EFFECTS OF GARLIC SOLUTION ON THE PERFORMANCE AND ON THE HAEMATOLOGICAL PARAMETERS OF BROILER BIRDS

A Thesis

By

MD. ENAMUL HAQUE BHUIYAN
Registration No. 1205120
Semester: July- December, 2014
Session: 2012-13

MASTER OF SCIENCE (M.S.)

IN

PHARMACOLOGY

DEPARTMENT OF PHYSIOLOGY AND PHARMACOLOGY
HAJEE MOHAMMAD DANESH SCIENCE AND TECHNOLOGY UNIVERSITY, DINAJPUR-5200

DECEMBER, 2014

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DEDICATED

TO

MY BELOVED PARENTS

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LIST OF ABBREVIATIONS AND SYMBOLS

ADG	=	Average Daily Gain
AGP	=	Antimicrobial Growth Promoter
AID	=	Apparent Ileal Digestibility
b.wt.	=	Body Weight
BAU	=	Bangladesh Agricultural University
BCCA	=	Bilateral Common Carotid Arteries
BMD	=	Bacitracin Methylene Disalicylate
BWG	=	Body Weight Gain
Conc.	=	Concentration
CP	=	Crude Protein
cu mm	=	Cubic Millimeter
d.w.	=	Drinking water
EE	=	Ether Extract
EO	=	Essential Oil
EOC	=	Essential Oil Combination
EOM	=	Essential Oil Mixture
ESR	=	Erythrocytes Sedimentation Rate
et al.	=	Associate
FCR	=	Feed Conversion Ratio
Fig.	=	Figure
gm	=	Gram
Hb	=	Hemoglobin
HPS	=	Hydropericardium Syndrome
i.e.	=	That is
IBDV	=	Infectious Bursal Disease Virus
J.	=	Journal
kg	=	Kilogram

Lt	=	Litre
mg	=	Milligram.
LMI	=	Leukocyte Migration Inhibition
MAT	=	Minutes After Treatment
mm^3	=	Cubic Millimeter
NC	=	Negative Control
NDV	=	Newcastle Disease Virus
NFE	=	Nitrogen Free Extract
No.	=	Number
NS	=	Non-Significant
µg	=	Microgram
PBS	=	Phosphate Buffer Solution
PCV	=	Packed Cell Volume
PM	=	Population Mean
RS	=	Resistant Stress
S	=	Significant
SAT	=	Standard Tube Agglutination
SE	=	Standard Error
SGOT	=	Serum Glutamate Oxalo-Acetate Transaminase
SGPT	=	Serum Glutamate Pyruvate Transaminase
SM	=	Sample Mean
SOD	=	Superoxide Dismutase
TEC	=	Total Erythrocyte Count
Vol.	=	Volume
%	=	Percent
@	=	At the rate of
<	=	Less than
°C	=	Degree centigrade

CHAPTER 1

INTRODUCTION

CHAPTER 1

INTRODUCTION

The economy of Bangladesh mainly depends on agriculture and livestock plays an important role as the backbone of agriculture. Poultry farming plays an important role to create employment and to improve the nutritional status of the people and also in the national economy. A considerable amount of foreign exchange is being earned by exporting eggs and meats of poultry. Poultry husbandry also acts as a profession in unemployed young persons, landless farmers, poor, divorced women and children which can supplement their family income. The eggs and meats of poultry are the source of protein. The meats of poultry are nutritious, tasty and contain less fat. It has no harmful effects on health. Irrespective of age, sex and cast everybody likes it. These factors favor producing poultry in Bangladesh.

The poultry production systems have led to marked increase in the production of poultry meat production and egg production throughout the world. It has triggered the discovery and widespread use of a number of "feed additives". The term feed additive is applied in a broad sense, to all products other than those commonly called feedstuffs, which could be added to the ration with the purpose of obtaining some special effects. The main objective of adding feed additives is to boost animal performance by increasing their growth rate, better-feed conversion efficiency, greater livability and lowered mortality in poultry birds. These feed additives are termed as "growth promoters" and often called as non-nutrient feed additives. Many synthetic drugs and growth promoters are supplemented to the broilers to get rapid growth but their use have shown many disadvantages like high cost, adverse side effect on health of birds and long residual properties etc. Growth promoters are chemical and biological substances which are added to livestock feed with the aim to improve the growth of chickens in fattening, improve the utilization of feed and in this way realize better production and financial results. Their mechanism of action varies. Positive effect can be expressed through better appetite, improved feed conversion, stimulation of the

immune system and increased vitality, regulation of the intestinal microflora, etc. In any case, expected results of the use of these additives are increased financial effects of production. Because of the fact that growth promoters have different mechanisms of action, it is necessary to present every group individually and present the effect, which can be expected with their utilization. With the development and wide use of synthetic and semi-synthetic antibiotics, pros and cons have been experienced throughout the last 50 years, which have been directed research back to natural antimicrobial products as indispensable resources. The World Health Organization, the American Medical Association, and the American Public Health Association have urged a ban on growth promoting antibiotics (AGPs). So, scientists are again concentrating on the use of our ancient medicinal system to find beneficial herbs and plants, which can be safely used to increase the production performance of broiler.

In recent years great concern has arisen about the use of antibiotics as supplement at sub-therapeutic level in poultry feed due to emergence of multiple drug resistant bacteria.

Generally, plant paste or extracts have no problem of drug resistance. Herbs normally used are picorhiza, garlic, cloves, neem fruit and leaves, *Sophora flavescens*, nutmeg, cinnamon, ginger, peppermint, sage, thyme, mustard and fenugreek. These plants are used as digestive stimulants, anti-diarrhoic, antiseptic, anti-inflammatory, anti-parasitic and appetite stimulants in human beings as well as animals. Earlier studies indicate that many plant paste or extracts have antimicrobial activity.

Considering the hazards of antimicrobials and beneficiary effects of herbs and spices, scientists are again concentrating on the use of our ancient medicinal system to find beneficial herbs and plants, which can be safely used to increase the production. One of such plant is garlic (*Alium sativum*).

From the above points of view, considering the fact, the work has been undertaken with the following objectives:-

1. To know the growth performance of broilers supplemented with garlic (*Alium sativum*) solution.
2. To examine the effects of garlic solution on hematological parameters (TEC, Hb, ESR and PCV) of broiler.

CHAPTER 2

REVIEW OF LITERATURE

CHAPTER 2

REVIEW OF LITERATURE

A selected review of the past research works, related to the present study are discussed below:

Elagib *et al.* (2013) worked on "Effect of Dietary Garlic (*Allium sativum*) Supplementation as Feed Additive on Broiler". This study was undertaken to investigate the effects of incorporating garlic (*Allium sativum*) powder, as a growth promoter in broiler feed on growth performance, carcass characteristics and blood profile. Sixty three one day-old commercial broiler chicks (Cobb) were reared in an open sided poultry house and divided into three groups of 21 birds each. The groups were assigned to three diets containing (0, 3 and 5%) garlic powder. Feed and water were offered *ad libitum* till the termination of the trial after 42 days. Diet with 3% level of garlic significantly ($P<0.05$) increased feed intake (3051.6 gm), body weight gain (1688.7 gm), body weight (1733.8 gm) and achieved the best efficiency of feed utilization (1.81 kg feed for one kg meat).The different levels of garlic has no significant effect ($P>0.05$) on total red blood cells, packed cells volume, total white blood cells and the differential count of white blood cells including neutrophil, eosinophil, monocytes and lymphocytes. They concluded that the incorporation of garlic as feed additive at 3% level significantly enhanced growth and performance of broiler chicks without any side effects as detected by blood profile.

Elijah *et al.* (2012) reported that commercial poultry production is ranked among the highest source of animal protein in the world. Microbial infections caused by bacteria (*Salmonella, Clostridium perfringes*) and parasites particularly *Eimeria* has continued to challenge the poultry industry. Antibiotic Growth Promoters (AGPs) have been traditionally used to counter microbial infections in poultry. But due to public health concerns, the use of AGPs in poultry is either restricted or out rightly banned in several countries.

