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

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| Session:2016-2017 |

**A thesis submitted in partial fulfillment of the requirements for the degree of**

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**Department of Animal Science and Nutrition**

 **Faculty of Veterinary Medicine**

**Chittagong Veterinary and Animal Sciences University**

 **Chittagong-4225, Bangladesh**

**June 2018**

**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 foundthat the thesis is complete and satisfactory in all respects and that all revisions required bythe thesis examination committee have been made.**

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| **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_****(Dr. Gautam Buddha Das)**ProfessorDepartment of Animal Science and Nutrition**Supervisor** |
| **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_****Dr. Md. Manirul Islam**Professor and HeadDepartment of Animal Science and Nutrition**Chairman of the Examination Committee****Department of Animal Science and Nutrition****Faculty of Veterinary Medicine****Chittagong Veterinary and Animal Sciences University****Khulshi, Chittagong-4225, Bangladesh****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).Secondly, I am obliged to my supervisor **ProfDr. Gautam Buddha Das**, Department of Animal Science and Nutrition, Honorable Vice Chancellor of CVASU for his worthy inspection and guidance. It was really aeminent delight and prodigious experience for me to work under his supervision. I really deemed it and I realized it was a rare opportunity for me to work under his creative guidance. I understand it was impossible to complete the dissertation without his constructive supervision.It’s my pleasure to convey my profound gratitude to **Dr.MuktiBarua**, Assistant Professor, Department of Animal Science and Nutrition, CVASU for her valuable counsel, scholastic guidance, exhortation and motivation. It is my privilege to acknowledge **Md. Manirul Islam**, Professor and Head, Department of Animal Science and Nutrition, CVASU for his support, valuable advice and encouragement for the research work. I thanks to all the members of the department of Physiology, Biochemistry and Pharmacology and Animal Science and Nutrition for their help in using their laboratory.Last but not least, I outright my deepest sense of gratitude to my beloved family members and my friends for their sacrifice, blessings and encouragement. **The Author** **June 2018** |

**ABSTRACT**

Thestudy was conducted to the effectsofherbal products (Garlic & Basil)supplementationon growth performance, carcasscharacteristicsandserum biochemical parameter in commercialbroiler.

A total of 112 day old cobb500 chicks were randomly divided into four dietary treatments:i.e. food containing no herbal products (T0), food containing 1% garlic (T1), food containing 1% basil (T2), food containing 0.5% garlic & 0.5% basil (T3).Each treatmentconsistsinto tworeplicationhaving 14birdsper replicate.

Itwasevidentthat,therewasapositiverelationshipbetween herbal productsandperformance parameters at later stage.Maximumweightgain& feed intakewasrecordedinthebird’stake foodcontaining 0.5% garlic& 0.5% basil after 4th week of age.Therewere nounusualchangesinthe blood and serum parameterincomparisontothereferencelevel.

***Keywords*:**Herbal products, feedintake, weight gain,feed conversion ratio, carcasscharacteristics, 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](http://www.european-poultry-science.com/The-use-of-natural-feed-additives-as-alternative-to-an-antibiotic-growth-promoter-in-broiler-diets%2CQUlEPTQyMTYwODkmTUlEPTE2MTAxNA.html#Hertrampf_2001); Humphrey et al, 2002). Many scientists searched for alternatives to antibiotic growth promoters ([Langhout, 2000](http://www.european-poultry-science.com/The-use-of-natural-feed-additives-as-alternative-to-an-antibiotic-growth-promoter-in-broiler-diets%2CQUlEPTQyMTYwODkmTUlEPTE2MTAxNA.html#Langhout_2000); [Mellor, 2000](http://www.european-poultry-science.com/The-use-of-natural-feed-additives-as-alternative-to-an-antibiotic-growth-promoter-in-broiler-diets%2CQUlEPTQyMTYwODkmTUlEPTE2MTAxNA.html#Mellor_2000); [Wenk, 2000](http://www.european-poultry-science.com/The-use-of-natural-feed-additives-as-alternative-to-an-antibiotic-growth-promoter-in-broiler-diets%2CQUlEPTQyMTYwODkmTUlEPTE2MTAxNA.html#Wenk_2000); [Kamel, 2001](http://www.european-poultry-science.com/The-use-of-natural-feed-additives-as-alternative-to-an-antibiotic-growth-promoter-in-broiler-diets%2CQUlEPTQyMTYwODkmTUlEPTE2MTAxNA.html#Kamel_2001)).

