SUDAN UNIVERSITY OF SCIENCE AND
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EFFECT OF FEEDING GUM ARABIC (ACACIA SENEGAL) WITH OR WITHOUT COMERCIAL XYLAM 500 ENZYMES ON THE PERFORMANCE OF BROILER CHICKS

أثر التغذية بالصمغ العربى مع او بدون انزيم الزيلام ٥٠٠
التجاري على أداء كتاكيت اللاحم

By:
Ekram Kamal Abdalhafeiz Maken
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Supervisor: Professor:
Dr. Mohammed Hassan Musa Tabidi

Department of Animal Production, College of Agricultural Studies, Sudan University of Science and Technology

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الآيـة

قال تعالى :

{ وَقُلِ اعْمَلُوا فَسَيَرَى اللهُ عَمَلَكُمْ وَرَسُولُهُ وَالْمُؤْمِنُونَ}

صدق الله العظيم

سورة التوبة الآية ١٠٥

DEDICATION

FOR MY PARENTS

FOR ALL MY BROTHERS AND SISTERS

FOR MY FRIENDS

ACKNOWLEDGMENT

Firstly and lastly thanks to **ALLAH** who gave me persistence, and patience to complete this work. No words can adequately express my deep gratitude to my supervisor **Prof.Dr.Mohammed Hassan MusaTabidi** for generously providing and for patience, constant support, advices and insight was invaluable to me.

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ABSTRACT

The experiment was conducted to investigate the effects of Gum Arabic powder with or without Xylam 500 to broiler chick's diet on the performance and serum chemistry. Three experimental diets were designed as A, B, and C. A served as a control, B was supplemented with 0.6% Gum Arabic, and C was supplemented with0.6% Gum Arabic and Xylam 500 at level ½ Kg/Ton. Sixty three broiler chicks, 7 days old were randomly distributed into three treatments, each treatment with three replicates and each replicate with seven chicks. Average weight gain, feed consumption, feed conversion ratio, mortality rate, dressing percentage, non carcass component (heart, gizzard, liver) and chemical analysis of blood serum parameters were used as a criteria of response. Economics for each group was calculated at the end of the experimental period.

Results showed significant between treatment groups in performance parameters, dressing percentage, non carcass components, and chemical analyses of blood serum.The supplementation of control diet with Gum Arabic significantly (P> 0.05) decreased total cholesterol, in the blood serum compares to control group and improved the general performance of broiler chicks.

Chicks group fed on diet containing GA and supplemented with Xylam 500 had no significant effect on the mortality rate throughout the experimental period and consumed the lowest value of feed compared to other tested groups, also obtained the highest total profit compared to other tested groups.

ملخص البحث

أجريت هذه التجربة لمعرفة أثراضافه بودرة الصمغ العربي مع أو بدون الزيلام الي عليقة كتاكيت اللاحم و تأثيرة على الأداء العام، ومصل الدم في ثلاث معاملات وهي أ، ب، ج. أ هي المجموعة القياسية، ب مضاف لها الصمغ العربي بنسبة ٦، % ج مضاف لها الصمغ العربي بنسبة ٦،% مع الزيلام . أستخدمت في هذه التجربة ٦٣ كتكوت لاحم عمر ٧ أيام حيث وزعت عشوائيا على ثلاث معاملات كل معاملة بها ثلاث مكررات، كل مكرر ٧ طيور وذلك لجمع البيانات عن العليقة المستهلكة، معامل التحويل الغذائي والوزن المكتسب، ومعدل النفوق ونسبة التصافي وأيضا أوزان الأجزاء الداخلية (الكبد، القلب، القانصة). حيث أوضحت النتائج أن هناك فرق معنوي على مختلف المعاملات في مقاييس الأداء ونسبة التصافي و الأجزاء الداخلية و أيضا التحليل الكيميائي لمصل الدم . و أظهرت النتائج أن هناك فرق معنوي ($P> 0.05$) بين المجموعة المضاف لها الصمغ العربي و المجموعة القياسية و المجموعة المضاف لها الصمغ العربي مع الزيلام٥٠٠ بمعدل ٢/١ كجم/طن. حيث أن الصمغ العربي خفض الكلسترول في مصل الدم مقارنة بالعليقة المغذاة على العليقة القياسية و أظهر تحسن في الأداء العام للدجاج اللاحم.

الكتاكيت التى غذت على العليقة المضاف لها الصمغ العربي مع الزيلام ٥٠٠ ليس لها تأثير معنوي على معدل النفوق خلال فترة التجربة و إستهلكت أقل كمية من العليقة مقارنة بالمجموعات المختبرة الأخرى، أيضا حققت أعلي ربح كلي مقارنة بالمجموعات المختبرة الأخرى.

CHAPTER ONE

INTRODUCTION

The rise in poultry production and consumption in Sudan generally and in Khartoum State particularly may be attributed to many precipitating reasons including, increased preference to white meat, rise in living standards and the change in food habits.(Agricultural census, 2009).

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 & efficiency of feed utilization is increased (Qureshi, 1991). To achieve a profitable balance among the cost of feed, the broiler performance, and quality of product, certain additives; are available in the market for use in broiler ration. Some of these additives are recommended for chemotherapeutic and prophylactic purposes while others are reputed for the growth promoting effect.

During these decades, antibiotics have widely been used in poultry production as a growth promoter to enhance the performance. However, in, 2006, EU and many countries have banned using antibiotics as growth promoter in animal nutrition. This action encourages many investigators to search for alternatives to enhance performance. (Patterson and Burkholder, 2003) referred to an alternative approach to sub-therapeutic antibiotics in livestock is the use of probiotic micro-organisms, prebiotic substrates that enrich certain bacterial populations, or synbiotic combinations of prebiotics

and probiotics. Probiotic (direct-fed microbials) is a generic term and products can contain bacterial cultures that stimulate micro-organisms capable of modifying the gastrointestinal environment to favor health status and improve feed efficiency (Dierck, 1989).

Prebiotics are defined as a non-digestible food ingredient that beneficially affects the host by selectively stimulating the growth and/or activity of one or a limited number of bacteria in the colon (Gibson and Roberfroid, 1995). The application of probiotics and prebiotics significantly improved the weight gain of broiler chickens (Mateova *et al.,* 2008).

Gum Arabic (Gum acacia Senegal) is defined as the dried exudates obtained from the stems and branches of Acacia Senegal or the related species of Acacia. it consists mainly of high molecular weight polysaccharides and their calcium, magnesium and potassium salts which on hydrolysis yield arabinose, galactose, rhanose and glucuronic acid. It is important to remember that a damage tree will give a larger yield of gum (Glicksman, 1969). *Acacia senegal* and *Acacia seyal*, the two species of acacia that are commercially exploited, mainly in Africa and Asia. Nowadays, its use is extended to cosmetics, pharmaceutics, lithography and foods. The properties of gum exudates are affected by the age of the tree, amount of rainfall, season of exudation and type of storage (Aspinall *et al.,* 1968).

Enzymes is defined as “The enzyme protein together with the other constituents deriving from the fermentation or extraction process, but excluding any water, which may be separated without affecting the stability of the enzyme protein or changing its composition” (ECHA, 2007).

The objectives behind this research to investigate the usage of Gum Arabic as natural prebiotic with or without commercial Xylam 500 enzyme on the performance, serum chemistry, weight of internal organs and dressing percentage.

CHAPTER TWO

LITERATURE REVIEW

2.1 Feed Additives:

Feed additives are defined as "products that are used in animal nutrition for purposes of improving the quality of feed and the quality of food from animal origin, or to improve the animals' performance and health, e.g. providing enhanced digestibility of the feed materials" (Regulation (EC) No 1831/2003). Feed Additives, non nutritive, are sometimes included in the feed mixture in very small quantities and with careful weighing, handling and mixing, to insure that dietary nutrition are ingested, digested, protected from destruction, absorbed and transported to the cells of the body. Other feed additives have been used to alter the metabolism of the chicken in an effort to produce better growth or more desirable finished products (Leesons and summers, 2001). Feed additives can be used to increase the heath status, fertility and performance of farm animals. They improve the feed conversion ratio mainly by regulating feed intake and increasing digestibility of nutrients and energy (Gibson and Roberfroid, 1995).

2.1.1 Antibiotics:

Antibacterials are a type of antimicrobial used specifically against bacteria (UK, 2010) and (European Centre, 2014), and are often used in medical treatment of bacterial infections. (UK, 2010**).** They may either kill or inhibit the growth of bacteria. Several antibiotic agents are also effective against a number of fungi, protozoans and some are toxic to humans and animals, even when given in therapeutic dosage. Antibiotics are not effective

against viruses such as the common cold or influenza, and may be harmful when taken inappropriately.

Antibiotics are widely used in modern livestock and poultry production to treat sick animals, but they are also administered in sub therapeutic doses, usually in water or feed, to protect animals against disease and to promote growth. Sub therapeutic antibiotics (STAs) can promote growth, particularly in poultry and hogs, by improving nutrient absorption and by depressing the growth of organisms that compete for nutrients, thereby increasing feed efficiency (McBride, 2008). 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).

The continued feeding of antibiotics at sub therapeutic levels has created concerns about the extent to which usage increase the possibilities of antibiotic residue, the development of drug-resistant bacteria, and reduction in ability to cure these bacterial diseases in human (Jensen, 1998). Increased awareness of the potential problems associated with the use of antibiotics has stimulated research efforts to identify alternative to their use as feed additives. The increased use of antibiotics has given rise to a fear of the development of resistant pathogens bacterial strains (Wegener *et al.,* 1998, Kyriakis *et al.,* 1999, Budino *et al.,* 2005).

2.1.2 Probiotics:

Probiotics are feed additives that contain live microorganisms and promote beneficial effects to the host by favoring the balance of the

intestinal microbiota (Fuller, 1989). They when ingested by animals have beneficial effects in the prevention and treatment of diseases (Miles and Bootwalla 1991; Havenaar and Huis In`t Veld, 1992).

2.1.2.1 Mechanisms of Probiotics:

The mode of action of probiotics in poultry includes: maintaining normal intestinal microflora by competitive exclusion and antagonism (Nurmi and Rantala, 1973; Jin *et al.,* 1998; Line *et al.,* 1998; Kabir *et al.,* 2005; Fuller, 1989; Rantala and Nurmi, 1973; Kizerwetter and Binek, 2009), altering metabolism by increasing digestive enzyme activity and decreasing bacterial enzyme activity and ammonia production (Cole *et al.,* 1987; Yoon *et al.,* 2004), improving feed intake and digestion (Dierck, 1989; Awad *et al.,* 2006), and stimulating the immune system (Kabir *et al.,* 2004; Nayebpor *et al.,* 2007; Apata, 2008; Haghighi *et al.,* 2005; Mathivanan and Kalaiarasi, 2007; McCracken *et al.,* 1999; Brisbin *et al.,* 2008). The effect of probiotics depends on the combination of selected bacterial genera, their doses, and on the interaction of probiotics with some pharmaceuticals feed composition, storage conditions and feed technology (Kyriakis *et al.,* 1999; Park *et al.,* 2001; Chen *et al.,* 2005).

2.1.2.2 Use of probiotics as growth promoters in poultry feeding:

Little is known about growth performance and intestinal bacteria of broiler chicken fed diets supplemented with a natural botanical probiotics fermented from fruits and vegetables. Others probiotics used to evaluate growth performance and intestinal microorganisms of poultry have contained either Lactobacillus plantarum or Lactobacillus salivarius as a single strain or in combination with other lactobacillus strains. (Balevi *et al.,* 2001) used a commercial probiotics directly fed microbial containing nine

species of bacteria on performance of laying hens and for that study Lactobacillus plantarum was one of the nine bacteria in that commercial probiotics. (Faria *et al.,* (2006) conducted study to evaluate the efficiency of probiotics utilization as growth promoters in broiler chicken feeding. Their results showed that probiotics promoted better weight gain and feed conversion in the initial phase (1- 20-28 days), never the less, results were similar in the total period. Also the botanical probiotics may reduce Clostridium perfringens and Clostridium jejuni in market age of broilers. Other studies have reported increased body weights in poultry fed with lactobacillus supplemented diets in both the started and grower periods (Mohan *et al.,* 1996; Jin *et al.,* 1998; Zulkifli *et al.,* 2000).