Suriya *et al.* (2012) reported that the growth performances of fast growing birds led with garlic, cinnamon and turmeric powder improve than bird that not feed with herbal medicine. Since, uses of on antibiotics as growth promoter have been banned by the European Union, herbs or products containing plant extracts are using as alternative feed supplements in animal production. Garlic, turmeric (*Curcuma longa*) and cinnamon (*Cinnamomum verum*) have been widely used as medicinal and growth promoter purposes in animals. However, the information of the effect of these herbs on broiler production especially under tropical environmental condition is still inadequate. About 240 one-day old chicks were randomly allocated to 10 treatment groups consisting of 3 replications of 8 chicks in each pen. The experimental groups were formulated consisting of non-supplemented (control) and supplemented diets. The groups were assigned to receive treatment diet as garlic, turmeric and cinnamon were incorporated at three concentrations: 0.125%, 0.5% and 1% into the basal diet (mash form). The overall body weight gain of broiler chickens fed with 0.25% turmeric, 0.5% garlic and 0.5% cinnamon found to be significant different compared with the control group. From the result of present study it could be suggested that the use of powdered garlic as feed additive at level of 0.5% as it proved be significantly different in body weight gain and FCR compared with the control group.

Mohebbifar *et al.* (2011) reported that of dietary inclusion of ground pits of palm dates (*Phoenix dactylifera* L.) with or without medicinal plants a ground mixture of dried garlic and thyme (*Thymus vulgaris*) on productive performance, antibody (Ab) response against Newcastle Disease Virus (NDV), serum biochemical parameters and differentiable counts of white blood cells in broiler chicks. A total number of 240 one-day old male Ross chicks were distributed in 24 battery pens (N=l0). Birds in four pens were assigned to feed each of six iso-caloric and iso-nitrogenous experimental diets including grounds date pits (0, 50 and 100 gm/Kg diet) and medicinal plants (0 and 2 gm/Kg diet). Body weight and feed intake was measured on days 21, 42 and 49 of age. Antibody response to inactivated NDV vaccine was used to evaluate the humoral immunity of chicks. At 14 and 28 days of age, all 240 chicks were vaccinated against NDV. Blood samples were

withdrawn at 0 and 7 day after first and 14 and 21 day after second vaccination for determination of primary and secondary Ab responses. Data in a 3X2 factorial arrangement was subjected to analysis of variance based on completely randomized design using the GLM procedure of SAS. Dietary treatment did have no significant effect on Body weight, Body weight gain feed intake and feed conversion ratio of birds ($P>0.05$). There was no interaction between dietary inclusion of date pits surd MP inclusion on performance traits; however, a significant interaction was found on Ab titer 14 days after primary vaccination ($P=0.02$). Ab titer of chicks fed the diet including 50 gm of DP without MP was the highest compared to birds fed other diets. Dietary DP inclusion significantly decreased the serum levels of High Density Lipid (HDL). In conclusion, including ground date pits to broiler diet up to 10% shown growth performance comparable to the com-SBM diet. Further investigations on beneficial effects of dietary DP inclusion on blood levels of HDL should be appreciated.

Navid, (2011) shown the effects Butyric Acid, Probiotic and Garlic on performance and serum composition of broiler chickens. In this study which was carried out for 42 days, there were four treatments. At first 300 day-old broiler chicks were divided to 20 groups of 15 chicks each. Each 4 groups randomly assigned to one of the 4 treatments. Experimental groups was named as T1, control group, T2, basal diet containing 1% Probiotic (*L. acidophilus* and *L. casei*) 1-28, T3, using powder form of butyric acid glycerides (BaBy C) containing 0.2% days and T4, fed by basal diet plus 1 gm/Kg garlic powder. As compared to the Control group with the other groups observably gave improve gain in all of the experimental ($P<0.05$) groups. According to the results, total cholesterol (Chol), triglyceride (TG), HDL, LDL and VLDL were measured in blood samples of day 42. The amount of total Chol and LDL in the serum did shown a significant differences, but TG, HDL and VLDL were not significantly different among groups.

Navid *et al.* (2011) conducted an experiment to evaluate the effects of Zizaphora, Probiotic and Garlic on performance and serum Composition of broiler chickens. In this study that starts 1 day following until 42 days there were five treatments and three replicates, at first 225 one-day old broiler chicks were divided to 15 groups of 15 chicks each. Each 5 groups randomly assigned to one of the 5 treatments. Experimental groups included T1, control group, T2,basal diet containing 1% probiotic (*L. acidophilus* and *L. casei*) 1-28, T3, using 1.5% of Zizaphora, T4, fed by basal diet plus 1 gm/Kg garlic powder, T5, using 1.5% of Zizaphora plus 1 gm/Kg garlic. As compared to control group with the other groups observably to give improve gain in all of the experimental ($P<0.05$) groups. The lowest percent of abdominal fat was observed in experimental group 2 and 5, the highest percent of breast was observed in experimental group 2. According to the results, total cholesterol (Chol), triglyceride (TG), HDL, LDL and VLDL were measured in blood samples of day 42. The amount of total Chol, TG, and LDL in the serum did show a significant difference, but, HDL and VLDL were not significantly different among groups. The results evidence that the using of Zizaphora, probiotic and garlic in broiler feeds have significantly effects on performance and biochemical and immunity parameters.

Rahimi *et al.* (2011) has shown the effects of three herbal extracts and an antibiotic virginiamycin on growth performance, immune system, blood factors and selected intestinal bacterial populations in broiler chickens. A total of four hundred and eighty (480) 1-day old male broiler chicks were assigned to the basal diet (control), basal diet supplemented with 15 ppm of virginiamycin, basal diets with a 0.1% dose of either thyme (*Thymus vulgaris*), coneflower (*Echinacea purpurea*) and garlic or a blend of the three extracts in the drinking water. The highest and the lowest body weight and weight gain were related to virginiamycin and coneflower ($P<0.05$) respectively. The lowest and the highest feed conversion rates were respectively related to virginiamycin and coneflower ($P<0.05$). Relative weight of bursa of Fabricius in the garlic group shown a significantly more increase as compared with other groups, while the relative weight of spleen was unaffected by treatments. Cutaneous basophil's hypersensitivity response (to

phytohemaglutinin injection) and antibody response to Sheep Red Blood Cells (SRBC) was higher in coneflower group ($P<0.05$). Antibody responses to Newcastle Disease vaccine (LaSota) was unaffected by treatments but coneflower improved antibody levels ($P>0.05$). Garlic significantly reduced the serum levels of cholesterol, LDL and triglyceride as well as significantly increasing the level of HDL. Thyme improved hematocrit percentage and hemoglobin concentration, but not significantly. The colony forming units of *Escherichia coli* in digesta of ileo-cecum in the blend group shown a significantly lower number compared with control. However, no difference was observed in *E. coli* counts between blend group and others, except for control. The lactic acid bacteria counts in the thyme group increased as compared to other groups, except for coneflower ($P<0.05$).

Vidica *et al.* (2011) reported that the feed exploitation was found to be better in groups treated with garlic by the paper examines the effects of garlic and Cu separately as well as their combined effects on the production parameters and carcass quality in broiler chicks. Garlic has antimicrobial, antihypertensive and antioxidative properties; while high copper levels in feed (100 ppm) displays stimulating and bacterial effects, which may be an alternative to antibiotics whose use is prohibited by the EU. The objective of this study was to prove the effects of garlic in broiler feed on production parameters, health status and carcass quality. The testing was carried out under production conditions with one-day old Hubbard broilers of the same weight divided in 4 groups, each consisting of 75 birds, in 4 repetitions. Treatment groups were given: 2% of commercial garlic in group II, 2% garlic and l00 ppm Cu in group III and 100 ppm Cu in group IV. At the end of the experiment which lasted for 42 days it was found that the addition of garlic led to a significant ($P<0.05$) increase of body mass in group II (2055.55 gm) and group III (2038.65 gm) in comparison to the control group (1964.52 gm). The feed exploitation was found to be better in groups treated with garlic.

Raeesi *et al.* (2010) shown the effect of periodically use of garlic on performance and carcass characteristics in broiler chickens. 240 one-day old Ross broiler chicks randomly allocated into the 10 dietary treatments (A, B, C, D, E, F, G, H, I

and J) for 6 wks. Treatment A or control group received basal diet (based on standards of Ross management guidelines) without supplementation of garlic powder while B, I and D dietary treatments were basal diet supplemented with 0.5%, l% and 3% garlic powder respectively for the whole time of experiment (6 weeks). Birds in group E, F and G were fed control diet supplemented with 0.5%, l% and 3% garlic powder respectively just in their starter diet (0-21d). Birds in three other treatments (H, I and J) received control diet for the first 21 days and 0.5%, l% and 3% of garlic powder was added to their finisher diets respectively. 1% and 3% supplemented groups in finisher period had better performance as compared with other groups. Since present study conducted in optimum and antiseptic conditions, it seems that better or more responses could be expected in performance if the raising conditions would not be healthy.

