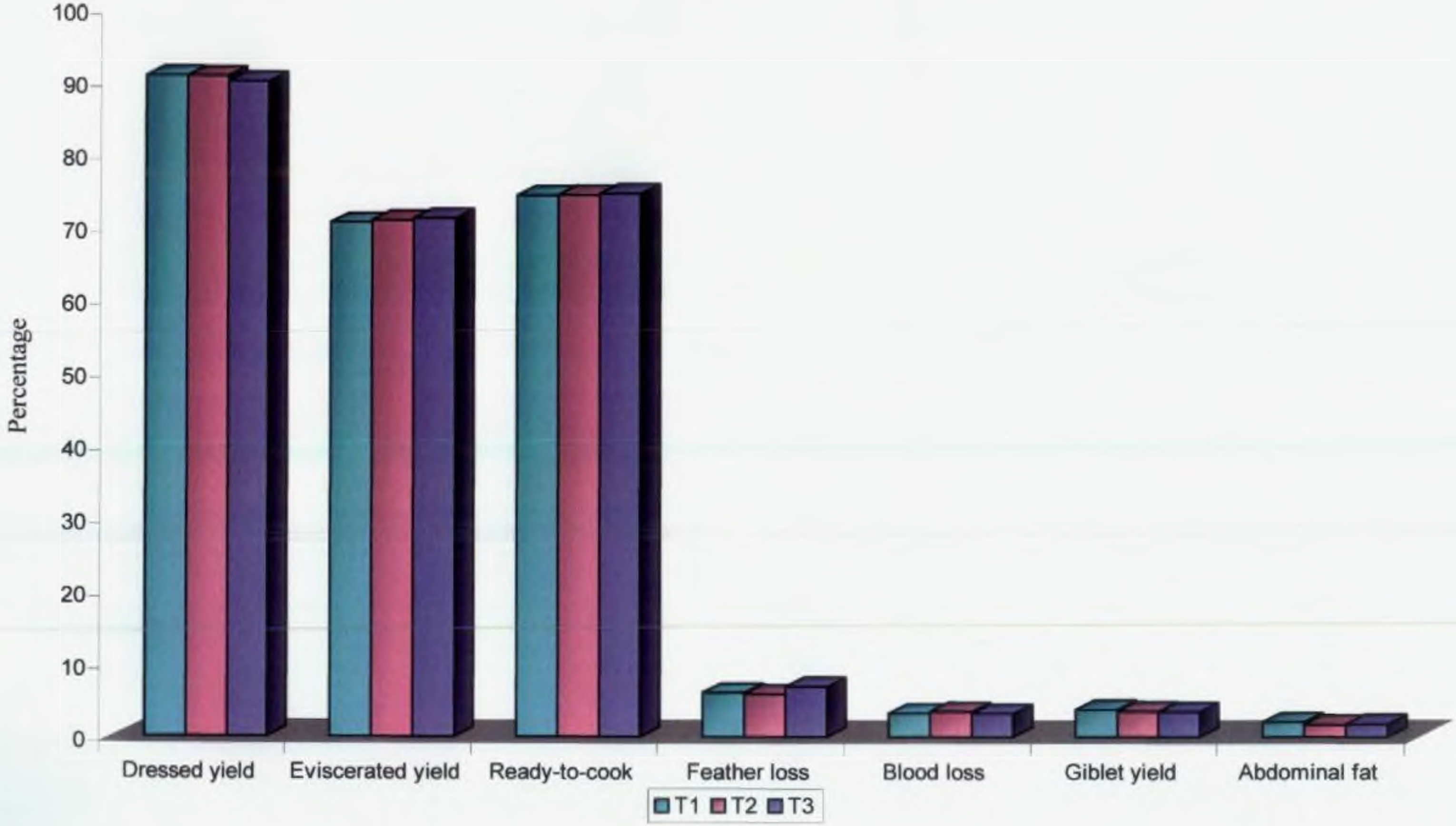

Fig. 8. Influence of baker's yeast on mean per cent processing yields and losses of broilers at eight weeks of age

3.73, 3.51 and 3.44 respectively for T1, T2 and T3 with an overall mean of 3.56 per cent. Statistical analysis of the data revealed no significant difference between treatment groups. The mean per cent ready-to-cook yield for the treatments T1, T2 and T3 were 74.29, 74.37 and 74.59 respectively with an overall mean of 74.42. Statistical analysis of the data did not reveal any significant difference between treatment groups.

The mean per cent blood loss for T1, T2 and T3 were 3.22, 3.46 and 3.19 respectively with an overall mean of 3.29. Statistical analysis of the data did not reveal any significant difference between treatment groups. The per cent feather loss for treatments T1, T2 and T3 were 6.05, 5.86 and 6.87 respectively with an overall mean of 6.26. Statistical analysis of the data did not reveal any significant difference between treatment groups. Even though there was numerical reduction in per cent abdominal fat due to supplementation of baker's yeast.

The per cent abdominal fat recorded for treatments T1, T2 and T3 were 2.02, 1.69 and 1.77 with an overall mean of 1.83. Statistical analysis of the data did not reveal any significant difference between treatment groups, eventhough there was numerical reduction in per cent abdominal fat due to supplementation of baker's yeast.

Nutrient utilization

Metabolism trial was conducted to study the digestibility of dry matter, crude protein, crude fibre and ether extract and also the availability of calcium and phosphorus. The chemical composition of droppings voided by the experimental birds during the metabolism trial is given in Table 15.

The moisture content in the faeces was 76.56, 76.30 and 76.70 and the dry matter content was 23.44, 23.70 and 23.30 respectively for T1, T2 and T3. The crude protein and nitrogen content in the faeces were 30.90, 38.41 and 38.22 and 4.94, 6.15 and 6.12 respectively for T1, T2 and T3. The highest crude fibre values were in control (T1) group with 12.33 per cent followed by T3 with 9.43 and then T2 with 9.31. The highest ether extract value of 2.90 was reported in T3 followed by 2.77 in T2 and then T1 with 2.51 per cent. The calcium and phosphorus values were 2.36, 2.71 and 2.86 and 1.74, 1.93 and 2.22 respectively for T1, T2 and T3.

Dry matter retention

The influence of baker's yeast supplementation on dry matter retention of broilers fed finisher ration are presented in Table 16 and its graphical representation in fig. 9. The mean dry matter retention was 64.26, 66.67 and 69.44 per cent for T1, T2 and T3 respectively with an overall mean of 66.79.

Though there was variation in the dry matter retention among different treatment groups, statistical analysis of the data did not reveal any significant difference (Table 17).

