SYNERGISTIC EFFECT OF ALOEVERA (*Aloe barbadensis miller)* AND GARLIC (*Allium sativum)* ON THE PERFORMANCES OF BROILER

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CERTIFICATE

This is to certify that the thesis entitled, "SYNERGISTIC EFFECT OF ALOEVERA (Aloe barbadensis miller) and GARLIC (Allium sativum) ON THE PERFORMANCES OF BROILER"Submitted to the Department of Animal Nutrition, Genetics and Breeding, Faculty of Animal science and veterinary medicine, Sher-E-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of ***MASTER OF SCIENCE (MS) in Animal Nutrition*** *embodies the result of a piece of bonafide research work carried out by* ***SEPIA PAUL, Registration No. 17-08291*** *under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

I further certify that such help or source of information, as has been availed of during the course of this investigation has been duly acknowledged by her.

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Dedicated
To
My Beloved Parents

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The Author

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LIST OF ACRONYMS AND ABBREVIATION

ABBREVIATION		FULL MEANING
A.M	=	Ante meridian
ANOVA	=	Analysis Of variance
AVG	=	Aloevera and Garlic
BARC	=	Bangladesh Agricultural Research Council
BBS	=	Bangladesh Bureau of Statistics
BCR	=	Benefit Cost Ratio
BDT	=	Bangladeshi Taka
BLRI	=	Bangladesh Livestock Research Institute
BW	=	Body weight
BWG	=	Body weight gain
$CaCO_3$	=	Calcium Carbonate
CaO	=	Calcium Oxide
$Ca(OH)_2$	=	Calcium Hydroxide
CF	=	Crude Fibre
Cm	=	Centimeter
CO_2	=	Carbon Dioxide
CONT'D	=	Continued
CP	=	Crude Protein
DLS	=	Department of Livestock Services
DM	=	Dry Matter
DMI	=	Dry Matter Intake
DOC	=	Day Old Chick
DCP	=	Di-calcium phosphate
e.g.	=	For Example
et al.	=	And others/Associates
FC	=	Feed Consumption
FCR	=	Feed Conversion Ratio
Gm	=	Gram
GDP	=	Gross Domestic Product

LIST OF ACRONYMS AND ABBREVIATION (CONT'D)

ABBREVIATION		FULL MEANING
i.e.	=	That is
IB	=	Infectious Bronchitis
IBD	=	Infectious Bursal Disease
Kcal	=	Kilo-calorie
Kg	=	Kilogram
M.S.	=	Master of Science
ME	=	Metabolizable Energy
Ml	=	Mililitre
Mm	=	Milimeter
NDV	=	Newcastle Disease Vaccine
NS	=	Non-significant
P.M	=	Post meridian
Rh	=	Relative Humidity
SAU	=	Sher-e-Bangla Agricultural University
SE	=	Standard Error
SPSS	=	Statistical Package for Social Sciences

LIST OF SYMBOLS

SYMBOLS		FULL MEANING
*	=	5% level of significance
&	=	And
@	=	At the rate of
℃	=	Degree Celsius
℉	=	Degree Fahrenheit
$	=	Dollar
>	=	Greater than
<	=	Less than
/	=	Per
%	=	Percentage
±	=	Plus-minus
:	=	Ratio

SYNERGISTIC EFFECT OF ALOEVERA (*Aloe barbadensis miller)* AND GARLIC (*Allium sativum)* ON THE PERFORMANCES OF BROILER

ABSTRACT

A trial using 120 day old "Lohman strain (Indian River)" commercial broiler chicks were carried out on littered floor for a period of four weeks at Sher-e-Bangla Agricultural University Poultry Farm, Dhaka. The study was designed to investigate the efficacy of Aloevera and Garlic extract in drinking water in order to evaluate the bird's performance, carcass characteristics and economic utility on broiler rearing that includes production cost, profit per bird (PPB) and benefit cost ratio (BCR). The experimental birds were allocated randomly into 3 treatments and a control group with three replications having 8 broilers per replication. The AVG was mixed with drinking water at three concentration levels: 1% Aloevera gel of DW in DW (T_2), 1% Garlic of DW in DW (T_3), 0.5% Aloevera gel + 0.5% Garlic of DW in DW (T_4) and the group without AVG supplementation was control (T_0 and T_1). As per the result T_4 performed well according to the production performance. Results demonstrated that the average water intake in different groups were insignificant ($P>0.05$). A significant difference ($P<0.05$) was noted on body weight, feed consumption, body weight gain (BWG) in the birds treated with AVG. Additionally, Feed Conversion Ratio (FCR) had been improved. The better FCR was observed in combined AVG treated group, T_4 (1.31) than the other. A difference was figured on broilers survivability between the treatment groups and the control. Carcass percentage was significantly ($P<0.05$) higher in all treatment groups than control. Edible portion of birds was found significantly ($P<0.05$) higher in T_4 (67.00%±0.58) than T_2 (66.00%±0.58), T_3 (65.67%±0.33), T_1 (65.00%) and control T_0 (64.67%±0.67). The combination of aloevera and garlic was not cost effective due to the treatment cost. Where, the antibiotic positive and the antibiotic negative control were cost effective. However, negative control had been found with higher mortality than the other. It is reviewed that, though antibiotic promotes the growth, such type of practice reduces the natural improvement of gut environment as well as disease fighting capability, a reason behind reducing production in broiler industry. Therefore, the application of AVG will help naturally, in production without resistance. However, Aloevera & Garlic induced treatments (T_2, T_3, T_4) lead to less BCR and profit than controls (T_1, T_0). It is recommended that T_4 (0.5% Aloe+ 0.5% Garlic) can be used for safe broiler meat production rather than using antibiotics.

CHAPTER 1

INTRODUCTION

1.1 Background

Poultry industry is one of the important industries in Bangladesh in terms of employment avenue and source of protein supply at a cheaper price for the nation. Commercial poultry production has been growing rapidly in Bangladesh since early 1990 by using improved genetics, manufactured feeds and management. Bangladeshis consume 6.3kg broiler meat per capita per year out of total consumption around 40% share of Broiler meat. This profitable business is responsible for meeting up unemployment problem in young generation as we as for growing 198 registered commercial feed mills as per DLS which collectively produces 5.3 – 5.4 million metric ton. According to recent statistics, total poultry population in our country is 3470.35 million of which about 2892.83 million chicken and 577.52 million duck (DLS, 2019).

Poultry meat alone contributes 37% of the total meat production in Bangladesh. Poultry contributes about 22-27% of the total animal protein supply in the country (Prabakaran *et al*., 2003). The progress of the poultry industry in Bangladesh is mainly in the private sector. In the early 90s, a number of private parent stock poultry farms started their operations to produce commercial broiler and layer Day-Old chicks. During 1970-80, the poultry population growth rate was 0.7% which increased to 4% per year during 1990-2005. Since 1995, a significant annual average growth rate of 15-20% in commercial poultry has been achieved until 2007 and slow down after due to avian influenza outbreak (Da Silva *et al*., 2014).

In Bangladesh, the per capita requirements of meat and eggs are 120 g/day and 104 eggs/ year, respectively however the average per capita availability of meat and eggs are 124.9 g/day and 103.8 eggs/ year (DLS, 2019). The demand of meat consumption per head almost able to fulfill the requirement but egg consumption still lack 0.2%. Poultry can play a pivotal role to retain in meat production level and to achieve the expected egg production.

Chicken is the most common type of poultry in the world. Owing to the relative ease and low cost of raising them in comparison to animals such as cattle or hogs, chickens

have become prevalent throughout the cuisine of cultures around the world, and their meat has been variously adapted to regional tastes.

Total output from poultry is coming from broiler sector because of its commercialization and also rapid return to the farmers. However, diseases in production are problematic especially with the development of antibiotic-resistant bacteria. Lowered immunity arises the chance of disease occurrence into the farm. Therefore, exploring safe, green and efficient addictive that increase immunity in broilers has become a research priority.

1.2 State of the problem

The herbal supplement specially aloevera and garlic for production performance is practiced in broiler industry in lowest amount. Because enhanced broiler production depends on growth promoter. An antibiotic promotes the growth. However, such type of practice reduces the natural improvement of gut environment as well as disease fighting capability, a reason reducing production in broiler industry. Therefore, we have to use such type of agent which will help naturally, in production without resistance.

Aloevera and garlic has such active component giving them anti-inflammatory, wound-healing, anti-viral, antifungal, anti-tumor, anti-diabetic, and antioxidant effects. Beneficial effects of bioactive plant substances in animal nutrition may include the stimulation of appetite and feed intake, the improvement of endogenous digestive enzyme secretion, activation of immune responses and antibacterial, antiviral and antioxidant actions (Toghyani *et al*., 2011).

The mode of action of herbs and plant extracts has not been fully elucidated. Most of the herbs have antibacterial, coccidiostat, anthelmintic, anti-viral, anti-inflammatory or particularly, antioxidant properties. Herbs and spices can protect the feed against oxidative deterioration during storage. This is a widely used practice in the food industry. Herbs and their mixture can ameliorate the performance of birds by improving digestive tract function, by anti- inflammatory, anti-oxidative and anti-microbial effects and in addition some have influences on different physiological functions. Herbs may exert multiple functions in the bird's body system. Most of them act as sialogogues and stimulate the secretion of saliva, which makes swallowing easier. The extracts from *Salvia officinalis*, *Thymus vulgaris* and *Rosmarinus officinalis* and the blend of carvacrol, cinnamaldehyde and capsaicin improved feed digestibility in broilers.

The levels of multi-drug resistant bacteria have also increased. It is known that worldwide, more than 60% of all antibiotics that are produced find their use in animal production for both therapeutic and non-therapeutic purposes. The main reasons for the use of antibiotics in food-producing animals include prevention of infections, treatment of infections, promotion of growth and improvement in production in the farm animals.

The main reason for this is that in birds, the early gut colonization occurs during the development of the egg in the mother's oviduct. The chicks absorb microorganisms from the mother at this stage, as well as through the pores of the eggs during brooding. Once the chicks have hatched, they continue to enrich their microbiome by exposure to feces. However, in modern farming systems, the eggs are taken away from the mother and cleaned on the surface, which removes the beneficial bacteria. Also, when the eggs hatch, the chicks do not get access to an outdoor space where they would have access to feces and other sources of beneficial bacteria. They also do not interact with adult chickens. Finally, the crowded conditions that chickens often live in can cause heat stress. This, in turn, is a fertile ground for the development of E. coli and Salmonella infections. This is yet another example of how the environment can affect the birds' microbiome. So, birds have to depend on supplement of antibiotic growth promoter enzyme feed additive to promote gut environment along with meat production. However, highest use of them is taking part in generating the emergence of resistant bacteria for human and animal also.