Shiva *et al.* (2010) reported that the dietary supplementation of natural non-antibiotic garlic can be used active based growth promoter, i.e. G-PRO naturo would be used as a natural alternative to antibiotics growth promoters in broiler diets. Three hundred sixty, 1-day old straight run broiler chicks (Cobb 400) were randomly divided into 3 treatment groups of 20 birds each with 6 replicates. The groups were 1. Negative control (basal diet), 2. G-PRO naturo 250 ppm (+basal diet) 3. Positive Control (basal diet+Virginamycin) 500 ppm. The basal diets (starter/grower: 0-21 d, finisher: 22-42 d) were based on maize and soybean meal. Each group was fed *ad libitum* with its own diets for a period of 42 days. Light was provided for 24 hrs each day throughout. Water was always available. The body weight gains of birds were measured individually and feed consumption and feed conversion efficiency (gm feed/gm weight) were calculated weekly. At the end of the experiment all birds were sacrificed to determine intestinal microbial count. The results obtained in the experiment shown that the garlic based additive supplementation affected some performance parameters significantly ($p<0.05$). Addition of G-PRO naturo at 250 ppm to the diets improved body weight and feed conversion efficiency. The results obtained in the experiment also shown that the supplement was able to reduce the *Salmonella sps.* and *E. coli* counts in the intestine when in comparison to the negative control. This study can be concluded

that G-PRO naturo supplementation at 250 ppm to broiler diets could have potential to improve growth performance of broilers.

Yabaya *et al.* (2010) reported that garlic has been considered to be an excellent medical panacea and a natural antimicrobial drug that can be considered as an alternative form of treatment of pathogenic infections. The antimicrobial effects of fresh aqueous garlic extract (FAGE) and dried aqueous garlic extract (DAGE) against *Salmonella typhi* was studied. Antibacterial activity of FAGE and DAGE was characterized by inhibition zones of 5-29 mm and 5-19 mm respectively with FAGE giving a higher sensitivity against the tested isolate. *Salmonella typhi* was tested against some commercial antibiotics susceptibility of *S. typhi* to these antibiotics was characterized by inhibition zones of 10-26 mm against four antibiotics and no sensitivity or inhibition zones recorded for antibiotics. The partition principle of paper and TLC reveals that FAGE had more component ingredients than DAGE. The observation made in this study supports the use of garlic in health products and herbal remedies as a low cost intervention in the enhanced therapy against bacterial infections in Nigeria.

Sultan *et al.* (2009) reported that garlic or kalongi in the rations may be used for economical and efficient production of broilers by conducting an experiment with One hundred and fifty (150) one-day old broiler (Hubbard) chicks. They divided them into five groups viz., A, B, C, D and E. Group A served as control and was fed ration without any supplementation. Whereas group B and C were fed ration supplemented with 0.5% and 1.0% kalongi respectively. Similarly the birds in group D and B were fed ration supplemented with 0.5% and 1.0% garlic respectively. The experimental rations consisted of broiler starter mash and broiler finisher mash, which were fed from 2-4 and 5-6 weeks of age respectively. The supplementation of kalongi and garlic in the broiler ration significantly ($P<0.05$) improved the weight gain of the birds of various groups as compared to those of control group. The birds (in group D) using ration supplemented with 0.5% garlic gained the highest live weight (1588 gm) among the treated groups and the best-feed conversion ratio of 1.91. Different levels of the herbal growth promoters did

not exhibit any significant influence upon the feed intake values of the experimental groups. There was no difference ($P>0.05$) between the average dressing percentages, relative giblet weight (heart, gizzard, liver & spleen) and relative pancreas weight of the broilers fed rations with or without supplementation of garlic or kalongi. It is therefore concluded that dietary inclusion of garlic or kalongi in the ration may be used for economical and efficient production of broilers.

Ala Al Deen H. Jawad (2007), worked on "Some Hematological and Biochemical Effects of Garlic on Broiler Chicken". This study was conducted to investigate the effects of adding raw garlic in the diets on certain hematological and serum biochemistry of broiler chicken. Total of (40) birds (one day old) were used for this study. The birds divided randomly and equally into (4) treatment groups which fed on one of the following for 56 days: group (1) was fed on 10% raw garlic with basal diet, group (2) was fed on 5% raw garlic with basal diet, group (3) fed on basal diet and antibiotic (Ampicillin) which was added to the drinking water and group (4) fed on basal diet only (control group) The results showed that there were no significant alteration in PCV and RBCs in the group which fed on 10% raw garlic compared with the control one, however these group showed significant ($p<0.01$) reduction in HbC, MCV, MCHC and MCH. The addition of 5% raw garlic to the diet of bird caused significant ($p<0.01$) reduction in MCH and MCV only where as other hematological parameters (PCV, RBCs count, HbC and MCHC) have not affected significantly compared with the control group. The group which received antibiotic showed significant reduction ($p<0.01$) in HbC and MCHC. On the other hand, all treatment groups have not altered the total WBC and differential leucocytic counts. The coagulation time was prolonged significantly in groups that fed on both levels of garlic.

Jay *et al.* (2007) reported that the use of Growth Promoter Antibiotics (GPAs) increases the market value of the chickens by an amount on the order of \$0.0016 per chicken, but increases the growing cost by a larger amount of \$0.0069. For the Delmarva Peninsula, withdrawal of GPAs from the feed increases the net value of

the flock by $0.0009 to $0.0097 per chicken. In this case, withdrawal of GPAs increases the net value of the flock by $0.0048 to 580.0135 per chicken. The two sets of calculations shown that for every combination of assumptions removal of GPAs increases the net value of the flock.

Chauhan, (2006) reported that garlic is expected to produce cumulative benefits and exhibit enhanced neuroprotection by virtue of being "natural statin", "natural NSAID", "natural anti-oxidant", "natural anti-apoptotic agent" and "memory enhancer", a combination of many single-ingredient synthetic pharmaceutical drugs currently used for Alzheimer's therapy only with least adverse effects.

Sabayan *et al.* (2006) reported that garlic's organosulfur compounds may be able to prevent glutathione depletion. Patients who experience increases in reactive oxygen species-induced stress on liver function may be protected by garlic ingestion.

Yeh *et al.* (2006) reported garlic is a popular supplement well-perceived a healthy choice among people looking to increase cardiovascular wellness. Approximately 4% of all cardiovascular disease patients and 30% of cardiovascular patients who use herbal supplements take garlic.

Danmap, (2005) shown that when the use of antimicrobial growth promoters was discontinued in the poultry sector, antimicrobial resistance in broilers and broiler meat was high for some antimicrobials and bacteria. For example resistance by *Enterococcus faecium* to the antimicrobials tetracycline and erythromycin were 20% and 76% respectively and the resistance to growth promoters was 80-100%, decreasing subsequent to the ban.

Sarica *et al.* (2005) conducted a study to compare the effects of an antibiotic growth promoter (flavomycin) and two herbal natural feed additives (garlic and thyme) with and without a xylanase-based enzyme complex in wheat-based diets on growth performance, carcass parameters, total plasma cholesterol concentration, intestinal traits and the dry matter content of excreta of broiler chickens. A total of 112 one-day old male broiler chicks was randomly assigned to

eight groups containing 14 chicks each and raised from 1 to 42 days of age. The control group received the wheat-soyabean meal basal diet. In the treatment groups the basal diet was supplemented with one of the following: an antibiotic, thyme, garlic, an enzyme, the antibiotic plus the enzyme, thyme plus the enzyme or garlic plus the enzyme. During the 42 days of growth period there were no significant differences in body weight gain, feed intake and feed conversion ratio of the broilers between dietary treatments. Feeding the diet supplemented with the antibiotic plus the enzyme significantly increased hot and cold carcass yields compared to the diets supplemented with thyme, garlic, enzyme and garlic plus enzyme. Total plasma cholesterol concentration, the dry matter content of excreta and the relative weights of the heart, pancreas, liver, gizzard and spleen were not significantly influenced by dietary treatments. The relative weight of the small intestines of the broilers receiving the diets supplemented with the antibiotic, antibiotic plus enzyme, thyme plus enzyme and garlic plus enzyme were significantly less than those of the broilers led the basal diet and the diets supplemented with thyme, garlic and enzyme. The basal diet and garlic supplemented diet significantly increased the length of the small intestine compared to the other dietary treatments. Broilers receiving the diet supplemented with antibiotic had significantly lower total aerobic bacterial counts in the small intestines compared to those on the other dietary treatments. The combined supplementation of the antibiotic and enzyme resulted in a significantly lower *E. coli* concentration in the small intestines compared to the basal diet and the other dietary treatments.