Nitrogen retention

The data pertaining to nitrogen retention of broilers fed finisher ration supplemented with baker's yeast is presented in Table 18 and graphically represented in fig. 9. The mean nitrogen retention (per cent) of the experimental birds during the period of metabolism trial for treatments T1, T2 and T3 were 47.31, 37.04 and 44.60 per cent respectively with an overall mean of 42.98. Although there were variations in per cent nitrogen retention among different treatments, statistical analysis of the data (Table 19) revealed no significant difference between treatments.

Crude fibre retention

The retention of crude fibre in the ration of different treatment groups T1, T2, and T3 were 36.29, 45.64 and 46.38 per cent respectively with an overall mean of 42.77 (Table 20, fig. 9). Better retention was noticed in group supplemented with 0.6 per cent baker's yeast (T3) followed by T2 and T1.

Table 15. Chemical composition of droppings voided by the broilers during the metabolism trial at eight weeks of age, %*

Treatments	Moisture	Dry matter	Crude protein	N	CF	EE	Ca	P
T1	76.56	23.44	30.90	4.94	12.33	2.51	2.36	1.74
T2	76.30	23.70	38.41	6.15	9.31	2.77	2.71	1.93
T3	76.70	23.30	38.22	6.12	9.43	2.90	2.86	2.22

**On dry matter basis*

Table 16. Influence of baker's yeast supplementation on dry matter retention in broilers

Treatments	DM intake (g/day)	DM outgo (g/day)	DM retention (per cent)
T1	147.19	51.76	64.26
T2	145.82	47.81	66.67
T3	149.06	45.81	69.44
Overall mean ± SE	147.36±.94	48.46±1.75	66.79±1.50

Table 17. Analysis of variance for dry matter balance and retention in birds maintained on different dietary treatments.

Parameter	Source	d.f	SS	MSS	F
DM retention	Treatment	2	107.264	53.632	2.190
	Error	21	514.3199	24.49142	

Table 18. Influence of baker's yeast supplementation on N balance and retention in broilers

Treatments	N intake (g/day)	N outgo (g/day)	N balance (g/day) ^{NS}	N retention (per cent) ^{NS}
T1	4.94	2.55	2.39	47.31
T2	4.73	2.92	1.81	37.04
T3	4.97	2.68	2.29	44.60
Overall mean ± SE	4.88 ± 0.08	2.72 ± 0.11	2.16 ± 0.18	42.98 ± 3.07

^{NS} - Non-significant

Table 19. Analysis of variance for N balance and retention in birds maintained on different dietary treatments

Parameter	Source	d.f	SS	MSS	F
N balance	Treatment	2	1.56238	0.78119	0.921
	Error	21	17.80964	0.848078	
N retention	Treatment	2	452.6052	226.3026	0.962
	Error	21	4942.066	235.3365	

Table 20. Influence of baker's yeast supplementation on crude fibre balance and retention in broilers

Treatments	CF intake (g/day)	CF outgo (g/day)	CF balance (g/day)	CF retention* (per cent)
T1	10.10	6.38	3.71	36.29[a]
T2	8.02	4.36	3.66	45.64[b]
T3	8.01	4.30	3.71	46.38[b]
Overall mean ± SE	8.71±0.70	5.01±0.68	3.69±0.02	42.77±3.25
CD				7.961

*Means bearing same superscript within the column differs significantly ($P<0.05$)

Table 21. Analysis of variance for crude fibre balance and retention in birds maintained on different dietary treatments

Parameter	Source	d.f	SS	MSS	F
CF balance	Treatment	2	0.009601	0.0048	0.007
	Error	15	11.16544	0.744363	
CF retention	Treatment	2	379.8359	189.918	4.536*
	Error	15	628.0287	41.86858	

Statistical analysis of the data revealed (Table 21) significant ($P<0.05$) differences in crude fibre balance and retention. The highest retention of 46.38 per cent was found in group fed with 0.6 per cent baker's yeast (T3) followed by T2 with 45.64 per cent and then T1 with 36.29 per cent.

Ether extract retention

The data on per cent ether extract retention (Table 22, fig. 9) for T1, T2 and T3 were 71.66, 69.70 and 72.55 per cent respectively with an overall mean of 71.30. Statistical analysis of the data did not reveal any significant difference between treatments (Table23).

Retention of calcium

The data pertaining to calcium availability of the different treatment groups are set out in Table 24 and its graphical representation is given in Fig 9. The per cent availability of calcium in experimental birds of T1, T2 and T3 were 32.64, 31.24 and 33.40 with an overall mean of 32.43. Statistical analysis of the data showed no significant difference between treatment groups (Table 25).

Retention of phosphorus

The mean per cent phosphorus availability of birds among different treatment group are shown in Table 26 and graphically represented in fig. 9. Birds fed with 0.6 per cent baker's yeast (T3) reported significantly higher phosphorus balance than T1 and T2. The per cent availability of phosphorus in treatments T1, T2 and T3 were 24.31, 24.05 and 32.63 with an overall mean of 27.00. Birds fed with 0.6 per cent baker's yeast (T3) registered 32.63 per cent phosphorus availability than T2 and T1. Statistical analysis of the data showed no significant difference between treatments (Table 27).

Serum cholesterol

The per cent serum cholesterol estimated at eight weeks of age is presented in Table 28. The serum cholesterol levels recorded for treatments T1,

Table 22. Influence of baker's yeast supplementation on ether extract balance and retention in broilers.

Treatment	EE intake (g/day)	EE outgo (g/day)	EE balance (g/day) [NS]	EE retention (per cent) [NS]
T1	4.65	1.29	3.37	71.66
T2	4.51	1.32	3.19	69.70
T3	4.81	1.31	3.51	72.55
Overall mean ± SE	4.66 ± 0.09	1.31 ± 0.01	3.36 ± 0.09	71.30 ± 0.84

[NS] – Non significant

Table 23. Analysis of variance for ether extract balance and retention in birds maintained on different dietary treatments

Parameter	Source	d.f	SS	MSS	F
EE balance	Treatment	2	0.409532	0.204766	0.297
	Error	21	14.495	0.690238	
EE retention	Treatment	2	34.10823	17.05411	0.143
	Error	21	2506.549	119.3595	

Table 24. Influence of baker's yeast supplementation on calcium balance and retention in broilers

Treatments	Ca intake (g/day)	Ca outgo (g/day)	Ca balance (g/day) NS	Ca retention (per cent) NS
T1	1.81	1.22	0.59	32.64
T2	1.88	1.28	0.60	31.24
T3	1.95	1.30	0.66	33.40
Overall mean ± SE	1.88 ± 0.04	1.27 ± 0.02	0.62 ± 0.02	32.43 ± 0.63

NS – Non significant

Table 25. Analysis of variance for calcium balance and retention in birds maintained on different dietary treatments

Parameter	Source	d.f	SS	MSS	F
Ca balance	Treatment	2	0.022981	0.01149	0.234
	Error	21	1.03005	0.04905	
Ca retention	Treatment	2	19.19555	9.59777	0.091
	Error	21	2204.195	104.9617	

