A Comparative Study of Herbal Products on Growth Performance, Carcass Quality & Serum Biochemical Parameter of Broiler

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APPLAUSE

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The Author

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This is to certify that we have examined the above Master's thesis and have found that the thesis is complete and satisfactory in all respects and that all revisions required by the thesis examination committee have been made.

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RECOGNITION

Firstly, I am pleased to Almighty God who enables me to finish the research work and write up the ascertainment successfully for the degree of Master of Science (MS) in Animal and Poultry Nutrition under the Department of Animal Science and Nutrition, Chittagong Veterinary and Animal Sciences University (CVASU).

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The Author
June 2018

ABSTRACT

The study was conducted to the effects of herbal products (Garlic & Basil) supplementation on growth performance, carcass characteristics and serum biochemical parameter in commercial broiler.

A total of 112 day old cobb500 chicks were randomly divided into four dietary treatments:i.e. food containing no herbal products (T_0), food containing 1% garlic (T_1), food containing 1% basil (T_2), food containing 0.5% garlic & 0.5% basil (T_3). Each treatment consists into two replication having 14 birds per replicate.

It was evident that, there was a positive relationship between herbal products and performance parameters at later stage. Maximum weight gain & feed intake was recorded in the bird's take food containing 0.5% garlic & 0.5% basil after 4th week of age. There were no unusual changes in the blood and serum parameter in comparison to the reference level.

***Keywords*:** Herbal products, feed intake, weight gain, feed conversion ratio, carcass characteristics, blood parameters.

CHAPTER I: INTRODUCTION

Antimicrobial compounds are commonly included in poultry diets for promoting of growth and control of diseases. The European Union banned feed grade antibiotic growth promoters, due to, not only cross-resistance, but also to the risk of possible drugs multiple resistances in human pathogenic bacteria. Only two such drug-related compounds are planned to remain in use.Feeds containing no chemical additives are increasingly used in poultry nutrition.

Therefore, antibiotic growth promoters were discredited by consumer associations as well as by scientists, e.g. the use of most antibiotic growth promoters was banned by the European Union. Consequently, the animal feed manufacturers are exposed to increasing consumer pressure to reduce the use of antibiotic growth promoters as feed additive and find alternatives to antibiotic growth promoters in poultry diets (Hertrampf, 2001; Humphrey et al, 2002). Many scientists searched for alternatives to antibiotic growth promoters (Langhout, 2000; Mellor, 2000; Wenk, 2000; Kamel, 2001).

The feed manufacturers are adopting new forms of natural feed additives that are the products of modern science (Wezyk et al, 2000). This new generation of growth enhancers include botanical additives like appropriate blends of herbs or plant extracts. The herbs and plant extracts used as feed additives include many different bio-active ingredients such as alkaloids, bitters, flavonoids, glycosides, mucilage, saponins and tannin (Wenk, 2000).

Therefore, the effects expected of herbs and plant extracts are also various: the herbs and plant extracts act on the appetite and intestinal microflora, stimulate the pancreatic secretions to increase endogenous enzyme activity and immune system. Many plant products and their constituents have a broad antimicrobial activity, antioxidant and sedative properties.Tulsi or basil, an important sacred medicinal herb to possess remarkable biological activities like antimicrobial, immunomodulatory, anticancerous, antioxidant & anti-inflammatory, hepatoprotective, cardioprotective etc (Guo et al, 2000) have demonstrated that herbs and herbal products have a positive effect on broiler growth performance.

It also have indicated that garlic & basil may be used as a natural herbal growth promoter for broilers without side effects, neither for chicken performance nor consumers, and meat was not tainted with flavour or smell of garlic & basil Wezyk et al, (2000) reported that replacing antibiotic growth promoters with herbs resulted in decreased body weights, increased feed conversion per kg of weight gain and insignificant effects on carcass yield and carcass fatness.

The results of some experiments with broiler chicks indicate that herb supplements have a positive effect on performance and the colour of skin.Results from chick performance experiments show that feeding dietary garlic powder for 21 d significantly reduced plasma cholesterol level of broiler without changing growth of the chickens or feed efficiency reported that replacing antibiotic growth

promoter (Zinc Bacitracin) by Rhubarb (Rheum rhaponticum WILLD.) as a herb did not significantly affect body weight, body weight gain, feed intake, feed efficiency and dry matter content of excreta.

Feed is the major component of the entire cost of production in the poultry industry. Broiler and layer feed is formulated with an optimum level of nutrition at reasonable cost for desirable weight gain, production and capability of feed utilization. To make certain more net return and to minimize high cost on feed introducing feed supplement and feed additives has been introduced to commercial feed industry which are the common practical strategy now-a-days (Javed *et al.*, 2009).

Mainly feed additives are non-nutritive substances used in poultry feed including antibiotics (bacitracin, methylene disalicylate or virginiamycin etc.), enzymes, antioxidants, pellet-binders, antifungal, colored pigments and flavoring agents. Some antibiotics are most effective against gram positive or gram negative or 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 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). But many scientific finding suggested that antibacterial used for animal feeding as growth promoters become risky for human and animal health (Sahin *et al*, 2002; Thorns, 2000).

That's why World Health Organization (WHO, 1997) has recommended that antibiotic should be phased and replaced by alternatives (Bywater, 2005). The use of the most antibiotics as feed additives has been banned by the EU due to cross-resistance against pathogens and residues in tissues. For this reason, scientists have searched for alternatives to antibiotics. In this view, varieties of substances are used in conjunction with or as alternatives to antibiotics in poultry diets.

Herbs spices like garlic (*Allium sativum*) & basil (*Ocimum sanctum*) have been reported to empower useful pharmacological substances. Freshly broken garlic & basil contains allicin, alliin, ajoene, diallylsulfide, dithiin, S-allylcysteine. Garlic as natural feed additives in poultry nutrition may be of great benefit and value especially for broiler growers. This is due to their antibacterial, anti-inflammatory, antiseptic, anti-parasitic and immunomodulatory properties of garlic & basil.

Aims & Objectives of the Study

a) Evaluating the upshot of garlic and basil supplementation on growth performance of broiler chicken.

b) Understanding the yielding of garlic and basil supplementation on serological and hematological profile.

CHAPTER II: REVIEW OF LITERATURE

2.1 Herbal Medicine

An herb is a plant or plant part used for its scent,flavor or therapeutic properties. Herbal medicines are one type of dietary supplement. They are found as tablets, powders, teas, extracts, and fresh or dried plants. People use herbal medicines to try to maintain or improve their health. Herbs spices like garlic (*Allium sativum*) have been reported to possess useful pharmacological substances. Freshly crushed garlic contains allicin, alliin, ajoene, diallylsulfide, dithiin, S-allylcysteine. Garlic as natural feed additives in poultry nutrition may be of great benefit and value especially for broiler growers. This is due to their antibacterial, anti-inflammatory, antiseptic, anti-parasitic and immunomodulatory properties of garlic & basil.