The feed manufacturers are adopting new forms of natural feed additives that are the products of modern science ([Wezyk et al, 2000](http://www.european-poultry-science.com/The-use-of-natural-feed-additives-as-alternative-to-an-antibiotic-growth-promoter-in-broiler-diets%2CQUlEPTQyMTYwODkmTUlEPTE2MTAxNA.html#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](http://www.european-poultry-science.com/The-use-of-natural-feed-additives-as-alternative-to-an-antibiotic-growth-promoter-in-broiler-diets%2CQUlEPTQyMTYwODkmTUlEPTE2MTAxNA.html#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, cardioprotectiveetc([Guo et al,2000](http://www.european-poultry-science.com/The-use-of-natural-feed-additives-as-alternative-to-an-antibiotic-growth-promoter-in-broiler-diets%2CQUlEPTQyMTYwODkmTUlEPTE2MTAxNA.html#Guo_et_al__%282000)) 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](http://www.european-poultry-science.com/The-use-of-natural-feed-additives-as-alternative-to-an-antibiotic-growth-promoter-in-broiler-diets%2CQUlEPTQyMTYwODkmTUlEPTE2MTAxNA.html#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 andnitrofurans have been found to possesbacteriostatic 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 theuse 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 (*Alliumsativum*)& basil (*Ocimumsanctum*) 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**

1. Evaluating the upshot of garlic and basil supplementation on growth performance of broiler chicken.
2. 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 (*Alliumsativum*) 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 *Escherichiacoli*, *Salmonella*,*Clostridium*, *Staphylococcusaureus, Pseudomonas, Proteus, Klebsiella,Micrococcus, Bacillussubtulis*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 *Opalinaranarum,Entamoebahistolytica, Balantidiumentozoon, O. dimidicita, Trypanosomes, Leishmania,* and *Leptomonas*. Diallyltrisulfide 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 *Trichomonasvaginalis*and *Entamoebahistolytica.*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 diallyltrisulfideagainst cryptococcal meningitisand 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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**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 *Salmonellaenteritidis, Pasteurellamultocida and Leptospirapomona*bacteria, which indicate that it increase the activity of B lymphocytes.

Alliums at low levels in the diet improved the humoral immune response against *Brucellaabortus*(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 butylatedhydroxyanisole and butylatedhydroxytoluene 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 theNahar 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.

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**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 adlibitumthroughout 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 treatmentsGroups | No. of birds per replicate | No. of birds per treatment |
| T0 (Basal diet) | R1 | 14 | 28 |
| R2 | 14 |
| T1 (Diet containing 1% garlic) | R1 | 14 | 28 |
| R2 | 14 |
| T2 (Diet containing 1% basil) | R1 | 14 | 28 |
| R2 | 14 |
| T3 (Diet containing 0.5% garlic + 0.5% basil) | R1 | 14 | 28 |
| R2 | 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 chicksupbringing 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. Feedingredientsused inexperimentalbroilerdiets(starterphase)

**Ingredients**

**Starterration(0-14 days)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **(Kg/100kg)** | **T0** | **T1** | **T2** | **T3** |
| Maize | 56 | 55.5 | 56 | 56 |
| Ricepolish | 8.0 | 7.5 | 7.5 | 7.5 |
| Soybean oil | 2.5 | 2 | 2 | 2 |
| Soybean meal | 22 | 23.5 | 23 | 23 |
| Proteinconcentrate(ProvimiR) | 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 |
| Basilandgarlic | 0 | 0 | 0 | 1(0.5 basil+0 |
|  |  |  |  | .5garlic) |
| Methionine | 0.25 | 0.25 | 0.25 | 0.25 |
| Lysine | 0.25 | 0.25 | 0.25 | 0.25 |
| Vit-mineralpremix(Compfeed-BR) | 0.25 | 0.25 | 0.25 | 0.25 |
| Toxin binder(Vtox-XLR) | 0.25 | 0.25 | 0.25 | 0.25 |
| Enzyme(Cbt-XLR) | 0.25 | 0.25 | 0.25 | 0.25 |
| Total | 100 | 100 | 100 | 100 |

