Sudan University of Science and Technology

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Effect of Commercial Synbiotic (Bacflora) on the Performance and Carcass Characteristics of Broiler Chicks

اثر السينبايوتك التجاري (الباكفلورا) في الأداء الإنتاجي وخصائص الذبيح للدجاج اللاحم

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الآية

قال تعالى:

وَمَا مِنْ دَابَّةٍ فِي الْأَرْضِ وَلَا طَائِرٍ يَطِيرُ بِجَنَاحَيْهِ إِلَّا أُمَمٌ أَمْثَالُكُمْ مَا فَرَّطْنَا فِي الْكِتَابِ مِنْ شَيْءٍ ثُمَّ إِلَى رَبِّهِمْ يُحْشَرُونَ

صدق الله العظيم

سورة الأنعام الآية (38)

Dedication

I am pleased to dedicate this work and extend my deepest thanks, gratitude and appreciation to the family of Post Graduate in animal Production which were and still give generously the renewed nectar of science and providing the opportunities

Singled I dedicate this to all my colleagues who have been the good companions in the journey of knowledge.
I dedicate this to every reader who gave precious time and attention Reading this research.

Acknowledgement

First praise and thanks to ALLAH to spire me to work on this topic and giving me strength and patient to complete this work successfully

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Abstract

This experiment was conducted to study the effect of different levels of synbiotic on the performance, carcass characteristics, serum attributes and economical appraisal of broiler chicks . Atotal of one hundred and five , seven days old, unsexed Arbor Acers strain were used. Chicks were divided into five experimental (A,B,C,D and E) dietary diets, each treatment was further subdivided into five replicates in a complete randomized design .The first group (A) fed on control diet as negative control diet, group (B) fed on control diet supplemented with (0.5mg /kg) klavamycin as positive control diet, groups C,D and E were fed on negative control diet supplemented with 0.5mg/kg , 1mg/kg and 2mg/kg symbiotic respectively .Experimental diets were fed for five weeks .

Results obtained showed that supplementing of broiler diets with synbiotic recorded significantly ($P<0.05$) heavy body weight, weight gain and more feed consumption while no significant ($P>0.05$) effect in FCR compared to both NC and PC was observed.

Result also showed no significant differences for non carcass components, commercial cuts and their meat/bone ratio components among the various treatment groups.

Result obtained for meat chemical attributes revealed a significant ($P<0.05$) increase in the values of protein , fat , total solids , T.N.F and acidity for chicks fed on diet supplemented with synbiotic compared with both NC and PC groups, while biochemical serum values showed no significant difference between tested treatment groups

The result of economical evaluation of experimental diets showed that the addition of synbiotic at various levels to the diet of broiler caused more profit compared to NC groups.

The result of this study showed that synbiotic can be used as a good alternative to antibiotic in broiler diets as growth promoter without any adverse effects.

ملخص البحث

أجريت هذه التجربة لدراسة اثر مستويات مختلفة من المعزز الميكروبي الحيوي علي الاداء الإنتاجي ، خصائص الذبيح ،خواص مصل الدم والتقييم الاقتصادي للدجاج اللاحم.

استخدمت 105 كتكوت عمر أسبوع يوم غير مجنسة من سلالة اربورايكر.

قسمت الكتاكيت إلي خمس معاملات (أ ، ب ، ج ، د ، ه) عن طريق التوزيع العشوائي الكامل ثم تم تركيب خمس علائق.

غذيت المجموعة (أ) علي العليقة القياسية (العليقة السالبة) والمجموعة (ب) علي العليقة القياسية مضافا إليها المضاد الحيوي (0.5كجم/طن كلفامايسين العليقة الموجبة)، والمجموعات (ج ، د ، ه) علي المجموعة القياسية السالبة مضافا إليها المعزز الميكروبي الحيوي 0.5 ،1 ، 2ملم/ كجم علي التوالي. استخدمت علائق التجربة لمدة خمس أسابيع.

أظهرت النتائج أن إضافة المعزز الميكروبي الحيوي لعلائق الدجاج اللاحم سجلت فروقات معنوية موجبة ($P<0.05$) في وزن الجسم الحي والوزن المكتسب والعليقة المستهلكة مع عدم وجود اثر معنوي ($P>0.05$) في معدل التحويل الغذائي مقارنة بالعليقة القياسية السالبة والعليقة القياسية الموجبة.

أظهرت النتائج عدم وجود فرق معنوي في مكونات الذبيح غير المأكولة ونسبة اللحم والعظم للقطع التجارية بين المعاملات المختلفة.

كما أظهرت نتائج تحليل خواص اللحم الكيميائية فروقات معنوية ($P<0.05$) في زيادة قيم البروتين، الدهن ، والمواد الغير ذائبة في الدهن والحموضة في الدجاج المغذاه علي العليقة المضاف إليه المعزز الميكروبي الحيوي مقارنة بالعليقة القياسية السالبة والموجبة.

بينما لا يوجد فرق معنوي في قيم تحليل مصل الدم الكيميائي لكل مجموعات التجربة.

أوضحت نتيجة التقييم الاقتصادي لعلائق التجربة أن إضافة المعزز الميكروبي الحيوي بالمستويات المختلفة لعلائق الدجاج اللاحم يسبب ربحية عالية مقارنة بالعليقة السالبة والموجبة.

أوضحت نتائج هذه التجربة ان المعزز الميكروبي الحيوي بإمكانه أن يستخدم كبديل جيد للمضاد الحيوي في علائق الدواجن كمحفز نمو دون آثار سالبة.

CHAPTER ONE

INTRODUCTION

Poultry production, particularly broiler production is the quickest way to increase the availability of high quality protein for human consumption. Since the feed cost alone contributes to about 70-75% of the total cost of production, economically poultry production is, therefore, possible only when the feed cost is reduced and efficiency of feed utilization is increased (Qureshi, 1991).

Poultry Feed is probably the most important entity in the poultry industry that can expose the birds to a wide variety of factors through the gastrointestinal tract (GI). The importance of feed supplementation in poultry production has increased in the last years with the aim of improving the economic situation of poultry projects (Zeweil *et al*., 2006).

The use of antibiotics to promote growth and control diseases in farm animals has been the usual practice for many decades among farmers (Plail, 2006; Zeweil *et al*., 2006; Akinleye *et al*., 2008). But by long-term use, side effects of antibiotics occur, like residues in meat.

One way is to use specific feed additives or dietary raw materials to favorably affect animal performance and welfare, particularly through the modulation of the gut microbiota which plays a critical role in maintaining host health (Tuohy *et al*., 2005).

Invariably the various alternatives to antibiotic growth promoter (AGP) as well as means of enhancing performance in poultry, while reducing economic losses, due to enteric infections is directed majorly at the gut which functions, for nutrient digestion and absorption as well as immunological organ. Other feed additives such as probiotics, prebiotics and enzymes can modulate the gut microflora and performance of broiler chickens (Choct, 2009).

The most common types of feed additives used are : Antibiotics and arsenicals which used to help protect feeds from microbial destruction to prevent production of toxic products by the intestinal micro flora , probiotics , prebiotics , essential oils , enzymes , vitamins and synbiotic.

Recent development and applications of synbiotic products (probiotic and prebiotic) have focused on the assessment of beneficial effects in poultry health and production; however, information available to date is scarce. Mohnl *et al*. (2007) found that a synbiotic product had a comparable potential to improve broiler performance as avilamycin treatment.

The objective of this study was to evaluate the effect of different levels of bacflora (synbiotic) on the performance, carcass characteristics, serum constituents and economical appraisal of broiler chicks.

CHAPTER TWO

2. LITERATURE REVIEW

2.1 Antibiotics

The growth promoter effect of antibiotics was discovered in the 1940s, when it was observed that animals fed dried mycelia of Streptomyces aureofaciens containing chlortetracycline residues improved their growth. The mechanism of action of antibiotics as growth promoters is related to interactions with intestinal microbial population (Dibner and Richards, 2005; Niewold, 2007). It is commonly known that the sub-therapeutic use of antibiotic growth promoters (AGP) in poultry production may result in the development of antibiotic-resistant pathogenic bacteria, which may be hazardous to human health. In search of effective alternatives to AGP, especial attention is given to their effect on gut microbial community which contributes to the intestine function. Until now, the interest has been focused mainly on fermentable functional feed ingredients, like fructans, or mannanoligosaccharides that exhibit beneficial effect on gut microflora, integrity of intestinal mucosa, enzymes activity and performance parameters in broiler chickens (Kim *et al*., 2011; Bogusławska-Tryk *et al*., 2012;. Nabizadeh, 2012). An insoluble, non-fermentable fiber fraction, including cellulose and lignin, is conventionally Considered as a diet diluent which can influence energy balance of broilers (Svihus and Hetland, 2001; Kras *et al*.,2013), whereas little attention is given to the effect of cellulose or lignin on the gastrointestinal microflora population. However, studies show that cellulose, as an effective feed ingredient, may influence the number of gut bacteria, especially beneficial Bifidobacterium and Lactobacillus as well as potential pathogens and its effect depends on the level of cellulose supplementation and bird age (Cao *et al*., 2003; Shakouri *et al.*, 2006; Saki *et al*., 2010). It is generally accepted that phenolic fragments of purified lignin exhibit the antimicrobial properties (Baurhoo *et al*., 2008).

The sub-therapeutic use of antibiotics as growth promoters is a public health concern because of the transfer of antibiotic-resistant microorganisms. 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.

Antibiotic feed additives as growth promoters have long been supplemented to poultry feed to stabilize the intestinal microbial flora and improve the general performances and prevent some specific intestinal pathologies (Truscott and Al-Sheikhly, 1977; Miles *et al*., 1984; Waldroup *et al*., 1985).The increasing interest in the use of bacteria as probiotics has prompted a number of organizations to recommend guidelines for their use (FAO⁄WHO 2002; Sanders 2003).

Bedford (2000) pointed out that the growth-promoting effects of antibiotics in animal diets are clearly related to the gut microflora because they exert no benefits on the performance of germ-free (GF) animals.

2.2 Antibiotic Use in Animal Feed:

Antibiotics as prophylactic and growth promoting compounds has long been practiced in commercial poultry farming.

However, the using of antibiotics as feed additives is risky due to, not only cross-resistance, but also to multiple resistance in pathogens (Neu,1992;Bach Knudsen, 2001; Schwarz *et al*., 2001) .

Therefore, antibiotics have been discredited by consumer associations as well as by scientists, e.g. the use of most antibiotic growth promoters has been banned by the European Union (EU). Consequently, the animal feed industry is under increasing consumer pressure to reduce the use of antibiotics as a feed additive and find substitutes for antibiotics in the diet (Humphrey *et al*.,

2002). Many scientists have searched for alternatives to antibiotics (Langhout, 2000; Mellor, 2000; Wenk, 2000; Kamel, 2001).

Antibiotics are the main tool sutilised to prevent or treat such infections. In animals, antibiotics are also added to the feed as growth promoters and to accelerate the growth of healthy animals.

Unfortunately, the long term and extensive use of antibiotics for veterinary purpose may eventually result in selection for the survival of resistant bacteria species or strain (Aarestrup, 1999).