2.2 Antibacterial effects

Historically it is believed that Louis Pasteur first scientist who exhibit the antimicrobial effects of garlic 'juices' in 1858, however, no reference is available. Recently it is substantiated that garlic is effective against many acid-fast, gram-positive and gram-negative bacteria. These include *Escherichia coli*, *Salmonella*, *Clostridium*, *Staphylococcus aureus*, *Pseudomonas*, *Proteus*, *Klebsiella*, *Micrococcus*, *Bacillus subtulis* and *Helicobacter*. So, garlic can be used to treat Colibacillosis, Salmonellosis and Cholera in poultry. Garlic exerts a differential inhibition between beneficial intestinal microflora and potentially harmful enterobacteria.

For the same garlic dose inhibition zone observed in E. coli was more than 10 times than that seen in *Lactobacillus casei.* The exact mechanism of this differential inhibition is not known, but one of the possible reasons may be the change in chemical composition of membranes of different bacteria and their absorptivity to allicin. An inhibitory synergism of antimicrobial properties of garlic was observed when it was used in combination with vancomycin.

2.3 Antimicrobial properties

Use of garlic and basil as a medicine and condiment goes back to written history. It is thought that these are originated in traditions of both India and China. Egyptian medical papyrus, Codex Ebers, interpreted in 1937; has more than 800 medical formulations, of which 22 contains garlic.

Recently the first testimony of its antimicrobial properties was established when four men were employed to remove the dead bodies during a plague in Marseilles in 1721 in France. None of them became infected. When research is done to identify the secret then it was known that they use garlic, basil and wine tincture. The precursor alliin, a cysteine sulfoxide, and the corresponding alliinase enzyme are the main components of garlic. Garlic & basil have been used for centuries in many countries to control infectious diseases. It has been used to prevent wound infection and food spoilage in India.

2.4 Antiviral effects

Mostly the commercially available antibiotics are not workable against viruses. That is the reason these cannot be used to control the viral diseases of poultry. Very less research is done on antiviral properties of garlic compared to antibacterial. Allicin and allicin-derived substances are active against viruses and no activity has been indicated with alliin or S-allyl cysteine. It has been proved that garlic shows in vitro activity against influenza A and B viruses, rhinovirus, HIV, herpes simplex virus 1 and 2, cytomegalovirus, viral pneumonia and rotavirus.

2.5 Antiprotozoal effects

Use of garlic & basil in poultry feed shows antiprotozoal effects in poultry but the exact mechanism of action remains to be explored. Several studies have shown that it is effective against a host of protozoa including *Opalina ranarum*, *Entamoeba histolytica*, *Balantidium entozoon*, *O. dimidicita*, *Trypanosomes*, *Leishmania*, and *Leptomonas*. Diallyl trisulfide a component of garlic is commercially available in many countries like China in commercial preparation named Dasuansu and has been prescribed for treatment of diseases caused by *Trichomonas vaginalis* and *Entamoeba histolytica.* Allicin, ajoene and organosulfides are the main components of garlic which have antiprotozoals properties. Thiol content of microbial cells are not quite enough, to counterbalance the thiol oxidation by allicin and allicin-derived products that why these are more influenced than animal cells.

2.6 Antifungal effects

Alike other antimicrobial properties antifungal activity of garlic has also been vindicated to be thanksgiving. The first ever report of antifungal activity of garlic in epidermophyte cultures was reporterd by Schmidt and Marquardt. Studies suggest that garlic can prevent the growth of *Aspergillus, Torulopsis, Trichophyton, Cryptococcus, Candida*, *Trichosporon* and *Rhodotorula*. Garlic has oxygen scavenging molecules which decrease the oxygen uptake, reduce the growth of the organism, stops the synthesis of protein, lipids, and nucleic acids and denature the membranes. A sample of pure allicin was shown to be antifungal. Solvent extraction of allicin from garlic decreased the antifungal activity. Activity has also been observed with diallyl trisulfide against cryptococcal meningitis and ajoene, against *Aspergillus, Candida.*

2.7 Broiler Growth Performance

Many scientists supervised the effects of long term feeding of garlic and its' preparations on the performance of broilers. Most of these studies reported a statistically significant improvement in cumulative feed conversion ratio. Garlic increases growth and improves feed conversion ratio by increasing height of villus of small intestine, activation of absorption process. To support these ideas a study has proven that dietary fermented garlic supplementation in broiler ration can increase the intestinal villus height, villus area, cell area, cell mitosis in the intestine and results in better feed efficiency.

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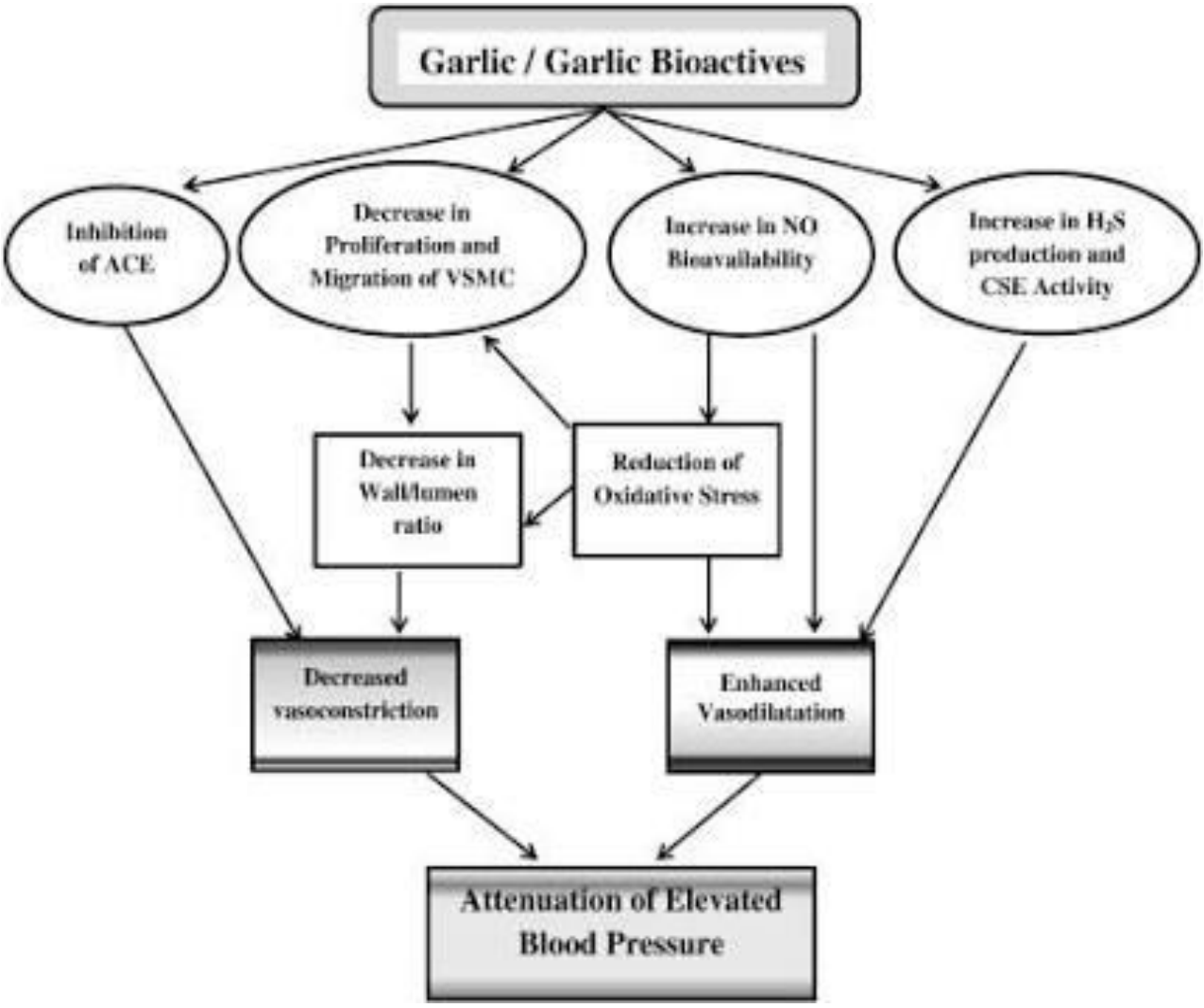
BACTERIA/VIRUS KILLING EFFECT (ANTI BIOTIC/ANTI SEPTIC ACTION)