Table 26. Influence of baker's yeast supplementation on phosphorus balance and retention in broilers

Treatments	P intake (g/day)	P outgo (g/day)	P balance (g/day) *	P retention (per cent) NS
T1	1.21	0.91	0.30	24.31
T2	1.19	0.91	0.29	24.05
T3	1.51	1.02	0.49	32.63
Overall mean ± SE	1.30±0.10	0.65±0.04	0.36±0.07	27.00±2.82

*Means bearing same superscript within the column differs significantly ($P<0.05$)

NS – Non-significant

Table 27. Analysis of variance for phosphorus balance and retention in birds maintained on different dietary treatments

Parameter	Source	d.f	SS	MSS	F
P balance	Treatment	2	0.15711	0.07856	4.627*
	Error	15	0.25464	0.01697	
P retention	Treatment	2	285.4627	142.7313	1.818
	Error	15	1177.695	78.51298	

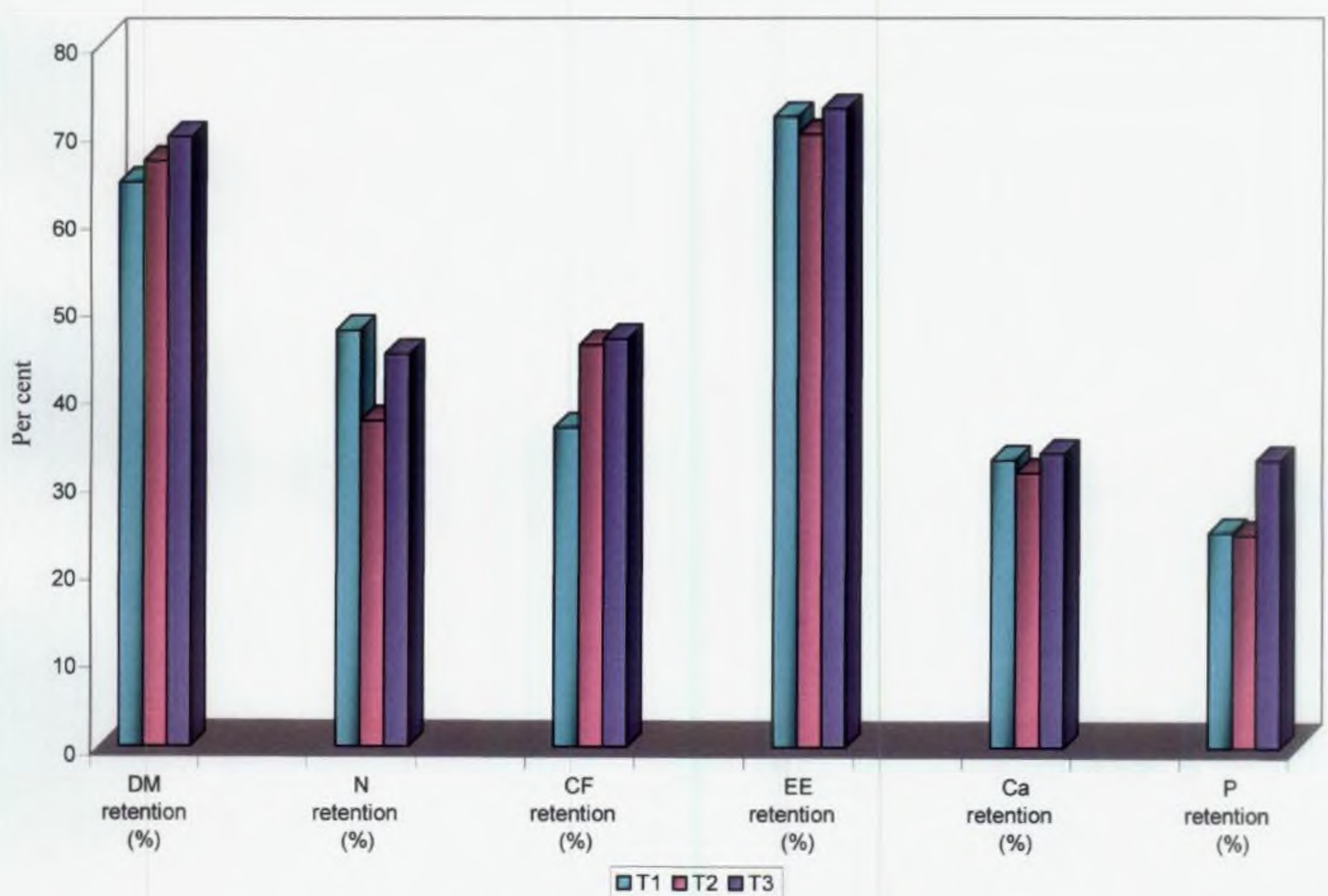

Fig. 9. Per cent nutrient utilization in birds maintained on different dietary treatments.

T2 and T3 were 95.68, 114.86 and 127.54 mg per dl respectively with an overall mean of 112.69 mg per dl. Statistical analysis of the data did not reveal any significant difference between treatment groups (Table 29, fig. 10).

Serum total protein

The mean serum total protein content (g per dl) of blood estimated at eight weeks of age was 3.3, 3.6 and 3.1 respectively for T1, T2 and T3 with an overall mean of 3.33 (Table 28, fig. 11). Statistical analysis of the data did not reveal any significant difference between treatment groups (Table 29).

Livability

Mortality pattern of birds in the different treatment groups is given in Table 30. There was no mortality among treatments during the first, second, third, fourth, fifth and sixth week of age. One bird died during the seventh week of age in the group fed with 0.6 per cent baker's yeast. No mortality was recorded in the other two treatments at seventh week of age. Mortality was nil in all the three treatments during the eighth week of age. Thus the overall livability in treatment groups T1 to T3 was 100, 100 and 97.92 per cent respectively with a total livability percentage of 99.31

Economics

The costs of experimental rations are set out in Table 31. The economics of rearing broilers by supplementing baker's yeast at 0.3 per cent and 0.6 per cent level was worked out in Table 32. The average cost of production and total return from a bird at sixth week and eighth week was calculated to asses the cost-benefit. The cost of production includes the chick, feed and miscellaneous cost. The miscellaneous expenditure includes vaccination, medication and litter cost. In each treatment there were 48 birds and chick cost was Rs.13 per bird. The birds are sold at the rate of Rs.32 per kg live weight. Poultry manure also accounted for the total return.