So, investigation of alternative substances and strategies for animal growth promotion and disease prevention is an important issue which will reduce susceptibility to disease and increase survivability.

1.3 Justification of study

Aloevera, sometimes described as a "wonder plant," is a short-stemmed shrub. Aloe is a genus that contains more than 500 species of flowering succulent plants. Many Aloes occur naturally in North Africa. The leaves of aloevera are succulent, erect, and form a dense rosette. Many uses are made of the gel obtained from the plant's leaves. Aloevera has been the subject of much scientific study over the last few years, regarding several claimed therapeutic properties. The most important part of aloevera is its leaf which is composed of two main sections: latex and gel (Boudreau and Beland, 2006). The gel contained in aloevera leaves is composed of about 98.5% to 99.5% water (Femenia *et*

al., 1999), and the remaining dry matter contains more than 75 biologically active ingredients which have medicinal effects that are useful in treating diseases (Boudreau and Beland, 2006).

Garlic is an herb, related to onions, leeks, and chives. It is thought that garlic is native to Siberia, but spread to other parts of the world over 5000 years ago. Garlic cloves are used for consumption (raw or cooked) or for medicinal purposes. They have a characteristic pungent, spicy flavor that mellows and sweetens considerably with cooking. Many studies have indicated that allicin is the most potentially active component of garlic that is responsible for its characteristic odor, flavor as well as most of its biological properties (Heinrich *et al*., 2004). Improvement of broilers performance and carcass merits can be achieved by supplementation of diets with GP (Demir *et al*., 2003). The supplementation with aloevera and garlic has positive effects on the growth rates, feed efficiency, and livestock health (Rozbeh Fallah, 2015).

If we implement this study successfully, we hope every people in our country will be able to meet the requirement of broiler meat by increasing its production. In this article, we will look at some of these claims and investigate the research behind them.

1.4 Obectives

From the above consideration, the present study was undertaken to determine the efficacy of AVG (Aloevera and Garlic) with the following specific objectives:

- To assess the level of consumption of drinking water containing aloevera and garlic by broiler.
- To evaluate the production performance and carcass characteristics of broiler.
- To estimate the economical utility in broiler rearing.

CHAPTER 2

REVIEW OF LITERATURE

It is essential to review the previous research works which are related to the proposed study before conducting any type of survey or experiment. The literature reviewed here have been limited to those which are considered pertinent and related to the objectives of the present study.

Several compounds such as enzymes, organic acids, probiotics, prebiotics and phytogenic are used to improve the performance. Recently aromatic plants and their associated essential oils or extracts are being concerned as potentially growth promoters. These compounds have many effects as antimicrobial, stimulating animal digestive system, antioxidants, anticoccidail increase production of digestive enzymes and improve utilization of digestive products by enhancing liver functions (Ziarlarimi *et al*., 2011). Plant extracts and spices as single or mixed compounds can be used as a promotion of performance and health condition of the animal (Goodarzi *et al*., 2014). In literature aloevera and garlic are the most commonly used herbal in the feed componenet for poultry. The benefits of using these plants in animal feed are well recognized.

2.1 Aloevera

Aloevera is a succulent plant species of the genus Aloe. An evergreen perennial, it originates from the Arabian Peninsula but grows wild in tropical climates around the world and is cultivated for agricultural and medicinal uses. The species is also used for decorative purposes and grows successfully indoors as a potted plant.

It is found in many consumer products including beverages, skin lotion, cosmetics, or ointments for minor burns and sunburns. There is little clinical evidence for the effectiveness or safety of aloevera extract as a cosmetic or medicine.

Aloevera is used in traditional medicine as a skin treatment. In Ayurvedic medicine it is called kathalai, as are extracts from agave. Early records of aloevera use appear in the Ebers Papyrus from the 16th century BC and in Dioscorides' De Materia Medica and Pliny the Elder's Natural History – both written in the mid-first century AD. It is also written in the Juliana Anicia Codex of 512 AD.

Aloevera is a stemless or very short-stemmed plant growing to 60–100 cm (24–39 in) tall, spreading by offsets. The leaves are thick and fleshy, green to grey-green, with some varieties showing white flecks on their upper and lower stem surfaces. The margin of the leaf is serrated and has small white teeth. The flowers are produced in summer on a spike up to 90 cm (35 in) tall, each flower being pendulous, with a yellow tubular corolla 2–3 cm (0.8–1.2 in) long. Like other Aloe species, Aloevera forms arbuscular mycorrhiza, a symbiosis that allows the plant better access to mineral nutrients in soil.

Aloevera leaves contain phytochemicals under study for possible bioactivity, such as acetylated mannans, polymannans, anthraquinone C-glycosides, anthrones, and other anthraquinones, such as emodin and various lectins (Eshun & He, 2004 and King *et al*., 1995).

2.1.1. Composition of Aloevera

The botanical name of Aloevera is *Aloe barbadensis miller*. It belongs to Asphodelaceae (Liliaceae) family, and is a shrubby or arborescent, perennial, xerophytic, succulent, pea-green color plant. The aloe plant has long (up to 20 inches long and 5 inches wide), triangular, fleshy leaves that have spikes along the edges. The fresh parenchymal gel from the center of the leaf is clear; this part is sometimes dried to form aloevera concentrate or diluted with water to create aloe juice products. The sticky latex liquid is derived from the yellowish green pericyclic tubules that line the leaf (rind); this is the part that yields laxative anthraquinones. The flowers (not used medicinally) are yellow (Schulz, 1997).

From the gel

1.Polysaccharides: glucomannan and acemannan

2.Other: carboxypeptidase, magnesium, zinc, calcium, glucose, cholesterol, salicylic acid, prostaglandin precursors (gammalinolenic acid [GLA]), vitamins A, C, E, lignins, saponins, plant sterols and amino acids (Atherton, 1998)

From the latex leaf lining

3. Anthraquinone glycosides: aloin, aloe-emodin, barbaloin

Where it's grown

Aloes are indigenous to South Africa and South America, but are now cultivated worldwide except in tundra, deserts and rainforests. In the US aloe is commercially cultivated in Southern Texas.

2.1.2 General uses of Aloevera

Aloevera is used on facial tissues where it is promoted as a moisturizer and anti-irritant to reduce chafing of the nose. Cosmetic companies commonly add sap or other derivatives from Aloevera to products such as makeup, tissues, moisturizers, soaps, sunscreens, incense, shaving cream, or shampoos. A review of academic literature notes that its inclusion in many hygiene products is due to its "moisturizing emollient effect" (Eshun & He, 2004).

2.1.3 Medicinal uses of Aloevera

Aloevera Gel is widely used for the external treatment of minor wounds and inflammatory skin disorders. The gel is used in the treatment of minor skin irritations, including burns, bruises, and abrasions. The gel is further used in the cosmetics industry as a hydrating ingredient in liquids, creams, sun lotions, shaving creams, lip balms, healing ointments, and face packs (Davis *et al*, 1994).

Aloevera Gel has been traditionally used as a natural remedy for burns. Aloevera Gel has been effectively used in the treatment of first and second-degree thermal burns and radiation burns. Both thermal and radiation burns healed faster with less necrosis when treated with preparations containing Aloevera gel. In most cases the gel must be freshly prepared because of its sensitivity to enzymatic, oxidative, or microbial degradation. Aloevera Gel is not approved as an internal medication, and internal administration of the gel has not been shown to exert any consistent therapeutic effect.

Uses described in folk medicine, not supported by experimental or clinical data are for the treatment of acne, haemorrhoids, psoriasis, anaemia, glaucoma, petit ulcer, tuberculosis, blindness, seborrhoeic dermatitis, and fungal infections (Shelton, 1991 & Haller, 1990).

2.1.4 Healing properties of Aloevera

Various researchers reported that the effective components for wound healing may be tannic acid and a type of polysaccharide. Other researchers have also reported that glucomannan, a mannose-rich polysaccharide and gibberellin a growth hormone interacts with growth factor receptors on the fibroblast thereby stimulating its activity and proliferation, which in turn significantly increase collagen synthesis after topical and oral application. Aloe gel not only increases collagen content of the wound but also changed collagen composition and increased the degree of collagen cross linking. Due to this, it accelerated wound contraction and increased the breaking strength of resulting scar tissue. An increased synthesis of hyaluronic acid and dermatan sulfate in the granulation tissue of a healing.

2.1.5 Immunomodulatory action of Aloevera

Immunostimulant and anti-inflammatory (gel), In a case studies of 14 HIV-1 + patients showing significant increase in the number of circulating monocytes and macrophages which mirrored clinical improvements. In a pilot study in HIV-infected persons acemannan increased the number of white blood cells and improved symptoms. Aloe extracts also increased phagocytosis in asthmatic adults. Alprogen inhibit calcium influx into mast cells, thereby inhibiting the antigen-antibody-mediated release of histamine and leukotriene from mast cells. In a study on mice that had previously been implanted with murine sarcoma cells, acemannan stimulates the synthesis and release of interleukin -1(IL-1) and tumor necrosis factor from macrophages in mice, which in turn inhitiated an immune attack that resulted in necrosis and regression of the cancerous cells. Several low-molecular weight compounds are also capable of inhibiting the release of reactive.

2.1.6 Antimicrobial action of Aloevera

Aloevera contains 6 antiseptic agents: Lupeol, salicyclic acid, urea nitrogen, cinnamonic acid, phenols and sulfur. They all have inhibitory action on fungi, bacteria and viruses. Acemannan acts alone and synergistically with azidothymidine (AZT) and acyclovir to block reproduction of Herpes and the AIDS virus. Antifungal aloe extract treatment of guinea pig feet that had been infected with Trichophyton mentagrophytes resulted in a 70% growth inhibition compared with untreated animals. In recent studies, a polysaccharide fraction has shown to inhibit the binding of benzo a pyrene to primary

rat hepatocytes, thereby preventing the formation of potentially cancer-initiating benzo a pyrene-DNA adducts. An induction of glutathione S transferase and an inhibition of the tumorproting effects of phorbol myristic acetae has also been reported which suggest a possible benefit of using aloe gel in cancer chemoprevention.