2.3 Probiotics:

2.3.1 Definition of probiotics:

In animal nutrition probiotics are defined as viable microorganisms, which lead after sufficient oral intake to beneficial effects for the host animal because of an improvement of the intestinal microbial balance (Fuller, 1989). This definition differs from that used in human nutrition, where health promoting effects are the main scope of using microorganisms as additives in food (Sanders, 2000).

Probiotics are mono-or mixed culture of living microorganisms, which induce beneficial effect on the host by improving the properties of the indigenous microflora (Ghadban, 2002).

Probiotics are viable micro-organisms that should lead to beneficial effects for the host animal due to an improvement of the intestinal microbial balance, or the properties of the indigenous micro-flora (Havernaar *et al*, 1992).

Probiotics have been defined by Collins and Gibson (1999) as “a live microbial feed supplement which beneficially affects the host animal by improving its intestinal balance”. This description on the mode of action of probiotics shows that there still is no consistent data to precisely explain

probiotics effects. Our knowledge about the mode of action of probiotics is very limited (Simon *et al* 2003).

Probiotics are known as live microbial feed supplements, digestive bio-regulators or direct-fed microbial (Fuller, 1995), as health-promoting bacteria inhabiting the gastrointestinal tract of humans and animals (Gong, *et al*,2002).

Probiotics are viable microbial additives which assist in the establishment of an intestinal population which is beneficial to the animal and antagonistic to harmful microbes (Green and Sainsbury, 2001).

Probiotics are microorganisms able to multiply and adapt quickly to the intestines of most animals and capable of preventing unwanted bacteria from attaching themselves in the GIT.

Molecular approaches identifying changes in specific bacterial populations or general changes in microbial community structure should enhance our understanding of intestinal microbial ecology, including the influence of probiotics and prebiotics (Apajalahti *et al*., 1998; Netherwood *et al*., 1999; Gong *et al*., 2002; Zhu *et al*., 2002).

2.3.2 Three groups of probiotics:

most commonly used in animal nutrition are bacteria, spores and yeasts, e.g., *Bacillus, Bifidobacterium, Enterococcus, E. coli, Lactobacillus,* Lactococcus, *Streptococcus, Pediococcus* species, and *Saccharomyces cerevisiae* (Patterson and Burkholder, 2003; Kabir *et al*., 2004; Mountzouris *et al*., 2007).

The major probiotic strains include *Lactobacillus, Saccharomyces, Bacillus, Streptococcus* and *Aspergillus* , Moreover, *Saccharomyces cerevisiae* could act as bioregulator of the intestinal micro flora and reinforcing the host natural defenses, through the sanitary effect by increasing the colonization resistance and stimulation of the immune response (Line *et al*., 1998).

2.3.3 Use of Probiotic in broiler feeds:

The health benefits attributed to probiotic bacteria can be summarized as nutritional benefits, enhancing bio-availability of some minerals, synthesis of vitamins, increase in natural resistance to infectious diseases of the intestinal tract, prevention diarrhea, reduction of serum cholesterol, reduction of lactose intolerance, enhancement of immune system, pre-digestion of proteins, improved absorption, enhancement of bowel motility and maintenance of mucosal integrity (Ziemer and Gibson,1998; Holzaphel and Schillinger, 2002; Collins and Gibson,1999).

Probiotics are defined as feed additives that contain live microorganism and promote beneficial macrobiota (Fuller 1989, Huang *et al*., 2004), probiotics improve immunity and live weight gain and feed conversation rate of broiler (Jin *et al* , 2000;Zulkifli *et al*.,2000; and Huang *et al* , 2004) , and improve broiler growth performance and prevent poultry pathogens and diseases (Owings *et al*., 1990; Jin *et al*., 1998; Zulkifli *et al*., 2000 ; Kalavathy *et al* ., 2003; Kabir *et al*.,2004 ;Gil De los Santos *et al*.,2005 ;Timmerman *et al*., 2005;Mountzouris *et al*., 2007 and Awad *et al*., 2009) .

Probiotic efficacy depends several factors, such as microbial species composition (e.g., single or multi strain) and viability ,application procedure , dosing level , frequence of application , age , type of diet, sanitation and environmental stereos factors . However ,beneficial effects of probiotic on broilers including: performance (Mountzouris *et al*., 2007) modification of intestinal microflora (Mountzouris *et al* ., 2007), nutrient digestibility (Apata , 2008) and immunomodulation and gut mucosal immunity (Farnell *et al* ., 2006) have been reported. These positive effects by application of probiotics could be related to increase population of beneficial microflora and removal of pathogenic bacteria by means of competitive exclusion and antagonism (Fuller , 1989) ; adapting bacterial metabolism (Jin *et al* ., 1997); improving feed intake digestion and absorption (Nahanshon *et al*., 1992) and

stimulating the immune system (Flore *et al*., 2010) .The enhancement of the of immune system may be in relation to increase production of antibodies production of antibodies particularly ImmunoglobulinA and ImmunoglobulinG (lgA and lgG) classes and also . increase local antibodies at mucosal surface such as gut wall (usually lgA) (Koenen *et al* ., 2004).

Gong *et al*. (2002) define probiotics as health-promoting bacteria inhabiting the gastrointestinal tract of humans and animals. Research is focused on identifying beneficial bacterial strains and substrates along with the conditions (Patterson and Burkholder, 2003).

2.3.4 The beneficial modes of action:

include: regulation of intestinal microbial homeostasis, stabilization of the gastrointestinal barrier function (Salminen *et al*., 1996), expression of bacteriocins (Mazmanian *et al*., 2008), enzymatic activity inducing absorption and nutrition (Hooper *et al*., 2002; Timmerman *et al*., 2005), immunomodulatory effects (Salzman *et al*., 2003), inhibition of procarcinogenic enzymes and interference with the ability of pathogens to colonize and infect the mucosa (Gil De los Santos *et al*.,2005). The main action of probiotics is a reinforcement of the intestinal mucosal barrier against deleterious agents Removing antibiotics as growth promoters in recipes for chicken meat has led to a need to improve biosecurity, genetic selection and also their replacement by new products such as probiotics, prebiotics, essential oils and organic acids (Simeanu, 2004).

Probiotic supplementation, especially with lactobacillus species, has also shown beneficial effects on resistance to the other infectious agents such as Clostridium population (Decroos *et al*., 2004) and Campylobacter (Stern *et al*., 2001). Regarding the gut microbiota of normal birds, the results of probiotics supplementation are variable because of the difference in origin, strain as well as species of probiotics. Reduced caecal coliform populations

were noticed in chickens given a diet supplemented with lactobacilli strains, isolated from chicken intestine, but the populations of other kinds of bacteria were not affected (Watkins and Kratzer, 1984; Jin *et al*., 1998a, 1998b)

Lactobacillus, Enterococcus, Bacillus and Saccharomyces are actually the most used probiotics in livestock and poultry. Many studies indicate that the organisms cited on the labels of certain probiotic products are not actually contained within the product and often the products contain other species than those claimed on the label (Huff, 2004; Mattarelli *et al*., 2002; Wannaprasat *et al*., 2009) .

2.3.5 Efficiency of probiotic in farm animals:

Since probiotics are discussed as alternatives to antimicrobial growth promoters their impact on performance of farm animals is of prime interest. For authorization of microorganisms as feed additives it is also required to show significant effects on performance data (Simon *et al*., 2003).

Published experimental and commercial studies have shown that these selected probiotic organisms are able to reduce idiopathic diarrhea in commercial turkey brooding houses (Higgins *et al*., 2005).

2.3.6 The mechanism of action of probiotics against Salmonella:

Probiotics are defined as live microorganisms that, when administered in adequate amounts, confer a health benefit on the host. Among the many benefits associated with the consumption of probiotics, modulation of the immune system has received the most attention (Borchers *et al*.,2002; Borchers *et al* ., 2009).

Previously, it was thought that administration of bacteria such as probiotics to neonates directly reduced infection by pathogens due to ‘competitive exclusion’ between the bacteria. Competitive exclusion was first described in 1973 by Nurmi and Rantalla (1973), citing that bacteria compete with each

other for space and nutrients. Their data indicated that early administration of 'good' bacteria prevented infection by pathogens. Since Nurmi and Rantala proposed that competitive exclusion could be used as a method to prevent salmonella infection, numerous researchers have reported the ability of live bacterial cultures (Callaway *et al*., 2008; Corrier *et al*., 1998; Hollister *et al*., 1999; Hume *et al*., 1998; Nisbet *et al*., 1998; Wagner *et al*., 2003) and probiotic organisms (Higgins *et al*., 2007; Higgins *et al*., 2010; S. E. Higgins *et al*., 2008;Patterson and Burkholder, 2003; Vicente *et al*., 2008) to also reduce colonization of opportunistic pathogens in the gastrointestinal tract. Yet our understanding of how probiotics mediate these health benefits, specifically reduction of Salmonella infection, is very limited. Balanced colonic microflora and immunostimulation are major functional effects attributed to the consumption of probiotics (Amit-Romach *et al*., 2010; Boirivant *et al*., 2008; Boirivant and Strober, 2007; Flint *et al*., 2010; Flore *et al*., 2010; Ibrahim *et al*., 2010; Klein *et al*., 2010; Nayak, 2010). Many probiotic effects are mediated through immune regulation, particularly through balance control of proinflammatory and anti-inflammatory cytokines (Di Giacinto *et al*., 1950; Foligne *et al*., 2010; Hacini-Rachinel *et al*., 1950; Jobin, 2010; Li, Xia, and Li, 2009).

Phytogenic feed additives were also reported to stimulate intestinal secretion of mucus in broilers, an effect that was assumed to impair adhesion of pathogens and thus to contribute to stabilizing the microbial eubiosis in the gut of the animals (Jamroz *et al*., 2006).

Morphological changes in gastrointestinal tissues caused by phytogenic feed additives may provide further information on possible benefits to the digestive tract; however, the available literature does not provide a consistent picture. Available reports have shown increased, unchanged, and reduced villi length and crypt depth in the jejunum and colon for broilers and pigs treated with

phytogenic feed additives (Namkung *et al*., 2004; Demir *et al*., 2005; Jamroz *et al*., 2006; Nofrarias *et al*., 2006; Oetting *et al*., 2006).

2.4 Prebiotics :

2.4.1 Definition of prebiotic

Prebiotics are now defined as "selectively fermented ingredients that allow specific changes, both in the composition and/or activity in the gastrointestinal microbiota that confers benefits upon host well-being and health" (Gibson *et al*., 2004).

Gibson and Roberfroid (1995) defined a prebiotic as a non-digestible food ingredient which beneficially affects the host by selectively stimulating the growth of and/or activating the metabolism of one or a limited number of health-promoting bacteria in the intestinal tract, thus improving the host's microbial balance. Any dietary ingredient that can reach the colon has the potential of being a prebiotic.

2.4.2 Criteria of a food ingredient as a prebiotic:

It must be neither hydrolyzed, nor absorbed in the upper part of the gastro-intestinal tract, Selective fermentation by potentially beneficial bacteria in the colon, Alteration in the composition of the colonic microbiota towards a healthier composition, Preferably, induce effects which are beneficial to the host health.