VARIOUS INORGANIC COMPOUNDS PRESENTS IN TULSI KILL INFECTIOUS DISEASES CAUSING BACTERIA AND VIRUS.



2.8 Serum cholesterol

Garlic, being the king of medicinal plants, appoint beneficial effects on body metabolites. Several clinical studies have supported this idea. Allicin may reduce the levels of serum cholesterol, triglyceride and LDL. Diets comprising garlic powder has ability to lower down serum and egg cholesterol level in hens. An investigation has reported that supplementation of garlic powder at the levels of 0, 2, 6 and 8% does not affect the egg weight, egg mass, feed consumption and feed efficiency in the laying hens.

However, lowering effect on the serum and egg yolk cholesterol concentrations was observed with dietary garlic. Garlic paste, solvent-extracted fractions or garlic oil reduced the concentration of serum cholesterol by 23% and 18% in twelve week-old Leghorn pullets and broilers respectively, when diets were fed for 4 week. Decrease in hepatic cholesterol concentration in chickens was observed when 2% garlic was fed for 14 day. Similar effects of garlic were found in rats fed diets containing either cholesterol or triglyceride.

The mechanism which involved in lowering the cholesterol, triglyceride and LDL is that it reduces the activities of hepatic lipogenic and cholesterogenic enzymes such as fatty acid synthase, malic enzyme, 3-hydroxy-3-methyl-glutaryl-CoA (HMG CoA) reductase and glucose-6 phosphate dehydrogenase. Garlic also increased the excretion of cholesterol, as demonstrated by enhanced excretion of acidic and neutral steroids after garlic feeding. LDL isolated from human, given aged garlic extract and aqueous garlic extract was found to be decisively more resistant to oxidation. Suppressed LDL oxidation may be one of the controlling mechanisms for the benefits of garlic in atherosclerosis. Allicin was identified initially as the active compound responsible for depressing the atherosclerotic effect. However, in vitro studies revealed that organosulfur compounds especially, diallyl-di-sulfide, present in garlic oil and water-soluble S-allyl cysteine, present in aged garlic extract are also potent inhibitors of cholesterol synthesis.

2.9 Hematology

Garlic & basil supplementation in poultry settle positive effects on hematological parameters of poultry birds. Hematological analysis reported by Kung-chi et al. demonstrated that intake of garlic oil significantly increased white blood cell and reduced red blood cell counts, hemoglobin, hematocrit and mean corpuscular hemoglobin values in rats. Addition of garlic in diet of fish increase the red blood cells and mean corpuscular volume when it was used at the concentration of 20, 30, 40g/Kg. The scientists reported that hematocrit values reached a significant increase in fish fed on 20g garlic but no significant differences in mean corpuscular hemoglobin concentration was noted.

It is also possible that the end product of garlic metabolism in the body stimulates the kidney directly to cause formation and secretion of erythropoetin. Now, scientists are trying to determine the effect of garlic on erythropoetin level. Another experiment concluded that garlic supplementation increases the white blood cells, lymphocytes and immunoglobulin G in broilers. In contrast, it has been reported that garlic does not affect leukocyte numbers in broilers. With regards to WBC counts, it was reported that dietary addition of garlic increased lymphocyte concentration in peripheral blood

of pigs. The enhanced lymphocyte proliferation by garlic treatment along with the possible protection of the cells from oxidative stress seemed to contribute for the increased WBC count.

2.10 Immune System

Although garlic destroy viruses, bacteria and other microorganisms directly, it also excites the body's natural defenses against these antigens. Garlic's amazing and famous power against diseases is due to a combination of both these properties. Aged garlic extracts have an immunomodulatory effect and lessens the age-related deterioration of the immune response. Garlic supplementation in chickens increase the relative weights of the spleen, bursa of Fabricius and thymus.

In vitro garlic substances excites the rat and human lymphocytes. A protein fraction (F4), isolated from aged garlic extract, boost the cytotoxicity of human peripheral blood lymphocytes against natural killer-sensitive and resistant cell lines and induced lymphocyte infiltration and cytokine release. Diallyltrisulfide and protein fraction, the components of garlic has been shown to enhance activation of T lymphocytes and also progresses the ratio of helper to suppressor T cell in AIDS. It also enhances antibody production against *Salmonella enteritidis*, *Pasteurella multocida* and *Leptospira pomona* bacteria, which indicate that it increase the activity of B lymphocytes.

Alliums at low levels in the diet improved the humoral immune response against *Brucella abortus* (non-replicating T-cell independent antigen) in chickens. Garlic extracts have been found to suppress pro-inflammatory cytokines like IL-2 and elevate inter lukin (IL) -10 and IL-12 in monocytes. Garlic preparations encouraged the macrophageinfiltration and cytokine release. Garlic components boost the immune stimulation by mitogenic activation (e.g. allicin).