2.1.7 Aloevera use for Skin and mucous membranes

In humans, aloe has been reported to accelerate healing from deep.

2.1.8 The effect of Aloevera on Growth Performance in Broiler

Waihenya *et al*. (2002) reported that the guts of *Aloe secundiflora* supplemented chickens were lined with a layer of Aloe material leads to decreased mortality rate during Salmonella infection.

Jagohan Singh *et al*. (2003) found that administration of aloevera in drinking water of broiler leads to increased dressing percentage.

Banna *et al*. (2013) found that inclusion of 0.5% combination of aloevera and *Allium sativum* in broiler feed diet leads to decreased shedding of faecal oocyst of *Eimeria* spp. And also improve feed conversion ratio.

According to Mehala and Moorthy (2008), the addition of aloevera in broiler feed leads to maintain beneficial microbial population, improve feed intake and efficient digestion.

Darabighane and Nahashon (2014) observed that, the inclusion of aloevera in broiler diet improve intestinal health, immune system response, growth performance and control coccidiosis.

According to Rozbeh (2015), addition of 1.5% aloevera gel in drinking water and 1.5%of garlic powder in diet of broiler birds reared for 42 days, lead to improve feed intake, low feed conversion ratio and increased body weight.

Meisam *et al*., (2016) concluded that the addition of 1% aloevera gel in broiler drinking water act as an alternative source for antibiotic growth promoter.

2.2 Garlic

Garlic (*Allium sativum*) is a species in the onion genus, Allium. Its close relatives include the onion, shallot, leek, chive and Chinese onion. Garlic is native to Central Asia and northeastern Iran, and has long been a common seasoning worldwide, with a history of several thousand years of human consumption and use It was known to ancient Egyptians, and has been used both as a food flavoring and as a traditional medicine. In Ancient Rome, it was "much used for food among the poor". China produces some 80% of the world's supply of garlic.

Allium sativum is a bulbous plant, growing up to 1 metre (3.3 ft) in height. If garlic is planted at the proper time and depth, it can be grown as far north as Alaska. It produces hermaphrodite flowers. It is pollinated by bees, butterflies, moths, and other insects.

Allium sativum grows in the wild in areas where it has become naturalized. The "wild garlic", "crow garlic", and "field garlic" of Britain are members of the species *Allium ursinum*, *Allium vineale*, and *Allium oleraceum*, respectively. Identification of the wild progenitor of common garlic is difficult, due to the sterility of its many cultivars which may all be descended from the species *Allium longicuspis*, which grows wild in central and southwestern Asia. There are at least 120 cultivars originating from Central Asia, making it the main center of garlic biodiversity.

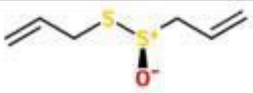
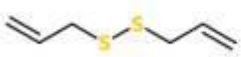
2.2.1 Composition of Garlic

The majority of reported medicinal effects of this botanical appear to come from the sulfur containing compounds, high trace mineral content, and enzymes. Most of the sulfur found in whole garlic cloves are of two types found in equal quantities: The S-alkylcysteine sulfoxides and the γ-glutamyl-S-alkylcysteines. The most abundant sulfur compound in garlic is alliin (S-allylcysteine sulfoxide), which is present at 10 mg/g in fresh garlic or 30 mg/g dry (Lawson, 1998). Recent studies from Korea has further elucidated novel sulfur containing nitrogenous compounds responsible for the greening process of crushed or bruised garlic. These compounds are not released when the garlic is finely peeled and have been found to differ significantly from other green plant pigents (Lee *et al*., 2007). It is clear that even with a plant medicine as well characterized as garlic, there is still much to be learned.

Typical garlic food preparation includes chopping, mincing, or crushing the garlic. When these traumas occur the odor-free cysteine sulfoxides are exposed to the allinase enzymes, and quickly convert to thiosulfanates, which give off garlic's characteristic aroma. The main thiosulfanate is allicin, which has a half-life of up to 16 hours at room temperature, or two and a half days when kept as a juice or crushed form. Other thiosulfanates include alliin, allyl cysteine and allyl disulfide. The allinase enzyme responsible for thiosulfanate conversion becomes inactivated below a pH of 3.5 or with heating. Microwave radiation will destroy allinase activity within one 1 minute. (Pedrazza-Cheverri *et al*., 2006).

2.2.2 Therapeutic Value of Ingredients

Up until recently, the therapeutic value of garlic has been attributed to the low-molecular weight thiosulfinates. Although allicin is considered the major antioxidant and scavenging compound, studies are showing that other compounds may play stronger roles (Chung, 2006). In addition, newer research has characterized some polar compounds of phenolic and steroidal origin, which proffer various pharmacological properties. These latter compounds, in contrast to the thiosulfinates, are without odor, and are also heat stable (Lanzotti, 2006). Furthermore, some of the scavenger properties of garlic are not affected by heating or cutting (Pedraza-Chaverri).

Compound	Molecular structure	Description
Allicin		This compound does not occur in garlic until it is crushed or injured (Londhe *et al*, 2011) (28)
DDS		Active against yeasts (Avato *et al*, 2000) (26).
Ajoene		The most active antiviral compound present in garlic (Weber *et al*, 1992) (52)
DTS		Active against yeasts (Avato *et al*, 2000) (26)
SAC		The most abundant organosulfur compound found in aged garlic extract (Cruz *et al*, 2007) (77)

2.2.3 General Uses of Garlic

Garlic (*Allium sativum*), is used widely as a flavoring in cooking, but it has also been used as a medicine throughout ancient and modern history; it has been taken to prevent and treat a wide range of conditions and diseases. Garlic may have a range of health benefits, both raw and cooked. It has significant antibiotic properties.

Currently, garlic is widely used for several conditions linked to the blood system and heart, including atherosclerosis (hardening of the arteries), high cholesterol, heart attack, coronary heart disease, and hypertension. Garlic is also used today by some people for the prevention of lung cancer, prostate cancer, breast cancer, stomach cancer, rectal cancer, and colon cancer.

It is important to add that only some of these uses are backed by research. A study published in the journal Food and Chemical Toxicology warned that short-term heating reduces the anti-inflammatory effects of fresh raw garlic extracts. This may be a problem for some people who do not like or cannot tolerate the taste and/or odor of fresh garlic.

Garlic has been used all over the world for thousands of years. Records indicate that garlic was in use when the Giza pyramids were built, about 5,000 years ago. Richard S. Rivlin wrote in the Journal of Nutrition that the ancient Greek physician Hippocrates (circa. 460-370 BC), known today as "the father of Western medicine," prescribed garlic for a wide range of conditions and illnesses. Hippocrates promoted the use of garlic for treating respiratory problems, parasites, poor digestion, and fatigue. The original Olympic athletes in Ancient Greece were given garlic - possibly the earliest example of "performance enhancing" agents used in sports.

2.2.4 Antiparasitic Activity of Garlic

An ultrastructural study showed that allicin is able to produce morphological changes in the male *Schistosoma mansoni*. Another study indicated that Allicin has antiparasitic activity against Plasmodium falciparum and Trypanosoma brucei. It is also effective against some major human intestinal protozoan parasites such as *Entamoeba histolytica* and *Giardia lamblia*. Diallyl trisulfide is a chemically stable final transformation product of allicin. The activity of diallyl trisulfide was investigated against several important protozoan parasites in vitro. The results indicated that the compound has the

potential to be used in the treatment of several human and animal parasitic diseases such as *Trypanosoma* spp, *Entamoeba histolytica* and *Giardia lamblia* (Lun *et al*., 1994 and Waag *et al*., 2010). Ajoene isolated from *Allium sativum* is an inhibitor of human glutathione reductase and *Trypanosoma cruzi* trypanothione reductase. The antiparasitic and cytostatic actions of ajoene may at least in part be due to the multiple effects on key enzymes of the antioxidant thiol metabolism. Alchinal is a preparation of three different substances including *Echinacea purpurea* and *Allium sativum* extracts and cocoa. It has been demonstrated that this preparation significantly decreases the number of adult forms and muscular larvae of *Trichinella spiralis*. It was demonstrated that after Alchinal administration, the number of adult forms and muscular larvae of this parasite was significantly decreased (Bany *et al*, 2003). Garlic oil is effective against a wide range of microorganisms including *Plasmodium* spp, *Trypanosoma* spp, *Leishmania* spp, *Giardia* spp, and *Cochlospermum planchonii*. Its aqueous extract has been shown to be effective against hymenolepiasis and giardiasis also. In an in vitro study the ethanol, dichloromethane and water extracts of *A. sativum* were shown to have anthelmintic activity against *Haemonchus contortus* from sheep. The ethanol extract was the most effective in decreasing larval count (Ahmed *et al*., 2012). Another study showed that garlic is effective against nematodes. Aqueous extract from garlic has good activity against *Trichuris muris* and *Angiostrongylus cantonensis* when followed by chloroform extract. Garlic is an ingredient of a mixture (Prepared from the extracts of coconut, onion, garlic, fig, date tree, chicory, ananas, and cistrose) tested in vivo and in vitro for its anthelmintic activity against cestodes (*Hymenolepis diminuta*, *Hymenolepis microstoma* and *Taenia taeniaeformis*) and trematodes (*Fasciola hepatica*, *Echinostoma caproni*). In all in vitro tests, the target parasites died. In addition, the same composition was effective against the intestinal fluke *Echinostoma caproni*, but not against the liver fluke *Fasciola hepatica* in the final host, while both worms were killed in vitro (Abdel-Ghaffar *et al*.,2011). Essential oil of *A. sativum* has paralytic effect on *F. gigantica*. The essential oil produced significant reduction in the frequency and the amplitude of the spontaneous muscular activity of whole fluke at 1 and 3 mg/ml concentrations. The extract of *A. sativum* also possesses mosquito larvicidal properties. It is effective against filarial mosquito *Culex quinquefasciatus* (after 24-hour treatment), *Cul. quinquefasciatus* and *Anopheles stephensi*. Essential oil from *A. sativum* has acaricidal activity against *Rhipicephalus*, *Boophilus microplus* (Canestrini) tick larvae. The insecticidal activity of *A. sativum* against larvae of *Aedes albopictus*

(Skuse), *Lycoriella ingénue*, and *Spodoptera litura* (1000 ppm) has also been proved (Meriga *et al*., 2012).