Table 28. Influence of dietary supplementation of baker's yeast on mean serum cholesterol (mg/dl) and serum total protein in broilers (g/dl)

Treatment	Serum cholesterol (mg/dl)[NS]	Total serum protein (g/dl)[NS]
T1	95.68	3.3
T2	114.86	3.6
T3	127.54	3.1
Overall mean ± SE	112.69 ± 9.26	3.33 ± 0.14

[NS] - Non-significant

Table 29. Analysis of variance for mean serum cholesterol and serum total protein in broilers as influenced by different dietary treatments

Source	Serum cholesterol				Total protein			
	d.f	SS	MSS	F	d.f	SS	MSS	F
Treatment	2	4115.59	2057.79	1.423	2	1.0833	0.54167	0.314
Error	21	30362	1445.79		21	36.25	1.7262	
Total	23	34477.58			23	37.333		

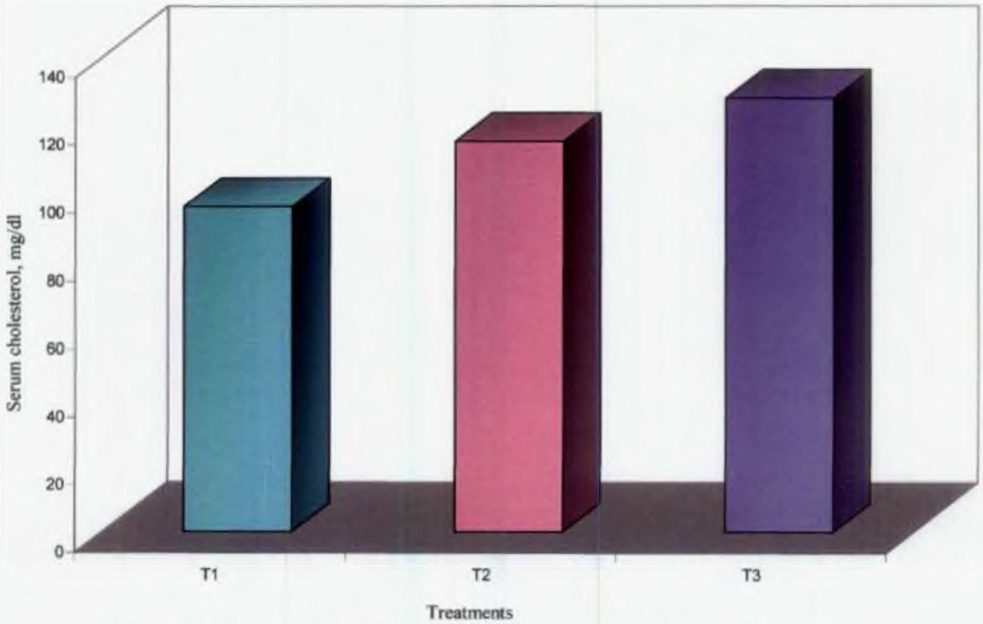

Fig. 10. Influence of dietary supplementation of baker's yeast on mean serum cholesterol , mg/dl

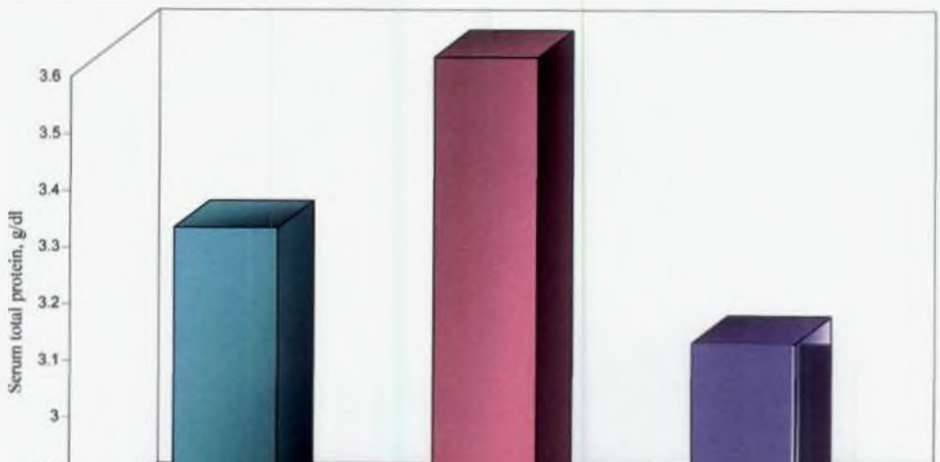

Fig. 11. Influence of dietary supplementation of baker's yeast on mean serum total protein in broilers, g/dl

Table 30. Mortality and overall livability per cent in different dietary treatment groups.

Treatment	Age in weeks								Total	Overall livability per cent
	1	2	3	4	5	6	7	8		
T1	0	0	0	0	0	0	0	0	0	100
T2	0	0	0	0	0	0	0	0	0	100
T3	0	0	0	0	0	0	1	0	1	97.92
Total	0	0	0	0	0	0	1	0	1	99.31

The net profit per kg body weight at sixth week of age was Rs.2.45 and Rs.0.95 for T1 and T2 respectively where as at 0.6 per cent level of inclusion of yeast there was a loss of Rs.0.29. The profit at eighth week of age were Rs.2.47 and Rs.1.75 respectively for T1 and T2 and in T3 there was a loss of Rs.0.60.

Table 31. Cost of experimental rations

Ingredients	Cost/kg (Rs.)	Broiler starter ration			Broiler finisher ration		
		T1	T2	T3	T1	T2	T3
Maize	6.48	301.32	301.32	301.32	362.88	362.88	362.88
De-oiled rice bran	5.87	41.09	41.09	41.09	35.22	35.22	35.22
Soya bean meal	13.45	430.34	430.34	430.34	309.30	309.30	309.30
Gingelly oil cake	12.38	49.54	49.54	49.54	37.15	37.15	37.15
Unsalted dried fish	10.75	91.38	91.38	91.38	107.50	107.50	107.50
Mineral mixture	21.90	38.33	38.33	38.33	38.33	38.33	38.33
Common Salt	2.23	0.56	0.56	0.56	0.56	0.56	0.56
Vitamin mixture	668.50	6.69	6.69	6.69	6.69	6.69	6.69
D.L.Methionine	348.50	34.85	34.85	34.85	17.43	17.43	17.43
Choline chloride	107.00	12.84	12.84	12.84	10.70	10.70	10.70
Lysine hydrochloride	328.12	45.94	45.94	45.94	32.81	32.81	32.81
Coccidiostat	230.00	11.50	11.50	11.50	11.50	11.50	11.50
Toxin binder	36.80	9.20	9.20	9.20	9.20	9.20	9.20
Baker's yeast	150.00	-	45.00	90.00	-	45	90
Total cost/100 kg feed		1073.56	1118.56	1163.56	979.26	1024.26	1069.26
Cost/kg of feed		10.74	11.19	11.64	9.79	10.24	10.69

Table 32. Cost-benefit analysis for the different treatment groups at the end of sixth and eighth week of the experiment.