Scientists have reported that addition of garlic extract to a macrophage culture of laying hens at 50 μg/mL tended to enhance Sheep red blood cells uptake; on the other hand, high concentration of the extract (200 μg/mL) inhibited phagocytosis. Experiments in humans and mice revealed that addition of aged garlic extract to a culture enhances the phagocytosis of peritoneal cells and increases the production of interleukin (IL)-2, IL-12, interferon-y and tumor necrosis factor-a from spleenocytes , and the addition of different garlic extracts enhances the engulfment ability of phagocytes , as well as the secretory metabolism of macrophages.

2.11 Carcass Characteristics

One of the new imagination in poultry industry is to improve the quality of meat with nutrition modelling. Alteration in the quality of intact muscle is possible by nutrition. Direct addition of antioxidants or feed additives to improve the quality of meat are too effective because these compounds are not deposited in the muscles where these are required and this can be done by adding them in the feed.

To obstruct the oxidative deterioration of meat by free radicals, antioxidants have been extensively used as feed additives. Synthetic antioxidants are extensively used for industrial processing in order to prolong the storage stability of meat. Antioxidants like butylated hydroxyanisole and butylated

hydroxytoluene have been widely rejected by the consumers due to their supposed carcinogenic potential as demonstrated by toxicologists. Rejection to synthetic food additives by the consumer has been increasing in advanced countries. That's why scientists are searching for the natural additives which have the greatest potential of anti-oxidation.

Garlic & basil supplementation has an antioxidant effect that is why lowers the thiobarbituric acid-reactive substance value and might protect lipid oxidation. Garlic has many kinds of antioxidant compounds such as flavonoid and sulfur containing compounds. Besides, Leonarduzzi et al, reported that LDL particles may have significant amount of cholesterol oxidation products. Therefore, the decrease in LDL cholesterol could also mirror the antioxidant effects of garlic supplementation. The anti-oxidative impact of garlic in meat becomes more authoritative in less developed nations, considering storage problems and increasing use of alternative feed resources without due consideration for meat quality. By using garlic as feed additive in broiler ration we can get the bioactive components in meat that directly cannot be consumed by human.

Research examination indicated that pH plays a significant role in the extent of microbial spoilage. Glycogen concentration in muscle is the main factor on which pH relies. If birds are exposed to stress before slaughtering then glycogen is depleted in the muscles. Meat having higher pH, holds more water during storage and will produce more juice after meat preparation. If more juice is produced from the meat then it will give juicier, more succulent and tender eating experience. The pH values of chicken sausage can be increased by the treatment of garlic. The pH of meat of finishing pigs can also be increased by garlic treatment.

CHAPTER III: MATERIALS AND METHODS

3.1 Study Area of the Trial

The study was carried out at the poultry research shed, Department of Animal Science and Nutrition, research laboratories of Chittagong Veterinary and Animal Sciences University (CVASU), Khulshi, Chittagong, Bangladesh.

3.2 Study Epoch

The overall research work was driven from August 2017 to March 2018 where the actual feeding trial on broiler was carried out in between 14th August to 13th September 2017 where August was considered as monsoon seasons (Islam and Uyeda, 2006). In August average maximum temperature was 30 °C and humidity was 76% (BMD, 2017).

3.3 Trial Birds

The day-old chicks (Cobb 500 strain) of mixed sex (male and female) were bought from an agent of the Nahar Agro Complex Limited, Jhoutala Bazar, Khulshi, Chittagong, Bangladesh. Before purchased, all chicks were examined for uniform size and any kind of abnormalities. The average body weight of purchasing chicks was about 46.00±0.01gm.

3.4 Processing of Garlic and Basil

The garlic bulbs were divided into cloves which were chopped into chips and sun dried. Dried garlic chips were stored in an air tight container which was later pounded. Leaves dried basil were also pounded, milled and stored. Powdered basil and garlic were later incorporated in the diets.

3.5 Feeding Grade

Feeding standard followed in the trial was that of Bangladesh standard of specification for poultry feed (2nd Revision, BDS 233: 2003). The birds were provided with dry mash feed throughout the trial period. All the rations were iso-caloric and iso-nitrogenous. Feeds were supplied ad-libitum along with fresh clean drinking water for all the time.

3.6 Experimental Birds and Management

A total of 112 broiler chicks with initial weights of 40-52g acquired from a commercial farm of Chittagong were used in this experiment. The chicken were randomly apportioned to four food treatments groups of 28 chicken each. Each treatment was further sub-divided into 2 replicate of 14 chicken. The chicken were weighed at the beginning of the experiment to obtain their initial body weight and subsequently weekly. Feed and water were supplied adlibitum throughout the experimental period of 4 weeks. The chicken were housed in cages in a completely randomized design. Performance criteria measured include weight gain, feed intake and feed conversion ratio.

3.7 Experimental Design

The experiment was steered out for a period of 28 days where we considered 0 to 14 days as starter and 15 to 28 days as grower. The statistical design used for the experiment was CRD (Completely Randomized Design). In this experiment, total 112 chicks were equally and randomly distributed in four treatment groups (To, T1, T2 and T3) with two replications for each having 28 birds per treatment group and 14 birds per replication. Diet To was the control diet formulated without the inclusion of basil and garlic. 1% garlic, 1% basil, and a mixture of 0.5% basil and 0.5% garlic were formulated for T1, T2 and T3 dietary treatment, respectively. Diets for all treatment groups including control were iso-caloric and iso-nitrogenous both in starter (0-14 days) and grower periods (15-28 days) according to NRC (1994) feeding standard.

Table 1. Layout of the Experiment

Dietary treatments Groups	No. of birds per replicate		No. of birds per treatment
T_0 (Basal diet)	R_1	14	28
	R_2	14	
T_1 (Diet containing 1% garlic)	R_1	14	28
	R_2	14	
T_2 (Diet containing 1% basil)	R_1	14	28
	R_2	14	
T_3 (Diet containing 0.5% garlic + 0.5% basil)	R_1	14	28
	R_2	14	
Grand total			112

3.8 Experimental Diet

Four experimental diets were formulated such that diet 1 contained neither garlic nor basil. Diets 2, 3 and 4 contained 1% garlic, 1% basil & 0.5% garlic + 0.5% basil respectively.

3.9 Statistical Exploration

Data acquired from all the broiler chicken were treated as experimental unit. All chicken from all units will be weighed weekly for weight gain, feed intake and feed conversion. Data related to weight gain, feed intake, FCR and carcass characteristics will be compiled by using MS excel. Data management and data analysis will be done by STATA version-12.1 (STATA Corporation, College Station, Texus).Statistical significance was accepted at $P < 0.05$.