The certain carbohydrates in the form of oligo- and polysaccharides, meeting the criteria of prebiotics, have been isolated from different natural sources at large scale by using different technologies and have become commercially available. There are many prebiotic oligosaccharides in the markets including fructo-oligosaccharides, inulin, galactooligosaccharides, soybean oligosaccharides, xylooligosaccharides, lactulose, gentio-oligosaccharides, raftiloses, raftiline, isomalto-oligosaccharides and mannan-oligosaccharides

(Gibson and Roberfroid, 1995;Ziemer and Gibson,1998; Holzaphel and Schillinger , 2002 ;Tuohy *et al*.,2005; Gibson.,1998 and Saminathan *et al*., 2011).

To sustain poultry production to meet global demand, antibiotic replacements are needed. Among the feed additives evaluated to date in poultry, prebiotics are considered favorable alternatives, because they can promote competitive exclusion of pathogenic microbes and selective colonization by beneficial microbes (Biggs *et al*., 2007).

2.4.3 The use of prebiotics in broiler's diets:

The use of prebiotics in broiler's diets does not have a long history. Several authors have observed the positive effects of prebiotics fractions included in the broiler's diet (Yang *et al*., 2009). reported supplemented with inuline had higher body weight gain and increased growth performance, dressing percentage, breast and thigh muscle weight (Park *et al*., 2010) , perbiotics improved digestion in clouding enhancing mineral absorption (Coxam VCNOV 2007). Gibson and Roberfroid (1995) defined prebiotics as the food ingredients that provide beneficial effect to the host by selectively stimulating the growth and/or metabolism of a limited group of bacteria in the intestinal tract, acting closely to probiotics because it would constitute the “food” of probiotic bacteria and also blocking adherence sites, immobilizing and reducing the fixation capacity of pathogenic bacteria in the intestinal mucous. This association favors the intestinal microbiota by the action of prebiotics that are able to link themselves to the fimbriae of pathogenic bacteria, conducting them along the fecal bolus, stimulating the growth and accelerating the metabolism of alimited number of non-pathogenic microorganisms.The action of probiotics is added to this mechanism, making easy the nutrition of cells (enterocytes) that recover the digestive tract and provide balance and intestinal health to birds.

Most probiotics are approved for the claim of improving performance (daily weight gain, feed conversion ratio). However, the explanation of the mode of action is based mainly on hypotheses. This includes modifications of the intestinal microbial population, of the morphology and transport properties of the intestinal mucosa. Furthermore, modifications of the immune system are discussed. The main aspects were reviewed several years ago (Simon *et al*., 2001)

Prebiotics have been shown to alter gastrointestinal microflora, alter the immune system, prevent colonic cancer, reduce pathogen invasion including pathogens such as Salmonella Entritidis and *E.coli* and reduce cholesterol and odor compounds (Cummings and Macfarlane, 2002).Also, prebiotics supplementation of broilers diet result in an increase of the pH of the GIT and useful bacteria population such as *lactobacillus* and *bifidobacteria*, due to increasing production of volatile fatty acids (Ziggers.,2000).

Prebiotics such as inulin, Fructo-oligosaccharides (FOS), Isomaltooligosaccharides (IMO) and Mannan Oligosaccharides (MOS) have been defined by Gibson and Roberfroid (1995) as non-digestible food ingredients that selectively stimulate the growth and activity of one or a limited number of bacteria in the intestine that can improve the host health (Gibson and Roberfroid, 1995).

Prebiotics have been reported to produce a beneficial effect upon the animal that receives them. This is due to the proliferation of certain beneficial bacteria such as *Bifidobacterium sp*. and *Lactobacillus sp*. or an increase in their metabolic activity (Gibson and Roberfroid, 1995). Inulin, FOS and IMO are reported to be substrates for certain species of beneficial bacteria (Chung and Day, 2004).

Prebiotics have the advantage, compared with probiotics, that bacteria are stimulated which are normally present in the GIT of that individual animal

and therefore already adapted to that environment (Snel *et al*., 2002). The dominant prebiotics are fructo-oligosaccharide products (FOS, oligofructose, inulin) (Patterson and Burkholder, 2003); gluco-oligosaccharides, stachyose, malto-oligosaccharides, andoligochitosan have also been investigated in broiler chickens (Zhang *et al*., 2003; Gao and Shan, 2004; Jiang *et al*., 2006; Huang *et al*., 2007).

Prebiotics may enhance the digestibility and performance parameters by creating the favourable conditions for beneficial bacteria (Steiner, 2006). Several carbohydrates that may be fermented by intestinal microorganisms can be classified as prebiotics (Bauer *et al*., 2006)

The primary ones are the type and inclusion level of the supplement as high dosage of prebiotics can have negative effects on the gut system and retard the growth rate of birds as observed by Biggs *et al*. (2007). It is reported that rapid fermentation of prebiotics, leading to high concentrations of organic acids, impaired the barrier function, which reduced the ability of rats to resist salmonella infection (Ten Bruggencate *et al*., 2003). It may also be worthwhile to examine the interaction between prebiotics and bird sex. In the report by Yusrizal and Chen (2003), body weight and feed conversion ratio (FCR) of female birds were improved by 10% and 9%, respectively, on oligofructose treatment but no such effects were observed in males.

2.4.4 Criteria of prebiotic:

For a dietary substrate to be classed as a prebiotic, at least three criteria are required: (1) the substrate must not be hydrolysed or absorbed in the stomach or small intestine, (2) it must be selective for beneficial commensal bacteria in the large intestine such as the bifidobacteria, (3) fermentation of the substrate should induce beneficial luminal/systemic effects within the host. (Scantlebury- Manning and Gibson, 2004).

The prebiotic approach has not a long history of use in broiler chickens (Yang *et al*., 2009). However, application studies have been increasing in the last years to assess their effect on gut health ,performance, and reduction of pathogen shedding. (Xu *et al*.,2003) Mainly, prebiotics seem to selectively enhance *lactobacilli* and *bifidobacteria* populations and reduce colonization by pathogenic bacteria (Baurhoo *et al*., 2009; Biggs and Parsons, 2008).

2.4.5 Probiotics and prebiotics effect on the immune system:

2.4.5.1 Probiotics:

Immune suppression has been observed after associating germfree rodents with defined bacterial species (Scharek *et al*.,2000). The numerous studies have reported immune stimulating abilities for different bacterial species. For example, in vitrocytokine production of macrophages was stimulated by Bifidobacteria (Marin *et al*., 1997). Bifidobacterium longum as well as several other lactic acid bacteria have been found to increase the total amount of intestinal (IgA) ImmunoglobulinA (Vitini *et al*., 2001).

2.4.5.2 Prebiotics:

The intestinal microbiota, epithelium and immune system are effective barriers against pathogen colonization. However, when pathogens successful in colonizing the intestinal tract, the immune system responds with an inflammatory and/or an antibody response. There is increasing understanding of the extensive amount of cross-talk between these systems McCracken and Lorenz (2001). Stress suppresses the ability of these systems to inhibit pathogen colonization, with a resultant increase incidence of infection Soderholm and Perdue (2001). The mucosal immune system develops oral tolerance to the indigenous microbiota and food antigens, resulting in an accumulation of ImmmunoglobulinA (IgA) secreting Blood cell (B cells), T cells, macrophages and denditric cells. In essence the mucosal epithelium elicits a mild or controlled Th1 or inflammatory response. This allows the

mucosal epithelium to respond more rapidly to pathogen challenge however, It's expensive from an energetic standpoint to maintain in the absence of pathogen challenge Anderson *et al* (2000). When the animal is stressed, the hypothalamic-pituitary axis (HPA) responds by secretion of corticosteroids and direct neuronal stimulation of the mucosal tissues. The mucosal response is suppression of the Th1 response and mild potentiating of the Th2 response, (Petrovsky., 2001).

2.5 Benefit of synbiotic

Synbiotic is defined as a mixture of probiotics and prebiotics that beneficially affects the host by activating the metabolism of one or a limited number of health promoting bacteria and/or by selectively stimulating their growth improving the host's welfare (Gibson and Roberfroid, 1995).

Recent research and development of synbiotic products has been increasingly focused on functional benefits including resistance to gastrointestinal bacterial infection, antibacterial activity, and improved immune status in broiler chicks (Gibson and Roberfroid, 1995).

Synbiotics may be defined as a mixture of probiotics and prebiotics that beneficially affects the host by improving the survival and implantation of live microbial dietary supplements in the gastrointestinal tract (Gibson and Roberfroid, 1995). The acquisition of data on the efficacy of synbiotic products as feed additives in livestock and poultry needs further investigation. However, results on in vivo trials are promising, showing a synergistic effect coupling probiotics and prebiotics in the reduction of food-borne pathogenic bacterial populations (Bomba *et al*., 2002).

In recent years, the effects of probiotics and prebiotics on human health are of great interest to both consumers and food manufacturers.

Many efforts have been made to develop novel functional foods or preparations containing probiotics and prebiotics. The human gastrointestinal tract (GIT) is a kinetic micro-ecosystem that enables normal physiological functions of host organism unless harmful and potentially pathogenic bacteria dominate it. It is stated that systematic supplementation of the diet with probiotics, prebiotics or synbiotics may ensure maintaining a proper equilibrium of the microflora in the GIT (Gibson and Roberfroid, 1995;Ziemer and Gibson,1998; Holzaphel and Schillinger, 2002 and Tuohy *et al*.,2005).

Recent development and applications of synbiotic products have focused on the assessment of beneficial effects in poultry health and production; however, information available to date is scarce. Mohnl *et al*. (2007) found that a synbiotic product had a comparable potential to improve broiler performance as avilamycin treatment. A Lactobacillus spp.-based probiotic product, in combination with dietary lactose, was successfully assessed, improving body weight and feed conversion in Salmonella-challenged turkeys (Vicente *et al*., 2007 and Li *et al*.,2008).

This combination could improve the survival of the probiotic organism, because its specific substrate is available for fermentation. This could result in advantages to the host through the availability of the live micro-organism and the prebiotic. Bengmark (2001) regards synbiotics as products of fermentation. Since in mixtures of pre- and probiotics, the prebiotics will be fermented when the appropriate choice of products is used, this definition may also be plausible.

In addition to the stimulation of development of desirable bacteria, the probiotic and prebiotic effect of lactobacillus is also manifested in the prevention of development of coli-bacteria and in its inhibition of enterotoxins in the digestive system (Fuller, 2001).

Prebiotics have been reported to produce a beneficial effect upon the animal that receives them. This is due to the proliferation of certain beneficial bacteria such as Bifidobacterium sp. and Lactobacillus sp. or an increase in their metabolic activity (Gibson and Roberfroid, 1995). Inulin, FOS and IMO are reported to be substrates for certain species of beneficial bacteria (Chung and Day, 2004).

A prebiotic, reduced the serum cholesterol and abdominal fat of broiler chicken (Yusrizal and Chen,2003).

It was reported that probiotics benefit the host animal by stimulating synthesis vitamins of B-groups, improving immunity stimulation, preventing harmful microorganisms, providing digestive enzymes and increasing of production of volatile fatty acids (Fuller, 1989; Rolfe, 2000; Coates and Fuller, 1977).