Intable2,T0= Control diet T1= Experimentaldietwith 1%garlic,T2= Experimental dietwith1% basil,

T3= Experimentaldietwith0.5%basil and0.5%garlic VitaminMineral PremixinRationsthatmentionedintable3.2:containsfollowingingredientsperkgdiet:VitaminA=5200IU,VitaminD3=1000IU,VitaminK=1.8mg,Vitamin B1=1.5mg,VitaminB2=2.5mg,VitaminB3=15mg,VitaminB6=1.6mg,Vitamin B9=300µg,VitaminB12=5.8µg, H=30mg,Cu =4mg,Mn=50mg,Zn =30mg,Fe=2.4mg,I=160µg.

## Table3.Estimatednutritionalcomposition(DMbasis)oftheexperimentalbroilerstarter diets

**Traits Calculated value(%)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **T0** | **T1** | **T2** | **T3** |
| ME (kcl/kg) | 3043.28 | 3009.55 | 3008.25 | 3008.25 |
| CrudeProtein(CP) | 21.75 | 21.46 | 21.50 | 21.50 |
| CrudeFiber(CF) | 3.98 | 3.94 | 3.95 | 3.95 |
| EtherExtract(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:**Intable3, T0=ControldietT1=Experimentaldietwith1%garlic, T2=Experimentaldietwith 1%basil,T3=Experimentaldietwith0.5%basil and0.5%garlic.

## Table 4. Proximatecompositionofthe experimentalbroiler diets(starter phase)Proximatevalue(%)

 **Traits**

|  |  |  |  |
| --- | --- | --- | --- |
| **T0** | **T1** | **T2** | **T3** |
| 87.3 | 87.35 | 88.1 | 88.1 |
| 21.7 | 21.6 | 21.53 | 21.35 |
| 3.40 | 3.25 | 3.70 | 3.65 |
| 3.95 | 4.20 | 4.07 | 4.69 |
| 5.85 | 5.90 | 6.53 | 6.39 |
| 52.63 | 52.52 | 52.09 | 51.85 |
|  |  |  |  |
|  |  |  |  |

DryMatter (DM)

CrudeProtein (CP)

CrudeFiber (CF)

EtherExtract (EE)

Ash

Nitrogen Free

Extract(NFE)

**N.B:**Intable4, T0=ControldietT1=Experimentaldietwith1%garlic, T2=Experimentaldietwith 1%basil,T3=Experimentaldietwith0.5%basiland0.5%garlic

**Table 5. Feedingredientsused inexperimentalbroilerdiets(growerphase)**

|  |
| --- |
| **Ingredients(kg/100gm) Growerration(15-28days)** |
|  | **T0** | **T1** | **T2** | **T3** |
| Maize | 57 | 57.5 | 57.5 | 57.5 |
| Ricepolish | 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 |
| Proteinconcentrate(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 |
| Basilandgarlic | 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-BR) | 0.25 | 0.25 | 0.25 | 0.25 |
| Toxin binder(Vtox-XLR) | 0.25 | 0.25 | 0.25 | 0.25 |
| Enzyme (Cbt-XLR) | 0.25 | 0.25 | 0.25 | 0.25 |
| Total | 100 | 100 | 100 | 100 |

Intable5,T0= Controldiet T1= Experimentaldietwith 1%garlic,T2= Experimental dietwith1% basil,T3=Experimentaldiet with 0.5%basiland 0.5% garlic Vitamin Mineral Premixin Rationsthatmentionedintable3.5:containsfollowingingredientsperkgdiet:VitaminA=4500IU,VitaminD3=1500IU,VitaminK=1.8mg,Vitamin B1=1.2mg,VitaminB2=2.5mg,VitaminB3=20mg,VitaminB6=1.8mg,Vitamin B9=420µg.