Particulars	Treatment					
	0-6 weeks			0-8 weeks		
	T1	T2	T3	T1	T2	T3
Live body weight (g)	1973.96	1931.57	1942.29	2584.27	2556.46	2495.73
Total feed consumption/bird (g)	4006.04	3990.94	4073.65	6230.83	6057.81	6179.27
Feed cost per kg of feed (Rs.)	10.74	11.19	11.64	9.79	10.24	10.69
Total feed cost (Rs.)	43.03	44.66	47.42	61.00	62.03	66.06
Chick cost (Rs.)	13.00	13.00	13.00	13.00	13.00	13.00
Miscellaneous cost (Rs.)	3.00	3.00	3.00	3.00	3.00	3.00
Total cost (Rs./bird)	59.03	60.66	63.42	77.00	78.03	82.06
Return from sale of birds (Rs.)	63.17	61.81	62.15	82.70	81.81	79.86
Return from sale of manure (Rs.)	0.70	0.70	0.70	0.70	0.70	0.70
Net profit per bird (Rs.)	4.84	1.85	-0.57	6.4	4.48	-1.5
Net profit/kg body weight (Rs.)	2.45	0.95	-0.29	2.47	1.75	-0.60

Discussion

5. DISCUSSION

The results obtained in the study to evaluate the effect of dietary supplementation of baker's yeast on the performance of broilers are discussed in this chapter.

Meteorological parameters

The data pertaining to microclimate inside the experimental house are presented in Table 4. During the course of the experiment from November 2003 to January 2004, the mean maximum temperature ranged from 31.9 to 34.3 °C with an average of 33.2°C. The mean minimum temperature ranged from 20.0 to 26.6 °C with an average of 23.2°C. The mean relative humidity ranged from 63.7 to 78.1 per cent in the morning with an average of 73.0 and 43.7 to 58.3 in the evening with an average of 49.9 during the experimental period. Somanathan *et al.* (1980) reported the highest mean maximum temperature of 32.35°C during May and lowest during July (28.15°C) in Mannuthy. The lowest mean minimum temperature recorded was 23.28°C during May. The daily average per cent relative humidity varied between 75.68 during May and 86.52 during July. Climatograph of this locality fell within the hot and humid climate.

Body weight

Data on mean body weight recorded at fortnightly interval for different treatment groups are presented in Table 5. Statistical analysis of the data (Table 6) did not reveal any significant difference between treatments except on fourth week of age. Broilers fed with control ration and group fed with 0.3 per cent and 0.6 per cent baker's yeast reached body weight of 1117.92, 1199.48 and 1188.23 g respectively at fourth week of age. This agrees with the work of Thayer and Jackson (1975) who reported significant difference in body weight at fourth week in growing chicken when yeast was added in the ration at the rate of 2.5 per cent. Similarly, Sims and Mitchell (1994) reported increase in body weight of turkey toms at 26 and 54 days of age by the inclusion of yeast in the diet. Abd El Wahed *et al.* (2003) found significant improvement in body weight by the addition of yeast in the diet of broilers.

During sixth week of age body weight recorded for T1, T2 and T3 were 1973.96, 1931.57 and 1942.29 g respectively and during eighth week of age mean body weight recorded for T1, T2 and T3 were 2584.27, 2556.46 and 2495.73 g respectively. There was numerical improvement in body weight in control group, than T2 and T3. Statistical analysis of the data did not reveal any significant difference between treatments. The results of the present study agree with the findings of Savage *et al.* (1985), Yadav *et al.* (1994), Saha *et al.* (1999 b) and Singh and Prasad (2000). The present study disagrees with Trammell (1988) and Thayer and Jackson (1975) who reported significant improvement in body weight by the addition of baker's yeast in the diet of broilers. The present study reveals that the inclusion of baker's yeast did not have any significant influence on overall body weight in broilers at sixth and eighth week of age. The reason for non-significant response in cumulative body weight at sixth week of age may be due to better management and climatic conditions prevailing during the period of study and probiotics have their beneficial effects mainly during the period of stress.

Body weight gain

The data on body weight gain in broilers fed with three dietary treatments recorded at fortnightly interval is presented in Table 7. Statistical analysis of data showed significant difference among treatments at fourth and sixth week of age. At fourth week of age, broilers fed with baker's yeast at 0.3 and 0.6 per cent level recorded significantly higher body weight gain than the control group. During sixth week, control group (T1) had significant higher body weight gain than treatment group. The body weight gain during fourth fortnight did not reveal any significant difference between treatment groups. Bhatt *et al.* (1995) reported significantly higher gain in body weight in yeast supplemented group during starter phase and during finisher phase the difference among different treatment groups were non-significant. Taking into account the increase in body weight gain during fourth week of age it can be concluded that baker's yeast have some positive influence on the growth of birds during the initial stage and not much effect in the finisher stage of broiler growth.

The overall mean body weight gain recorded during first, second, third and fourth fortnightly intervals were 357.91, 764.42, 780.73 and 596.22 g respectively. Maximum body weight gain was recorded during fifth to sixth week of age. This follows normal trend in body weight gain in broilers.

The cumulative body weight gain up to sixth week of age and eighth week of age did not reveal any significant difference between dietary treatments. These results agree with the findings of Saha *et al.* (1999b). They reported non-significant effect in eighth week body weight gain in broilers fed 0.25 per cent baker's yeast. Singh and Prasad (2000) also reported non-significant effect in body weight gain of broilers fed with 0.1, 0.2, 0.3 and 0.4 per cent baker's yeast.

Feed intake

Data on mean daily feed consumption (g per bird per day) of broilers in different dietary treatments (Table 9) revealed that mean daily feed consumption up to fourth week of age was not affected by supplementation of baker's yeast. Significant difference ($P<0.05$) among treatments was recorded during fifth week of age. Broilers fed with control ration recorded significantly higher feed consumption than T2 and T3, group fed with 0.3 per cent baker's yeast (T2) was statistically similar to T3. During sixth week of age mean daily feed consumption was not influenced by supplementation of baker's yeast. During seventh week mean daily feed consumption of broilers fed with baker's yeast revealed significant difference between treatments. Group fed with control ration (T1) recorded significantly higher ($P<0.05$) mean daily feed consumption (162.13 g) than T2 but was statistically comparable to T3. Group fed with 0.3 per cent baker's yeast (T2) did not differ significantly from T3 but recorded lower mean daily feed consumption (149.67 g). During eighth week of age significantly lower

($P<0.05$) feed consumption was recorded in broilers fed with baker's yeast at 0.3 and 0.6 per cent level. Lower feed consumption was recorded in T2 from fifth week onwards indicating supplementation of baker's yeast at 0.3 per cent level is beneficial as far as this parameter is concerned. These findings agree with the findings of Sarkar *et al.* (1997). They reported that feeding yeast did not improve feed intake in broiler up to six weeks of age. Significant difference in feed intake between control and yeast fed group was reported by Thayer *et al.* (1978). On the contrary, Lopez *et al.* (2002) and Soliman *et al.* (2003) reported significant increase in feed consumption in yeast fed group compared to control.