Recently, (Lan *et al.,* 2003) studied the effect of two lactobacillus strains. (L.Salvarius and L. agillis) isolated from chicken intestine on weight gain and fecal lactobacilli levels in leghorn chickens. Broilers in the present study consumed the diet supplemented with the probiotic readily remained healthy throughout the experiment and their body weight and weight gain were similar to those fed control diets. Rigobelo *et al.,* (2011) studied the use of probiotics as an alternative strategy to substitute growth promoters added to the diet fed to broilers. The results showed that the treatment supplemented with probiotics displayed the best ratio feed intake per weight gain.

2.1.2.3 Effects of probiotics on poultry health:

Probiotics supplementation to broiler diets had positive effects on body weight gain, feed conversion ratio and mortality rate in broiler chickens (Anjum *et al.,* 2005). Live microorganisms as probiotics improve

immunity, live weight gain and the rates of feed conversion and mortality of broiler (Jin *et al.,* 2000; Zulkifli *et al.,* 2000 and Huang *et al.,* 2004).

Supplementation with probiotics has been shown to enhance survival by altering gastrointestinal flora (Netherwood *et al.,* 1999) to suppress the growth of pathogenic bacteria (Ehrmann *et al.,* 2002) and by enhancing immune potency (Balevi *et al.,* 2001). Haghighi *et al.,* (2006) reported that periodic treated birds had significantly more serum antibody than the birds that not treated with probiotics. (Cross, 2002) indicated that some probiotic could stimulate a protective immune response sufficiently to enhance resistance to microbial pathogen.

According to the definition by FAO, (1999) probiotics are live microorganism which when administered in adequate amounts confer a health benefit on the host (Fuller *et al.,* 1989). In broiler nutrition, probiotic species such as lactobacillus, streptococcus, Bacillus, Bifido bacterium, Entercoccus, Aspergillus, Candida and Saccharomyces are widely used to prevent poultry pathogens and diseases and improve broiler`s growth performance (Tortuero, 1978; 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; Mountzaouris *et al.,* 2007; Awad *et al.,* 2009).

2.1.3 prebiotics:

They are defined as non-digestible or low-digestible food ingredients that benefit the host organism by selectively stimulating the growth or activity of one or a limited number of probiotic bacteria in the colon (Crittenden and Playne, 1996; Dimer and Gibson, 1998; Zimmer and Gibson, 1998; Manning and Gibson, 2004). Much of the prebiotic-

associated improvement in poultry performance can be explained by selective enhancement of bacterial populations in the intestinal lumen (Ferket, 2004; Janardhana *et al.,* 2009).

2.1.3.1 Non-Starch oligosaccharides used as Prebiotics:

Prebiotics which are included in category of oligosaccharides are one of the most important natural productions which improve body immunity level. The most important production from this category is manna oligosaccharides because they modify the microbial gut ecosystem by binding to the receptors present in the intestinal epithelium, thereby preventing the colonization of bacteria pathogens (Zimmermann *et al.,* 2001, Shim *et al.,* 2005). Mannanoligosaecharides isolated from the Saccharomyces cerevisiae cell wall also have a beneficial effect on the intestinal microflora (Lyons and Bourne, 1995) and animal growth (kumprecht *et al.,* 1994 kumprecht and Zobac, 1998, shim *et al.,* 2005). It was found that they suppress the growth of E. coli, salmonella typhimurium, clostridium botulinum and C. Sporogenes, and conversely stimulate the growth of B.longum, L. casei, L. acidophillus.

2.1.3.2 Mechanism of actions of prebiotics:

Mechanism of actions of prebiotic can be listed as followed: Lowering the gut pH through lactic acid production (Chio *et al*., 1994; Gibson and Wang, 1994), Inhibiting/preventing colonization of pathogens (Morgan *et al*., 1992; Bengmark, 2001), Modifying metabolic activity of normal intestinal flora (Demigne *et al*., 1986), Stimulation of immune system (Monsan and Paul, 1995), increasing resistance against infectious diseases, producing vitamins of B complex , increasing calcium and

absorption of magnesium (Zakeri and Charkhkar,2007; Fanooci and Torki, 2010).

2.1.3.3 Substances used as prebiotics:

Since then the interest in the use of prebiotics in animal feed and pet food has resulted in a high research activity. The use of prebiotics in diets for farm animals and pets has been documented by (Mul and Perry, 1994). The use of prebiotics or fermentable sugars instead of antibiotics is going to be popular in birds in order to improve the useful microbial population of the Gastrointestinal (GI) tract (Kermanshahi and Rostami, 2006).

Bezkorovainy (2001) suggested that the use of prebiotics is a promising approach for enhancing the role of endogenous beneficial organisms in the gut. They can be used as potential alternatives to growth promoting antibiotics (Hatemink, 1995).

Non-digestible carbohydrates (oligo and polysaccharides), some peptides, proteins and certain lipids (both ester and ethers) are candidate prebiotic. Lactose is a disaccharide consists of glucose and galactose, which has prebiotic effect in chickens. Since chickens does not have lactase enzyme, lactose enters to the lower segment of the intestine and caeca, where hydrolyzed by microbial activity. The dominant prebiotics are fructo-oligosaccharide products (FOS, oligufroctose, inulin); gluco-oligosaccharides, stachyose, malto-oligosaccharides and oligochitosan have also been investigated in broiler chickens (Jiang *et al*., 2006; Huang *et al*., 2007).

2.1.3.4 Advantages of prebiotics supplementation in poultry diets:

Prebiotics supplementation of the diet influences volatile fatty acid content, branched chain proportion, lactic acid concentrations and ammonia concentrations of short chain fatty acids, stimulate natural bacteria activity and proliferation of bifido bacteria and lactic acid bacteria. The production of butyrate which is abominating energy source for enterocytesatso increases (Houdijk *et al.,* 2002).

Favorable effects of addition of prebiotics reflect in presence of antagonism towards pathogens, competition with pathogens, and promotion of enzyme reaction, reduction of ammonia and phenol products and increase of resistance to colonization. Improve gut health (improvement intestinal microbial balance). Improve performance. Enhance nutrient utilization (eg, amino acids and proteins). Decrease environmental pollution Decrease production cost (Peric *et al*., 2009; Khksar *et al.,* 2008; Midilli *et al*., 2008; Ghiyasi *et al*., 2007). Due to the ban on the use of antibiotics as growth promoters in poultry diets investigations evaluating the potential of dietary probiotics and /or prebiotics as substitutes for antibiotics should receive high priority. Waldroup *et al.,* (2003) reported that body weight and body weight gain of broilers were not affected by the supplementation of prebiotics. However, Piray *et al.,* (2007) have previously demonstrated significant increases in body weight gain in broilers receiving diets supplemented with prebiotics. Recent report suggested that feeding of chicory beta fructans, a prebiotic, reduced the serum cholesterol and abdominal fat of broiler chicken (Yusrizal and Chen, 2003).

The improvement in feed intake by dietary Prebiotics supplementation often resulted in improved growth performance. However, results reported

by Sims and Soften (1999) showed no difference in feed intake and consequently in body weight and body weight gain for Prebiotics, however, in a series of experiments dietary Prebiotics have been shown to increase feed intake by (Sanchez and Ayaya, 1998).

2.1.3.5 Effects of Prebiotics on Poultry health:

By adding prebiotics to poultry diets, producers can minimize the use of antibiotics and drug resistance to bacteria. Patterson and Burkholder (2003) have reported that prebiotic supplementation can improve health status of the bird's gastrointestinal tract. FOS (fructo-oligosaccharides) reduced the colonization of *Salmonella* in the chickens' intestine, especially when the animals received competitive exclusion flora in addition to FOS (Bailey *et al*., 1991). Supplementation of 0.4% FOS in the diet of broiler chicks significantly increased the number of *Bifidobacteria* and *Lactobacilli* and decreased *E. coli* in the caecum and small intestine. FOS has been observed to alleviate *Salmonella* induced necrosis of cecal mucosal epithelium, enhances the length of ileal microvilli (Chio *et al*., 1994) and thereby increases the surface area for digestion and absorption of nutrients. (Ammerman *et al.,*1989) reported that broilers receiving a diet supplemented with 0.375 % oligo fructose produced heavier birds at 47 days and improved percentage carcass and breast weights while the percentage fat pad was lower than in the un supplemented group. Probiotics and prebiotics may enhance health by stimulating antibody production (Savage and Zakrseweska, 1996).

2.1.4 Enzymes:

Enzymes are one of the many types of protein in biological systems. Their essential characteristic is to catalyze the rate of a reaction but is not

themselves altered by it. They are involved in all anabolic and catabolic pathways of digestion and metabolism (Acamovic and McCleary, 1996). Performance improvement was observed in consistently in birds fed diets with enzyme supplementation (McCracken *et al.,* 2001). Lack of improvement in performance with enzyme supplementation has been observed, while nutrient digestibility was still improved (Iji *et al.,* 2003; Troche *et al.,* 2007). Therefore, it seems that enzyme supplementation enhances nutrient digestibility no matter whether performance is improved or not. How enzyme supplementation increases nutrient digestibility becomes important. Amylase activity in the crop, pancreas, or small intestine of the poultry has not been consistently changed by amylase and xylanase supplementation (Ritz *et al.,* 1995).

Feeding enzymes to poultry is one of the major nutritional advances in the last fifty years. It is the culmination of something that nutritionists realized for a long time but until 1980's it remained beyond their reach (Wallis, 1996).

2.1.4.1 Benefits of Exogenous Enzymes:

Benefits of using feed enzymes to poultry diets include; reduction in digesta viscosity, enhanced digestion and absorption of nutrients especially fat and protein, improved Apparent Metabolizable Energy (AME) value of the diet, increased feed intake, weight gain, and feed–gain ratio, reduced beak impaction and vent plugging, decreased size of gastrointestinal tract, altered population of microorganisms in gastrointestinal tract, reduced water intake, reduced water content of excreta, reduced production of ammonia from excreta, reduced output of excreta, including reduced N and P (Campbell *et al.,* 1989; Jansson *et al.,* 1990; Annison and Choct, 1991;

Bedford *et al.,* 1991; Benabdeljelil, 1992; Jeroch and Dänicke 1993; Marquardt *et al*. 1994; Leeson and Proulx, 1994; Bedford, 1995; Choct *et al.,* 1995; Classen *et al.,* 1995; Dunn, 1996; Marquardt *et al.,* 1996; Esteve-Garcia *et al.,* 1997; Ouhida *et al.,* 2000; Gill, 2001; Odetallah, 2002; Gracia, *et al.,* 2003; Saleh, *et al.,* 2003; Odetallah, *et al.,* 2005 and Wang *et al*., 2005).

Pourreza *et al.,* (2007) evaluated the effect of different levels. 100,200,400 and 800g/kg of supplemental enzyme (xylanase) on dry matter, protein and energy digestibility of a basal diet containing 65% triticale for broiler. The results showed a significant improvement of protein and energy digestibility due to the supplemental enzyme. The highest digestibility was observed with 200g/kg added enzyme. Enzyme had no significant effect on dry-matter digestibility.

Soliman *et al.,* (1996) found that addition of commercial dietary enzyme (Kemzyme H. F., mixture of amylase, beta- glucanse, cellulose, protease and lipase) at level of 1g/kg diet significantly increase the digestibility of coefficient of crude fiber of broiler starter and finisher containing high fiber sunflower meal (24%) at levels of 15% and 25% respectively. In the studies reported by Zanellu *et al.,* (1999), addition of 0.1% Avizyme (a product containing mixture of xylanase, amylase and protease enzymes) to corn- soybean meal based diet resulting in a significant improvement in digestibility of crude protein, starch and fat.

2.1.4.2 Enzymes in Poultry Nutrition:

The use of enzymes in animal feed is of great importance. Consistent increase in the price of feed ingredients has been a major constraint in most of the developing countries. As a consequence cheaper and non conventional

feed ingredients have to be used which contain higher percentage of Non-Starch Polysaccharides (soluble and insoluble/crude fiber) along with starch. Non Starch Polysaccharides (NSPs) are polymeric carbohydrates which differ in composition and structure from starch (Morgan and Bedford, 1995) and possess chemical cross linking among them therefore, are not well digested by poultry (Adams and Pough, 1993; Annison and Choct, 1993). A part of these NSPs is water-soluble which is notorious for forming a gel like viscous consistency in the intestinal tract (Ward, 1995) thus by reducing gut performance.