## Table6.Estimatednutritionalcomposition(DMbasis)oftheexperimentalbroilergrower diets

**Traits Calculated value(%)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **T0** | **T1** | **T2** | **T3** |
| ME (kcl/kg) | 3088.08 | 3054.09 | 3054.09 | 3054.09 |
| CrudeProtein(CP) | 20.85 | 20.74 | 20.74 | 20.74 |
| CrudeFiber(CF) | 3.92 | 3.89 | 3.89 | 3.89 |
| EtherExtract(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:**Intable6, T0=ControldietT1=Experimentaldietwith1%garlic, T2=Experimentaldietwith 1%basil,T3=Experimentaldietwith0.5%basiland0.5%garlic

## Table 7. Proximatecompositionofthe experimentalbroiler groweriets Diets Proximate value(%)

|  |  |  |  |
| --- | --- | --- | --- |
| **T0** | **T1** | **T2** | **T3** |
| 88.68 | 88.32 | 89.12 | 88.52 |
| 18.50 | 17.64 | 17.92 | 18.11 |
| 4.08 | 3.96 | 4.32 | 3.81 |
| 7.44 | 7.95 | 8.04 | 7.66 |
| 6.82 | 6.72 | 7.58 | 7.22 |
| 47.63 | 52.03 | 51.24 | 51.83 |

DryMatter(DM)

CrudeProtein (CP)

CrudeFiber (CF)

EtherExtract (EE)

Ash

NitrogenFree

Extract(NFE)

**N.B:**Intable7, T0=ControldietT1=Experimentaldietwith1%garlic, T2=Experimentaldietwith 1%basil,T3=Experimentaldietwith0.5%basiland0.5%garlic

## 3.13.1 FeedConversionRatio(FCR)

Theamountoffeedintakeperunitofweightgainisthefeedconversion(FC)andtheresulting 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

## Chemical analysis ofbasil and garlic containingformulatedfeed

Afteroperatingofbasilandgarlicabout200gmsamplewascollectedforchemicalanalysis.Afterchemicalanalysistherationswereformulatedasneededasexperiment.Afterformulationofdietsabout200gmofsample(twosamples)fromeachdietwastakenforchemicalanalysis.Theselaboratory worksweredonebeforethearrivalof DOCin poultryshed.

Theexperimentalsampleswerealsosubjectedforproximateanalysisformoisture,crudeprotein(CP),drymatter(DM), crudefiber(CF),etherextracts(EE),totalashandinsolubleashintheAnimalNutritionlaboratory,ChittagongVeterinaryandAnimalSciencesUniversity,Chittagong,BangladeshinaccordancewithstandardmethodsdescribedbytheAOAC (2006).

## 3.15 Collection ofblood and serumsample

Ontheday28,fourbirdswereelectedfromeachreplicationrandomlyforcollectionofblood.About3.0mlofbloodwascollectedfromeachbirdbysterilesyringeandputthosesyringeinrefrigeratorvertically.After6hoursserumwascollectedinsterileplasticvial to estimate serum parameters.

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## Table 8. ProximateCompositionofBasil Leaf

|  |  |
| --- | --- |
| **Traits** | **Proximate value(%)** |
|  Moisture | 8.62 |
| CrudeProtein (CP) | 9.58 |
| DietaryFiber(CF) | 39.82 |
| EtherExtract(EE) | 0.85 |
| Ash | 0.25 |
| NitrogenFree Extract(NFE) | 13.67 |

**Table 9. ProximatecompositionofGarlic**

|  |  |
| --- | --- |
| **Traits** | **Proximate value(%)** |
| DryMatter(DM) | 21.42 |
| CrudeProtein (CP) | 3.21 |
| CrudeFiber(CF) | 1.97 |
| EtherExtract(EE) | 0.51 |
| Ash | 2.31 |
| NitrogenFree Extract(NFE) | 13.42 |

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**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).

