CHAPTER ONE

INTRODUCTION

The biggest challenge of commercial poultry production is the availability of good quality feed on sustainable basic at stable prices in spite of this challenge, commercial poultry production ranks among the highest source of animal protein. The increase of the size of the poultry industry has been faster than the other food–producing animal industries. The trade volume of poultry products has also increased parallel to rapid growth of global poultry meat and egg production. Feed is the major component of the total cost of production in the poultry industry: to ensure more net return and to minimize high expenditure on feed, many research strategies have been practiced such as introducing feed supplement and feed additives (**Javed et al.,2009**).

Antibiotic have been added to poultry diets to maintain health and production efficiency in the past 80 years. Various mechanism have been proposed which are include:(a) the nutrients are more efficiently absorbed and less are utilized by the gut, (b) more nutrients are available to the host because of reduced intestinal micro flora, (c) there is a reduction in harm full gut bacteria, (d) production of growth suppressing toxins or metabolites is reduced, (e) microbial de-conjugation of bile acids is decreased (**Roozbeh et al., 2012**). But,continuous and misuses of antibiotics in poultry industry resulted many concerns about development of drug-resistant bacteria, drug residues in the body of the birds, and imbalance of normal micro flora (**Behrouz et al., 2012**),this led to the ban of these products by the European Union in January 2006. (**Jimoh et al., 2013**). This decision has therefore stimulated a search for alternatives: Essential oils have been proven to control pathogens due to their antimicrobial activity **(Dorman and Deans, 2000)**, to have ant oxidative potential (**Hui, 1996**) by delaying lipid oxidation in broiler meat, and to enhance digestion (**Brugali, 2003**) by stimulating the indigenous enzymes. Both garlic and ginger essential oils have gained prominence due to their wide range of properties not only in improving performance of broilers but, many other ways where the almost aim is to improve nutritive value of poultry meat products (**Bamidele and Adejumo ,2012**). Several studies have identified the separate use

of this plants extracted oils in broiler nutrition as natural feed additives ,the present study was conducted to evaluate the combined therapeutic effect of garlic (*Allium sativum*) and ginger (*Zingiber officinale*) on the growth performance and subjective meat quality attributes of broiler chicks.

CHAPTER TOW

LITERATURE REVIEW

2.1 Feed additives:

Feed for broiler and laying hens is formulated to contain an optimum nutrients concentration 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, handling 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 group covers those compounds concerned 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).**

The most common type of feed additives used are:(1) antibiotics and arsenicals, which have been used at low levels to help protect feeds from microbial destruction and to prevent production of toxic products by the intestinal micro flora;(2) anticoccidials, which are routinely used in broiler feed and also(usually at lower levels) in diets for rearing replacement pullets;(3) antifungal, have been used to prevent growth of harmful molds and fungi in feed or in the digestive tract of the chicken;(4) worming drugs which are periodically added to feed for protection against internal parasites;(5) antioxidant, are used to protect poly-unsaturated fatty acids and that fat soluble vitamins from destructions by per oxidation;(6) probiotics, which can be used to influence the intestinal micro flora;(7) enzymes, which have been shown, under certain condition, to improve the digestibility of

specific nutrients;(8)pellet binders, which effect texture and firmness of pelleted feed;(9)flavoring agents, have been used in an effort to improve the palatability of feed;(10)carotenoids, which are added to many feeds to improve pigmentation of broiler or egg yolk **(Parks et al,2000 and Allam,2000).**

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 nitrofurans have been found to posses 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 of 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 may instances prevent or cure actual pathological disease which occur either in the intestinal tract 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 finding suggested that antibacterial used for animal feeding as growth promoters become risky for human and animal health **(Manning et al, 1994; Sahin et al, 2002; Thorns, 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 1986 and 1999, respectively **(FMI, 2006).** Also world 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 world.

The united states banned the use of enrofloxacin in2005**,(Colligon,1999).**since 1th January2006 the use of antibiotic growth promoters is prohibited in the European Union **(Buchanan et al.,2008).**The nutritional 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, variety of substances are used in conjunction with or as alternatives 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 Phytobiotic:

Plant products have been used for centuries by humans as food and to treat ailments. Natural medicinal products originating from herbs and spices have also been used as feed additives for farm animals in ancient cultures for the same length of time .To differentiate from the plant products used for veterinary purposes (prophylaxis and therapy of diagnosed health problems),phytobiotic were defined by (**Windisch and Kroismayr2006)** as plant-derived products added to the feed in order to improve performance of agricultural live stock .Around the world ,phytobiotic have been investigated as natural sources of biologically important

chemicals since efforts are being made to ban all types of IFAs in many countries .Compared with synthetic antibiotics or inorganic chemicals, these plant-derived products have proven to be natural, less toxic, residue free, and are thought to be ideal feed additives in food animal production **(Wang et al.,1998**). With respect to biological origin, formulation, chemical description and purity ,phytobiotic comprise avery wide range of substances and four sub groups may be classified: 1) herbs(product from flowering ,non-woody and non-persistent plants) ,2) botanicals (entire or processed parts of plant, e.g. roots, leaves, bark), 3) essential oils (hydro distilled extracts of volatile plant compounds) and4) oleoresin (Extract based on non-aqueous solvents) **(Windisch andKroismayr,2006).**The active compounds of phytobiotic are secondary plant constituents.

Antimicrobial activity and immune enhancement probably are the two major mechanisms by which phytobiotic exert positive effects on the growth performance and health of animals. Compounds (photochemical) in phytobiotic are well known to have antimicrobial ability **(Cowan.1999)** polysaccharide components are considered to be the most important immune active components **(Xue and Meng, 1996).** In diseased chickens (either infected with avian mycoplasma gallisepticum or Eimeriatenella). **(Guo et al, 2004a, 2004b, 2004c)** demonstrated that plants and their extracts could improve the growth performance, reduce the populations of coli forms and\or C.perfringens, and enhance both cellular and humeral immune responses of chickens .some herbal extracts have also been shown to posses acoccidiostatic activity **(Allen et al., 1997; Youn and Noh, 2001; Christakia et al., 2004).**

A common feature of phytobiotic is that they are Avery complex mixture of bioactive components.for example, hawthorn fruit ,a common growth –enhancing and digestion modifier, has been shown to contain more than 70 kinds of organic chemicals along with some un identified factors and active bio-active compounds **(Wang et al.,1998).** Therefore they may exert multiple functions in the animal body. Increased feed intake and digestive secretions are also observed in animals offered phytobiotic-supplemented feed **(Windish and Kroismayr, 2006).** Growth enhancement through the use of phytobiotic is probably the result of the synergistic effects among complex active molecules existing in phytobiotic **(Gauthier, 2002).** However the exact growth –promoting mechanisms of phytobiotic in broiler chickens are poorly understood. Among phytobiotics, essential oils (EO) have been