Montagne *et al.* (2003) reported that Genes encoding for resistance also can be transferred to other formerly susceptible bacteria, thereby posing a threat to both animal and human health.

Al-Harthi, (2002) shown that the impact of different types and levels of herbs and spices as growth promoters on performance of broiler chicks. Three trials were conducted in which black or hot (cayenne) pepper, canella, carnation and garlic were fed at different doses individually in trial 1 and 2 or as a mixture with or

without Neomycin in trial 3 and compared to herbs and spices free-diet and antibiotic (Neomycin) supplemented-diet. Growth feed intake and feed conversion ratio (FCR) as well as percentage of dressing and internal organs were the studied traits.

United States Food and Drug Administration (2000) shown that the use of GPAs is loosely defined as antibiotics provided to healthy animals at concentrations below 200 grams per ton of feed for more than 14 days.

Aarestrup, (1999) reported that the long term and extensive use of antibiotics for veterinary purpose may eventually results in selection for the survival of resistant bacterial species or strain.

Coffman *et al.* (1999) reported that antimicrobial growth promoters are most effective animals under stress, as result of both poor nutrition and sanitation.

Jensen, (1998) reported that as much as 6 per cent of the net energy in the diet of broiler could be lost due to microbial fermentation in the intestine.

Qureshi, (1998) reported that the resistance to antibiotics and therapeutic levels, a large percentage of resistant isolates of different microbial species have been observed. Moreover, at least three *E. coli* isolates were found completely resistant to quinolones.

Thomke *et al.* (1998) found that cytokines released during the immune response may also stimulate the release of metabolic hormones, which would reduce muscle mass. Therefore a reduction in gastrointestinal infections would result in the subsequent increase in muscle weight.

Gassner *et al.* (1994) have demonstrated the presence of chloramphenicol metabolites in meat products and have concluded that a link with the presence of these antibiotic residues in meat and the occurrence of aplastic anaemia in humans cannot be ruled out.

Prescott *et al.* (1993) reported that there can be no doubt that growth promoters are effective. Use of growth promoters is an improvement in daily growth rates between 1 and 10 per cent resulting in meat of a better quality, with less fat and increased protein content.

Chatterjee and Pakrashi, (1991) reported that the roots of *Boerhavia diffusa* have been considered as expectorant, diuretic and laxative and useful in treatment of edema, jaundice, ascites, gonorrhoea and other internal inflammations.

Ghandi *et al.* (1988) reported that Ajoene is an active compound in garlic that may also play a role as a topical fungal agent.

Feighner *et al.* (1987) shown the mode of action of AGPs is mainly related to an inhibiting effect on certain intestinal bacteria that produce toxins or compete with the host for available nutrients. The inhibition of different species of bacteria that may depress dietary fat absorption due to bile acid deconjugation may further explain the working mechanism of AGPs.

Cohen *et al.* (1986) and Feinman (1979) shown that the use of GPAs contributes to contamination of flocks and loud products by antibiotic resistant pathogens, including *Campylobacter, Salmonella, Enterococcus* and *Escherichia coli* and thereby to increased risks human infections by these and other resistant pathogens.

Adetumbi *et al.* (1983), Koch (1993) and Hughes *et al.* (1991) reported that garlics antibiotic properties remained a mystery until Sandoz Pharmaceuticals isolated a compound, alliin. When garlic is chopped, crushed or bruised the alliin converts to the active ingredient, allicin. Garlic exerts broadspectrum antimicrobial activity against many species of bacteria, virus, parasites, protozoan and fungi.

CHAPTER 3

MATERIALS AND METHODS

CHAPTER 3

MATERIALS AND METHODS

The experiment was conducted in Basher hat, near Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur, Bangladesh under the close observation of department of Physiology and Pharmacology, during the period from 10 September, 2013 to 7 November 2013. To complete the research work the following steps were followed:

3.1 Preparation of Chicken Shed

At first the shed for rearing broiler chickens (experimental shed at Basher Hat near the HSTU campus governed by department of Physiology and Pharmacology) was properly prepared, i.e. the floor and compartment of cages and other surroundings of the shed were properly cleaned and then disinfectant was used to kill organism. We performed our experiment, when environment was little rainy and cold. We covered all windows by polyethene bag to protect the chicks from rain and cold. We used 200W bulb to provide heat to the chicks.

3.2 Collection and Management of Chickens

Broiler of Cobb-500 strain of 1-day old was collected from nourish poultry hatchery limited. Then the broiler chickens were managed carefully. Immediately after unloading from the chick boxes the chicks were given Vitamin-C and glucose to prevent the stress occurring during transport. The broiler chicks were kept in the same compartment for 7 days. We tried to maintain brooding temperature were correctly. The body weights of assigned chickens were taken with digital weight machine and the results were recorded. During acclimatization, the chickens were supplied with recommended feed and water. During the adaptation period the birds were fed a commercial broiler starter mash *ad libitum*. The chicks on both the extremities were discarded.

3.3 Collection and Processing of Plant Material

Garlics (*Allium sativum*) were collected from Bahadur Bazar, Dinajpur, Bangladesh to determine its efficacy as growth promoter on broiler. Fresh, mature and diseases free garlics were collected.

3.3.1 Preparation of garlic solution

3.3.1.1 Materials Required:

- Garlics
- Micro grinder
- Morter and Pestle
- Distilled water
- Measuring cylinder
- Beaker
- Pipette
- Stirrer
- Sieve and other conventional laboratory instruments.

3.3.1.2 Procedure of garlic solution preparation

At first the superficial bulk of garlics were removed and then washed with distilled water. After washing, 50 gm garlic was grinded with mortar and pestle. After grinding, 50 ml distilled water was added with it to make 100 ml stock solution and properly filtered. Finally it was stored in a refrigerator at the temperature of 4°C to maintain the active ingredients.

Fig-1: Intact garlics.

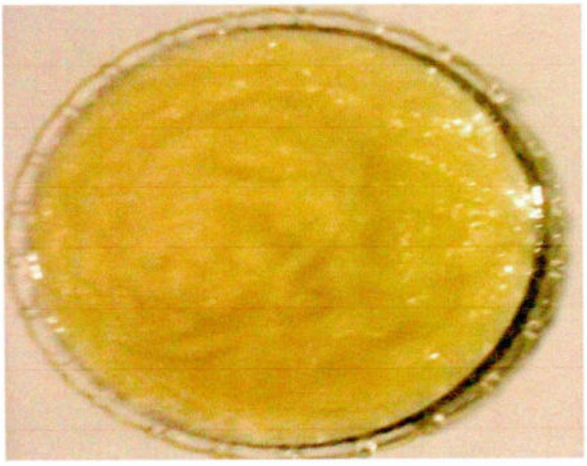

Fig-2: Paste of garlics.

3.4 Management Procedure of Seven-Day Old Broiler

100 ml stock solution contain 50 gm of garlic paste so, 5 ml stock solution contain 2.5 gm garlic. This 5 ml solution was mixed with 995 ml of drinking water every time to ensure 0.25% of garlic solution. Birds of group B were provided with 0.25% garlic solution of drinking water. The birds of each group were fed *(ad libitum)* an experimental ration with or without supplementation of garlic. The ration consisted of broiler starter mash and broiler finisher mash, which were fed from 2-4 and 5-6 weeks of age respectively.

Chicks were randomly divided into 2 equal groups having 20 chicks each, one of them was selected as control, group A and the other one as treatment, group B. All the birds were provided with the same management conditions like floor space, temperature, relative humidity, ventilation and light. The broiler of both groups was kept on a floor litter system in separate pens each measuring 3x4 square feet. A weight amount of the ration was offered to the birds twice a day and the left over feed was collected to calculate feed consumption of the birds. To provide heat all the time, electricity was used. Few fans were used to provide proper ventilation. The litter was changed every week.

The experiment was conducted according to the completely randomized design and data about per replicate initial body weight, weekly body weight and weekly feed consumption. The collected data were utilized to calculate weekly growth rate and efficiency of feed utilization. The data collected on the production cost in Taka of broiler were used to find the commercial viability of the herbal growth promoter in Taka. Cost of production of the broiler in each group was calculated on per kg basis to work out the economics of production of the birds for each groups, three birds from each replicate were picked up randomly and slaughtered for their dressing percentage and giblet weight (heart, liver, gizzard & spleen). The weight of pancreas was also recorded. After that, the birds were manually plucked by hanging them on shackles by their feet. The weight of each carcass was recorded and dressing percentages was calculated on the basis of dressed meat including giblets and skin.