Cumulative feed intake from zero to six weeks and zero to eight weeks of age did not differ significantly among treatment indicating that baker's yeast supplementation did not affect the feed intake of birds. This finding agrees with findings of Saha *et al.* (1999a) who reported non-significant effect on cumulative feed consumption of broilers fed with 0.3 and 0.5 per cent yeast up to eight weeks of age. Numerically lower feed consumption at finisher stage in T2 indicates beneficial effect of baker's yeast at 0.3 per cent level.

Feed conversion ratio

Feed conversion ratio based on kg feed consumed per kg body weight gain at fortnightly intervals (Table 11) revealed significant difference among treatments only at third fortnight. During sixth week of age, the group fed control diet had significantly superior feed efficiency of 2.44 compared to 2.77, the value recorded both in T2 and T3 groups. This was resulted due to the significantly higher body weight gain recorded in the control group. During eighth week of age, the feed conversion ratio recorded for T1, T2 and T3 was 3.65, 3.31 and 3.93 respectively and did not differ significantly.

Cumulative feed conversion ratio from zero to six weeks of age and zero to eight weeks of age revealed no significant difference among treatment groups. This finding agrees with the findings of Yadav *et al.* (1994), Saha *et al.* (1999 a) and Singh and Prasad (2000). But Saha *et al.* (1999 b) reported significant improvement in feed conversion ratio in broilers fed with baker's yeast at 0.25 per cent level.

Mean feed conversion ratio of 2.12 from zero to six weeks of age is within the normal limit of broilers. Lower feed conversion ratio from zero to eight weeks of age (2.47), may be due to the higher feed consumption recorded during the last fortnightly period. This agrees with the findings of Saha *et al.* (1999a) who reported the feed conversion ratio of 2.45 and 2.58 in birds supplemented with baker's yeast at 0.35 and 0.5 per cent level.

Processing yields and losses

Data on processing yields and losses recorded at the end of eight weeks of age given in Table 13 reveal that parameters tested were not influenced by the different dietary treatments. The dressing percentages were 90.72, 90.68 and 89.94 respectively for treatments T1, T2 and T3 with an overall mean of 90.45. The per cent eviscerated yield recorded for treatments T1, T2 and T3 were 70.56, 70.86 and 71.15 respectively with an overall mean of 70.86. Statistical analysis of the data did not show any significant difference among treatments (Table 14). The present findings agree with the findings of Yadav *et al.* (1994) and Saha *et al.* (1999a).

The mean per cent giblet yield was 3.73, 3.51 and 3.44 respectively with an overall mean of 3.56 for the treatments T1, T2 and T3. Ready-to-cook yield for the treatments T1, T2 and T3 were 74.29, 74.37 and 74.59 respectively with an overall mean of 74.42. The per cent blood loss was 3.22, 3.46 and 3.19 respectively for the treatments T1, T2 and T3 with an overall mean of 3.29. The per cent feather loss was 6.05, 5.86 and 6.87 respectively for treatments T1, T2 and T3 with an overall mean of 6.26. Statistical analysis of the data did not reveal any significant difference between treatments. Present findings agree with the findings of Baidya *et al.* (1993) and Yadav *et al.* (1994). They reported that processing losses and ready-to-cook yield were not significantly affected by yeast supplementation.

The per cent abdominal fat deposited for T1, T2 and T3 were 2.02, 1.69 and 1.77 respectively with an overall mean of 1.83. The data pertaining to per cent abdominal fat revealed no significant difference among treatments. However, a numerical improvement could be noted among yeast supplemented broilers over the control group. The lowest abdominal fat per cent (1.69) was recorded in broilers fed with yeast at 0.3 per cent level. The highest fat per cent (2.02) was recorded in control group. The present findings agree with the findings of Onifade *et al.* (1999). They also reported that supplementation of yeast caused a lower deposition of abdominal fat in broilers. Contrary to the above findings Soliman *et al.* (2003) reported that abdominal fat increased insignificantly in yeast supplemented group compared to control.

Nutrient utilization

The data on chemical composition of droppings voided by the broilers is presented in Table 15. The crude protein content ranged from 30.90 to 38.41 per cent, calcium 2.36 to 2.71 per cent and phosphorus 1.74 to 2.22 per cent. The values are within the normal range for poultry manure.

Dry matter retention

From the results given in Table 16, it could be seen that the average dry matter retention of birds maintained on different dietary treatments varied numerically but did not differ significantly. The mean values were 64.26, 66.67 and 69.44 per cent for T1, T2 and T3, respectively. There was an apparent increase of DM retention in T2 and T3 compared to the control (T1). The better retention of dry matter in the present study may be due to the production of amylase, protease, lipase and cellulose by the yeast. The finding is comparable to the results of Singh and Prasad (2000) who reported insignificantly better digestibility for dry matter in yeast fed broilers.

Nitrogen retention

The effect of different dietary treatments on N balance, per cent retention and excretion was determined (Table 18) and their statistical analysis is given in Table19. The treatments T1, T2 and T3 has registered nitrogen balance of 2.39, 1.81 and 2.29 g per day and 47.31, 37.04, and 44.60 per cent N retention, respectively. Even though there is no significant difference between treatments for N balance and retention the values reduced numerically in T2 and T3 when compared to control (T1) group. This finding is · contrary to the reports of Kumprechtova *et al.* (2000) who reported significantly higher nitrogen retention for broilers fed with *Saccharomyces cerevisiae* and higher levels of crude protein than with lower levels of crude protein. However, Saha *et al.* (1999b) and Soliman *et al.* (2003) reported that added baker's yeast showed non-significant differences in nitrogen balance.

Crude fibre retention

The retention of crude fibre in the ration of different treatment groups T1, T2 and T3 were 36.29, 45.64 and 46.38 per cent respectively (Table 20). Broilers fed with 0.3 and 0.6 per cent baker's yeast (T2 and T3) had higher ($P<0.05$) crude fibre retention than the control diet (T1). The findings are comparable to the works results of Kumprechtova *et al.* (2000) who reported increased coefficient of fibre digestibility in the broilers receiving *Saccharomyces cerevisiae* in high crude protein diet. Contrary to this Soliman *et al.* (2003), reported that digestibility coefficients of crude fibre were not affected by yeast supplementation. The increased fibre digestion may be due to improvement of beneficial caecal microbial content and also due to the presence of cellulase in yeast.