Makkawi, (2009) examined the effects of addition dietary Xylam 500 (xylanase + amylase) to sorghum based diet on the performance and carcass characteristics of broiler. The results indicated that the body weight, feed intake, mortality rate, percentage of (dressing, liver, heart, and gizzard), commercial cuts (thigh, drumstick and breast) meat of commercial cuts, meat chemical composition aspects (moisture, fat, protein, and ash) and subjective meat attributes of broiler chicks were not affected significantly by the addition of Xylam commercial enzyme.

2.1.4.3 The role of non- starch polysaccharides enzymes in poultry nutrition:

The use of enzymes can be categorized into five areas, firstly by removal of anti-nutritional factors, secondly by digestibility of existing nutrients, thirdly by making a certain nutrients more available for absorption in intestine, fourthly supplementing host endogenous enzymes, for example at young ages. Fifthly affecting the micro flora in the gastro intestinal tract (Oluskosi *et al*., 2007 and Classen and Richard 1999). Numerous researchers, (White *et al.,* 1983; Edney *et al.,* 1989 and Friesen *et al.,* 1992)

found that addition of NSP degrading enzyme improved significantly protein and energy digestibility in broiler diets. Response to enzymes addition probably is due to their ability to hydrolysis arabinoxylans and beta glucans the major component of non polysaccharides present in cereal grains. This includes an efficient reduction in viscosity of the gut content, liberation of entrapped nutrients, thereby allowing, more nutrients available for digestion in intestinal tract of birded chicks (Castanon *et al.,* 1997).

2.2 Gum Arabic:

It is defined by the FAO Joint Expert Committee for food additives (JECFA) as 'a dried exudation obtained from the stems of A. senegal (L.) (FAO, 1999). GA is a branched-chain, complex polysaccharide, and either neutral or slightly acidic, found as a mixed calcium, magnesium and potassium salt of a polysaccharidic acid (Arabic acid). The backbone is composed of 1, 3-linked b-D-galactopyranosyl units. The side chains are composed of two to five 1, 3-linked b-D-galactopyranosyl units, joined to the main chain by 1, 6-linkages. Both the main and the side chains contain units of a-L-arabinofuranosyl, a-L-rhamnopyranosyl, b-D-glucuronopyranosyl and 4-O-methyl-b-D-glucuronopyranosyl, the last two mostly as end units **(**Anderson and Stoddart, 1996; Islam *et al.,* 1997; Verbeken *et al.,* 2003). Idris *et al.,* (1998**)** reported GA to be comprised of 39–42% galactose, 24–27% arabinose, 12–16% rhamnose, 15–16% glucuronic acid, 1.5–2.6% protein, 0.22–0.39% nitrogen, and 12.5–16.0% moisture.

2.2.1 Arabinoxylans:

Arabinoxylans are the major component of NSP. The best effect of a high content of soluble arabinoxylans in the rations for monogastric animals is increased viscosity of the intestinal content. This increase is caused by the enormous water binding capacity of the arabinoxylans. They are capable of binding ten times their weight in water (Nutrex, 2000). The viscosity of arabinoxylans depends in their solubility in molecular weights.

Insoluble arabinoxylans can effect gut transit time, gut motivate and may also hinder the ability of endogenous enzymes to gain access to their respective substrates (Choct, 2001). The soluble arabinoxylans can not only act as physica barrier to nutrient digestion and absorption by increasing gut viscosity, but also change gut functions by modifying endogenous secretion of water, proteins, electrolytes and lipids (Johnson and Gee 1981; Angkanaporn *et al.,* 1994). The ability of certain arabinoxylans to bind bile salts, lipids and cholesterol to be also well documented (Vahouny *et al.,* 1980). This property at arabinoxylans may influence lipid metabolism in the intestine. Furthermore, viscous arabinoxylans may be able to enhance bile acid secretion and subsequent resulted in significant loss of these acids in faeces (Ide *et al.,* 1989; Ikegami *et al.,* 1990).

The addition of soluble arabinoxylans in broiler chicken diets significantly elevated fermentation in the small intestine. It also increase the residence time of digest in the intestine (Goh and Gol i, 1977; Vanderklis and Vanvoorst, 1993) which may decrease oxgen tension and favour the development of anaerobic micro flora. The viscosity of arabinoxylans depends in their solubility and in molecular weights. Solubility of arabinoxylans, in turn, depends on the chemical structure of the

arabinoxylans and their association with the rest of the wall components. The physical effect of viscosity on the nutrient digestion and absorption appears to be similar regardless of the arabinoxylans sources (Choct, 1997).

Generally, high gut viscosity decreases the rate of diffusion substrates and digestive enzymes and hinders their affective interaction at the mucosal surface (Edwards *et al.,* 1988; Ikegami *et al.,* 1990). Soluble arabinoxylans interact with the glycocalyx of the intestinal brush border and thicken the rate-limiting unstirred water layer of the mucosa, which reduces the efficiency of nutrient absorption through the intestinal wall (Johnson and Gee, 1981). The fact that the viscous property of arabinoxylans is the major factor in the anti-nutritive effect of arabinoxylans in monogastric diets is supported by the wide-spread use of enzymes in monogastric diets. The enzyme cleave the large molecules of arabinoxylans in to smaller polymers, thereby reducing the thickness of the gut content and increasing the nutritive value of the feed (Bedford *et al.,* 1991 and Choct and Annison, 1992).

2.2.2 Benefits of Gum Arabic:

GA has wide industrial uses as a stabilizer, thickening agent and emulsifier, mainly in the food industry (e.g. in soft drinks syrup, gummy candies and marshmallows), but also in the textile, pottery, lithography, cosmetics and pharmaceutical industries (Verbeken *et al.,* 2003). Mee and Gee, (1997), conducted study to determine the combined effect of fiber derived from apple pulp and gum Arabic on blood cholesterol levels in men with mild hypercholesterolemia. The results of this study suggest that consumption of a beverage containing modest amounts of gum Arabic and apple fiber has a significant cholesterol- lowering effect in men with mild

hyper cholesterdemia. Previous studies have demonstrated that, individually, each of these components has potential hypocholes – terolemia.

Atsushi *et al.,* (2007) investigated whether the efficiency of intestinal calcium (Ca) absorption was improved by concomitant ingestion of gum Arabic in rats. They observed increased in vitro Ca permeation in rats that ingested water with 7.5 % gum Arabic for 10 days. It has been reported that the addition of gum Arabic to sodium L glucose oral rehydration solution enhanced the effectiveness of water and electrolyte absorption in normal rats due to morphologic changes in the intestinal villi (Wapnir *et al.,* 1997).

In folk medicine, GA has been reported to be used internally for the treatment of inflammation of the intestinal mucosa, and externally to cover inflamed surfaces **(**Gamal el-din *et al.,* 2003). Despite the fact that GA is widely used as a vehicle for drugs in experimental physiological and pharmacological experiments, and is assumed to be an ‘‘inert” substance, some recent reports have claimed that GA possesses anti-oxidant, nephroprotectant and other effects (Rehman *et al.,* 2001; Gamal el-din *et al.,* 2003; Ali *et al.,* 2008).

2.2.3 Gum Arabic as a natural prebiotics:

Gum Arabic contains soluble dietary fibers with more than 85% of its weight as soluble fermentable fractions, derived from dried exudates of Acacia Senegal (Nasir, 2004). It contains of high molecular weight (lipoprotein) and low molecular weight (heterogeneous gum polysaccharides). Dietary fiber is the edible parts of plants or analogous carbohydrates that are resistant to digestion and absorption in the human small intestine, with complete or partial fermentation in the large intestine. Dietary fibers found to promote beneficial physiological effects including

laxation and / or attenuation each of blood cholesterol and glucose and it also improves mineral availability Gum Arabic is a water soluble , fermentable, by indigenous bacteria, polysaccharide, resistant to gut enzymes in human and animals and thus can be described as a dietary fiber (Phillips, 1998).

2.2.4 Supplementing poultry diets with Gum Arabic:

Palji and Tivey (1997) conducted study to test the relative effects of different pure non-starch polysaccharides on gastro intestinal tract and body growth of broiler chickens. They fed seven- day old chicks a commercial diet supplemented with alginic acid, Gum Arabic, guar gum or gumxan than at 5% (7 days) and 25 % (14 days). There were no significant differences between the duodenal and ileal digesta viscosities of chicks on the different diets. Chicks fed the GA diet significant $P< 0.001$ gained more weight and were heavier than chicks on the other diets. Small intestinal weight and ingest a capacity differed significantly between, chick on the different diets while there were no significant. In ileal crypt depth, villus height and surface area in chicks fed to different diets. The performance (body weight egg and daily egg production) of laying hens showed significant increase. As a whole they concluded that the addition of Gum Arabic as supplement of laying hens showed no significant difference in daily egg product and serum cholesterol and with significant decrease in triglyceride total lipid and phospholipids. It is indicated that the supplementation with Gum Arabic increases fecal nitrogen excretion and lowers serum urea concentration in chronic renal failure patients consuming a low protein diet (Bliss *et al.,* 1996).

Abd-Razig *et al.,* (2010) studied the effect of Gum Arabic as supplementary diet and its effect on lipid profile (serum, egg yolk and meat) and performance of laying hen, which were fed on graded levels of Gum Arabic (1,3,5, and 7%) respectively. Results revealed a significant decrease in serum cholesterol, triglyceride, but with no difference in high density protein. Cholesterol in egg yolk Lipid profile of meat for treated groups showed no significant difference compared with untreated group. Increase the ratio of the G A (5-15%) in the basal a layers diet significantly reduced serum cholesterol in a graduated manner and consequently in egg where lower yolk cholesterol was observed by Sabah Elkhier (2009).

CHAPTER THREE

MATERIAL AND METHODS

3.1 Site of Experiment:

The experiment was conducted in the department of Animal Production, College of Agricultural Studies, Sudan University of Science and Technology, Shambat, during the period from (29 September – 1 November 2014). The ambient temperature ranged between 28.5℃- 40℃.

3.2 Experimental Chicks:

A total number of chicks are 63 on 7 day old unsexed broiler chicks of Aberker strain from a local commercial hatchery (Meico) were randomly divided into three treatment diets (A, B, and C). Each treatment group was sub divided into three replicates of 7 birds per each. The chicks were adapted of fed over 7 days on commercial broiler pre- starter before start of the experiment.

3.2.1Vaccination Program:

The chicks were vaccinated against infectious Bronchitis (IB) and Newcastle disease (ND) at 7 days of age and given multi-vitamin to chicks before vaccination to guard against stress. At 14 days were vaccinated against Newcastle disease and infectious Bursal disease (IBD) Gumboro through drinking water. The dosage was then repeated at 21 and 28 days of age for Newcastle disease and Gumboro respectively.

3.3 Experimental diets:

Gum Arabic (Hashab) was used in this experiment was purchased from Gum Arabic Company (Savanna). Microbial xylam 500 was used in

this experiment, produced by Nutrex Company for feed enzyme production, obtained from Khayrat El-Nile (Khartoum, Sudan). It is mixed enzymes preparation made from bacteria Bacillus Subtilis which is composed of Endo-1,4-B-xylanase 126 U/g and a-Amylase 8000 U/g. The experimental diets were designed as A control diets, B was supplemented with GA (0.6%) as growth promoter, C was supplemented with GA (0.6%) and Xylam 500 enzyme (25mg). The experimental diets were formulated to meet the nutrients of broiler chicks according to (NRC, 1994). The calculation chemical analysis of experimental diets Calculated according to (Ellis, 1981). The ingredients percent composition and the calculated chemical analysis of the experimental diet were presented in Tables (1,2). Experimental diets were fed for 6 weeks.

3.4 Housing:

An open wire mesh-side poultry house was used. The house cleaned and well disinfected before the commencement of the experiment. The house was constructed on a concrete floor with corrugated metal sheets roof and a solid brick western-eastern wall up to 3 meters the eaves and 4-5 meters for apex. 9 pens inside the house were prepared using wire mesh partitioning. Each pen was equipped with one feeder and drinker to allow ad libitum consumption of feed and water. Light was provided approximately 24 hours in a form of natural light during the day and artificial light during the night.