After evisceration the heart, liver, gizzard, spleen and pancreas of the slaughtered birds were taken out and weighed for their absolute weight. The data thus obtained were used for the calculation of a) dressing percentage (%) [(Dressing weight of bird/Live weight of bird) X 100)], b) relative weight of (i) heart, (ii) liver, (iii) gizzard, (iv) spleen and (v) pancreas. Alter evisceration, relative weights [weight of the organ/live body weight) X 100] of various internal organs such as liver, heart, gizzard, spleen and pancreas of the slaughtered bird were recorded. The data thus collected regarding weight gain, feed consumption, feed conversion ratio, dressing percentage and relative weights heart, gizzard, liver, spleen and pancreas were subjected to the analysis of variance (student-t) technique in completely randomized design.

3.5 Experimental Design

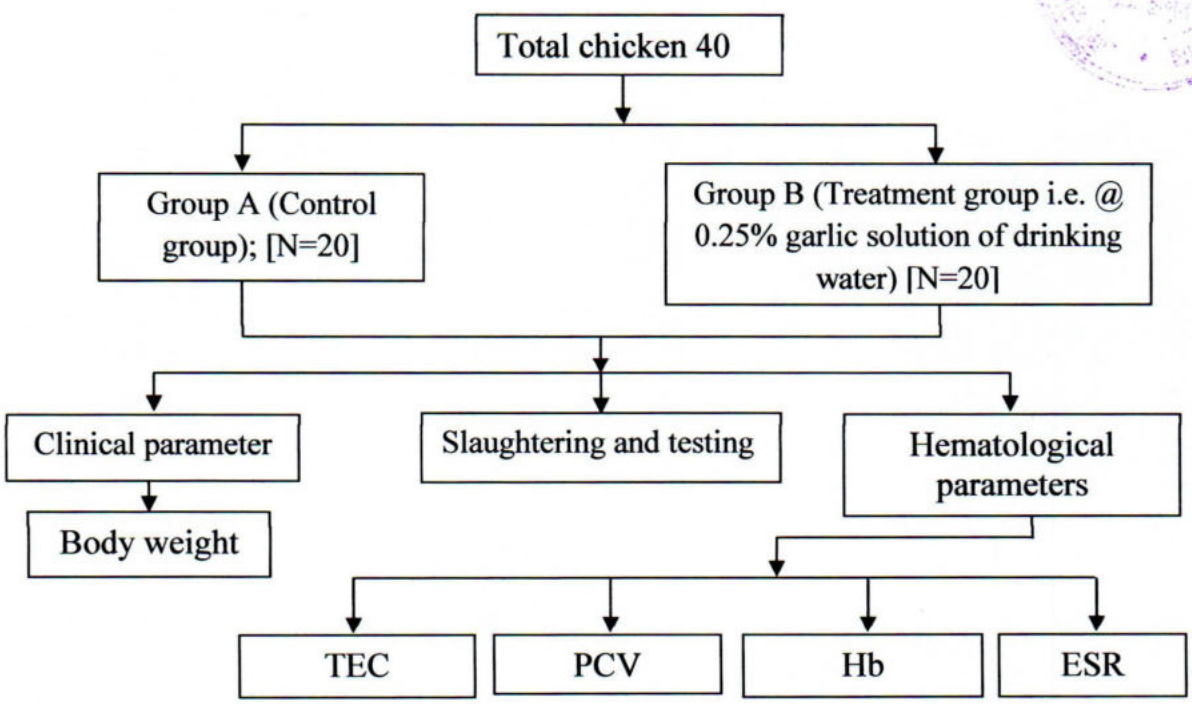

Fig-3: Layout of the experiment.

At 7 days of age all the 40 broiler chicks were divided into 2 groups (A and B) for assessing the efficacy of garlic solution as growth promoter on broilers.

- ❖ Chicks of group 'A': were kept as control and was not treated.
- ❖ Chicks of group 'B': were treated with drinking water of 0.25% garlic solution for the next 5 weeks.

All the chicks of treated and control groups were closely observed for 42 days after treatment and following parameters were studied:

3.6 Clinical Examination

i) The effect of garlic solution on body weight of broilers was recorded before and after treatment.

ii) Broilers chicks of control and treatment groups were weighed with digital weighing machine. The weight of broiler chickens was taken weekly. The average of these weights was calculated and recorded.

Mean live weight gain of each group of chicken on 7^{th}, 14^{th}, 21^{th}, 28^{th}, 35^{th} and 42^{th} days were recorded.

Fig-4: Day old chicks.

Fig-5: Weighing of broiler chick.

Fig-6: Examination of a bird from the control group after slaughtering.

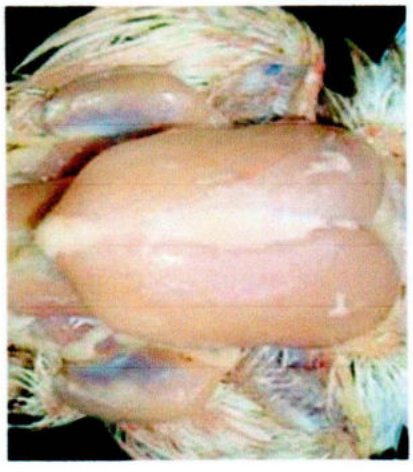

Fig-7: Examination of a bird from the treatment group after slaughtering.

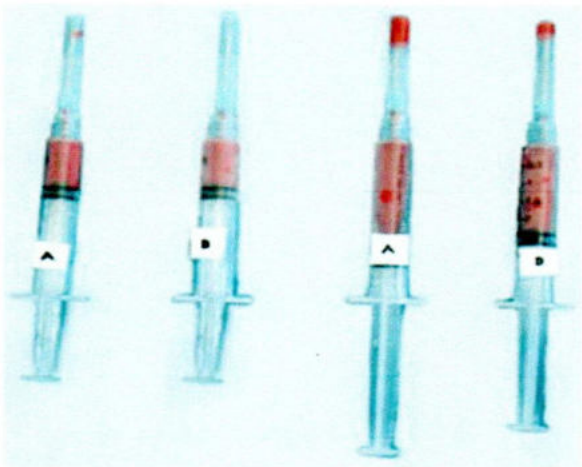

Fig-8: Collected blood sample for hematological examination.

3.7 Determination of Hematological Parameters

Blood samples were collected from wing vein of chicken from both control group and treatment group at 17^{th} and 35^{th} days of age to study the effect of garlic solution on the hematological parameters of broiler and the following parameters were observed:

(a) Total Erythrocyte Count (TEC),

(b) Hemoglobin (Hb) estimation,

(c) Packed Cell Volume (PCV) and

(d) Erythrocyte Sedimentation Rate (ESR).

3.7.1 Determination of Total Erythrocyte Count (TEC)

Determination of total erythrocyte count was done following the method described by Lamberg and Rothstein (1977). Well-mixed blood sample was drawn with red blood cell diluting pipette exactly up to 0.5 marks of the pipette. Outside of the tip of the pipette was wiped with cotton. Then the pipette was immediately filled with the red cell diluting fluid (Hayem's solution) up to 101 marks. The free end of the pipette was wrapped around with the rubber tube stretching to both the ends and held with thumb and middle finger. The content of the pipette was mixed thoroughly by shaking with 8-knot motion for 3 to 5 minutes. Then the counting chamber was placed with special cover glass under microscope using low power (10x) objectives. After discarding 2 or 3 drops of fluid from the pipette, a small drop was placed to the edge of the cover glass on the counting chamber as the entire area under the cover glass was filled by the fluid. One-minute time was spared to allow the cells to settle on the chamber under the cover glass. Taking 5 larger squares (4 in the 4 corners and the central one) of the central large square, the cells were counted from all the 80 small squares (16X5) under high power objectives (45x). After completion of counting, the total number of RBC was calculated as number of cells counted x 10,000 and the result was expressed in million/µl of blood.

3.7.2 Determination of Hemoglobin Concentrations (Hb)

The N/10 hydrochloric acid was taken in a graduated tube up to 2 marks with the help of a dropper. Well-homogenized blood sample was then drawn into the Sahli pipette up to the mark of 20 cm. The tip of the pipette was wiped with sterile cotton and the blood of the pipette was immediately transferred into the graduated tube containing hydrochloric acid. This blood and acid were thoroughly mixed by stirring with a glass stirrer. There was a formation of acid hematin mixture in the tube by hemolysis of red blood cells (RBC) by the action of hydrochloric acid.