Ether extract retention

The data on per cent ether extract retention (Table 22) for treatments T1, T2 and T3 were 71.66, 69.70 and 72.55 respectively. The values showed no statistical significance among the treatments. The group fed with 0.6 per cent baker's yeast showed numerically better digestibility of ether extract than control group. The results are comparable to the findings of Singh and Prasad (2000) who reported non-significant but slightly better utilization of ether extract by yeast fed broilers. Similarly Soliman *et al.* (2003) found no significant difference for ether extract retention between control and yeast fed groups. However Bhatt *et al.* (1995) and Saha *et al.* (1999 b) reported significantly better utilization of ether extract by baker's yeast fed broilers than the control group. The better retention of ether extract in 0.6 per cent yeast included group may be due to the presence of lipase in the yeast.

Retention of calcium

The per cent retention of calcium in experimental birds of T1, T2 and T3 were 32.64, 31.24 and 33.40 and statistical analysis of the data revealed no significant difference between treatments. The availability of calcium was numerically better in T3 and lower in T2 compared to control (Table 24). Slightly better utilization of calcium by yeast fed broilers was reported by Saha *et al.* (1999 b) and Singh and Prasad (2000). But Yadav *et al.* (1994) and Saha *et al.* (1999 a) reported non-significant differences for calcium balance among yeast fed and control groups.

Retention of phosphorus

The per cent retention of phosphorus in experimental birds of T1, T2 and T3 were 24.31, 24.05 and 32.63 respectively (Table 26) and statistical analysis of the data revealed no significant difference between treatment groups. Broilers fed with 0.6 per cent baker's yeast had a trend for higher retention over group fed 0.3 per cent baker's yeast and control diet. The phosphorus balance revealed significant difference between treatment groups. Broilers fed with 0.6 per cent baker's yeast (T3) had significantly higher ($P<0.05$) balance (0.49 g per day) than those fed 0.3 per cent baker's yeast (0.29 g per day) and control birds (0.3 g per day). Thayer and Jackson (1975) reported that live yeast culture at 2.5 per cent level in the feed of turkeys improved the utilization of dietary phosphorus by the synthesis of phytase in the digestive tract of turkeys. Thayer *et al.* (1978) also reported significant increase in phosphorus in turkey breeder hens by the addition of live yeast culture. Saha *et al.* (1999 b) and Singh and Prasad (2000) also reported better utilization of phosphorus by broilers. The higher phosphorus availability in this experimental group can be attributed to the phytase present in the yeast. But Saha *et al.* (1999 a) found that baker's yeast at 0.35 and 0.5 per cent levels had no effect on phosphorus balance in broilers. They reported phosphorus balance of 0.50, 0.55 and 0.50 respectively for 0, 0.35 and 0.5 per cent yeast levels.

Serum cholesterol

The per cent serum cholesterol estimated at eight weeks of age were 95.68, 114.86 and 127.54 mg per dl respectively for groups T1, T2 and T3 (Table 28). Statistical analysis of the data revealed no significant difference between treatments. But numerically there was increase in cholesterol content depending on the level of inclusion of yeast. Sturkey (1976) reported normal serum cholesterol of 116 to 134 mg per 100 ml in broilers. On the contrary, Garcia *et al.* (2002) reported that cholesterol in serum decreased in the heat treated product of *Saccharomyces cerevisiae* (93.2 mg per dl) compared to the control (119.2 mg per dl) at 35 days of age. The values were 98.42 mg per dl for the product and 118.53 mg per dl for control group at 42 days of age. Soliman *et al.* (2003) also reported that there was slight reduction in the cholesterol values due to yeast supplementation.

Serum protein

The mean total serum protein content of blood estimated at eight weeks of age was 3.3, 3.6 and 3.1 respectively for treatment groups T1, T2 and T3 (Table 28). There was no significant difference between treatment groups. This agrees with the findings of Bartov *et al.* (1974). They reported plasma protein level of 3.54 g per 100 ml in male and 3.73 g per 100 ml in female broilers. The normal range as reported by Sturkey (1976) was 4.0 and 5.24 for adult male and female chicken respectively. Shafey *et al.* (2001) reported that serum total protein was influenced by dietary addition of *Saccharomyces cerevisiae* in specific pathogen free chicken but not in meat chicken. Contrary to the present findings Soliman *et al.* (2003) reported serum total protein values of 3.57 and 4.08 g per dl in control and yeast fed group respectively. The yeast fed group was having a higher value for total protein. In this study it was found that there was no increase in total protein values in yeast fed groups.

Livability

There was only one mortality recorded during the entire period of study. The mortality was recorded in the birds fed with 0.6 per cent yeast at seventh week of age. The overall livability in treatment groups T1 and T2 was cent per cent and that of T3 was 97.92 per cent with an overall livability percentage of 99.31 per cent (Table 30) and was within the normal range.

Economics

The economics of rearing broilers by supplementing baker's yeast at 0.3 per cent and 0.6 per cent level was worked out in Table 32. Feed cost, chick cost and other miscellaneous cost are taken into account for cost-benefit analysis. The total cost of production up to sixth week of age recorded lowest cost in control ration (Rs.59.03) followed by T2 (Rs.60.66) and T3 (Rs.63.42). Net profit calculated per bird at the end of sixth week was Rs.4.84 for control group, Rs.1.85 for T2 and Rs.-0.57 for T3. Cost-benefit analysis calculated up to the end of eighth week also recorded a high profit for control group than treatment group. Net profit at the end of eighth week for control group was Rs.6.4, for T2 was Rs.4.48 and for T3 (-1.5). The drastic reduction in profit margin was because of the increased cost of feed and chicks and the fall in market price for chicken.

Based on the present study it can be concluded that inclusion of baker's yeast in broiler ration is not economical while considering the cost benefit factor. However there is a trend in reduction of abdominal fat deposition in broilers with the inclusion of baker's yeast.

Summary

6. SUMMARY

An experiment was designed and carried out in the Department of Poultry Science, College of Veterinary and Animal Sciences, Mannuthy to study the effect of dietary supplementation of baker's yeast on the performance of broilers.

One hundred and forty four day-old, commercial broiler chicks (Ven cob) were used for the study. The chicks were wing banded, weighed individually and allotted randomly to three dietary treatments viz., T1, T2 and T3. Each group consisted of four replicates of 12 birds each. Standard managemental practices were followed throughout the experimental period. Feed and water were provided *ad libitum*. The dietary treatments consisted of a standard broiler ration formulated as per the BIS specifications (1992) formed control (T1), control ration containing 0.3 per cent baker's yeast (T2) and 0.6 per cent baker's yeast as T3. The chicks were provided with broiler starter ration up to six weeks of age and thereafter broiler finisher ration up to eight weeks of age.