3.5 Data Collected:

3.5.1 Parameters:

Average body weight, weight gain and feed intake (gm) for each group were determined weekly throughout the experimental period. Health of the experimental stock and mortalities were closely observed and recorded daily.

3.5.2 Carcass preparation:

At the end of the experiment 3 birds were selected randomly from each group and weighed individually after an overnight fasting with only water allowed, and then they were slaughtered by severing the right and left carotid and jugular vessels, trachea and esophagus and blood samples were collected in test tubes and analysis to determine total plasma cholesterol. After bleeding they were scalded in hot water, hand-plucked and washed. The head was removed closed to skull, feet and shanks were removed at the hock joint.

3.6 Chemical analysis:

Experimental diets were analyzed Table (2), and separated serum from the collected blood samples also were analyzed according to Central Veterinary Research Laboratory Soba Table (7).

3.7 Calculation:

The hot carcasses were weighed for calculation the dressing percentage expressed as a percentage of live weight. Non carcasses components (heart, liver, and gizzard) also were weighed.

3.8 Experimental Design and Statistical Data Analysis:

The data were tabulated and subjected to one-factor separated according to Duncan Multiple Range Test (DMRT) by using the statistical analysis system (SAS) computer program. Completely randomized design was used in this experiment. The significance level setups $P< 0.05$, all values were presented as means and standard error. The significant differences (LSD) were used for treatment means separation as outline by (Montgomery and Douglas C, 2001).

Table (1): The ingredients percent composition of experimental diets:

Ingredients%	A	B	C
Sorghum	64.142	64.142	64.142
Groundnut cake	14	14	14
Sesame cake	15	15	15
Concentrate	5	5	5
Di calcium phosphate	0.618	0.618	0.618
Salt	0.25	0.25	0.25
Methionine	0.159	0.25	0.25
Lysine	0.344	0.344	0.344
Oyster shell	0.487	0.487	0.487
Gum Arabic	-	0.6	0.6
Total	100	100	100

Enzyme as feed additive, 5 kg/Ton

* Crude protein 40% ; Crude fat 3.90%; Crude fiber 1.44%; Calcium 10%; Available phosphorus 6.40%; Energy 1950 Cal/Kg; Methionine 3%; Methio+Cystin 3.3%; Lysine 10-12%; Crude minerals 39.30%; Sodium

2.77%; Lenoleic acid 0.24%; Vitamins: Vit.A 200.000 I.U/kg; D3 70.000 I.U/kg; K3 30 mg/kg; B1 50 mg/kg; B2 150 mg/kg; B6 50 mg/kg; B12 180 mg/kg; D. Pantothenic acid 155 mg/kg; Niacine 440 mg/kg; Folic acid 8 mg/kg; Choline chloride 5.800mg/kg; Antioxydant (BHT) 1000 mg/kg.
Trace Elements; Manganise 1600 mg/kg; Zinc 1600 mg/kg; Iron 580 mg/kg; Copper 450 mg/kg; Iodine 55 mg/kg; Selenium 8 mg/kg; Cobalt 9 mg/kg; Molbden 20 mg/kg.

Table (2): Calculated chemical analysis of experimental diets:

Components	Diets		
	A	B	C
Dry matter	94.85	94.85	94.85
Crude protein	22.70	22.70	22.70
Crude fiber	04.35	04.35	04.35
Ether Extract	03.35	03.35	03.35
Ash	04.65	04.65	04.65
Nitrogen Free Extract	59.80	59.80	59.80
Calcium	01.06	01.06	01.06
Total phosphorous	00.79	00.79	00.79
Available phosphorous	00.50	00.50	00.50
ME.cal/kg	3117	3117	3117

**Calculated according to Ellis (1981).*

Table (3): The ingredients per 100g of Gum Arabic Nutrition Value:

Energy	9Kcal
Protein	1.9g
Available Carbohydrates	<0.1g
Fat	0.1g
Soluble Dietary Fibre	85.5g
Cholesterol	<1mg
Sodium	14mg
Calcium	1074mg
Potassium	736mg
Magnesium	207mg
Iron	2mg

Table (4): Chemical Analysis of Gum Arabic (GA):

Ingredient	%
Moisture	7.45 % (w/w)
Total ash	3.2 % (w/w)
Reducing sugars	0.72 % (w/w)
Calcium	0.25 % (w/w)
Potassium	3.1 % (w/w)
Sodium	0.006 % (w/w)
Dietary fiber (in soluble)	13 % (w/w)
Dietary fiber (soluble)	76.2 % (w/w)

CHAPTER FOUR

Results

4.1 Response of Broiler Chicks to Dietary Gum Arabic with or without commercial Xylam 500 enzyme:

4.1.1 Performance:

The effects of feeding Gum Arabic (GA) with or without Xylam 500 on the performance of broiler chicks were illustrated in Table (5).

The result revealed that chicks group fed on diet supplemented with GA recorded significantly ($P< 0.05$) heavy body weight compared to other tested groups, although chicks group on control diet recorded significantly ($P> 0.05$) the lowest value of body weight. The same result was recorded for body weight gain.

Chicks fed on control group consumed significantly ($P< 0.05$) more feed, while chicks group fed on diet containing GA and supplemented with Xylam 500 consumed significantly ($P> 0.05$) the lowest value of feed. However, there is no significant difference for feed conversion ratio (FCR) between experimental groups.

4.1.2 Values of Non Carcasses Component and Dressing Percentage:

The addition of GA with or without Xylam 500 in Broiler chick's diet increased Significantly ($P < 0.05$) the heart weight, in **Table (6).** The result revealed that chicks group fed on diet supplemented with GA recorded significantly ($P < 0.05$) increased the carcass dressing percentage compared to other tested groups, although chicks group on control diet recorded significantly ($P> 0.05$) lowest value of the carcass dressing percentage.

The addition of GA and GA with Xylam 500 in broiler chick's diet significantly increased ($P < 0.05$) the heart weight compared to control group .Also the addition of GA in broiler chicks' diet significantly decreased ($P > 0.05$) the gizzard weight compared to the tested groups, although the inclusion of GA with Xylam 500 in broiler chicks diet significantly increased ($P < 0.05$) the gizzard weight compared to other tested groups. Results also showed that inclusion of GA in broiler chicks diet Significantly ($P < 0.05$) enlarge the liver size compared to control group, while the supplementation of Xylam 500 to broiler diet containing GA highly Significantly ($P < 0.05$) increased the liver size compared to other tested groups.

4.1.3 Chemical Analysis of Blood Serum:

The results of broiler chicks fed on diet containing GA with or without Xylam blood serum chemistry tabulated in Table (7). Results showed that the inclusion of GA in broiler chicks diet significantly ($P > 0.05$) decreased the level of cholesterol compared to chicks fed on control diet, however, GA supplementation with Xylam significantly decreased ($P > 0.05$) the cholesterol level in the blood serum compared with other tested groups. The similar trend was recorded for alkaline phosphate.

The broiler chick's diet supplementation with GA with Xylam significantly decreased ($P > 0.05$) the Ca level in blood serum compared to control group, although the addition of GA without Xylam to broiler diet had no significant on Ca level. Results also showed that the inclusion of GA with or without Xylam in broiler diet recorded no significant effects ($P > 0.05$) on the levels of Uric Acid and Total Protein.

4.1.4 Mortality:

The chicks fed on Control diets had the higher mortality rate (3.1%) compared to those fed on diet containing GA (1.6%).

4.1.5 Economical Appraisal:

The total cost, returns, net profit and profitability ratio per head of broiler chicks fed of Gum Arabic with or without Xylam for 6 weeks are shown in Table(8). Chicks purchase, management and feed cost values (SDG) were the major inputs considered. The selling values of meat are the total revenues obtained. The results of economical evaluation indicated that the dietary groups B, C gained more net profit than that of group A. The value profitability ratio (1.28) of group C was the highest of the tested groups.

Table (5): Effect of feeding Gum Arabic with or without enzyme on performance of broiler chicks:

Parameter	Treatments			$Lsd_{0.05}$	SE±
	A	B	C		
Final weight (gm)	1786.33^{c} ±185.77	1870.33^{a} ±56.92	1810.33^{b} ±434.53	54.91^{*}	15.87
Body weight gain (gm)	1655^{a} ±187.73	1738^{b} ±118.19	1676^{a} ±191.23	33.78^{*}	9.763
Feed intake (gm)	3790.00^{a} ±166.87	3513.67^{b} ±347.34	3416.00^{c} ±122.56	46.64^{*}	13.48
Feed conversion ratio	2.29^{a} ±0.32	2.02^{a} ±0.21	2.4^{a} ±0.23	$0.5171^{n.s}$	0.1494
Mortality rate (%)	3.1	1.6	0	-	-

Values are mean±SD.

Any two mean value(s) bearing different superscript(s) in a row are significantly different ($P \leq 0.05$).

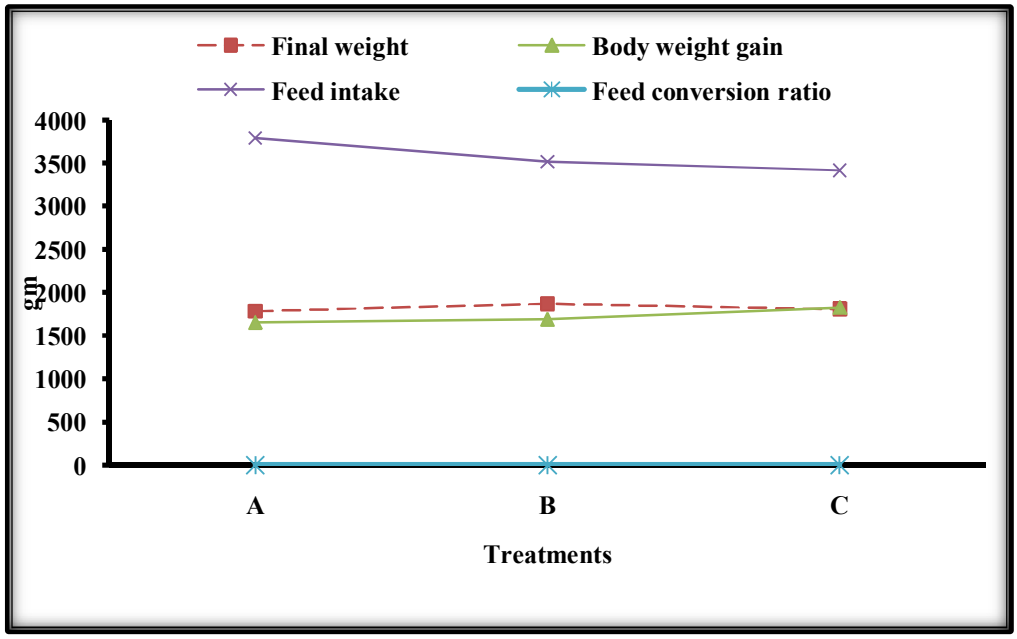
Key:

A ≡ Sample without treatment (control)

B ≡ Sample treated with gum Arabic.

C ≡ Sample treated with gum Arabic and enzyme.

Fig (1): Effect of feeding Gum Arabic with or without enzyme on performance of broiler chicks:



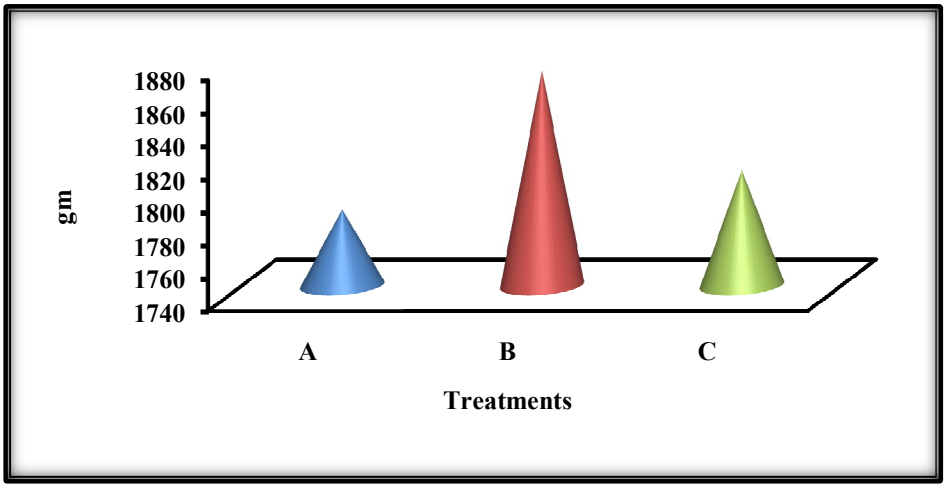
Key:

A ≡ Sample without treatment (control).