2.5.1 Characteristics of ideal probiotics and prebiotics:

2.5.2.1 Probiotics:

Be of host origin ,Non-pathogenic ,Withstand processing and storage ,Resist gastric acid and bile .Adhere to epithelium or mucus ,Persist in the intestinal tract ,Produce inhibitory compounds Modulate immune response ,Alter microbial activities

2.5.2.2 Prebiotics:

Be neither hydrolyzed or absorbed ,by mammalian enzymes or tissues ,Selectively enrich for one or a limited number of beneficial bacteria ,Beneficially alter the intestinal microbiota and their activities ,Beneficially alter luminal or systemic aspects of the host defense system, Beneficial effects of probiotics and prebiotics.

Modify intestinal microbiota, Increase production of VFA, Stimulate immune system, Increase biomass and stool bulking, Reduce inflammatory reactions

Increase B vitamin synthesis, Prevent pathogen colonization Improve mineral absorption, Enhance animal performance, Prevent cancer

Decrease carcass contamination, Lower serum cholesterol, Decrease ammonia and urea excretion, Lower skatol, indole, phenol, etc (Stavric and Kornegay 1995; Jenkins *et al*. 1999; Monsan and Paul 1995; Piva 1998; Simmering and Blaut 2001).

2.6 Types of synbiotic:

Bifidobacteria and other probiotic lactic cultures thought to contribute to human and animal health through mechanisms such as competitive exclusion of pathogenic and putrefactive bacteria, immune stimulation, increased production of short-chain fatty acids, control of intestinal function, prevention of cancer(Reddy and Rivenson, 1993; Sako *et al*., 1999), and improved digestion and nutrient absorption (Yaeshima,1996), inulin, Fructo-oligosaccharides (FOS), Isomaltooligosaccharides (IMO) and Mannan Oligosaccharides (MOS) have been defined by Gibson and Roberfroid (1995) as non-digestible food ingredients that selectively stimulate the growth and activity of one or a limited number of bacteria in the intestine that can improve the host health (Gibson and Roberfroid, 1995).

Although *Bifidobacterium* predominate in the human intestine, Ruminococcus and Streptococcus tend to predominate in the chicken intestinal tract (Apajalahti *et al*., 1998; Van der Wielen *et al*., 2000).

Prebiotics and probiotics are two of several approaches that have potential to reduce enteric disease in poultry and subsequent contamination of poultry products. Probiotic, which means “for life” in Greek (Gibson and Fuller, 2000), has been defined as “a live microbial feed supplement which beneficially affects the host animal by improving its intestinal balance” (Fuller, 1989).

Various findings on the effect of different probiotics and prebiotics on the health and growth responses of broiler chickens was reported (Kabir *et al*., 2004; Piray *et al*.,2007). Most recently, considerable attention has been paid to test the potency of growth promotants on altering lipid metabolism.). Growth performance, intestinal microbial populations, and serum cholesterol of broilers fed diets containing Lactobacillus cultures.

The inhibition of different species of bacteria that may depress dietary fat absorption due to bile acid deconjugation may further explain the working mechanism of antibiotic feed additives (Feighner and Dashkevicz, 1987). Many indigenous bacteria including *lactobacilli*, *enterococci*, *bifidobacteria*, *clostridium*, and *bacteroides*, are able to catalyze bile acid deconjugation (Masuda, 1981; Klaver and van Der Meer, 1993). Among these intestinal bacteria, *Streptococcus faecium* as well as *C. perfringens* have been suspected to be responsible for chicken growth depression (Fuller et al., 1979; Stutz and Lawton, 1984).

Probiotics and organic acids are the most promising alternative to antibiotics. Probiotics are viable microbial additives which assist in the establishment of an intestinal population which is beneficial to the animal and antagonistic to harmful microbes (Green and Sainsbury, 2001). It was reported that probiotics benefit the host animal by stimulating synthesis vitamins of B-groups, improving immunity stimulation, preventing harmful microorganisms, providing digestive enzymes and increasing of production of volatile fatty acids (Fuller, 1989; Rolfe, 2000; Coates and Fuller, 1977). Zhang *et al*. (2003) found that some probiotics or synbiotics were effective in increasing the body weight of chickens. In addition, Mohnl *et al*. (2007) found that the synbiotic product (Biomin® PoultryStar) had a comparable potential to improve broiler performance as Avilamycin (an antibiotic growth promoter).

Whereas, species of *Bacillus*, *Enterococcus*, and Saccharomyces yeast have been the most common organisms used in livestock (Simon *et al*., 2001).).

However, there has been a recent increase in research on feeding Lactobacillus to livestock (Gusils *et al*., 1999; Pascual *et al*., 1999; Jin *et al*., 2000; Tellez *et al*., 2001).

2.7 Bacflora :

Bacflora is an in-feed probiotic, prebiotic and acidifier product with triple effect. One of the most determining facts regarding livestock growth and weight gain is a healthy digestive tract. A well established gut flora is not only a barrier against transient pathogens, it is also important for cost effective production. A healthy gut is important for the proper breakdown and complete absorption of nutrients. The combined probiotic and prebiotic effect of *B. licheniformis*, *B. subtilis* and *E. Faecium* with saccharomyces cerevisiae results in optimum digestion, increased weight gain, improved feed conversion and egg yield. Organic acids while supporting digestion, they lower intestinal pH and support colonization of beneficial gut flora. The ammonia decomposition property of SC also helps to maintain litter quality. Bacflora is a very useful tool to recover altered intestinal flora after stress conditions, viral and/or bacterial infections, antibiotic treatments and dehydration. SC apart from stimulating the digestion is a source of bio-available vitamins, amino acids, minerals and enzymes.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Experimental Site

The experiment was carried out at the department of animal production, College of Agricultural Studies, Sudan University of Science and Technology, during the period 42 days , in which the ambient temperature ranged between 27C^{o} to 32C^{o} (Appendix1).

3.2 Experimental birds:

A total of one hundred and five, seven days old, unsexed broiler chicks, strain Arbor acers strain were purchased from local commercial hatchery (Mico).

Chicks were fed pre-tarter diet for week of adaptation period, then they were randomly divided into five treatments (A,B,C,D and E), each treatment was further subdivided into three replicates of seven chicks per each in a complete randomized design (CRD), feed and water were provided adlibitum through the experimental period (5 weeks).

Chicks were vaccinated against marek's disease on hatchery, on farm they were vaccinated against Gamboro disease at 7 days age and Newcastle disease at age of 22 days (colon), soluble multivitamin compounds provided three days before and after vaccination to guard chicks against stress.

3.3 Housing :

The experiment was conducted in a semi closed house. The house dimensions were 25m length, 8.8m width and 3.05m height. The roof ceiling was made of trapezoid corrugated aluminum sheets and was insulated of (100MM) glass wool with thermal conductivity of (0.04 w/m2)

The house was equipped with adjustable side wall curtains to control the flow of air into the house. Mechanical ventilation system was used in the house to generate on one direction air flow to provide the required levels of uniformity condition

Two exhaust fan with air 44500 m2 /h were positioned in the middle of the western side wall to maintain negative pressure inside the house as a result of negative pressure outside air flows into the house through inlet opening with cellulose pad besides maintaining the desired temperature and ventilations inside.

Cooling system was evaporative cooling panel comportment the cooling pad was situated of the two sides, north and south directions at the rear of the poultry house.

The temperature inside the house was maintained at 27 Co -30 C^{o} throughout the experimental period. 15 pens (1x1m) were prepared using wire mesh portioned cleaned and disinfected. Each pen was provided by (5 kg) rounded feeder and (2.5 liter) drinker

The light provided 24 hours al through the experimental period.

3.4 Experimental diets:

The commercial synbiotic manufacture compound (Bacflora) was provided from commercial company, made in Germany.

It's a kind of commercial synbiotic (Bacflora contain probiotics and prebiotics) that contains Bacillus Licheniforms is and Bacillus subtilis$10x10^{9}$ CFU,Enterococcus faecium $20x10^{9}$ CFU, Lactobacillus acidophilus$20x10^{9}$ CFU,Raw protein (from 40% Saccharomyces cerevisiae) 13.00 %,Calcium12%Magnesium 4.5%

The chicks were fed on a commercial broiler pre-starter for a week, then they were fed one of five (A,B,C,D and E) dietary treatments groups.

Group A fed on basal diet (negative control), group B fed on basal diet supplemented with antibiotic (klavomycin 0.5g/kg).Positive control diets, the other groups C,D and E were fed on basal diet supplemented with (0.5mg/kg ,1mg/kg and 2mg/kg), Synbiotic respectively as alternative growth promoter to antibiotic .

The basal diet was formulated to meet the nutrient requirements of broiler chicks according to Nutritional Research Council (NRC,1994)

The ingredients percent composition, the calculated chemical analysis of the experiment diets were presented in table (1) and table (2).

Table (1): The Composition of the experimental basal diet used.

Ingredients	%	Kg
Sorghum Grain	65	273 kg
Ground nut cake	14.03	58.8 kg
Sesame cake	14	63 kg
Concentrate	5	21 kg
Oyster shell	0.317	2.45 kg
Di calcium phosphate	0.9	2.59 kg
Lysine	0.344	1.44 kg
Methionine	0.159	0.66 kg
Premix	0.05	0.21 gm
Salt	0.25	1.05 gm
Total		

- CP=40% , CF=2%, Ca 16% , P=4%, Lysine =12%, Methionine 3%, ME= 200Kcal, ME = 200kcal , Vit A= 20000 IU. Vit D3 = 5000 IU, Vit K = 3mg, Vit B2 = 4mg, Vit B 3mg, Flic acid = 0.5mg, Fe= 0.4mg, Mn= 64microgram.

Table (2): Chemical Composition of the experimental control diets used*.

Analysis	%
Dry matter	91.00
Ash	5.4
Crude protein	25.00
Ether extract	3.8
Crude fibre	6.2

*Animal Production Research Central Kuku Lap

3.5 Parameters

Birds of each replicate were group weighted at weekly intervals and feed intake was recorded at the time of weighting , average body weight gain and feed conversion ratio were determined weekly throughout experimental period , the mortality was recorded daily.

3.6 Slaughter and carcass preparation:

At the end of the 5th weeks age birds were fasted overnight with only water allowed ,one bird from each replicate was selected ,weighted individually then slaughtered, after bleeding chicks were scaled in hot water, feather plucked manually then washed ,head was removed closed to skull , feet and shank were removed at the hock joint then eviscerated. The visceral organs (heart, liver, gizzard, abdominal fat) were separated weighted individually and were expressed as a percentage of live weight. The carcass divided into two halves by mid sawing along vertebral column, the left side was divided into three commercial cuts (breast, thigh , drumsticks), each cut was separately weighted them deboned, meat expressed as a percentage of their cut. The meat was frozen and stored for further analysis and they deboned expressed as a percentage of hot carcass.

3.7 Panel test:

The stored left of carcasses was slightly seasoned wrapped individually in aluminum foil and roasted at 190C for 70 minutes with average internal temperature of 88C and served warm.

Semi trained panel test were used to color, tenderness, juiciness and flavor of meat on scale of (Appendix 2), The roasted room samples were served randomly to each judge at room temperature.

Water was provided to the panelist to rinse their mouth after lasting each sample following recommended procedure (Hawrysh *et al*., 1980).