3.10 Work/Activities Plan

Work/Activities	Year 1											
Month	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Literature review												
Broiler chicken collection, rearing												
Laboratory analysis												
Report writing & submission												

3.11 Expected Outcome

The major outcome of the study is to understand the effect of garlic and basil supplement in the broiler chicken ration. Because of no detrimental effect the study result will help the animal nutritionist as well as the farmers to formulate the ration in all season.

3.12 Managemental Procedure of the Trial

3.12.1 Housing

At first, poultry shed was selected and prepared for broiler upbringing. The broiler shed was thoroughly washed and cleaned by using tap water with caustic soda & tincture iodine. For killing microorganism, phenyl solution (according to the manufacturer guideline) was also spread on the floor, corners and ceiling. Following this, brushing was done by using steel brush and clean water. Brooding boxes and broiler cages were also cleaned by using tap water, caustic soda and phenyl solution in the same manner. After cleaning and disinfecting the house was left for one week for drying. All windows were opened for proper ventilation. After one-week, the lime was spread on the floor and around the shed for strictly maintaining bio-security. Arrangement for rearing broilers was made according to treatments and replications. The compartments were selected in an unbiased way, according to treatments and replications for uniform distribution of chicks.

3.12.2 Brooder and Space of Cage

Each box brooder having 2.36 ft. × 2.10 ft. was allocated for 22 birds. After 14 days later broiler birds were transferred to cage having 3.5 ft. × 1.63 ft. for 12 birds. Therefore, floor space for each bird in the brooding box was 0.17 sq. ft. and cage was 0.57 sq. ft. respectively.

3.12.3 Brooding of Chicks

The brooding boxes were ready for broiler chicks upbringing after proper cleaning and drying. Dry and clean newspaper were placed on the floor of the brooding box as bedding materials and was changed for every 4 hours intervals in whole brooding period. Brooding temperature was maintained by using 100, 50 and 25 watt incandescent lamps in each brooding box. The broilers were exposed to continuous lighting. During the brooding period chicks were brooded at a temperature of 95 °F, 90 °F, 85 °F and 80 °F for the 1st, 2nd, 3rd and 4th week respectively.

3.12.4. Feeder and Spaces of Drinker

At the elementary stage of brooding, feed and water were given to birds on paper and small drinker. Feeding and watering were performed by using one small round plastic feeder and one round drinker with a capacity of 1.5 liter in each brooding box. Three drinkers were given as far one drinker for ten birds. The feeders and drinker were fixed in such a way so that the birds could eat and drink conveniently. After 7th day small round feeder was replaced by small liner feeder (2.21 ft. × 0.25 ft.) in each brooding box. During the period of cage rearing large liner feeder (3.5 ft. × 0.38 ft.) and large round drinker with a capacity of three litters was used for feeding and drinking.

3.12.5 Feed Formulation and Feeding the Birds

The birds were provided mash feed. Mash feed was equipped manually from raw feed ingredients, which was collected from retail and wholesale market. Four types of ration were used for two phases such as broiler starter for To (Control), T1 (1% garlic), T2 (1% basil), T3 (0.5% basil and 0.5% Garlic) and broiler grower for To (Control), T1 (1% garlic), T2 (1% basil) T3 (0.5% basil and 0.5% Garlic). Rations were formulated according to the requirement of birds (For broiler starter: ME=3050 kcl/kg, CP=21.80%, Ca=1% and P=0.5% and for broiler grower: ME=3150 kcl/kg, CP=21.20%, Ca=0.9% and P=0.45%.

Table 2. Feed ingredients used in experimental broiler diets (starter phase)

Ingredients (Kg/100kg)	Starter ration (0-14 days)			
	T_0	T_1	T_2	T_3
Maize	56	55.5	56	56
Rice polish	8.0	7.5	7.5	7.5
Soybean oil	2.5	2	2	2
Soybean meal	22	23.5	23	23
Protein concentrate(Provimi^R)	5.75	4.75	4.75	4.75
Fishmeal	4	4	4	4
Dicalcium phosphate	0.5	0.5	0.5	0.5
Basil	0	0	1	0
Garlic	0	1	0	0
Basil and garlic	0	0	0	1(0.5 basil+0 .5 garlic)
Methionine	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Vit-mineral premix(Compfeed-B^R)	0.25	0.25	0.25	0.25
Toxin binder (Vtox-XL^R)	0.25	0.25	0.25	0.25
Enzyme(Cbt-XL^R)	0.25	0.25	0.25	0.25
Total	100	100	100	100

In table 2, T_0 = Control diet T_1 = Experimental diet with 1% garlic, T_2 = Experimental diet with 1% basil, T_3= Experimental diet with 0.5% basil and 0.5% garlic Vitamin Mineral Premix in Rations that mentioned in table 3.2: contains following ingredients per kg diet: Vitamin A = 5200 IU, Vitamin D_3 = 1000 IU, Vitamin K = 1.8 mg, Vitamin B_1 = 1.5 mg, Vitamin B_2 = 2.5mg, Vitamin B_3 = 15 mg, Vitamin B_6 =1.6 mg, Vitamin B_9 = 300 µg, Vitamin B_{12} = 5.8 µg, H = 30 mg, Cu = 4 mg, Mn = 50 mg, Zn = 30 mg, Fe= 2.4 mg, I = 160 µg.

Table 3. Estimated nutritional composition (DM basis) of the experimental broiler starter diets

Traits	Calculated value (%)			
	T0	**T1**	**T2**	**T3**
ME (kcl/kg)	3043.28	3009.55	3008.25	3008.25
Crude Protein (CP)	21.75	21.46	21.50	21.50
Crude Fiber (CF)	3.98	3.94	3.95	3.95
Ether Extract (EE)	5.20	5.18	5.19	5.19
Calcium (Ca)	0.87	0.86	0.86	0.86
Phosphorus (P)	0.83	0.83	0.83	0.83

N.B: In table 3, T0 = Control diet T1 = Experimental diet with 1% garlic, T2 = Experimental diet with 1% basil, T3= Experimental diet with 0.5% basil and 0.5% garlic.

