EFFECT OF YEAST (*Saccharomyces cerevisiae*) BASED PROBIOTIC ON THE GROWTH PERFORMANCE OF BROILER

A Thesis

By

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*This is to certify that the thesis entitled "**EFFECT OF YEAST (Saccharomyces cerevisiae) BASED PROBIOTIC ON THE GROWTH PERFORMANCE OF BROILER**" submitted to the Department of Animal Nutrition, Genetics and Breeding, Faculty of Animal Science & Veterinary Medicine, Sher-e-Bangla Agricultural University, Dhaka-1207, as partial fulfillment for the requirements of the degree of Master of Science (MS) in Animal Nutrition, embodies the result of a piece of bona fide research work carried out by **MD. MINHAZUL ISLAM**, Registration No.: 13-05686, Semester: **JULY DECEMBER/2019** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

I further certify that any help or source of information, received during the course of this investigation has been duly acknowledged.

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DEDICATED TO MY BELOVED GRANDMOTHER AND MY PARENTS

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LIST OF ACRONYMS AND ABBREVIATION

ABBREVIATION	FULL WORD
ADG	Average daily gain
AGPs	Antibiotic growth promoter
ANOVA	Analysis of variance
Avg	Average
BWG	Body weight gain
CFU	Colony forming Unit
Cm^2	Square centimeter
CP	Crude protein
DOC	Day Old Chick
DP	Dressing percentage
e.g.	For example
et al	And others/Associates
EU	European Union
FAO	Food and Agricultural Organization
FC	Feed Consumption
FCR	Feed Conversion Ratio
FDA	Food and Drug Administration
FI	Feed Intake
g	Gram
GALT	Gut-associated lymphoid tissue
GFI	Global food initiative
GIT	Gastro intestinal tract
i.e.	That is
IB	Infectious bronchitis
K Cal	Kilo calorie
Kg	Kilogram
L	Liter
LSD	Least Significant Difference
M.S.	Master of Science

ABBREVIATION	FULL WORD
ME	Metabolizable energy
ml	Mililiter
mm	Milimetre
MT	Metric ton
ND	Newcastle disease
No	Number
NS	Non-Significance
RH	Relative Humidity
SAU	Sher-e-Bangla Agricultural University
SC	*Saccharomyces cerevisiae*
SE	Statistical error
SPSS	Statistical package for Social Science
TLRs	Toll-like receptors
TM	Trade mark
Viz	Such as
Vs.	Versus
WHO	World Health Organization
Wks	Weeks

LIST OF SYMBOLES

SYMBOLES	FULL MEANING
^{0}C	Degree Celsius
^{0}F	Degree Fahrenheit
@	At the rate of
:	Ratio
<	Less than
>	Greater than
*	5% level of significance
&	And
/	Per
±	Plus-minus
%	Percentage

EFFECT OF YEAST (*Saccharomyces cerevisiae*) BASED PROBIOTIC ON THE GROWTH PERFORMANCE OF BROILER

ABSTRACT

A total of 120 day-old Lohmann Meat (Indian River) broiler chicks were reared at Sher-e-Bangla Agricultural University Poultry Farm, Dhaka. The present study was designed to evaluate the productive performance of commercial broiler chicks fed diet containing yeast based probiotics compared to basal diet. The aims of the present study were to investigate the influence of a yeast based probiotic on the growth performance of broiler, body weight, feed intake, FCR, carcass merits of male and female broiler were compared to control feeding of broiler. A total of 120 day-old Lohmann Meat (Indian River) chicks were used in this experiment. Chicks were divided randomly into 5 experimental groups of 3 replicates (08 chicks with each replication). Among the 5 experimental groups one group were fed this diet as control and another one antibiotic mixed feed, the remaining three groups were fed diet mixed with 3 categories of yeast based probiotics. Here this study T_1 = (antibiotic 0.25g/kg feed), T_2 = (probiotic 1.5g/kg feed), T_3 = (probiotic 2 g/kg feed), T_4 = (probiotic 2.5g/kg feed) and T_0= (control). The duration of experimental work was 28 days. Results of the experiment showed that addition of yeast based probiotics improved ($P<0.05$) broilers growth performance and the impact starting from the third and the fourth week of the feeding trial. However, it increased the effect on feed intake. Feed conversion ratio was better and dressing percent was increased ($P<0.05$) in birds fed diets supplemented with yeast based probiotics. Yeast based probiotic supplementation had no significant effect on broiler carcass cuts compared to control. The study therefore concluded that yeast based probiotic supplemented with 2g/ kg of the broiler feeds proved to be beneficial for increasing the growth performance of broiler.

CHAPTER I

INTRODUCTION

1.1 Background

Poultry farming has emerged as one of the fastest growing agribusiness industries in the world, even in Bangladesh. Research on meat production globally indicates poultry as the fastest growing livestock sector especially in developing countries. It has triggered the discovery and widespread use of a number of “feed additives”. The term feed additive is applied in a broad sense, to all products other than those commonly called feedstuffs, which could be added to the ration with the purpose of obtaining some special effects. The main objective of adding feed additives is to boost animal performance by increasing their growth rate, better-feed conversion efficiency, greater livability and lowered mortality in poultry birds. These feed additives are termed as “growth promoters” and often called as non-nutrient feed additives.

One of the major challenges faced by the poultry industry in the developing world is improving efficiency of production. To meet this challenge and maintain the efficiency of feed utilization, series of attempts have been made by researchers. These include incorporation of antimicrobials and other natural products, such as yeasts to animal feeds (Kung, 1997). Live yeast addition to animal feed has been known to improve the nutritive quality of feed and performance of animals (Glade and Sist, 1988; Martin *et al*., 1989). Yeast from malted grain fermentation constitutes a natural concentrate mixture of essential nutrients minerals and vitamins. *Saccharomyces cerevisiae* (*SC*) yeast has biologically valuable proteins, vitamin B-complex, important trace minerals and several unique “plus” factors. Many other beneficial factors identified such as ability to enhancement of phosphorus availability (Glade and Biesik, 1986; Brake, 1991; Moore *et al*., 1994) and utilization by animals (Erdman, 1989; Pagan, 1990), reduction in cases of disease infection (Line *et al*., 1997) in addition, improvement of feed efficiency (Day, 1997; Onifade and Babatunde, 1996). Santin *et al*. (2001) reported that manna oligosaccharides and fruct- oligosaccharides in the cell wall of yeast assist the balance of the the gastro-intestine by maintaining or reestablishing the conditions of eubiosis in the digestive tube, Some authors (Hayat *et al*., 1993, Bradley and Savage, 1993) have attributed the increase in mineral retention and better bone mineralization of broilers supplemented with manna oligosaccharide probiotic.

However, there are still conflicting reports on the beneficial effect of yeast inclusion in poultry diets. (Hayat *et al*., 1993) suggested that the beneficial effects of *Sacchaomyces* dried yeast in feeds may be influenced by the bird's genome and recom-mended further studies. In spite of these series of studies on the effect of yeast inclusion in poultry diets no one has come out with the specific effect of *SC* in different levels on growth performance, carcass characteristics of broiler chicks.

This work therefore, has the objective of evaluating the effects of feeding different levels of supplemental *yeast* (*S. cerevisiae*) on growth performance, blood constituents and carcass characteristics of Lohmann Meat (Indian River).

1.2 State of the problems

Now a days people are very concern about antibiotics resistance. Most of the framers use antibiotics at high dose for preventing diseases. But it is unethical because antibiotics are used for treating the disease. If we use this in healthy or normal birds, it causes residual effect. Most of the farmer doesn't know that proper management can prevent different types of diseases. And if we use yeast based probiotics in farm, it increases the production performance and reduce the risk of disease susceptibility. In a while, the profit will be higher and feed will be safe for the people.

1.3 Justification of the study

In addition to growth performance, there are trials showing that enrichment of diets with yeast could favorably improve the quality of edible meat of broilers.

For example, edible meats from broiler chicks fed a diet containing chromium-enriched (*SC*) exhibited increased tenderness (Bonomi *et al*., 1999) and increased water holding capacity (Lee *et al*., 2002). The effect of *SC* supplementation on oxidative stability of chicken meat has not been extensively studied, albeit there are indications that *SC* may have an antioxidant property.

Thus, the present study was conducted to evaluate the effects of whole cell, cell wall, and cell content of (*SC*) on growth performance, various meat qualities, and carcass development of broiler chicks.

1.4 Objectives

- ✓ To evaluate the effects of *Saccharomyces cerevisiae* on broiler
- ✓ To estimate growth performance and food conversion ratio (FCR) of broiler
- ✓ To determined carcass development of broiler chicks
- ✓ To investigate various broiler meat qualities
- ✓ To mitigate antibiotic use in broiler production

CHAPTER II

REVIEW OF LITERATURE

It is very important to review the past research works which are related to the proposed study before conducting any type of survey or experiment. It is well documented that antibiotics benefit animal growth, performance, and health. However, increasing concerns regarding overuse of antibiotics has prompted extensive investigation into alternatives to use of subtherapeutic antibiotics in production diets. Yeast products are important natural growth promoters. Eckles and Williams (1925) first reported the use of *Saccharomyces cerevisiae* as a growth promoter for ruminants. Commercial yeast products specifically for animal feeding are used worldwide in animal production particularly in ruminant diets. Effects of yeast products on production and their mode of action in monogastrics have been reported in poultry (Hayat *et al*., 1993; Bradley and Savage, 1995; Stanley *et al*., 2004a; Zhang *et al*., 2005) and pigs (Mathew *et al*., 1998; van Heugten *et al*., 2003; Shin *et al*., 2005a).

Probiotics have been defined by Tellez as living microorganisms contained in the feed of animals positively affect the host by improving its digestive system; on the other hand, Simon et al. (2001) defined probiotics as viable microorganisms that increase the weight gain and conversion ranges feed and reduce the incidence of diarrheas.

Probiotics are one of the most exploited proposals when it comes to production systems ensure efficient and safe to consumers and the environment Brown.

Zimmermann *et al*. (2001) ensured that probiotic supplementation has been recommended for the treatment or prevention of various diseases and stress conditions of a number of species.

2.1 Yeast based probiotics (*Saccharomyces cerevisiae* yeast)

Yeasts are an important source for obtaining products with probiotic activity, either as live strains or using derivatives from their cell walls. These preparations have shown a proven immunostimulatory activity in farm animals as well as improvements in the processes of the digestive physiology, contributing to better production results Morales *et al*. (2004), Campeanu *et al*. (2002), Bovill *et al*. (2001), and Coenen, (2000). They stated that strains use as probiotic yeast belonging to the genera *Saccharomyces, Kluyveromyces, Hansenula, Pichia* and *Candida* and within these *genera, species S. boulardii, S. cerevisiae, K. fragilis, K. lactis, C. saitoana* and *C. pintolopesii*.

It is important to note that the selection of the probiotic strain, depends on the requirements of the animal that will be delivered, should ensure the diversity of biota in the intestine and provide stability to their ecology, which can be affected by changes diet, stress and strenuous exercise.

Paryad *et. al.,* (2008). States that the most important selection criteria that have been used to select yeast strains with probiotic properties are grouped by their strength properties, functions and potentials, highlighting among these:

• Tolerance to high acidity.

• Resistance to bile salts.

• Adhesion capacity to intestinal cells.

• Direct antagonistic effect on enterobacteria and other yeasts.

• Antisecretory effect against the toxins of pathogenic microorganisms.

• Trophic effect on the mucosa through the production of polyamines.

• Immunostimulant effect.

2.2 Impact of yeast based probiotics on mode of action of broiler production

Effects of yeast products on production and their mode of action in monogastrics have been reported in poultry (Stanley *et al.*, 2004a; Zhang *et al*., 2005) and pigs (van Heugten *et al*., 2003; Shin *et al.*, 2005a). However, mode of action of yeast products in these animals is less clear. Some studies have confirmed the effects of yeast culture (**YC**) in increasing concentrations of commensal microbes or suppressing pathogenic bacteria (Stanley *et al*., 2004a). However, these effects were not reported by others (White *et al*., 2002; van Heugten *et al.*, 2003). We hypothesize that there may be other mechanisms responsible for effects of YC in monogastrics other than modulation of microbial ecology. Mannan-oligosaccharide and 1,3/1,6 β-glucan are components of the yeast cell wall that modulate immunity (Shashidhara and Devegowda, 2003), promote growth of intestinal microflora (Spring *et al*., 2000; Stanley *et al*., 2000), and increase growth (Parks *et al*., 2001). Yeast culture contains viable cells, cell wall components, metabolites, and the media on which the yeast cells were grown. In a recent in vitro study (Jensen et al., 2007), the addition of a soluble fraction of YC showed an antiinflammatory effect in conjunction with activation of natural killer cells and B lymphocytes. In addition, others have reported that yeast products affect nutrient digestibility (Shin *et al*., 2005b) and intestinal mucosal development (Santin *et al*., 2001; Zhang *et al*., 2005). Therefore, the objective of this study was to evaluate effects of YC in broiler diets on performance, nutrient digestibility, intestinal morphology, and immune function in poultry.

2.3 Yeast based probiotics effects on nutrients digestibility

Poultry scientists have used many techniques like supplementation of feed additives, natural or synthetic origin in a compound feed to improve weight gain, feed efficiency and to decrease mortality rate in broilers to meet protein requirements of rapidly increasing population. These additives include antibiotics, prebiotics, probiotics, enzymes and coccidiostats (Saegusa *et al*., 2004). Poultry diets usually contain antibiotic growth promoters to enhance performance of birds. Estimated cost of antibiotic growth promoters in poultry diets in Pakistan ranged from 2-3 rupees/kg of feed (Bhatti, 2011). The addition of antibiotics is not cost effective and also has an issue of bacterial resistance that's why European Union Commission banned the incorporation of antibiotics in animal feed (EUC, 2005). As an alternative to antibiotic growth promoters, probiotics can be used for competitive exclusion of bacterial pathogens (Karaoglu and Durdag, 2005). Dietary supplementations of probiotics prevent the spread of pathogens and improve growth performance, immune response in poultry birds by modulating native microflora (Bezkorovainy, 2001). Probiotics are those viable microbes (bacteria and fungi) which have beneficial effect on the host animal (Ghadban, 2002). Baker's yeast (Saccharomyces cerevisiae) is extensively used in livestock as feed additive. It is rich source of crude protein (40-45%) and also contains number of water soluble vitamins (biotin, niacin and pantothenic acid) which increases the nutritive quality of the feed (Walker *et al*., 2002). Several digestive enzymes are also excreted by the yeast that help the gastrointestinal tract to boost the nutrient digestibility, growth rate and feed conversion ratio (Nawaz *et al*., 2008). From bacterial origin, Lactobacillus and Bifidobacteria have the potential to modulate the composition of microbial communities in the gut. In the gut, bacterial probiotic forms a physical obstruction on the binding sites of intestinal mucosa by their own attachment causes blockage of pathogenic bacteria (Lorenzoni, 2012). Probiotic containing Lactobacillus species provide resistance to the host against disease causing agents like *E. coli,* Salmonella, Campylobacter and *Eimeriaacervulina* (Dalloul *et al*., 2003). It was, therefore, intended to initiate a comparative study by using probiotics of both origins; yeast (*Saccharomyces cerevisiae*) and bacteria (*Bacillus cereus toyoi*) in broilers. The main objective of present study was to compare the effect of probiotics on growth performance, immune response, carcass characteristics and nutrient digestibility in broilers.

2.4 Effects of probiotic-supplemented diets on growth performance

A variety of different supplements, as the alternatives to antimicrobial growth promoters, have been explored to maintain growth performance of broilers (Dickens *et al*., 2000; Ghadban, 2002; Biggs and Parsons, 2008; Chowdhury *et al*., 2009). Several studies showed that dietary supplementation of lactic acid bacteria (e.g., *Lactobacillus*) improved the performance of broilers in the starter phase (Zulkifli *et al*., 2000). Feeding *Saccharomyces cerevisiae* products was shown to improve growth performance of broilers after 21 d of age (Stanley *et al*., 2004; Gao *et al*., 2008, 2009). Although the manner by which probiotics act remains to be clarified, they are thought to function by maintaining the presence of beneficial microorganisms, and competitive exclusion of pathogenic bacteria adherence in the intestine of broilers (Reid and Friendship, 2002; Callaway *et al*., 2008). In addition, Gao *et al*. (2008) and Higgins *et al*. (2008) reported that intestinal immunity was increased in chickens fed diets supplemented with yeast product and *Lactobacillus*-based probiotic culture, respectively. Our previous study on probiotics products incorporating *Lactobacillus fermentum* and *Saccharomyces cerevisiae* indicated that they improved the intestinal balance of the diverse microflora species in the rectum of broiler chickens (Lei *et al*., 2009). However, Klasing (1998) reviewed that probiotics enhanced the intestinal microbial balance and intestinal immunity in chickens, which might result in decreased growth performance.

The immunological function of chick gut-associated lymphoid tissue (GALT) is critical for reducing the incidence of poultry enteric disorders (Reid and Friendship, 2002; Callaway *et al*., 2008) because GALT is exposed to the microflora from concomitant feed and the environment (Bar-Shira *et al*., 2003). The immunobiotic lactic acid bacteria (Sato *et al*., 2009) and yeast product (Gao *et al*., 2009) could stimulate the GALT immune system in chicks. Moreover, evidence is accumulating that suggests probiotics might augment Toll-like receptor (TLR) signaling, regulate local mucosal cell-mediated immune responses, enhance dendritic cell-induced T cell hyporesponsiveness, and promote epithelial barrier integrity in avian and mammalian species (Gao *et al*., 2008; Ng *et al*., 2009).

We postulated that this probiotic product might enhance the immunological function of GALT in chicks. Therefore, in the present study, the effects of probiotics in the form of *Lactobacillus fermentum* and *Saccharomyces cerevisiae* on the intraepithelial lymphocyte subpopulations and TLRs mRNA expression were investigated in the intestine of broiler chickens.

2.5 Use of probiotics instead of antibiotics in broiler production

Nowadays, the efficiency of poultry to convert the feed into meat plays a key role in economics of broiler industry. Therefore, it is highly essential to improve feed efficiency of poultry to produce meat economically and also food safety is more seriously considered than before. On the other hand, economy of food production is also a factor that cannot be ignored. A huge amount of antibiotics has been used to control diseases and improve performances in livestock. However, due to growing concerns about antibiotic resistance and the potential for a ban for antibiotic growth promoters in many countries in the world, there is an increasing interest in finding effective alternatives to antibiotics in poultry production. Poultry feed influences the production cost of chicken. Recently, it is believed that Probiotics have beneficial effects to improve the productive performance of poultry. Probiotics are specific agents produced by micro-organism containing *Lactobacillus acidophilus, Lactobacillus casei*, *Bifidobactuium bifidum*, *Aapergillus oryzae* and *Torulopsis* (Mohan *et al*. 1995). However, according to the currently adopted definition by Food and Agriculture Organization and World Health Organization (2001), probiotics are: live microorganisms which when administered in adequate amounts confer a health benefit on the host. The most important advantage of a probiotic is that it neither hasany residues in animal production nor exerts any antibiotic resistance by consumption. Therefore, a lot of researchers have partially replaced antibiotics with probiotics as therapeutic and growth promoting agents.

It was reported that probiotics have a good impact on the poultry performance (Mountzouris *et al*., 2007; Koenen *et al*., 2004), improve microbial balance, synthesize vitamins, decrease pH and release bacteriocins (Rolfe, 2000), improve feed consumption in layers and broilers (Nahashon *et al*., 1994).