2.2.5 The effect of Garlic on Growth Performance in Broiler

A ban on the use of antibiotics apart from medical feeds was imposed by the European Commission in January 2006, following confirmation that some bacterial strains were resistant to antibiotics used in humans and animals (EC Regulation No. 1831/2003). This fact has triggered research on natural feed additives that exhibit antibacterial properties and protect the avian digestive tract against various pathogenic bacteria. In the digestive tract of birds, bacteria originating from feed, water and the environment can induce inflammatory processes, especially in the small intestine, thus impairing nutrient absorption, reducing chicken growth rate and productivity, and lowering immune resistance, as well as causing necrotic enteritis, which damages the mucosa by destroying the intestinal villi (Bedford, 2000; Annett *et al*., 2002; Dahiya *et al*., 2006). Ramiah *et al*. (2014) demonstrated that dietary supplementation of garlic, may improve the growth performance of broilers. other authors reported that the positive effect of garlic supplement in broilers feed diets (Kim *et al*., 2009; Park, 2008; Ordialez *et al*., 2016). The group of the birds fed a diet containing 3% garlic powder attained the highest hot weight, dressed weight, breast weight, fleshed breast weight and fleshed breast percentage(Eligab, 2013) Toghyani *et al*. (2011) noted that garlic and cinnamon are usually used as flavoring agents, there was the assumption that applying the foregoing spices in broiler diets may leave an influence on meat flavor and tenderness. Brzóska *et al*. (2015) reported that, incorporation of Garlic feed additives at the levels of 1.00, 1.50 and 2.25 ml per kg of diet increased the body weight of chickens at 42 days by 1.0, 3.5, and 5.8%, respectively, with control group. in contrast Pourali *et al*. (2010) reported that garlic supplementation at 0.2, 0.4, 0.6, and 1.0% had negligible influence on growth performance also, Horron *et al*. (1991); Onibi *et al*. (2009) Fadlalla *et al*. (2010), reported that garlic powder had no significant effect on the body weight gain and feed conversion ratio of birds.

Gastro Intestinal Development by Garlic Supplement

Inclusion of herbs in poultry diet initiates development and enzymatic activities of intestinal morph metric structure. Allicin content of allium family have the ability to change the physiological activities of chicken. Allicin in garlic promotes the

performance of the intestinal flora thereby improving digestion and enhancing the utilization of energy, leading to improved growth had been reported by (Pourali *et al*., 2010; okoleh and adeolu, 2014). Different researchers reported that positive effects of garic and onion on gut improvement. Ramakrishna *et al*. (2003) also suggested that garlic supplementation enhances the activity of pancreatic enzymes and provides an environment for better absorption of nutrients Structure of intestinal mucosa reflects the health condition of the intestine. Reported that the largest villus height in the duodenum was observed in 1.5% Garlic supplemented group as compared to villus height. Using garlic improved the villus height: crypt depth ratio compared to all other treatments. Saeid *et al*. (2013), who also reported the improved intestinal morphological characteristics like villi length and small crypts in birds receiving 0.5% garlic powder containing diet as compared to control.

Effect of Garlic on Mortality% of Chicken

Bird mortality decreased significantly, from 2.78% in the control group to 0.10–0.63% in the GFA supplemented groups ($P \leq 0.01$) by Brozska *et al*. (2015).

Effect of Garlic on Dressing % of Chicken

Dressing percentage was significantly higher in chickens from the GFA3 group compared to chickens from the control group ($P \leq 0.01$). As well, breast muscles of the GFA3 group were significantly heavier compared to the control group. The weight of muscles and gizzards did not differ significantly among the groups (Broszka *et al*., 2015).

Effect of Garlic on Carcass Characteristics

Chickens receiving 1.50 ml of GFA per kg had significantly heavier livers, and those fed 2.25 ml of GFA per kg had a greater amount of abdominal fat ($P \leq 0.01$) compared to the other chickens. No significant differences were found in the weight of skin and leg bones ($P \geq 0.01$). Expression of the weight of various carcass parts as a percentage of cold carcass weight showed no significant differences between the groups, with the highest value being liver weight as a percentage of carcass ($P \geq 0.05$). Chickens receiving 1.50 ml of GFA per kg diet differed significantly from the other groups in terms of the highest percentage of liver weight in carcass weight ($P \leq 0.01$). Economic benefits of onion and garlic as feed additives.

2.3 Previous result of Combined Aloevera & Garlic extract

Olupona *et al*. (2010) supplemented broiler drinking water with Aloevera and reported an increase in final body weight, weekly body weight gain, and average feed intake in the groups that received Aloevera. In addition, improvement in FCR was observed for broilers treated with Aloevera compared to the control group, but the difference was not significant. Sinurat *et al*. (2002) examined Aloevera gel and whole leaf added to broiler feed in both dry and fresh forms and found that adding fresh gel (0.25 g/kg) and dry gel (0.25 and 0.1 g/kg) improves FCR. The other researchers have examined potential effects of Aloevera on improving growth performance in broilers and found that Aloevera powder (0.1%, 0.3%, and 0.5%) added to the Feed of these broilers does not lead to significant difference in terms of body weight gain (Yim *et al*., 2011). However, particular attention must be paid to anti-bacterial activities and improvement in immune response as these two factors may contribute to better growth performance in broilers (Yang *et al*., 2009), and previous studies confirm these two properties (anti-bacterial effect and improvement in immune response) for aloevera. In fact, antibacterial properties of Aloevera improve intestinal microflora and reduce pathogens, thereby changing intestinal morphology and improving growth performance. On the other hand, by improving immune response in broilers and increasing body resistance, Aloevera indirectly affects growth performance. The improvement in weight gain of the birds using garlic in their rations may probably be due to the fact that allicin (an antibiotic substance found in garlic), inhibits the growth of intestinal bacteria such as S. aureus and E. coli and inhibit aflatoxin producing fungi (Fadlalla *et al*., 2010). Better feed conversion ratio of the broilers may be attributed to the antibacterial properties of this supplement, which resulted in better absorption of the nutrients present in the gut and finely leading to improvement in feed conversion ratio (Meraj, 1998). These findings were in agreement with the findings of (Yang *et al*., 2009; Sinurat *et al*., 2002; Yim *et al*., 2011; Olupona *et al*., 2010).

Several compounds such as enzymes, organic acids, probiotics, prebiotics and phytogenic are used to improve the performance. Recently aromatic plants and their associated essential oils or extracts are being concerned as potentially growth promoters. These compounds have many effects as antimicrobial, stimulating animal digestive system, antioxidants, anticoccidail increase production of digestive enzymes and improve utilization of digestive products by enhancing liver functions (Ziarlarimi

et al., 2011). Plant extracts and spices as single or mixed compounds can be used as a promotion of performance and health condition of the animal (Goodarzi *et al*., 2014). In literature aloevera and garlic are the most commonly used herbal in the feed componenet for poultry. The benefits of using these plants in animal feed are well recognized.

CHAPTER 3

MATERIALS AND METHODS

3.1 Study area

The experiment was carried out at Sher-e-Bangla Agricultural University (SAU experimental shed during the period of 26th August and 23th september 2019, for a period of 4 weeks using aloevera and garlic extract which are not commercially available. The experiment was performed by applying different concentration levels of Aloevera and Garlic extract in drinking water.

3.2 Study Period

The duration of total research period was about 1 month started from August to September, 2019.

3.3 Collection of experimental broilers

The day-old broiler chicks 120 in number of "Lohman meat (Indian River)" were purchased from Kazi Agro Complex Limited, Savar, Dhaka. All the chicks were examined for abnormalities and uniform size. Average body weight of the chicks was tried to maintain similar (about 40.74g±0.26).

3.4 Experimental materials

The collected chicks were carried to the university poultry farm early in the morning. They were kept in electric brooders equally by maintaining standard brooding protocol. Among 120 DOC, 72 chicks were selected and distributed randomly in three treatments of aloevera and garlic extract providing with drinking water; remaining 48 chicks were distributed another treatment for control.

For proper handling and data collection, the chicks of each treatment group were divided into three replications and in each replication, there were 8 birds. After 28 days of nursing and feeding, data were collected for the following parameters: amount of water intake, feed intake, live weight, body weight gain, feed conversion ratio, carcass characteristics, profit per bird and benefit-cost ratio.

3.5 Experimental treatments

To find out the effect of garlic and aloevera extract on broiler production, the experiment was carried out after 3rd days of age.

The aloevera, garlic and mixture of aloevera & garlic were added 10g, 10g and 5g aloe, 5g garlic respectively per litre of drinking water for each time. The experimental treatments were as follows:

T_1: Antibiotic supplement/ Positive Control group

T_2: 1% aloevera of drinking water

T_3: 1% garlic of drinking water

T_4: 0.5% garlic and 0.5% aloevera of drinking water

T_0: No aloevera or garlic supplement/ Control group

Table 1: Lay out of the experiment Treatment groups

Treatment Groups	No. of Replicants			Total
	R_1	R_2	R_3	
T_1	8	8	8	24
T_2	8	8	8	24
T_3	8	8	8	24
T_4	8	8	8	24
T_0	8	8	8	24
Total	40	40	40	120

3.6 Preparation of experimental treatment (Aloevera & Garlic)

3.6.1 Preparation of Aloevera extract

The oldest, largest about 8 inches (20 cm) long and richest of the leaves were used. Using a sharp knife at the base of the plant the outermost leaves of aloevera were Cut off. The yellow ooze produced in this step is a sap called aloe latex, was cleaned up. It

is not the aloevera gel, which is clear and thick in appearance and it has laxative properties that may mess up digestive tract. Because of the thinness of the top, pointed part of the aloevera leaf, the top thinnest portion was cut off and discard. Because it would waste more time trying to get gel from this portion than it is cost effective. Spine edges on either side of each leaf were removed. Carefully cutting them away, it is to remembered to move the knife away from myself so as to avoid potentially cutting myself in the process. It had to make sure that aloevera leaves should have to be dry before beginning that portion of the cutting as a slippery leaf could lead to potential accidents. The cut was made as close to the spines as possible to not to lose a lot of gel in the process. With leaf lying flat on a cutting board, carefully the skin of the aloevera leaf was sliced away. The knife was made run between it and the thick, clear gel at the center and that process was repeated for the remaining top layer by flipping it to the bottom. This time aloevera gel was obtained. Any bits of leaf on them was trimmed off. Before cutting aloevera leaves aloevera gel itself washed 2-3 times to make the gel free from latex a yellowish substance. Any excess gel left over along the skin was scraped up by a spoon. Gotten gel was stored in plastic container separating from the water.

