Sudan University of Science and Technology

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Evaluation of Shamar (*Foenicum vulgre*) Seeds as Natural Growth Promotion (NGP) in Broiler Chicks

تقييم بذور الشماركمحفز طبيعي للنمو في الدجاج اللاحم

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الآية

بسم الله الرحمن الرحيم

قال تعالى:

نْ دَابَّةٍ فِي الأ ْ َرْ ضِ وَلاَ طَائِرٍ يَطِيرُ بِجَنَاحَيْهِ إِلاَّ أُمَمٌ أَمْثَالُكُمْ مَا فَرَّطْنَا فِي الْكِتَابِ مِنْ شَيْءٍ ثُمَّ إِلَى رَبِّهِمْ يُحْشَرُونَ).

صدق الله العظيم

سورة الأنعام الآية (38)

Dedication

To my parents,

To my brothers,

To my husband,

To my friends and Relatives.

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 Mukhtar Ahmed Mukhtar** for generously providing and for patience, constant support, advices and insight was invaluable to me. He is always available not only for consultation but also to solve any difficulties. Then I wish to express grateful thanks to administration of Sudan University of Science and Technology, College of Agricultural Studies for allowing me to conduct my research and providing any assistance requested.

Very special gratitude is extended to my husband and my parents for their unlimited support.

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ABSTRACT

This experiment was conducted to evaluate the response of broiler chicks fed on graded levels of Shamar seed (Foeniculum Vulgare mill) as natural growth promoter alternative to antibiotic. Experimental parameters covered growth performance, carcass dressing percentage, subjective and objective meat quality and economical appraisal. The experimental design used was complete randomize design (CRD). A total number of (84), 8 days-old, 140 gm initial weight unsexed(Abar Acer) strain of broiler chicks randomly divided into four experimental groups with three replicates, each of seven chicks. The first group (A) fed on basal diet without feed additives (control group), the other groups B, C and D were fed basal diet supplemented with different levels of (Foeniculum Vulgare mill) 1,2,3,%. The basal diet was formulated to meet the nutrients requirements of broiler chicks according to (NRC, 1994). Experimental diets fed for 6 weeks.

The results indicated that there were no significant differences ($P > 0.05$) among all treatment groups in the values of body weight gain, feed intake, feed conversion ratio, carcass dressing percentages and subjective and objective meat quality attributes. No mortality recorded throughout the experimental period. The economical evaluation showed that levels of dietary (Foeniculum Vulgare mill) were economical feasible compared to control group, but the values of profitability ratio (1, 14) (1.08) of group B, C, were the highest of the tested groups.

ملخص الدراسة

أجريت هذه الدراسة لتقييم مدى استجابة كتاكيت الدجاج اللاحم المغذاة على علائق تحتوى على مسحوق بذور الشمار (Foeniculum vulgare) كمحفز طبيعي للنمو بديلا للمضادات الحيوية.

شملت قياسات التجربة الأداء العام ، نسبة التصافي للذبيحة، الصفات النوعية للحم والتقييم الاقتصادي .

صممت هذه التجربة باستخدام النظام العشوائي الكامل .تم استخدام 84 كتكوت عمر 8 أيام بوزن ابتدائي 140 جم من سلالة الابرايكر، تم تقسيمها عشوائيا إلى أربعة مجموعات تجريبية ,كل مجموعة ضمنت ثلاثة مكررات، بكل مكرر سبعة كتاكيت. تمت تغذية المجموعة الأولى (A)على عليقة أساسية بدون أي إضافة (عليقة أساسية)، أما المجموعات الأخرى (B, C, D) فقد تم تغذيتها على العليقة الأساسية مضافا إليها مسحوق بذور الشمار بنسبة 1,2,3.% على التوالي. تم تكوين العليقة القياسية لتقابل الاحتياجات الغذائية للدجاج حسب توصية(NRC, 1994) تمت التغذية على العلائق التجريبية لمدة 6 أسابيع .

أثبتت النتائج المتحصل عليها بأنه لاتوجد فروقات معنوية ($P<0.05$) بين كل المجموعات التجريبية في قيم وزن الجسم المكتسب، العليقة المستهلكة، معدل التحويل الغذائي، نسبة التصافي للذبيحة وصفات اللحم الانطباعية النوعية للدجاج اللاحم.

لم تسجل أي حالات للنفوق خلال فترة التجربة. اظهر التقييم الاقتصادي بان المستويات الغذائية لبذور الشمار كانت مجدية اقتصاديا وخصوصا في المجموعة (B) و(C) قيمة الربحية النسبية (1.14) و (1.08) على التوالي كانت الأعلى بين المجوعات المختبرة.

CHAPTER ONE

INTRODUCTION

Growth-promoting feed additives are described as substances added to feed in relatively small amounts, to impart desirable properties or to suppress undesirable ones, hence, increasing growth performance and live weight gain or egg output and improved feed conversion efficiency and lower mortality rates (Steiner, 2006). The food of poultry origin supply high quality readily digested protein and energy and readily-available micronutrients thus, the intensive poultry production system results in stress. Ani-microbial feed additives such as antibiotics are often used alleviate, these stresses (Pasteiner, 2006). However, one major aspect of production and safety today is the reduction in the use of antibiotics and other medicinal products in the poultry production, largely due to fears over bacterial resistance and possible transmission of these antibiotic residues into the human food chain (Steiner,2006).

Since January 2006, the European Union has banned the use of antibiotic growth promoters (AGPs), and for the last two decades considerable research has been done on exploring suitable alternative growth promoters to antibiotics (Steiner, 2006). Different categories non-antibiotic growth promoters feed additives are referred to as natural growth promoters (NGPs). They are commonly regarded as favourable alternatives to AGPs in poultry production. The main advantage of NGPs over AGPs is that they do usually not bear any risk regarding bacterial resistance or undesired residues in poultry meat or eggs (Steiner, 2006). Addition of NGPs to poultry feed may have number of beneficial effects, including rapid development of healthy microflora, stabilization of digestion, increased stimulation, rapid maturation of the immune system, reduced incidence of diarrhea and higher profitability. (NGPs) include predominantly organic acids, probiotics, prebiotics, symbiotic, phytogenic, feed enzymes and immune stimulants (Pasteiner, 2006).

Aromatic plants are becoming more important due to it's their antimicrobial activity (Valero and Salmeron, 2003).They possess biological activities such as that antioxidants (Miura et al, 2002) as hypo

cholesterol emirs (Craig, 1999). To increase production of digestive enzymes and to improve utilization of digestive products through enhanced liver function it (Hernandez *et al.*, 2004).

The Shamar (FoeniculumValgare Mill) belongs to Order Apiales, Family: Apiaceae (Umbelliferae) commonly known as fennel of many synonems (Large Fennel, Sweet Fennel, Wild Fennel, Finocchio, Carosella and Florence) . Fennel is an aromatic, glabrous erect perennial reaching a height of Im with finely dissected leaves and yellow flowers in large umbels. Different plant parts - including the seed - are used medicinally. The seed yields up the oils of Fenchone, Alfa, Phellandrine, Anisic acid, Anisic aldehyde and Limonine.

The main products form fennel is the seed, seed oil, herb, herb oil and anethole, for all of which quality specifications exist. Of the medicinal properties, it is recognized as antioxidant, hepatoprotective, anticancer, antimicrobial and as a treatment against nausea.

Data available for *F. vulgare* seed feeding to poultry were meagre. Fennel is one of the aromatic plants which is containing high percentage of the fatty acids linolenic and stearic. In addition fennel has 16.81% trans - anethol plus 47.20% estragole with total sweeting components of 64.01% in essential oil (Guifraz *et al.*, 2008).

The aim of this experiment is to evaluate the effect of dietary Shamar seeds on the performance, carcass characteristics and blood and serum composition.

CHAPTER TWO

LIETERATURE REVIEW

2.1 Feed additives:

Feed for broiler and laying hens is formulated to contain an optimum nutrient obtainable at reasonable cost for desirable growth, production and efficiency of feed utilization. To insure that dietary nutrients are ingested, digested, protected from destruction, absorbed and transported to the cells of body, certain non- nutritive feed additives are sometimes used in addition to this optimum concentration and balance nutrients. 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). Additives are usually included in the feed mixture in very careful weighing, handing and mixing. The feed additives are falling in to two groups. The first group comprises those additives that have a specific nutrition role, and includes fifteen or more promoting substances alone, the second groups covers those compounds with the prevention and control of disease, and here the number used has so far to top sixty. Antibiotics may be included in both groups (Ray and Fox, 1979).

2.2 Antibiotics:

Antibiotics represent a group of chemicals compounds produced biologically by certain plants or microorganism, usually a fungus, which possess bacteriostatic or bactericidal properties, some antibiotics are particularly effective against negative bacteria. Other antibiotics are most effective against positive bacteria, wide range of both gram positive and gram negative bacteria.