The broiler industry is constantly searching for ways to improve its product and quality in order to meet the demands of an increasingly demand of consuming public. In this regard, numerous references exist on increasing poultry meat yields and improving carcass quality. For this reason, many ingredients have been using in broiler diets, in recent years. Moreover, there is currently a world trend to reduce the use of antibiotics in animal food due to the contamination of meat products with antibiotic residues (Menten, 2001), as well as the concern that some therapeutic treatments for human diseases might be jeopardized due to the appearance of resistant bacteria (Dale, 1992). It is also reported that additional benefits can be gained by supplementing probiotics in broiler diets as feed additives. Probiotics are used to get rid of abnormalities in the gastrointestinal tract produced by stress and therefore normalize the gut activity (Kutlu and Görgülü, 2001). Studies on the beneficial impact on poultry performance have indicated that probiotic supplementation can have positive effects. Probiotics are reported to prevent colonization gut by pathogens like *Escherichia coli* and *Salmonella*. They also prevent contamination of carcasses by intestinal pathogens during processing and promote higher growth rate and feed conversion efficiency in growing chickens (Hose and Sozzi, 1991; Juven *et al*., 1991).

The use of probiotics for meat and carcass quality improvement has been questioned and many unclear results have been shown. Some authors reported advantages of probiotic administration (Jensen and Jensen, 1992; Maruta, 1993; Corrêa *et al*., 2000; Vargas *et al*., 2002), whereas others did not ob-serve improvement when probiotics were used (Owings *et al*., 1990; Quadros *et al*., 2001). There has been others research by scientists to evaluate probiotics on broilers; however, to date, the data is inconclusive.

Therefore need for research on comparison effect of available probiotics. This study was carried out to evaluate effects of four probiotics include; Guardizen-M (trade name), Protexin (trade name) and Poultry star sol (trade name) in comparison of probiotics less and antibiotics on broilers performance.

2.6 Dietary inclusion of a probiotic, a prebiotic or their combinations on the growth performance of broiler chickens

Antimicrobial growth promoters (AGPs) have been used at subtherapeutic doses in poultry diets to prevent diseases and to promote growth performance. The positive effects of AGPs on performance are well documented (Visek, 1978). AGPs improve broiler growth performance and reduce the populations of potentially-pathogenic organisms such as *Clostridium perfringens*, *Salmonella* and *E. coli* (Hume *et al*., 2011). However, the risk of developing cross-resistance and multiple antibiotic resistance in human pathogenic bacteria, which could result in proliferation of antibiotics-insensitive bacteria, has led to the ban or severe limitations of the use of AGPs in many countries. The objective of this study was to test a variety of safer products which could be used alternatives to AGPs in broiler diets during the starter period.

Many feed additives are presently used in the animal industry, such as probiotics, prebiotics, and symbiotics. Probiotics are live organisms which have been studied for their antimicrobial and growth promoter abilities (Teo & Tan, 2006; Hume, 2011). Probiotics have been reported to prevent gut colonization by pathogenic bacteria, such as *Clostridium perfringens* and *Salmonella* spp., by the mechanism of competitive exclusion (Teo & Tan, 2006; Abudabos *et al*., 2013). Prebiotics are a possible alternative to AGPs in poultry diets. Prebiotics typically refers to oligosaccharides that are not digested by the animal's enzymes, but can selectively stimulate the replication of selected intestinal bacterial species, which have potential beneficial effects on the host's health. Prebiotics present more advantages compared with probiotics: while probiotics supply microbes beneficial to the gut, prebiotics are thought to selectively stimulate the beneficial microbes that already live in the gut (Yang *et al*., 2009).

Another possible alternative to AGPs are symbiotics. Symbiotics are combinations of probiotics and prebiotics, as well as other growth-promoting substances. Symbiotics have shown to have positive effects on gut health, diet digestibility, and live performance of broilers (Patterson and Burkholder, 2003).

The objective of the current study was to examine the effects of prebiotics, probiotics, and symbiotics on the growth performance ofbroilers during the starter period (1 to 14 days of age) in comparison with a standard AGP.

2.7 Alternatives to antibiotics for maximizing growth performance and feed efficiency in poultry

Since the discovery of antibiotics in the 1920s, they have played a substantial role in the advancement and prosperity of the poultry industry. Antibiotics have been supplemented in animal feed at sub-therapeutic doses to improve growth and feed conversion efficiency and to prevent infections for more than 60 years (Castanon, 2007). The effect of antibiotics on improving performance was first reported by Moore *et al*. (1946) when they observed that birds fed streptomycin exhibited increased growth responses. Many experiments conducted later in the early 1950s in chickens (Groschke and Evans, 1950; Whitehill *et al*., 1950), pigs and calves (Rusoff *et al*., 1951) corroborated these results. In-feed antibiotic (IFA) use soon became a common and well-established practice in the animal industry and rose with the intensification of livestock production. In a review conducted by Rosen (1995), it was concluded that inclusion of antibiotics in the diets gave a positive response 72% of the time. It was also proposed that the net effect of using IFA in the poultry industry was a 3–5% increase in growth and feed conversion efficiency (Choct, 2001; Dahiya *et al*., 2006). Thus, it can be noted that IFA played a crucial role in contributing to the economic effectiveness of the livestock production (Wierup, 2000). Despite the well-demonstrated beneficial effects of IFA in improving the growth rate, reducing the mortality and increasing resistance to disease challenge, their use was also known to be associated with some disadvantages and challenges. Concerns exist that the use of IFA leads to development of antimicrobial resistance, posing a potential threat to human health (WHO, 2012). However, mixed opinions still exist on the transfer of antibiotic resistance genes from animal to human pathogens. Several studies showed that there might be a link between the practice of using sub-therapeutic antibiotics and the development of antimicrobial resistance among the microflora (Endtz *et al.*, 1990; Witte, 1998; Wegener *et al.*, 1999; Greko, 2001; M'ikanatha *et al.*, 2010; Medeiros *et al*., 2011; Cosby *et al*., 2015).

Despite these debates on the role of IFA use in conferring antimicrobial resistance to human pathogens, the European Union issued a ban on the approval for antibiotics as growth promoters since 1 January 2006 on precautionary grounds (Dibner and Richards, 2005; Castanon, 2007). In the USA, antibiotic use in livestock and poultry feeds is under great scrutiny as a result of increasing consumer awareness and the demand for livestock products from antibiotic-free production systems. In 2013, the US Food and Drug Administration (FDA) called for major manufacturers of medically important animal drugs to voluntarily stop labeling them for growth promotion in animals and revise the labels such that veterinary supervision is required for therapeutic uses (GFI#213; FDA, 2013). FDA continued to strengthen its agenda on promoting judicious use of antimicrobials in food-producing animals and published its final rule of the VFD (Veterinary Feed Directive) in early 2015, bringing the use of medically important antimicrobials in feed under veterinary supervision, so that they are used only when necessary to ensure the health of the animals. In late 2015, the state of California passed a bill (Senate Bill 27) enforcing a strict ban on using medically important antimicrobials in animal feeds for both growth promotion and disease prevention.

The decline in the use of antibiotic growth promoters (AGPs) in the future seems inevitable, and the practice of using antimicrobials may prove economically impractical because of market limitations and export restrictions (Dibner and Richards, 2005). In view of the increasing concerns over AGP use, the quest for novel alternate replacements to mitigate antibiotic use in animal agriculture has grown over the years. In the past two decades, a great deal of research has focused on the development of antibiotic alternatives to maintain or improve poultry health and performance. This review, therefore, is focused on current knowledge pertaining to several of the strategies that are being employed to improve poultry growth performance and provides a brief overview of such alternatives along with a description of their efficacy and modes of action.

2.8 Functional-food supplementation and health of broilers

The microbial populations in the gastrointestinal tracts of poultry play a key role in normal digestive processes and in maintaining animal health. In Greek probiotic means "for life" and can be defined as a live microbial feed supplement, which beneficially affect the host animal by improving its intestinal balance (Huang *et al.*, 2004). The inclusion of probiotics in foods is designed to encourage certain strains of bacteria in the gut at the expense of less desirable ones. The use of probiotics, yeast cultures and acidifiers in poultry feeds generated because of increased public awareness and objection to the use antibiotics as growth promotant feed additive. The combine use of lactobacillus and yeast cultures in the feed and water has been shown to be effective in reducing morbidity and mortality and improving growth performance and production. (Choudhari, *et al*; 2008). Live yeast culture (S. cerevisiae) plus lactic acid producing bacteria (L. acidophilus and S. faecium) was supplemented in broiler (1 kg/ton) and the results showed improved weight gain and feed conversion. With laying hens lactobacilli resulted in an improvement in egg production and feed efficiency (Mohan *et al*., 1996). In commercial broilers the inclusion of L. sporogens @100 mg/kg feed resulted into increased body weight gain, improved FCR and humoral immune response in broiler chicks during 0-6 weeks of age. Over the last several years' considerable attention has been given. Themechanism of action of probiotics had not been fully explained although there are several hypotheses. The health-promoting effect of probiotics in the gastrointestinal tract had been mainly associated with their capacity to stimulate the immune response and to inhibit the growth of pathogenic bacteria.

2.9 Dietary mannan oligosaccharide from *Saccharomyces cerevisiae* on live performance of broilers

There are increasing concerns about the risk of developing cross-resistance and multiple antibiotic resistances in pathogenic bacteria in both humans and poultry linked to the therapeutic and subtherapeutic use of antibiotics in livestock (Castanon, 2007,Castanon, J.I.R. 2007). Current trends in poultry production point to reduction or total elimination of antimicrobial growth promoters (AGPs) use and increase the use of non-antibiotic feed additives that offer similar benefits, such as to improve the growth of broilers and improve the utilization of feed (Mountzouris, *et al.*, 2007). Several groups of these additives are in use such as probiotics, prebiotics, acidifiers, antioxidants and phytogene additives.

Prebiotics are a possible alternative to antibiotics in poultry diets. Prebiotic usually refers to oligosaccharides which are not digested by the animal enzymes, but can selectively stimulate certain intestinal bacteria species, which have potential beneficial effects on the host health. While probiotics are meant to bring beneficial microbes to the gut, oligosaccharides are supposed to selectively stimulate the beneficial microbes that already live there (Yang *et al.*, 2009 Yang, Y., Iji, P.A. and Choct, M. 2009). Prebiotic have two advantages relative to probiotics: a technological, because there are no problems with the thermal processing of the feed and the acidic conditions of the digestive system, and a safety, because there is no introduction of any foreign microbial species into the gut. However, similar to probiotics, results of the effects of prebiotics on broiler performance are contradictory.

Mannan oligosaccharide (MOS) is derived from the outer layer of yeast cell walls, *Saccharomyces cerevisiae*. The effects of MOS on poultry production can be expressed in reduction of diseases by inhibition of pathogenic bacterial colonization to gut lining by binding to them and thus preventing them of proliferating and producing toxins (Benites *et al.*, 2008). Reducing intestinal pathogen counts (Benites *et al.*, 2008 Benites, V. Gilharry, R., Gernat, A.G.and Murillo, J.G. 2008). Improving the immune system (Ferket, 2002 Ferket, P.R. 2002). and exhibit influence on morpho-functional characteristics of intestines (Ferket, 2002 Ferket, P.R. 2002). However, results of the effects of MOS on broiler performance are contradictory. Other reports showed that MOS had no positive influence on the performance of poultry (Waldroup *et al.*, 2003 Waldroup, P.W., Fritts, C.A.and Yan, F. 2003). There are limited reports on the effect of MOS on broilers under bacterial challenge. The objective of this study was to further determine the effects of MOS supplementation from SAF-Mannan® (S.I. LeSaffre, Marcq en Baroeul, France) to broiler diets compared to a growth promoting antibiotic (enramycin) on growth performance, histomorphology and bacterial count of small intestinal mucosa in broilers raised in cages under subclinical *C. perfringens* model and to determine the product with the most return and pathogen colonization control.

2.10 Use of antibiotics in broiler production: global impacts and alternative (probiotics)

The discovery of antibiotics was a success in controlling infectious pathologies and increasing feed efficiencies (Engberg *et al*., 2000). Antibiotics, either of natural or synthetic origin are used to both prevent proliferation and destroy bacteria. Antibiotics are produced by lower fungi or certain bacteria. They are routinely used to treat and prevent infections in humans and animals. However, scientific evidence suggests that the massive use of these compounds has led to increased problem of antibiotic resistance (Diarra *et al*., 2007, Forgetta et al., 2012, Furtula *et al*., 2010), and presence of antibiotics residues in feed and environment (Carvalho and Santos, 2016, Gonzalez Ronquillo *et al*., 2017), compromises human and animal health (Diarra *et al*., 2010). Hence, there is a growing need to find effective alternatives to control infectious diseases and limit the spread of resistant bacteria, but more importantly, keep antibiotics a useful tool for the future.

Probiotics are defined as "live micro-organisms, when administered in adequate amounts, confer a health benefit to the host" (WHO, 2001). Probiotic feed supplementation improves growth, feed efficiency and intestinal health (Ghasemi *et al*., 2014, Giannenas *et al*., 2012, Samli *et al*., 2007). This improvement is achieved by reducing intestinal pH, intestinal bacteria composition and digestive activity. Mechanisms of action of probiotics include stimulation of endogenous enzymes, reduction of metabolic reactions that produce toxic substances, and production of vitamins or antimicrobial substances (Hassanein and Soliman, 2010). Probiotic bacteria produce molecules with antimicrobial activities such as bacteriocins which inhibits toxins' production and pathogens' adhesion (Pan and Yu, 2014). On the other hand, probiotics stimulate the immune response and increase resistance to colonization of bacteria (Hassanein and Soliman, 2010).

Administration of *Enterococcus faecium* in chicken feed had an antibacterial effect on bacterial microflora in the small intestine (Levkut *et al*., 2012). Similar results were reported with *Streptomyces* sp. (Latha *et al*., 2016) and *Bacillus subtilis* (Zhang *et al*., 2013). In a study (Zhang *et al*., 2013), comparing *B. subtilis* with enramycin, widely used as a feed additive for chickens to prevent necrotic enteritis, administration of 105 cfu of *B. subtilis* UBT-MO_2/kg in broiler feed increased body weight by 4.4% and relative weight of the thymus. In addition, the treatment reduced NH_3 and H_2S concentrations in chicken excretions leading to less odor emissions.

Probiotics have positive effects on poultry meat quality (Hassanein and Soliman, 2010, Popova, 2017). They improve pH, color, fatty acid profile, chemical composition, water retention capacity and oxidation stability (Popova, 2017). The probiotics affect the protein and fat contents of meat and thus the meat quality. (Abdurrahman et al. 2016) reported that lipid oxidation is one of the main causes of deterioration in feed quality. This hypothesis can be confirmed by other studies that showing the inclusion of *Aspergillus awamori* and *Saccharomyces cerevisiae* in chicken feed reduced blood saturated fatty acids and increased the polyunsaturated (Saleh *et al*., 2012). Another similar study of (Liu *et al*. 2012b) showed that treatment with *Bacillus licheniformis* significantly increased the protein content and the respective essential and aromatic amino acids (Liu *et al*., 2012b). Feed containing *B. licheniformis* improves meat color, juiceness and flavor of broiler chickens (Liu *et al*., 2012b). These factors are very important in terms of consumer appreciation especially the color.

Probiotics may also have anticoccidial role. Results of (Giannenas *et al*. 2012) suggest that treatment with probiotics may mitigate the impact of parasitic infection on chickens in the absence of anticoccidial infections. The use of probiotics exerted coccidiostatic effect against *Eimeria tenella*. This can help to minimize the risk and spread of coccidiosis and maintain intestinal health.

2.11 Antibiotic use in poultry production and its effects on bacterial resistance

Antibiotic resistance (AR) which is defined as the ability of an organism to resist the killing effects of an antibiotic to which it was normally susceptible and it has become an issue of global interest. This microbial resistance is not a new phenomenon since all microorganisms have an inherent capacity to resist some antibiotics. However, the rapid surge in the development and spread of AR is the main cause for concern. In recent years, enough evidence highlighting a link between excessive use of antimicrobial agents and antimicrobial resistance from animals as a contributing factor to the overall burden of AR has emerged. The extent of usage is expected to increase markedly over coming years due to intensification of farming practices in most of the developing countries. The main reasons for the use of antibiotics in food-producing animals include prevention of infections, treatment of infections, promotion of growth and improvement in production in the farm animals.

Poultry is one of the most widespread food industries worldwide. Chicken is the most commonly farmed species, with over 90 billion tons of chicken meat produced per year. A large diversity of antimicrobials, are used to raise poultry in most countries. A large number of such antimicrobials are considered to be essential in human medicine.

The indiscriminate use of such essential antimicrobials in animal production is likely to accelerate the development of AR in pathogens, as well as in commensal organisms. This would result in treatment failures, economic losses and could act as source of gene pool for transmission to humans. In addition, there are also human health concerns about the presence of antimicrobial residues in meat, eggs and other animal products.

Generally, when an antibiotic is used in any setting, it eliminates the susceptible bacterial strains leaving behind those with traits that can resist the drug. These resistant bacteria then multiply and become the dominating population and as such, are able to transfer (both horizontally and vertically) the genes responsible for their resistance to other bacteria. Resistant bacteria can be transferred from poultry products to humans via consuming or handling meat contaminated with pathogens. Once these pathogens are in the human system, they could colonize the intestines and the resistant genes could be shared or transferred to the endogenous intestinal flora, jeopardizing future treatments of infections caused by such organisms.

2.12 Effect of probiotics on broilers performance

In Greek Probiotic means "for life" (Gibson and Fuller, 2000) and can be defined as a live microbial feed supplements, which beneficially affects the host animal by improving its intestinal balance (Fuller, 1989). With increasing concern about antibiotics resistance, the ban on sub-therapeutic antibiotics usage in Europe and the potential for a ban in the United States, there is an increasing interest in finding alternatives to antibiotics in poultry production. Probiotics are one of the approaches that have a potential to reduce chances of infections in poultry and subsequent contamination of poultry products. Probiotic foods have been consumed for centuries, either as natural components of foods. A food can be said functional if it contains a component (which may or may not be a nutrient) that affects one or a limited number of functions in the body in a targeted way so as to have positive effects on health (Bellisle *et al.,* 1998) or if it has a physiologic or psychologic effect beyond the traditional nutritional effect (Clydesdale, 1997). Amongst the most promising targets for functional foods are the gastrointestinal functions, including those that control transit time, bowel habits, and mucosal motility as well as those that modulate epithelial cell proliferation. Promising targets are also gastrointestinal functions that are associated with a balance colonic microflora, that are associated with control of nutrient bioavailability (ions in particular), that modify gastrointestinal immune activity, or that are mediated by the endocrine activity of the gastrointestinal system. Finally, some systemic functions such as lipid homeostasis that are indirectly influenced by nutrient digestion or fermentation represent promising targets (Clydesdale, 1997; Roberfroid, 1996).

2.13 Benefits of probiotics and/or prebiotics for antibiotic-reduced poultry

Antibiotics have been used for many years as growth promoters. They contribute to build the immunocompetence (i.e. ability of the body to produce a normal immune response following exposure to an antigen) of birds against infectious diseases and as growth promoters. Antibiotics have been widely used as growth promoters in the field of animal production since 1940s. There is a hypothesis that is effect is brought about by dynamic biological interaction with the micro-flora in the intestine. In 1951, the United States Food and Drug Administration approved the use of antibiotics as animal additives to prevent disease in general and, in some cases, to improve efficiency without veterinary prescription. In the 1950s and 1960s, each European state approved its own national regulations about the use of antibiotics in animal feeds. However, using antibiotics may develop bacteria resistant to these drugs. Accordingly, the use of antibiotics has been minimized and replaced by effective dietary supplements such as probiotics and/or prebiotics that are claimed to enhance growth and positively modulate the immune response. The current review paper sheds light on the benefits of using probiotics and/or prebiotics in poultry feed versus the risk of using antibiotics and the mechanisms by which they exert their effects, as well as the economic analysis of using these beneficial additives in poultry feed.

2.14 An alternative for antibiotic use in poultry: probiotics

During the past 50 years, antibiotics have been used in poultry production as therapeutic agents to treat bacterial infections that decrease performance and cause diseases. Many of the antibiotics used in the poultry industry have been used in human medicine as well. Shortly after the initiation of widespread use of antibiotics in the animal industries, they were placed under increased scrutiny because of concern over development of bacterial resistance to the usual microbiocidal effects of the antibiotics. Ever since their first usage in animals, there has been a cause for concern about the use of antibiotics in poultry and livestock production.