B ≡ Sample treated with gum Arabic.

C ≡ Sample treated with gum Arabic and enzyme.

Fig (2): Effect of feeding Gum Arabic with or without enzyme on Final



Weight:

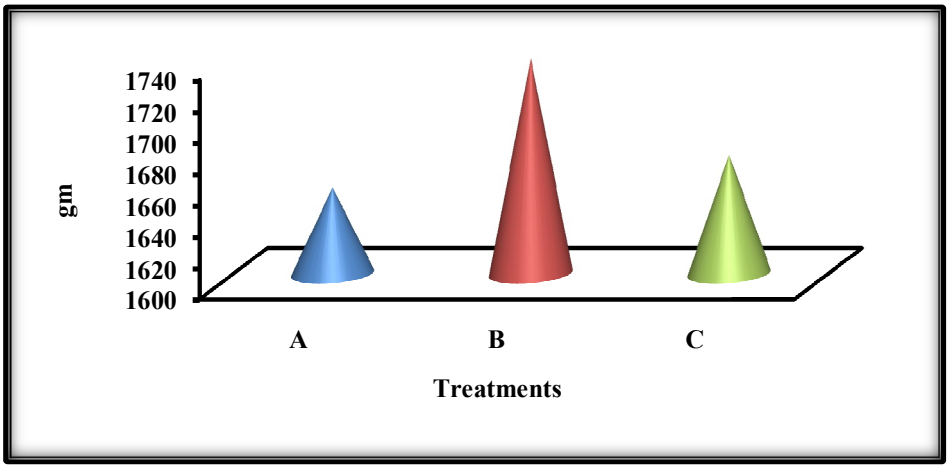
Key:

A ≡ Sample without treatment (control).

B ≡ Sample treated with gum Arabic.

C ≡ Sample treated with gum Arabic and enzyme.

Fig (3): Effect of feeding Gum Arabic with or without enzyme on Body Weight Gain:



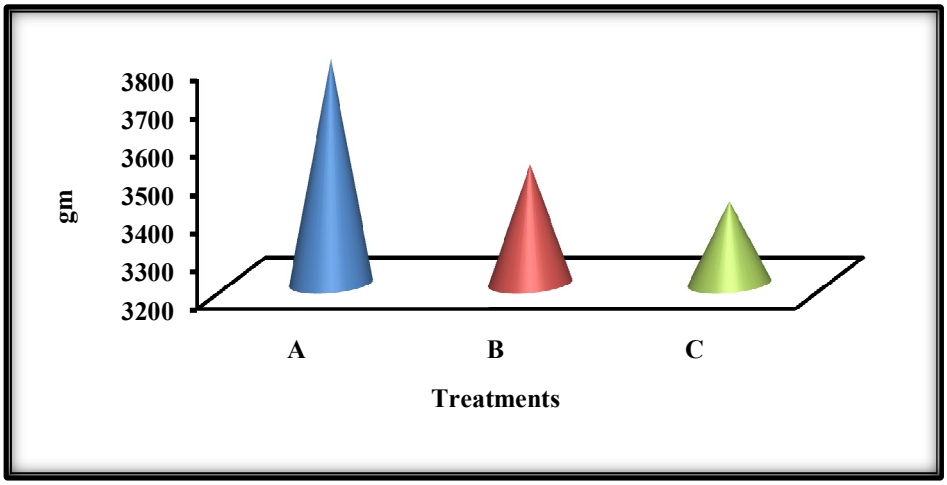
Key:

A ≡ Sample without treatment (control).

B ≡ Sample treated with gum Arabic.

C ≡ Sample treated with gum Arabic and enzyme.

Fig (4): Effect of feeding Gum Arabic with or without enzyme on Feed Intake:



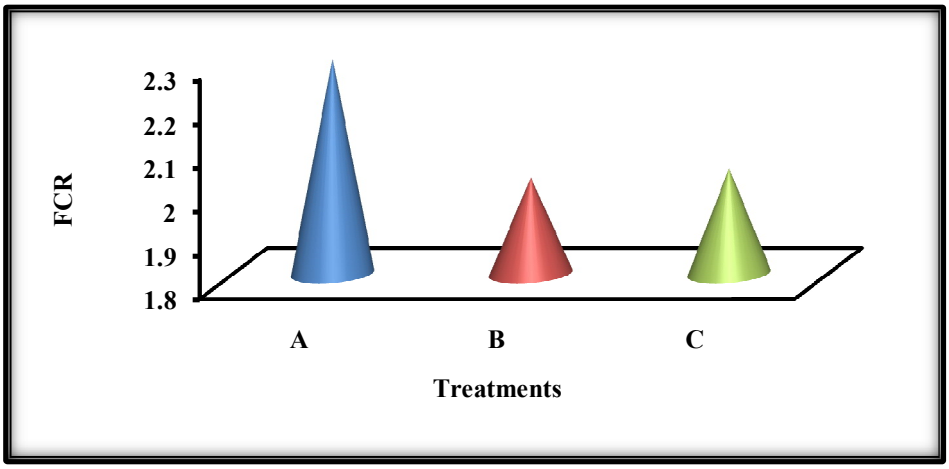
Key:

A ≡ Sample without treatment (control).

B ≡ Sample treated with gum Arabic.

C ≡ Sample treated with gum Arabic and enzyme.

Fig (5): Effect of feeding Gum Arabic with or without enzyme on Feed Conversion Ratio:



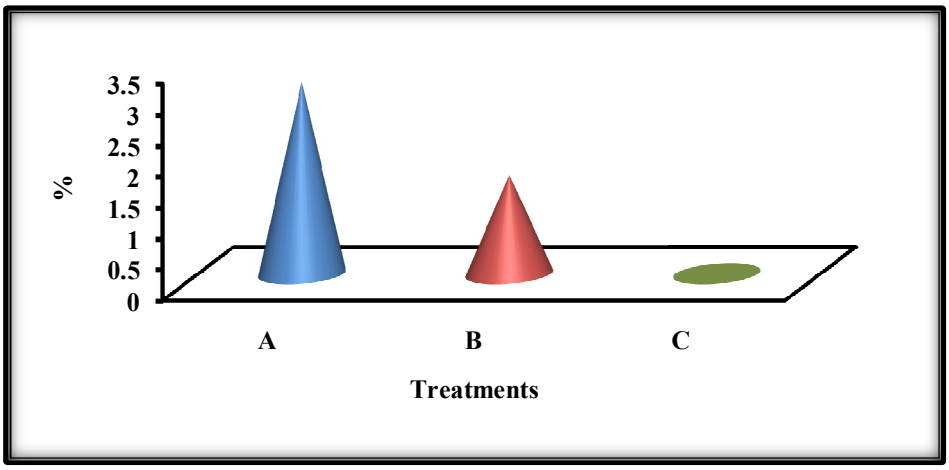
Key:

A ≡ Sample without treatment (control).

B ≡ Sample treated with gum Arabic.

C ≡ Sample treated with gum Arabic and enzyme.

Fig (6): Show Mortality during the Experimental:



Key:

A ≡ Sample without treatment (control).

B ≡ Sample treated with gum Arabic.

C ≡ Sample treated with gum Arabic and enzyme.

Table (6): Effect of feeding Gum Arabic with or without enzyme on Dressing Percentage and Non Carcasses Component of broiler chicks:

Parameter	Treatments			$Lsd_{0.05}$	SE±
	A	B	C		
Hot dressing	67.33^{c} ±8.39	69.33^{a} ±1.15	68.33^{b} ±1.15	0.9855^{*}	0.2848
Heart	10.00^{b} ±0.0	11.67^{a} ±2.89	11.67^{a} ±2.89	0.709^{*}	0.1361
Gizzard	26.67^{c} ±2.89	23.33^{b} ±2.89	33.33^{a} ±7.64	2.989^{*}	0.9287
Liver	25.00^{c} ±5.00	26.67^{b} ±2.89	33.33^{a} ±12.58	0.1597^{*}	0.04615

Values are mean±SD.

Any two mean value(s) bearing different superscript(s) in a row are significantly different ($P \leq 0.05$).

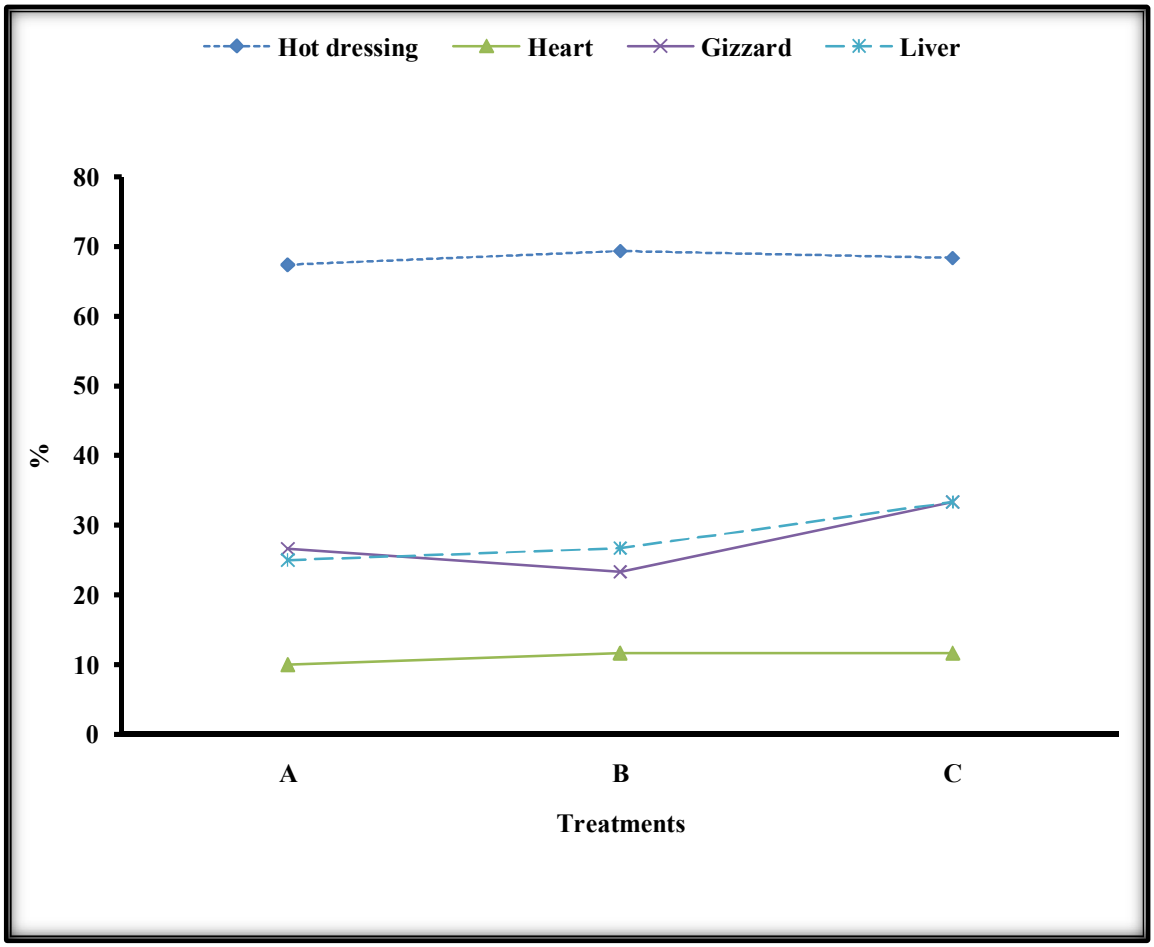
Key:

A ≡ Sample without treatment (control).

B ≡ Sample treated with gum Arabic.

C ≡ Sample treated with gum Arabic and enzyme.