Certain chemotherapeutic agents such as arsenicals and nitro furans have been found to possess bacteriostatic or bactericidal properties and, at the effective levels, are not toxic to chickens or other host animals (Parks *et al.*, 2000).

The growth promoter effect of antibiotics was discovered in the 1940s, when it was observed that animals fed dried mycelia of streptomycin aureofaciens containing chlortetracycline residues improved their growth. The mechanism of action of antibiotics as growth promoters is related to interaction with intestinal microbial population (Dibner and Richards, 2005; Niewold, 2007).

The United States food and drug administration approved the use of antibiotics as animal additive without veterinary prescription in 1951(Jones and Ricke, 2003). Also in the 1950s and 1960s, each European State approved its own national regulations about the use of antibiotics in animal feed (Castanon, 2007). The antibiotics as growth promoter may produce one or more 0f the following effect:(1) they may favor the growth nutrients- synthesizing microbes or in habit that of nutrient destroying microorganism:(2) antibiotics may inhibit the growth of organisms that produced excessive amount of ammonia and other toxic nitrogenous waste products in the intestine ,(3) they may improve availability or absorption of certain nutrient,(4)they may improve feed or water consumption or both, (5) antibiotics ystemicaiiy may instances prevent or cure actual pathological disease which occur either in the intestinal or systemically,(6) they may reduce the maintenance cost associated with turnover of the intestinal epithelium(Kahn et al.,2005 and Miles *et al.*, 2006).

Many scientific findings suggested that antibacterial used for animal feeding as growth promoters become risky for human and animal health (Manninig *et al*., 1994; Sahin *et al*., 2002; Thens, 2000). However, the swan committee report (1969) was the first to suggest that the use of sub therapeutic levels of antibiotics for growth promotion and disease prevention could increase the risk of bacteria acquiring resistance to specific antibiotics (Nasir and Grashorn., 2006).

The United Kingdom banned the use of penicillin and tetracycline for growth promotion, in the 1970s.Sweden and Denmark banned all growth promoting antibiotics in 1968 and 1999, respectively (FMI, 2006). Also Word Health Organization (WHO) has recommended (1997) that antibiotic should be phased and replaced by alternatives, (Bywater, 2005). In 1999, European Union banned four antibiotic growth promoters (virginamycin, spiramycin, tylosin and zinc bacitracin) which are commonly used in feed around the word.

The United States banned the use of enrofloxacin in 2005, (Collinon, 1999). Since 1th January the use of antibiotic growth promoters is prohibited in the European Union (Buchanan *et al* ., 2008).

2.3 Nutrition strategies and feed additives:

The use of the most antibiotics growth promoters as feed additives has been banned by the EU. Due to cross- resistance against pathogens and residues in tissues, scientists has searched for alternatives to antibiotics, in this view, varieties of substances are used in conjunction with or as alternative to antibiotics in poultry diets. Herbs and spices, essential oils extracted from aromatic plants enzymes, organic acid, and probiotics all shown promising results for use in organic poultry production (Griggs and Jacob, 2005).

2.3.1 Herbs, spices and plant extracts:

Herb spices, and various plant extracts have received increasing attention as possible antibiotics growth promoters' replacement. There is endence to suggest that some of these components have appetite. Stimulating properties (menthol from peppermint), antibacterial effect (caracrol from oregano) or provide antioxidant function (Cinnamadhyde from cinnamon) (Revington, 2002). In different herbs, a wide variety of active, phytochemicals, including the flavonoids, terpendoid, lignana, sulphides, polyhenolice, catonoids coumarins, saponion, plant sterols, curcumin and phthaldes have been identified. (Mehmet *et al*., 2005).

Research interest has focused on various herbs that possess hypolipidermic, antiplatelet, antitumor, or immune-stimulating properties that many useful adjuncts in helping reduce risks of cardio vaculars disease and cancer. In addition to their antimicrobial activity (Elayyar *et al*., 2001;Singh *et al*., 2002; Valero and Salmeron, 2003), they possess biological activities such as that of anti-oxidants (Lopez –Bote *et al.*, 1998; Botsoglou *et al*., 2002 and Miura *et al.*, 2002) and as hypo colostomies (Craig,1999) and stimulate effect on animal digestive systems(Jamroz and Kamal, 2002; Ramakrishna *et al*, 2003), to increase production of digestive enzymes and improve utilization of digestive products through enhanced liver functions (Langhout, 2000; Hernandez *el al*., 2004).

2.3.2 Organic acid:

Organic acid such as formic, acetic and probiotic acid reduce the prevalence of Salmonella and campylobacter bacteria found in the intestines of broiler through lowering of pH of the intestinal environment and antimicrobial effect (these acids are able to penetrate the bacterial

cell wall in non-dissociated from) (Hinton and Linton, 1998; Chaveerach *et al*., 2004). Typically, blends of organic acids representing an array of "aka" optima are more effective than single acids alone (Revington, 2002).

2.4 Description:

Fennel (F.v) is an annual, biennial or perennial plant, depending on the variety and it is a well-known umbellilerous plant.

The seeds, leaves and stalk are edible part. Fennel is a ripe fruit known as seeds Foeniculum vulgare (Cosge *et al*.,2008) fennel is aromatic herb,1-3 m - high with green, glaucose, furrowed, branched stems bearing alternate leaves, 2-3 timers pinnate with extremely narrow leaf lefts super leaves with sheaths longer than the blade. Umbels compound ,large ,nearly regular ,on long peduncles. Flowers yellow, no in volucre, calyx with five very slight teeth, petal five, entire, lips involute, stamens five, ovary two-celled, stylopodium large, conical. Fruit an oblong cremocarp 6-10 mm long, 1-4 mm in diameter, greenish, glabrous mericarp compressed dorsally, semicylindried with five prominent, nearly regular ribs. Seeds somewhat, concave with longitudinal furrows. The seeds have a taste similar to anise, (Blamey and Greep., 1989).

2.5 Fennel varieties:

Fennel is native to Southern Europe and grown extensively all over Europe, Middle -East, China, India, and Turkey (Grieve, 1971).

There are two main varieties of fennel. Sweet fennel (Foeniculum Vulgare.var dulce.), developed mainly for production of fennel seeds. It is treated as a perennial and left in the ground to produce seeds. The other developed for eating in its own right, is called florence fennel

(Foeniculum Vulgare var. a zoricum). It is a cultivar group with inflated leaf bases which form a bulb-like structure. It is of cultivated origin and has a mild anise-like flavour, but is sweeter and more aromatic Florence fennel plants are smaller than the wild type. Their inflated leaf bases are eaten as vegetable both raw and cooked (Rombauer, 1997). Wild fennel (Foeniculum vulgare Mill. "aka") is used particularly in sardine and pasta dishes(Rombauer, 1997).

2.6 Chemical assay:

Fennel seeds contains not less than 1.4% v/w essential oils . The major constituent is essential oil (2-6%), which contains transanethole (50-82%), ±Fenchone (6-2%), estragole (methylchavicol) (3-20%),limonene (2-13%), Panisaldehyde (6-27%),a- pinene (1-5%) and-phelladrene (0.1-19.8%).(Abou- Raila *et al.*,1991) reported that fennel seeds are rich in carbohydrates, moisture, protein and fat. Its minerals content are calcium, phosphorus, iron, sodium and potassium. Vitamins contains are thiamine, riboflavin and niacin (Bakhru, 1992). The major fatty acids components of fennel seeds are oleic and linoleic acids. Fennel seeds are high in isoleucine, histidine (Abou- Raila *et al.*,1991). Fennel volatile oil is a mixture of different chemicals and the main ingredients are anethole, fenchone and estragole (Cosge *et al.*, 2008).

Romila (2001), stated that fennel is one of these aromatic plants which is containing high percentage of the fatty acids linolenic and stearic. In addition, fennel has 16.8% trans- anethol plus 47.2% estagole with total sweeting components of 64.01% in essential oils.

(Abou-Raia *et al.*, 1991) reported that fennel seeds are rich in total carbohydrates (61.0%) and low in total soluble sugars(7.6%).The seeds

are rich of Ca, P and Mg and contain considerable ammounts of K, Fe and Zn, and traces Ma.

The aroma and flavocomponents of the essential oils for fennel seeds contains anethole, limonene, fenchme, estragole, safrole, alpha-psnene, camphene, beta-pinene, sabenine, beta-myrcene, phelladrene, cisocimene, para-cymene, gamma- terpinenes, camphor and several other votalite constituents as well as fixed oils (Charles *et al*., 1993).

Mona (2007), found that fennel seeds contain nutrient compounds on air dry matter basis; moisture 8.94%, CP 10.35%, EE 2.93%, CF 24.5%, NFE 42.92% and ash 9.96%.