The tube containing acid hematin mixture was kept standing in the comparator for 5 minutes. After that distilled water was added drop by drop. The solution was mixed well with a glass stirrer until the color of the mixture resembled to the standard color of the comparator. The result was read in daylight by observing the height of the liquid in the tube considering the lower meniscus of the liquid column. The result was then expressed in gm%.

3.7.3 Determination of Packed Cell Volume (PCV)

The citrated well mixed blood sample was drawn into special loading pipette (Wintrobe pipette). The tip of the pipette was inserted up to the bottom of a clean, dry Wintrobe hematocrit tube. Then the Wintrobe tube was filled from the bottom by pressing the rubber bulb of the pipette. As blood came out, the pipette was slowly withdrawn but pressure was continued on the rubber bulb of the pipette so as to exclude air bubbles. The tip of the pipette was tried to keep under the rising column of blood to avoid foaming and the tube was filled exactly to the 10 cm mark. Then the Wintrobe hematocrit tube was placed in the centrifuge machine and was centrifuged for 30 minutes at 3000 rpm. Then, the hematocrit or PCV was recorded by reading the graduation mark; the percent volume occupied by the hematocrit was calculated by using the following formula as described by Lamberg and Rothstein (1977).

$$PCV\% = \frac{\text{Height of the red cell volume in cm}}{\text{Height of total blood in cm}} \times 100$$

3.7.4 Determination of Erythrocyte Sedimentation Rate (ESR)

The fresh anticoagulant blood was taken into the Wintrobe hematocrit tube by using special loading pipette exactly up to 0 marks. Excess blood above the mark was wiped away by sterile cotton. The filled tube was placed vertically undisturbed on the wooden rack for one hour. After one hour the ESR was recorded from the top of the pipette. The result was expressed in mm in 1st hour.

3.8 Slaughtering and Testing for Side Effects

Four broilers from each group were slaughtered to see if there were any pathological changes present on 42th day after treatment. There were no significant pathological changes in any internal organs of the broilers of treatment group.

3.9 Method of Statistical Analysis

The data were analyzed statistically between control and treated groups of broilers by the well known "the student's test" ('t' test).

CHAPTER 4

RESULTS AND DISCUSSION

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This experiment was conducted to study the efficacy of garlic (*Allium sativum*) solution as a growth promoter in broilers.

4.1 Effects of Garlic Solution on Growth in Broiler

This experiment was conducted to study the efficacy of garlic solution as a growth promoter in broilers.

This experiment was held under the department of Physiology and Pharmacology, HSTU, Dinajpur. 40 one-day old chicks were randomly divided into 2 groups (A and B) for assessing the efficacy of garlic solution as growth promoter on broiler. The experimental units were kept on a floor litter system in separate pens. A weight amount of the ration was offered to the birds twice a day and the left over feed was collected to calculate feed consumption of the birds. Fresh and clean water was made available at all the times. The experiment was conducted according to the completely randomized design and data about per replicate body weight, weekly body weight, weekly feed consumptions and mortality were recorded during the experimental period (1 to 6 weeks of age).

The birds were supplemented with 0.25% of garlic solution of drinking water in group B and gained the highest live weight (Table-1). Table-1 and Table-2 revealed that in control group (group A), the initial average live weight on 7^{th} day was 161 gm, final live weight found 1563 gm, weight gain found 1402 gm (Fig-2) and Feed conversion ratio (FCR) found 2.24 and in the treatment group (group B), the initial average live weight on 7^{th} day was 162 gm, final live weight found 1790 gm, weight gain found 1628 gm (Fig-2) and FCR found 1.96. The birds of group B, supplied 0.25% garlic solution of drinking water utilized their feed statistically significantly ($P<0.05$) and more efficiently than the birds of group A (Table-1).

Statistical analysis of the data did not show any difference ($P<0.05$) between the dressing percentages of the birds of the two groups (Table-3).

Statistical analysis of the data did not show any difference between the relative gizzard weights of the birds of the two groups (Table-3). Statistical analysis of the data did not show any difference between the relative spleen weight of the birds of the two groups using ration with or without supplementation of garlic (Table-3).

Economies of Production: The average rearing cost of broiler in the two groups were 169.24 Tk and 174 Tk for group A and group B respectively (Table-4), excluding the cost of labour. Miscellaneous cost was 20 Tk per broiler which included the estimated cost of electricity, litter and disinfectant. The average live weight/broiler in group A and group B were 1.563 kg and 1.790 kg respectively. The broilers were sold in live weight basis at the rate of 120 Tk per kg body weight. The net profit/Kg live weight in the respective group excluding the cost of labour was found to be 18.032 Tk and 40.4 Tk.

Table-1: Initial and Final Live Weight of the Birds.

Variables	**Initial live weight (in gm) on 7th day**		**Final live weight (in gm) on 42nd day**	
Groups	Control (Group A)	Treatment (Group B)	Control (Group A)	Treatment (Group B)
Mean	161	162	1563	1790
Std. Deviation	6.900	7.6344	213.8778	245.3396
Std. Error Mean	1.5429	1.7071	47.8245	54.8596
P value	0.034508		0.041427	
Significance level	*		*	

[*=Significant at 0.05% level of significance.]

Table-2: Body Weight Gain and FCR.

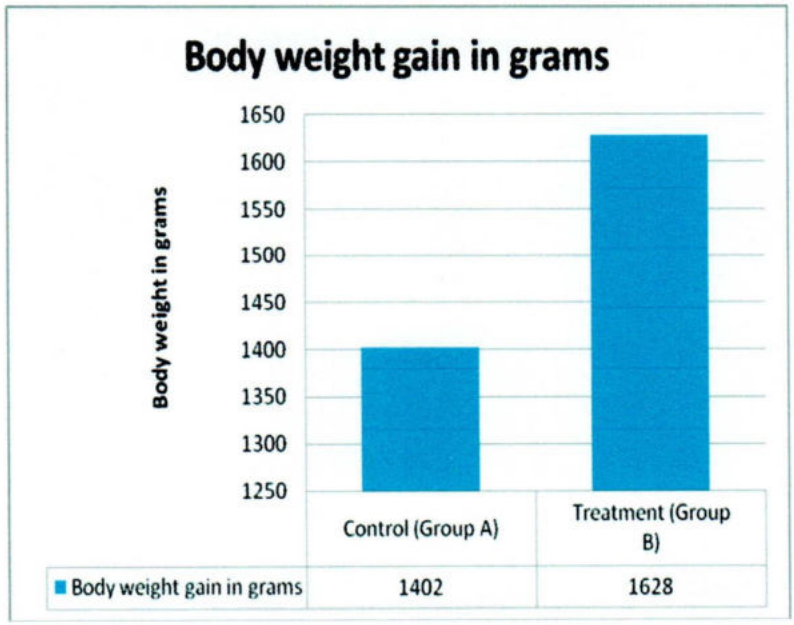
Variables	Body weight eight gain (in grams)	
	Control	Treatment
Number of birds	20	20
Feed consumption/broiler (in grams)	1402	1628
Feed consumption/broiler (in grams)	3138	3205
*FCR	2.23	1.96

[* = (FCR = Total feed consumed by birds/total weight)]

FCR 1.96 means it takes 196 gm of feed to produce 100 gm of chicken.

FCR 2.23 means it takes 223 gm of feed to produce 100 gm of chicken.

So, It can be said that each bird of group B takes 27 gm less feed than the birds of group A to produce 100 gm of chicken.



Graph-1: Live body weight gain of broiler.

Table-3: Dressing Percentage, Relative Giblet Weight (Weight of Heart, Gizzard, Liver, Spleen and Pancreas) of Broiler at 42 Days of Age.