Fig (7): Effect of feeding Gum Arabic with or without enzyme on dressing percentage and non carcasses component of broiler chicks:



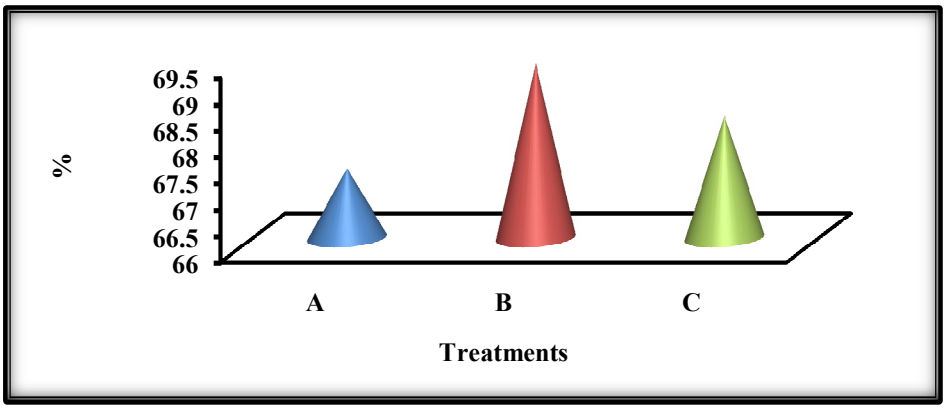
Key:

A ≡ Sample without treatment (control).

B ≡ Sample treated with gum Arabic.

C ≡ Sample treated with gum Arabic and enzyme.

Fig (8): Effect of feeding Gum Arabic with or without enzyme on dressing percentage:



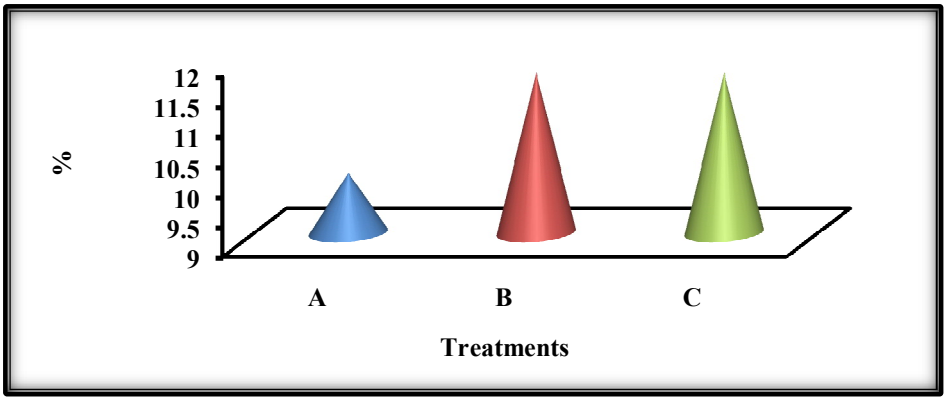
Key:

A ≡ Sample without treatment (control).

B ≡ Sample treated with gum Arabic.

C ≡ Sample treated with gum Arabic and enzyme.

Fig (9): Effect of feeding Gum Arabic with or without enzyme on Heart:



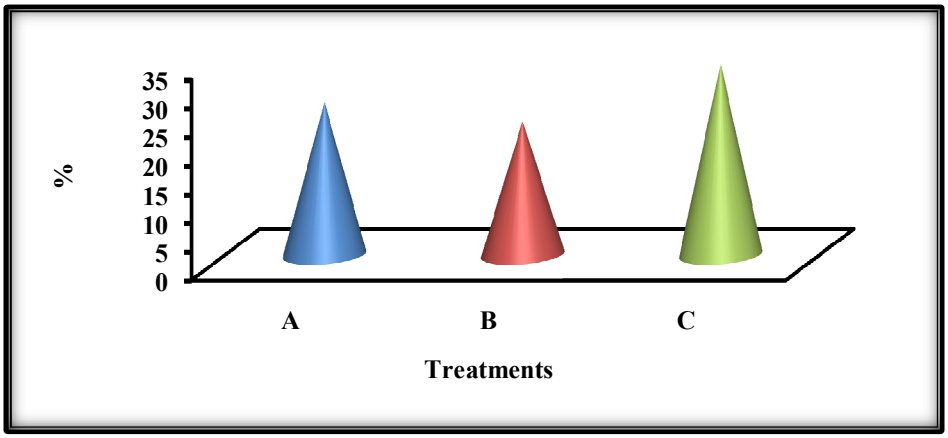
Key:

A ≡ Sample without treatment (control).

B ≡ Sample treated with gum Arabic.

C ≡ Sample treated with gum Arabic and enzyme.

Fig (10): Effect of feeding Gum Arabic with or without enzyme on Gizzard:



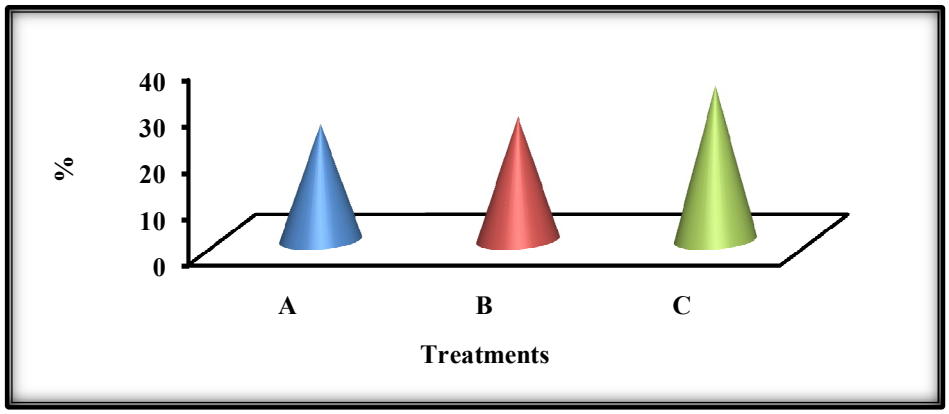
Key:

A ≡ Sample without treatment (control).

B ≡ Sample treated with gum Arabic.

C ≡ Sample treated with gum Arabic and enzyme.

Fig (11): Effect of feeding Gum Arabic with or without enzyme on Liver:



Key:

A ≡ Sample without treatment (control).

B ≡ Sample treated with gum Arabic.

C ≡ Sample treated with gum Arabic and enzyme.

Table (7): Effect of feeding gum Arabic with or without enzyme on Chemical analysis of blood serum of broiler chicks:

Parameter	Treatments			$Lsd_{0.05}$	SE±
	A	B	C		
Cholesterol (mg/dL)	116.67^{a} ±2.52	115.00^{b} ±4.58	114.00^{c} ±3.61	0.7325^{*}	0.2117
Uric acid (mg/dL)	2.77^{a} ±0.25	2.57^{a} ±0.40	2.67^{a} ±0.35	$0.6834^{n.s}$	0.1975
Alkaline phosphate (mg/dL)	86.00^{a} ±2.00	85.33^{b} ±3.06	83.33^{c} ±4.51	0.6693^{*}	0.1934
Ca (mg/dL)	7.43^{b} ±0.12	7.67^{ab} ±0.15	7.93^{a} ±0.21	0.3283^{*}	0.09487
Total protein (gm)	4.37^{a} ±0.15	4.33^{a} ±0.32	4.33^{a} ±0.21	$0.477^{n.s}$	0.1378

Values are mean±SD.

Any two mean value(s) bearing different superscript(s) in a row are significantly different ($P \leq 0.05$).

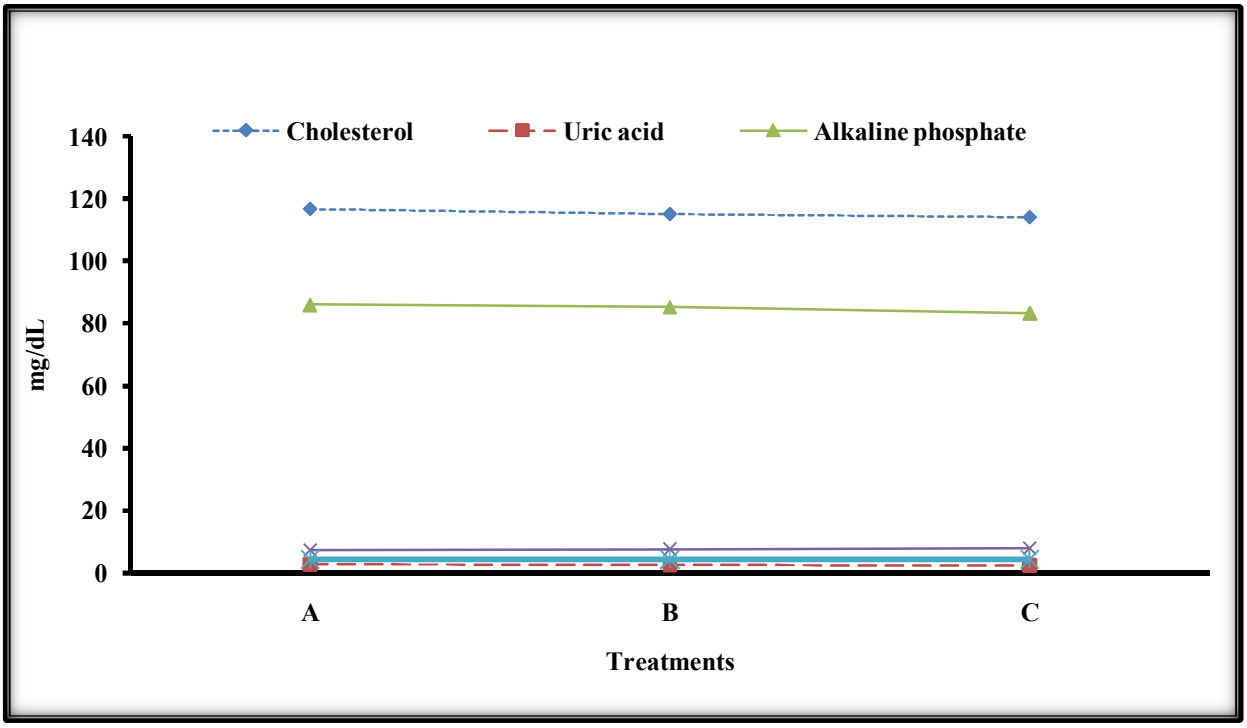
Key:

A ≡ Sample without treatment (control).

B ≡ Sample treated with gum Arabic.

C ≡ Sample treated with gum Arabic and enzyme.

Fig (12): Effect of feeding Gum Arabic with or without enzyme on Chemical analysis of blood serum of broiler chicks:



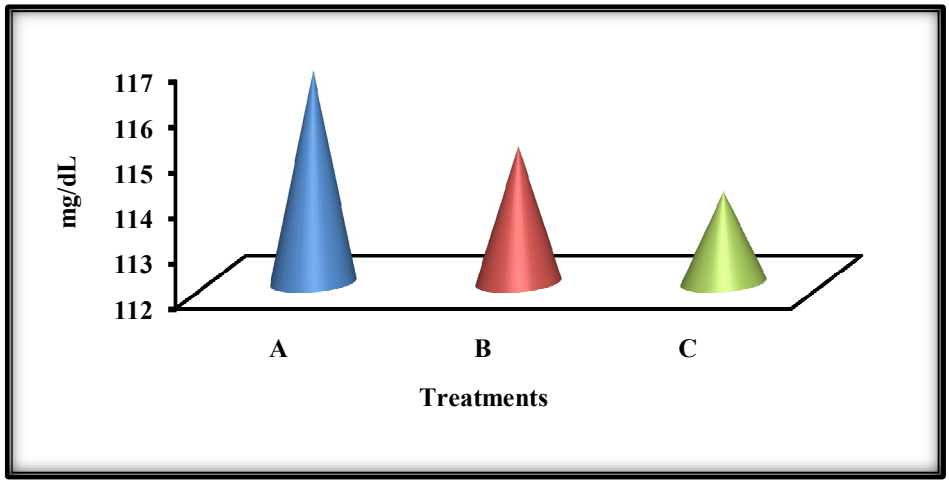
Key:

A ≡ Sample without treatment (control).

B ≡ Sample treated with gum Arabic.

C ≡ Sample treated with gum Arabic and enzyme.