Table 4. Proximate composition of the experimental broiler diets (starter phase)

Proximate value (%)				
Traits	**T_0**	**T_1**	**T_2**	**T_3**
Dry Matter (DM)	87.3	87.35	88.1	88.1
Crude Protein (CP)	21.7	21.6	21.53	21.35
Crude Fiber (CF)	3.40	3.25	3.70	3.65
Ether Extract (EE)	3.95	4.20	4.07	4.69
Ash	5.85	5.90	6.53	6.39
Nitrogen Free Extract (NFE)	52.63	52.52	52.09	51.85

N.B: In table 4, T0 = Control diet T1 = Experimental diet with 1% garlic, T2 = Experimental diet with 1% basil, T3= Experimental diet with 0.5% basil and 0.5% garlic

Table 5. Feed ingredients used in experimental broiler diets (grower phase)

Ingredients(kg/100gm)	Grower ration (15-28days)			
	T_0	T_1	T_2	T_3
Maize	57	57.5	57.5	57.5
Rice polish	8.5	7.5	7.5	7.5
Soybean oil	2.75	2.5	2.5	2.5
Soybean meal	22	21.5	21.5	21.5
Protein concentrate(Provimi)	4.5	4.75	4.75	4.75
Fishmeal	3.5	3.5	3.5	3.5
Dicalcium phosphate	0.5	0.5	0.5	0.5
Basil	0	0	1	0
Garlic	0	1	0	0
Basil and garlic	0	0	0	1(0.5+0.5)
Methionine	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Vit-mineral premix (Compfeed-B^R)	0.25	0.25	0.25	0.25
Toxin binder (Vtox-XL^R)	0.25	0.25	0.25	0.25
Enzyme (Cbt-XL^R)	0.25	0.25	0.25	0.25
Total	100	100	100	100

In table 5, T_0 = Control diet T_1 = Experimental diet with 1% garlic, T_2 = Experimental diet with 1% basil, T_3= Experimental diet with 0.5%basil and 0.5% garlic Vitamin Mineral Premix in Rations that mentioned in table 3.5: contains following ingredients per kg diet: Vitamin A = 4500 IU, Vitamin D_3 =1500 IU, Vitamin K = 1.8 mg, Vitamin B_1 = 1.2 mg, Vitamin B_2 = 2.5mg, Vitamin B_3 = 20 mg, Vitamin B_6 = 1.8 mg, Vitamin B_9 = 420 µg.

Table 6. Estimated nutritional composition (DM basis) of the experimental broiler grower diets

Traits	Calculated value (%)			
	T_0	T_1	T_2	T_3
ME (kcl/kg)	3088.08	3054.09	3054.09	3054.09
Crude Protein (CP)	20.85	20.74	20.74	20.74
Crude Fiber (CF)	3.92	3.89	3.89	3.89
Ether Extract (EE)	6.43	6.33	6.33	6.33
Calcium (Ca)	0.88	0.88	0.88	0.88
Phosphorus (P)	0.77	0.72	0.72	0.72

N.B: In table 6, T_0 = Control diet T_1 = Experimental diet with 1% garlic, T_2 = Experimental diet with 1% basil, T_3= Experimental diet with 0.5% basil and 0.5% garlic

Table 7. Proximate composition of the experimental broiler grower iets

Diets	Proximate value (%)			
	T_0	T_1	T_2	T_3
Dry Matter (DM)	88.68	88.32	89.12	88.52
Crude Protein (CP)	18.50	17.64	17.92	18.11
Crude Fiber (CF)	4.08	3.96	4.32	3.81
Ether Extract (EE)	7.44	7.95	8.04	7.66
Ash	6.82	6.72	7.58	7.22
Nitrogen Free Extract (NFE)	47.63	52.03	51.24	51.83

N.B: In table 7, T_0 = Control diet T_1 = Experimental diet with 1% garlic, T_2 = Experimental diet with 1% basil, T_3= Experimental diet with 0.5% basil and 0.5% garlic

3.13.1 Feed Conversion Ratio (FCR)

The amount of feed intake per unit of weight gain is the feed conversion (FC) and the resulting ratio between them was measured as FCR.

3.13.2 Body Weight Gain

The body weight gain was measured by deducting initial body weight from the final body weight of the birds.
Body weight gain = Final body weight - Initial body weight

3.14 Chemical analysis of basil and garlic containing formulated feed

After operating of basil and garlic about 200 gm sample was collected for chemical analysis. After chemical analysis the rations were formulated as needed as experiment. After formulation of diets about 200 gm of sample (two samples) from each diet was taken for chemical analysis. These laboratory works were done before the arrival of DOC in poultry shed.
The experimental samples were also subjected for proximate analysis for moisture, crude protein (CP), dry matter (DM), crude fiber (CF), ether extracts (EE), total ash and insoluble ash in the Animal Nutrition laboratory, Chittagong Veterinary and Animal Sciences University, Chittagong, Bangladesh in accordance with standard methods described by the AOAC (2006).

3.15 Collection of blood and serum sample

On the day 28, four birds were elected from each replication randomly for collection of blood. About 3.0 ml of blood was collected from each bird by sterile syringe and put those syringe in refrigerator vertically. After 6 hours serum was collected in sterile plastic vial to estimate serum parameters.

Table 8. Proximate Composition of Basil Leaf

Traits	Proximate value (%)
Moisture	8.62
Crude Protein (CP)	9.58
Dietary Fiber (CF)	39.82
Ether Extract (EE)	0.85
Ash	0.25
Nitrogen Free Extract (NFE)	13.67

Table 9. Proximate composition of Garlic

Traits	Proximate value (%)
Dry Matter (DM)	21.42
Crude Protein (CP)	3.21
Crude Fiber (CF)	1.97
Ether Extract (EE)	0.51
Ash	2.31
Nitrogen Free Extract (NFE)	13.42

3.16 Blood Parameter Estimation

Blood was collected without anticoagulant from a total 6 birds from each group (2 birds from each replicate) at 28th days of age of broilers. Serum was separated after centrifugation at 3,000 rpm for 15 minutes. Different blood parameters (cholesterol, glucose, triglyceride, LDL and HDL were measured in the post graduate laboratory under the department of Physiology, Biochemistry and Pharmacology, CVASU using standard kits (BioMereux, France) and automatic analyzer (Humalyzer 300, Merck®, Germany) according to the manufacturer's instruction (FVMAAU; Addis Ababa, Ethiopia).

3.17 Statistical Analysis

All the data of live weight, weight gain, feed consumption and feed conversion etc., related to carcass parameters, blood parameters and chemical analysis of meat were entered into MS excel (Microsoft office excel-2007, USA). Data were compared among the groups by one way ANOVA in STATA version-12.1 (STATA Corporation, College Station, Texas) and subsequent Duncan's Multiple Range Tests (DMRT). Results were expressed as means and SEM. All P values of ≤ 0.05 and ≤ 0.01 were considered significant and highly significant, respectively.

Chapter IV: Results

The experiment was performed to examine the effect of basil and garlic on the performance parameter and carcass characteristics of Cobb500 broilers. The results achieved from the study have been described in this chapter.

4.1 Body weight gain per week

Table no 10 represented that, significant difference (P<0.01) in weight gain of broilers among experimental dietary treatment groups were observed at 1st and 2nd weeks of age. From 3rd to 4th weeks of age, in live weight gain of broilers among dietary treatment groups were not significant (P>0.05).