applied into chicken feed in Europe and USA **(Hooge, 2004b).** However, bird growth responses to EO supplementation are still controversial. No EO effects on growth performance were reported by **Botsoglou et al (2002);Zhang et al.(2005), Jang et al.(2007);**Whereas improved growth performance were observed at different age of birds fed certain EO-supplemented diet(S) by **Jamroz et al.(2003), Hernandez et al.(2004), and cross et al .(2007)** on the other hand ,some EO(s)induced growth improvements similar to or even better than an antibiotic treatment . While comparing the effects of various herbs and oils on broiler performance, **(Cross et al., 2007)** concluded that the quality as well as the quantity of active chemicals in plant extract determines bird response. In addition, the efficacy of dietary EO can be affected by intrinsic and extrinsic factors such as nutritional status of animals, infection, diet composition and environment **(Giannenas et al, 2003; Lee et al, 2004b).** Essential oils function mainly as antimicrobials. and antioxidants; their antimicrobial ability may modulate the gut ecosystem to affect fat digestibility **(Lee et al.,2004a**) , starch or\and protein digestibility of feeds **(Jamroz et al.,2003;Hernandez et al,2004).** A commercial preparation of essential oil components reduced faecal C.perfringens caunts of broilers in afield study **(Mitsch et al .,2002).** In addition, dietary supplementation of EO reduced the intestinal populations of E.coli **(Jamroz et al.,2003;Jang et al.,2007)** and increased digestive enzymes in either pancreas and \ or intestinal mucosa **(Lee et al 2003;Jange et al.,2007)**however intestinal mucosal morphology was not affected by EO supplementation **(Garcia et al.,2007).** Four factors may affect the effectiveness of phytobiotic additive: 1) plant part and their physical properties, 2) source, 3) harvest time, and 4) compatibility with the other ingredient (s) in the feed **(Wang et al., 1998),** which may also explain why 50% difference in BWG and 63% difference in FCR could happen when different kind of phytobiotic are used in chicken diet **(Xing, 2004).**

Although phytobiotic are group of natural additives, research into their mechanisms of action compatibility with diet toxicity and safety assessment (based on the fact that some phytobiotic might have harmful substances(s) need to be done before they can be applied more extensively in poultry feed.

2.4Garlic (Allium Sativum):

2.4.1Scientific classification:

According to ***Wikipedia*** **(2013)** the garlic is classified scientifically as follow:

Kingdom: plantae

Clade: Angiosperm

Clade: Monocots

Order: Asparagales

Family: Amaryllidaceae

Subfamily: Allioideae

Genus: Allium

Species: A.sativum

Binomial name: Allium sativum

Allium sativum, commonly known as garlic, is a species in the onion genus, Allium. Its close relatives include onion, shallot, leek, chive and rakkyo with a history of human use of over 7,000 years, garlic is native to central Asia **(Ensminger, 1994)** and has long been a staple in the Mediterranean region, as well as a frequent seasoning in Asia, Africa, and Europe. It was known to Ancient Egyptians, and has been used for both culinary and medicinal purposes **(Simonetti, 1990).**

2.4.2Botanical description:

A perennial herb with a bulb divided into segments (cloves), basal linear leaves and an erect stem terminated by an umbel with numerous small bulbils between the purplish-white flowers. The flowers cluster is enclosed by asheath (spathe) of papery bracts. The fruit is capsules with black seeds do not ripen in cultivated plants **(Singh and Panda, 2005).**

2.4.3Constituents of bulb (clove):

a)Enzymes: allinase, peroxide, myrosinase and others(e.g catalase, superoxidase, dismutase, aginase and lipase) (**Koch and Lawson,1996).**

b)volitle oils (essential oils): 0.1-0.36%, sulfur containing compounds including alliin, compound produced enzymatic ally from alliin including allicin (diallyl ehisosulfinate), allylpropyl disulfide, diallyl disulfide, diallyl trisulfide, ajoene and vinyldithiines (secondary products of alliin produced non-enzymatically from allicin); S-allylmeracaptocystocysteine (ASSC) and S-methymeracaptocysteine (MSSC); terpens include citra, geranoil, linalool alfa and beta-phellandrene **(Sendl, 1995).**

According to result of gas chromatography coupled with mass spectrometry (GM\MS) analysis (**Dieumou et al.,2009)** found that the garlic essential oils contain the following chemical compounds: 1-propene (0.7%), 3,3-thiobis-sulfide (1.4%), methyl-trans-propenyl-disulfide (1.1%), disulfide, diet-2-propenyle (37%), trisulfide, methyl-2-propenyl (5.6%), 2-vinyl-4h-1,3-dithiin (0.9%),trisulfide, di-2-propenyl (49.6%) and diallyl tetrasulphide (1.8%).

c) Other constituents: proteins (eg. Glutamyl, peptides), aminoacids (eg. Arginine, glutamic acid, asparatic acid, methionine, threonine) minerals, vitamins, trace elements, lipids, prostaglandins (A_2, D_2, E_2, and F2) (**Sendle, 1995**).

Allicin and other sulfur containing compounds are formed from alliin by enzyme allinase when garlic is crushed or chopped. (Alliin and allinase are separated while the cell of agarlic bulb is intact, but crushing and chopping damage the cell of bulb, allowing alliin and allinase to come into contact with each other). It considered that one mg alliin equivalent to 0.45mg allicin**(Rashid and Khan, 1974).** Commercial garlic preparation is often standardized on content of sulfur containing constituents, particularly to alliin or on allicin yield. Garlic powder contains not less than 0.45% allicin calculated with reference to the dried drugs **(Joanne et al., 2007)**

2.4.4 Uses:

2.4.4.1Food use:

Garlic is used extensively as food and as ingredient in food. It listed by the council of Europe as natural source of food flavoring (Category NI) this category indicates that there are no restrictions on the use of garlic in foods. Previously, garlic has been listed as GRAS (Generally Recognized As Safe) (**Joanne et al., 2007).**

Garlic along with cinnamon is used as a fish and meat preservative, and displays antimicrobial property at temperature as high as 120 degree Celsius; the combination can also be used to preserve fried and deep fried foods, and in the future might be used in an inner layer of plastic**. (Shivendu et al., 2012; Vipul et al., 2012; Pankaj et al., 2012 and Madhumite et al., 2012).**

2.4.4.2 Medicinal use:

Garlic is stated to possess diaphoretic, antiseptic, bacteriostatic, antiviral, hypotensive and anthelmintic properties, and to be a promoter of leukocytosis. Traditionally, it has been used to treat chronic bronchitis asthma, influenza and chronic bronchitis **(Durak et al., 2002; Chan et al., 2007; Lissiman et al., 2012; Lemar et al., 2005 and Ried et al., 2010).** Modern use of garlic and ginger extracts is focused in their reputed antihypertensive, anti–atherogenic, antithrombotic, antimicrobial, fibrinolytic, cancer preventive and lipid lowering effects **(Joanne et al., 2007).**

2.4.5 Pharmacological actions:

2.4.5.1 Anti-atherosclerotic and cholesterol and lipid-lowering effects:

The effects of garlic and its constituents on cholesterol biosynthesis in vitro and in animal's models of hypercholesterolemia are well documented **(Koch and Lawson, 1996).**

Several in vitro studies shown that garlic and its sulfur containing constituents inhibit cholesterol biosynthesis in cultured hepatocytes **(Liu and Yeh, 2001).** In other in vitro studies, garlic extracts were shown to inhibit fatty acid and triglyceride synthesis **(Yeh and Yeh, 1994).**