Fig (13): Effect of feeding Gum Arabic with or without enzyme on Cholestrol:



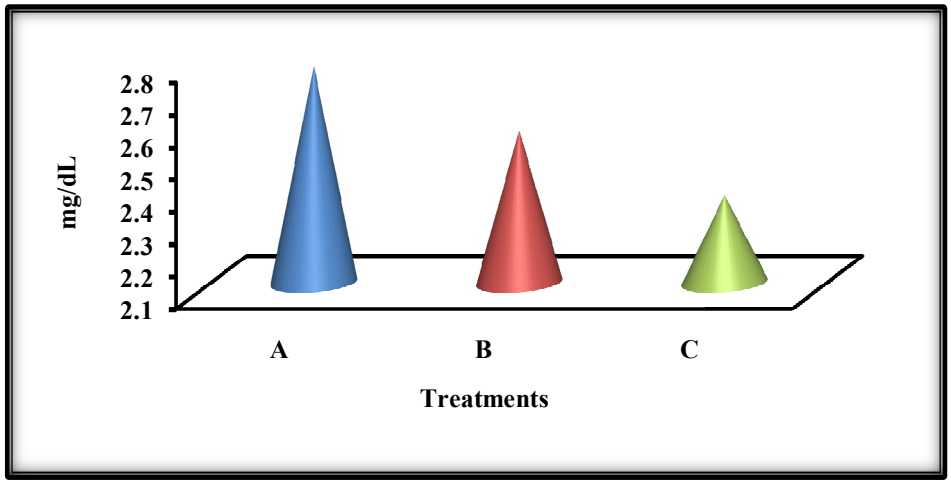
Key:

A ≡ Sample without treatment (control).

B ≡ Sample treated with gum Arabic.

C ≡ Sample treated with gum Arabic and enzyme.

Fig (14): Effect of Gum Arabic with or without enzyme on Uric Acid:



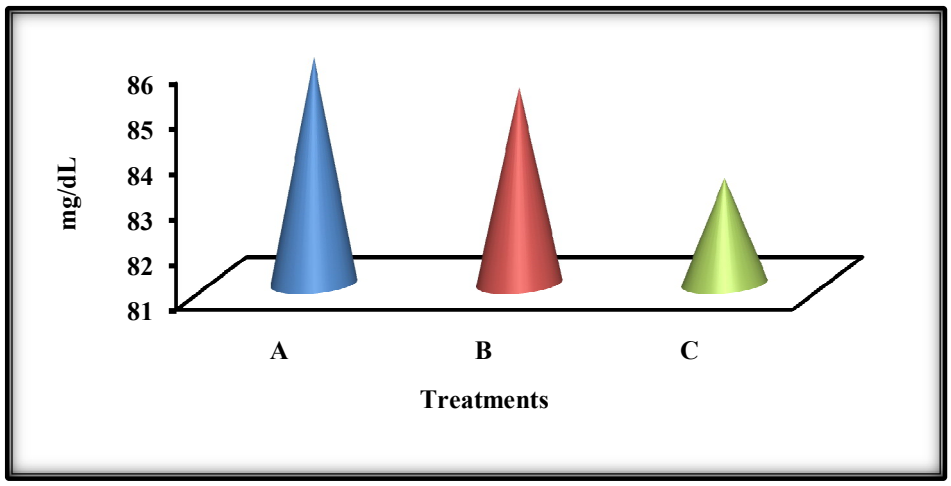
Key:

A ≡ Sample without treatment (control).

B ≡ Sample treated with gum Arabic.

C ≡ Sample treated with gum Arabic and enzyme.

Fig (15): Effect of Gum Arabic with or without enzyme on Alkaline Phosphate:



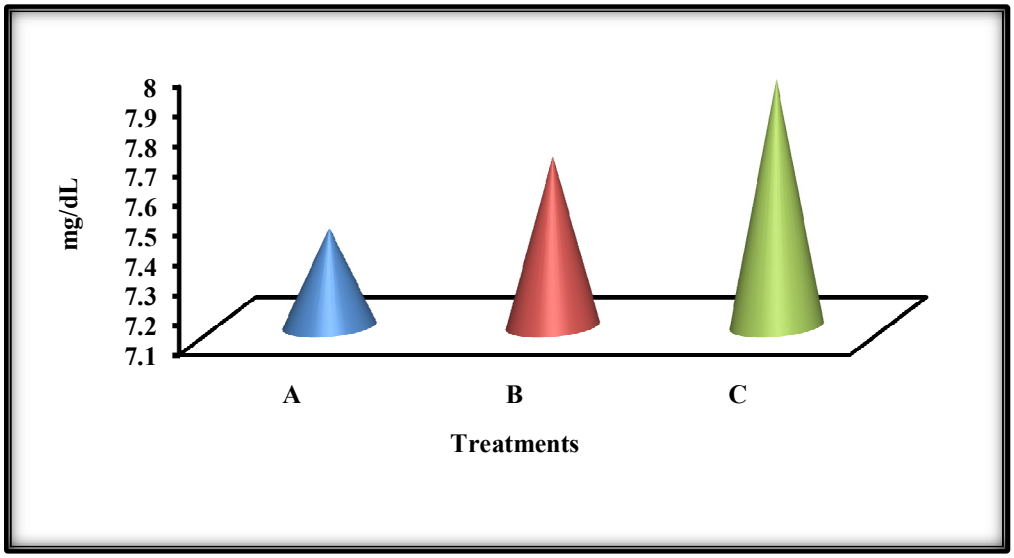
Key:

A ≡ Sample without treatment (control).

B ≡ Sample treated with gum Arabic.

C ≡ Sample treated with gum Arabic and enzyme.

Fig (16): Effect of Gum Arabic with or without enzyme on Calcium:



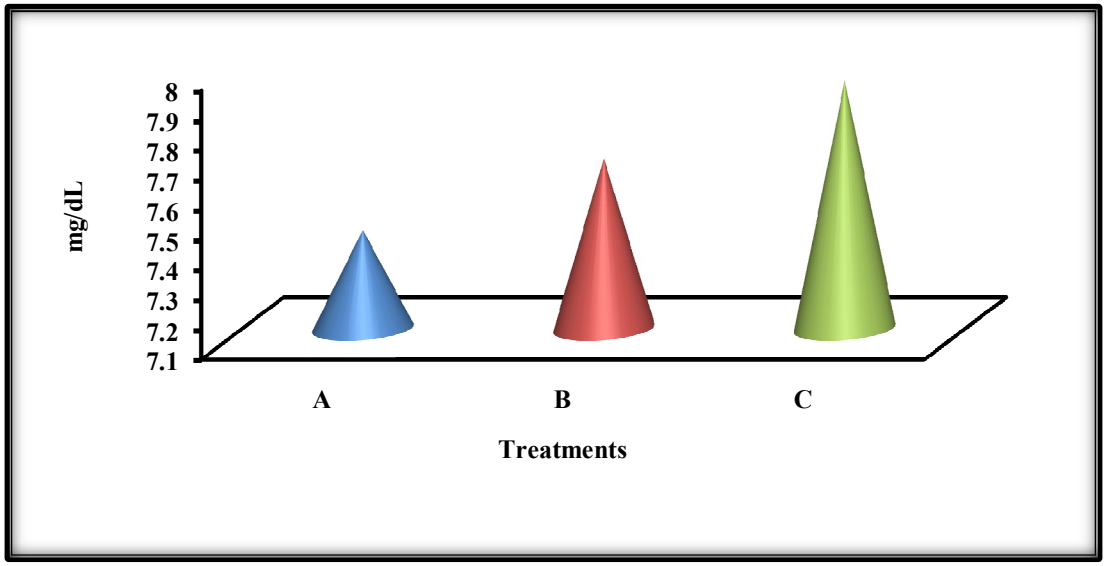
Key:

A ≡ Sample without treatment (control).

B ≡ Sample treated with gum Arabic.

C ≡ Sample treated with gum Arabic and enzyme.

Fig (17): Effect of Gum Arabic with or without enzyme on Total Protein:



Key:

A ≡ Sample without treatment (control).

B ≡ Sample treated with gum Arabic.

C ≡ Sample treated with gum Arabic and enzyme.

Table (8): The Economic Appraisal of dietary Gum Arabic with or without enzyme for broiler chicks:

Items	**A**	**B**	**C**
Costs:			
Chicks purchase	3	3	3
Total Feed cost	17	17	17
Management	2	2	2
Total costs of Production	22	22	22
Revenues :			
Dressing Percentage	67.3	69.3	68.3
Average Weight	1658	1692	1827
Price / kg of bird	33	33	33
Total Revenues	36.8	38.6	41
Profits:			
Total Revenues	36.8	38.6	41
Total costs of production	22	22	22
Total Profit	14.8	16.6	19
Profitability Ratio	1	1.12	1.28

Total costs calculation according to September 2014 price.

Price kilogram of bird calculated according to November 2014.

CHAPTER FIVE

DISCUSSION

Many authors and researchers they confirm that the important role of prebiotic and probiotic for increase the performance values in poultry feeding in special way in broilers chicken feeding. Gum Arabic one of the most prebiotic for feed additive in broiler chicks. In the present study the effect of application Gum Arabic (0.6%) and Gum Arabic (0.6%) with Xylam 500 enzyme showed that significant difference in the performance (body weight gain (BWG), feed intake (FI)) of broiler chicks. Although chicks fed with Gum Arabic and Gum Arabic with Xylam 500 enzyme recorded significantly ($p < 0.05$) the highest values of body weight in compared to these fed on control group, while chicks fed with Gum Arabic recorded significantly ($p < 0.05$) the highest values of body weight gain in compared to other tested groups.

These results were in line with findings of Piray *et al.,* (2007) demonstrated significant increases in BWG in broilers recovering diets supplemented with prebiotics and Abd- Razing *et al.,* (2010) who reported significant increasing in body weight of hen from addition of graded levels of Gum Arabic in laying hens, this might be due to stimulate natural bacteria activity and proliferation of bifido bacteria and lactic acid bacteria. On the other hand, these results disagreed with Sims and Soften, (1999) who reported no difference in BW, BWG and FI for prebiotics and Waldroup *et al.,* (2003) and Midilli and Tuncer, (2001) who found that dietary prebiotic supplementation did not significantly affect BW, BWG.

Chicks fed on control group consumed significantly ($p < 0.05$) more feds, while chicks group fed on diet containing GA with Xylam 500 enzyme

consumed significantly ($p > 0.05$) the lowest value of feed. This might be due to increase of energy availability with GA and enzyme. These results disagreed with (Sanchez and Ayaya, 1998) who found that dietary prebiotics have been shown to increase feed intake and El- Kheir *et al.*, (2009) found that supplementation of 15% GA in layer based diet increased feed intake.

There was no significant difference for feed conversion ratio between all experimental groups, the results were in agreement with the report of Makkawi, (2009) who related, the negative response of FCR with addition dietary xylam 500 it might be due to inadequacy of the enzyme supplementation in proportion to the amount of non starch polysaccharids. On the other hand these results disagreed with Midilli *et al.,* (2001) who found that FCR was significantly improved for chicks fed diet supplemented with prebiotic.

Throughout the experimental period, mortality rate decreased with the addition of GA compared to control group which recorded the highest rate of mortality. This might be due that natural prebiotic (GA) creates suitable environment for probiotics to grow and help eliminate toxins, fats and balance out bad bacteria thus, enhance the immune system, which will secure body to be less prone to sickness and severe as energy booster. This result was in agreed with report of Gibson and Roberfroid, (1995); and Marinho *et al.,* (2007); and Rayes *et al.,* (2009); and savage *et al.,* (1996) that prebiotics may enhance health by stimulating antibody production.

Data obtained showed significant difference in non- cacrcass components (liver, heart and gizzard) and dressing percentage. The supplementation of diets with GA improves the carcass dressing percentage compared to other tested groups. The addition of GA and GA with enzyme

in broiler chick's diet increased heart weight compared to control group. Also supplementation of diets with GA and enzyme increased gizzard and liver weight compared to other groups. These results disagreed with Midilli *et al.,* (2001). Makkawi, (2009) who found that the percentage of carcass dressing, liver, heart, and gizzard were not affected significantly by the addition of Xylam commercial enzyme.