3.8 Blood serum profile:

Blood samples were collected from jugular veins in a heparin tubes, serum prepared from the blood analyzed for the concentration of total protein, albumin , cholesterol , AST, ALT, triglyceride and mineral (Mg and Ca)

3.9 Statistical analysis:

The data collected were statistically analyzed with the standard procedure of analysis of variance (ANOVA). Frequently distribution 5 were set and treatment means were compared for significance at the level of probability (Obi, 1990)

CHAPTER FOUR

4. Results

The effects of graded levels of synbiotic supplementation compared with antibiotic in broiler diets were illustrated in table (1).

Results obtained showed that group on diet supplemented with antibiotic (PC) recorded heavy weight compared to group fed on control (NC), however there is no significant difference between antibiotic group and synbiotic (B and C) groups in the above parameter.

There is no significant ($P>0.05$) difference between control and antibiotic groups in feed intake. Synbiotic groups B and C recorded significantly ($P<0.05$) more feed consumption compared to both control and antibiotic groups. Result showed no significant ($P>0.05$) difference in weight gain between control and antibiotic groups, although synbiotic group C recorded significantly ($P<0.05$) heavy weight gain compared to both of them. Result obtained showed no significant ($P>0.05$) difference between all tested groups in Feed conversation Ratio.

Table 4. 1:Effects of graded levels of synbiotic and antibiotic and control on the broiler chicks performance

Treatments	Average weight	Total feed intake	Body weight gain	FCR
Control	2127.1[a]	3260.5[ab]	1927.0[a]	1.6922[a]
Antibiotic	2244.0[a]	3293.3[ab]	2046.2[a]	1.6105[a]
Synbiotic A	2096.9 [a]	3126.1[b]	1886.2[a]	1.6586[a]
Synbiotic B	2155.5[a]	3373.8[a]	1954.3[a]	1.7267[a]
Synbiotic C	2309.6[a]	3394.8[a]	2101.0[a]	1.6546[a]
L.S.D	341.39	175.08	346.72	0.2702
SE±	148.05	75.921	150.36	0.1172
CV%	8.29	2.83	9.29	8.60
Grand mean	2186.6	3289.7	1983.0	1.6685

Synbiotic A 0.5mg/kg , Synbiotic B 1mg/kg, Synbiotic C 2mg/kg

Figure 1: Effects of graded levels of synbiotic and antibiotic and control on the broiler chicks performance

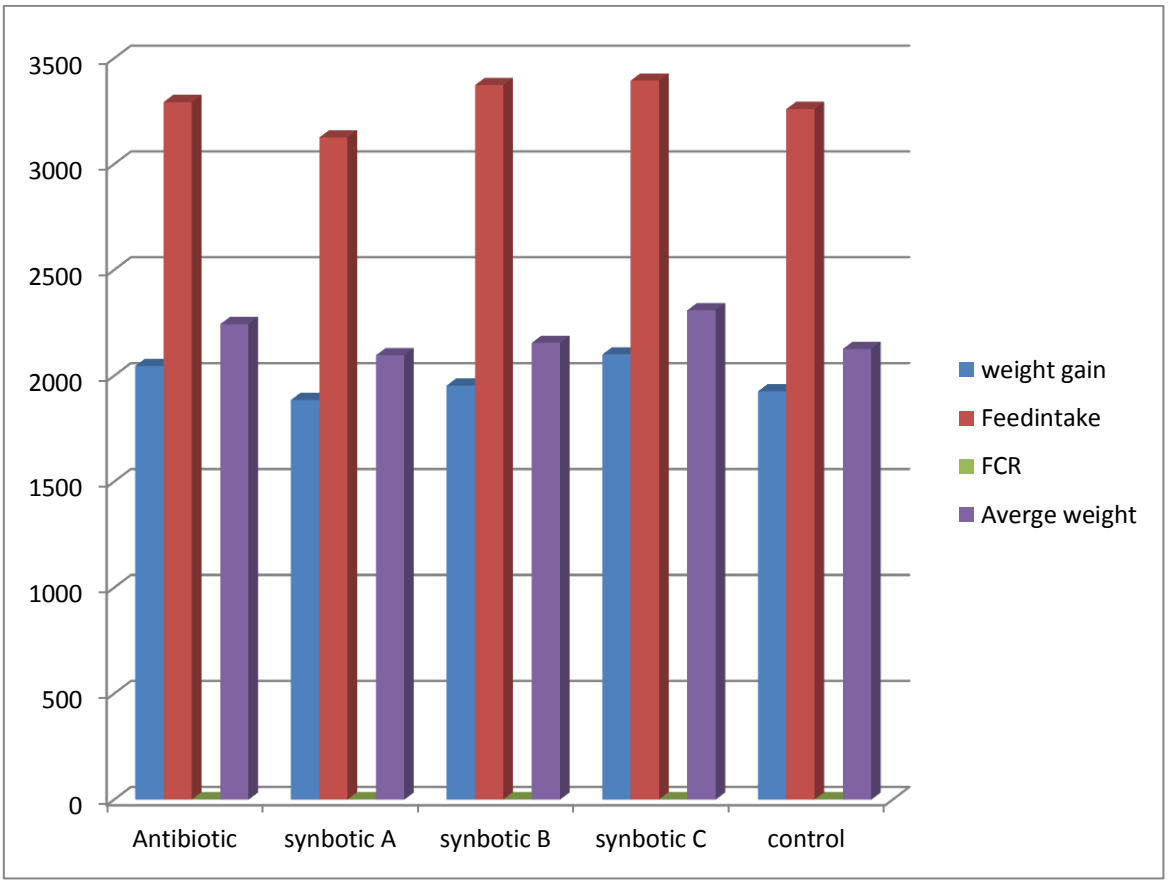


Table 4. 2:Means of live weight and non carcass component

Treatments	Live weight	Heart	Liver	Abdominal fat	Neck	Head	Legs	Gizzard empty	Gizzard content	Gut weight	Gut length
Control	2001.7^{a}	0.4133^{b}	1.9200^{bc}	1.0867^{a}	4.0833^{ab}	2.3267^{a}	3.6533^{a}	1.7433^{a}	2.1567^{a}	3.6567^{b}	11.857^{a}
Antibiotic	2081.7^{a}	0.5567^{a}	2.1600^{ab}	1.5267^{a}	5.1967^{a}	2.4800^{a}	3.5867^{a}	2.0733^{a}	2.8767^{a}	4.7267^{a}	10.237^{a}
SynbioticA	2121.7^{a}	0.4700^{ab}	2.2000^{a}	1.1700^{a}	3.8967^{b}	2.6667^{a}	3.7833^{a}	1.9600^{a}	2.4400^{a}	4.3233^{ab}	10.193^{a}
SynbioticB	2161.7^{a}	0.4667^{ab}	1.8467^{c}	1.4000^{a}	4.7133^{ab}	2.4033^{a}	3.7167^{a}	2.0900^{a}	2.5533^{a}	4.1067^{ab}	9.037^{a}
SynbioticC	2298.3^{a}	0.4400^{ab}	1.9833^{abc}	1.4633^{a}	4.4767^{ab}	2.3400^{a}	3.5033^{a}	1.8433^{a}	2.2900^{a}	3.9833^{ab}	8.883^{a}
L.S.D	335.89	0.1301	0.2502	0.6154	1.2426	0.8157	1.3775	0.5731	0.3502	0.8006	4.3924
SE±	145.66	0.0564	0.1085	0.2669	0.5389	0.3537	0.5973	0.2485	0.8075	0.3472	1.9048
CV%	8.36	14.72	6.57	24.59	14.75	17.73	20.05	15.67	17.41	10.72	23.23
Grand mean		0.4693	2.0220	1.3293	4.4733	2.4433	3.6487	1.9420	2.4633	4.1593	10.041

Data collected for non carcass components revealed no significant difference (P>0.05) among tested groups for heart, abdominal fat , gizzard , legs , gut length and liver weight values.

Table 4. 3: Means of commercial cuts and their meat/bone ratio

Treatment	Carcass	Breast weight	Breast meat	Breast bone	Thigh	Thigh meat	Thigh bone	Drumstik	Drumstick meat	Drumstick bone	Wing weight	Back weight
Control	1443.0[a]	37.020[a]	86.080[a]	14.137[a]	11.553[a]	79.190[a]	20.667[a]	15.593[a]	74.300[ab]	19.027[a]	11.820[a]	25.740[a]
Antibiotic	1610.0[a]	37.900[a]	87.553[a]	11.873[ab]	16.587[a]	84.137[a]	15.610[a]	12.260[b]	80.197[a]	18.387[a]	10.960[a]	18.420[b]
SynbioticA	1485.0[a]	32.227[a]	90.920[a]	8.487[b]	16.347[a]	78.430[a]	20.237[a]	14.893[a]	75.590[ab]	19.793[a]	11.713[a]	21.007[ab]
SynbioticB	1565.0[a]	38.860[a]	86.587[a]	11.063[ab]	15.647[a]	84.340[a]	13.073[a]	15.553[a]	70.847[b]	22.610[a]	11.313[a]	22.860[ab]
SynbioticC	1665.0[a]	37.413[a]	87.693[a]	12.307[ab]	13.407[a]	79.117[a]	14.217[a]	12.920[b]	78.333[ab]	21.667[a]	11.353[a]	21.913[ab]
L.S.D	322.51	8.2872	7.8204	4.9233	6.8489	19.775	13.527	1.9017	8.1860	7.5868	2.4477	3.5074
SE±	139.86	3.5938	3.3913	2.1350	2.9700	8.5755	5.8660	1.8247	3.5499	3.2900	1.0615	1.5210
CV%	11.02	12.00	4.73	22.59	24.73	12.96	42.86	7.09	5.73	19.85	11.37	16.94
Grand mean	1553.7	36.684	175.53	23.147	14.708	162.09	33.521	14.244	151.71	40.593	11.432	10.994

Result obtained also showed no significant differences (P>0.05) between all tested groups for commercial cuts (breast, thigh and drumsticks) and their meat / bone ratios.

Table 4. 4: Means of meat chemical attributes

Treatment	Moisture	Protein	Fat	Ash	TS	T.N.F	PH	Acidity
Control	70.333[a]	21.400[e]	5.9333 [b]	0.9167[b]	29.667[d]	23.733[c]	6.0000[a]	0.3400[c]
Antibiotic	69.333[a]	21.667[d]	5.9333[b]	0.9367[b]	30.667[cd]	25.067[bc]	5.7333[b]	0.3500[c]
SynbiotiA	68.333[b]	22.100[c]	6.3333[ab]	0.9600[b]	31.667[c]	27.000 [a]	5.5333[c]	0.3667 [b]
SynbioticB	67.000[c]	22.800[b]	6.6333 [a]	0.9767[b]	33.000[b]	26.367[ab]	5.4333[d]	0.3767 [b]
SynbioticC	65.667[d]	23.100[a]	6.8667 [a]	1.0967[a]	34.333[a]	27.467[a]	5.3000[e]	0.3933 [a]
L.S.D	1.0595	0.1479	0.5869	0.0864	1.0595	1.7227	0.0842	0.0124
SE±	0.4595	0.0641	0.2545	0.0375	0.4595	0.7471	0.0365	5.375
CV%	0.83	0.35	4.92	4.70	1.77	3.53	0.80	1.80
Grand mean	68.133	22.213	6.3400	0.9773	31.867	25.927	5.6000	0.3653

TS : Total Solid

Data obtained for meat attribute values were presented in table (6) .