In June of 1999 the European Union (EU) banned the use of some growth promoting antibiotics in poultry feeds. This ban was due to very disturbing observations that potential human pathogens, frequently found on processed poultry and swine carcasses, were increasingly resistant to certain antibiotics. However, it was the determination that bacterial resistance was not due to single but to multiple antibiotics that finally resulted in the ban on the use of sub-therapeutic dosing of certain antibiotics in poultry (DANMAP 97).

In the year 2006, the EU will officially ban the usage of all antibiotics for the sole purpose of growth promotion in poultry and livestock (Halfhide, 2003). Therapeutic use of appropriate antibiotics will be allowed via prescription only through a veterinarian. The impact of this political decision will have dramatic influences on the methods used to produce broilers, turkeys and table eggs. The EU decision, to make such a drastic change in the way poultry production is practiced, was precipitated by the DANMAP 97 report (Bager, 1998). The DANMAP 97 report indicated that the use of low levels of antibiotics in food animal feed leads to the development of resistance in zoonotic organisms of animal origin. Around the world, controversy has surrounded this report, but the impact of the work has been extremely influential as it has caused unprecedented changes in the way food animal production is being conducted today.

2.15 Effects of antibiotic, probiotic and prebiotic supplementation in broiler diets on performance characteristics and apparent nutrient digestibility

Nutrition plays an important role in maintaining animal health and prevention of various diseases (Surai, 2002). Feed additives are products used in animal nutrition for purposes of improving the quality of feed and the quality of food from animal origin or to improve the animal performance and health (Hashemi and Davoodi, 2010). Antibiotics as feed additives have been used for many years in poultry diets (Engberg *et al*., 2000). Due to the potential of bacterial resistance and antibiotic residues in animal products (Nasir and Grashorn, 2006), attempts are being made to replace them with prebiotics and probiotics (Goodarzi and Nanekarani, 2014). Probiotics have been reported to have favourable effects on performance (Santin *et al*., 2001). Their mode of action includes competitive exclusion (Berchieri *et al.,* 2006), microbial antagonism (Mountzouris *et al.*, 2006) and immune modulation (Lan *et al.*, 2005). Prebiotics are food ingredients that stimulate selective growth and activity of beneficial microorganisms in the gut and thereby benefit health (Cummings and Macfarlane, 2002). They also enhance digestibility and performance parameters by creating favourable conditions for beneficial bacteria (Steiner, 2006). Supplementation with probiotics and prebiotics can improve the performance of broiler chickens (Bozkurt *et al.*, 2014). However, there are still indications that the results of using probiotic and prebiotic in poultry diets are quite inconsistent. Hence, the current study is to determine the effects of antibiotic, probiotic and prebiotic supplementation in broiler diets on performance characteristics and apparent nutrient digestibility.

2.16 Use of probiotics instead of antibiotics in broiler production

Nowadays, the efficiency of poultry to convert the feed into meat plays a key role in economics of broiler industry. Therefore, it is highly essential to improve feed efficiency of poultry to produce meat economically and also food safety is more seriously considered than before. On the other hand, economy of food production is also a factor that cannot be ignored. A huge amount of antibiotics has been used to control diseases and improve performances in livestock. However, due to growing concerns about antibiotic resistance and the potential for a ban for antibiotic growth promoters in many countries in the world, there is an increasing interest in finding effective alternatives to antibiotics in poultry production. Poultry feed influences the production cost of chicken. Recently, it is believed that Probiotics have beneficial effects to improve the productive performance of poultry. Probiotics are specific agents produced by micro-organism containing *Lactobacillus acidophilus*, *Lactobacillus casei*, *Bifidobactuium bifidum*, *Aapergillus oryz*ae and *Torulopsis* (Mohan *et al*. 1995). However, according to the currently adopted definition by Food and Agriculture Organization and World Health Organization (2001), probiotics are: live microorganisms which when administered in adequate amounts confer a health benefit on the host. The most important advantage of a probiotic is that it neither has any residues in animal production nor exerts any antibiotic resistance by consumption. Therefore, a lot of researchers have partially replaced antibiotics with probiotics as therapeutic and growth promoting agents. It was reported that probiotics have a good impact on the poultry performance (Mountzouris *et al*., 2007; Koenen *et al*., 2004), improve microbial balance, synthesize vitamins (Fuller, 1989), decrease pH and release bacteriocins (Rolfe, 2000), improve feed consumption in layers and broilers

(Nahashon *et al*., 1994). The broiler industry is constantly searching for ways to improve its product and quality in order to meet the demands of an increasingly demand of consuming public. In this regard, numerous references exist on increasing poultry meat yields and improving carcass quality. For this reason, many ingredients have been using in broiler diets, in recent years. Moreover, there is currently a world trend to reduce the use of antibiotics in animal food due to the contamination of meat products with antibiotic residues (Menten, 2001), as well as the concern that some therapeutic treatments for human diseases might be jeopardized due to the appearance of resistant bacteria (Dale, 1992). It is also reported that additional benefits can be gained by supplementing probiotics in broiler diets as feed additives. Probiotics are used to get rid of abnormalities in the gastrointestinal tract produced by stress and therefore normalize the gut activity (Kutlu and Gorgulu, 2001). Studies on the beneficial impact on poultry performance have indicated that probiotic supplementation can have positive effects. Probiotics are reported to prevent colonization gut by pathogens like *Escherichia coli* and *Salmonella*. They also prevent contamination of carcasses by intestinal pathogens during processing and promote higher growth rate and feed conversion efficiency in growing chickens (Hose and Sozzi, 1991; Juven *et al*., 1991). The use of probiotics for meat and carcass quality improvement has been questioned and many unclear results have been shown. Some authors reported advantages of probiotic administration (Jensen and Jensen, 1992; Maruta, 1993; Correa *et al*., 2000; Vargas *et al*., 2002), whereas others did not ob-serve improvement when probiotics were used (Owings *et al.*, 1990; Quadros *et al*., 2001). There has been others research by scientists to evaluate probiotics on broilers; however, to date, the data is inconclusive. There is therefore a need for research on comparison effect of available probiotics. This study was carried out to evaluate effects of four probiotics include; Guardizen-M (^{TM}), Protexin (^{TM}) and Poultry star sol (^{TM}) in comparison of probiotics less and antibiotics on broilers performance.

CHAPTER III

MATERIALS & METHODS

3.1 Statement of the experiment

The research work was conducted at Sher-e Bangla Agricultural University Poultry Farm, Dhaka, for a period of 28 days during the period from 26th August 2019 to 24th September 2019; to investigate the effect of yeast (saccharomyces) based probiotics on the growth performance of broiler in Bangladesh.

3.2 Collection of experimental broilers

A total of 120 day-old Lohmann Meat (Indian River) broiler chicks were collected from Kazi Farm Group, Gazipur, Dhaka.

3.3 Experimental materials

The collected chicks were carried to the university poultry farm early in the morning. They were kept in electric brooders equally for 4 days by maintaining standard brooding protocol. During brooding time, only basal diet was given, no yeast was used as treatment. After four days 96 chicks were selected from brooders and distributed randomly in four (4) dietary treatments; another 24 chicks were distributed randomly in one treatment for control. Each treatment had three (3) replications with 8 birds per replication. The total numbers of treatments were five (5) and their replications were fifteen (15).

3.4 Experimental treatment

Treatment 1: Antibiotic 0.25g/kg feed

Treatment 2: Yeast (*Saccharomyces*) based probiotic 1.5g/kg of feed

Treatment 3: Yeast (*Saccharomyces*) based probiotic 2g/kg of feed

Treatment 4: Yeast (*Saccharomyces*) based probiotic 2.5g/kg of feed

Treatment 5: Basal diet

Detailed experimental layout is presented in table 1.

Table 1. Layout of the experiment

	No. of replications			
Treatment groups	**R1**	**R2**	**R3**	**Total**
T_1	8	8	8	24
T_2	8	8	8	24
T_3	8	8	8	24
T_4	8	8	8	24
T_0	8	8	8	24
Total	40	40	40	120

3.5 Experimental diets

Starter and grower commercial Kazi broiler feed were purchased from the local market. Starter diet was enriched with minimum 4 times daily by following Lohmann Meat (Indian River) Manual and *ad libitum* drinking water 2 times daily. Detail composition of feed are presented in table 2, 3, 4 & 5.

Table 2. Name and minimum percentage of ingredients present in Starter ration

Name of ingredients in Starter ration	Minimum percentage Present
Protein	21.0 %
Fat	6.0%
Fiber	5.0%
Ash	8.0%
Lysine	1.20%
Methionine	0.49%
Cysteine	0.40%
Tryptophan	0.19%
Threonine	0.79%

Source: Kazi starter feed 50 kg packet

Table 3. Name and minimum percentage of ingredients Grower ration

Name of ingredients in Grower ration	Minimum percentage Present
Protein	20.0 %
Fat	6.0%
Fiber	5.0%
Ash	8.0%
Lysine	1.10%
Methionine	0.47%
Cysteine	0.39%
Tryptophan	0.18%
Threonine	0.75%
Arginine	1.18%

Source: Kazi grower feed 50 kg packet

Table 4. Proximate analysis of starter ration in ANGB laboratory

Nutrients in Starter ration	Amount%
Protein	20.8
Fat	5.5
Fiber	5.2
Ash	8.0
Moisture	12

Table 5. Proximate analysis of grower ration in ANGB laboratory

Nutrients in Grower ration	Amount%
Protein	19.0
Fat	5.0
Fiber	5.0
Ash	8.0
Moisture	12.0

3.5.1 Collection of yeast

Yeast (*Saccharomyces*) based probiotics collection from ACI Company Limited. Brand name was boviestimul powder, normally used for cattle. But I tried for my research in broiler rearing (table 6).

Table 6. Nutritional composition of Yeast (saccharomyces) based probiotics

Yeast (saccharomyces) based probiotics composition (20gm)	Amount
Saccharomyces cerevisiae (CFU/g)	4×10^{8}
Brewer`s yeast (g)	7
D, L-Methionine (g)	0.6
L-Lysine (g)	0.1
Casein (g)	3
Dextrose (g)	1.7
Disodium phosphate (g)	1
Mono calcium phosphate (g)	0.8
Cobalt sulfate (g)	0.01
Starch q.s. total (g)	20

Source: ACI animal health Company limited

3.6 Preparation of experimental house

The experimental room was properly cleaned and washed by using tap water. Ceiling walls and floor were thoroughly cleaned and disinfected by spraying diluted timsen solution disinfectant solution (2 gm /liter water). After proper drying, the house was divided into 15 pens of equal size using wood materials and wire net. The height of wire net was 36 cm. A group of 8 birds were randomly allocated to each pen. The stocking density was $1m^2$/8 birds

3.7 Management procedures

Body weight and feed intake were recorded every week and survivability was observed for each replication up to 28 days of age. The following management procedures were followed during the whole experiment period.

3.7.1 Brooding of baby chicks

The experiment was conducted during 26th August 2019 to 24th September 2019. The average temperature was 31^0C and the RH was 80% in the poultry house. Common brooding was done for four days. After four days the chicks were distributed in the pen randomly. There were 8 chicks in each pen and the pen space was $1m^2$. Due to hot climate brooding temperature was maintained as per requirement. Brooding temperature was adjusted (below 35^0C) with house temperature. So when the environmental temperature was above the recommendation, then no extra heat was provided. At day time only an electric bulb was used to stimulate the chicks to eat and drink. Electric fans were used as per necessity to save the birds from the heat stress.

3.7.2 Room temperature and relative humidity

Daily room temperature (^{0}C) and humidity (%) were recorded every six hours with a thermometer and a digital thermometer respectively. Averages of room temperature and percent relative humidity for the experimental period were recorded.

3.7.3 Litter management

Rice husk was used as litter at a depth of 6 cm. At the end of each day, litter was stirred to prevent accumulation of harmful gases and to reduce parasite infestation. At 3 weeks of age, droppings on the upper layer of the litter were cleaned and fresh litter was added.

3.7.4 Feeding and watering

Feed and clean fresh water was offered to the birds *ad libitum.* One feeder and one round drinker were provided in each pen for 8 birds. Feeders were cleaned at the end of each week and drinkers were washed daily. All mash dry feed was fed to all birds *ad libitum* throughout the experimental period.

3.7.5 Lighting

At night, there was provision of light in the broiler farm to stimulate feed intake and body growth. For first 2, weeks 24 hours' light was used. Thereafter, 22 hours light and 2 hours' dark was scheduled up to 28 days.

3.7.6 Bio security measures

To keep disease away from the broiler farm, recommended vaccination and sanitation program was undertaken in the farm and its premises.

3.7.7 Vaccination

The vaccines collected from medicine shop (Ceva Company) and applied to the experimental birds according to the vaccination schedule, given in (table 7).

Table 7. The vaccination schedule

Age of birds (Days)	Name of Disease	Name of vaccine	Route of administration
0	IB + ND	MA-5 + Clone-30	One drop in each eye
11	Gumboro	Hipragumboro (GM97)	Drinking Water
19	Gumboro	Hipragumboro (GM97)	Drinking Water

3.7.8 Ventilation

The broiler shed was south facing and open-sided. Due to wire-net cross ventilation, it was easy to remove polluted gases from the farm. Ventilation was regulated as per requirement by folding polythene screen.

3.7.9 Sanitation

Strict sanitary measures were taken during the experimental period. Disinfectant (timsen) was used to disinfect the feeders and waterers and the house also.

3.8 Study parameters

3.8.1 Recorded parameters

Weekly live-weight, weekly feed consumption and death of chicks to calculate mortality percent were recorded. FCR was calculated from final live weight and total feed consumption per bird in each replication. After slaughter of broiler chicken gizzard, liver, spleen, heart, proventriculus and bursa were measured from each bird. Dressing yield was calculated for each replication to find out dressing percentage.

3.9 Data collection

3.9.1 Live weight: The initial day-old live weight and weekly live weight of each replication was kept to get final live weight record per bird.

3.9.2 Dressing yield = Live weight- (blood + feathers + head + shank+ digestive system + Liver+ Heart)

3.9.3 Feed consumption

Daily feed consumption record of each replication was kept to get weekly and total feed consumption record per bird.

3.9.4 Mortality of chicks

Daily death record for each replication was counted up to 28 days of age to calculate mortality.

3.9.5 Dressing procedures of broiler chicken:

Three birds were picked up at random from each replicate at the 28th day of age and sacrificed to estimate dressing percent of broiler chicken. All birds to be slaughtered were weighed and fasted by halal method or overnight (12 hours) but drinking water was provided *ad-libitum* during fasting to facilitate proper bleeding. All the live birds were weighed again prior to slaughter. Birds were slaughtered by severing jugular vein, carotid artery and the trachea by a single incision with a sharp knife and allowed to complete bleed out at least for 2 minutes.

Outer skin was removed by sharp scissor and hand. Then the carcasses were washed manually to remove loose singed feathers and other foreign materials from the surface of the carcass. Afterward the carcasses were eviscerated and dissected according to the methods by Jones (1982). Heart and liver were removed from the remaining viscera. The proventiculus was cut and then the gizzard was cut from both incoming and outgoing tract. Dressing yield was found by subtracting blood, feathers, head, shank, liver, heart and digestive system from live weight.

3.10 Calculations

3.10.1 Live weight gain

The average body weight gain of each replication was calculated by deducting initial body weight from the final body weight of the birds.

Body weight gain = Final weight – Initial weight

3.10.2 Feed intake

Feed intake was calculated as the total feed consumption in a replication divided by number of birds in each replication.

$$\text{Feed intake (g/bird)} = \frac{\text{Feed intake in a replication}}{\text{No. of birds in a replication}}$$

3.10.3 Feed conversion ratio

Feed conversion ratio (FCR) was calculated as the total feed consumption divided by weight gain in each replication.

$$\text{FCR} = \frac{\text{Feed intake (kg)}}{\text{Weight gain (kg)}}$$

3.10.4 Statistical analysis

The data was subjected to statistical analysis by applying one-way ANOVA (Duncan method-1955) using statistical package for social sciences (SPSS) version 16. Experiment was laid out in Randomized Complete Block Design (RCBD)

CHAPTER IV

RESULTS AND DISCUSSION

Production performances of broiler chicken was evaluated by Average live weight, Average feed Consumption (FC) , Weekly feed consumption, Feed Conversion Ratio (FCR), Average body weight gain, Weekly body weight gain, Survivability and Flock uniformity. And Carcass characteristics were taken by Dressing percentage (DP), Carcass weight and Relative weight of giblet organs.

The parameters research data analysis is given and discussed below:

4.1 Production performances of broiler chicken

4.1.1 Average live weight

Data presented in figure 1 and table 10 showed that the effect of treatments on final live weight (gram per broiler chicken) was significant ($P<0.05$). The relative final live weight (g) of broiler chickens in the dietary group T_1, T_2, T_3, T_4 and T_0 were 1819.58±33.06, 1852.46±13.18, 1882.33±33.38, 1831.50±28.28 and 1717.50±81.96 respectively. The highest live weight was found in T_3 (1882.33±33.38) and lowest result was in T_0 (1717.50±81.96) group.

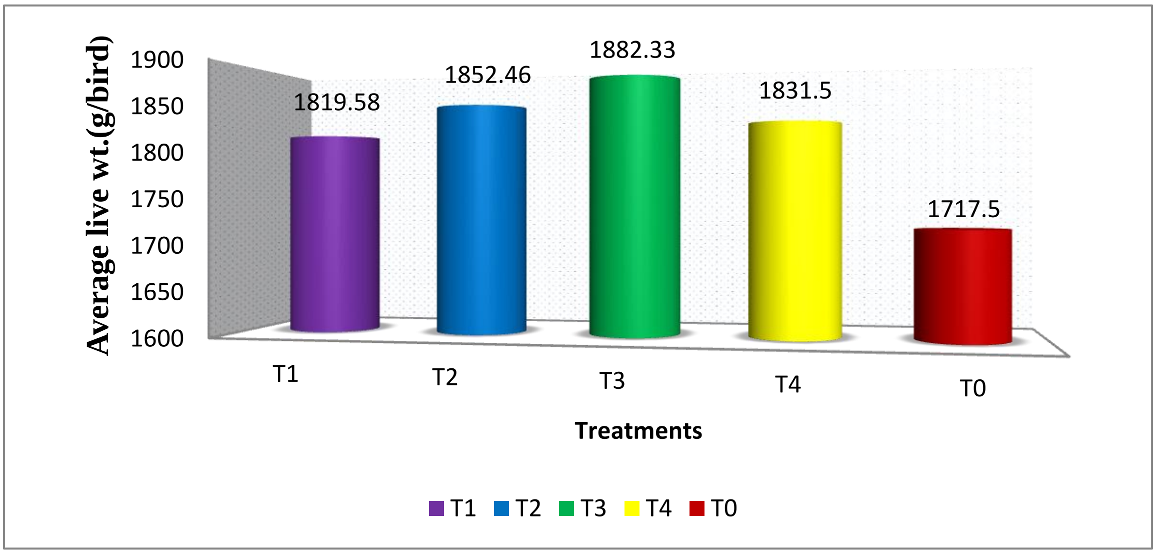

Fig. 1: Average live weight (g/bird)

These results are in agreement with the previous findings of Zhang *et al*. (2005); Angel *et al*. (2005); Santin *et al.* (2003) who reported that dietary inclusion of probiotics in the diets of broilers showed improved body weight gain. Therefore improvement in body weight gain of the birds in this study may be due to better utilization of probiotics supplemented feed of crude protein, which may have contributed in better growth of the birds.

4.1.2 Average feed consumption (FC)

Data presented in table 10 and figure 2 showed that the effect of treatments on final feed consumption (gram per broiler chicken) was significant ($P<0.05$).

The mean of total feed consumption of broiler chicks at the end of 4^{th} week in the dietary group T_1, T_2, T_3, T_4 and T_0 were 2361.51±23.70, 2361.22±14.14, 2330.51±24.05, 2353.41±19.92 and 2227.52±24.44 respectively. The highest average feed consumption was found in T_1 (2361.51±23.70) and lowest result was in T_0 (2227.52±24.44) group. The average feed consumption of T_3 is also lower than others.