Variables	Groups (N=5)	Mean	Std. Deviation	Std. Error	P value	Significance level
Dressing percentage	A	64.4400	0.750831 1	0.167809	0.763	NS
	B	65.4900	0.7839509	0.1678909		
Relative heart weight	A	0.450	0.0355409	0.1740607	0.000	*
	B	0.5500	0.0384887	0.0079472		
Relative gizzard weight	A	1.4600	0.0868856	0.0078119	0.611	NS
	B	1.5400	0.1869694	0.0149561		
Relative liver weight	A	2.5400	0.0355409	0.0528634	0.007	*
	B	2.9100	0.2215687	0.0079472		
Relative spleen weight	A	0.150	0.0121395	0.0171836	0.000	*
	B	0.1800	0.0138416	0.0027145		
Relative pancreas weight	A	0.23000	0.0344887	0.0033311	0.001	*
	B	0.2700	0.040000	0.0077119		

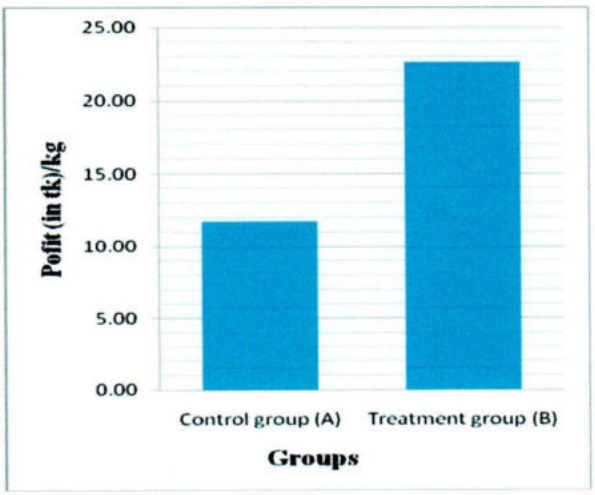
[A = Control group; B = Treatment group]

[*=Statistically Significant; NS= Statistically not Significant]

- Relative weight = (Weight of organ/ Live body weight of bird) X 100
- Dressing % = (Dress weight of bird/ Live weight of bird) X 100

Table-4: Data Showing Economics of Broiler Production Kept in Control Group, A and Treatment Group, B for the whole 42 days.

Description	Group A	Group B
Cost per chick (Taka)	30.00	30.00
Average feed consumed (Kg)/chicks	3.138	3.205
Feed price/kg (in Taka)	38.00	38.00
Cost of herbal growth promoters (in Taka)	0.00	2.50
Feed cost (in Taka.)	119.244	124.29
Miscellaneous (in Taka)	20.00	20.00
Total cost/broiler (in Taka.)	169.244	174.29
Average live weight (in Kg)	1.563	1.790
Unit of sale price/Kg live wt. (in Taka.)	120.00	120.00
Sale price/broiler (in Taka)	187.56	214.8
Net profit/broiler (in Taka)	18.316	40.51
Profit/Kg live weight (in Taka)	11.72	22.63



Graph-2: Profit/kg live weight of broiler (Taka).

4.2 Effect of Garlic Solution on Hematological Parameter of Broiler

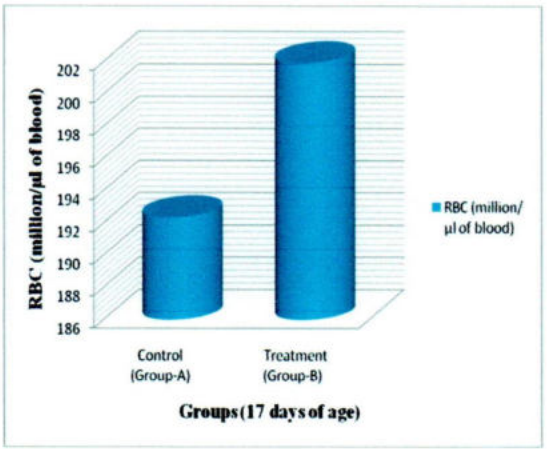
Observation of hematological parameter (RBC, Hb, PCV and ESR) on 17 day and 35 day did not show any significant difference ($P<0.05$) between the control group and the treated group (Table-5 and Table-6).

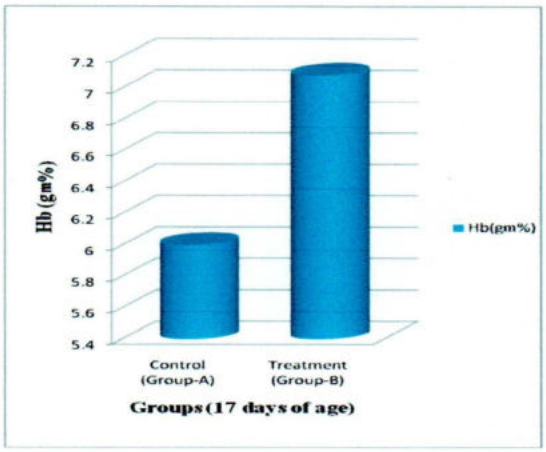
Table-5: Effects of Garlic Solution on Hematological Parameter of Broiler at 17 Days of Age.

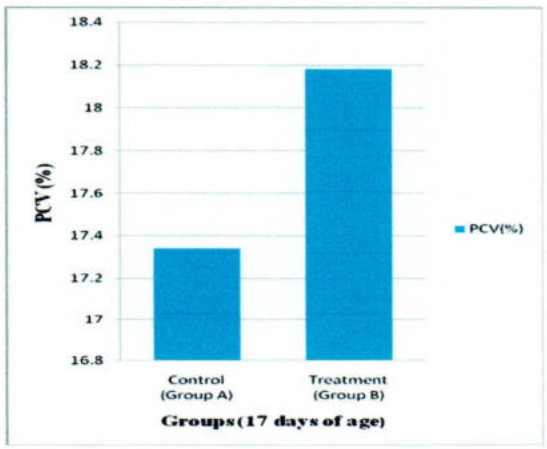
Hematological Parameter	Groups (N=5)	Mean	Std. Deviation	Std. Error Mean	P value	Significance value
RBC (million/ µl of blood)	A	192.35	2.350000	1.0375355	0.000	*
	B	201.95	2.150000	0.9128142		
Hb (gm %)	A	6.000	0.500000	0.0894427	0.336	NS
	B	7.080	0.8800000	0.5382693		
PCV (%)	A	17.340	1.3400000	0.5992662	0.014	*
	B	18.180	1.01000	0.3561579		
ESR (mm in 1st hour)	A	10.680	0.7072482	0.3162910	0.000	*
	B	9.280	0.7052482	0.3112910		

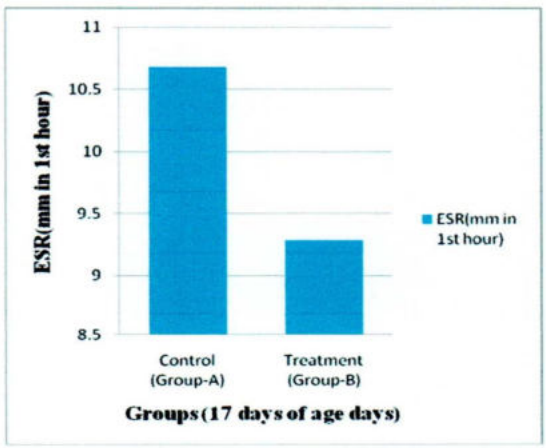
[A = Control group; B = Treatment group]

[*=Statistically Significant; NS= Statistically not Significant]









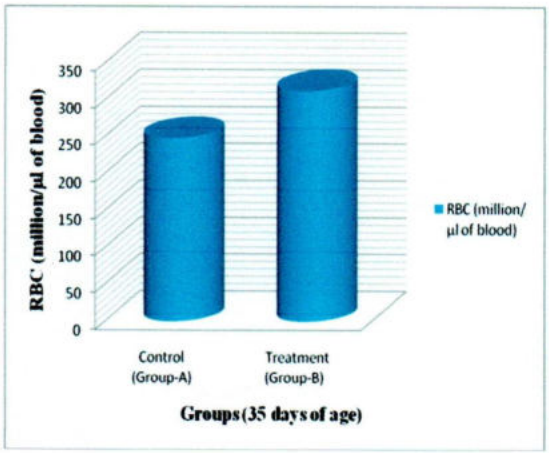
Graph-3: Hematological parameters of broiler (at 17 days of age).

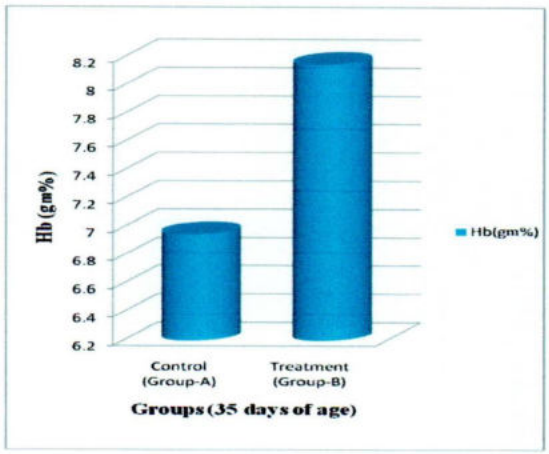
Table-6: Effects of Garlic Solution on Hematological Parameter of Broiler at 35 days of age.