## Statistical Analysis

Allthedataofliveweight,weightgain,feedconsumptionandfeedconversionetc.,relatedtocarcassparameters,bloodparametersandchemicalanalysisofmeatwereenteredintoMSexcel(Microsoftofficeexcel-2007,USA).DatawerecomparedamongthegroupsbyonewayANOVAinSTATAversion-12.1(STATACorporation,CollegeStation,Texas)andsubsequentDuncan’sMultipleRangeTests(DMRT).ResultswereexpressedasmeansandSEM.AllPvaluesof≤0.05and≤0.01wereconsideredsignificantand highlysignificant, respectively.

# ChapterIV:Results

TheexperimentwasperformedtoexaminetheeffectofbasilandgarlicontheperformanceparameterandcarcasscharacteristicsofCobb500broilers.Theresultsachieved from the studyhave been described in this chapter.

## Body weight gainper week

Tableno 10representedthat,significantdifference(P<0.01)inweightgainofbroilersamongexperimentaldietarytreatmentgroupswereobservedat1stand2ndweeksofage.From3rdto4thweeksofage,inliveweightgainofbroilersamongdietarytreatmentgroups were notsignificant (P>0.05).

## Table10.Weeklybodyweightgainofbroilersofdifferentdietarytreatment(gm/broiler)

**Ageof**

**Dietarytreatments SEM Pvalue**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Bird** | **T0** | **T1** | **T2** | **T3** |  |
| 1stweek | 71.7 | 84.0 | **85.0** | 77.4 | 0.42 | 0.00 |
| 2ndweek | 155.9 | 151.2 | 170.6 | 185.3 | 02.06 | 0.00 |
| 3rdweek | 281.4 | 294.6 | 301.7 | 285.8 | 05.06 | 0.45 |
| 4thweek | 440.0 | 501.0 | 468.0 | **514.0** | 12.76 | 0.12 |

T0= control feed;T1=feedcontain 1% garlic;T2=feedcontain 1% basil; T3=feedcontain 0.5%basil &

0.5%garlic;SEM=StandardErrorofMean;Significant(p≤0.05);

## FeedExpenditure

Table no 11showedthatthemomentousdifference(P<0.05)infeedconsumptionofbroilerindifferentgroupswereexecutedat1stand2ndweekofage.At3rdto4thweekofage,therewasnosignificantdifference(P>0.05)infeedconsumptionofbroilerindifferenttreatmentgroups.

## Table 11.Weeklyfeedintakeofbroilersamongdifferenttreatmentgroups(gm/broiler)

**Age of bird**

**Dietarytreatments SEM Pvalue**

**T0 T1 T2 T3**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 1stweek | 76.7 | 72.6 | 77.5 | 74.8 | 0.72 | 0.00 |
| 2ndweek | 207.0 | 203.9 | 211.2 | 217.8 | 1.97 | 0.00 |
| 3rdweek | 405.5 | 411.5 | 413.0 | 387.3 | 5.80 | 0.46 |
| 4thweek | 750.5 | 813.0 | 778.0 | 822.0 | 12.99 | 0.16 |

T0= control feed;T1=feedcontain 1% garlic;T2=feedcontain 1% basil; T3=feedcontain 0.5%basil &

0.5%garlic;SEM=StandardErrorofMean;Significant(p≤0.05),

## 4.3 FCR

In1stand2ndweeksofage,weeklyfeedconversionratio(FCR)ofbroilersamongdifferentdietarytreatmentgroupswerestatisticallysignificant(P<0.05).At3rdto4thweek ofage, therewas no significant difference(P>0.05).

## Table12.Weeklyfeedconversionofbroilersamongdifferentdietarytreatmentgroups

**Ageof**

**Dietarytreatments SEM Pvalue**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Bird** | **T0** | **T1** | **T2** | **T3** |  |
| 1stweek | 1.0 | 0.8 | 0.9 | 0.9 | 0.88 | 0.00 |
| 2ndweek | 1.3 | 1.3 | 1.2 | 1.1 | 1.20 | 0.00 |
| 3rdweek | 1.4 | 1.3 | 1.3 | 1.3 | 1.35 | 0.06 |
| 4thweek | 1.7 | 1.6 | 1.6 | 1.5 | 1.60 | 0.09 |