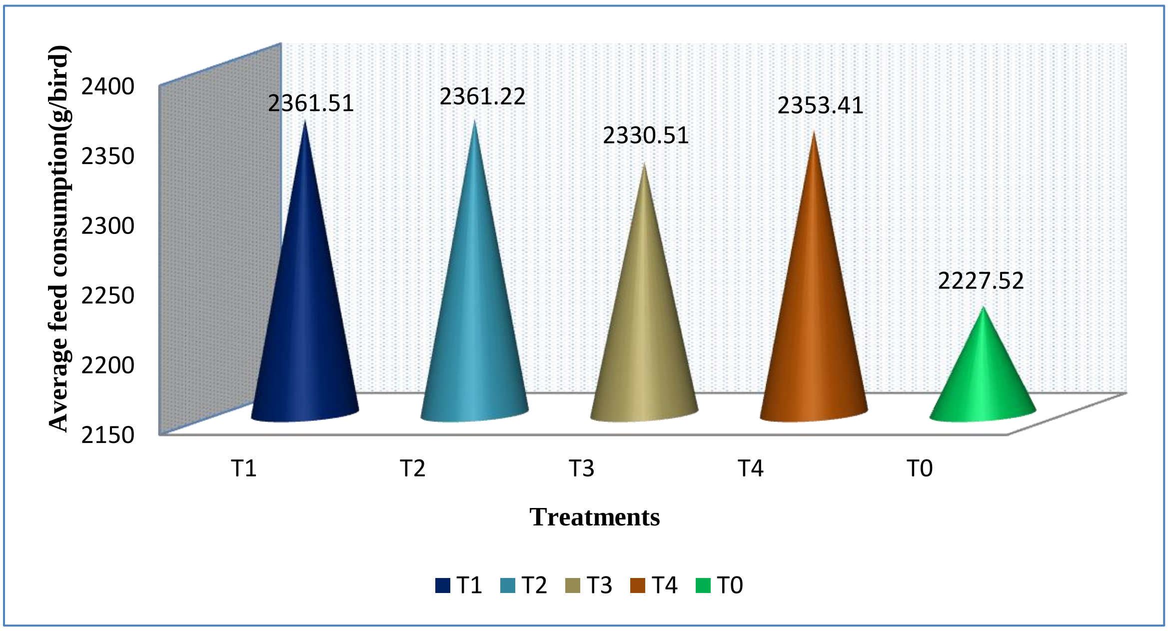

Fig. 2: Average feed consumption (g/bird)

Results of the present study supported the findings of Paryad and Mahmoudi (2008) who reported increased feed intake in broilers fed diet supplemented with different levels of *Saccharomyces cerevisiae*. Results were also in accordance with those of Shareef *et al.* (2009) who used 1.0, 1.5 and 2.0% *Saccharomyces cerevisiae* in broiler diet and found a significant increase in feed intake.

4.1.3 Weekly feed consumption:

Data regarding presented in table 8 and figure 3 showed that the mean feed consumption (g) of broiler chicks at the end of 1st week in different groups 181.68±1.60, 179.38±.51, 179.38±.26, 177.27±.75 and 182.22±1.88 were respectively. The overall mean feed consumption of different groups showed that there was significant ($P<0.05$) effects. The higher feed consumption was found in T_1 (181.68±1.60), T_0 (182.22±1.88) and comparatively lower in T_4 (177.27±.75).

The mean feed consumption (g) of broiler chicks at the end of 3rd week in different groups 791.83±10.59, 802.08±10.42, 782.83±15.06, 794±17.62 and 741.96±7.59 were respectively. The overall mean body weight gain of different groups showed that there was significant ($P<0.05$) effects. The higher feed consumption was in $T_{1,}$ T_2 T_3 T_4 and comparatively lower in T_0.

The mean feed consumption (g) of broiler chicks at the end of 4th week in different groups 973.42±20.67, 969.88±7.71, 950.59±32.79, 973.30±2.21 and 895.96±22.01 were respectively. The overall mean feed consumption of different groups showed that there was significant ($P<0.05$) effects. The higher feed consumption was in $T_{1,}$ T_2,T_4 and comparatively lower in T_0.

Results of the present study supported the findings of Paryad and Mahmoudi (2008) who reported increased feed intake in broilers fed diet supplemented with different levels of *Saccharomyces cerevisiae*. Results were also in accordance with those of Shareef *et al.* (2009) who used 1.0, 1.5 and 2.0% *Saccharomyces cerevisiae* in broiler diet and found a significant increase in feed intake.

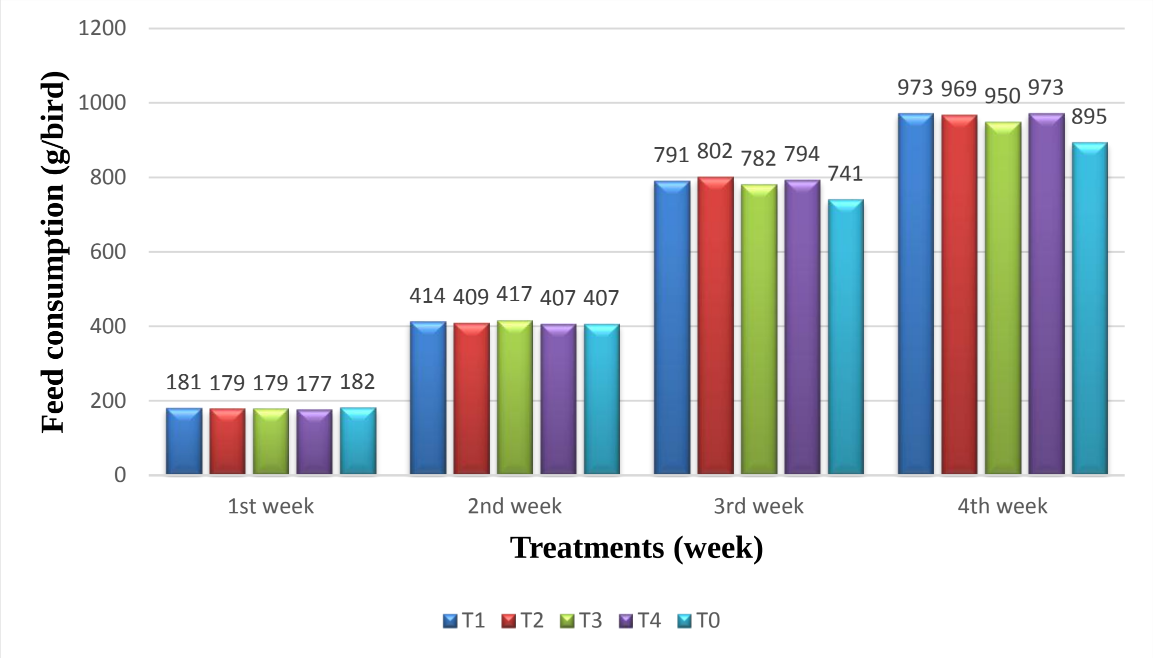

Fig. 3: Effects of probiotics on feed consumption (FC) (g/bird) of broiler chickens at different week

Table 8. Effects of probiotics on feed consumption (FC) (g/bird) of broiler chickens at different weeks

Treatments	1st Week FC	2nd Week FC	3rd Week FC	4th Week FC	Total FC
T_1	$181.68^{a}\pm1.60$	414.59 ± 4.18	$791.83^{b}\pm10.59$	$973.42^{b}\pm20.67$	$2361.51^{b}\pm23.70$
T_2	$179.38^{ab}\pm.51$	409.88 ± 1.94	$802.08^{b}\pm10.42$	$969.88^{b}\pm7.71$	$2361.22^{b}\pm14.14$
T_3	$179.38^{ab}\pm.26$	417.71 ± 5.96	$782.83^{b}\pm15.06$	$950.59^{ab}\pm32.79$	$2330.51^{b}\pm24.05$
T_4	$177.27^{a}\pm.75$	$407.38\pm.92$	$794.88^{b}\pm17.62$	$973.30^{b}\pm2.21$	$2353.41^{b}\pm19.92$
T_0	$182.22^{b}\pm1.88$	407.38 ± 3.14	$741.96^{a}\pm7.59$	$895.96^{a}\pm22.01$	$2227.52^{a}\pm24.72$
Mean±SE	179.99±.65	411.50±1.75	782.72±7.46	952.63±11.00	2326.83±15.89

Here, T_1 = (Antibiotic 0.25g/kg feed), T_2 = (Yeast based probiotic 1.5g/kg feed), T_3 = (Yeast based probiotic 2g/kg feed), T_4 = (Yeast based probiotic 2.5 g/kg feed) and T_0 = (control) Values are Mean ± S.E (n=15) one way ANOVA (SPSS, Duncan method).

Mean with different superscripts are significantly different ($P<0.05$)

- ✓ Mean within same superscripts don't differ ($P>0.05$) significantly
- ✓ SE= Standard Error

4.1.4 Feed Conversion Ratio (FCR)

Data presented in table 10 and figure 4 showed that feed conversion ratio (FCR) was not significant (P>0.05). Feed supplemented with yeast based probiotics 2gm/kg feed at T_3 is better (1.27±.01).

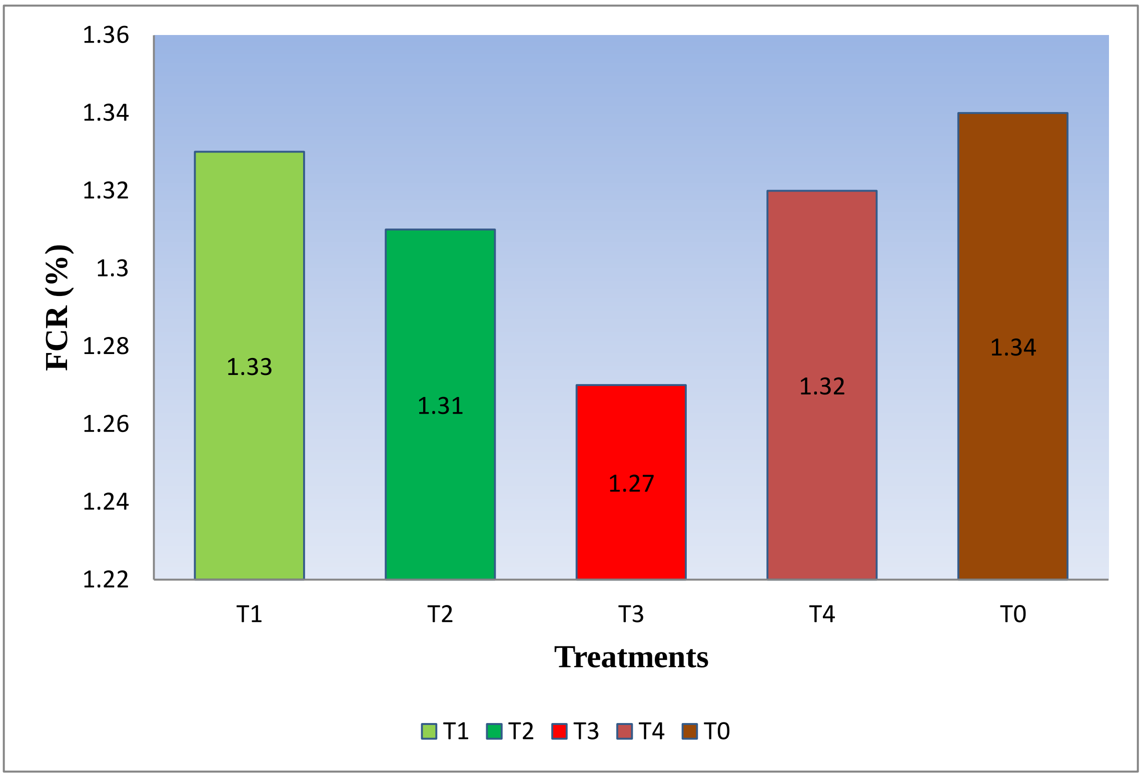

Fig. 4: Feed conversion ratio

However, Feed conversion ratio (FCR) was higher in T_1 group (1.33±.01) and T_0 group (1.34±.05) compared to T_2 (1.31±.01), T_3 (1.27±.01) and T_4 (1.32±.01) groups respectively.

These results are in agreement with the findings of Ramesh *et al.* (2000) who fed *Lactobacillus acidophilus* based probiotic to broiler chicks and observed that probiotic cultures showed better FCR than those control chicks.

Paryad and Mahmoudi (2008) observed better FCR due to dietary inclusion of yeast @ 1.5%/kg of diet. Better FCR of the birds using the yeast culture may be attributed to the digestion of crude protein, which enhanced growth of the birds due to efficient conversion of feed to meat.

4.1.5 Average body weight gain

Data presented in table 10 and figure 5 showed that the effect of treatments on total body weight gain (gram per broiler chicken) was significant (P<0.05). The relative total body weight gain (g) of broiler chickens in the dietary group T_1, T_2, T_3, T_4 and T_0 were 1777.58±33.06, 1810.46±13.18, 1840.33±33.38, 1789.50±28.28 and 1675.50±81.96 respectively. The highest result was found in T_3 (1840.33±33.38) and lowest result was in T_0 (1675.50±81.96) group.

These results are in agreement with the previous findings of Zhang *et al*. (2005); Angel *et al*. (2005); Santin *et al.* (2003) who reported that dietary inclusion of probiotics in the diets of broilers showed improved body weight gain.

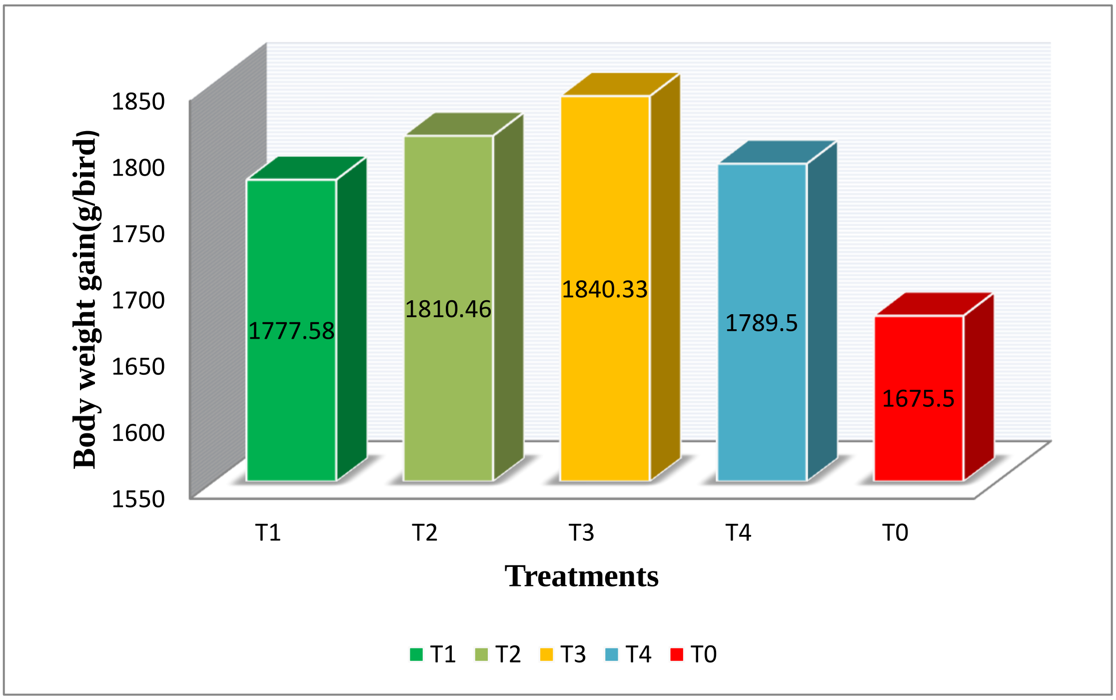

Fig. 5: Average body weight gain (g/bird)

4.1.6 Weekly body weight gain

Data regarding presented in table 9 and figure 6 showed that the mean body weight gains (g) of broiler chicks at the end of 2nd week in different groups 361.21±6.66, 368.17±10.27, 380.54±3.89, 365.12±15.02, 341.67±8.35 were respectively. The overall mean body weight gains of different groups showed that there was significant (P<0.05) effects. The highest result was found in T_3 (380.54±3.89) yeast 2gm/kg feed and lowest in control T_0 (341.67±8.35).

The mean body weight gains (g) of broiler chicks at the end of 4th week in different groups 695.00± 18.05, 708.71±12.68, 724.83±14.03, 701.92±2.74 and 618.25±56.34 were respectively. The overall mean body weight gains of different groups showed that there was significant ($P<0.05$) effects. The highest result was found in T_3 (724.83±14.03) yeast 2gm/kg feed and lowest in control T_0 (618.25±56.34).

These results are in agreement with those obtained by Effect of probiotic (*Saccharomyces cerevisiae*) on performance of broiler chicks A.M. Shareef and Al-Dabbagh A.S.A. (2009). Body weight gain for the entire period (3 weeks) were significantly ($P<0.05$) increased in the treatments 3, 4 and 5, when *Sc* was added at a rate of 1, 1.5 and 2%, as compared with the other treatments. Best results were seen in treatments 4 and 5. Moreover, these birds also had significantly higher feed intake and feed conversion ratio than others ($P<0.05$). In all treatments no mortality was recorded.

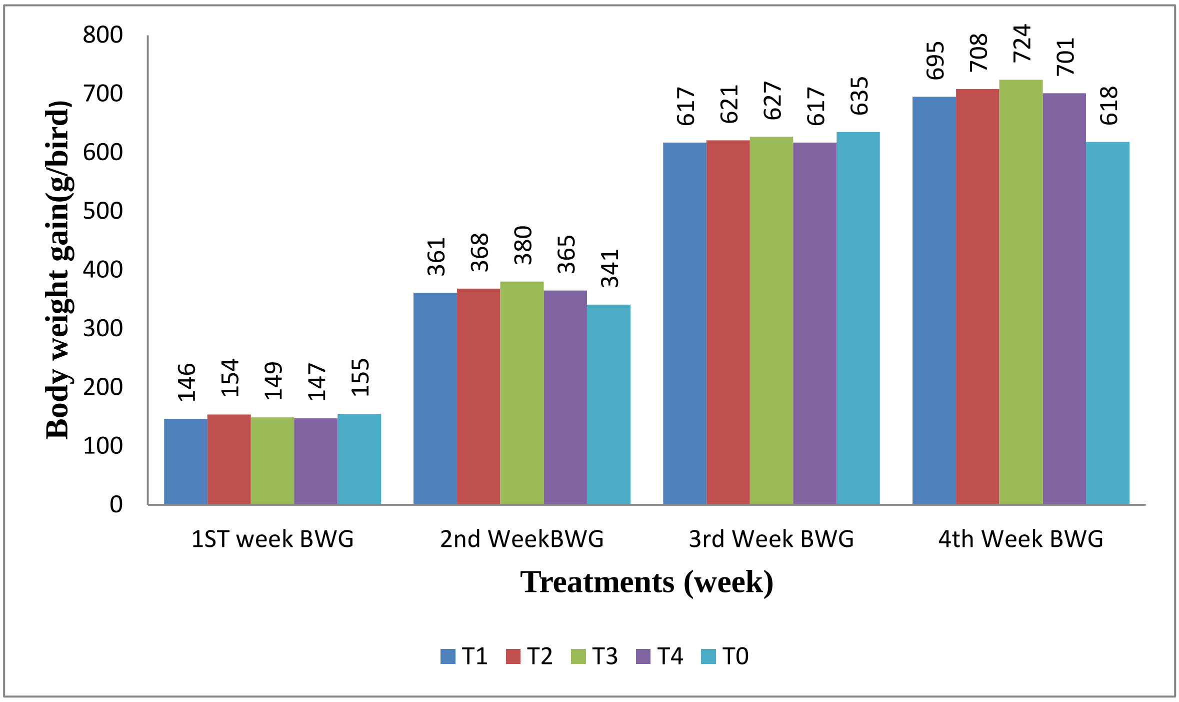

Fig. 6: Effects of probiotics on body weight gain (BWG) (g/bird) of broiler chicken at different weeks

Table 9. Effects of probiotics on body weight gain (BWG) (g/bird) of broiler chicken at different weeks

Treatments	Weekly Body Weight Gain				Total BWG
	1^{ST}	2^{nd}	3^{rd}	4^{th}	
T_1	146.13±1.30	361.21^{ab}±6.66	617.25±15.95	695.00^{ab}± 18.05	1777.58^{ab}±33.06
T_2	154.04±.20	368.17^{ab}±10.27	621.54±9.43	708.71^{ab}±12.68	1810.46^{ab}±13.18
T_3	149.46±4.66	380.54^{b}±3.89	627.50±13.71	724.83^{b}±14.03	1840.33^{b}±33.38
T_4	147.38±6.03	365.12^{ab}±15.02	617.08±15.55	701.92^{ab}±2.74	1789.50^{ab}±28.28
T_0	155.29±1.46	341.67^{a}±8.35	635.62±23.13	618.25^{a}±56.34	1675.50^{a}±81.96
Mean±SE	150.46±1.64	363.34±4.95	623.80±6.40	689.74±14.45	1778.68±22.48

Here, T_1 = (Antibiotic 0.25g/kg feed), T_2 = (Yeast based probiotic 1.5g/kg feed), T_3 = (Yeast based probiotic 2g/kg feed), T_4 = (Yeast based probiotic 2.5 g/kg feed) and T_0 = (control) Values are Mean ± S.E (n=15) one way ANOVA (SPSS, Duncan method).