The step(s) the cholesterol biosynthesis pathway inhibited by garlic, and the constituents of garlic causing inhibiton have not been definitively established. Several mechanism of action for the effect of garlic constituents on cholesterol and lipids synthesis have been proposed, including inhabitation hydroxymethylglutaryl- CoA (HMG - CoA) reuotase activity and other enzymes, such as lanosterol-14-demethylase, involved in cholesterol biosynthesis **(Koch and Lawson, 1996).** Other proposed mechanisms include reduction in triacylglycerol biosynthesis via areduction in tissue concentration of NADPH, increase in hydrolysis of triacylglycerol via increase lipase activity and inactivation of enzymes involved in lipids synthesis via an interaction with enzyme thiol groups **(Fulder, 1989 and Adoga, 1987).** More recently, fresh garlic extract and the constituents S-allylcystein, diallyl trisulfide and diallyl disulfide were shown to inhibit human squalene monooxygenase, an enzyme catalyzing a step in cholesterol biosynthesis **(Gupta and Porter, 2001).** Another in vitro study reported that S-allylcystein, S-propylcystein and S-ethylcystein inhibit triglyceride biosynthesis in part by decreasing de novo fatty acid synthesis via inhibition of fatty acid synthase **(Liu and Yeh, 2001).**

The anti - atherogenic, anti - therosclerotic and cholesterol - and lipid-lowering effects of garlic and its constituents have been documented in several animals models (eg. Rabbits, rats, chickens and pigs) of atherosclerosis, hypercholesterolaemia and hyperlipidaemic **(Koch and Lawson,1996).**For example areduction in both blood and tissue lipid concentrations in hypercholesterolaemic animals fed a diet supplemented with dried garlic powder, garlic oil, or allicin has been documented **(Kamanna and Chandrasekhara, 1982).** Several studies showed that the addition of garlic and its essential oils to broiler diet as growth promoters reduced significantly the serum level of cholesterol and triglyceride **(Rahimi et al., 2011; Ademola et al., 2009; Meraj., 1998; Onibi et al., 2009 and Pesti., 1997).**

2.4.5.2 Antimicrobial effects:

Antimicrobial activity including (anti-bacterial, antiviral, anti-fungal, antiprotozoal and anti-parasitic activities) is well documented for garlic **(Shalaby et al., 2006; Durak et al.,2002 and Racesi et al., 2010).**

The in vitro antimicrobial studies of garlic considered to allicin which is(+)-S-mrthyl-L-cystein sulfoxide,has equated to 15IU of pencillin**(Jimoh et al., 2013).**

In vitro studies have shown that allicin significant antibacterial activity against several species including Bacillus subtilis, Staphylococcus aurus, Staphylococcus faeclis, Escherichia coli, mirabilis, Salmonella typhi and Vibrio cholera**(Ahsan and Islam, 1996).**

In other in vitro studies garlic essential oil and four diallyl sulfide constituents, including diallyl disulfide, showed activity against antibiotic resistant Pseudomonas aeruginosa and Klebiella pneumonia **(Tsao and Yin, 2001)** and against S.aureus, Methicillin-resistant S.aureus, Candida spp and Aspergillus spp .

It has been documented that garlic extracts exert a differential inhibition between beneficial intestinal microflora and potentially harmful enrobicbacteria **(Rees et al., 1993).** Inhibition observed in E.coli was more than 10 times greater than that seen in Lactobacillus casei for the same garlic dose **(Skyrme, 1997).** Exactly why this differential Inhibition should occure is not clear, but it may be due to differing composition of bacteria membranes and their permeability to allicin **(Mirson et al., 2000).**

Broad-spectrum activity against fungi has been documented for garlic including Microsporum, Epidermophyton, Trichophyton, Rbodotorula, Torudopsis, Trichosporon, Cryptococcus neoformans and Candida, including Candida albicans **(Adctumbi and Lau, 1983)**.

Garlic extracts has been reported to be more effective than nystatin against pathogenic yeast especially Candida albicans **(Adctumbi and Lau, 1983).** Inhibition of lipid synthesis is through to be an important factor in the anti-candidal activity of garlic with a disulfide-containing component such as allicin through to the main active components. Garlic has been found to inhibit the growth and toxin production of Aspergillus parasiticus **(Joanne et al., 2007).**

In vitro antiviral activity against parainfluenza type 3. Herbs simplex type1 and influenza B has been documented. Activity was attributed to allicin or an allicin derivative. Garlic was reported to be in effective towards coxsackie B1 virus **(Joanne et al., 2007).**

2.4.5.3 Antioxidant effect:

Antioxidant properties have been documented for garlic in vitro and vitro (Animals**) (Koch and Lawson, 1996).** Garlic constituents inhibit the formation of free radicals, support endogenous radical scavenging mechanisms, and enhance cellular antioxidant enzymes (eg. Superoxide dismutase, catalase, glutathione proxidase), protect low-density lipoprotein from oxidation by free radicals, and inhibit the activation of oxidant-induced transcription factor nuclear factor Kappa (NI-KB) **(Koch and Lawson, 1996 and Borck, 2001).**

2.4.5.4 Immunomodulatory activity:

Allicin (diallylthiosulfinale) is the most abundant compound representing about 70% of all thiosulfate present in crushed garlic was found to inhibit tumor metabolism and enhance the immune response **(Sumiyoahi, 1997),** the Allium species show immune enhancing activities and include promoting of lymphocyte synthesis, cytokine release, phagocytosis and natural killer cell activity **(Kyo et al., 1998).**

(**Dorhoi et al.,2006)** found that the essential oils of garlic substantially improve the inherent cell immunity of poultry, **(Haq et al., 1999)** showed that higher garlic supplement increase level of titer anti NDV, as well, **(Gabor et al .,1998)** found a significant rise in serological response of broilers when using garlic extract of 1gmL-in drinking water for 20 days.

2.5 Ginger (Zingiber officinale):

According to **Wikipedia (2013)** the ginger is classified scientifically as follow

2.5.1 Classification of ginger:

Kingdom: Plantae

Division : Angiosperma

Class : Monocotyledoneae

Order : Scitaminaea

Family : Zingiberaceae

Genus : Zingiber

Species : Officinale

2.5.2 Botanical description:

Herbaceous rhizomatous perennial, reaching up to 90 cm in high under cultivation. Rhizomes are aromatic thick lobed,pale yellowish,bearing simple alternate distichous narrow oblong lanceolate leaves . The herb develops several lateral shoots in clumps, which begin to dry when the plant matures. Leaves are long and 2-3 cm broad with sheathing bases, the blade gradually tapering to apoint inflorescence solitary lateral radical pedunculate oblong cylindrical spikes. Flowers are rare, rather small, calyx superior; gamaosepalous three toothed open splitting on one side, corolla of three sub equal oblong to lanceolate connate grennish segment **(Schauenberg,1977).**

2.5.3 Constituents:

The main constituents of ginger root are:

Carbohydrates: starch (major constituent, up to 50%) **(Joanne et al 2007).**

Lipids 6-8% free fatty acids (e.g. palamitic acid, oleic acid, linoleic acid, caprylic acid, lauric acid, myritic acid, pentadecanoic acid, heptadecanoic acid, stearic acid,

linolenic acid, arachidic acid); **(Lawrence and Reynolds,1984).**Triglycerides, phosphatidic acid, lecithins; gingerglycolipids A,B and C **(Yoshikawa et al.,1992).**

Oleo-resin Gingerole homologues (major, about 33%) including derivatives with amethyl side-chain**,(Chen et al.,1986)** shogaol homologues(dehydration products of gingerols, zingerone(degradation product of gingerols),1- dehydrogingerdione **(Charles et al.,2000),** 6-gingesulfonic acid **(Yoshikawa et al.,1992).**

Volatile oils: 1-3%.complex, predominately hydrocarbons.β-bisabolene and zingiberene (major) other sesquiterpenes include zingiberol,αr-curcumence,β-sesquiphellandrene, β-sesquiphellandrol (cis and trans);numerous monoterpenc hydrocarbons, alcohols and aldehydes (e.g. phellandrene, camphene, geraniol, neral, linalool,d-nerol) **(Joanne et al 2007).**

(Dieumou et al., 2009) reported that, in ginger essential oils, 26 constituents were identified with zingiberene, sabinene, camphene,geranial,z-citral and 1,8-cineole as major components**(appendix 1).** Also, **(Tekeli et al., 2010)** was summarized the zingiber officinales essential oils as shown in **(appendex2).**

Other constituents: Amino acids (e.g. arginine, aspartic acid, cysteine, glycine, isoleucine, leucine, serinc, threonine and valine), protein (about9%), resins, diterpenes (galanolactone), **(huang et al., 1991).** Vitamins (especially nicotinic acid (niacin) and vitamin A) minerals. **(Lawrence and Reynolds., 1984).** The material contains not less than 4.5% of alcohol (90%)-soluble extractive and not less than10% of water- soluble extractive.