Fennel seeds were found to have a high pensive effect (El Bgrdaietal 2001), anti-spasmodic activities, (Ostad *et al*., 2001), antihirsutism (Javidnia *et al*., 2003), hepato protective (Ozbeck *et al.,* 2003), antinflammatary (Choi and Hwang 2004), antidemtia (Joshi and Parle, 2006), possess pain reliever in primary dysmenorrhoea (Modaress and Asadipour, 2006), anti platelet and antithrombatic (Tognolini *et al* ,2007) immun modulatory (Kaileh *et al*., 2007), protective effect against ethanol induced gastric mucosal lesions (Birdane *et al.*, 2007), Anticancer, (Celik and Isik,2008), potential in the treatment of glaucoma (Agarwal *et al*., 2008) and anti oxidant (Barros *et al*., 2009).

2.7 Uses:

2.7.1 Culinary uses:

It is a highly aromatic and flavourful herb with culinary and medicinal uses. Fennel seeds are anise like in aroma and are used as flavourings in baked goods, meat and fish dishes, ice cream, alcoholic beverages and herb mixtures (Diaaz-maroto *et al.* 2006),the bulb, foliage and seeds of

the fennel plant are widely used in many of the culinary traditions of the world.

Dried fennel seed is an aromatic ,anise - flavoured spice, the bulb is a crisp, hardy root vegetable and may be sautéed, stewed, braised, grilled or eaten raw, cooked, the oil can be used to protect stored fruits and vegetables against growth of toxic fungi, beekeepers have grown it as a honey plant. It has been used to stimulate milk How in breast -feeding, tea made from crushed fennel seeds has been used as an eye wash. Powdered fennel is said to drive away from kennels and stables, (Grieve, 1971).

Both the seeds, leaves and root of garden fennel are much used in drinks for those that are grown fat, to abate their un wleldiness and cause them to grow more gaunt and lank.

The use of medical plants for health started from thousands of years and still applied in the medical practice. Fennel is a commonly used in household for various medicinal purposes (Sandhu and Heinrich, 2005).Fennel seeds commonly used to flavour bread, fishes, salads and cheese (Kaur and Arora, 2010) . Some people use fennel as diuretic, and it may be an effective diuretic and potential drug for treatment of hypertension (Wrigh *et al.*, 2007). It can be added into syrup to treat babies with colic.

Fennel fruit have been used as a traditional herbal medicine in Europe and China. Fennel tea has been used as a remedy to treat indigestion in infants, and also used for gastrointestinal disorders and to improve digestion. According to preliminary evidence, fennel when compined with other herbal agents may decrease pain associated with colitis (Inflammation of colon) and reduce constipation.

2.7.2 Medical uses:

Fennel water has similar properties to those of anise and dill water: mixed with sodium bicararbonate and syrup, these waters constitute the domestic gripe water, used to correct flatulence of infants. Extracts of fennel seeds have been shown in animal studies to have a potential use in the treatment of glaucoma, as a diuretic and potential drug for the treatment of hypertension. It has been used as a glactaggue improving the milk supply of a breast feeding mother. This is suggested to be due to the presence of phytoestrogens present in fennel which promote growth of breast tissues (Agarwal *et al.*,2008).

Fennel is used for various digestive problems including heart burn, intestinal gas ,bloating ,loss of appetite ,and colic in infants (Turkyilmaz *et al*., 2008). It is also used for upper respiratory tract infections, coughs, bronchitis, cholera, backache, bedwetting and visual problems. Fennel bulb can help decrease the rise of developing colon cancer because it helps remove carcinogenic toxins from the colon. Iron and histidine an amino acid found in fennel, are both helpful in treatment of anemia (Ruberto *et al*., 2000)

Fennel is very popular as an anti flatulent, due to the carminative properties of the aspartic acid found in fennel. Fennel is a great source of fibre, in powder form it act as a laxative, it also helps to maintain healthy levels of chotesterol in the blood stream. This means that it can stimulate the elimination damaging LDL cholesterol, which is a major factor in heart disease, artherosderosis and strokes (Ostad *et al*., 2001).

Fennel is a very rich source of potassium, which relaxes the tension of blood vessels, thereby reducing blood pressure .Fennel is rich in vitamin C, which improves general immune system heath, produces and repairs

skin tissue , helps it form collagen , and also protects blood vessel walls as an antioxidant against the harmful effects of free radicals that can frequently lead it heart disease (Chainy *et al*., 2000).

The flavonoids present in fennel seeds increase the amount of estrogen by acting as stimulant and tonic increase the size of breasts as- they increase the formation of new cells and tissues in the breast. Using fennel in food helps protect the eyes from inflammation, this is due to high of antioxidants (vitamin C and amine acids like Arginine). Fennel is useful in respiratory disorders such as congestion, bronchitis and cough due to the presence of, cineole and anetol . Fennel is diuretic which means that it increases the amount and frequency of urination, thereby helping the removal of toxic substances from the body and helping in rheumatism and swelling (Ensminger *et al*.,1986,)

2.3.7 Poultry feeding:

Amr (2012)found that supplemented high fat diet of broiler chicks with fennel seeds at different levels reduced significantly serum total lipid ,triglycerides and total cholesterol, induced significantly decrease in serum aspartate aminotransferase(AST) alanine amino transferase (ALT), Alkaline Phosphate (ALP) levels.

Abdullah and Rabia, (2009) recorded a significant improvement in final body weight and feed efficiency and no significant effect on carcass characteristics, higher red blood cells, haemoglobin and packed cell volume when fed broiler chicks on different levels (1,2 and 3 g/kg diet) fennel seeds for broiler chicks.

El- deek *et al*., (2003) reported that body weight was increased and improvement feed conversion by using fennel in diets. Tollba (2003)

noted that adding fennel, total diets restated increased body weight. Simon *et al.*, (1984) reported that fennel is a good herb for the entire digestive system as laxative appetite, stimulant , antispasmodic and carminative, revels abdominal pain and useful for gastrointestinal and colon phliem, promot a liver and kidney health.

Mona (2007) studied the effect of using fennel seeds in growing Japanese quail diets varying in their protein content with or without enzyme supplementation, she found that the supplementation of growing Japanese quail with 1.5% fennel improved productive performance.

Gharaghani *et al*., (2015), studied the effect of feeding laying hens on different levels (0,10 and 20 g/kg) of diet of fennel seeds on the egg quality of laying hens under heat stress , they found hens that consumed fennel presented lower yolk cholesterol and triglyceride levels, and because its antioxidant properties, it may alleviate the adverse effects of heat stress on laying hens.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Site:

This study was conducted at the poultry department of Animal Production, College of Agricultural Studies, Sudan University of Science and Technology, during the period from 17/2to28/3/2015 in which the ambient temperature ranged between 28 to 38^{o}C (Appendix1).

3.2 Experimental birds:

A total of eighty four of 8 days old unsexed broiler chicks strain (Abar Acer) Purchased from a local commercial hatchery (Mico Company) were randomly divided into four treatment diets (A, B, C and D). Each treatment group was sub divided into three replicates of 7 birds per each.

The chicks were adapted of feed over 8 days on broiler pre- starter before the start of experiment.

Chicks were vaccinated against Gumboro disease at 11 days of age and Newcastle disease in drinking water at 22 days age. Soluble multivitamin compound (Univet) given to chicks before and after vaccination to guard against stress height.

3.3 Experimental diets:

The chicks were fed a commercial broiler pre- starter for a week. The ingredients and conducted nutrients composition of the control diet were presented in table (3).

The Foeniculum vulgare seeds were purchased from the local market in Omdurman, dried fennel seeds were cleaned then grind mill and sieves were used to obtain a powder sample was analyses to determine its chemical composition (table 1) . The experimental diets were designed as A control diets, B is control diet supplemented with 1% of Shamar as natural growth promoter diets C, D, were supplemented with 2-3% of Shamar respectively. The experimental diets were analyzed for the crude protein, moisture content, crude fat and crude ash percentages according to the method of(AOAC, 1984)Table(4).

Metabolizable energy of feed ingredients was calculated based on equation of (Ellis, 1981). The diets were formulated to meet the requirements established by(NRC, 1994). The feed and drinking water were provided *adlibitium* (Table 2).

3.4 Housing:

Strict sanitation practices were maintained in the house before and during the experiment. Chicks were kept in semi closed, wire mesh-side poultry house, the house was constructed on concrete floor. The roof was made of metal sheets; the sides were permanently covered with sacks to reduce hot current wind.

Stand fans of air coolers were used to keep the temperature in house cool. Twelve pens inside the house were prepared with wire mesh partitioning; the pens were cleaned, washed and disinfected with formalin and phenol solution before the start of the experiment. Layer of wood shavers used as a litter material. Each pen was supplied with clean disinfected 2.5 gallon drinker and 5 kg feeder, light was provided 24hours in a form of natural light during the day and artificial during night.