Result showed no significant difference ($P>0.05$) between both control and antibiotic groups for protein values while groups fed on diets supplemented with synbiotic recorded significantly ($P<0.05$) difference compared with control and antibiotic groups and between them, the protein value increased significantly ($P<0.05$) with the increase of synbiotic level, the same results were recorded for fat ,PH and T.N.F values .

No significant ($P<0.05$) difference between tested groups in ash content and the acidity of meat although the acidity of meat increased with the increase of synbiotic levels but not significant ($P>0.05$).

Table 4. 5: Means of Biochemical serum data collection and analysis

Treatment	AST(GOT) U/L	ALT (SGPT) U/L	Total protein (TP) g/dl	albumin (ALB)	Cholestrol (CHOL) mg/dl	Mg	Triglyceride mg/dl	Ca mg/dl
Control	54.963[a]	21.093[a]	6.1667[a]	2.8667[a]	109.67[ab]	1.1333[a]	114.33[a]	7.8600[b]
Antibiotic	46.657[a]	14.867[b]	5.9333[a]	2.9000[a]	106.67[b]	1.1333[a]	116.00[a]	8.4400[ab]
SynbiotiA	48.873[a]	21.103[a]	6.0667[a]	2.9333[a]	114.67[ab]	1.3467[a]	121.00[a]	8.7533[a]
SynbioticB	48.873[a]	14.977[b]	6.1333[a]	4.5667[a]	117.67[ab]	1.3667[a]	120.33[a]	8.8633[a]
SynbioticC	50.530[a]	20.400[ab]	6.5000[a]	2.7000[a]	121.67[a]	1.3400[a]	122.00[a]	9.0000[a]
L.S.D	8.4729	5.8596	0.6797	2.3519	12.956	0.1589	11.051	0.8441
SE±	3.6743	2.5410	0.2948	1.0199	5.6184	0.0689	4.7924	0.3660
CV%	9.00	16.83	5.86	39.12	6.03	6.68	4.94	5.22
Grand mean	49.979	18.488	6.1600	3.1933	114.07	1.2640	118.73	8.5833

AST : Aspartate Aminotrans Ferase
ALT : Alanine Aminotrans Ferase

Biochemical serum analysis results table (7) showed no significant (P>0.05) differences for total protein , albumin , AST , ALT, Mg Triglyceride , Ca and cholesterol content , however the cholesterol and triglyceride increased with the addition and the level increase of synbiotic in the diets.

4 : 1:Sensory Evaluation.

The effect of treatment on subjective meat attributes is shown in Table (8) the average subjective meat quality score (Color, tenderness, juiciness and flavor) were not significant in all treatment groups and scores given for all attributes were above moderate acceptability.

Table 4. 6: Subjective meat attributes:

Treatment	Juiciness	Tenderness	Flavor	Color
Control	6.5	6.5	6.3	6.6
Antibiotic	6.5	6.2	6.7	5.6
Snybiotic A	6.6	7.0	6.2	6.1
Snybiotic B	6.5	6.7	6.3	6.2
Snybiotic C	6.5	6.5	6.7	6.4

4:1 Economic appraisals:

Appraisal of total cost, revenues and profit of broiler chicks fed on different level synbiotic (Bacflora) shown in Table (7) chicks purchased, management and feed costs values were the major input considered. The total selling values of meat was the total revenues .profitability ratio /Kg. meat is higher in 2 % synbiotic (Bacflora) (1. 11), compared to both negative and positive control groups.

Table 4. 7: Economic appraisal of experimental chicks

Treatment	**Control**	**Antibiotic**	**Synbiotic A**	**Synbiotic B**	**Synbiotic C**
Cost					
Feed cost	13.68	13.98	13.16	14.34	14.57
Chicks	4.50	4.50	4.50	4.50	4.50
Management	2.00	2.00	2.00	2.00	2.00
Total cost	20.18	20.48	19.66	20.84	21.07
Revenue	55.3	57.34	54.52	56.04	60.05
Profit	35.12	36.86	34.86	35.2	38.98
Profitable ratio	1	1.05	0.98	1.00	1.12

Figure 2:

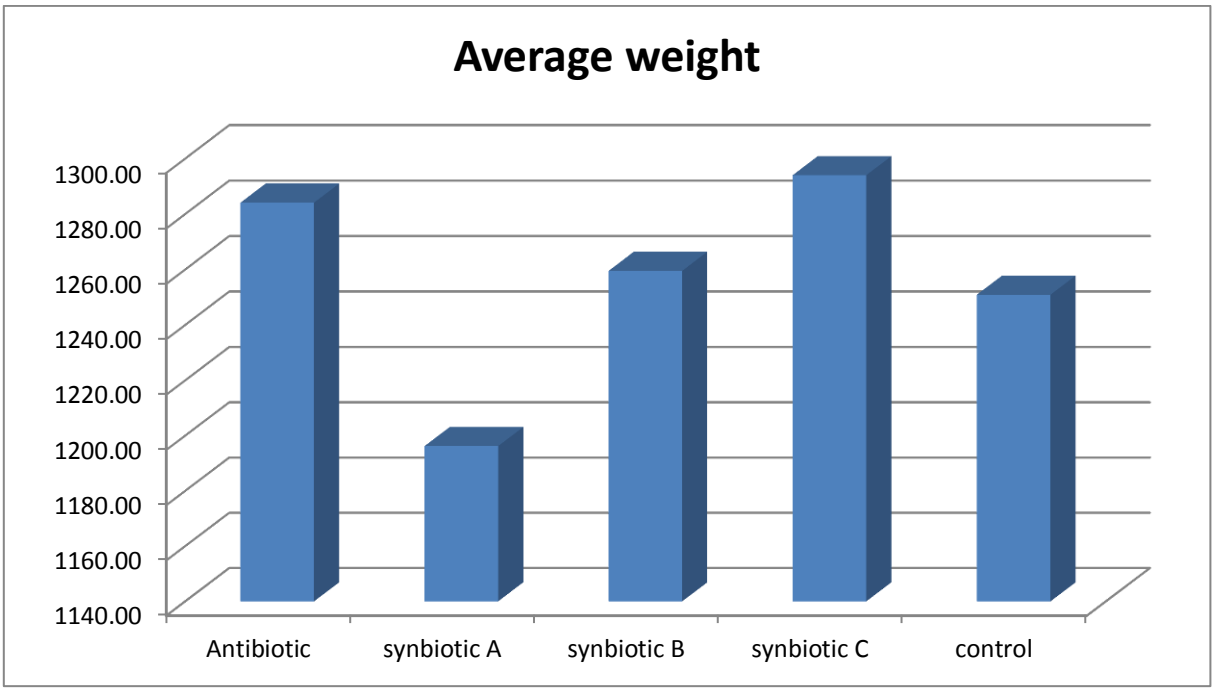

Average weight
1300.00
1280.00
1260.00
1240.00
1220.00
1200.00
1180.00
1160.00
1140.00
Antibiotic
synbiotic A
synbiotic B
synbiotic C
control

Figure 3:

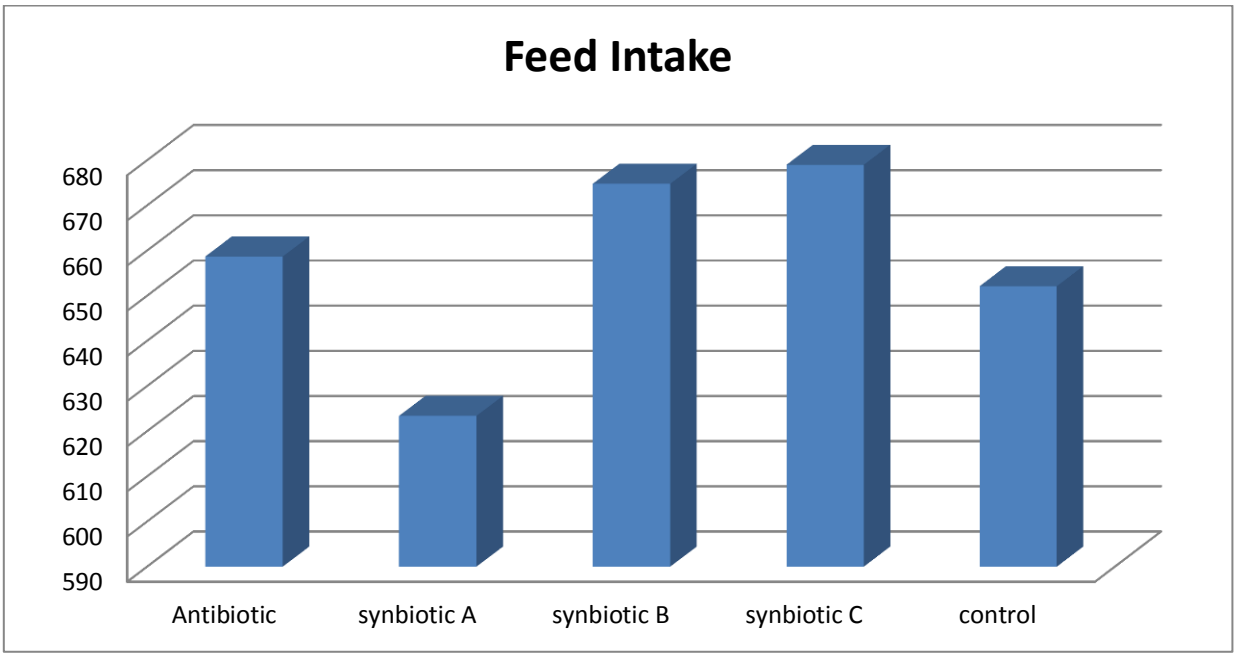

Feed Intake
680
670
660
650
640
630
620
610
600
590
Antibiotic
synbiotic A
synbiotic B
synbiotic C
control

Figure 4:

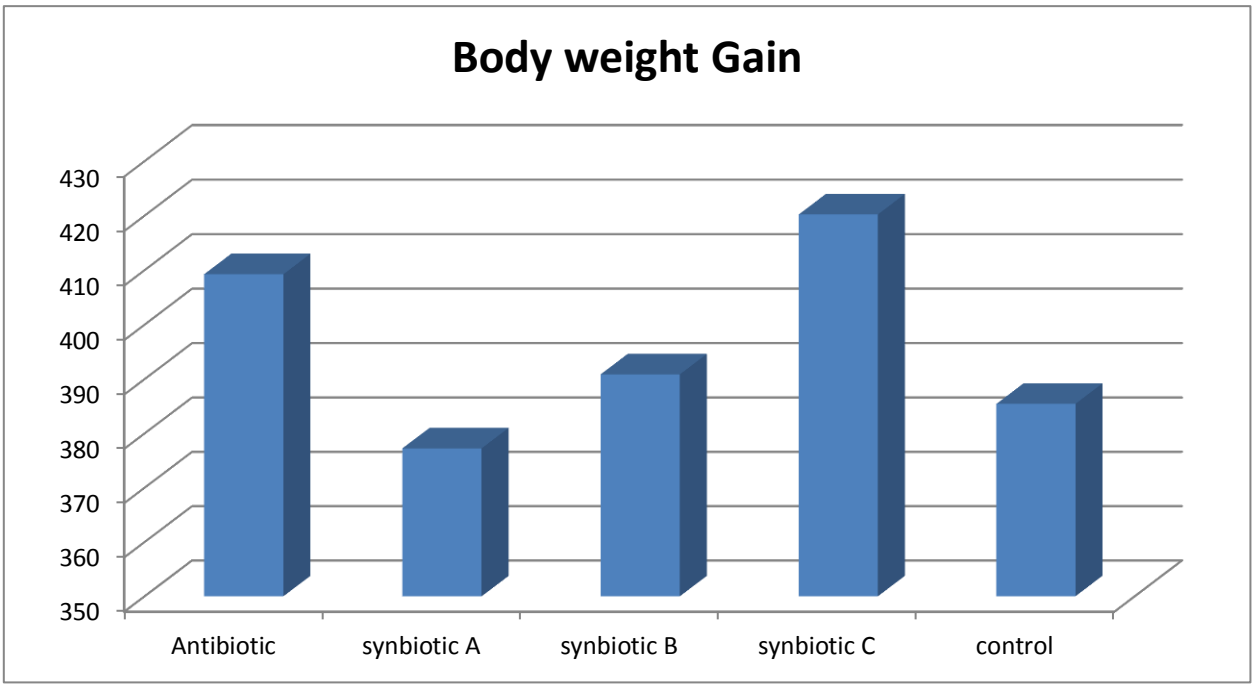

Body weight Gain
430
420
410
400
390
380
370
360
350
Antibiotic
synbiotic A
synbiotic B
synbiotic C
control

Figure 5:

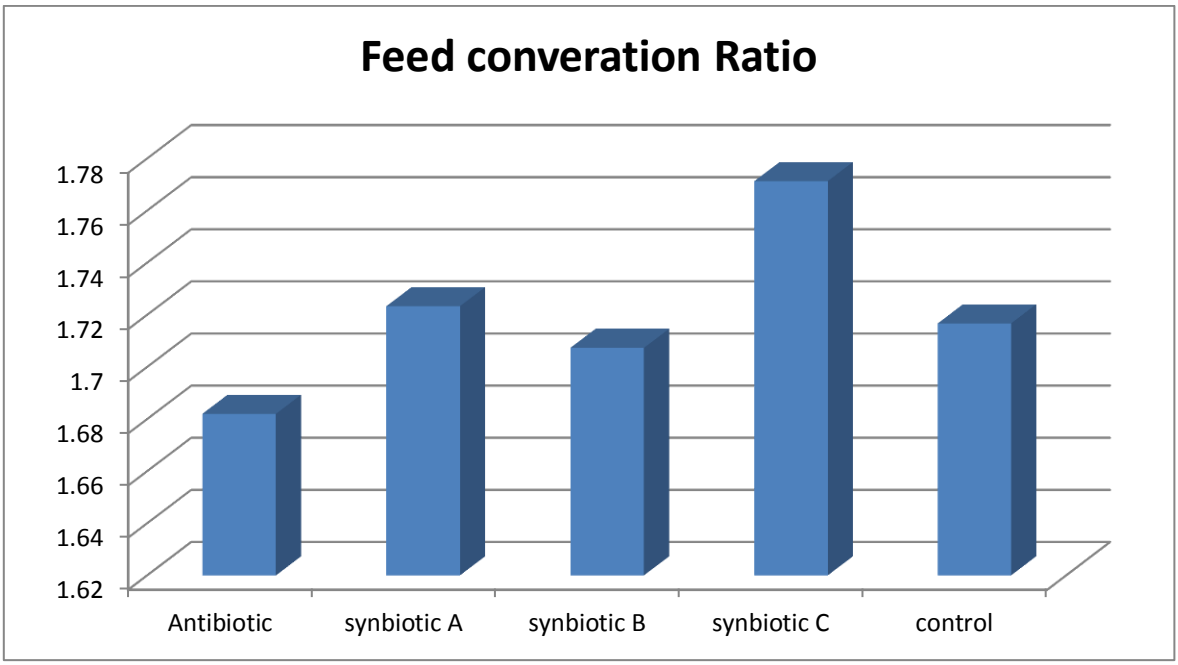

Feed converation Ratio
1.78
1.76
1.74
1.72
1.7
1.68
1.66
1.64
1.62
Antibiotic
synbiotic A
synbiotic B
synbiotic C
control