T0= controlfeed;T1=feedcontain 1%garlic;T2=feedcontain 1%basil;T3=feedcontain 0.5%basil &0.5%garlic;SEM=StandardErrorofMean;Significant(p≤0.05),

## Effect of differentdiets on carcass quality of broilers

Nomeaningfuldifferences(P>0.05)wereobservedinweightofdrumstick,thigh,breast,wing,neck,legandhead(table4.4).Controlgroupshowedlowerweightthanotherthreegroups.Significantdifferences(P≤0.05)wereobservedinweightofbackindifferentdietarytreatmentgroups.Internalediblepartsdidnotshowsignificantresult(p>0.5)indifferentdietarytreatmentsamongthecontrol T0and garlic and basil containingT1, T2and T3groups.

##  Table 13.Weightpercentageofprimalpartsandinternaledibleorgansofbroilersat28 days ofage(%)

**Treatments**

**Traits (%)**

**SEM Pvalue**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **T0** | **T1** | **T2** | **T3** |
| **PrimalParts** |
|  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 | 0.52JhHjhJh |
| Abdominal fat | 2.0 | 1.6 | 2.2 | 2.0 | 0.11 | 0.34 |
| Neckregionfat | 0.9 | 0.7 | 1.0 | 0.7 | 0.14 | 0.91 |

T0= control feed;T1=feedcontain 1% garlic;T2=feedcontain 1% basil; T3=feedcontain 0.5%basil &0.5%garlic;SEM=StandardErrorofMean;Significant(p≤0.05);

## 4.3 Effect of differentdiets on bloodparameters ofbroilers

Table no 14 representthat,thereisnosignificantdifferenceamongthedifferentserumconstituentslevel of broilers at 28 days ofage.

## Table 14. Differentserumcomponentslevel ofbroilers at 28 days ofageSerum constituentslevel (mg/dl)

**Parameter**

**SEM Pvalue**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **T0** | **T1** | **T2** | **T3** |  |
| 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 |

T0= controlfeed;T1=feedcontain 1%garlic;T2=feedcontain 1%basil;T3=feedcontain 0.5%basil &0.5%garlic;SEM=StandardErrorofMean;Significant(p≤0.05),

# ChapterV: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 *Staphylococcusaureus*and *Escherichiacoli*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 *Alliumsativum*. 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 propylpropanethiosulfonate (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,Shigellaspp.* Salmonella *typhi,* and *Pseudomonasaeruginosa*. 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.

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## Feedconsumption

Thetreatment which wascontaininggarlic & basil in diettend to lower feed intakein contraryofgarliccontainingdiet,thoughtheyhadsignificantresultbetweenthegroups.Goodrazi*etal,* (2014),reportedthatdailyfeedintakeincreasedincaseof1%garlic/kgfeedofdiet.Hisreportsupportsfirsttwoweeksofageofbroilerbecausesignificantresultwasfound at that period.Thefeed intake in this studytended to be higher in thechicks fed onsolelymixtureofgarliccomparedwithcontrol,basil,basilandgarlicmixturegroup,butthedifferenceswerenotstatisticallysignificant.Theseresultswereagreedwiththefinding of(BamideleandAdejumo, (2012),whoreportedthat 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 wassignificantly 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.

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## 5.2 FCR

TheweeklyfeedconversionatdifferentagesindifferentdietarysupplementationlevelimprovedthefeedconversionofCobb 500broilerstrain.Thoughthesignificantresultwas found at the 1stand 2ndof age. Significantresults werealsofound at3rdand 4thweeksofageatp≤0.05levelindifferentdietarytreatments.TheresultofthisexperimentwasnotsupportedbyGoodrazi*etal,*(2014),study’s.Herevealedthatbroilerreceiving1%garlicinfeedhadhighersignificanteffecttothebroilerchicken.Hisstudypartiallysupportstothecurrentexperimentwheresignificantresultwasfoundonlyinfirsttwoweeksofage.Theinsignificantresultofdifferentdietarytreatmentsin3rd,4th,weeksalsosupportsthefindingsofAji*etal*,(2011),MansoubandNezhady*etal,*(2011),whohavereportednon-significantresultofdietarygarliconFCR.Raeesi*etal,*(2010),reportedthat,1%basilinsupplementationlowerthefeedconversionratio.Hewasalsorevealedthat3%garlichadbetterFCRthancontrolgroup.Inhisexperimentcontrolgroupconsumedmorefeedthanothergroups.Eglabiet*etal*,(2013),alsoreportthatfeedconversionratiowassignificantlylowerinbirdsfeddietsupplementedwith3%garlic.