3.5 Parameters:

Body weights were recorded weekly by group weighing of the birds of each replicate and feed consumption also recorded at the time of weight. Body weight gain and FCR were calculated weekly and mortality was record daily through the experimented period.

3.6 Carcass preparation:

At the end of the experimental period, diets were withhold, chicks were fasted overnight except from water, one bird from each replicate was randomly selected, weighted individually, slaughtered and blood samples were collected in heparinized test tube and analysis to determine total plasma ,cholesterol (Spectrometerically using commercial kit). The internal organs were expressed as a percentage of live body weight.

The carcasses were eviscerated weight of chilled over night in a refrigerator (4 ^{o}C) to measure cold carcass weight. The chilled carcasses were weighted (cold weight) after 24 hours, then they were weighed after 24 hours then they were sawed into two halves. The left side then divided into the commercial cuts (breast, drumstick, and thigh).

Each cut was weighed individually then deboned to determine the weight of meat. The meat was stored frozen for analysis and panel taste, the right side for carcasses stored at 4^{o}C.

3.7 Chemical analysis:

Stored meat samples were cut into small pieces minced twice and twice samples were analyzed for protein, fat, ash, and moisture content according to AOAC (1975), control diet was analyzed (Table4), the

separated serum from the collected blood samples also analyzed to determine TP, AP, Cholesterol, eminences(ca, p), AST, ALT)

3.8 Panel test:

The stored right side of carcasses was slightly seasoned wrapped individually in aluminum foil and roasted at 190^{o} C for 40 minutes with average internal temperature of 88C^{o}and served warm. Semi well trained panel test were used to score color, flavor, tenderness and juiciness of meat (Cross *et al.*, 1978) on scale of 1-8 (Appendix2). The roasted samples were served randomly to each judge at room temperature.

Water was provided to the panelist to rinse their mouth after tasting each sample.

3.9 Calculations:

The hot and cold carcasses were expressed as a percentage of live weight. The commercial cuts were expressed as percentage of hot carcasses. Non carcasses components (heart, liver, and gizzard) were expressed as a percentage of hot carcass weight. Meat and bone of each cut were expressed as a percentage of the weight of their cut.

3.10 Statistical analysis:

The data obtained were statistically analyzed with the standard procedures of analyses of variance (ANOVA) using completely randomized design. Significant differences between treatment means were separated using the Duncan's multiple range tests with 5% probability (Duncan, 1995).

Table 1: Chemical Analysis of Shamar seeds:

Components	Percentage
Dry matter%	92.6
ASH%	3.07
Crude protein%	21.96
Ether Extract%	8.oo
Crude fiber%	22.oo

Table 2: Composition of the experimental control diet used:

Ingredient	Diets			
	A	B	C	D
Dura	64.142	64.142	64.142	64.142
Groundnut cake	14.00	14.0	14.0	14.0
Sesame cake	15.00	15.00	15.00	15.00
Concentrate*	5.00	5.00	5.00	5.00
Lysine	0.344	0.344	0.344	0.344
Meth mine	0.159	0.159	0.159	0.159
Oyster shell	0.487	0.487	0.487	0.487
Dcp	0.618	0.618	0.618	0.618
Salt	0.25	0.25	0.25	0.25
Total	100	100	100	100
Shamar %	_0.0	1.0	2.0	3.0

***Broiler concentrate** * : Crude protein 40% , crude fat 3.90%, crude fiber 1.% ,lysine 13.5 %, methionin 5.9 %, meth + cytine 60.25 % , calcium 6.8 % ,phosphorus 7% ,sodium 1.5 % Me. 2122K Cal /Kg .Added vitamins and minerals per Kg : vitamin A 250,000 IU , V. D 3 60,000IU ,V. E 800 ppm , v. K 3 60 ppm ,v,B6 50 ppm ,V. B2 300ppm ,V. C 4.000 ,ppm ,Biotin 2000 ppm ,Folic acid 30 ppm ,choline chloride 10,000 ppm ,Iron (Fe) 1.000 ppm , copper (cu) 300 ppm , zinc (zn) 1.000 ppm, Manganese (mn) 1.600 ppm, Iodine 20 ppm , cobalt 12 ppm ,Antioxidant added . ** Vitamins and minerals : Supplements per Kg product : V. A 300,000 IU , V. D3 100,000 IU ,V.E 4.00 ppm, V.K 98 ppm ,V.B2 1.320 ppm , V. B 12 4.0 ppm ,pantothenate 2.0 ppm ,Niacin 20.0 ppm ,Folic acid 100 ppm, Coline 50.0 ppm ,Copper15.0 ppm ,Iodine 250 ppm ,Selenium 50 ppm,Manganese 24 ppm ,Zinc 20 ppm ,Iron 10 ppm ,Coccide 25 ppm , Antioxidant b125 ppm

Table 3: Calculated composition of control diet:

Ingredients	%
Crude protein	22.8
Crude fiber	4.15
Ash	4.91
NEF	54.21
Ether Extract	3.54
Lysine	1.49
Methionine	0.63
Calcium	1.49
Phosphorus	0.76
ME K/cal*	

*Calculated a according to Ellis (1981).

Table 4: Chemical Analysis of Experimental diets:

Components	Diets			
	A	B	C	D
Dry matter%	93.67	92.6	92.6	92.6
ASH%	10.6	6.31	7.24	8.07
Crude protein%	21.9	21.19	20.97	20.76
Ether Extract%	3.4	5.20	6.00	5.00
Crude fiber%	21.6	6.40	4.40	7.00

CHAPTER FOUR

RESULTS

4.1 Results:

The result of chemical analysis of Shamar (Table 1) showed that it contains 92.6 DM%, 3. 07% Ash, 21.96%C.P, 8.0% EE, and 22% CF.

Results obtained showed significant ($p<0.05$) difference in the performance (final body weight, and feed intake) of broiler chicks fed on diets supplemented with graded levels of Shamar seeds (Table 5).

Results of broiler chicks on diets containing different levels of Shamar seeds were illustrated in table (7). Result showed that group fed on diet supplemented with 3% Shamar consumed significantly ($p>0.05$) the lowest feed followed by control group however chicks fed on 1% Shamar consumed numerically the highest compared to control group.

Result obtained for body weight gain and FCR showed no significant ($p>0.05$) differences between tested groups, although group fed on 1% Shamar recorded numerically the best value for weight gain and FCR .

Average values of hot carcasses weights and yield of commercial cuts were illustrated in table (8) the results recorded no significant ($p>0.05$) differences among the tested groups.

Values of non carcass components (liver, gizzard and heart) and dressing percentage of experimental chicks showed no significant ($P>0.05$) difference (Table 6).

Results obtained for meat analysis for experimental chicks showed significant ($P<0.05$) decrease in moisture of meat with the increase of

Shamar level in the diets, on the opposite significant increase ($P<0.05$) in ash components of meat with the addition and increase of Shamar levels in diets. Results also showed significant ($P<0.05$) increase of Shamar level in the diets (Table 3).

Results of chemical analysis of blood samples collected from experimental chicks (Table 10) revealed no significant ($P>0.05$) differences in total protein, ALB, Ca, AST, ALP and Ph_4. values of many experimental groups. However, group fed on 1% Shamar showed significant ($P<0.05$). Increase in serum cholesterol. Also Shamar supplemented alien in broiler diets showed significant increase ($P<0.05$) in urea content compared to control group.

The subjective panel test meat attributes of tested groups (Table11) showed significant difference ($P<0.05$) between groups, scores given for all attributes were above moderate acceptability level.

Table 5: Effect of feeding on performance a broiler chick:

Treatments	Total feed intake	Body weight gain	FCR	Final body weight
A	3657.7[a]	1644.0[a]	2.23[a]	1846.0
B	3719.0[a]	1799.0[a]	2.01[a]	2010.0
C	3671.7[a]	1737.3[a]	2.12[a]	1942.0
D	3665.3[a]	1667.7[a]	2.11[a]	1880.0
L.S.D	145.63	216.19	0.24	-
SE±	59.52	88.35	0.10	-
CV%	2.00	6.32	5.58	-

Means followed by the same letter in the same column are not significant different at $p \leq 0.05$.