The results showed significant difference on blood serum between all treatment groups in cholesterol, alkaline phosphate, and calcium, while there was no significant difference for total protein, and uric acid. Therefore, prebiotics might absorb bile acid turn it into wastes to prevent re- absorption of cholesterol in blood as well as lowering LDL- cholesterol (bad cholesterol). These results confirmed by Elkhier (2009) who found that addition of GA at 15% in layer diet significantly reduced serum cholesterol, and Sena *et al.,* (2013) were confirm that the supplementation GA for broiler chicks is significantly (p> o.o5) decreased total cholesterol at the same time increased lightly the total protein. On the other hand, these results disagreed with Tageldin *et al.,* (2006) who reported increase on cholesterol level in rabbits fed GA and that GA associated with an increase in total cholesterol biosynthesis and Topping *et al,* (1985) who showed that plasma cholesterol concentration was unaffected by feeding. The Alkaline phosphate increased of chicks fed on control diets increased compared to other groups. The addition of GA with enzyme increased calcium compared to other groups.

Economical evaluation should be discussed .The addition of 0.6% GA with enzyme recorded highest value profitability ratio compared to other groups.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion:

- GA supplementation apparently improved the general performance of broiler chicks. Economically gum Arabic increased the profitability of broiler chicks.
- Based on the results obtained it may be concluded that GA can be supplemented in the broiler diets up to 0.6% without any adverse effects. Supplementation of GA to broiler diet significantly decreased cholesterol level in the blood serum.
- Chicks group fed on diet containing GA and supplemented with Xylam 500 consumed the lowest value of feed.

6.2 Recommendations:

- This study recommends using GA with enzyme Xylam 500 to resolve the intestinal viscosity and improve the performance values and to increase the immune response.
- Furthermore studies are needed to investigate the effect of Gum Arabic and enzyme addition in the diet on the performance, blood serum parameters, and carcass characteristics of the broiler chicks.

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APPENDIXES

Appendix (1)

(Final weight)

A N A L Y S I S O F V A R I A N C E T A B L E

S. of Var. df SS MS F-cal P-value

Between 2 11232.000 5616.000 12.074

Within 6 453138.000 75523.000

Total 8 464370.000

Coefficient of Variation = 15.08%

Var. V A R I A B L E No. 3

1 Number Sum Average SD SE

---

1 3.00 5359.000 1786.333 185.77 158.66

2 3.00 5611.000 1870.333 56.92 158.66

3 3.00 5431.000 1810.333 434.53 158.66

Total 9.00 16401.000 1822.333 240.93 80.31

Within 274.81

Duncan's Multiple Range Test

LSD value = 54.91

SE = 15.87 at alpha = 0.050

Mean 1 = 1786. C

Mean 2 = 1870. A

Mean 3 = 1810. B

(Body wt. gain)

A N A L Y S I S O F V A R I A N C E T A B L E

S. of Var.	df	SS	MS	F-cal	P-value
Between	2	48212.667	24106.333	9.843	
Within	6	171567.333	28594.556		
Total	8	219780.000			

Coefficient of Variation = 9.80%

Var. V A R I A B L E No. 4

1	Number	Sum	Average	SD	SE
1	3.00	4975.000	1658.333	187.73	97.63
2	3.00	5076.000	1692.000	118.19	97.63
3	3.00	5483.000	1827.667	191.23	97.63
Total	9.00	15534.000	1726.000	165.75	55.25
Within			169.10		

Duncan's Multiple Range Test

LSD value = 33.78

SE = 9.763 at alpha = 0.050

Mean 1 = 1658. C

Mean 2 = 1692. B

Mean 3 = 1828. A

(Feed intake)

A N A L Y S I S O F V A R I A N C E T A B L E

S. of Var. df SS MS F-cal P-value

Between 2 225774.889 112887.444 21.071 0.2070

Within 6 327014.667 54502.444

Total 8 552789.556

Coefficient of Variation = 6.53%

Var. V A R I A B L E No. 5

1 Number Sum Average SD SE

---

1 3.00 11370.000 3790.000 166.87 134.79

2 3.00 10541.000 3513.667 347.34 134.79

3 3.00 10248.000 3416.000 122.56 134.79

Total 9.00 32159.000 3573.222 262.87 87.62

Within 233.46

Duncan's Multiple Range Test

LSD value = 46.64

SE = 13.48 at alpha = 0.050

Mean 1 = 3790. A

Mean 2 = 3514. B

Mean 3 = 3416. C

(FCR)

A N A L Y S I S O F V A R I A N C E T A B L E

S. of Var. df SS MS F-cal P-value

Between 2 0.242 0.121 1.817 0.2416

Within 6 0.400 0.067

Total 8 0.642

Coefficient of Variation = 12.56%

Var. V A R I A B L E No. 6

1 Number Sum Average SD SE

---

1 3.00 6.800 2.267 0.32 0.15

2 3.00 6.100 2.033 0.21 0.15

3 3.00 5.600 1.867 0.23 0.15

Total 9.00 18.500 2.056 0.28 0.09

Within 0.26

Duncan's Multiple Range Test

LSD value = 0.5171

SE = 0.1494 at alpha = 0.050

Mean 1 = 2.267 A

Mean 2 = 2.033 A

Mean 3 = 1.867 A

(Hot dressing)

A N A L Y S I S O F V A R I A N C E T A B L E

S. of Var. df SS MS F-cal P-value

Between	2	6.000	3.000	4.123
Within	6	146.000	24.333	

Total	8	152.000

Coefficient of Variation = 7.22%

Var. V A R I A B L E No. 8

1	Number	Sum	Average	SD	SE
1	3.00	202.000	67.333	8.39	2.85
2	3.00	208.000	69.333	1.15	2.85
3	3.00	205.000	68.333	1.15	2.85
Total	9.00	615.000	68.333	4.36	1.45
Within			4.93		

Duncan's Multiple Range Test

LSD value = 0.9855

SE = 0.2848 at alpha = 0.050

Mean 1 = 67.33 C

Mean 2 = 69.33 A

Mean 3 = 68.33 B

(Heart)

A N A L Y S I S O F V A R I A N C E T A B L E

S. of Var.	df	SS	MS	F-cal	P-value
Between	2	5.556	2.778	6.500	

Within 6 33.333 5.556

Total 8 38.889

Coefficient of Variation = 21.21%

Var. V A R I A B L E No. 9

1	Number	Sum	Average	SD	SE
1	3.00	30.000	10.000	0.00	1.36
2	3.00	35.000	11.667	2.89	1.36
3	3.00	35.000	11.667	2.89	1.36
Total	9.00	100.000	11.111	2.20	0.73
Within			2.36		

Duncan's Multiple Range Test

LSD value = 4.709

SE = 1.361 at alpha = 0.050

Mean 1 = 10.00 B

Mean 2 = 11.67 A

Mean 3 = 11.67 A

(Gizzard)

A N A L Y S I S O F V A R I A N C E T A B L E

S. of Var.	df	SS	MS	F-cal	P-value
Between	2	155.556	77.778	7.111	0.1183
Within	6	150.000	25.000		

Total 8 305.556

Coefficient of Variation = 18.00%

Var. V A R I A B L E No. 10

1	Number	Sum	Average	SD	SE
1	3.00	80.000	26.667	2.89	2.89
2	3.00	70.000	23.333	2.89	2.89
3	3.00	100.000	33.333	7.64	2.89
Total	9.00	250.000	27.778	6.18	2.06
Within			5.00		

Duncan's Multiple Range Test

LSD value = 2.989

SE = 0.9287 at alpha = 0.050

Mean 1 = 26.67 C

Mean 2 = 23.33 B

Mean 3 = 33.33 A

(Liver)

A N A L Y S I S O F V A R I A N C E T A B L E

S. of Var.	df	SS	MS	F-cal	P-value
Between	2	116.667	58.333	4.913	
Within	6	383.333	63.889		
Total	8	500.000			

Coefficient of Variation = 28.21%

Var. V A R I A B L E No. 11

1	Number	Sum	Average	SD	SE
1	3.00	75.000	25.000	5.00	4.61
2	3.00	80.000	26.667	2.89	4.61
3	3.00	100.000	33.333	12.58	4.61
Total	9.00	255.000	28.333	7.91	2.64
Within			7.99		

Duncan's Multiple Range Test

LSD value = 0.1597

SE = 0.04615 at alpha = 0.050

Mean 1 = 25.00 C

Mean 2 = 26.67 B

Mean 3 = 33.33 A

(Cholesterol)

A N A L Y S I S O F V A R I A N C E T A B L E

S. of Var.	df	SS	MS	F-cal	P-value
Between	2	10.889	5.444	6.405	
Within	6	80.667	13.444		
Total	8	91.556			

Coefficient of Variation = 3.18%

Var. V A R I A B L E No. 12

1	Number	Sum	Average	SD	SE
1	3.00	350.000	116.667	2.52	2.12
2	3.00	345.000	115.000	4.58	2.12
3	3.00	342.000	114.000	3.61	2.12
Total	9.00	1037.000	115.222	3.38	1.13
Within			3.67		

Duncan's Multiple Range Test

LSD value = 0.7325

SE = 0.2117 at alpha = 0.050

Mean 1 = 116.7 A

Mean 2 = 115.0 B

Mean 3 = 114.0 C

(Uric acid)

A N A L Y S I S O F V A R I A N C E T A B L E

S. of Var.	df	SS	MS	F-cal	P-value
Between	2	0.240	0.120	1.029	0.4130
Within	6	0.700	0.117		
Total	8	0.940			

Coefficient of Variation = 13.31%

Var. V A R I A B L E No. 13

1	Number	Sum	Average	SD	SE

1	3.00	8.300	2.767	0.25	0.20
2	3.00	7.700	2.567	0.40	0.20
3	3.00	7.100	2.367	0.35	0.20
Total	9.00	23.100	2.567	0.34	0.11
Within			0.34		

Duncan's Multiple Range Test

LSD value = 0.6834

SE = 0.1975 at alpha = 0.050

Mean 1 = 2.767 A

Mean 2 = 2.567 A

Mean 3 = 2.367 A

(Alk Phos)

A N A L Y S I S O F V A R I A N C E T A B L E

S. of Var.	df	SS	MS	F-cal	P-value
Between	2	11.556	5.778	7.515	
Within	6	67.333	11.222		
Total	8	78.889			

Coefficient of Variation = 3.95%

Var. V A R I A B L E No. 14

1	Number	Sum	Average	SD	SE
1	3.00	258.000	86.000	2.00	1.93
2	3.00	256.000	85.333	3.06	1.93

3	3.00	250.000	83.333	4.51	1.93
Total	9.00	764.000	84.889	3.14	1.05
Within			3.35		

Duncan's Multiple Range Test

LSD value = 0.6693

SE = 0.1934 at alpha = 0.050

Mean 1 = 86.00 A

Mean 2 = 85.33 B

Mean 3 = 83.33 C

(Ca)

A N A L Y S I S O F V A R I A N C E T A B L E

S. of Var.	df	SS	MS	F-cal	P-value
Between	2	0.376	0.188	7.042	0.0267
Within	6	0.160	0.027		
Total	8	0.536			

Coefficient of Variation = 2.13%

Var. V A R I A B L E No. 15

1	Number	Sum	Average	SD	SE
1	3.00	22.300	7.433	0.12	0.09
2	3.00	23.000	7.667	0.15	0.09
3	3.00	23.800	7.933	0.21	0.09

Total	9.00	69.100	7.678	0.26	0.09
Within			0.16		

Duncan's Multiple Range Test

LSD value = 0.3283

SE = 0.09487 at alpha = 0.050

Mean 1 = 7.433 B

Mean 2 = 7.667 AB

Mean 3 = 7.933 A

(TP)

A N A L Y S I S O F V A R I A N C E T A B L E

S. of Var.	df	SS	MS	F-cal	P-value
Between	2	0.002	0.001	0.020	
Within	6	0.340	0.057		
Total	8	0.342			

Coefficient of Variation = 5.48%

Var. V A R I A B L E No. 16

1	Number	Sum	Average	SD	SE
1	3.00	13.100	4.367	0.15	0.14
2	3.00	13.000	4.333	0.32	0.14
3	3.00	13.000	4.333	0.21	0.14
Total	9.00	39.100	4.344	0.21	0.07
Within			0.24		

Duncan's Multiple Range Test

LSD value = 0.4770

SE = 0.1378 at alpha = 0.050

Mean	1 =	4.367	A
Mean	2 =	4.333	A
Mean	3 =	4.333	A

Appendix (2)

Gum Arabic tree branch

Appendix (3)

Gum Arabic

Appendix (4)

Chicks in one day of age

Appendix (٥)

Distribution of chicks in the house