2.5.4 Uses:

2.5.4.1 Food use:

Ginger is listed by the council of Europe as natural source of food flavoring (category N2). This category indicates that ginger can be added to foodstuff in small quantities, with a possible limitation of an active principle (as yet unspecified) in the final product. It is used widely in foods as a spice. Previously, ginger has been listed as GRAS (Generally Recognized As Safe) **(Joanne et al 2007).**

2.5.4.2 Herbal use:

Ginger is stated to possess carminative, diaphoretic and antispasmodic properties. Traditionally it has been used for colic flatulent dyspepsia, and specifically for flatulent intestinal colic **(Langnet et al., 1998)** modern interest in ginger is focused on its use in the prevention of nausea and vomiting particularly motion (travel) sickness, as a digestive aid and as an adjunctive treatment for inflammatory conditions such as osteoarthritis and rheumatoid arthritis.

2.5 .5 Pharmacological actions:

Several pharmacological activities, including anti-emetic antithrombotic, antimicrobial, anticancer, antioxidant, anti-inflammatory properties, have been documented for preparations of ginger in vitro and /or animal studies. Also ginger has been reported to have hypoglycemic, hypo- and hypertensive cardiac, prostaglandin and platelet aggregation inhibition anti hypercholesterolemia, and stomachic properties clinical studies have focused mainly on the effects of ginger in the prevention of nausea and vomiting.

In vitro and animal studies: In vitro studies have demonstrated that constituents of ginger, such as 6-8 and 10-gingerols and galanolactone, have antiserotonergic activity **(Huang et al., 1991 and Yamahara et al., 1989).**

2.5.5.1 Anti-atherosclerotic activity:

Ginger oleo-resin, by intra gastric administration, has been reported to inhibit elevation in serum and hepatic cholesterol concentration in rats by impairing cholesterol absorption **(Gujral et al.,1978).**anti hypercholesterolemia activity has also been documented for dried ginger rhizome when given to both rates fed a cholesterol- rich diet and those with existing hypercholesterolaemia **(Giri et al.,1984)** fresh ginger juice was not found to have an effect on serum cholesterol concentration within four hours of administration .in addition ,serum cholesterol concentrations were not greatly increased with in fours of cholesterol administration.

An ethanol (50%) extract of ginger administered orally at a dose of 500mg\kg to hyperlipidaemic rabbits led to a significant reduction in blood serum cholesterol concentrations .compared with those in control rabbits. **(Sharma et al., 1996)** in

study in rabbits fed cholesterol for 10 weeks, administration of an ethanolic extract of ginger (200mg\kg orally) decreased raised serum and tissue concentration of cholesterol, serum triglycerides and serum lipoproteins **(Bhandari et al., 1998).**

An ethanolic ginger extract, standardized to contain 40mg\g gingerols, shogaols and zingerone, and 90mg\g total polyphenols, was reported to inhibit low-density lipoprotein oxidation and to reduce the development of atherosclerosis in atherosclerotic mice, when compared with control.**(Fuhrman et al.,2000)** in rats fed a high-fat diet for 10 weeks, an aqueous preparation of ginger powder administered orally at doses of 35 and 70mg\kg demonstrated antioxidant activity, as measured by raised tissue concentration of thiobarbituric acid reactive substances and hydroperoxides, and reduced activates of superoxide dismutase and catalase.**(Jeyakumar et al.,1999)**

The antioxidant activity of ginger constituents has been documented in vitro. **(Surh et al., 1998)**

In broiler several studies to determine the effects of ginger on the concentration level of serum cholesterol. **(Arkan et al., 2012)** reported that, addition of ginger powder to the diets at levels 0.1 and 0.2% significantly reduce the serum cholesterol in broilers. This finding are similar those of **(AL-Homidan, 2005)** and (**Ademola et al.,2009)** who found significant decrease in blood serum cholesterol when feeding broiler chicks up to 60% ginger.

2.5.5.2 Antioxidant activity:

(Zhang et al.,2009) stated that, the ginger total superoxide dismutase TSOD and glutathione peroxidase GSHPx activity in the serum of ginger supplement broilers compared with that of control broilers indicate that ginger enhanced antioxidant enzymatic activity in the serum. The antioxidant defenses include natural and synthetic antioxidants and the antioxidant enzymes present in the biological system **(Sies,1991).**Free radicals are produced during normal metabolism but can in turn induce body damage if they are present in excessive levels. it has been generally recognized that superoxide dismutase SOD,GSHPx and catalase are 3 main antioxidant enzymes in seavenging the oxygen free radical**(Mc Cord,1979),**therefore ,Increasing activities of SOD and GSHPx would subsequently enhance the capacity of broilers to clear out the oxygen free radicals.

Consistent with the increased activity of serum SOD and GSHx, MDA Malondi aldehde concentration in the serum was reduced by inclusion of ginger in broiler diets. Malondi aldehyde is formed as an end product of lipid peroxidation and therefore the extent of lipid peroxidation by reactive oxygen species can be monitored by MDA levels **(Sumida et al.,1989).** Hence, the reduced serum MDA level in ginger –supplemented as compared with control broilers indicated that lipid peroxidation was reduced by ginger via enhancing ant oxidative action. All together, these results demonstrated that ginger supplemented at the level of 5g\kg improved antioxidant status of broiler chickens **(kota et al., 2008).** Also observed that supplementation of ginger at the levels of 5, 10, and 50g\kg significantly enhanced SOD and GSHPx activity (liver) and lowerd MDA (liver and kidney) in rat. In contrast, **(Ahmed et al., 2000) and (Ahmad et al., 2006)** reported no effect (100mg\kg of BW) on either SOD or GSHPx but markedly reduced concentration of MDA in the blood. The discrepancy among these studies is likely due to the different animals, physiological stages, diet compositions and the ginger source and its application level. Although reduced MDA concentration in the serum could partially be attributed to the increased antioxidant enzymatic activity associating with ginger supplementation, the reason why ginger increased these antioxidant enzymatic activities remains unknown. The improved anti oxidant status of broiler in ginger – supplemented groups. Obtained by **(Zhang et al., 2009)** could partially be attributed to the antioxidant compounds in ginger. A body of literature has shown that plant polyphenolic flavonoids was one of the major groups of compounds acting as primary antioxidant free-radical terminators**(Huang and Frankel,1997;Singh et al.,2005).** The potential active constituents in ginger are the gingerols, shogaols, gingerdiol,gingerdione and some related phenolic ketone derivatives **(Kikuzaki and Nakatani,1996;Fuhrman et al .,2000)** . previous studies showed that ginger crude plant material **(Kuo et al.,1999)** and single constituents such as (6)-gingerol **(Aeschbach et al .,1994; Ippoushi et al .,2003),**curcumin **(Surh et al .,1999).** And zingerone **(Aeschbach et al., 1994)** have the ability to protect against lipid per oxidation in different model.