Figure 1: Commercial cuts and their meat percentages

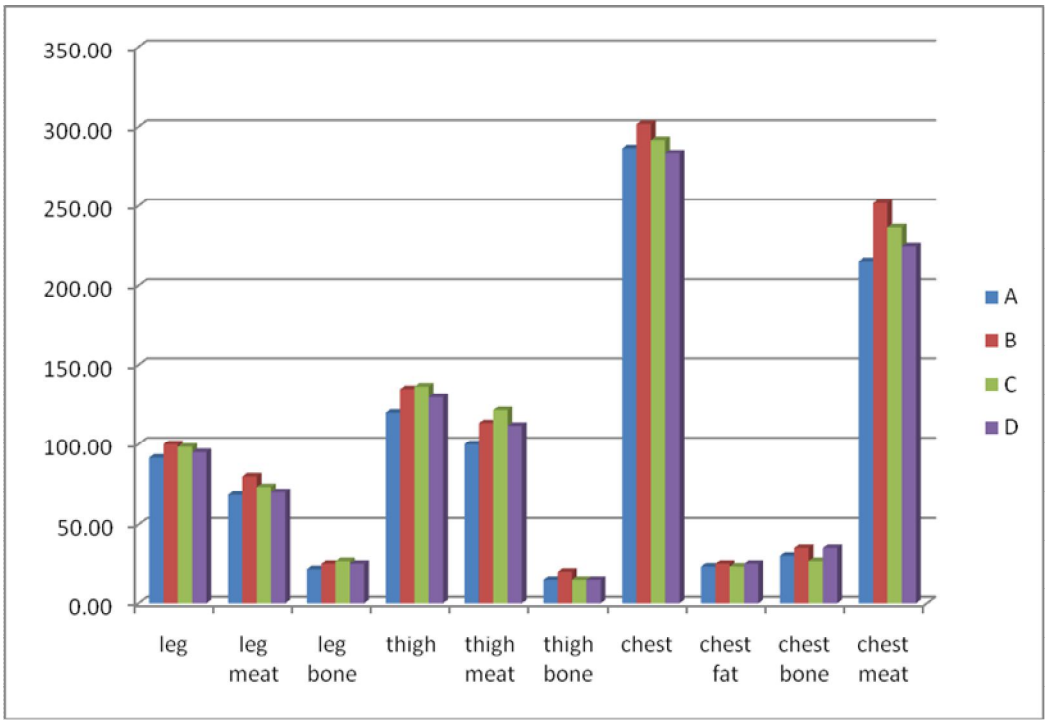

Table 6: Means of experimental chicks organs as a percentage of hot carcass weight:

Treatments	A	B	C	D	Grand mean	L.S.D	CV%
Carcass	1465.00[a]	1605.00[a]	1601.67[a]	1465.00[a]	1534.17	289.08	9.43
SE	±(46.46)	±(57.95)	±(139.11)	±(24.66)	±(39.91)		
legs	78.33[a]	90.00[a]	81.67[a]	83.33[a]	83.33	21.13	12.69
SE	±(4.41)	±(7.64)	±(8.33)	±(4.41)	±(3.04)		
Head	46.67[a]	51.67[a]	48.33[a]	50.00[a]	49.17	6.86	6.99
SE	±(1.67)	±(3.33)	±(3.33)	±(0.00)	±(1.20)		
Neck	88.33[a]	90.00[a]	95.00[a]	91.67[a]	91.25	12.46	6.83
SE	±(1.67)	±(5.77)	±(2.89)	±(1.67)	±(1.64)		
Back	136.67[a]	141.67[a]	153.33[a]	141.67[a]	143.33	63.11	22.04
SE	±(10.93)	±(6.67)	±(26.03)	±(13.64)	±(7.08)		
Wing	84.67[a]	90.00[a]	85.00[a]	87.33[a]	83.75	8.97	5.36
SE	±(1.67)	±(2.89)	±(2.89)	±(1.67)	±(1.64)		

Means on the same row with the same superscripts are not significant
A= control(without additive)
B= additive 1% Shamar
C= additive 2% Shamar
D= additive3% Shamar

Table 7: Means of experimental chicks organs as a percentage of hot carcass weight:

Treatments	A	B	C	D	Grand mean
Gut length	207.67[a]	200.67[a]	214.00[a]	208.67[a]	207.75
SE	±(8.76)	±(8.88)	±(6.43)	±(2.33)	±(3.35)
Gut weight	113.33[a]	113.33[a]	108.33[a]	118.33[a]	113.33
SE	±(14.53)	±(4.41)	±(14.53)	±(3.33)	±(4.66)
Fat	35.00[a]	28.33[a]	26.67[a]	28.33[a]	29.58
SE	±(7.64)	±(4.41)	±(3.33)	±(4.41)	±(2.42)
gizzard	53.33[a]	53.33[a]	55.00[a]	58.33[a]	55.00
SE	±(4.41)	±(7.26)	±(0.00)	±(6.01)	±(2.30)
Empty gizzard	33.33[a]	35.00[a]	35.00[a]	38.33[a]	35.42
SE	±(1.67)	±(0.00)	±(0.00)	±(6.01)	±(1.44)
liver	41.67[a]	48.33[a]	43.33[a]	46.67[a]	45.00
SE	±(4.41)	±(1.67)	±(3.33)	±(1.67)	±(1.51)
Heart	10.00[a]	11.67[a]	13.33[a]	10.00[a]	11.25
SE	±(0.00)	±(1.67)	±(1.67)	±(0.00)	±(0.65)

Means on the same row with the same superscripts are not significant
A= control(without additive)
B= additive 1% Shamar
C= additive 2% Shamar
D= additive3% Shamar

Table 8: Commercial cuts and their meat percentages

Treatments	A	B	C	D	Grand mean	L.S.
Drum stick	91.67[a]	100.00[a]	98.33[a]	95.00[a]	96.25	17.7
	±(1.67)	±(2.89)	±(8.82)	±(2.89)	±(2.31)	
meat	68.33[a]	80.00[a]	73.33[a]	70.00[a]	72.92	15.8
	±(4.41)	±(2.89)	±(6.01)	±(2.89)	±(2.26)	
bone	21.67[a]	25.00[a]	26.67[a]	25.00[a]	24.58	7.2
	±(3.33)	±(2.89)	±(1.67)	±(0.00)	±(1.14)	
Thigh	120.00[a]	135.00[a]	136.67[a]	130.00[a]	130.42	28.2
	±(2.89)	±(5.77)	±(11.67)	±(5.77)	±(3.66)	
meat	100.00[a]	113.33[a]	121.67[a]	111.67[a]	111.67	22.0
	±(2.89)	±(4.41)	±(9.28)	±(4.41)	±(3.39)	
bone	15.00[a]	20.00[a]	15.00[a]	15.00[a]	16.25	9.5
	±(2.89)	±(2.89)	±(2.89)	±(0.00)	±(1.25)	
Breast	286.67[a]	301.67[a]	291.67[a]	283.33[a]	290.83	46.5
	±(8.82)	±(6.01)	±(22.42)	±(6.01)	±(5.83)	
	23.33[a]	25.00[a]	23.33[a]	25.00[a]	24.17	12.5
	±(3.33)	±(5.77)	±(3.33)	±(2.89)	±(1.72)	
Bone	30.00[a]	35.00[a]	26.67[a]	35.00[a]	31.67	13.6
	±(5.77)	±(0.00)	±(1.67)	±(2.89)	±(1.78)	
meat	215.00[a]	251.67[a]	236.67[a]	225.00[a]	232.08	54.8
	±(7.64)	±(23.33)	±(19.22)	±(8.66)	±(8.04)	

Means followed by the same letter in the same rows are not significant different at $p \leq 0.05$.

Table 9: Means of chemical composition of experimental chicks meet

Treatments	Moisture	Protein	Fat	Ash	T.S	N.F.E	pH	Acidity	
A	71.07[a] ±(0.09)	19.20[a] ±(0.06)	4.23[a] ±(0.09)	0.88[a] ±(0.01)	28.93[a] ±(0.01)	24.70[a] ±(0.06)	6.53[a] ±(0.03)	0.32[a] ±(0.00)	1 ±
B	69.93[a] ± (0.09)	19.90[a] ±(0.12)	4.87[a] ±(0.0.3)	0.90[a] ±(0.00)	30.07[a] ±(0.09)	25.20[a] ±(0.06)	6.23[a] ±(0.03)	0.34[a] ±(0.01)	1 ±
C	69.47[a] ±(0.09)	21.50[a] ±(0.25)	5.13[a] ±(0.03)	0.94[a] ±(0.01)	30.53[a] ±(0.09)	25.40[a] ±(0.06)	6.07[a] ±(0.03)	0.37[a] ±(0.00)	1 ±
D	68.90[a] ±(0.10)	21.37[a] ±(0.03)	5.40[a] ±(0.00)	0.98[a] ±(0.01)	31.10[a] ±(0.10)	25.70[a] ±(0.10)	5.87[a] ±(0.03)	0.37[a] ±(0.00)	2 ±
Grand mean	69.84 ±(0.24)	20.49 ±(0.30)	4.91 ±(0.13)	0.92 ±(0.01)	30.16 ±(0.24)	25.25 ±(0.11)	6.18 ±(0.08)	0.35 ±(0.01)	±
L.S.D	0.34	0.54	0.14	0.02	0.34	0.28	0.12	0.02	
CV%	0.24	1.32	1.40	1.15	0.56	0.55	0.97	2.28	

Means followed by the same letter in the same column are not significant different at $p \leq 0.05$.