Mean with different superscripts are significantly different (P<0.05)

- ✓ Mean within same superscripts don't differ (P>0.05) significantly
- ✓ SE= Standard Error

4.1.7 Survivability

Data presented in table 10 showed that no birds died at the research period. It showed that 100 percent survivability of birds. Good management practice, vaccination and quality feed supply with probiotics make the birds healthier and reduced flock mortality.

With similar trials with broilers given different probiotic(s) preparations, the effects on mortality were inconsistent (Jin *et al*., 1998a, b; Zulkifli *et al*., 2000). O'Dea et al. (2006) reported that there were no significant differences in broiler mortality between the probiotic treatment groups in any of the trials.

4.1.8 Flock uniformity

Data presented in table 11 and figure 7 showed that the flock uniformity of broilers fed diet containing yeast (*Saccharomyces cerevisiae*), antibiotic and control group showed a non-significant (P>0.05) difference among the groups. The flock uniformity is better in control group T_0 (91.67±4.17) and comperatively lower in T_4 (58.33±8.33). Other treatment group is more or less similar.

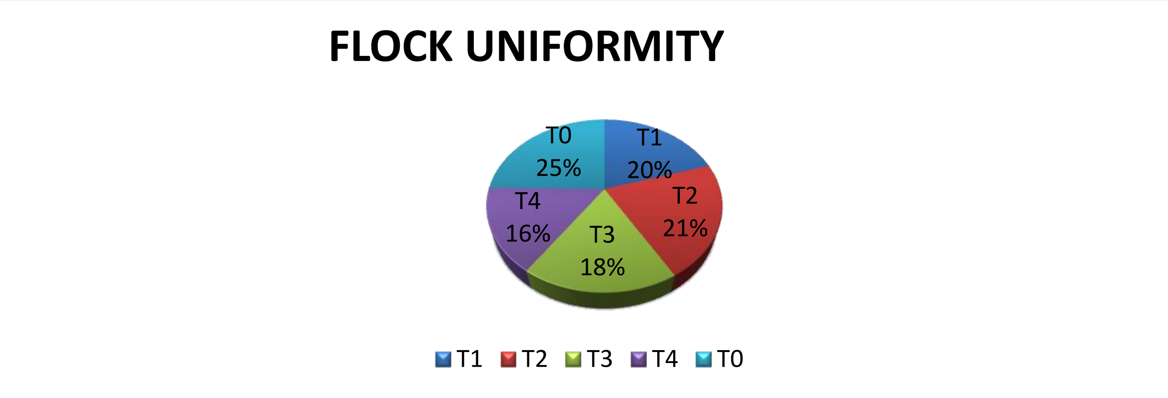

Fig. 7: Effects of probiotics on uniformity of broiler chicken

Table 10. Effects of probiotics on production performances of broiler chicken

Treatments	Average Live Weight (g/bird)	Average BWG (g/bird)	Average FC (g/bird)	Final FCR	Survivability
T_1	1819.58^{ab}±33.06	1777.58^{ab}±33.06	2361.51^{b}±23.70	1.33±0.01	100.00
T_2	1852.46^{ab}±13.18	1810.46^{ab}±13.18	2361.22^{b}±14.14	1.31±0.01	100.00
T_3	1882.33^{b}±33.38	1840.33^{b}±33.38	2330.51^{b}±24.05	1.27±0.01	100.00
T_4	1831.50^{ab}±28.28	1789.50^{ab}±28.28	2353.41^{b}±19.92	1.32±0.01	100.00
T_0	1717.50^{a}±81.96	1675.50^{a}±81.96	2227.52^{a}±24.72	1.34±0.05	100.00
Mean±SE	1820.68±22.48	1778.68±22.48	2326.83±15.89	1.31±0.01	100.00

Here, T_1 = (Antibiotic 0.25g/kg feed), T_2 = (Yeast based probiotic 1.5g/kg feed), T_3 = (Yeast based probiotic 2g/kg feed), T_4 = (Yeast based probiotic 2.5 g/kg feed) and T_0 = (control) Values are Mean ± S.E (n=15) one way ANOVA (SPSS, Duncan method).

Mean with different superscripts are significantly different (P<0.05)

- ✓ Mean within same superscripts don't differ (P>0.05) significantly
- ✓ SE= Standard Error

Table 11. Effects of probiotics on uniformity of broiler chicken

Treatments	Uniformity
T_1	75.00±7.22
T_2	79.17±4.17
T_3	66.67±11.02
T_4	58.33±8.33
T_0	91.67±4.17
Mean ± SE	74.17±4.13

Here, T_1 = (Antibiotic 0.25g/kg feed), T_2 = (Yeast based probiotic 1.5g/kg feed), T_3 = (Yeast based probiotic 2g/kg feed), T_4 = (Yeast based probiotic 2.5 g/kg feed) and T_0 = (control) Values are Mean ± S.E (n=15) one way ANOVA (SPSS, Duncan method).

4.2 Carcass characteristics

4.2.1 Dressing percentage (DP)

Data presented in table 12 and figure 8 showed that the dressing percentage at T_0 (control) group was significant ($p<0.05$) carcass percentage (77.52±2.17) compared with the other treatment group T_1 (74.61±1.78), T_2 (69.27±0.61), T_3 (73.73±0.86) and T_4 (70.87±1.07).Experiment, evaluation of dressing percentage on slaughtered representative birds revealed that T_0 group had significantly higher dressed percentage followed by T_1, T_4, T_3 and lower in T_2 groups. This result disagreed with These findings are compatible with those observed by Adejumo *et al.* (2004) who observed better dressing percentage in broilers by using dried yeast. The higher dressing percentage in birds fed diet containing yeast (*Saccharomyces cerevisiae*) may be due to higher body weight gain in the birds of this group compared to other treatment groups.

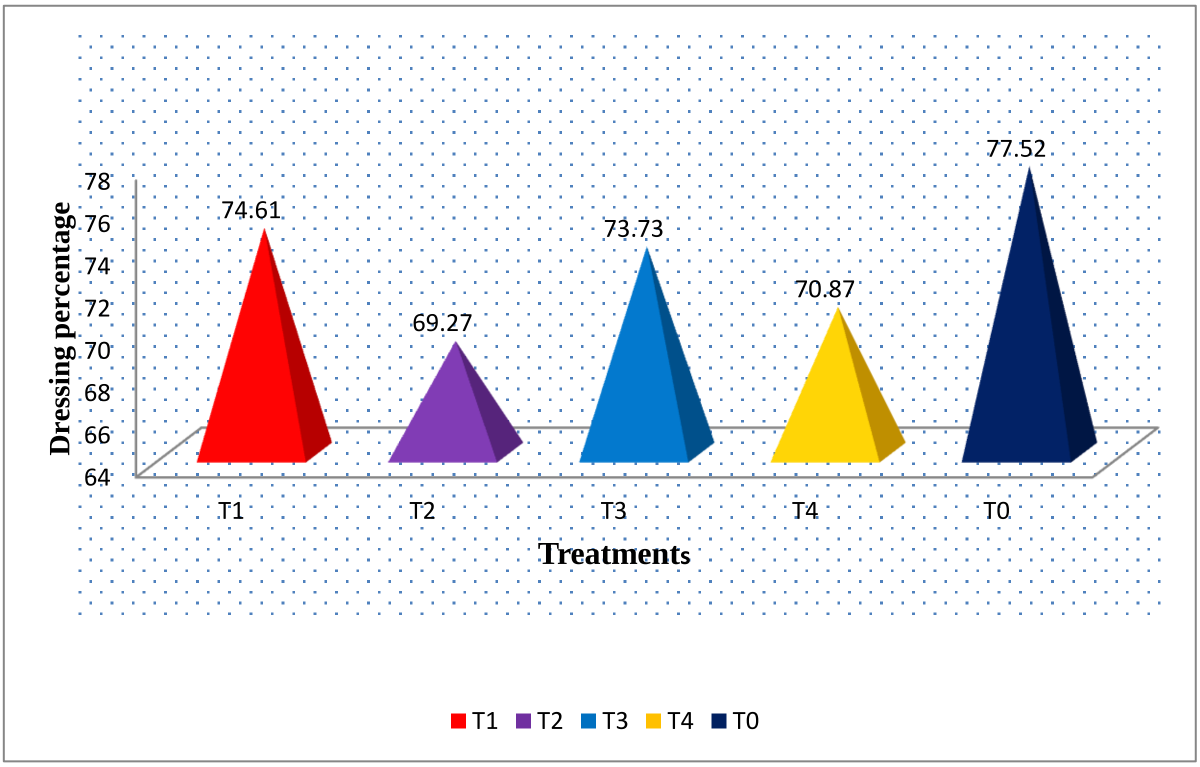

Fig. 8: Effects of probiotics Dressing percentage of broiler chicken

Table 12. Effects of probiotics Dressing percentage of broiler chicken

Treatments	Average live wt.	Eviscerated wt.	Dressing %
T_1	1851.19±16.19	1356.50±26.50	74.61^{cb}±1.78
T_2	1865.50±4.50	1283.00±15.00	69.27^{a}±0.61
T_3	1872.00±55.00	1389.00±65.00	73.73^{abc}±0.86
T_4	1857.81±17.94	1297.50±3.50	70.87^{ab}±1.07
T_0	1745.75±133.25	1331.50±44.50	77.52^{c}±2.17
Mean±SE	1838.45±26.82	1331.50±18.00	72.33±1.09

Here, T_1 = (Antibiotic 0.25g/kg feed), T_2 = (Yeast based probiotic 1.5g/kg feed), T_3 = (Yeast based probiotic 2g/kg feed), T_4 = (Yeast based probiotic 2.5 g/kg feed) and T_0 = (control) Values are Mean ± S.E (n=15) one way ANOVA (SPSS, Duncan method).

Mean with different superscripts are significantly different ($P<0.05$)

- ✓ Mean within same superscripts don't differ ($P>0.05$) significantly
- ✓ SE= Standard Error

4.2.2 Carcass weight

Data presented in table 13 and figure 9 showed that the carcass weight in the treatment groups are better than the control group. The results revealed that the treatments had significant effects in dressed Wings ($p<0.05$), but no difference in breast, back, thigh, drumstick, neck ($p>0.05$). However in treatment T_3 group the carcass weight is better than on other treatment groups.

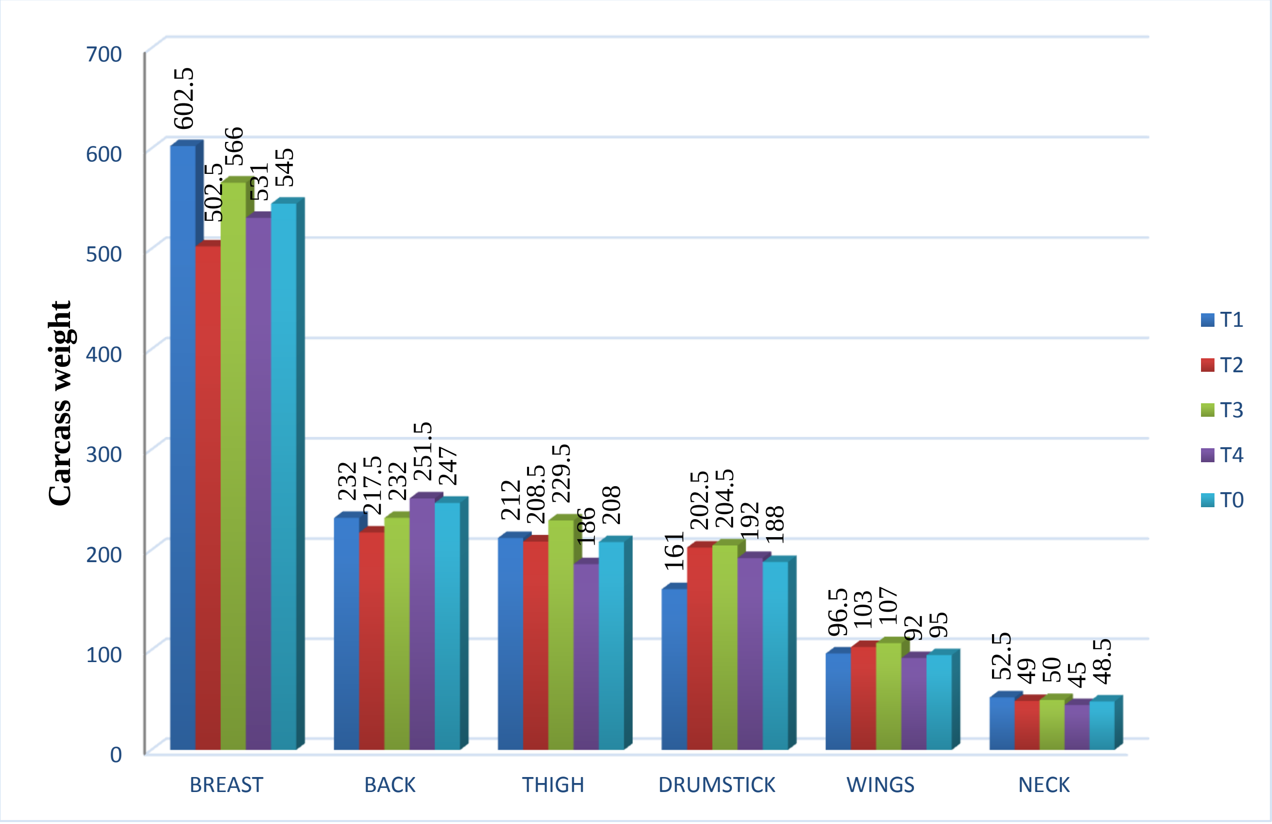

Fig. 9: Effects of probiotics on carcass characteristics of broiler chickens

The present findings were in agreement with previous findings (Mutassim,2013; Fathi *et al.* 2012; Manal 2012; Zhang, *et al*., 2006; Kannan *et al*., 2005; Panda *et al*., 2001; Mutassim (2013) who reported that supplementation of yeast increased breast meat yield in broilers. Fathi *et al.* (2012) and Manal (2012) reported that highest thigh meat yield was observed in birds fed diet containing yeast (*Saccharomyces cerevisiae*) than other treatment groups.

Table no 13. Effects of probiotics on carcass characteristics of broiler chickens

Treatments	Breast (g/bird)	Back (g/bird)	Thigh (g/bird)	Drumstick (g/bird)	Wings (g/bird)	Neck (g/bird)
T_1	602.50±13.50	232.00±6.00	212.00±11.00	161.00±20.00	96.50^{ab}±7.50	52.50±4.50
T_2	502.50±2.50	217.50±15.50	208.50±17.50	202.50±11.50	103.00^{ab}±1.0	49.00±3.00
T_3	566.00±50.00	232.00±11.00	229.50±17.50	204.50±4.50	107.00^{b}±2.00	50.00±2.00
T_4	531.00±24.00	251.50±5.50	186.00±15.00	192.00±15.00	92.00^{a}±2.00	45.00±2.00
T_0	545.00±40.00	247.00±11.00	208.00±13.00	188.00±7.00	95.00^{ab}±2.00	48.50±1.50
Mean±SE	549.40±15.29	236.00±5.34	208.80±6.81	189.60±6.74	98.70±2.21	49.00±1.24

Here, T_1 = (Antibiotic 0.25g/kg feed), T_2 = (Yeast based probiotic 1.5g/kg feed), T_3 = (Yeast based probiotic 2g/kg feed), T_4 = (Yeast based probiotic 2.5 g/kg feed) and T_0= (control) Values are Mean ± S.E (n=15) one way ANOVA (SPSS, Duncan method).

Mean with different superscripts are significantly different (P<0.05)

- ✓ Mean within same superscripts don't differ (P>0.05) significantly
- ✓ SE= Standard Error

4.2.3 Relative weight of giblet organs

Data regarding presented in table 14 and figure 10 showed that relative weight of giblet organs (liver, heart, gizzard and spleen) of broilers fed diet containing yeast (*Saccharomyces cerevisiae*), antibiotic and control group showed a non-significant difference among the groups. In yeast treatment group the weight of giblet organ is higher than in antibiotic and control group.

The glandular stomach showed significant (0.05) effect that in T_2 (12.50^{a}±1.50) treatment is higher than T_0 (8.50^{b}±0.50) in control group.

The present findings were not in agreement with previous findings (Dimcho *et al*., 2005; Pekoe *et al*., 2004; Ivanov, 2004) reported more improvements in liver, gizzard and heart of broilers, mules and ducklings by supplementing diets with probiotics.