2.5.5.3Anti-inflammatory activity:

Constituent of ginger have been shown to have anti-inflammatory activity in vitro. Ginger oil has demonstrated anti-inflammatory activity in a study in rats with sever chronic adjuvant arthritis induced by injection of 0.05ml of suspension of dead

mycobacterium tuberculosis bacilli **(Gujral et al.,1978).** Ginger oil 33mg\g administered orally for 26 days caused a significant suppression of paw and joint swelling, compared with control (no ginger oil). Several other studies describe anti-inflammatory activity for ginger constituents. **(Surh et al., 1998).**

2.5.5.4 Anitmicrobial activity:

In vitro activity against rhinovirus IB has been reported for sesquiterpenes isolated from ginger rhizomes **(Denyer et al., 1994).** The most active compound was B-sesquiphellandrene (IC_{50} 0.44Mmol\L). In vitro anthelmintic activity against Asaridia gilla Schrank has been documented for the volatile of Zingiber purpureum Roxb **(Joanne et al., 2007).** Activity exceeding that of piperazine citrate was exhibited by the oxygenated compounds fractionated from the volatile oil.

2.6 Effect of garlic and ginger their mixture on broiler performance:

Amouzmehr et al., (2013) evaluated the effect of various levels 0.3 and 6% of garlic extracts on the performance of broiler chicks for 42 days. The results showed that there were no significant differences among the treatment groups in weight gain feed intake and feed conversion ratio over the entire trail.

Fayed et al., (2011) evaluated the effect of garlic supplementation in diets as growth promoter on productive performance of broiler chicks. The chicks were fed on three experimental diets, 1 control diets (basal diets); 2 and 3 basal supplemented with 1kg/ton and 0.5kg/ton raw garlic powder, respectively. The result indicated that bird fed on ration supplemented with0.5kg/ton garlic gained the highest live weigh among treatment groups and the best feed conversion ratio although they consumed the same feed. There were no significant differences in mortality rate due to treatment.

Dieumou et al., (2012) studied the comparative effect of garlic organic extracts and antibiotic- streptomycin sulphate on growth performance of broiler chicks. The basal diet was supplemented with: no supplement (control), garlic organic extracts (GOE) at levels of 40 and 60ppm/kg and streptomycin sulphate at level 30ppm/kg administrated by oral gavages from day 13 to day 47 of experiment. The results showed that the growth performance did not differ significantly between the groups fed on diet supplemented with treptomycin sulphate and those fed (GOE),

but were significantly ($p<0.05$) better than the values obtained from birds fed on control diets. They concluded that diets supplemented with (GOE) at 40ppm could be used as alternative to antibiotic additives for broiler production.

Rahimi et al., (2011) evaluated the effect of garlic extracts and antibiotic. Virginamycin on growth performance of broilers. Basal diet (A) served as control group. The basal diet was supplemented with virginamycin at level 15ppm and garlic extract at 0.1% to formulate diets B and C respectively. The results indicated that there were no significant differences between garlic extract and virginamycin diets in feed conversion ratio and feed intake, while the chicks fed virginamycin gained significantly more than those garlic extracts diet. The results also showed no significant differences between garlic extract and control groups in all productive performance parameters throughout the experimental period.

The results of **Hertrampt,(2001); Wiliams and Losa,(2001); Tuker,(2002); Thakar et al.,(2004) and Sarica et al.,(2005)** showed no significant effect of garlic extracts on performance trails of broiler chicks.

Ziton, (2009) studied the effect of various levels of dried as natural growth promoter on the productive performance of broiler chicks. Five groups of chicks were fed on the experimental diets. The first group (A) fed on basal diet (negative control). The second group (B) fed on basal diet supplemented with antibiotic (Neomycin at level of 20mg/kg). The other groups C, D and E were fed on the basal diet supplemented with dried garlic at levels 2, 3 and 4% respectively. The results indicated that the supplemented with garlic groups had significantly better weight gain and feed conversion ratio than the control groups, whereas, the differences between garlic groups and antibiotic group were not significant. The feed intake and dressing percentage were not affected significantly by the dietary treatments. The control group significantly exhibits higher mortality rate compared to either garlic groups or antibiotic groups when no mortalities recorded.

Ammar et al., (2012) stated that, the addition of ginger essential oil to the diet at the levels 10, 20 and 40mg/kg/day caused no significant effect on the feed intake, weight gain and feed conversion ratio of broilers.

Arkan et al., (2012) reported that, the feed intake, weight gain and feed conversion ratio were improved in broiler chicks fed on dietary ginger powder at levels 0.1 and 0.2%.

Ademola et al., (2009) and (**Onimisi et al., 2005)** reported that, the ginger supplementation to the broiler to the broiler diets can increase body weight gain when supplemented up to 2% level.

Zomrawi et al., (2012) found no significant differences (p›0.05) were observed in dressing percentage among the birds that fed with different levels of ginger root powder (0.0%, 0.5%, 1% and 1.5%).

Herwati(2006) and Herwati(2010) scored significantly lower feed conversion ratio for birds fed with diets containing ginger up to 2%.

Janz et al., (2007) reported that, the essential oils (500mg/kg) from ginger had no effect on dressing percentage of finisher piggery.

Farinu et al., (2004) reported that supplementation of ginger at levels of 5, 10 or 15g/kg slightly improved growth performance of broiler.

EL-Deek et al., (2002) observed that diet containing 1g/kg of ginger did not affect the growth performance.

Khan et al., (2007) reported that dietary garlic powder at 2, 6 and 8% did not significantly affect feed intake and feed efficiency.

Dieumou et al., (2009) found that the either ginger or garlic essential oils given by stomach tube in 3 doses 10mg/kg/day and 40 mg/kg/day had no significant effect feed intake, body weight gain and feed conversion ratio of broiler chicks.

Bamidele and Adejumo(2012) reported that the experimental diets containing 1.00% garlic and 0.50% ginger mixtures and 2.00% and 0.75% ginger mixtures had no significant (p>0.05)effect on growth performance.

AL-Homidan, (2005) evaluated the efficacy of using different levels of Allium cepa, Allium sativum, and Zingiber officinal on broiler performance. A.cepa bulbs, A.sativum bulbs and Z. officinal rhizome were feed to broiler chicks at level 2 and 6% for 7 weeks. A. sativum (garlic) diet showed the highest weight gain and 6%

A. sativum did not adversely influence birds health, enter hepatonephropathy was observed in the chicks fed 6% A.cepa (onion) and 6% Z.officinale(ginger) diets.

Javed et al., (2009) studied the effect of aqueous extract of Zingiber officinal, Carum apticum, Wlthania sominfera, Trigonella, Foeenum. graecum, Silybum marianum , Allum sativum and Berberis lyceum on growth performance of broiler. Aqueous extracts of those plants was mixed at the rate of 5, 10 and 15ml/lit with water afford to group B, C and D respectively. The experimental was extended for 35 days. Main weight gain was significantly high ($p>0.05$) in group C with better feed conversion ratio, while mean feed intake was significantly high in control group .no mortality was recorded in this trail.