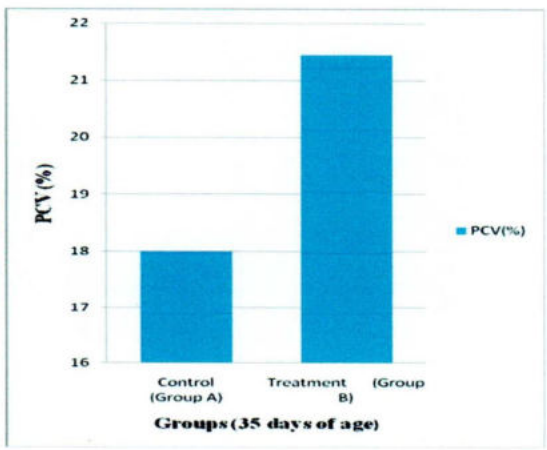
Hematological Parameter	Groups (N=5)	Mean	Std. Deviation	Std. Error Mean	P value	Significance value
RBC (million /µl of blood)	A	247.660	2.300000	1.0285913	0.000	*
	B	312.260	1.180000	0.6513118		
Hb (gm %)	A	6.95000	1.100000	0.4919350	0.249	NS
	B	8.1500	0.190000	0.1418034		
PCV (%)	A	18.000	0.30000	0.13416	0.000	*
	B	21.4400	0.04000	0.3345		
ESR (mm in 1st hour)	A	7.0000	0.60000	0.26833	0.005	*
	B	4.2900	1.34000	0.63348		

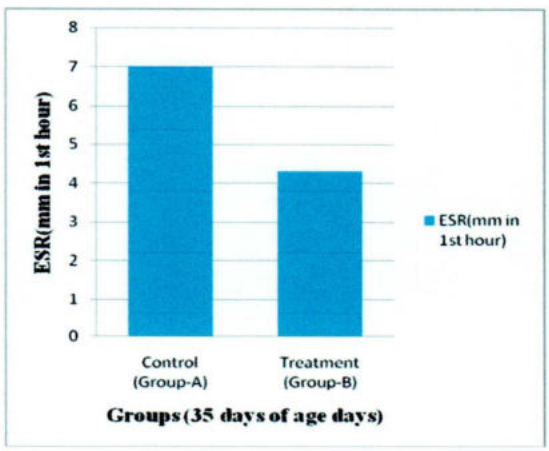
[A = Control group; B = Treatment group]

[*=Statistically Significant; NS= Statistically not Significant]









Graph-4: Hematological parameters of broiler (35 days of age).

Supplementation of garlic solution in the treatment group results in the improvement of the feed efficiency as compared to that of the control group. Birds supplemented with garlic solution had higher body weight, weekly gain in weight, feed consumption and feed efficiency. These results may be due to antimicrobial and antiprotozoal properties of garlic solution which help to reduce the microbial load of birds and improved the feed consumption and feed efficiency of the birds.

It is concluded that supplementation of garlic solution in the treatment group caused significant increase in final live body weight and improvement in weekly body weight gain and in the feed efficiency as compared to that of control group of broiler birds.

Therefore, it can be concluded that garlic solution has effects as alternative growth promoter and has hematological effects on broiler and moreover, no mortality was found without any antibiotic and vaccination taking proper biosecurity. This result may be due to antibacterial, anti-inflammatory, anti-stress, antifungal, insecticidal and liver tonic properties of garlic which help to ensure the microbial load of birds and improve the feed consumption and feed efficiency, Samthi *et al.* (2003).

Supplementation of garlic in the treatment group was found to be more profitable than the control group of broiler birds. However, dietary inclusion of garlic @ 0.25% fetched the maximum profit as compared to the control group. The results of the present study are in line with the findings of Ahmad *et al.* (2008), who reported that dietary inclusion of garlic at the rate of 6% in the rations was more beneficial in broiler production. Similar results have been reported by, where the broilers fed rations with added garlic, fetched more profit than those using rations without supplementation of this herbal growth promoter. Increase in the profit margin of the birds fed rations containing herbal growth promoters may be attributed to the better efficiency of feed utilization which resulted in more growth and better feed to gain ratio and ultimately led to higher profit margin in the broilers reared on garlic supplemented rations.

Addition of herbal growth promoter, i.e. garlic improved the weight gain (Table-1) of the broiler in this study. These results are in line with the findings that higher weight gain in broiler, fed rations supplemented without garlic. The improvement in weight gain may be due to the action of allicin (an antibiotic substance found in garlic) which inhibits the growth of pathogenic bacteria and aflatoxin producing fungi, Samthi *et al.* (2003). Resultantly, when the load of these bacteria in the intestine is low, birds may absorb more nutrients, thus leading to the improvement in weight gain of the birds using rations supplemented with garlic. The birds fed rations supplemented with herbal growth promoter, garlic utilized their feed more efficiently than those feed ration without addition of the growth promoter. The use of garlic at the rate of 6% showed more increase in live weight of the birds as compared to 0% level of garlic in this study, which is also in agreement with the findings of Samanta A.R. and Dey A. (1991), who concluded that powdered garlic at 0.5% level may be incorporated as a growth promoter in the ration of broiler. Better feed conversion ratio of the broiler using rations supplemented with garlic may be attributed to the antibacterial properties of these supplements which resulted in a better absorption of the nutrients present in the gut and finally led to improvement in feed conversion ratio of the rations.

Supplementation of 0.25% garlic solution did exhibit effect on the dressing percentage values of the broiler in this study. I found higher weight of liver, heart, gizzard, spleen and pancreas in group B than group A. This may be due to higher body weight gain in group B. The results of the present study are in line with those observed by Ahmad *et al.* (2008), who reported a non-significant effect on broiler dressing percentage values due to the inclusion of garlic in the diet of broiler.

Dietary inclusion of various levels of garlic did not exert any effect on the mean relative weight of heart, gizzard, liver, spleen and pancreas of the broiler used in this study. The results of the study are consistant with those observed by Soliman *et al.* (1999) and Ahmad *et al.* (2008), who reported that the dietary inclusion of

various levels of garlic did not exhibit any effect on the relative organs weight of broiler.

In this study I have found little increase in RBC, PCV and ESR and we have found little decrease in Hb value in the treatment group compared to the control group (Table-5 and Table-6). So it can be said that garlic has no significant effect ($P>0.05$) on different blood parameters. The results of the present study are in line with those observed by Elagib *et al.* (2013), who reported that different levels of garlic has no significant effect ($P>0.05$) on total red blood cells, packed cells volume, total white blood cells and the differential count of white blood cells including neutrophil, eosinophil, monocytes and lymphocytes.

CHAPTER 5

SUMMARY AND CONCLUSION

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In this experiment solution of garlic was studied in terms of growth promoter on broilers. The experiment was conducted in Basher Hat, under the observation of department of Physiology and Pharmacology, Hajee Mohammad Danesh Science and Technology University, Dinajpur. Forty (40) one-day old commercial broilers were divided into two groups after brooding of 7 days, i.e. B=20 chickens and A=20 chickens to carry out this research work. One group was kept as control (group A) and another as treatment (group B). Group B was supplemented with 0.25% of garlic solution of drinking water and group A was provided with fresh water all the time. Weekly observations were recorded for live body weight till 6 weeks of age and for blood parameters of birds at 17 and 35 days of age. The birds of the treatment group was recorded statistically significant ($p<0.05$), i.e. higher live body weight than that of control group and no significant ($p<0.05$) differences or effects were observed in hematological parameters between treatment group B and control group A.

In this research work, the continuous treatment with garlic solution produced a significant ($p<0.05$) increased of the live body weight and have no significant ($p<0.05$) effect on blood parameters.

It is concluded that supplementation of 0.25% garlic solution of drinking water of in the treatment group shown significant increase in live body weight of the broilers and shown no effects on hematological elements as compared to that of control group of broiler birds.

In fact, only few trials have been performed to evaluate the medicinal value of garlic solution. Here garlic was used as growth promoter and as an alternative for antibiotic growth promoter. I did the work in short term basis (only for 42 days) and many required modern equipments were also not available. So, further trial on a large scale basis is needed to make the findings more accurate and effective. Further study is also essential to determine the different levels of treated group by exposing some organism in the experimental broilers before culling of experimental birds.

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