The treatment group was provided with 1% Aloevera as mesh per liter of drinking water that was 10 gm aloe mesh per 1 liter of DW.

3.6.2 Preparation of Garlic extract

Peeling the garlic, cloves were peeled and removed any green sprouts (another source of bitterness). One easy way to peel garlic is to smash it with the side of a chef's knife, then pull off the loosened skin. Then garlic was chopped as finely as possible with a large, sharp chef's knife.

Garlic was processed in a blender. Until the garlic was evenly chopped into small pieces it was run into blender. Whenever the garlic was thrown to the sides then blender was made stop, then scrape it back down to the center using a rubber spatula.

Garlic mesh was used within three days at the 2nd week. Several outbreaks of botulism, a potentially fatal disease, have been linked to garlic storage. The bacteria that causes botulism can reproduce even in the refrigerator and does not cause any obvious changes in the paste's taste or appearance and the paste is safe to eat within three days. After 3 days, the leftovers were frozen or thrown away. Though, Garlic paste was made on a

daily basis and supplied with drinking water for the last 2 weeks. That slowed down the development of botulinum bacteria.

The treatment group was provided with 1% garlic as mash per liter of drinking water, that was 10 gm mesh per 1 liter of DW.

3.6.3 Preparation of Aloevera and Garlic Extract

Preparation of aloevera and garlic as mixture in DW was made by putting 0.5% aloevera and 0.5% garlic after weighing that is, 5g aloevera and 5 g garlic per 1 liter of DW.

3.7 Preparation of broiler house

The broiler shed was an open sided natural house. Cross ventilation system was provided by using wire-net. It was a tin shed house with concrete floor. There was 1ft. side wall around the shed with no ceiling. The floor was above 1ft. from the ground and the top of the roof was above 15ft. from the floor. Polythene sheet was hung around the side wall to protect the chicks from cold, storm, dust and heavy rainfall. The house was properly cleaned, rubbed with bleaching powder and washed the floor by using tap water and then disinfected by n-alkyl dimethyl benzyl ammonium chloride (Timsen TM) solution before starting the experiment. After proper drying, the house was divided into pens as per layout of the experiment by polythene sheet so that air cannot pass one pen to another. The height of pens was 5ft. Before placement of chicks the house was fumigated by formalin and potassium permanganate @500 ml formalin and 250 g potassium permanganate (i.e. 2:1) for 35 m^3 experimental area.

Starter and grower commercial Kazi broiler feed were purchased from the market. Starter diet was enriched with minimum: -

Name of ingredients:

Nutrient content of (%) starter diet

Nutrient	Amount (%)
Protein	21.0
Fat	6.0
Fiber	5.0

Nutrient	Amount (%)
Ash	8.0
Lysine	1.20
Methionine	0.49
Cysteine	0.40
Tryptophan	0.19
Threonine	0.79
Arginine	1.2

Nutrient content of (%) grower diet

Nutrient	Amount (%)
Protein	19.0
Fat	6.0
Fiber	5.0
Ash	8.0
Lysine	1.10
Methionine	0.47
Cysteine	0.39
Tryptophan	0.18
Threonine	0.75
Arginine	1.18

Feed were supplied 4 times daily by following Cobb 500 Management Manual and ad libitum drinking water was supplied 2 times daily.

3.8 Management procedures

Different aspects of the management of chicks, experimental events and management procedures are described in detail below:

3.8.1 Litter management

High absorbing bedding material was used as litter on the floor. Fresh, clean and sundried rice husk was used as shallow litter to absorb moisture from fecal discharge of broiler. The shallow litter was 5 cm (2 inch) in depth. About 250g calcium oxide powder was mixed with rice husk in every pen as disinfectant. At the end of each week the litter was harrowed to prevent accumulation of toxic gases and to reduce moisture and parasitic infection. At 3rd and 4th week of rearing period, droppings were cleaned from the surface level by removing a thin layer of litter and same amount new litter was placed in each pen.

3.8.2 Care of day-old chicks

Just after arrival of day-old chicks to the poultry house the initial weight of the chicks were recorded by a digital electronic balance, vaccination was done and distributed them under the hover for brooding. The chicks were supplied glucose water with vitamin-C to drink for the first 3 hours to overcome dehydration and transportation stress. Subsequently small feed particles were supplied on the newspapers to start feeding for the first 24 hours.

3.8.3 Brooding of baby chicks

Electric brooder was used to brood chicks. Partitioning brooding was done due to different experimental treatment. Each brooder had one hover and a round chick guard to protect chicks and four portioning chambers. Thereafter healthy baby chicks were randomly distributed to the pen according to the design of the experiment. The recommended brooding temperature was 35-21^{0}C from 1st to 4th weeks of age. Sometimes day temperature was 31-35^{0}C. So, at that time there was no need of extra heat to brood the baby chicks, but at night a 100-watt bulb was used in each pen to rise up low temperature according to heat requirement of brooding schedule. In case of high temperature cross ventilation was allowed by folding wall polythene and electric fans were used to reduce heat.

3.8.4 Feeding and drinking

Crumble feed was used as starter (0-2 wks.) and pellet feed for grower (3-4 wks.) ration. Ad libitum feeding was allowed for rapid growth of broiler chicks up to the end of the four weeks. Fresh clean drinking water was also supplied Ad libitum. Feeds were supplied 3 times: morning, noon and night; water 2 times: morning and evening daily. Left over feeds and water were recorded to calculate actual intake. Digital electronic balance and measuring plastic cylinder was used to take record of feed and water. Daily water consumption (ml) and weekly feed consumption (g)/bird were calculated to find out weekly and total consumption of feed and water. All feeders and drinkers were washed and sundried before starting the trial. One plastic made round feeder and one drinker were kept in the experimental pen. Feeder and drinker size were changed according to the age of the birds. Feeders were washed at the end of the week and drinkers once daily.

3.8.5 Lighting

At night there was provision of light in the broiler house to stimulate feed intake and rapid body growth. In summer and rainy season at night 4 energy lights were provided to ensure 24 hours light for the first 2 weeks. Thereafter 23 hours light and one-hour dark were scheduled up to marketable age. At night one-hour dark was provided in two times by half an hour.

3.8.6 Ventilation

The broiler shed was south facing and open-sided. Due to wire-net cross ventilation it was easy to remove polluted gases from the farm. Besides, on the basis of necessity ventilation was regulated by folding polythene screen.

3.8.7 Biosecurity measures

Biosecurity is a set of management practices that reduce the potential for introduction and spread of diseases causing organisms. To keep disease away from the broiler, farm the following vaccination, medication and sanitation program was undertaken. All groups of broiler chicks were supplied Vitamin B-Complex, Vitamin-ADEK, Vitamin-C, Ca and Vitamin-D enriched medicine and electrolytes.

3.8.8 Vaccination

The vaccines collected from medicine shop (Ceva Company) and applied to the experimental birds according to the vaccination schedule. One ampoule vaccine was diluted with distilled water according to the recommendation of the manufacturer. The cool chain of vaccine was maintained strictly up to vaccination. The vaccination schedule of broiler is shown in Table 2.

Table 2. Vaccination schedule

Age day	Name of Disease	Name of vaccine	Route vaccine
0	Infectious Bronchitis+ Newcaste disease (IB+ND)	CEVAC BIL	One drop in eye
09	Gumboro (IBD)	CEVAC IBDL	Drinking water
17	Gumboro (IBD)	CEVAC IBDL	Drinking Water

3.8.9 Medication

The broiler chicks were fed antibiotic drug against bacterial diseases. Ampicillin and oxytetracycline antibiotics were used only for antibiotic groups of birds. Besides vitamin B complex, vitamin-A, D3, E and sinacal-D were used against deficiency diseases. Electromin and vitamin-C also used to save the birds from heat stress. The medication program is presented in the table below:

Table 3. Medication program

Medication	Purpose	Dose	Period
Ultravit B+C	Vitamin B-complex+ vit C	1g/1L water	3-5 days (all groups)
Revit AD_3E	Vitamin A D & E	1 ml/5L water	3-5 days (all groups)
Electromin powder	Electrolytes	1g/2L water	Only in hot climate (all groups)

Medication	Purpose	Dose	Period
Calplex	Ca, P and Vit-D	10 ml/100 bird	3-5 days (all groups)
Oxytertacycline	Against bacterial diseases	1 ml/L water	Only for treatment purpose
COCCI-OFF (water soluble)	Anticoccidial	1g/ L water	Only for treatment purpose

3.8.10 Sanitation

Proper hygienic measures were maintained throughout the experimental period. Cleaning and washing of broiler shed and its premises were under a routine sanitation work. Flies and insects were controlled by spraying Phenol and Lysol to the surroundings of the broiler shed. The attendants used farm dress and shoe. There was a provision of Foot Bath at the entry gate of the broiler shed to prevent any probable contamination of diseases. Strict sanitary measures were followed during the experimental period.

3.9 Recorded parameters

Weekly live weight, weekly feed consumption and death of chicks to calculate mortality percent were taken during the study. FCR was calculated from final live weight and total feed consumption per bird in each replication. After slaughter carcass weight and gizzard, liver, spleen and heart were measured from each broiler. Dressing yield was calculated for each replication to find out dressing percentage.

3.10 Data collection

3.10.1 Consumption Of DW

During the study, the data of Consumption of treated and non-treated DW from broiler litter was collected daily at Morning from each replication of all treatment groups and untreated also. The average of the daily recorded Water Consumption was calculated.

3.10.2 Live weight

The initial day-old live weight and weekly live weight of each replication was kept to get final live weight record per bird.

3.10.3 Dressing yield

Dressing yield of bird was obtained from live weight subtracting blood, feathers, head, shank and inedible viscera.