Table 10. Weekly body weight gain of broilers of different dietary treatment (gm/broiler)

Age of	Dietary treatments				SEM	P value
Bird	**T_0**	**T_1**	**T_2**	**T_3**		
1st week	71.7	84.0	**85.0**	77.4	0.42	0.00
2nd week	155.9	151.2	170.6	185.3	02.06	0.00
3rd week	281.4	294.6	301.7	285.8	05.06	0.45
4th week	440.0	501.0	468.0	**514.0**	12.76	0.12

T_0 = control feed; T_1 = feed contain 1% garlic; T_2 = feed contain 1% basil; T_3 = feed contain 0.5% basil & 0.5%garlic; SEM =Standard Error of Mean; Significant ($p \leq 0.05$);

4.1 Feed Expenditure

Table no 11 showed that the momentous difference (P<0.05) in feed consumption of broiler in different groups were executed at 1st and 2nd week of age. At 3rd to 4th week of age, there was no significant difference (P>0.05) in feed consumption of broiler in different treatment groups.

Table 11. Weekly feed intake of broilers among different treatment groups (gm/broiler)

Age of bird	Dietary treatments				SEM	P value
	T_0	T_1	T_2	T_3		
1st week	76.7	72.6	77.5	74.8	0.72	0.00
2nd week	207.0	203.9	211.2	217.8	1.97	0.00
3rd week	405.5	411.5	413.0	387.3	5.80	0.46
4th week	750.5	813.0	778.0	822.0	12.99	0.16

T_0 = control feed; T_1 = feed contain 1% garlic; T_2 = feed contain 1% basil; T_3 = feed contain 0.5% basil & 0.5% garlic; SEM =Standard Error of Mean; Significant ($p \leq 0.05$),

4.3 FCR

In 1st and 2nd weeks of age, weekly feed conversion ratio (FCR) of broilers among different dietary treatment groups were statistically significant ($P<0.05$). At 3rd to 4th week of age, there was no significant difference ($P>0.05$).

Table 12. Weekly feed conversion of broilers among different dietary treatment groups

Age of Bird	Dietary treatments				SEM	P value
	T_0	T_1	T_2	T_3		
1st week	1.0	0.8	0.9	0.9	0.88	0.00
2nd week	1.3	1.3	1.2	1.1	1.20	0.00
3rd week	1.4	1.3	1.3	1.3	1.35	0.06
4th week	1.7	1.6	1.6	1.5	1.60	0.09

T_0 = control feed; T_1 = feed contain 1% garlic; T_2 = feed contain 1% basil; T_3 = feed contain 0.5% basil & 0.5% garlic; SEM =Standard Error of Mean; Significant ($p \leq 0.05$),

4.2 Effect of different diets on carcass quality of broilers

No meaningful differences (P>0.05) were observed in weight of drumstick, thigh, breast, wing, neck, leg and head (table 4.4). Control group showed lower weight than other three groups. Significant differences (P≤0.05) were observed in weight of back in different dietary treatment groups. Internal edible parts did not show significant result (p>0.5) in different dietary treatments among the control T_0 and garlic and basil containing T_1, T_2 and T_3 groups.

Table 13. Weight percentage of primal parts and internal edible organs of broilers at 28 days of age (%)

Traits (%)	Treatments				SEM	P value
	T_0	T_1	T_2	T_3		
Primal Parts						
Drumstick	8.2	8.6	8.3	8.7	0.13	0.74
Thigh	18.0	18.9	17.5	18.9	0.30	0.27
Breast	14.9	16.3	16.5	18.4	0.58	0.18
Back	11.2	12.1	11.4	13.1	0.30	0.06
Neck	4.3	3.4	3.5	3.9	0.21	0.51
Wing	5.7	6.1	5.6	5.3	0.22	0.80
Leg	4.9	4.2	4.5	4.6	0.16	0.63
Head	2.3	2.0	2.4	3.1	0.08	0.57
Internal Edible Organ						
Liver	2.6	2.4	2.4	3.1	0.23	0.81
Heart	0.4	0.4	0.6	0.4	0.03	0.32
Gizzard	2.9	2.8	3.2	3.0	0.10	0.52
Abdominal fat	2.0	1.6	2.2	2.0	0.11	0.34
Neck region fat	0.9	0.7	1.0	0.7	0.14	0.91

T_0 = control feed; T_1 = feed contain 1% garlic; T_2 = feed contain 1% basil; T_3 = feed contain 0.5% basil & 0.5% garlic; SEM =Standard Error of Mean; Significant (p≤0.05);

4.3 Effect of different diets on blood parameters of broilers

Table no 14 represent that, there is no significant difference among the different serum constituents level of broilers at 28 days of age.

Table 14. Different serum components level of broilers at 28 days of age

Parameter	Serum constituents level (mg/dl)				SEM	P value
	T_0	T_1	T_2	T_3		
Cholesterol	96.2	85.8	90.4	93.8	3.80	0.86
Glucose	128.2	96.3	112.4	91.4	7.60	0.37
Triglyceride	71.0	87.5	99.7	65.8	10.20	0.73
LDL	179.1	163.1	171.1	152.3	6.60	0.63
HDL	96.0	77.6	99.3	81.7	5.10	0.44

T_0 = control feed; T_1 = feed contain 1% garlic; T_2 = feed contain 1% basil; T_3 = feed contain 0.5% basil & 0.5% garlic; SEM =Standard Error of Mean; Significant ($p \leq 0.05$),

Chapter V: Discussion

Favourable effects of bioactive plant substances in animal nutrition may include the stimulation of appetite and feed intake, the improvement of endogenous digestive enzyme sexcretion, activation of immune responses and antibacterial, antiviral and antioxidant actions. Thus, all the nutrients are directed toward growth promotion resulting in enhanced growth performance. The findings of the current work reported a significant ($p<0.05$) positive effect on average body weight gain by the supplementation of graded levels of the GP and HBLP either alone or in their combinations in commercial broilers at 2, 4 weeks of age.

The improvement in weight gain of the bird using garlic in their rations may probably be due to the fact that allicin (an antibiotic substance found in garlic), inhibits growth of intestinal bacteria such as *Staphylococcus aureus* and *Escherichia coli* and inhibit aflatoxins producing fungi. Resultantly, when the load of these bacteria in the intestine is low, birds may absorb more nutrients, leading to the improvement in weight gain of the birds using rations supplemented with *Allium sativum*. The basil plant possessing antioxidant properties results in increase in the digestive enzymes and decrease in bacterial activities and thus leading to muscle weight gain in broiler chicks.

Even the improvement in live body weight in broilers may be due to antibacterial effects related to garlic derivative propylpropane thiosulfonate (PTSO) that led to modulation of normal intestinal microflora by competitive exclusion and antagonism and thus improved nutrients digestibility in growing broilers. The present investigation revealed that broilers supplemented with GP and HBLP at various levels andin their combinations led to utilization of their feed more efficiently than the birds fed ration without addition. The antibacterial properties of these herbal supplements resulted in better absorption of the nutrients present in the gut, finally leading to improved FCR.