CHAPTER THREE

MATERIALS AND METHODS

This experimentl was conducted during winter season 24th September – 2 November 2014). The ambient temperature average 28.5Ċ - 40Ċ during the experimental period for6 weeks

3.1 Experimental chicks:

A total number of 84 one day commercial unsexed broilers of *AborAcres* strain from local commercial hatchery (MEICO) and transported to the student poultry premises, faculty of agricultural studies, Sudan university of science and technology, Shambat. The chick were adapted to the premises and fed for 7 days before start of the experiment at the end of adaptation period, all chick were weighed with an average initial weight of 130 gm. The chicks were then assigned randomly into four dietary treatment groups (A, B, C and D) in completely randomized design (CRD). Each group was divided into three replicated, each of 7 chicks ground brooding/rearing system was adapted for 6weeks experimental period. The birds were vaccinated against Infectious Bronchitis (IBD) by IBD78 and New castle disease (ND) by Coloni30 at 7 days of age and also using multi-vitamin. At 14days were vaccinated against Gumboro, the dosage was repeated at 21 and 28days of age for ND and IBD respectively.

3.2 housing:

An open system poultry house was used. The house was construction on concrete floor with corrugated metal sheets roof and a solid brick western – eastern wall up to 5 meters. The eaves and 2.5 meters for apex 12 pens, $1m^2$ each inside the house, were prepared using wire mesh partitioning. Each pen was equipped with one feeder and drinker to allow adlibitum consumption of feed and water. Light was provided approximately 24 hours in a farm of natural light during the day and artificial light during the night. Five bulbs (60watt) were used for this purpose the house was cleaned and well disinfected before the commencement of the experiment.

3.3 Experimental rations:

Garlic and ginger essential oils were used in this experiment were purchased from Bahree market, Khartoum state. The chicks were fed on 4 dietary treatments. The first group A fed on basal diet without growth promoters. The other groups B, C and D were supplemented with garlic and ginger essential oils as natural growth promoter, at level 200,400,600gm/ton respectively.

The ingredients percent compositions and the calculated chemical analysis of the experimental diet were present in table (1, 2). Experimental diets were fed for 6 week.

3.4 Data collected:

3.4.1 Performance data:

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 recoded daily.

3.4.2 Slaughtering procedure:

At the end of the experiment three chicks were selected randomly from each group and weighed individually after an overnight fasting with only water allowed, then they were slaughtered by severing the right and left carotid and jugular vessels, trachea and esophagus. 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.

Evisceration was accomplished by posterior ventral cut to completely remove the visceral organs the hot carcasses were weighed for calculation the dressing percentage. The legs were separated from each then they were deboned, the meat was frozen and stored for sensory evaluation.

3.4.3The taste panel:

Frozen deboned legs cuts were thawed at 5-7Ċ before cooking for sensory evaluation. The meat was trapped in aluminum foil, Placed in roast pan and cooked at 176.7Ċ in conventional preheated electrical oven to about 80Ċ internal muscles temperature. The cooked meat was allowed to cool to room temperature for about 10 minutes. The samples were kept warm until served. Trained panelists were instructed to eat crackers drink water between samples testing to clear the plate and pause for 30seconds between all samples evaluated. Flowing recommended procedure **(Hawrysh et al., 1980).** The sensory panel evaluated the chops for tenderness; flavor, color and juiciness using an eight-point scale **(Appendix3).**

3.5 Experimental design and statistical data analysis:

Completely randomized design was used in this experiment the data were tabulated and subjected to one-way Analysis of Variance (ANOVA) by using the SAS computer program **(SAS, 1994).** The significant difference (LSD) was used for treatment means separation as outline by using **Steel and Trrie (1986).** All values were presented as means and standard error. The level significantly set up $p>0.05$).

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

Ingredient%	Diets			
	A	B	C	D
Dura	64.142	64.142	64.142	64.142
G.N cake	14	14	14	14
Sesame cake	15	15	15	15
Concentration	5	5	5	5
Lysine	0.344	0.344	0.344	0.344
Meth	0.159	0.159	0.159	0.159
Oyster shell	0.487	0.487	0.487	0.487
Dical	0.618	0.618	0.618	0.618
Salt	0.25	0.25	0.25	0.25
Total	100	100	100	100
Mixture garlic and ginger essential oils	_	200g/ton	400g/ton	600g/ton

* Crude protein 40% ; Crude fat 3.90; Crude fiber 1.44% ; Calcium 10%; Available phosphorus 6.40% ; Energy1950k 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 ; Experiment 400 mg/kg ; K3 30 mg/kg ; B1 50mg/kg ; B2 150 mg/kg ; B6 50 mg/kg ; B12 180 mcg/kg.D Pantothenic acid 155 mg/kg ; Niacine 440mg/kg ; folic acid 8 mg/kg ; choline chloride 5.800 mg/kg ; Antioxydant (BHT) 1000 mg/kg.

Trace Elements; Manganise 1600mg/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	D
Dry matter	94.85	94.85	94.85	94.85
Crude protein	22.70	22.70	22.70	22.70
Crude fiber	04.35	04.35	04.35	04.35
Ether Extract	03.35	03.35	03.35	03.35
Ash	04.65	04.65	04.65	04.65
Nitrogen. Free Extract	59.80	59.80	59.80	59.80
Calcium	01.06	01.06	01.06	01.06
Total phosphorous	00.79	00.79	00.79	00.79
Available phosphorous	00.50	00.50	00.50	00.50
ME. cal/kg	3117	3117	3117	3117

* Calculated a according to Ellis (1981).

CHABTER FOUR

RESULTS

4.1 Response of broiler chicks to diet containing mixture of garlic and ginger essential oils:

4.1.1 Performance:

Effects of various levels of the dietary mixture of garlic and ginger essential oils on the performance of broiler chicks are shown in table (3). All groups started in similar body weight (130gm).

The result showed the treatment effect on weight gain was not significant ($p>0.05$). However chicks in groups (B, C and D) gain more weight than that obtained by group (A). No significant ($p>0.05$) different were observed between the treatment on feed intake, but chicks in groups (B, C and D) were consumed more compared with groups (A). Feed conversion ratio (FCR) was not effected significantly by the dietary treatment and the mean values were closely similar in all experimental groups

4.1.2 Carcass dressing percentage:

No mortality was detected in all treatment groups all throughout the experimental period.

The results indicated no significant differences ($p>0.05$) between all treatment groups in carcass dressing percentage as shown in table (3).

4.1.3 Panel test (subjective meat attributes):

The effect of dietary treatment on subjective meat attributes is shown in table (4). The mean average subjective meat quality score values of color, tenderness, juiciness and flavor of leg cuts (thing and drumstick) did not differ significantly ($p > 0.05$) among the dietary treatment and score given for all attributes are above moderate acceptability level.

4.1.4 Economical appraisal:

The total cost, returns, net profit and profitability ratio per head of broiler chicks fed different level of garlic and ginger essential oils for 6 weeks are shown in table (5).Chicks purchase management and feed cost values (SDG) were the major in put considered. The selling values of meat is total revenues obtained profitability ratio (1.24) of test group D (600gm\ton at garlic and ginger essential oils mixture) was the highest of the test groups.

Table3: The Effects of various levels of the dietary mixture of garlic and ginger essential oils on the performance and carcass dressing percentage of broiler chicks for 6 weeks:

Items	Group					
	A	B	C	D	LSD0.05	SE±
Initial weight g/bird	130	130	130	130		
final weight g/bird	1380	1430	1440	1480		
Weight gain g/bird	1250	1300	1310	1350	812ns	103.536
Feed intake g/bird	2500	2450	2460	2470	869ns	63.122
Feed conversion ratio	2.0	1.89	1.90	1.83	872ns	215.650
Dressing %	69.60	69.60	69.65	69.68	1.000	5.22815

Means in a raw do not different significantly ($p > 0.05$)

LSD = least significant difference.