A= control(without additive)

B= additive 1% Shamar

C= additive 2% Shamar

D= additive3% Shamar

T.S= Total solid

N.F.E = nitrogen free extract

pH= Concentrate of Hydrogen Ione

Table 10: Means of experimental chicks blood composition.

Treatments	T.P g/dl	Alb g/dl	Cholesterol mg/dl	Ca mg/dl	Urea	Glob	ALP/ ul
A	6.12[a] ±(0.14)	2.91[a] ±(0.04)	121.60[a] ±(2.48)	7.90[a] ±(0.12)	23.37[a] ±(0.54)	3.17[a] ±(0.16)	61.67[a] ±(3.33)
B	5.63[a] ±(0.20)	2.90[a] ±(0.06)	119.30[a] ±(2.16)	8.33a ±(0.09)	25.37[a] ±(0.56)	3.30[a] ±(0.23)	55.33[a] ±(1.45)
C	5.83[a] ±(0.13)	2.82[a] ±(0.04)	118.80[a] ±(5.60)	8.10[a] ±(0.12)	26.13[a] ±(0.43)	3.02[a] ±(0.09)	61.00[a] ±(1.53)
D	6.13[a] ±(0.18)	2.82[a] ±(0.09)	11637[a] ±(4.74)	8.33[a] ±(0.18)	26.33[a] ±(0.71)	3.31[a] ±(0.20)	60.33[a] ±(1.67)
Grand mean	5.93 ±(0.09)	2.86 ±(0.03)	119.52 ±(2.33)	8.17 ±(0.08)	25.30 ±(0.43)	2.98 ±(0.13)	59.58 ±(1.18)
L.S.D	0.66	0.23	12.81	0.49	2.26	0.61	6.82
CV%	5.57	3.95	5.36	3.01	4.47	10.21	5.73

Means followed by the same letter in the same column are not significant different at $p \leq 0.05$.

A= control(without additive)
B= additive 1% Shamar
C= additive 2% Shamar
D= additive3% Shamar
T.P= Total protein
Alb= Alblomine
Glob= Globulin

Table 11: The effect of different dietary of Shamar on percentage of subjective values of broiler chicks for 6 weeks:

Items	Groups			
	A	B	C	D
Tenderness	6.18	6.22	6.26	6.28
Flavour	6.10	6.16	6.18	6.18
Colour	6.1	6.03	6.7	6.09
Juiciness	6.0	6.0	6.10	6.15

A=controlled

B= 1%Shamar

C= 2%Shamar

D=3%Shamar

Table 12: The total cost, revenue and profit of broiler chick fed on different levels of Shamar:

Item	Groups			
cost	A	B	C	D
Chick	4.5	4.5	4.5	4.5
Feed	14.437	15.4212	15.961	14.483
Management	2.0	2.0	2.0	2.0
Total cost	20.937	21.9212	22.461	20.983
Revenne				
Carcass waight	1.644	1.799	1.737	1.713
Price/kg	26.o	26.o	26.0	26.o
Tatal revenue	42.744	46.774	45.162	44.538
Profit	21.807	24.8528	23.001	13.555
Profitability	1.0	1.14	1.o6	1.08

*Total cost calculation according to

*A current (2014)price of meat 26(SDG)/KG

CHAPTER FIVE

DISCUSSION

Results obtained for chemical composition of fennel seeds used in this study showed highly significant in ether extract (10%) and mineral contents 13.4% compared with that recorded by (Mona, 2007) 2.93% and 9.96% respectively and low in CF 18.5% Via 24.5% . These differences might be due to varieties and or environmental conditions.

The experimental chicks heath was good although out the experimental period, no mortality was recorded. This might be due to good sanitation and environmental control, also fennel is rich in vitamin C, which improves general immune system health, produces and repairs skin tissue, helps to from collagen, and also protects the blood vessel walls as an anti- oxidant against the harmful effects of free radicals that can frequently lead to heart disease (Kaileb *et al*., 2007; Roberto *et al.,* 2000 and Ozbck *et al.*, 2006).

Results obtained for the performance of broiler chicks fed on diets supplemented with different levels (1, 2, and 3g/kg) of fennel seeds showed improvement in body weight, body weight gain, feed intake and FCR compared to control group, but this improvement is not significant. These results were in line with those of (Abdullal and Rabia, 2009 and Tollba, 2003), who found an increase in body weight when added fennel to the broiler diet. it might be to that some components of the essential oils in fennel are stimulants and they stimulate secretin of digestive and gastric juices, while reducing inflammation of the stomach and intestines, and facilitating proper absorption of nutrients from the food (Abdul -Azeez, 2000).

Also the improvement in feed consumption for chicks fed on different levels of fennel seed, might be due to active principles in the fennel such as anethole, limonene estraggle, which are known to have antioxidant,

carminative, anti-flatulent and digestive stimulating and appetizing effect's (Cabuk *et al*., 2003; Bown., 2001).

Results showed no significant effect on non-carcass components, commercial cuts and their meat. These results were in line with the findings of (Abdulla and Rabia, 2009).who found no significant different to addition of fennel seed in chicks diet.

Results on some blood constituents for chicks received to different levels of fennel seeds in their diets had significant increase in urea concentration compared to the control group, while fennel seeds had no effect on other parameters (total protein, albumin, Ca, globulin, phosphorus and cholesterol). Fennel seeds are rich source of dietary fibre, which besides of advantages to digestion that fibre provides it also helps to maintain healthy levels of cholesterol in the blood. This means that it can stimulate the elimination damaging LDL cholesterol, which is a major factor in heart disease. These results were in line with (Amr, 2012).

Also the main active component in fennel fruit (anethole) is a phytosterol itself, (Badoc *et al.*, 1994, Piccaglica and Marotti, 2001, Damianova *et al.*, 2004), alters metabolic path- way in the body of chicks leading to cholesterol and triglyceride reduction.

The economised evaluation revealed that the addition of fennel seeds at different levels (1, 2, 3, g/k) improved the performance of broiler chicks and recorded high profit compared to control group.

Conclusion and Recommendations

1. Conclusion:

From the results obtained, it can be concluded that:

Inclusion of fennel seeds at different level in broiler diets. Improved the performance (weight gain, feed consumption, FCR), and without any effect on non-carcass components, commercial cuts and meat objective subjective attributes. Fennel inclusion may by associate with the lowering cholesterol content, so it can be anew alternative. For clinical management of hyperlipidemic patients. Supplementation of broiler diets with different levels of Shamar recorded high profit compared to control group.

2. Recommendations

According to above conclusion the following recommendations could be drowning:

1. More experiment needed to be run to investigate the effect of different levels of Shamar supplementation to broiler diets.
2. It is better to mix Shamar seeds powder with the other ingredients of ration in the horizontal mixers and with obtaining all the vertical mixers.
3. Future research is needed to determine the effect of Shamar seed inclusion in layer performance and production.

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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