It can thus be concluded that there was significant positive effect on the average body weight and subsequent enhanced FCR due to supplementation of the diet with herbal products, GP and HBLP either individually or in combinations in the commercial broiler strains. Several studies have shown that the essential oils and biologically active compounds in fresh leaves of *O. sanctum* are effective against bacteria such as *E. coli*, *Shigella spp.* Salmonella *typhi*, and *Pseudomonas aeruginosa*. The antimicrobial action of essential oils in *O. sanctum* (Linn.) is attributed to monoterpene components which are mostly phenolic in nature.

They exert membrane damaging effects to microbial strains and stimulate leakage of cellular potassium which is responsible for a lethal action related to cytoplasmic membrane damage.

Immunostimulant potential of 'Tulsi' is helpful in the treatment of immunosuppression. It shows its immunomodulatory effect by increase in interferon-γ, interleukin-4, T-helper cells, NK cells thus reducing total bacterial count, increasing neutrophil and lymphocyte count and enhancing phagocytic activity and phagocytic index. Oil from 'Tulsi' seed can mediate GABAergic pathways and by this it can modulate both humoral and cell-mediated immunity. Antimicrobial effects of basil essential oil could also be owed to the higher concentrations of linalool and eugenol. Another study revealed that the ethanol and methanol extracts of *O. sanctum* had the ability to inhibit the growth of all test bacteria including *E. coli* and *P. aeruginosa*. Herbs can influence selectively the microorganism by an antimicrobial activity thus favors better nutrient utilization and absorption or the stimulation of the immune system.

5.1 Feed consumption

The treatment which was containing garlic & basil in diet tend to lower feed intake in contrary of garlic containing diet, though they had significant result between the groups. Goodrazi *et al*, (2014), reported that daily feed intake increased in case of 1% garlic/kg feed of diet. His report supports first two weeks of age of broiler because significant result was found at that period. The feed intake in this study tended to be higher in the chicks fed on solely mixture of garlic compared with control, basil, basil and garlic mixture group, but the differences were not statistically significant. These results were agreed with the finding of (Bamidele and Adejumo, (2012), who reported that the mixture of garlic 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 no significant effect of dietary garlic on the feed intake of broiler chicks.

Like- wise EL-tazi, (2014), indicated that the diet supplemented with garlic powder had significantly better feed intake compared to the control diet but these study indicates significant feed take was only found first two weeks of age of birds and no significationin 3rd to 4th weeks of age. Javandel et al, (2008), who reported that feed consumption was significantly higher in birds fed diets with lower concentration of garlic 0.125 and 0.25% compared to higher level 0.5, 1 and 2%. No significant result in 3rd, 4th weeks between the treatment groups is also supported with the findings of Dieumou et al, (2009), Amouzmehr et al, (2013), who showed no significant effect of garlic supplements on the feed intake.

5.2 FCR

The weekly feed conversion at different ages in different dietary supplementation level improved the feed conversion of Cobb 500 broiler strain. Though the significant result was found at the 1^{st} and 2^{nd} of age. Significant results were also found at 3^{rd} and 4^{th} weeks of age at $p \leq 0.05$ level in different dietary treatments. The result of this experiment was not supported by Goodrazi *et al,* (2014), study's. He revealed that broiler receiving 1% garlic in feed had higher significant effect to the broiler chicken. His study partially supports to the current experiment where significant result was found only in first two weeks of age.The insignificant result of different dietary treatments in 3^{rd}, 4^{th}, weeks also supports the findings of Aji *et al*, (2011), Mansoub and Nezhady *et al,* (2011), who have reported non-significant result of dietary garlic on FCR. Raeesi *et al,* (2010), reported that, 1% basil in supplementation lower the feed conversion ratio. He was also revealed that 3% garlic had better FCR than control group. In his experiment control group consumed more feed than other groups. Eglabiet *et al*, (2013), also report that feed conversion ratio was significantly lower in birds fed diet supplemented with 3% garlic.

5.3 Carcass Quality

Birds who received basil and garlic at 1% level did not show significant results in to primal and internal parts of the body. This study supports Kim *et al*, (2015), reported that the carcass traits and other edible parts dietary treatment containing basil and garlic had no significant effect. Aji *et al*, (2011), also replied that no significant effect was found in carcass yield obtained from broiler fed of basil and garlic. The results of this experiment is in line with Lydia *et al*, (2001), who reported that there were no significant differences on carcass percentage and organ weight of birds fed varying levels of garlic. Treatment effect in this study was not significant on carcass dressing percentage. These results are in agreement 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 did not have any significant effect on carcass dressing percentage of broiler chicks.

5.4 Blood Parameters

The study transpired that the garlic containing dietary treatments (T_1 and T_3) had no significant effect on reduction of blood cholesterol level. But a lots of scholar indicated that garlic is a good source of reducing cholesterol in blood. The study also revealed that basil and garlic had no effect on blood glucose. No significant result found on blood triglycerides during this study. Non significant results in LDL and HDL to blood level also indicates that onion and garlic had no effect on them. This study did not support Onyimonyi, (2011), who reported that using of 0.75% garlic results least serum cholesterol 76.30 mg/dl. In a study supplemented of 2% garlic in diet reduced 24.2% total cholesterol in the blood of white meat Stanaćev *et al, (*2012). Manan *et al,* (2012), reported that feeding garlic at two days interval may improves plasma lipid profile which is also supports this study. The study did not support Goodrazi, (2013), who reported that use of onion in diet reduced the level glucose in blood. He mentioned hypoglycemia stimulates nervous system higher feed intake. Garlic contains sulphar containing compunds likeS-Methylcysteine sulfoxide and Sallylcysteine suiloxide.

Conclusion

Garlic is king of medicinal plants and it has excellent effects in poultry. The garlic supplementation of poultry feed has shown better performance of birds, ultimately enhancing the production potential. Additionally, garlic reduces the number of pathogenic bacteria like Campylobacter, *E. coli* and Salmonella, clostridium, etc. It has beneficial effects on consumer's immunity. So, it can be effectively used to replace the antibiotic growth promoter in poultry feed. Although, there is huge pile of research literature in this area, but still there is a need to establish standards of garlic use in poultry feed. To fulfill this purpose more research is needed in this economics friendly supplement.

Recommendations

Although it was a experimental study, further studies may be directed on similar field to make a substantive remark. However, according to this experimental work, the following recommendations may be done:

- Basil and garlic percentage in feed can be increased (Instead of using 1% basil and garlic in diet).
- The ratio of basil and garlic mixture can be changed and recombined (Instead of basil : garlic = 0.5 : 0.5).

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