SE±=standard error

NS= not significantly difference ($p > 0.05$)

A = controlled

B =200 gm mixture of garlic and ginger essential oils at ratio (1:1)

C=400 gm mixture of garlic and ginger essential oils at ratio (1:1)

D=600 gm mixture of garlic and ginger essential oils at ratio (1:1)

Table 4: The effect of different dietary amount of mixture the garlic and ginger essential oils on percentage of subjective values of broiler chicks for 6 weeks:

Items	Group					
	A	B	C	D	LSD0.05	SE±
Tenderness	6.18	6.22	6.26	6.28	995ns	.45828
Flavor	6.10	6.16	6.18	6.18	998ns	.46351
Color	6.1	6.03	6.07	6.09	998ns	.41298
Juiciness	6.0	6.0	6.10	6.15	985ns	.43340

Means in a raw do not different significantly ($p > 0.05$)

LSD = least significant difference.

NS= not significantly difference ($p > 0.05$)

SE±=standard error

A = controlled

B =200 gm mixture of garlic and ginger essential oils at ratio (1:1)

C=400 gm mixture of garlic and ginger essential oils at ratio (1:1)

D=600 gm mixture of garlic and ginger essential oils at ratio (1:1)

Table (5): The total cost, revenue and net profit of broiler chicks fed on different levels of garlic and ginger essential oils:

Item	Group			
	A	B	C	D
Cost				
Chick purchase	3	3	3	3
Total feed cost	13.8	13.8	13..6	13.7
Management	2	2	2	2
Total cost of production	18.8	18.6	18.6	18.7
Revenue				
Dressing percentage	69.60	69.60	69.65	69.8
Average weight	870	904.8	912.4	940.68
Price/kg of bird	33	33	33	33
Total revenue	28.7	29.9	30.1	31.0
Profit				
Total revenue	28.7	29.9	30.1	31.0
Total cost of production	18.8	18.6	18.6	18.7
Total profit	9.9	11.3	11.5	12.3
Profitability ratio	1	1.14	1.16	1.24

*Total cost calculation according to October 2012.

*A current (2014) price of meat 33(SDG)\kg.

CHAPTER FIVE

DISCUSSION

This experiment was conducted to evaluate the response of broiler chicks fed graded levels of mixture garlic and ginger essential oils as natural growth promoter alternative to antibiotic. The mixture garlic and ginger essential oils was added to basal diets at level 200gm/ton, 400gm/ton and 600gm/ton. In this study the apparent health of experimental stock was good throughout the experimental period. The general behavior of the stock also was good. The ambient temperature during the experimental period fell within the thermoneutral zone has extracted no heat on the experimental period. No mortalities were recorded among the different treatment groups throughout the experimental period. This may be due to the hygienic situation of the experimental. In this study birds were kept in clean disinfected environment of following all hygiene regulations program. Similar results were obtained by **Fayed et al.(2011); EL-tazi(2014)** who reported that the mortality rate was not affected significantly by the addition of garlic powder in broiler diet also **EL-tazi,(2014)** found no significant by addition of ginger powder.

The addition of the mixture garlic and ginger essential oils to broiler diet improved the body weight gain, but the differences were not significant among the entire treatment groups. This result was in a line with the finding of **Dieumou et al., (2009)** who stated that the weight gain of broiler chick was not affected significantly by the addition of the mixture garlic and ginger essential oils in the diets. Similar results were obtained by **Sarica et al., (2005); Cross et al., (2002) and Amouzmehr et al., (2013)** who found no significant differences in weight gain of chick fed garlic essential oil. Like – wise, **Konjufca et al (1997); Botsoglou, (2001) and Blolukbasi et al., (2006)** reported non-significant effect of garlic powder supplementation on weight gain of broiler. Similarly **Garcia et al.,(2007) and Tollba et al (2007)** observed no difference in body weight gain in broiler fed on ginger and peper extract for a period of 6 weeks. This results contrary to the finding of **Herati and Marjuki (2011)** who mentioned that increase ginger in the ration up to 2% showed lower total weight gain. Also **Onimisi et al (2005); Ademola et al (2009); AL-Homidan(2005) and EL-tazi**

(2014) found that dietary ginger powder increased body weight gain. Similarly **Ahmad (2005); Ziton (2009) and Soliman (2000)** found that, the diets supplemented with garlic had significantly better weight gain than control group.

The feed intake in this study tended to be higher in the chicks fed on mixture of garlic and ginger essential oils diets compared with control group, but the differences were not statistically significant. This results were agreed with the finding of (**Bamidele and Adejumo, 2012)** who reported that, the mixture of garlic and ginger essential oils had no significant effect on feed intake of broiler chick. **Dieumou et al., (2009); Amouzmehr et al., (2013); Thakar et al., (2004); Tuker.(2002) Williams and Losa.(2001) and Zolikha.(2014)** found non-significant effect of dietary garlic essential oil on the feed intake of broiler chicks. Also **Doley et al.,(2009)** observed non-significant differences in feed intake between the broiler chicks fed on ginger extract and those fed on control diet. This was contrary to the finding of **Zomrawi et al (2013); Herawati (2006); Herawati (2010) and EL-tazi(2014)** who reported that, the broiler chicks fed on diets supplemented with ginger powder were consumed more feeds compared with those fed on control diets . Like- wise **EL-tazi(2014)** indicated that the diet supplemented with garlic powder had significantly better feed intake compared to the control diet.

The feed conversion ratio in the present study was not affected significantly by the experimental diets. This result is consistent with the finding of (**Bamidele and Adejumo, 2012)** who reported that, the mixture of garlic and ginger essential oils had no significant effect on feed conversion ratio. Similar results found by **Rahimi et al (2011); Dieumou et al.,(2009); Sarica et al., (2005); Zolikha.(2014)** who reported that, chicks fed with garlic essential oils diet had the same feed conversion ratio with control group whereas, **Dieumou et al,. (2012)** reported that use of garlic essential oil improved significantly the feed conversion ratio in broiler chicks. Also **(Ziton, 2009)** found that addition of garlic powder in broiler diet improved significantly the feed conversion ratio of the chicks. Similarly **EL-tazi(2014); Herawati (2006); Tollba (2003); Herawati (2010); Moorthey et al(2009) and Onimisi et al (2005)** they illustrated that broiler chicks fed on diets containing ginger up to 2% recorded better feed conversion ratio than un-supplemented ones. They attributed the better feed conversion ratio to the antibacterial properties of the mixture garlic and ginger and its extracts, which

resulted in better absorption of the nutrients in the gut and finally leading to improvement in feed conversion ratio.

Treatment effect in this study was not significant on carcass dressing percentage. These results are in line with the finding of **Sarica et al., (2005); Dieumou et al, (2009); Rahimi et al,(2011); zolikha,(2014) and Amouzmehr,(2013)** who reported that the dietary garlic essential oil did not have any significant effect on carcass dressing percentage of broiler chicks . similarly, **EL-Deek et al,(2002) and Moorthey et al,.(2009)** observed non- significant effect on carcass characteristics of broiler chicks fed with different levels of ginger powder and ginger extract up to six weeks. In contrast, (**Dieumou et al., 2012)** reported that carcass dressing percentage of broiler chicks fed on garlic essential oil was significantly better compared with un-supplemented group. Similarly, **Alcicek et al., (2004); Tollba et al., (2007); Ademola et al., (2009) and Javed et al.,(2009)** stated that, carcass characteristic were improved significantly in broiler fed different levels of powder and essential oils of ginger from 1-42 days of age .