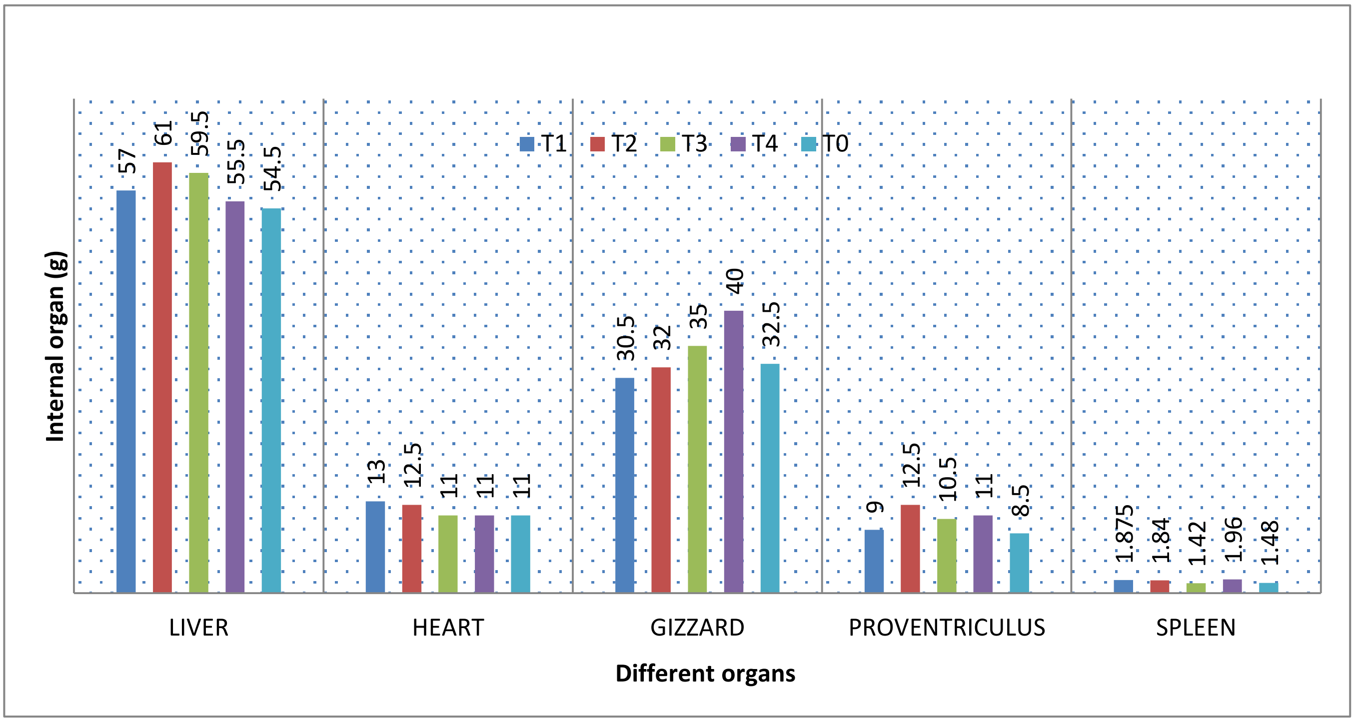

Fig. 10: Effects of probiotics on internal organs of broiler chicken under different treatment group

Table 14: Effects of probiotics on internal organs of broiler chicken under different treatment group

Treatments	Liver (g/bird)	Heart (g/bird)	Gizzard (g/bird)	Proventriculus (g/bird)	Spleen (g/bird)
T_1	57.00±5.00	13.00±.00	30.50±5.50	9.00^{ab}±00	1.88±0.03
T_2	61.00±2.00	12.50±.50	32.00±.00	12.50^{b}±1.50	1.84±0.28
T_3	59.50±4.50	11.00±1.00	35.00±3.00	10.50^{ab}±1.50	1.42±0.18
T_4	55.50±5.50	11.00±1.00	40.00±2.00	11.00^{ab}±.00	1.96±0.38
T_0	54.50±12.50	11.00±1.00	32.50±5.50	8.50^{a}±0.50	1.48±0.23
Mean±SE	57.50±2.43	11.70±0.40	34.00±1.69	10.30±0.58	1.72±0.11

Here, T_1 = (Antibiotic 0.25gm/kg feed), T_2 = (Yeast based probiotic 1.5g/kg feed), T_3 = (Yeast based probiotic 2g/kg feed), T_4 = (Yeast based probiotic 2.5 g/kg feed) and T_0 = (control) Values are Mean ± S.E (n=15) one way ANOVA (SPSS, Duncan method).

Mean with different superscripts are significantly different (P<0.05)

- ✓ Mean within same superscripts don't differ (P>0.05) significantly
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CHAPTER V

SUMMARY, CONCLUSION AND RECOMMENDATIONS

A total of 120 day-old lohmann meat (Indian river) chicks were reared in Sher-e-Bangla Agricultural University Poultry Farm, Dhaka. Chicks were divided randomly into 5 experimental groups of 3 replicates (8 chicks in each replications). One of the five experimental group one was fed with basal diet which was control group. The another group was fed with antibiotic mixed feed. The remaining three groups were fed diet with different dose of yeast based probiotic: 1^{st} one was 1.5g probiotics/kg of feed, 2^{nd} one was 2g probiotics/kg of feed and the 3^{rd} one was 2.5g probiotics/kg of feed.

The effects of supplementation of antibiotic, yeast based probiotics and control on broiler performance were measured. The performance traits *viz.* body weight, weight gain, feed consumption, FCR, dressed bird weight, relative giblet weight, survivability, flock uniformity and meat yield of broiler on different replication of the treatments was recorded and compared in each group. At 28 days of age, broilers were dissected to compare meat yield characteristics among different treatments.

Final live weight was significantly higher in group T_3 (1882.33±33.38) compared to any other group T_1, group T_2, T_4 and group T_0 (1717.50±81.96) was comparatively lower. However better value was found in group T_3.

Body weight gain was also significantly higher in group T_3 (1840.33±33.38) compared to group T_1, group T_2, T_4 and group $T_{0.}$ The lowest value was found in $T_{0.}$

FCR was also better in group T_3 (1.27±0.01) showed higher feed efficiency compared to any other group T_1, group T_2, T_4 and group T_0. The lowest value was found in $T_{0.}$

Feed consumption was higher in yeast based probiotic treatment group because we know that yeast based probiotic increase the feed consumption. The feed consumption at T_2 (2361.22±14.14) and T_4 (2353.42±19.92) group was comparatively higher and lowest feed consumption was inT_0 (2227.52±24.72).

There were no birds died at the research period. The mortality rate was 0% in all treatment groups. Which represented that survivability was 100 percent.

The uniformity was more or less good in all treatment groups. In control, it is (91.67±4.17) higher than another.

In experiment, evaluation of dressing percentage on slaughtered representative birds revealed that T_0 (77.52±2.17) group had significantly higher dressing percentage followed by T_1, T_4, T_3 and lower in T_2 groups. In T_3 (73.73±0.86) the result was better.

The results revealed that the treatments had significant effects in dressed Wings ($p<0.05$), but no difference in breast, back, thigh, drumstick, neck ($P>0.05$). But in T_3 treatment group the carcass weight is better than any other treatment group.

In yeast treatment group the weight of giblet organ is higher than in antibiotic and control group. The glandular stomach showed significant ($P<0.05$) effect that in T_2 (12.50±1.50) treatment is higher than T_0 (8.50±0.50) in control group.

The overall mean weekly body weight gains of different groups at 4^{th} week showed that there was significant ($P<0.05$) effects. The highest result was found in T_3 (724.83±14.03) yeast 2gm/kg feed and lowest in control T_0 (618.25±56.34).

The overall weekly mean feed consumption of different groups showed that there was significant ($P<0.05$) effects. The higher feed consumption was in T_1 (973.42±20.67) T_2, T_3, T_4 and comparatively lower in T_0 (895.96±22.01) because (*Saccharomyces cerevisiae*) yeast based probiotics increase the feed consumption.

The effect of YC supplementation on broiler performance was more apparent during the grower period. In addition, significantly improved digestibility was also observed during the grower period.

The results of the current study indicate that YC improves growth performance, make better FCR, improve carcass quality, and reduces use of antibiotic.

Analyzing the above research findings on the growth performance of broilers, the yeast had a great effect on growth performance of broiler.

It can be recommended by the study that the yeast based probiotic specially (*Saccharomyces cerevisiae*) yeast culture 2gm per kg of feeds proved to be beneficial for increasing the growth performance of broiler.

Therefore it is strongly suggest that yeast based probiotic can be used in our country for quality poultry production, diminishes the risk of antibiotic resistance in body and leads a healthier life with safe food consumption. However commercial application is recommended.

CHAPTER VI

REFERENCES

Aarestrup, F.M., Wegener, H.C. and Collignon, P. (1999). Resistance in bacteria of the food chain: Epidemiology and control strategies. *Expert Review of Anti-Infective Therapy*. **6**: 733-750

Abdurrahman, Z.H., Pramono, Y.B. and Suthama, N. (2016). Meat characteristic of crossbred local chicken fed inulin of dahlia tuber and *lactobacillus sp. Media Peternakan.* **39**: 112–118.

Abudabos, A., Alyemni, A. and Al Marshad, B.A. (2013). *Bacillus subtilis* PB6 based-probiotic (CloSTAT$^{TM)}$ improves intestinal morphological and microbiological status of broiler chickens under*Clostridium Perfringens* challenge. *Int. J. Agric. Biology* **15**(6): 978-982.

Addo, K.K., Mensah G.I., Aning, K.G., Nartey, N., Nipah, G.K., Bonsu, C., Akyeh, M.L. and Smits, H.L. (2011). Microbiological quality and antibiotic residues in informally marketed raw cow milk within the coastal savannah zone of Ghana. *Trop. Med. and Inter.l Health.* **16**: 227-23.

Adejumo, D. O., Onifade A. A. and Afonja, S. A. (2004). Supplemental effects of dried yeast (Yea-sacc 1026 P®) in a low protein diet on growth performance, carcass characteristics and organ weights of broiler chicken. *Tropical Vet.* **22**: 72-77.

Al-Khalaifah, H.S. (2018) Benefits of probiotics and/or prebiotics for antibiotic-reduced poultry, *Poultry Science*, Volume **97**, Issue 11, Pages 3807–3815.

Amaral, C. (2006) The analysis of patents, tool for determining lines of research on probiotics in Cuba. *The Master's Scientific Degree, University of Havana.*

Angel, R.R., Dalloul, A. and Doerr, J. (2005). Performance of broiler chickens fed diets supplemented with a direct-fed microbial. *Poult. Sci*. **84**:1222-1231.

Antimicrobial Resistance Global Report on Surveillance. (2014) Geneva: World Health Organization; 256.

Bager, F. (ed.). (1998). Consumption of antimicrobial agents and occurrence of antimicrobial resistance in bacteria from food animals, food and humans in Denmark. Dansk Copenhagen Zoonosecenter, Denmark.

Bar-Shira, E., Sklan, D. and Friedman, A. (2003). Establishment of immune competence in the avian GALT during the immediate post-hatch period. *Dev. Comp. Immunol*. **27**:147–157.

Bellisle, F., Diplock A.T. and Hornstra, A.T. (1998). Functional food science in Europe. *Br. J. Nutr*. **80**: 3-4.

Benites, V., Gilharry, R., Gernat, A.G. and Murillo, J.G. (2008). Effect of dietary Mannan Oligosaccharide from Bio-Mos or SAFMannan on live performance of broiler chickens. *J. Appl. Poultry Res.* **17**: 471-475.

Berchieri, A., Sterzo, E., Paiva, J., Luckstadt, C. and Beltran, R. (2006). The use of a defined probiotic product (Biomin® PoultryStar) and organic acids to control Salmonella enteritidis in broiler chickens. *9th International Seminar on Digestive Physiology in the Pig*. **2**: 217-219.

Bezkorovainy, A. (2001). Probiotics: Determinants of survival and growth in the gut. Am. *J. Clin. Nutr.* **73**: 399-405.

Bhatti, M.Y. (2011). Emerging prospects of poultry production in Pakistan at the dawn of 21st century. *Veterinary News and Views (Special Edition), 06 Sept*., 24-30.

Biggs, P. and Parsons, C.M. (2008). The effects of Grobiotic-P on growth performance, nutrient digestibilities, and cecal microbial populations in young chicks. *Poult. Sci*. **87**: 1796–1803.

Boamah, V.E., Agyare, C., Odoi, H. and Dalsgaard, A. (2016) Antibiotic practices and factors influencing the use of antibiotics in selected poultry farms in Ghana. *Journal of Antimicrobial Agents.* **2**: 120. DOI: 10.4172/2472-1212.1000120

Bonomi, A., Bonomi, B.M., Quarantelli, A. and Orlandi, A. (1999). Organic chromium in the feeding of broiler chickens. *Riv. Sci. Aliment*. **28**: 385–397.

Bovill, R., Bew, J. and Robinson, S. (2001) Comparison of selective media for the recovery and enumeration of probiotic yeasts for animal feed. *Int J Food Microbiol*. **67**: 55-61.

Bozkurt, M., Aysul, N., Küçükyilmaz, K., Aypak, S., Ege, G., Çatli, A.U. and Çınar, M. (2014). Efficacy of in-feed preparations of an anticoccidial, multienzyme, prebiotic, probiotic, and herbal essential oil mixture in healthy and Eimeria spp.- infected broilers. *Poult. Sci*. **93**(2): 389-399.

Bradley, G.L. and Savage, T.F. (1995). The effect of autoclaving a yeast culture of Saccharomyces cerevisiae on turkey poult performance and the retention of gross energy, and selected minerals. *Anim. Feed Sci. Technol*. **55**: 1–7.

Bradley, G.L. and Savage, T.F. (1985). The effect of autoclaving a yeast culture of Saccharomyces cerevisiae on turkey pullet's performance and the retention of gross energy and selected minerals. *Anim. Feed Sci. Tec*. **55**: 1-7.

Brake, J. (1991). Lack of effect of all live yeast culture on broiler, breeders and progeny performance. *Poultr. Sci.* **70**: 1037-1039.

Brown, M. (2011). Modes of Action of Probiotics: Recent Developments. *Anim Vet Adv* **10**: 1895-1900.

Callaway, T.R., Edrington, T.S., Anderson, R.C., Harvey, R.B., Genovese, K. J., Kennedy, C.N. Venn, D.W. and Nisbet, D.J. (2008). Probiotics, prebiotics and competitive exclusion for prophylaxis against bacterial disease. *Food and Feed Safety Research Unit.*

Campeanu, G.H. (2002). Biotechnological studies Obtaining Concerning the role of biomass with probiotic yeasts and bacteria form. *Roum Biotechnol Lett* **7**: 795-802.

Carvalho, I.T. and Santos, L. (2016). Antibiotics in the aquatic environments: a review of the European scenario. *Environ Int.* **94**: 736–757.

Castanon, J.I.R. (2007). History of the use of antibiotic as growth promoters in European poultry feed. *Poult. Sci.* **86**: 2466-2471.

Choct, M. (2001). Alternatives to in-feed antibiotics in monogastric animal industry. *American Soybean Association Technical Bulletin* **30**: 1–6.

Choudhari, A. Shinde, S. & Ramteke, B. N. (2008). Prebiotics and Probiotics as Health promoter. *Veterinary World, Vol.***1** (2): 59-61

Chowdhury, R.K., Islam M.S., Khan M.J., Karim M.R., Haque, M.N., Khatun, M. and. Pesti, G.M. (2009). Effect of citric acid, avilamycin, and their combination on the performance, tibia ash, and immune status of broilers. *Poult. Sci.* **88**: 1616–1622.

Clydesdale, F.A. (1997). Proposal for the establishment of scientific criteria for health claims for functional foods. *Nutr. Rev,* **55**: 413-22.

Coenen, T.M. (2000). Safety evaluation of enzyme preparation derived from lactate Kluyveromyces lactis. *Food Chem Toxicol.* **38**: 671-677.

Correa, G.S.S., Gomes, A.V.C., Correa, A.B. and Salles, A.S. (2000). Desempenho de frangos de corte alimentados com diferentes promotores de crescimento. *In:Reuniao Anual da SBZ, Vicosa.* p. 37.

Cosby, D.E., Cox, N.A., Harrison, M.A., Wilson, J.L., Buhr, R.J. and Cray, P.J. (2015). *Salmonella* and antimicrobial resistance in broilers: a review. *Journal of Applied Poultry Research* **24**: 408–426.

Cummings, J.H. and Macfarlane, G.T. (2002). Gastrointestinal effects of prebiotics. *Br. J. Nut.* **87** (2): 145-151.

Dahiya, J.P., Wilkie, D.C., Kessel, A.G. and Drew, M.D. (2006). Potential strategies for controlling necrotic enteritis in broiler chickens in post-antibiotic era. *Animal Feed Science and Technology* **129**: 60–88

Dale, N. (1992). Probióticos para aves. Avicultura Profesional. **10**(2): 88-89.

Dalloul, R.A., Lillehoj, H.S., Shellem, T.A. and Doerr, J.A. (2003). Enhanced mucosal immunity against Eimeria acervulina in broilers fed a Lactobacillus-based probiotic. *Poult. Sci.* **82**: 62-66.

Darwish, W.S., Eldaly, E.A., El-Abbasy, M.T., Ikenaka, Y., Nakayama, S. and Ishizuka, M. (2013). Antibiotic residues in food: The African scenario. *Japanese Journal of Veterinary Research.* **61**: 13-S22.

Day, E.J. (1997). Effect of yeast culture on tibia bone in three week old broiler chicks fed graded level of inorganic phosphorus. Res. Bull. *Mississipi State University Stark Villams.*

De Leener, E., Martel, A., de Graef, E.M., Top, J., Butaye, P., Haesebrouck, F., Willems, R. and Decostere, A. (2005). Molecular analysis of human, porcine, and poultry *Enterococcus faecium* isolates and their erm (B) genes. *Applied Environmental Microbiology*. **71**: 2766-2770.

Diarra, M.S., Rempel, H., Champagne, J., Masson L., Pritchard, J. and Topp, E. (2010). Distribution of antimicrobial resistance and virulence genes in enterococcus spp. and characterization of isolates from broiler chickens. *Appl Environ Microbiol*. **76**: 8033–8043.

Diarra, M.S., Silversides, F.G., Diarrassouba, F., Pritchard, J., Masson, L. and Brousseau, R. (2007). Impact of feed supplementation with antimicrobial agents on growth performance of broiler chickens, clostridium perfringens and enterococcus counts, and antibiotic resistance phenotypes and distribution of antimicrobial resistance determinants in *Escherichia Coli* isolates. *Appl Environ Microbiol*. **73**: 6566–6576.

Dibner, J.J. and Richards, J.D. (2005). Antibiotic growth promoters in agriculture: history and mode of action. *Poult. Sci.* **84**: 634–643.

Dickens, J.A., Berrang, M.E. and Cox, N.A. (2000). Efficacy of an herbal extract on the microbiological quality of broiler carcasses during a simulated chill. *Poult. Sci.* **79**: 1200–1203.

Dimcho, D., Svetlana, B., Tsvetomira, S. and Tatiana, V. (2005). Effect of feeding Lactina probiotic on performance, some blood parameters and caecal microflora of mule ducklings. *Trakia J. Sci*. **3**(2): 22-28.

Eckles, C.H. and Williams, V.M. (1925). Yeast as a supplementary feed for lactating cows. *J. Dairy Sci*.**8**: 89.

Endtz, H.P., Mouton, R.P., van der Reyden, T., Ruijs, G.J., Biever, M. and van Klingeren, B. (1990). Fluoroquinolone resistance in *Campylobacter* spp. isolated from human stools and poultry products. *Lancet* 335: 787.

Engberg, R.M., Hedemann, M.S., Leser, T.D. and Jensen, B.B. (2000). Effect of zinc bacitracin and salinomycin on intestinal microflora and performance of broilers, Poult, Sci. **79**: 1311- 1319.

Engberg, R.M., Hedemann, M.S., Leser, T.D. and Jensen, B.B. (2000). Effect of zinc bacitracin and salinomycin on intestinal microflora and performance of broilers. *Poult Sci*. **79**: 1311–1319.

Erdman, J.W. (1989). Phytic acid interactions with divalent cations in Foods and in Gastro intestinal tract. In F.R. Dintizisand J.A. Laszlo (ed.). Mineral absorption in monogastric gastro-intestinal tract. *Plenum Press, New York. NY* pp. 161-170.

Europe Union Commission (2005). Ban on antibiotics as growth promoters in animal feed enters into effect. Regulation 1831/2003/EC on additives for use in animal nutrition, replacing Directive 70/524/EEC on additives in feed-stuffs, Brussels, 22 December.

FAO/WHO (2001). Health and nutritional properties of probiotics in food including powder milk with live lactic acid bacteria. Cordoba, Argentina, October 1–4.

Fathi, M. M., Al-Mansoor, S., Al-Homidan, A., Al- Khalaf A. and Al-Damegh M. (2012). Effect of yeast culture supplementation on carcass yield and humoral immune response of broiler chicks. *Vet. World*. **5**: 651-657.

FDA (2013). Guidance for Industry 213: New animal drugs and new animal drug combination products administered in or on medicated feed or drinking water of food-producing animals: Recommendations for drug sponsors for voluntarily aligning product use conditions with GFI 209.

Ferket, P.R. (2002). Use of oligosaccharides and gut modifiers as replacements for dietary antibiotics. *Proc. 63rd Nat. Minnesota Nutrition Conf., Eagan, MN, USA*. pp 169-182

Food and Agricultural Organization. FAO Publications Catalogue (2017). United Nations: Food and Agricultural Organization . 43.

Forgetta, V., Rempel, H., Malouin, F., Vaillancourt, R. Jr., Topp E. and Dewar K. (2012). Pathogenic and multidrug-resistant Escherichia fergusonii from broiler chicken. *Poult Sci.* . **91**: 512–525.

Fuller, R. (1989). Probiotics in man and animals. *Journal of Applied Bacteriology*, **66**: 365–378.