The production performances of the broilers were recorded for a period of eight weeks. The body weight of individual birds were recorded at fortnightly intervals. Weekly feed consumption was recorded replicate wise. From the above data body weight gain and feed conversion efficiency are worked out. Processing yields and losses, serum cholesterol, total serum protein and nutrient utilization were recorded. Livability and cost-benefit analysis due to dietary supplementation of baker's yeast were also ascertained. At the end of the experimental period three day metabolism trial was conducted using two birds from each treatment.

Based on the results obtained during the course of the study the following conclusions were made.

1. The mean body weight of broilers recorded at sixth and eighth week of age did not reveal any significant difference between treatments. Body weight recorded at sixth week of age for T1, T2 and T3 were 1973.96, 1931.57 and 1942.29 g respectively. Final body weight at eight weeks of age for T1, T2 and T3 were 2584.27, 2556.46 and 2495.73 g respectively.

2. Cumulative body weight gain at sixth week of age for T1, T2 and T3 were 1927.54, 1885.51 and 1896.13 g respectively and weight gain at eighth week of age for T1, T2 and T3 were 2537.86, 2510.40 and 2449.57g respectively. Statistically analysis of the data did not reveal any significant difference between treatments. The gain in body weights are numerically lower for yeast included groups than control group.

3. The data on mean daily feed consumption (g/bird/day) revealed significant differences between treatments during seventh and eighth week of age. At seventh week of age mean daily feed consumption are 162.13, 149.67 and 153.68 g respectively for T1, T2 and T3 and at eight weeks of age mean daily feed consumption are 155.70, 145.60 and 147.13 g for T1, T2 and T3 respectively.

4. Feed conversion ratio at sixth week of age was significant. The control group registered better feed conversion ratio (2.44) than T2 (2.77) and T3 (2.77) groups. At eight weeks of age, the feed conversion ratio was not significantly different between treatments. But the group fed 0.3 per cent baker's yeast showed numerically better feed conversion ratio (3.31) than control (3.65) and T3 (3.93) group fed 0.6 per cent baker's yeast. The cumulative feed conversion ratio at sixth and eighth week of age did not show any significant difference among treatments. The cumulative feed conversion ratio upto six weeks of age for T1, T2 and T3 were 2.08, 2.12 and 2.15 respectively and upto eight weeks of age were 2.46, 2.41 and 2.53 respectively. Statistical analysis of the data did not show any significant difference among treatments.

5. Data on eighth week processing yields viz. dressed yield, eviscerated yield, giblet yield and ready-to-cook yield and losses due to blood loss and feather loss did not reveal significant difference among treatment groups. But the abdominal fat percentage was reduced numerically by the dietary supplementation of baker's yeast in the diet of broilers. The abdominal fat per cent recorded for T1, T2 and T3 were 2.02, 1.69 and 1.77 respectively.

6. The dry matter retention did not differ significantly between groups. However, there was a trend for higher retention of dry matter in broilers fed with baker's yeast.

7. Nitrogen retention did not show any significant difference between treatments though numerically higher retention was observed in control group than the two treatments containing baker's yeast supplementation.

8. Crude fibre retention was significantly different ($P<0.05$) among treatment groups. The treatment with 0.6 per cent baker's yeast showed highest retention followed by group fed with 0.3 per cent baker's yeast. The lowest crude fibre retention was noticed in control group and this indicate that baker's yeast in the diet of broilers improve the retention of crude fibre.

9. Retention of Ether extract was not significantly influenced by the addition of baker's yeast in the diet of broilers.

10. Data on calcium retention reveal that there was no significant influence of baker's yeast. But numerically higher retention was noticed in group fed with baker's yeast at 0.6 per cent level than the control group.

11. Balance of phosphorus was higher in birds fed with 0.6 per cent baker's yeast than control and T2 treatments. The retention of phosphorus did not differ significantly in the group supplemented with 0.6 per cent baker's yeast compared to the control and T2.

12. The serum cholesterol values did not differ significantly among treatment groups and it is evident that baker's yeast supplementation did not reduce the serum cholesterol level in broilers.

13. Total serum protein in broilers fed with diets containing baker's yeast and control diet did not differ significantly and is evident that baker's yeast did not influence the serum protein levels in broilers.

14. Mortality in broilers fed with T1, T2 and T3 did not indicate any adverse effects due to treatments and the overall livability in broilers was good in all groups.

15. Cost-benefit analysis revealed that the net profit per bird was the highest in the group fed with standard broiler ration (control) and the least in group supplemented with 0.6 per cent baker's yeast.

Based on the results of the study it can be concluded that eventhough profit margin of the baker's yeast supplementation in broiler feed is low, the lower deposition of abdominal fat is advantageous and it needs to be explored.

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EFFECT OF DIETARY SUPPLEMENTATION OF BAKER'S YEAST (*Saccharomyces cerevisiae*) ON THE PERFORMANCE OF BROILERS

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ABSTRACT

An experiment was designed and conducted at the Department of Poultry Science to investigate the effect of feeding baker's yeast on growth, feed consumption and nutrient utilization of broilers. One hundred and forty four day old commercial broiler chicks were reared under three different treatments with four replicates per treatment. The treatment consisted of control diet with standard broiler ration (T1) and T2 and T3 with 0.3 and 0.6 per cent baker's yeast supplemented respectively with control diet. Chicks were reared under standard managemental conditions up to 8 weeks of age. Broiler starter ration was fed up to 6 weeks of age and finisher ration up to 8 weeks of age. Results of the study revealed that cumulative body weight and body weight gain up to six weeks and eight weeks of age were not affected by the inclusion of yeast. Mean weekly feed consumption recorded significant ($P<0.05$) difference between treatment during fifth, seventh and eighth weeks of age. Cumulative feed intake up to six weeks and eight weeks of age did not differ significantly. But yeast supplemented groups recorded numerically lower feed consumption compared to control group. Feed conversion ratio revealed significant difference ($P< 0.05$) at sixth week of age recording lower feed efficiency in T2 and T3 compared to control (T1). But cumulative feed conversion ratio from zero to six weeks and zero to eight weeks of age did not differ significantly. Supplementation of baker's yeast had no effect on processing yields and losses. Numerically lower fat deposition was recorded in yeast supplemented groups than in control group, eventhough there was no significant difference. The addition of yeast at 0.3 per cent and 0.6 per cent levels significantly increased ($P<0.05$) crude fiber digestibility. Other parameters like retention of dry matter, nitrogen, calcium and phosphorus were not affected by yeast supplementation. Serum protein, serum cholesterol and livability were not affected by yeast supplementation. The net profit per bird was less in yeast supplemented group compared to control group. The higher cost of feed resulted in lower economical return from the treatment groups. The result suggests that inclusion of yeast is not beneficial on economical point of view. However the lower fat deposition consequent to yeast supplementation seems to be advantageous.