The results of this study showed no significant differences among all treatment groups in subjective meat quality attributes (color, flavor, juiciness and tenderness of the breast and thigh meat. All scores being at above moderate value. Similar results were found by (**Zolikha, 2014)** who found that, addition of garlic essential oils in the broiler diets had no significant effect on the subjective meat quality parameters. Like-wise (**EL-tazi, 2014)** detected no significant effect on subjective meat quality attributes of broilers fed on different levels of ginger powder. However, (**Eugeiuszr and Edyat, 2007)** stated that, diet containing 5mg/kg dried garlic powder contributed to increase sensory assessment of broiler chicks meat.

The results in this study showed that application of garlic and ginger essential oils had no significant effect on performance, Carcass dressing percentage and meat quality parameters. Although this experiment was performed in disinfected condition that may have resulted in decreased the efficiency of these growth promoters. However, the results cited in literature are highly variable about the degree of improvement in growth performance and carcass characteristic of broiler obtained by dietary garlic and ginger extracts as growth promoters. This may be due to the variation in the efficiency of the garlic and ginger extract additive which depend on many factors including birds materials, dose used, management, genetic

variation of garlic and ginger, age of plant and environmental factors such as climate and soil **Mohan,(2004); Barreto et al.,(2008); Pourali et al.,(2010) and Zolikha,(2014).**

The economical evaluation of the experimental diets indicated that, the diet with 600gm/ton level mixture of garlic and ginger essential oils showed the highest profitability ratio (1.24) as compared to the control group. This might be due to the highest return of the weight gains recorded by this group of chicks. **(Amal, 2012)** found that addition of black cumin, lemon grass, spearmint and halfa bar essential oil to the broiler diet economically was feasible. Also, (**Zolikha, 2014)** stated that, addition of garlic essential oils at various inclusion level in broilers diets was economically profitable.

5.1Conclusion:

1- The results of present study indicated that the use of mixture garlic and ginger essential oils at various inclusion levels in the diet had no significant effect on body weight gain, feed intake, feed conversion ratio and mortality rate of broiler chicks.
2- Adding of mixture garlic and ginger essential oils at all inclusion levels in the diet made no changes in carcass dressing percentage and subjective meat quality attributes of broiler chicks.
3- Using of mixture garlic and ginger essential oils at different levels in broiler diet economically feasible.

5.2 Recommendation:

*Practical implication:

1- Application of mixture garlic and ginger essential oils in the diet had no significant effect on the performance of broiler chicks reared under well disinfected condition in this study.
2- More effective influences of dietary mixture of garlic and ginger essential oils could probably be seen in broilers rearing in less hygienic situation.
3- All levels of mixture garlic and ginger essential oils added to the broiler diets in this study were recommended economic-wise, but the

level of dietary mixture garlic and ginger essential oils 600gm/ton was more profitable.

*Suggestion for future research:

-More trails are needed to clarify the effects of mixture garlic and ginger essential oils and its extract on productive performance, carcass characteristics, digestive system development immune system, intestinal micro flora and blood constituents of broiler with regard to varied management conditions including different stress factors, types and sources of garlic and ginger oils extraction methods, optimal dietary inclusion levels, dietary ingredients and nutrients contents.

-The future research also should be focused on the use of other herbs and spices and their organic extracts, enzymes, probiotics, prebiotics, synbiotics and organic acids as natural growth promoters in broilers production.

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Appendix 1

Chemical composition (%) of the essential oil of Zingiber officinale:

Retention	Library/ID	Percent in oil
936	α-pinene	4.1
954	Camphene	11.9
980	2-β- pinene	0.3
984	6-methyl-5-hepten-2-one	1.1
989	B-myrcene	1.7
1009	1-phellandrene	0.6
1037	Sabinene	12.0
1038	1,8-cineole	5.3
1091	α-terpinolene	0.4
1095	2-nonanone	0.6
1105	α-terpinolene	1.7
1155	Citronellal	0.4
1178	Endo-borneol	1.9
1198	β – fenchyl alcohol	0.8
1251	6-octen-1-ol, 3,7-dimethyl	0.9
1277	z-citral	8.2
1294	Geraniol	2.6
1296	Geranial	10.0
1316	2-undecanone	0.8
1370	Citronellyl acetate	0.3
1494	ar-curcumene	2.5
1497	Germacrene	0.8
1509	Zingiberene	14.0
1515	Farnesene	4.4
1520	β-bisabolene	2.6
536	β-sesquiphellandrene	4.8

Appendix 2

Zingiber officinale and propolis essential oil and major components (%)

Zingiber officinale	%	**Propolis**	%
Cis 2-nonenal	1.75	**Bilesikler components**	
(E,E)2,4-Decadienal	13.79	**Flavonoids**	
Ar-curcumene	8.93	Chrysin	5.33
Zingiberene	15.77	Naringenin	2.67
·-farnsene	3.27	2-methoxy-4-vinylphenol	0.47
Valancene	1.29	4-vinylphenol	0.44
·-Bisavolene	7.68	Hexanoic acid	0.64
·-Sesquiphellandrene	11.97	4-pentenoic acid	0.25
1,3,5-Cyclooctatriene	0.70	2-propenoic acid	0.38
Zingerone	4.63	3-hydroxy-4methoxy cinnamic acid	0.56
Viridiflorol	0.72	Hexadecanoic acid	1.21
·-Copanen-4,· ol	10.98	9-octadecanoic acid	0.55
Linoleic Asit	0.50	**Aliphatic, aromatic and fatty acids**	
Oleic Asit	0.62	Ferulic acid	2.26
n- Hekza Dekonoik Asit	1.04	**Esters**	
Retinol	0.54	Benzyl cinnamate	1.35
Monopalmitin	3.19	**Terpens**	
Retinol Acetate	0.22	d-limonene	0.28
Stearoik Asit	4.06	·-eudesmol	1.00
Linoleyl Choloride	4.19	·-eudesmol	0.89
Squalene	0.38	**Aldehidss, keton and others**	
3-(6-Hydroksi, 3,7Dimethy-octa	1.73	Crysophanol	22.07
2,7, dieniyl)-4-Methozy fenol			
Octadecane, 3-ethy-5-(2-ethylbutryl)	0.71	4-H-1-benzopyran-4-one	13.51
Lucerin 2	0.42		
n-Heptacosane	0.91		

Appendix3

Card used for judgment of subjective meat quality attributes

Sensory evaluation card

Name……

Date……..

serial	**Sample code**	**Tenderness**	**Flavor**	**Color**	**juiciness**
		8-extermely tender	8-extermely intense	8-extermely desirable	8-extermely juicy
		7-very tender	7-very intense	7-very desirable	7-very juicy
		6-moderatelty tender	6-moderatelty intense	6-moderateltydesirable	6-moderatelty juicy
		5-slightly tender	5-slightly intense	5-slightly desirable	5-slightly juicy
		4- slightly tough	4-slightly bland	4- slightly un desirable	4- slightly dry
		3- moderately tough	3- moderately bland	3- moderately undesirable	3- moderately dry
		2-very tough	2-very bland	2-very un desirable	2-very dry
		1-extremely tough	1-extremely bland	1-extremely un desirable	1-extremely dry