3.10.4 Feed consumption

Daily feed consumption record of each replication was kept to get weekly and total feed consumption record per bird.

3.10.5 Survivability of chicks

Daily death record for each replication was counted up to 28 days of age to calculate mortality if occurred that indicated the survivability of the bird.

3.10.6 Dressing procedures of broiler

Three birds were picked up at random from each replicate at the 28th day of age and sacrificed to estimate dressing percent of broiler. All birds to be slaughtered were weighed and fasted by halal method or overnight (12 hours) but drinking water was provided ad-libitum during fasting to facilitate proper bleeding. All the live birds were weighed again prior to slaughter. Birds were slaughtered by severing jugular vein, carotid artery and the trachea by a single incision with a sharp knife and allowed to complete bleed out for at least 2 minutes. Outer skin was removed by sharp scissors and hand. Then the carcasses were washed manually to remove loose singed feathers and other foreign materials from the surface of the carcass. Heart and liver were removed from the remaining viscera by cutting them loose and then the gallbladder was removed from the liver. Cutting it loose in front of the proventriculus and then cutting with both incoming and outgoing tracts removed the gizzard. Dressing yield was found by subtracting blood, feathers, head, shank and digestive system from live weight.

3.11 Calculations

Each data was collected by the following formulae:

3.11.1 Live weight gain

The average body weight gain of each replication was calculated by deducting initial body weight from the final body weight of the birds.

$$Body\ weight\ gain = Final\ Weight - Initial\ Weight$$

3.11.2 Feed intake

Feed intake was calculated as the total feed consumption in a replication divided by number of birds in each replication.

$$\text{Feed intake (g/bird)} = \frac{Feed\ Intake\ in\ a\ replication}{No.\ of\ birds\ in\ a\ replication}$$

3.11.3 Feed conversion ratio

Feed conversion ratio (FCR) was calculated as the total feed consumption divided by weight gain in each replication.

$$FCR = \frac{Feed\ \ Intake\ (KG)}{Weight\ Gain\ (KG)}$$

3.11.4 Dressing percentage

Dressing yield was found by subtracting blood, feathers, head, shank and digestive system from live weight. Liver, heart, gizzard and neck were considered as giblet. Dressing percentage of bird was calculated by the following formula-

$$DP = \frac{DressingYield(gm)}{Live\ Weight(gm)} \times 100$$

Dressing yield= breast, thigh, drumstick, back, wing, giblet, abdominal fat weight (g)

3.12 Economic analysis

3.12.1 Cost record

The economic viability of AVG supplement for broiler production was evaluated on the basis of total expenditure incurred on the used inputs and the return from the sale of live birds. The production cost was calculated by considering the expenses involved

in chicks, feed, vaccine and medication, litter materials, disinfectant, electricity, labor and AVG. Being common in both the groups, the general inputs and outputs during the whole study were not considered for economic analysis. Feed cost was calculated by the average amount of feed consumed in each treatment on phase basis. Litter cost was calculated with the required amount of rice husk bags multiplying price divided by number of birds in each replication. Cost of AVG was calculated with the required amount multiplying price divided by number of replicated birds in each treatment groups. All expenses and income were calculated on the basis of market price (BDT) at the time of experimental period.

3.12.2 Benefit Cost Ratio (BCR)

The capital expenditure, recurring expenditure and depreciation cost were considered to calculate total expenditure. The major expenditure included cost of chick, feed, litter, medicine, vaccine, labor and electricity charges. The common expenditure per bird was found out from the total expenditure of one batch. Feed consumption, litter cost and AVG extract were not the same in different replications, so expenditures were calculated for every individual replication. Similarly, due to differences of live weight gain, the sale value of birds was calculated for every individual replication. The sale value of poultry manure and feed bags were also considered to compute income. Number of live birds in each replication considered here to calculate average value. Finally, treatment wise production cost and income was calculated. Net profit was found out by deducting the total expenditure from the total income according to replication under each treatment.

3.12.3 Profit per bird (PPB)

The benefit cost ratio was analyzed considering stocking density and feeding regime. The capital expenditure, recurring expenditure and depreciation cost were considered to calculate total expenditure. The major expenditure included cost of chick, feed, litter, medicine, vaccine, labor, electricity, AVG extract and ammonia test kit. The common expenditure per bird was found out from the total expenditure of one batch. The consumption of feed was not the same in different replications, so feed expenditure was calculated for every individual replication. Similarly, due to differences of live weight gain, the sale value of birds was calculated for every individual replication. The sale value of poultry manure and feed bags were also considered to compute income.

Number of live birds in each replication considered here to calculate average value. Finally, treatment wise production cost and income was calculated. Net profit per bird was found out by deducting the total expenditure from the total income according to replication under each treatment.

3.13 Statistical Analysis

Total data were compiled, tabulated and analyzed in accordance with the objectives of the study. Excel Program was practiced for preliminary data calculation. The collected data was subjected to statistical analysis by applying one-way ANOVA using Statistical Package for Social Sciences (SPSS version 16.0). Differences between means were tested using Duncan's multiple comparison test and significance was set at $P<0.05$.



Plate 1: Sanitary Activities before arrival of Day-Old Chick (DOC)

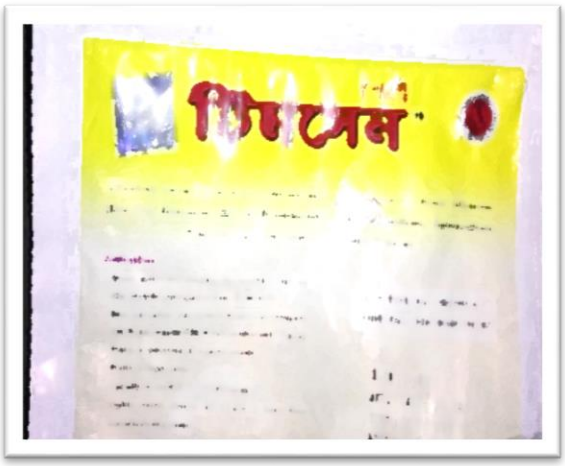
Plate 2: Arrival of Day-Old Chick (DOC)

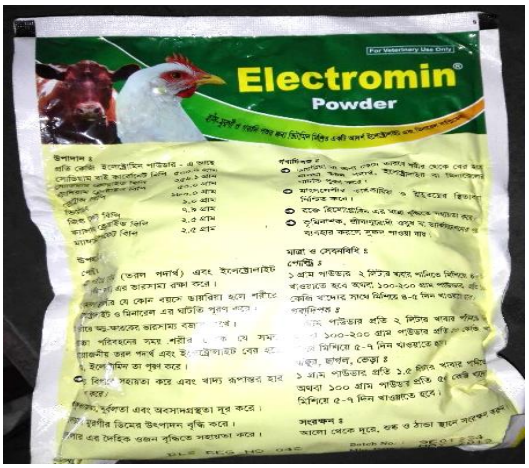
Plate 3: Preparation of Experimental Treatment (Aloevera & Garlic)