Figure 2: Carcass weight

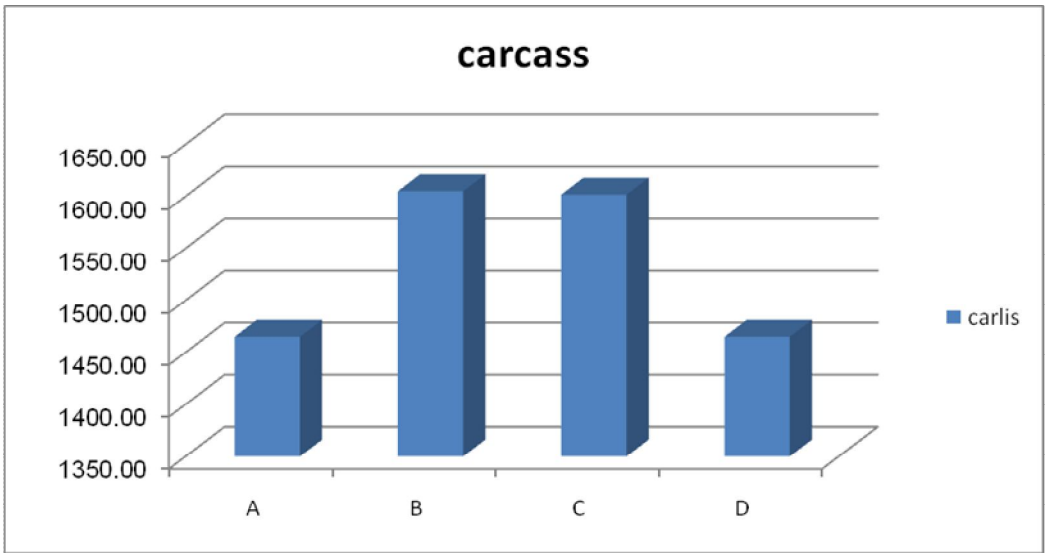
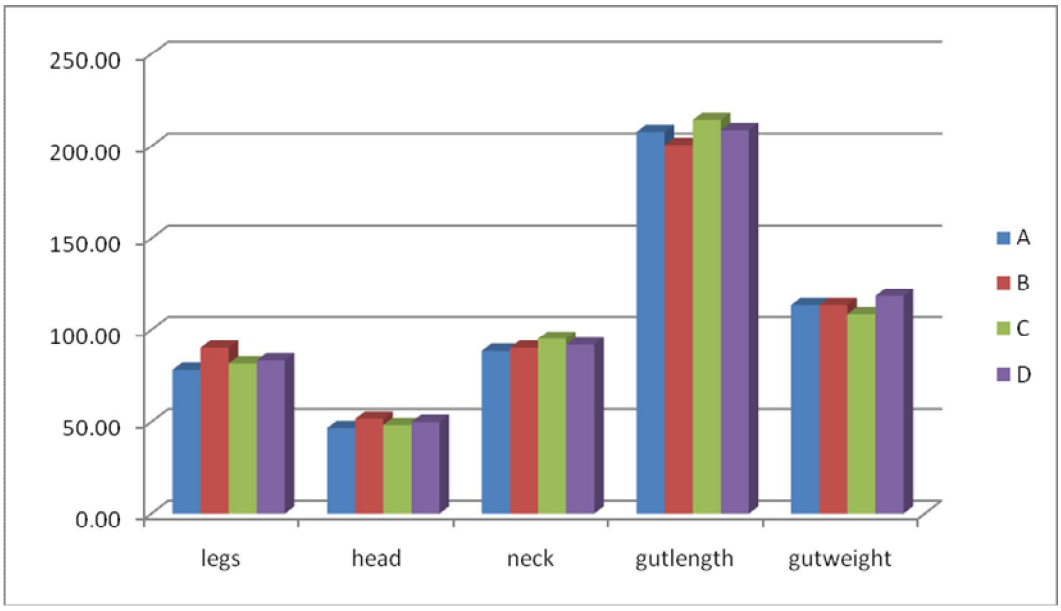


Figure 3: Means of experimental chicks organs as a percentage of hot carcass weight:



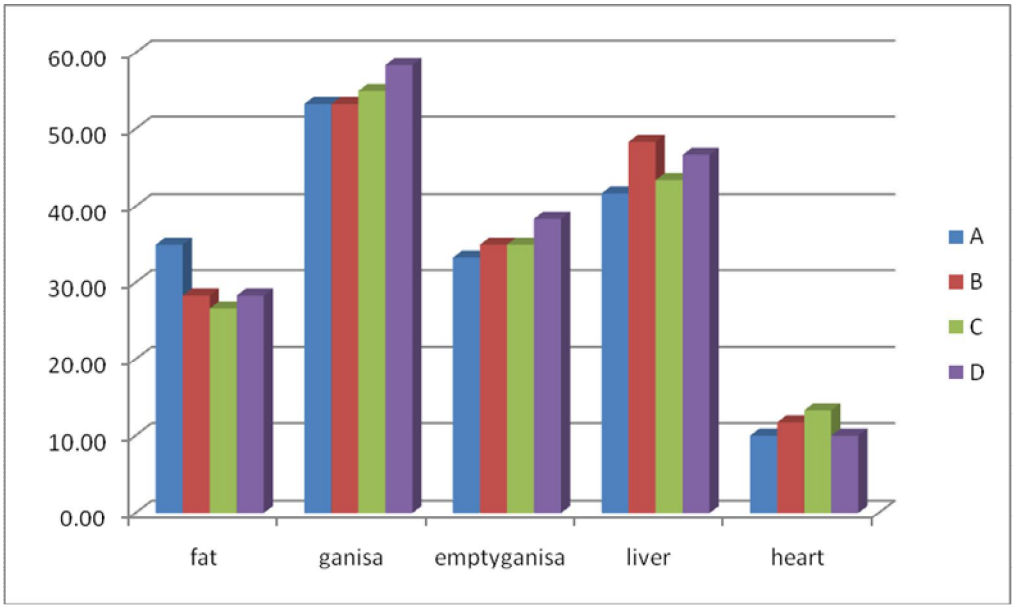


Figure 4: Means of experimental chicks back, neck and wing as a percentage of hot carcass weight:

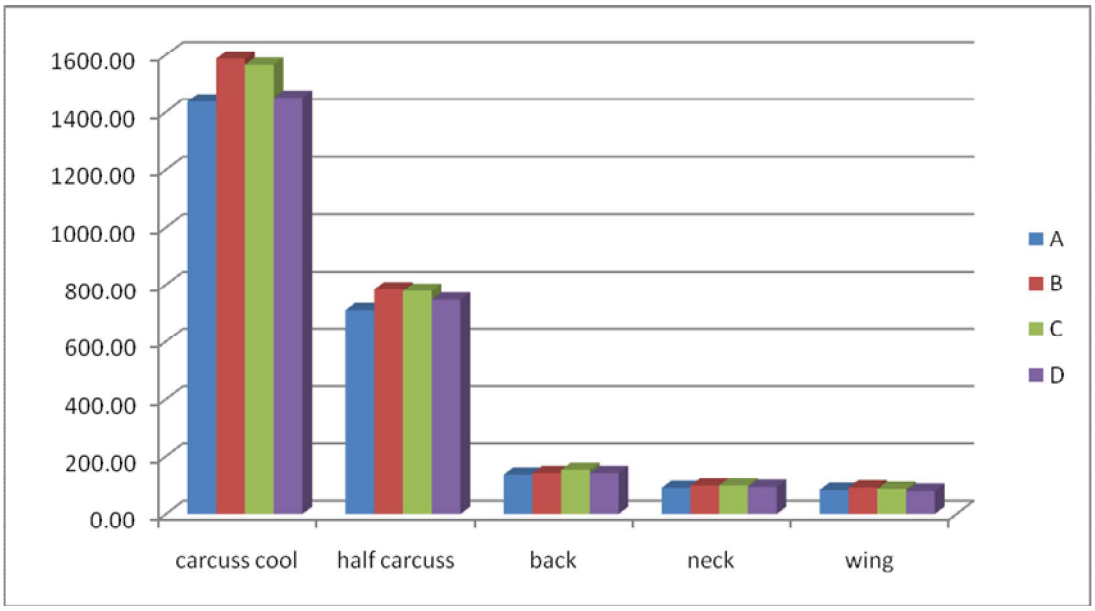
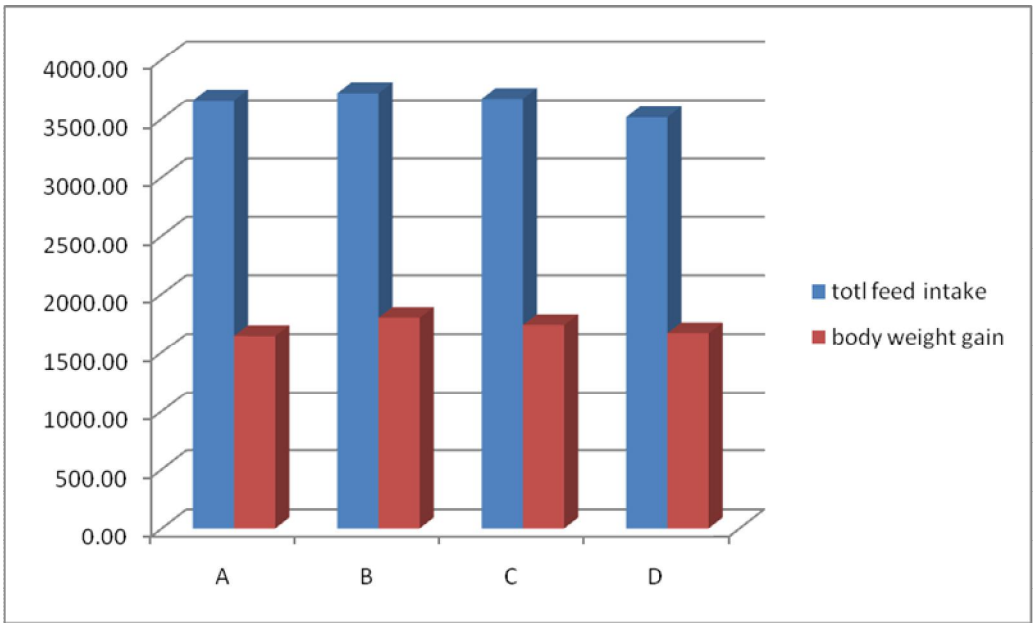


Figure 5: Effect of feeding on performance a broiler chick:



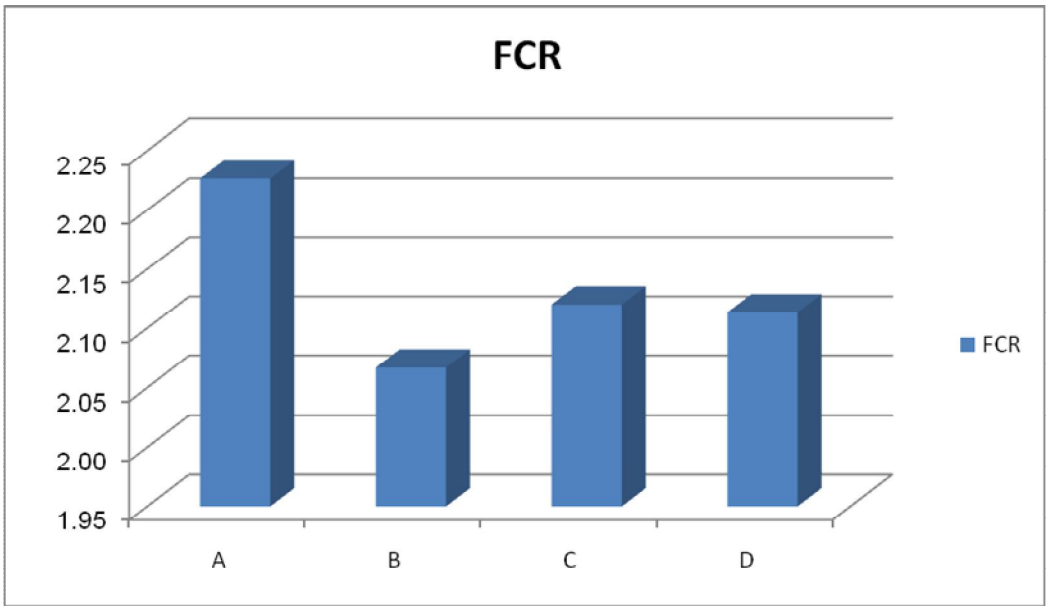
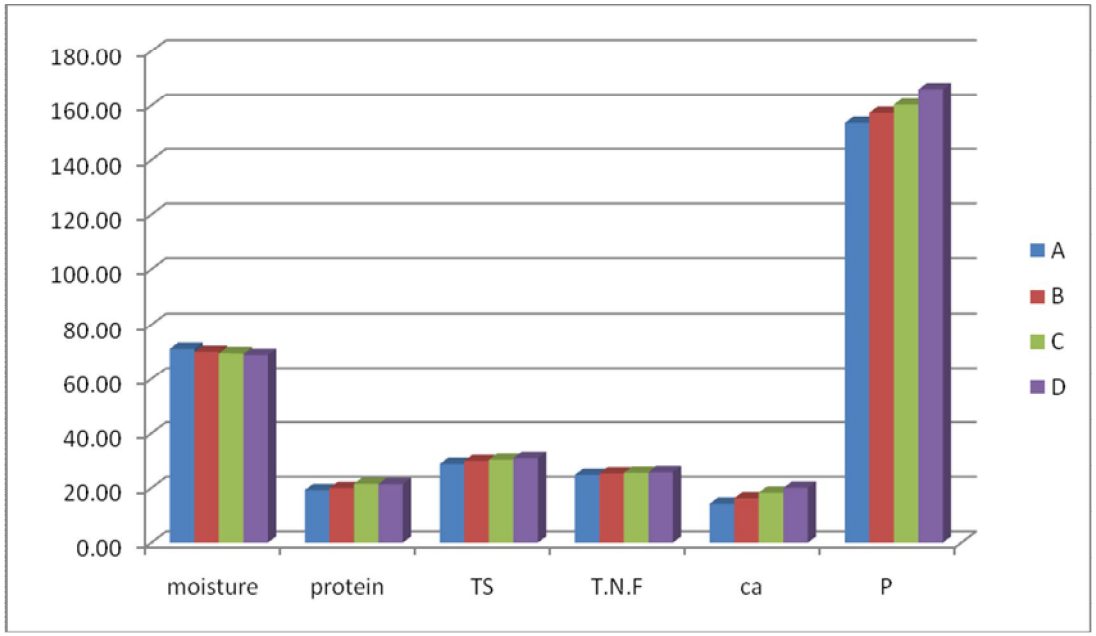


Figure 6: FRC

Figure 7: Means of chemical composition of experimental chicks meet



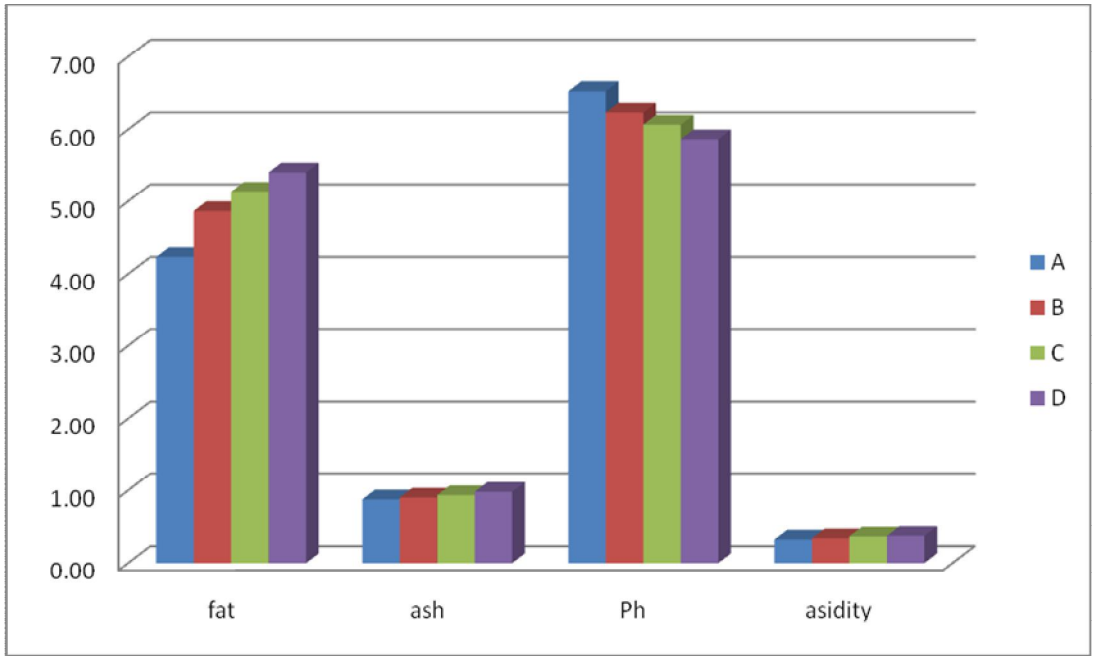


Figure 8: Means of experimental chicks blood composition

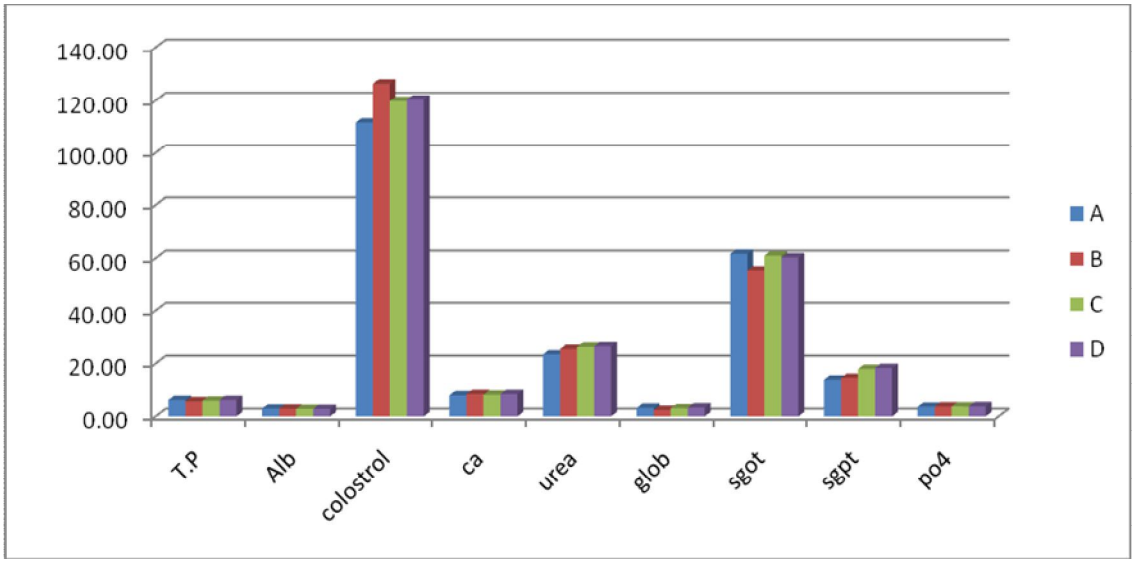


Plate 1: Fennal Seeds