Furtula, V., Farrell, E.G., Diarrassouba, F., Rempel, H., Pritchard, J. and Diarra, M.S. (2010). Veterinary pharmaceuticals and antibiotic resistance of Escherichia Coli isolates in poultry litter from commercial farms and controlled feeding trials. *Poult Sci.* **89**: 180–188.

Gao, J., Zhang, H.J., Wu, S.G., Yu, S.H., Yoon, I., Moore, D., Gao, Y.P., Yan, H.J. and Qi. G.H. (2009). Effect of Saccharomyces cerevisiae fermentation product on immune function of broilers challenged with Eimeria tenella. Poult. Sci. **88**: 2121–2151.

Gao, J., Zhang, H.J., Yu, S.H., Wu, S.G., Yoon, I., Quigley, J., Gao, Y.P. and Qi. G.H. (2008). Effects of yeast culture in broiler diets on performance and immunomodulatory functions. Poult. Sci. **87**: 1377–1384.

Ghadban, G.S. (2002). Probiotics in broiler production—A review. Arch. Geflugelkd. **66**: 49–58.

Ghasemi, H.A., Kasani, N. and Taherpour, K. (2014). Effects of black cumin seed (nigella sativa L.), a probiotic, a prebiotic and a synbiotic on growth performance, immune response and blood characteristics of male broilers. *Livest Sci.* **164**: 128–134.

Giannenas, I., Papadopoulos, E., Tsalie. E., Triantafillou, E., Henikl, S. and Teichmann, K. (2012). Assessment of dietary supplementation with probiotics on performance, intestinal morphology and microflora of chickens infected with Eimeria tenella. *Vet Parasitol.* **188**: 31–40.

Gibson, G.R. and Fuller, R. (2000). Aspects of in vitro and in vivo research approaches directed toward identifying probiotics and prebiotics for human use. *J. Nutr*. **130:** 391-395.

Glade, M.J. and Biesik, L.M. (1986). Enhanced nitrogen retention in yearling horses supplemented with yeast culture. *J. Anim. Sci.* **62**: 1635.

Glade, M.J. and Sist, M.O. (1988). Dietary yeast culture supplementation enhances urea recycling in equine large intestine. *Nutr. Reprod. Int*. **37**: 11- 17.

Goetting, V., Lee, K.A. and Tell, L.A. (2011) Pharmacokinetics of veterinary drugs in laying hens and residues in eggs: A review of the literature. Journal of Veterinary Pharmacology and Therapy. **34**: 521-556.

Gonzalez Ronquillo, M. and Angeles Hernandez, J.C. (2017). Antibiotic and synthetic growth promoters in animal diets: review of impact and analytical methods. *Food Contr.* **72**: 255–267.

Goodarzi, M. and Nanekarani, S. (2014). Effect of onion extract in drinking water on performance and carcass traits in broiler chickens. *International conference on agricultural and bio system engineering IERI Procedia*, **8**: 107-112.

Greko, C. (2001). Safety aspects on non-use of antimicrobials as growth promoters. In: Piva, A, Bach Knudsen, KE and Lindberg, KE (eds) *Gut Environment of Pigs*. *Nottingham: Nottingham University Press*, pp. 219–230.

Groschke, A.C. and Evans, R.J. (1950). Effects of antibiotics, synthetic vitamins, vitamin B_{12} and an APF supplement on chick growth. *Poult. Sci.* **29**: 616–618.

Halfhide, B. (2003). Role of the European Probiotic Association. Proceedings: Role of probiotics in animal nutrition and their link to the demands of European consumers, Lelystad, *The Netherlands*. p. 3-4.

Hall, M.A.L., Dierikx, C.M., Stuart, J.C., Voets, G.M. and van den Munckhof, M.P. (2011). Dutch patients, retail chicken meat and poultry share the same ESBL genes, plasmids and strains. *Clinical Microbiology and Infection*.;**17**(6): 873-880.

Hashemi, S.R. and Davoodi, H. (2010). Phytogenics as new class of feed additive in poultry industry. *J. Anim. Vet. Adv*.**, 9** (17): 2295-2304.

Hassanein, S.M. and Soliman N.K. (2010). Effect of probiotic (Saccharomyces Cerevisiae) adding to diets on intestinal microflora and performance of hy-line layers hens. *J Am Sci*. ; 6 .

Hayat, J., Savage, T.F. and Mirosh. L.W. (1993). The reproductive performance of two genetically distinct lines of medium white turkey hens when fed breeder diets with and without a yeast culture containing *Saccharomyces cerevisiae*. *Anim. Feed Sci. Technol.* **43**: 291–301.

Higgins, S.E., Higgins, J., PWolfenden, A.D., Henderson, S.N., Torres-Rodriguez, A., Tellez, G. and Hargis, B. (2008). Evaluation of a Lactobacillus-based probiotic culture for the reduction of Salmonella Enteritidis in neonatal broiler chicks. *Poult. Sci*. **87**: 27–31.

Hose, H. and Sozzi,, T. (1991). Probiotics-Facts or Faction. *J. Chem. Tech. Biotech*. **51**: 540-544.

Huang, M.K., Choi, Y.J., Hude, R., Lee, J.W., Lee, B. & Zhao, V. (2004) Effects of lactobacilli and acidophilic fungus on the production performance and immune response in broiler chickens. *Poult. Sci.*, **83**: 788 - 795.

Hugo, W.B. and Russel, A.D. (1998). Pharmaceutical Microbiology. 6th ed. Oxford: *Blackwell Science Ltd*; p. 514.

Hume, M.E. (2011). Historic perspective: prebiotics, probiotics, and other alternatives to antibiotics. *Poult. Sci.*, **90**:2663-2669.

Ivanov, I. (2004). Testing a probiotic mixture for broiler chickens. *Poultry Int.*, **43**: 44-47.

Jakobsen, L., Kurbasic, A., Skjøt-rasmussen, L., Ejrnæs, K., Porsbo, L.J., Pedersen, K., Jensen, L.B., Emborg, H., Agersø, Y., Olsen, K.E.P., Aarestrup, F.M., Frimodt-møller, N. and Hammerum, A.M. (2010). *Escherichia coli* isolates from broiler chicken meat, broiler chickens, pork and pigs share phylogroups and antimicrobial resistance with community-dwelling. Foodborne Pathogens and Disease. **7**: 537-547.

Jensen, J.F. and Jensen, M.M. (1992). The effect of using growth promoting Bacillus strains in poultry feed. In:World's Poultry Congress 18, (1992), Amsterdam. *Proc. Amsterdam: WPSA*, **3**: 398- 402.

Jin, L.Z., Ho, Y.W., Abdullah, N. and Jalaludin, S. (1998a). Growth performance, intestinal microbial population, and serum cholesterol of broilers fed diets containing Lactobacillus culture. *Poultry Science*, **77**: 1259–1265.

Jin, L.Z., Ho, Y.W., Abdullah, N., Ali, M.A. and Jalaludin, S. (1998b). Effects of adherent Lactobacillus cultures on growth, weight of organs and intestinal microflora and volatile fatty acids in broilers. *Animal Feed Science and Technology*, **70**: 197–209.

Juven, B.J., Meinersmann, R.J. and Stern, N.J. (1991). Antagonistic effects of Lactobacilli and Pediococci to control intestinal colonization by human entero-pathogens in live poultry. *J. Appl. Bacteriol*, **70(**2): 95-103.

Kannan, M., Karunakaran, R., Balakrishnan, V. and Prabhakar, T.G. (2005). Influence of Prebiotics Supplementation on Lipid Profile of Broilers. *International Journal of Poultry Sci*. **4** (12): 994-997.

Karaoglu, M. and Durdag H. (2005). The influence of dietary probiotics (Saccharomyces cerevisiae) supplementation and different slaughter age on the performance, slaughterand carcass properties of broilers. *Int. J. Poult. Sci*. **4**: 319-316.

Klasing, K.C. (1998). Nutritional modulation of resistance to infectious diseases. *Poult. Sci.* **77:** 1119–1125.

Koenen, M.E., Karmer, J., Van der Hulst, R., Heres, L., Jeurissen, S.H., Boersma, W.J. (2004). Immunomodulation by probiotic Lactobacilli in layer and meat-type chickens. *British Poultry Science,* **45**: 355–366.

Kumura, H., Tanoue, Y., Tsukahara, M., Tanaka, T., Shimazaki, K. (2004) Screening of yeast strains for probiotic applications. *J Dairy Sci* **87**: 4050-4056.

Kung, L. Kreck, E.M. Tung. R.S. Hession, A. Sheperd, A.C. Cohen, M.A. Swain, H.E. and Leedle, J. (1997). Effects of a live yeast culture and enzymes on *in vitro* ruminal fermentation and milk production of dairy cows. *J. Dairy Sci***. 80**: 2045–2051.

Kutlu, H.R., and Görgülü, M. (2001). The alternatives for antibiotics-growth factors used in poultry diets as feed additives. *Yem agazin Dergisi (in Turkish),* **27:** 45-51.

Lan, Y., Verstegen, M.W.A., Taminga, S. and Williams, B.A. (2005). The role of the commensal gut microbial community in broiler chickens, *World's Poult. Sci. J.,* **61**: 95-104.

Landers, T.F., Cohen, Wittum, T.E., and Larson, E.L. (*2012)* . A review of antibiotic use in food animals: Perspective, policy, and potential. *Public Health Reports.* **127**(1): 4-22

Latha, S., Vinothini, G., John dickson calvin, D. and dhanasekaran, D. (2016). In vitro probiotic profile based selection of indigenous actinobacterial probiont Streptomyces sp. Jd9 for enhanced broiler production. *J Biosci Bioeng.* **121**: 124–131.

Laxminarayan, R., Duse, A., Wattal, C., Zaidi, A.K.M., Wertheim, H.F.L., Sumpradit, N., Vlieghe, E., Hara, G.L., Gould, I.M., Goossens, H., Greko, C., So, A.D., Bigdeli, M., Tomson, G., Woodhouse, W., Ombaka, E., Peralta, A.Q., Qamar, F.N., Mir, F., Kariuki, S., Bhutta, Z.A., Coates, A., Bergstrom, R., Wright, G.D., Brown, E.D., Cars, O. (2013). Antibiotic resistance–The need for global solutions. *Lancet Infectious Diseases.* **13**: 1057-1098

Lee, J.I., Kim, Y.D., Kim, D.Y., Choi, Y.I., Ahn, J.N., Chae, H.S. and Choi, J.H. (2002). Effects of *Saccharomyces cerevisiae* on growth performance and meat quality of broiler chickens. *Proc. Korean J. Anim. Sci. Technol.* 34.

Lei, Y., Zhang, K.Y., Ding, X.M., Bai, S. P. and Jung. S. C. (2009). Effect of probiotics on growth performance, development of small intestinal tract and microbial populations in broilers. *J. Agric. Sci. Technol*. **3**: 24–31.

Leusink, G., Rempel, H., Skura, B., Berkyto, M., White, W., Yang, Y., Rhee, J.Y., Xu an, S., Chiu, S., Silversides, F., Fitzpatrick, S. and Diarra, M.S. (2010). Growt h performance, meat quality, and gut microflora of broiler chickens fed with cranberry extract. *Poultry Science* **89**: 1514–1523.

Levkut, M., Revajova, V., Laukova, A., Sevcikova, Z., Spisakova, V. and Faixova, Z. (2012). Leukocytic responses and intestinal mucin dynamics of broilers protected with Enterococcus faecium Ef55 and challenged with salmonella enteritidis. *Res Vet Sci.* . **93**: 195–201.

Line, J.E., Bailey, J.S., Cox, N.A. and Stern, N.J., (1997). Yeast treatment to reduce Salmonella and Campylobacter population associated with broiler chickens subjected to transport stress. *Poult. Sci.* **76**: 1227-1231.

Liu, X., Yan, H., Lv, L., Xu, Q., Yin, C. and Zhang, K. (2012). Growth performance and meat quality of broiler chickens supplemented with Bacillus licheniformis in drinking water. *Asian-Australas J Anim Sci.* **25**: 682–689.

Lorenzoni, A.G., Pasteiner, S,. Mohni, M. and Perazzo F. (2012). Probiotics: challenging the traditional modes of action. Iran. J. Appl. Anim. Sci. **2**: 33- 37.

Madigan, M.T., Martinko, J.M., Bender, K.S., Buckley, FH, Stahl, D.A. (2014). Brock Biology of Microorganisms. 14th ed. Illinois: Pearson International. p. 1006

Manal, K.A.N. (2012). Effect of dietary yeast supplementation on broiler performance. Egypt. *Poult. Sci.* **32**: 95-106.

Marshall, B.M. and Levy, S.B. (2011). Food animals and antimicrobials: Impacts on human health. Clinical Microbiology Reviews. **24**: 718-733.

Martin, S.A., Nisbet, B.J. and Dean, R.G. (1989). Influence of a commercial yeast supplement on the *in vitro* ruminal fermentation. *Nutr. Repro. In.,* **40**: 395-403.

Maruta, K. (1993). Probióticos e seus benefícios. In:Conferência APINCO de Ciência e Tecnologia Avícolas. *Santos, São Paulo. Brasil*. pp. 203-219.

Mathew, A.G., Chattin, S.E. Robbins, C.M. and Golden. D.A. (1998). Effects of a direct-fed yeast culture on enteric microbial populations, fermentation acids, and performance of weanling pigs. *J. Anim. Sci.* **76**: 2138–2145.

Mathew, A.G., Liamthong, S. and Lin, J. (2009). Evidence of Int 1 transfer between *Escherichia coli* and *Salmonella typhi*. *Food Biology*. **6**(8): 959-964

Medeiros, M.A., Oliveira, D.C., Rodrigues,Ddos, P. and Freitas, D.R. (2011). Prevale nce and antimicrobial resistance of *Salmonella* in chicken carcasses at retail in 15 Brazilian cities. *Pan American Journal of Public Health* **30:** 555–560.

Mehdizadeh, S., Kazerani, H.R., Jamshidi, A. (2010). Screening of chloramphenicol residues in broiler chickens slaughtered in an industrial poultry abattoir in Mashhad, Iran. *Iranian Journal of Veterinary Science and Technology*. **2**: 25-32.

Menten, J.F.M. (2001). Aditivos alternativos na nutrição de aves:Probióticos e Prebióticos. Sociedade Brasileira de Zootecnia, A produção animal na visão dos brasileiros, Piracicaba. *Fealq, pp*. 141- 157.

M'ikanatha, N.M., Sandt, C.H., Localio, A.R., Tewari, D., Rankin, S.C., Whichard, J. M., Altekruse, S.F., Lautenbach, E., Folster, J.P., Russo, A., Chiller, T.M., Re ynolds, S.M. and McDermott, P.F. (2010). Multidrugresistant *Salmonella* isolates from retail chicken meat compared with human clinical isolates. *Foodborne Pathogens and Diseases* **7**: 929–934.

Mirlohi, M., Aalipour, F., Jalali, M. (2013). Prevalence of antibiotic residues in commercial milk and its variation by season and thermal processing methods. *International Journal of Environmental Health Engineering*. **2**: 41.

Mohan, B., Kadirvel, R., Natarajan, A. & Bhaskaran, M. (1996). Effect of probiotic supplementation on growth, nitrogen utilisation and serum cholesterol in broilers. *British Journal of Poultry Science,* **37**: 995-401.

Mohan, B., Kadrive, R., Bhaskaran, M., Natarajan, A. (1995). Effect of probiotic supplementation on serum/yolk cholesterol and on egg cell thickness in layers. *British Poultry Science.* **36**(5): 799-803.

Moore, B.E., Newman, K.E., Spring, P., Chandler, F.E. (1994). The effect of yeast culture (Yea Sace 1026) in microbial population's digestion in the cecumand colon of the equine. *J. Anim. Sci.* **72**: 1.

Moore, P.R., Evenson, A., Luckey, T.D., McCoy, E., Elvehjem, C.A. and Hart, E.B. (1946). Use of sulfasuxidine, streptothricin and streptomycin in nutritional studies with the chick. *Journal of Biological Chemistry* **165**: 437–441.

Morales JL (2004) Application of a probiotic supplement in the recovery of a layer replacement. Fourth Congress of Aviculture, Santiago de Cuba.

Mountzouris K.C., Tsirtsikos, P., Kalamara, E., Nitsch, S., Schatzmayr, G.and Fegeros, K. (2007). Evaluation of the efficacy of a probiotic containing Lactobacillus, Bifidobacterium, Enterococcus, and Pediococcus strains in promoting broiler performance and modulating cecal microfloracomposition and metabolic activities. *Poultr. Sci.,* **86**: 309–317.

Mountzouris, K.C., Beneas, H., Tsirtsikos, P. Kalamara, E., Fegeros, K. (2006). Efficacy of a new multi-strain probiotic product in promoting broiler performance and modulating the composition and activities of cecal microflora, *International Poultry Science Forum, Atlanta, Georgia.* 59 p.

Mutassim, M.A. (2013). Effects of feeding dry fat and yeast culture on broiler chicken performance. *Turk. J. Vet. Anim. Sci.* **37**: 31-37.

Nahashon S.N., Nakne, H.S., Mirosh, L.W. (1994). Production variables and nutrient retention in single comb white leghorn laying pullets fed diets supplemented with direct-fedmicrobials. *Poult. Sci.,* **73**:1699–1711.

Nasir, Z; Grashorn, M.A. (2006). Use of black cumin (Nigella sativa) as alternative to antibiotics in poultry diets, Proceedings of the 9th Tagung schweine-und geflügelernährung, Halle, Germany, 210-213 pp.

Nawaz, H., Naseem, M.A., Yaqoob, M. Ahmad, F.and Yousaf M. (2008). Effect of dry yeast (Saccharomyces cerevisiae) on live performance and carcass characteristics of broiler chicks. *Indi. J. Anim. Sci.* **78**: 117-120.

Ng, S.C., Hart, A.L., Kamm, M.A., Stagg, A.J., and. Knight, S. C.(2009). Mechanisms of action of probiotics: Recent advances. *Inflamm. Bowel Dis.* **15**: 300–310.

O'Dea, E.E., Fasenko, G.M., Allison, G.E., Korver, D.R., Tannock, G.W. and Guan, L.L. (2006). Investigating the effects of commercial probiotics on broiler chick quality and production efficiency. *Poultr. Sci.,* **85**: 1855–1863.

Onifade, A.A. Babatune, G.M. (1996). Supplemental value of dried yeast in a high fiber diet for broiler chicks. *Anim. Feed Sci. Technol.* **62**: 91- 96.(Abstract).

Owings, W.J., Reynoldas, D.L., Hasiak, R.J., Ferket, P.R. (1990). Influence of dietary supplementation with Streptococcus faecium M-74 on broiler body weight, feed conversion, carcass characteristics, and intestinal microbial colonization. *Poult. Sci.,* **69**: 1257-1264.

Pagan, J.D. (1990). Effect of yeast culture supplementation on nutrient digestibility in mature horses. *J. Anim. Sci.* **68**: 1.

Pan, M., and Chu, L.M. (2017). Leaching behavior of veterinary antibiotics in animal manure-applied soils. *Sci Total Environ*. **579**: 466–473.

Panda, A.K., Reddy, M.R.and Parahaj, N.K. (2001). Dietary supplementation of probiotic on growth, serum cholesterol and gut microflora of broilers. *Indian J. Anim. Sci.* **71**(50): 488-490.

Parks, C.W., Grimes, J.L., Ferket, P.R and Fairchild A.S. (2001). The effect of mannanoligosaccharides, bambermycins, and virginiamycin on performance of large white male market turkeys. *Poult. Sci.* **80**: 718–723.

Paryad, A. and M. Mahmoudi (2008). Effect of different levels of supplemental yeast *(Saccharomyces cerevisae)* on performance, blood constituents and carcass characteristics of broiler chicks. *Afr. J. Agri. Res*. **3**: 835-842.

Patterson, J.A., Burkholder, K.M. (2003). Application of prebiotics and probiotics in poultry production. *Poult. Science.* **82**: 627-631.

Pekoe, D., Gerzilov, V., Nikolova, and Genchev, (2004). Study on the effect of probiotic Lactina feeding in biofarming of Muskovy ducklings. Growth performance. *Anim. Sci.* **4**: 24-27 (in Bulgarian).