Plate 4: Assessment of Treated Water Consumption by the Broiler




Plate 5: Monitoring of Research Activities by the Supervisor





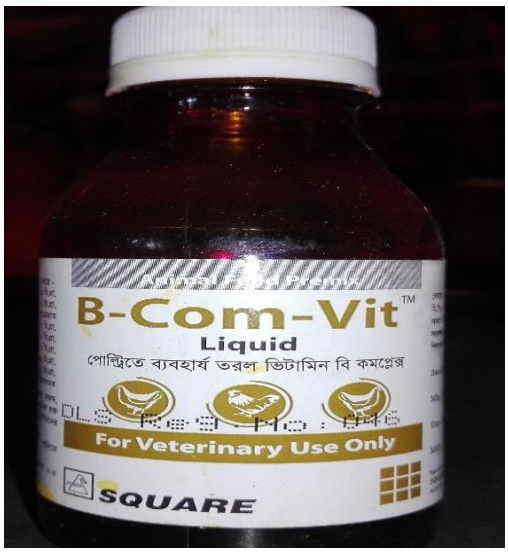


Plate 6: Different types of Medication and Vaccine used in the Experiment

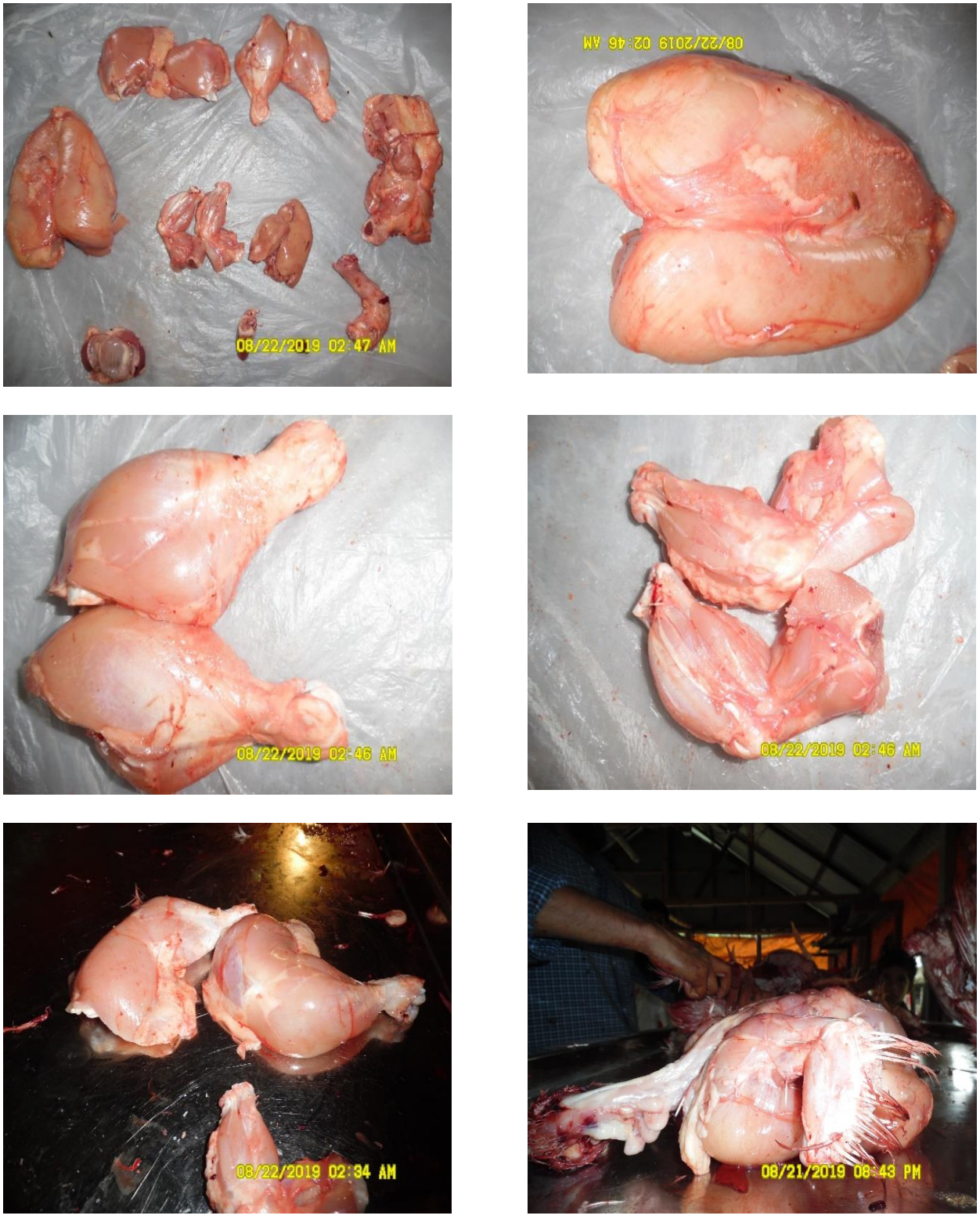


Plate 7: Weighing of Dressed Broiler

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Water intake

The amount of water intake in different treatment groups against the 28 days of rearing period of birds in different concentration level of aloevera and garlic had been shown in Table 4 and Figure 1. No significant difference in water intake was found among all treatment groups. However, water intake was comparatively higher in T_2 group at 2nd week, T_4 group at 3rd week and in control group at 4th week.

The result is similar to the previous researchers Odo *et al.* (2010) who reported no significant difference ($P > 0.05$) on water intake using aloevera in groups.

4.2 Production Performances of broiler

4.2.1 Final Live Weight

The relative final live weight (g) of broiler in the different groups T_0, T_1, T_2 T_3 and T_4 were 1798.5g±32.7, 1765.9g±30.2, 1791.4g±39.0, 1812.3g±12.9 and 1896.7g±55.4, respectively (Table 5 & Figure 2). The highest result was found in T_4 (1896.7g) and lowest result was in T_1 (1765.9g) and which was statistically significant ($P<0.05$). Results also demonstrated that the body weights also varied among the treatment groups having statistical significance ($P<0.05$) and T_4 showed comparatively higher.

These results are in harmony with those of previous researchers Olupona *et al.* (2010); Darabighane *et al.* (2011) who supplemented broiler drinking water with aloevera and reported an increase in final body weight. Tollba and Hassan (2003) stated that 0.5% garlic of the diet Improve broiler growth. Though Konjufca *et al.* (1997) reported that feeding garlic powder at levels of 1.5, 3 and 4.5% had no effect on bird's performance. On the other hand, Farhad *et al.* (2011) related that blends of medicinal plants including; garlic, cinnamon, thyme, rosemary and anise induced a significant ($P<0.05$) decrease in the live body weight at both 21 and 42 days as compared to control birds.

4.2.2 Weekly Body weight gain (BWG)

The data of weekly body weight gains of broiler chicks are presented in Table 6 & Figure 3. The mean body weight gains (g) at 1st, 2nd and 3rd week of different treatment groups were statistically insignificant (P>0.05). At 2^{nd} and 3^{rd} week all treatment groups had higher BWG than T_0 and T_1 group (control group). At the 3^{rd} week there were also higher body weight gain values recorded in treatment groups than control, but was statistically insignificant (P>0.05). The mean body weight gain at the end of 4th week or final BWG showed significant (P<0.05) differences among the groups where, T_4 had higher body weight gain than T_3, T_0, T_2 and T_1 sequentially.

Results are positively related to the result of those of previous researchers Olupona *et al.* (2010). They supplemented broiler drinking water with aloevera and reported an increase in weekly body weight gain. Tollba and Hassan (2003) stated that 0.5% garlic of the diet Improve broiler growth. Yet, Farhad *et al.* (2011) reported that blends of medicinal plants (garlic, cinnamon, thyme, rosemary and anise) including garlic induced a significant (P>0.05) decrease in the daily weight gain at both 21 and 42 days of age as compared to control birds. Additionally, Konjufca *et al.* 1997 informed that feeding garlic powder at the level of 1.5%, 3% and 4.5% had no effect on bird's weight gain.

4.2.3 Total Feed Consumption (FC)

Total feed consumption of different treated groups and control group have been cataloged in Table 5. Treatment T_4 consumed higher amount of feed (2428.1g±37.0) and T_1 group consumed a lower amount of feed (2284.5g±13.5), whereas T_3, T_0 and T_2 consumed 2381.2g±5.1, 2359.4g±7.0 and 2337.8g±1.7 respectively. Result in total feed consumption demonstrated that treatment and control groups showed significant (P>0.05) differences among them.

These results are in agreement with Rozbeh Fallah (2015) showed highest feed intake (g) in groups fed with 1.5% aloevera gel in drinking water + 1.5% garlic powder in diet and the lowest feed intake was shown in control group.

4.2.4 Weekly Feed consumption (WFC)

The mean of weekly feed consumption of broiler chicks in different groups; T_0, T_1, T_2, T_3 and T_4 showed in Table 7 & Figure 4. The result indicated that feed consumption for the 1st two weeks (starter phase) significantly ($P<0.05$) higher in T_4 group whereas during 3rd week feed consumption was significantly ($P<0.05$) higher in T_4 group and lower in T_1 groups. There was significant ($P>0.05$) difference in weekly feed consumption among the treated groups for the first 3 weeks. T_4 (aloevera and garlic) consumed higher than T_2, T_0, T_1 and T_3 at the end of 4^{th} week. Though, there was no significant ($P>0.05$) differences among groups.

The findings are partially correlated to those of previous researchers Olupona *et al.* (2010). They supplemented broiler drinking water with aloevera and reported an increase in average feed intake.

4.2.5 Feed Conversion Ratio (FCR)

The data of feed conversion ratio (FCR) of broilers under different treatment groups have been shown in Table 5. The lowest (1.31±0.02) feed conversion ratio (FCR) was found in birds, supplemented with combined treatment (T_4) than any other groups. However, feed conversion ratio (FCR) was lower in T_1 (1.32±0.01) and T_2 (1.33±0.03) groups compared to T_3 (1.34±0.01) and control group (1.34±0.02). Groups have no significant ($P<0.05$) differences among them on the basis of FCR.

The findings of the study are partially correlated to previous researcher Rozbeh Fallah (2015) who calculated the lowest FCR in the group fed with 1.5% aloe gel in drinking water + 1.5% garlic powder in diet and the highest of FCR was shown in the control group (1.94). Noman ZA *et al.* (2015) calculated FCR every 7 days: the best FCR was in 1% garlic group at 35th day. Olupona *et al.* (2010) supplemented broiler drinking water with aloevera and reported, improvement in FCR in broilers treated with aloevera compared to the control group, however the difference was not significant. Tollba and Hassan (2003) stated that 0.5% garlic of the diet Improve feed conversion ratio (FCR). Darabighane *et al.* (2011) in their study, on feeding broilers with aloevera gel added to diet, observed that, aloevera gel groups showed improved body weight gain compared to the control group, however no significant difference was observed in feed conversion ratio. Moreover, the aloevera gel groups had higher FCR than the antibiotic group.

4.2.6 Weekly Feed Conversion Ratio (WFCR)

The mean weekly FCR of broiler chicks in different groups were presented in Table 8 and Figure 5. The FCR of 1st week were nonsignificant (P>0.05) among the treated groups and control also. Yet, on the 2nd week, T_4 group showed significantly higher FCR than the treated and at 4th week T_0 group showed lower value than the other groups. Finally, on the 28th days the FCR which was final, was insignificant among different groups. However, the lowest and best FCR was observed in the T_4 group.

Results of the study for 1st week is contradictory to Mehala and Moorthy (2008). They fed broilers with aloevera powder (0.1% and 0.2%) and Curcuma longa powder (0.1% and 0.2%) additionally a mixture of these two powders and reported significant difference of FCR for the first week of treatment.

4.2.7 Survivability

Results presented in Table 5 revealed that the survivability of the broilers in the treatment groups were higher than the control group but that was statistically insignificant (P>0.05).

Findings are similar to Tollba and Hassan (2003), stating that 0.5% garlic of diet decreased mortality rate. Along with that, El-Banna *et al.* (2013) described that, due to Anticoccidial Activity of *Allium sativum* and *Aloevera*, total oocyst count in broiler significantly decreased. The experimental non-medicated infected chicks with mixed *Eimeria* spp had been induced with severe coccidiosis and led to high mortality reached to 36%. Addition of 100ppm aqueous extract of either *Allium Sativum* or aloevera alone or combination of both extracts reduced mortality to 2%, 4% and 2 % respectively.

4.3 Carcass characteristics

Carcass characteristics of the birds had shown in Table 9 and Figure 6, The result demonstrated that dressing or edible percentage was significantly (P<0.05) higher in all groups. Among the groups, T_4 had a greater eviscerated percentage (59.00%±0.58) compared with the others T_3 (58.00%±0.58), T_2 (57.33%±0.33), T_1 (56.33%±0.33) and negative control T_0 (57.00%±0.58), respectively. Giblet percentage was significantly (P<0.05) higher in T_2 and T_1 groups and the lowest were in T_4 and T_0 group. Breast meat percentage was significant (P<0.05) in T_4, T_3, T_0, T_1 and T_2 sequentially. Drumstick percentage found significantly (P<0.05) higher in T_2 and lower in T_0 group. Edible

portion of birds was found significantly ($P<0.05$) higher in T_4 (67.00%±0.58) than T_2 (66.00%±0.58), T_3 (65.67%±0.33), T_1 (65.00%) and control T_0 (64.67%±0.67). The result demonstrated that dressing percentage was significantly ($P<0.05$) higher in all the treatment groups than the control.