Figure 6: Effects of graded level of all treatments on weekly average weight

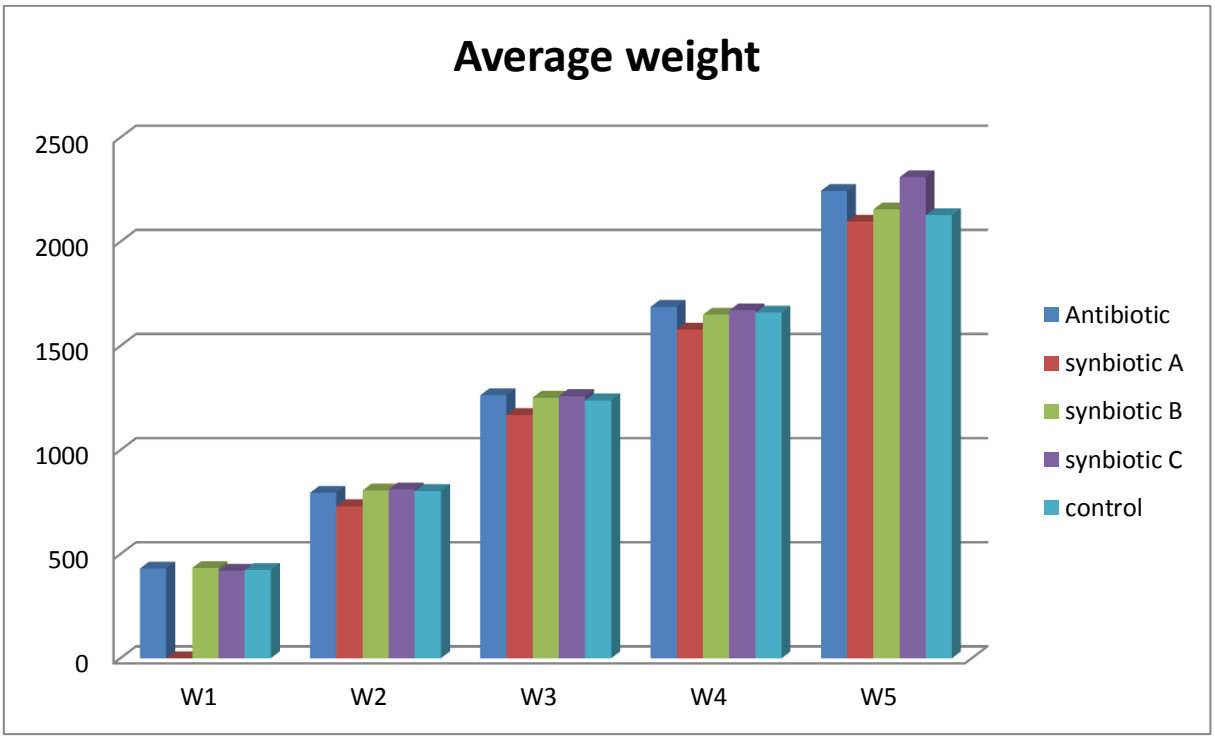


Figure 7: Effects of graded level of all treatments on weekly Feed Intake

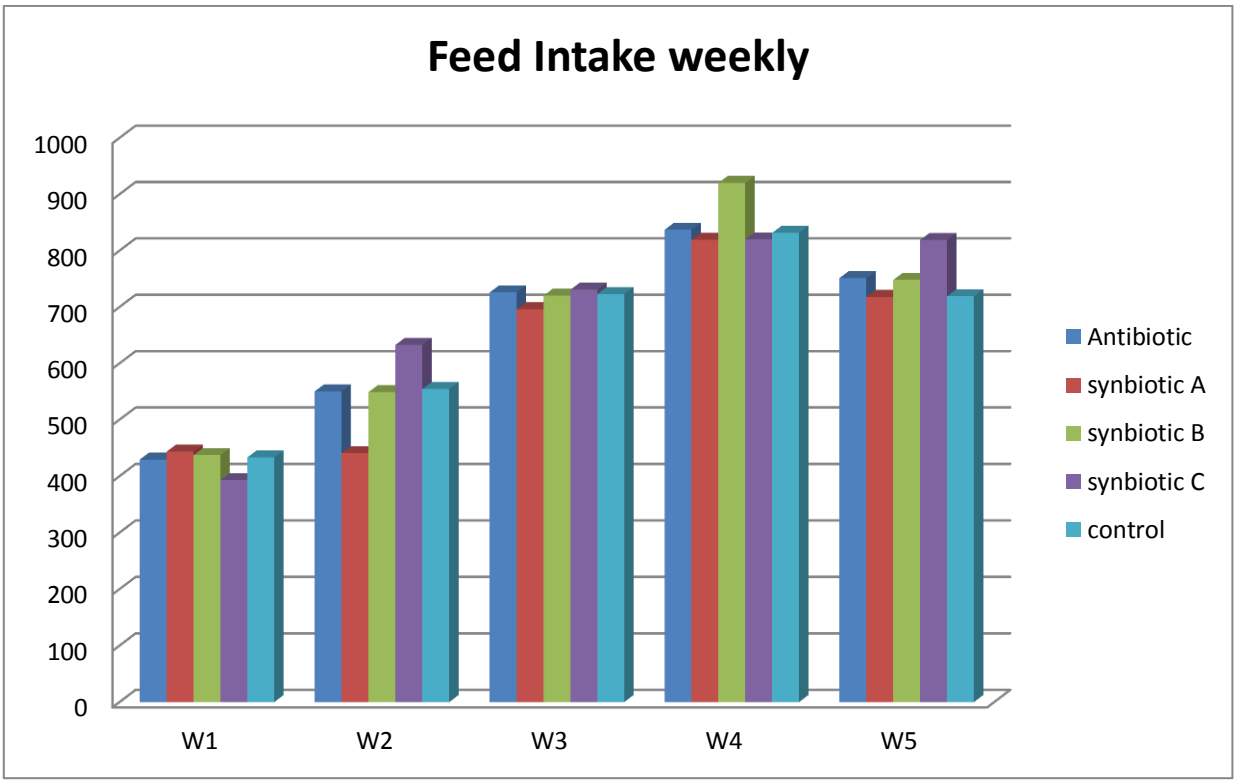


Figure 8: Effects of graded level of all treatments on weekly body weight gain

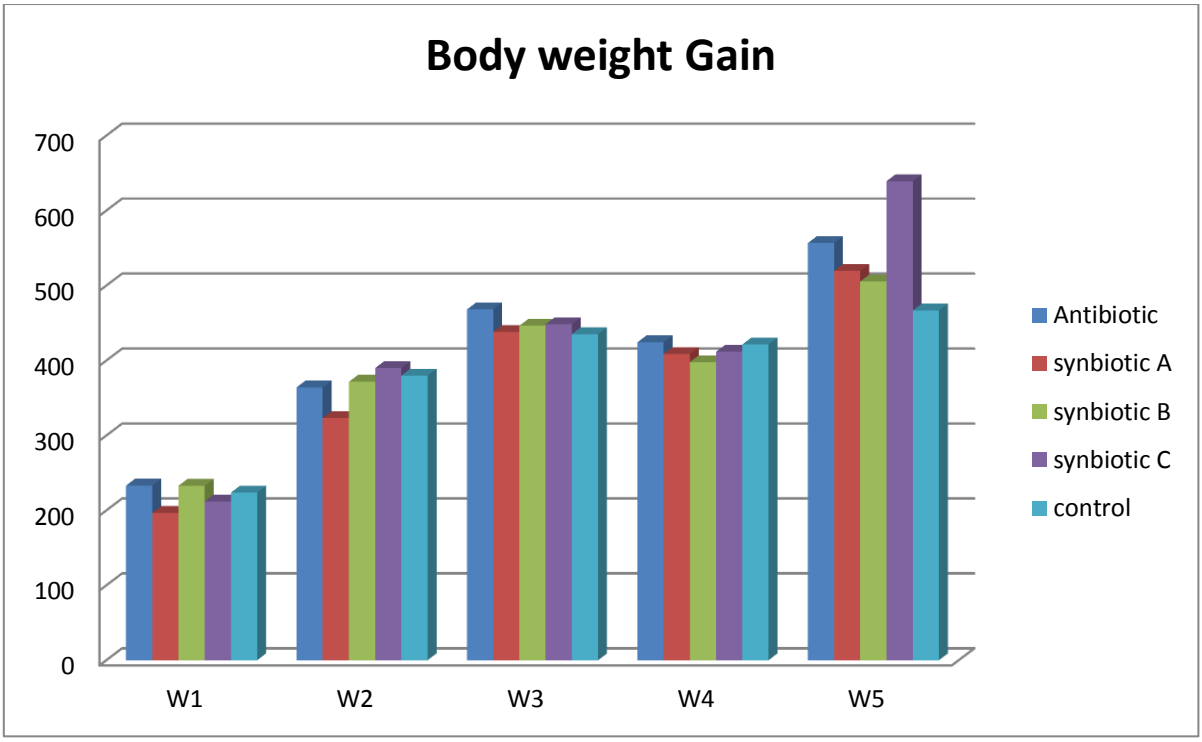
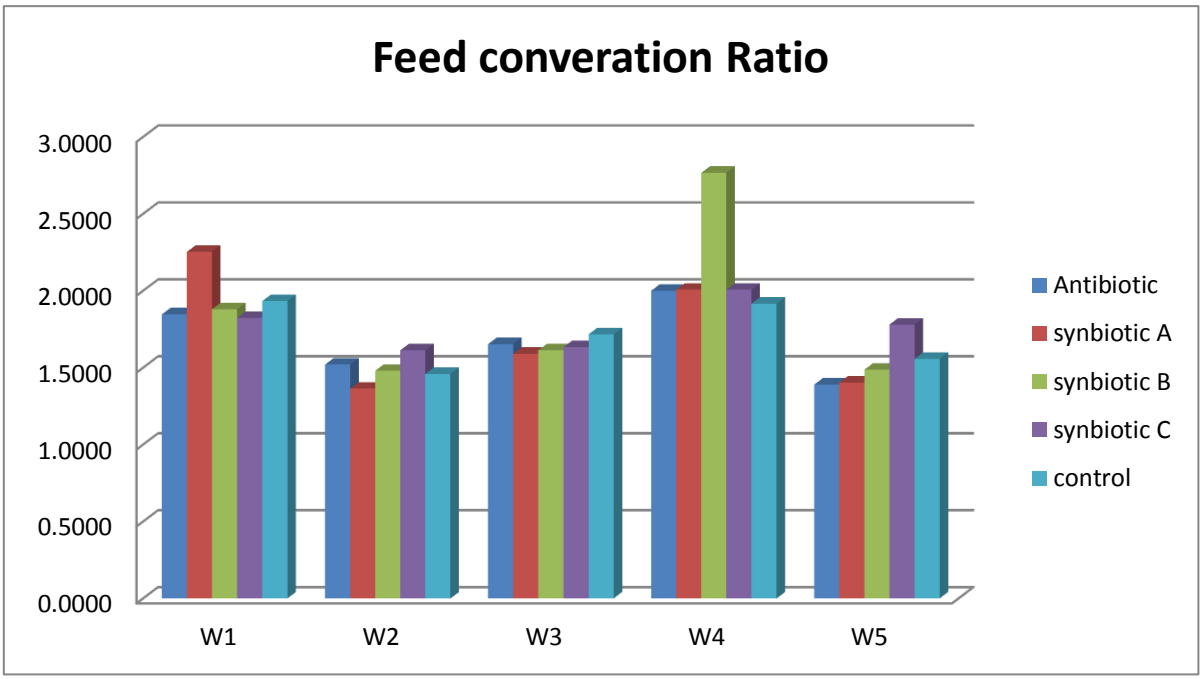


Figure 9: Effects of graded level of all treatments on weekly FCR



CHAPTER FIVE

5. DISCUSSION

A probiotic was defined as alive microbial feed supplemented that beneficially effects the host animal by improving its microbial intestinal balance (Fuller , 1989).

On the other hand the prebiotic was defined as non digestible food ingredient that beneficially effects in the host, selectively stimulating the growth or activity , or both, of one or a limited number of bacteria in the colon(Gibson and Roberford 1995). Away potentiating the efficiency may be the combination of both probiotics and prebiotics as synbiotics, that beneficially effects the host by improving the survival and implantation of live microbial dietary supplemented in the gastrointestinal tract.

Result revealed no significant difference ($P>0.05$) in average body weight among treatments . whereas there was no significant ($P>0.05$) difference between control and antibiotic groups in total feed intake, body weight gain and feed conversion ratio.

Furthermore, it was shown that synbiotic supplemented to broiler diets recorded a significant improvement in feed intake and body weight gain compared to both negative and positive control groups. The improvement in growth performance is thought to be the beneficial effect of synbiotic on broiler performance this results were related to agreed the findings of (Cavazzoni *et al*, 1998, Jin *et al* ., 1998; Zulkifli *et al* 2000; Kabir *et al*,2004; Mountzouris *et al* 2007 and Samli *et al* ., 2007).

More over Mohnl *et al* (2007) found that synbiotic product (Biomin® poultry star) had a comparable potential to improve broiler performance.

The result of this study showed no significant difference between the various experimented group in non carcass components (head, heart, gizzard and

liver), commercial cuts (breast, drumstick and thigh) and their meat/bone ratio, these results were in line with the findings of Awad *et al* 2008 and Seyyed ,2011.

Result obtained showed a significant increase with the synbiotic addition and the level increase in some meat attributes mainly protein fat, TS, TNF and meat acidity, these results might be due to the production of volatile fatty acid (Ziggers 2000).

Serum analysis showed no significant difference in TP, Albumin , AST, ALT, Mg , Triglyceride , Ca and cholesterol this results were in line with Sena *et al* (2013) who found no significant difference on blood serum when fed chicken of graded levels of gum arabic as a natural prebiotic growth promoter.

However cholesterol and triglyceride increased as the level of symbiotic increased in the diets. This results were in agreement with the findings Tageldin *et al* ., (2006) who reported increase on cholesterol level in rabbits fed gum arabic, so synbiotic was associated with an increase in total cholesterol biosynthesis.

On the other hand, results were disagree with (Topping *et al* .,1985 and Annison *et al* 1995) reported that the addition of prebiotic in broiler diet result in an increase of PH of the GIT and useful bacteria population and might due to increasing production of volatile fatty acids (Ziggers 2000).

The results of economical evaluations of the experimental diets showed that the supplementation of synbiotic (2kg/ton) to broiler diets improved the performance of chicks and resulted the best economical benefits.

5.2 Conclusion and Recommendations:

5: 2 : 1 Conclusion:

1. Inclusion of different levels of synbiotic in broiler diets had no negative effect on broiler performance (body weight , feed intake , feed conversation ratio and mortality rate .).
2. The performance was increased with the increase of the level of synbiotic, however, chicks fed on diet containing (2kg/ton) recorded the best performance.
3. Addition of synbiotic at different levels had no negative effect on the carcass characteristics and meat quality.
4. The result of economical evaluations of experimental diets showed that supplementation of synbiotic (2kg/ton) to broiler diets improved the performance of chicks and resulted the best economical benefits.

5 : 2:2 Recommendations :

1. Synbiotic is recommended to replace the antibiotic in broiler diets up to 2kg/ton.
2. Based on the finding of present study, it may be worthwhile to investigate further; whether or not higher levels of synbiotic above level 2kg/ton in broiler diets could give beneficial effect.
3. Further experiments are needed to confirm these results in layers testing its effect on egg yield and quality.

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APPENDICES

Appendix (1)

Temperature

	Maximum	Minimum	Average
Week1	32	29	30.5
Week2	28.6	27.3	27.95
Week3	31.6	25	28.3
Week4	32	28	30
Week5	35	32	33.5

Humidity

	Maximum	Minimum	Average
Week1	37	35.3	36
Week2	48	32	40
Week3	39	30	34.5
Week4	45	34	39.5
Week5	45	40	42.5

Appendix (2)

Card used for judgment of subjective Meat quality attributes Sensory Evaluation Card

Evaluate these sample for color , flavor, juiciness and tenderness. For each sample use the appropriate to show your attribute by checking at the point that desk describes your feeling about the sample , If you have any question please ask. Thanks for your cooperation.

Name_____ Date_____.

Tenderness	Flavor	Color	Juiciness
8-Extremely tender	8-Extremely intense	8-Extremely desirable	8-Extremely Juicy
7-Very tender	7-Very intense	7-Very desirable	7-Very Juicy
6-Moderately tender	6-Moderately intense	6-Moderatel desirable	6-Moderately Juicy
5-Slightly tender	5-Slightly intense	5-Slightly desirable	5-Slightly Juicy
4-Slightly tough	4-Slightly bland	4-Slightly desirable	4-Slightly Juicy
3- Moderately tough	3- Moderately bland	3- Moderately undesirable	3- Moderately dry
2- Very tough	2- Very bland	2- Very undesirable	2- Very dry
1- Extremely tough	1- Extremely bland	1-Extremelyundesirable	1- Extremely dry

Serial	Sample Code	Tenderness	Flavor	Color	Juiciness	Comment

Appendix (3)

Chicken meat analysis

Salmonella and E.coli is very critical point and hazard to health of humans and it can cause disease there for analyzed it in meat for maintains safe consumers (Appendese3).

Sample code	E.coli	Salmonella
Control	NIL NIL NIL	NIL NIL NIL
Antibiotic	NIL NIL NIL	NIL NIL NIL
Synbiotic A	NIL NIL NIL	NIL NIL NIL
Synbiotic B	NIL NIL NIL	NIL NIL NIL
Synbiotic C	NIL NIL NIL	NIL NIL NIL

*National Food Research Center