Popova T. (2017). Effect of probiotics in poultry for improving meat quality. *Curr Opin Food Sci.* **14**: 72–77.

Quadros, A.R.B., Kiefer, C., Ribeiro, N.L.C. and Zink, L.A. (2001). Características qualitativas da carne de suínos alimentados com rações contendo ou não probióticos. In:XXXVIII Reunião Anual da SBZ, Piracicaba. *Anais. Piracicaba, pp.* 794-795.

Ramesh, B.K., Satyanarayana, M.L., Gowda, R.N.S., Vijayasarathi S.K. and Rao S. (2000). Effect of *Lactobacillus acidophilus* on the growth of *Salmonella gallinarum* infected broilers. *Ind. J. Poult.Sci.***35**: 338-340.

Reid, G. and R. Friendship. (2002). Alternative to antibiotic use: Probiotics for the gut. *Anim. Biotechnol*. **13**: 97–112.

Roberfroid, M.B. (1996). Functional effects of food components and the gastrointestinal system: chicory fructooligosaccharides. *Butr. Rev*., **54**: S38-42.

Rolfe, R.D. (2000). The role of probiotic cultures in the control of gastrointestinal health. *Journal of Nutrient,* **130**: 3965–4025.

Rosen, G.D. (1995). Antibacterials in poultry and pig nutrition. *Biotechnology in Animal Feeds and Animal Feeding*. Weinheim, Germany, pp. 143–172.

Rusoff, L.L., Davis, A.V. and Alford, J.A. (1951). Growth-promoting effect of aureomycin on young calves weaned from milk at an early age. *Journal of Nutrition* **45**: 289–300.

Saegusa, S., Totsuka, M.. Kaminogawa, S. and Hosoi T. (2004). Candida albicans and Saccharomyces cerevisiae induce interleukin-8 production from intestinal epithelial-like Caco-2 cells in the presence of butyric acid. FEMS Immunal Med. Microbiol. **41**: 227–235.

Sahoo, K.C., Tamhankar, A.J., Johansson, E. and Lundborg. C.S. (2010). Antibiotic use, resistance development and environmental factors: A qualitative study among healthcare professionals in Orissa, India. *BioMedical Central Public Health*. **10**: 629.

Saleh, A.A., Eid, Y.Z., Ebeid, T.A., Ohtsuka, A., Hioki, K.and Yamamoto, M. (2012). The modification of the muscle fatty acid profile by dietary supplementation with aspergillus awamori in broiler chickens. *Br J Nutr*. **108**: 1596–1602.

Samli, H.E., Senkoylu, N., Koc, F., Kanter, M. and Agma, A. (2007). Effects of Enterococcus faecium and dried whey on broiler performance, gut histomorphology and intestinal microbiota. *Arch Anim Nutr*. . **61**: 42–49.

Santin, E., Maiorka, A., Macari, M., Grecco, M., Okada, T.M. and Myasaka, A.M., (2001). Performance and intestinal mucosa development of broiler chickens fed diets containing Saccharomyces cerevisiae cell wall. *J. Appl. Poult. Res*. **10**: 236–244.

Santin, E., Maiorka, A., Macari, M., Grecco, M., Sanchezi, J.C., Okada, T.M. and Myasaka, A.M. (2001). Performance and intestinal mucosa development of broiler chickens fed diets containing *Saccharomyces cerevisiae* cell wall. *J. Appl. Poult. Res.* **10**: 236-244.

Santin, E., Maoirka, A., Macari, M., Grecco, M., Sanchez, JC., Okada, T.M. and Myasaka, A.M. (2001). Performance and intestinal mucosa development of broiler chickens fed diets containing Saccharomyces cerevisiae cell wall. *J. Appl. Poultry Res*., **10**: 236-244.

Sato, K., Takahashi, K., Tohno, M., Miura, Y., Kamada, T. Ikegami, S. and Kitazawa. H. (2009). Immunodulation in gut-associated lymphoid tissue of neonatal chicks by immunobiotic diets. *Poult. Sci*. **88**: 2532–2538.

Shareef, A.M. and Al-Dabbagh A.S.A. (2009). Effect of probiotic (*Saccharomyces cerevisiae*) on performance of broiler chicks. *Iraqi J. Vet. Sci*. **23**: 23-29.

Shashidhara, R.G. and Devegowda, G. (2003). Effect of dietary mannan oligosaccharide on broiler breeder production traits and immunity. *Poult. Sci.* **82**: 1319–1325.

Shin , Y.W. , Kim, J.G., and Whang, K.Y. (2005b). Effect of supplemental mixed yeast culture and antibiotics on nitrogen balance of weaned pigs. *J. Anim. Sci.* **83**(Suppl. 1): 34.

Shin , Y.W. , Kim, J.G., and Whang. K.Y. (2005a). Effect of supplemental mixed yeast culture and antibiotics on growth performance of weaned pigs. *J. Anim. Sci.* **83**(Suppl. 1): 34.

Simon, O., Jadamus, A., Vahjen, W. (2001) Probiotic feed additives- effectiveness and expected modes of action. *J Anim Feed Sci* **10**: 51-67.

Spring , P. , Wenk, C., Dawson, K. A. and Newman K.E. (2000). The effects of dietary mannanoligosaccharides on cecal parameters and the concentrations of enteric bacteria in the ceca of Salmonella-challenged broiler chicks. *Poult. Sci.* **79**: 205–211.

Stanley , V.G. , Brown, C. and Sefton. A.E. (2000). Comparative evaluation of a yeast culture, mannanoligosaccharide and an antibiotic on performance of turkeys. *Poult. Sci.* **79**(Suppl. 1): 117. (Abstr.)

Stanley, V.G., Gray, C., Daley, M., Krueger, W.F. and Sefton, A.E. (2004). An alternative to antibiotic-based drug in feed for enhancing performance of broilers grown on Eimeria spp.-infected litter. *Poult. Sci.* **83**: 39–44.

Stanley, V.G., Gray, C., Daley, Krueger, M.W.F. and Sefton, A. E. (2004a). An alternative to antibiotic-based drugs in feed for enhancing performance of broilers grown on Eimeria spp.-infected litter. *Poult. Sci.* ***83***: 39–44.

Steiner, T. (2006). Managing gut health: natural growth promoters as a key to animal performance. Nottingham University Press, Nottingham, UK.

Surai, P.F. (2002). Natural antioxidants in avian nutrition and reproduction. Nottingham University Press, Nottingham, UK.

Tellez, G. (2008). Prebiotics, probiotics and symbiotic, its role on gut integrity. Av Tec By 5.

Teo A.Y.L., Tan, H.M. (2006). Effect of Bacillus subtilis PB6 (CloSTAT) on broilers infected with a pathogenic strain of Escherichia coli. *Journal of Applied Poultry Research.* **15**: 229-235.

Van Boeckel, T.P., Brower, C., Gilbert, M., Grenfell, B.T., Levin, S.A., Robinson, T.P., Teillant A, and Laxminarayan, R. (2015). Global trends in antimicrobial use in food animals. *Proceedings of the National Academy of Sciences*. **112**: 5649-5654.

van Heugten, E. , Funderburke, D.W. and Dorton. K.L. (2003). Growth performance, nutrient digestibility, and fecal microflora in weanling pigs fed live yeast. *J. Anim. Sci.* **81**: 1004–1012.

van, den Bogaard, A.E. and Stobberingh, E.E. (2000). Epidemiology of resistance to antibiotics: Links between animals and humans. International Journal of Antimicroial. Agents.;**14**: 327-335 44 Antimicrobial Resistance - A Global Threat.

Vargas Jr. JG., Toledo, R.S., Albino, L.F.T., Rostango, H.S., Oliveira, J.E., Carvalho, D.C.O. (2002). Características de carcaça de frango de corte, submetidos a rações contendo probióticos, prebióticos e antibióticos. In: XXXIX Reunião Anual da SBZ, Recife. Anais. Recife, CD ROM.

Visek, W.J. (1978). The Mode of Growth Promotion by Antibiotics. *Journal of Animal Science* **46**: 1447-1469.

Waldroup, P.W., Fritts, C.A. and Yan, F. (2003). Utilization of Mos mannan oligosaccharide and Bioplex® copper in broiler diets. *Int. J. Poultry Sci*. **2**: 44-52.

Walker, K., Skelton, H. and Smith, K. (2002). Cutaneous lesions showing giant yeast forms of Blastomycesdermatitidis. *J. Cutan. Pathol*. **29**: 616–618.

Wegener, H.C., Aarestrup, F.M., Jensen, L.B., Hammerum, A.M. and Bager, F. (1999). Use of antimicrobial growth promoters in food animals and *Enterococcus* *faecium* resistance to therapeutic antimicrobial drugs in Europe. *Emerging Infectious Diseases* **5**: 329–335.

White, L.A., Newman, M.C., Cromwell, G.L. and Lindemann, M.D. (2002). Brewers dried yeast as a source of mannan oligosaccharides for weanling pigs. *J. Anim. Sci.* **80**: 2619–2628.

Whitehill, A.R., Oleson, J.J. and Hutchings, B.L. (1950). Stimulatory effects of aureomycin in the growth of chicks. *Ibid* **74**: 11–13.

WHO. (2001). Food and agriculture organization of the united nations/world health organization (Fao/Who). Health and nutritional properties of probiotics in food including powder milk with live lactic acid bacteria. [Internet] Report of a Joint Fao/Who Expert Consultation. 2001.

Wierup, M. (2000). The control of microbial diseases in animals: alternatives to the use of antibiotics. *International Journal of Antimicrobial Agents* **14**: 315–319.

Witte, W. (1998). Medical consequences of antibiotic use in agriculture. *Science* . **279**: 996–997.

World Health Organization Model List of Essential Medicines. (2010). Geneva: World Health Organization: 1-43. Retrieved from essentialmedicines/en/ on 13th April, 2018.

World Health Organization (2012). The evolving threat of antimicrobial resistance: options for action.

World Health Statistics (2017): Monitoring Health for the Sustainable Development Goals. Geneva: World Health Organization; 2017. Retrieved from PDS_DOCS/B5348.pdf on the 10th April, 2018

Yang, Y., IjiP, A. and Choct, M. (2009). Dietary modulation of gut microflora in broiler chickens: a review of the role of six kinds of alternatives to in-feed antibiotics. *World. Poultry Sci. J.* **65**: 97-114.

Zhang, A.W., Lee, B.D., Lee, S.K., Lee, K.W., An, G.H., Song, K.B. and Lee. C.H., (2005). Effects of yeast (Saccharomyces cerevisiae) cell components on growth performance, meat quality, and ileal mucosa development of broiler chicks. *Poult. Sci.* **84**: 1015–1021.

Zhang Z.F., Cho J.H., Kim I.H. (2013). Effects of Bacillus subtilis Ubt-Mo2 on growth performance, relative immune Organ weight, gas concentration in excreta, and intestinal microbial shedding in broiler chickens. *Livest. Sci.* **155**: 343–347.

Zhang, S.J., Wang, X.U., Zhang, J. and Xie, Y.N. (2006). Effects of lanthanum on composition, crystal size, and lattice structure of femur bone mineral of Wistarrats. *Calcified Tissue International*, **78**(4): 241-247.

Zimmermann, B., Bauer, E., Mosenthin, R. (2001) Probiotics and prebiotics in pig nutrition potential modulators of gut health? *J. Anim. Feed Sci.* **10**: 47-56.

Zulkifli, I., Abdullah, N., Azrin, N. M. and Ho. Y. W., (2000). Growth performance and immune response of two commercial broiler strains fed diets containing Lactobacillus cultures and oxytetracycline under heat stress conditions. *Br. Poult. Sci.* **41**: 593–597.

CHAPTER VII

APPENDICES

Appendix 1. Effects of probiotics on production performances of broiler chicken

Treatment	Replication	Final Live Weight (G/Bird)	Total Feed Consumption (G/Bird)	Total Body Weight Gain(G/Bird)	Final FCR	Survivability
T_1	R_1	1867.38	2403.71	1825.38	1.32	100
	R_2	1756.13	2321.71	1714.13	1.36	100
	R_3	1835.25	2359.12	1793.25	1.32	100
T_2	R_1	1826.63	2361.66	1784.63	1.32	100
	R_2	1860.88	2336.50	1818.88	1.29	100
	R_3	1869.88	2385.49	1827.88	1.31	100
T_3	R_1	1817.00	2283.26	1775.00	1.29	100
	R_2	1903.13	2346.39	1861.13	1.26	100
	R_3	1926.88	2361.89	1884.88	1.25	100
T_4	R_1	1778.88	2313.59	1736.88	1.33	100
	R_2	1875.75	2374.62	1833.75	1.30	100
	R_3	1839.88	2372.01	1797.88	1.32	100
T_0	R_1	1612.50	2184.83	1570.50	1.39	100
	R_2	1879.00	2270.47	1837.00	1.24	100
	R_3	1661.00	2227.25	1619.00	1.38	100

Appendix 2: Recorded Temperature & Relative Humidity% During Experimental period

Age in weeks	Period	Average Temperature ^{0}C	Average Humidity %
1st	27.08.19-03.09.19	31.1	79.0
2nd	04.09.19-10.09.19	30.0	78.5
3rd	11.09.19-17. 09.19	29.6	78.0
4th	18.09.19-24.09.19	30.9	76.87

Appendix 3. Effects of probiotics Dressing percentage of broiler chicken (g/bird)

Treatment	Replication	Average Live Weight	Eviscerated Weight	Dressing %
T_1	R_1	1867.38	1330.0	71.22
	R_2	1756.13	1356.5	77.24
	R_3	1835.25	1383.0	75.37
T_2	R_1	1826.63	1283.0	70.25
	R_2	1860.88	1268.0	68.14
	R_3	1869.88	1298.0	69.41
T_3	R_1	1817.00	1324.0	72.76
	R_2	1903.13	1389.0	72.98
	R_3	1926.88	1454.0	75.45
T_4	R_1	1778.88	1297.5	72.93
	R_2	1875.75	1301.0	69.36
	R_3	1839.88	1294.0	70.33
T_0	R_1	1612.50	1287.0	79.18
	R_2	1879.00	1376.0	73.23
	R_3	1661.00	1331.5	80.16

Appendix 4. Effects of probiotics on carcass characteristics of broiler chickens (g/bird)

Treatment	Replication	Breast	Back	Thigh	Drumstick	Wing	Neck
T_1	R_1	616.0	226.0	201.0	141.0	89.0	57.0
	R_2	602.5	232.0	212.0	161.0	96.5	52.5
	R_3	589.0	238.0	223.0	181.0	104.0	48.0
T_2	R_1	502.5	217.5	208.5	202.5	103.0	49.0
	R_2	505.0	233.0	191.0	191.0	102.0	46.0
	R_3	500.0	202.0	226.0	214.0	104.0	52.0
T_3	R_1	516.0	243.0	212.0	200.0	105.0	48.0
	R_2	566.0	232.0	229.5	204.5	107.0	50.0
	R_3	616.0	221.0	247.0	209.0	109.0	52.0
T_4	R_1	531.0	251.0	186.0	192.0	92.0	45.0
	R_2	555.0	257.0	171.0	177.0	94.0	47.0
	R_3	507.0	246.0	201.0	207.0	90.0	43.0
T_0	R_1	505.0	236.0	221.0	181.0	97.0	47.0
	R_2	585.0	258.0	195.0	195.0	93.0	50.0
	R_3	545.0	247.0	208.0	188.0	98.7	49.0

Appendix 5. Effects of probiotics on internal organs of broiler chicken under different treatment group (g/bird)

Treatment	Replication	Liver	Heart	Gizzard	Proventriculus	Spleen
T_1	R_1	62.0	13.0	25.0	09.0	1.85
	R_2	57.0	13.0	30.5	09.0	1.88
	R_3	52.0	13.0	36.0	09.0	1.90
T_2	R_1	61.0	12.5	32.0	12.5	1.84
	R_2	63.0	12.0	32.0	11.0	1.56
	R_3	59.0	13.0	32.0	14.0	2.12
T_3	R_1	64.0	10.0	38.0	09.0	1.60
	R_2	59.5	11.0	35.0	10.5	1.42
	R_3	55.0	12.0	32.0	12.0	1.24
T_4	R_1	55.5	11.0	40.0	11.0	1.96
	R_2	50.0	10.0	38.0	11.0	1.58
	R_3	61.0	12.0	42.0	11.0	2.34
T_0	R_1	42.0	10.0	27.0	08.0	1.71
	R_2	67.0	12.0	38.0	09.0	1.25
	R_3	54.5	11.0	32.5	8.5	1.48

Appendix 6. Effects of probiotics on uniformity of broiler chicken

Treatment	Replication	Uniformity(%)	Average uniformity (%)
T_1	R_1	75.0	75.00
	R_2	87.5	
	R_3	62.5	
T_2	R_1	75.0	79.27
	R_2	87.5	
	R_3	75.0	
T_3	R_1	87.5	66.67
	R_2	50.0	
	R_3	62.5	
T_4	R_1	50.0	58.33
	R_2	75.0	
	R_3	50.0	
T_0	R_1	87.5	91.67
	R_2	87.5	
	R_3	100.0	

Appendix 7. Effects of probiotics on body weight gain (BWG) (g/bird) of broiler chicken at different weeks (g/bird)

Treatment	Replication	1st week BWG	2nd week BWG	3rd week BWG	4th week BWG	Total BWG
T_1	R_1	145.50	374.50	646.25	701.13	1825.38
	R_2	148.63	355.12	591.25	661.13	1714.13
	R_3	144.25	354.00	614.25	722.75	1793.25
T_2	R_1	153.63	347.62	625.00	700.38	1784.63
	R_2	154.25	378.63	635.87	692.13	1818.88
	R_3	154.25	378.25	603.75	733.63	1827.88
T_3	R_1	140.50	375.75	603.75	697.00	1775.00
	R_2	151.75	388.25	627.5	735.63	1861.13
	R_3	156.13	377.62	651.25	741.88	1884.88
T_4	R_1	136.13	336.37	607.50	698.88	1736.88
	R_2	156.75	372.00	647.50	699.50	1833.75
	R_3	149.25	387.00	596.25	707.38	1797.88
T_0	R_1	152.37	339.76	592.25	528.12	1570.50
	R_2	156.75	357.00	643.38	721.88	1837.00
	R_3	156.75	328.25	671.25	604.75	1619.00

Appendix 8. Effects of probiotics on feed consumption (FC) (g/bird) of broiler chickens at different weeks (g/bird)

Treatment	Replication	1st week FC	2nd week FC	3rd week FC	4th week FC	Total FC
T_1	R_1	182.96	406.25	812.50	1002.00	2403.71
	R_2	183.58	419.38	785.50	933.25	2321.71
	R_3	178.49	418.13	777.50	985.00	2359.12
T_2	R_1	179.78	408.13	812.50	961.25	2361.66
	R_2	178.37	413.75	781.25	963.13	2336.50
	R_3	179.99	407.75	812.50	985.25	2385.49
T_3	R_1	179.51	406.25	812.50	885.00	2283.26
	R_2	178.88	420.63	763.50	983.38	2346.39
	R_3	179.76	426.25	772.50	983.38	2361.89
T_4	R_1	178.58	406.25	759.63	969.13	2313.59
	R_2	177.24	408.25	812.50	976.63	2374.62
	R_3	176.00	409.38	812.50	974.13	2372.01
T_0	R_1	184.58	412.75	733.75	853.75	2184.83
	R_2	183.58	401.88	757.13	927.88	2270.47
	R_3	178.50	407.50	735.00	906.25	2227.25

Some pictorial view of my experiment

Plate 01: Preparation of farm (Cleaning and disinfection)

Plate 02: Bruder preparation and chick receiving

Plate 03: Chick observation, preparation of stall and chick distribution

Plate 04: Yeast based probiotics measurement

Plate 05: Data collection and supervisor observation

Plate 06: Final observation and data collection

Plate 07: Medicine used during experimental period

Plate 08: Vaccine and medicine used in farm

Plate 09: Feed analysis in ANGB laboratory