5.3 Carcass Quality

Birdswhoreceivedbasilandgarlicat1%leveldidnotshowsignificantresultsintoprimalandinternalpartsofthebody.ThisstudysupportsKim*etal*,(2015),reportedthatthecarcasstraitsandotherediblepartsdietarytreatmentcontainingbasilandgarlichadnosignificanteffect.Aji*etal*,(2011),alsorepliedthatnosignificanteffectwasfoundincarcassyieldobtainedfrombroilerfedofbasilandgarlic.TheresultsofthisexperimentisinlinewithLydia*etal,* (2001),whoreportedthattherewerenosignificantdifferencesoncarcasspercentageandorganweightofbirdsfedvaryinglevelsofgarlic.Treatmenteffectinthisstudywasnotsignificantoncarcassdressingpercentage.TheseresultsareinagreementwiththefindingofSarica*etal,*(2005),Dieumou*etal,*(2009),Rahimi*etal*, (2011),zolikha, (2014),andAmouzmehr, (2013),whoreportedthatthedietarygarlicdidnothaveanysignificanteffectoncarcassdressingpercentageofbroilerchicks.

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## BloodParameters

Thestudytranspiredthatthegarliccontainingdietarytreatments(T1andT3)hadnosignificanteffectonreductionofbloodcholesterollevel.Butalotsofscholarindicatedthatgarlicisagoodsourceofreducingcholesterolinblood.Thestudyalsorevealedthatbasilandgarlichadnoeffectonbloodglucose.Nosignificantresultfoundonbloodtriglyceridesduringthisstudy.NonsignificantresultsinLDLandHDLtobloodlevelalsoindicatesthat onion andgarlichad noeffecton them.ThisstudydidnotsupportOnyimonyi,(2011),whoreportedthatusingof0.75%garlicresultsleastserumcholesterol76.30mg/dl.Inastudysupplementedof2%garlicindietreduced24.2% total cholesterol inthe blood of white meat Stanaćev*et al, (*2012). Manan*etal,*(2012),reportedthatfeedinggarlicattwodaysintervalmayimprovesplasmalipidprofilewhichisalsosupportsthisstudy.ThestudydidnotsupportGoodrazi,(2013),whoreportedthatuseofonionindietreducedthelevelglucoseinblood.Hementionedhypoglycemiastimulatesnervoussystemhigherfeedintake.GarliccontainssulpharcontainingcompundslikeS-MethylcysteinesulfoxideandSallylcysteinesuiloxide.

# 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.

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#  Recommendations

Althoughitwasaexperimentalstudy,furtherstudiesmaybedirectedonsimilarfieldtomakeasubstantiveremark.However,accordingtothisexperimentalwork,thefollowingrecommendations maybe done:

* + - Basilandgarlicpercentageinfeedcanbeincreased(Insteadofusing1%basiland garlic in diet).
		- Theratioofbasilandgarlicmixturecanbechangedandrecombined(Insteadofbasil : garlic= 0.5 : 0.5).

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I am Shibu Das &completedmygraduationdegreeonDoctorofVeterinaryMedicine(DVM)fromChittagongVeterinaryandAnimalSciencesUniversity (CVASU),Bangladesh.AsaninternstudentIreceivedclinicaltrainingfromMadras VeterinaryCollegeandVeterinaryCollege&ResearchInstitute,Namakkal,Tamilnadu,India.The authorhasagreatenthusiasminresearchandhasdonesome nutritional and clinical research works. Hehas investigated the physical performances and semen characteristics of bulls at Central Cattle Breeding & Dairy Farm, Savar, Dhaka, BangladeshduringhisinternshipatChittagong.Myresearchinterestistoprovidequalityandless expensive livestockand poultry feed by using unconventional feed ingredients.

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