Findings are positively related to the result of previous researchers Mirazul *et al.* (2017) reported highest dressing percentage at the supplementation of different level of aloe gel in DW. On the contrary, Sinurat *et al.* (2002) stated that supplementation of fresh Aloevera gel (0.25 g/kg) and dry Aloevera gel (1.0 g/kg) in broiler diet from 1 day old to 5 weeks of age, showed no significant effect on abdominal fat levels.

4.4 Economics

The cost of different treatment groups and control group presented in Table 10 and Figure 7. Production costs include feed cost, cost of aloevera and garlic and common costs (litter cost, vaccine, medicine, electricity etc.) for both the treated group and untreated group. Total expenditure per bird was significantly higher ($P<0.05$) in treated groups T_4, T_3 and T_2 which were 173.01TK±1.67, 165.41TK±0.23, 159.61TK±7.33 than control group. Feed cost was comparatively higher in T_4 and T_3 groups which were statistically significant ($P>0.05$).

The price of aloevera was BDT 30TK /leave; the price of garlic was 180TK/kg and the charge for incorporation in feeding was calculated. Cost of aloevera and garlic were added with the treatment groups and it was high in T_2 (22.22 TK/ bird) group than T_4 (16.74 TK/ bird) and T_3 (11.25 TK/ bird) according to different concentration level and composition of treatment. As T_2, T_3 and T_4 were 1% aloevera, 1% garlic and mixture of 0.5% aloevera & 0.5% garlic in drinking water, respectively. Profit per bird (PPB) and benefit cost ratio (BCR) also presented in Table 10, demonstrated the economic impact of the treatment groups compared with the untreated group. Return was calculated after selling the live birds per kg and profit was computed by subtracting the expenditure.

Profit per bird was higher in control group those were T_0 (98.62TK±4.56) and T_1 (95.62TK±3.65) than the treatment groups; T_4 (92.53TK±6.22), T_2 (91.19TK±12.69) and T_3(88.32TK±1.59). Among the treatment groups T_4 performed better than other treatment groups. BCR was also higher in control groups; T_0 (1.64±0.03) and T_1

(1.63±0.02); lower in treatment groups as per as follows; T_2 (1.58±0.10), T_3 (1.53±0.01), T_4 (1.53±0.03) represented in Table 10 and Figure 8. The BCR was statistically insignificant ($P<0.05$) among different groups.

These results are in agreement with those of previous researchers (Mirazul *et al.,* 2017) reported, mean feed cost and gross return per broiler were not affected by giving aloe extract to broilers in drinking water. In their result, among the treatment groups mean feed cost was not significant, however, higher gross return per broiler were found from 10ml aloe extract/lite of drinking water and 15 ml per liter of drinking water relatively, than other treatment groups like 5, 20 ml per liter of drinking water and control group.

The result of present study showed that addition of 0.5% aloevera gel in drinking water + 0.5% garlic in drinking water had best effect on broiler performance at 28 days of age. However, the combination of aloevera and garlic was not cost effective due to the cost of treatment. Yet, the benefits of AVG supplementation include (1) Improved body weight of birds (2) improved feed conversion (3) lower mortality which proves efficiency of AVG in the improvement of production.

Table 4: Effects of aloevera and garlic on consumption of water

Treatments	1st week	2nd week	3rd week	4th week
T_1	522.00±0.58	981.67 ±33.83	1247.00 ±53.97	2136.00 ±62.96
T_2	522.00±1.53	1016.67 ±23.47	1189.67 ±82.01	2190.67 ±52.74
T_3	522.00±0.58	986.67 ±30.66	1300.67 ±30.39	2095.67 ±45.32
T_4	521.67±0.88	999.67 ±20.93	1340.00 ±30.07	2221.33 ±82.19
T_0	522.33±0.33	899.00 ±53.63	1262.00 ±46.51	2246.00 ±21.00
Mean±SE	522.00±0.34	976.73 ±16.98	1267.87 ±23.94	2177.93 ±25.96

Here, T_0 = (Negative Control), T_1=Positive Control (Control with antibiotic) T_2= (1% Aloevera gel of drinking water), T_3 = (1% Garlic mash of drinking water), T_4 = (0.5% Aloevera and 0.5% Garlic of drinking Water). Values are Mean ± SE (n=15).

- Mean with different superscripts are significantly different ($P<0.05$)
- Mean within same superscripts don't differ ($P>0.05$) significantly
- SE= Standard Error
- Means significant at 5% level of significance ($P<0.05$)

Table 5: Effects of aloevera and garlic on Production performances of broiler

Treatments	Final live weight (g/bird)	Total FC (g/bird)	Total BWG (g/bird)	Final FCR	Survibility
T_1	1765.92^{b}±30.28	2284.52^{c}±13.55	1725.92^{b}±30.28	1.32±0.01	100.00±0.00
T_2	1791.42^{ab}±39.06	2337.82^{bc}±1.72	1751.42^{ab}±39.06	1.33±0.03	100.00±0.00
T_3	1812.34^{ab}±12.99	2381.21^{ab}±5.13	1772.34^{ab}±12.99	1.34±0.01	100.00±0.00
T_4	1896.70^{a}±55.42	2428.10^{a}±37.09	1856.70^{a}±55.42	1.31±0.02	100.00±0.00
T_0	1798.59^{ab}±32.75	2359.47^{b}±7.02	1758.59^{ab}±32.75	1.34±0.02	87.50±0.00
Mean±SE	1812.99±18.29	2358.22±14.41	1772.99±18.29	1.33±0.01	97.50±1.34

Here, T_0 = (Negative Control), T_1=Positive Control (Control with antibiotic) T_2= (1% Aloevera gel of drinking water), T_3 = (1% Garlic mash of drinking water), T_4 = (0.5% Aloevera and 0.5% Garlic of drinking Water). Values are Mean ± SE (n=15).

- **Mean with different superscripts are significantly different (P<0.05)**
- **Mean within same superscripts don't differ (P>0.05) significantly**
- **SE= Standard Error**
- **Means significant at 5% level of significance (P<0.05)**

Table 6: Effects of aloevera and garlic on body weight gain (BWG) (g/bird) of broiler at different weeks

Treatments	1st week BWG	2nd week BWG	3rd week BWG	4th week BWG
T_1	151.88±5.24	361.04±8.66	532.08±25.83	680.924^{b}±23.65
T_2	156.04±1.63	356.46±10.16	541.50±12.45	697.42^{ab}±19.71
T_3	155.42±2.21	369.58±6.55	570.67±5.14	676.67^{b}±9.35
T_4	166.69±5.81	371.82±10.88	565.82±19.84	752.37^{a}±20.71
T_0	152.50±6.42	351.25±3.61	501.92±30.47	752.92^{a}±8.71
Mean±SE	156.51±2.28	362.03±3.79	542.40±10.31	712.06±11.22

Here, T_0 = (Negative Control), T_1=Positive Control (Control with antibiotic) T_2= (1% Aloevera gel of drinking water), T_3 = (1% Garlic mash of drinking water), T_4 = (0.5% Aloevera and 0.5% Garlic of drinking Water). Values are Mean ± SE (n=15).

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- SE= Standard Error
- Means significant at 5% level of significance (P<0.05)

Table 7: Effects of aloevera and garlic on feed consumption (g/bird) of broiler at different weeks

Treatments	1st week FC	2nd week FC	3rd week FC	4th week FC
T_1	177.27^{b}±0.745	376.31^{c}±4.52	733.92^{b}±4.80	997.02±4.54
T_2	179.30^{ab}±0.463	368.63^{c}±2.10	785.44^{a}±4.98	1004.46±8.21
T_3	179.39^{ab}±0.263	408.81^{b}±8.45	797.21^{a}±4.49	995.81±2.43
T_4	184.45^{a}±3.322	431.33^{a}±3.18	800.50^{a}±11.73	1011.82±19.83
T_0	180.41^{ab}±0.92	396.16^{b}±8.74	778.70^{a}±3.38	1002.97±6.23
Mean±SE	431.33±3.18	396.25±6.45	779.15±6.87	1002.41±4.17

Here, T_0 = (Negative Control), T_1=Positive Control (Control with antibiotic) T_2= (1% Aloevera gel of drinking water), T_3 = (1% Garlic mash of drinking water), T_4 = (0.5% Aloevera and 0.5% Garlic of drinking Water). Values are Mean ± SE (n=15).

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- Means significant at 5% level of significance (P<0.05)

Table 8: Effects of aloevera and garlic on feed conversion ratio (FCR) of broiler at different weeks

Treatments	1st week FCR	2nd week FCR	3rd week FCR	4th week FCR	Final FCR
T_1	1.17±0.04	1.04^{c}±0.01	1.38±0.06	1.47^{a}±0.05	1.32±0.01
T_2	1.10 ±0.01	1.03^{c}±0.03	1.45±0.04	1.44^{ab}±0.04	1.33±0.03
T_3	1.15±0.01	1.10^{b}±0.03	1.40±0.01	1.47^{a}±0.02	1.34±0.01
T_4	1.11±0.04	1.16^{a}±0.03	1.42±0.03	1.35^{bc}±0.02	1.31±0.02
T_0	1.19±0.04	1.13^{b}±0.02	1.56±0.09	1.33^{c}±0.01	1.34±0.02
Mean±SE	1.15±0.01	1.09±0.02	1.44±0.03	1.41±0.02	1.33±0.01

Here, T_0 = (Negative Control), T_1=Positive Control (Control with antibiotic) T_2= (1% Aloevera gel of drinking water), T_3 = (1% Garlic mash of drinking water), T_4 = (0.5% Aloevera and 0.5% Garlic of drinking Water). Values are Mean ± SE (n=15).

- Mean with different superscripts are significantly different ($P<0.05$)
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Table 9: Effect of different treatment on carcass parameter of broiler

Treatments	*Eviscerated weight %	*Giblet %	**Breast meat %	**Drumstick %	*Edible %
T_1	56.33^{b}±0.33	8.00^{a}	41.67^{a}± 0.33	15.00^{a}	65.00^{b}
T_2	57.33^{b}±0.33	8.00^{a}	39.67^{b}±0.88	15.33^{a}±0.33	66.00^{ab}±0.58
T_3	58.00^{ab}±0.58	7.33^{b}±0.333	42.67^{a}±0.33	13.00^{b}±0.58	65.67^{ab}±0.33
T_4	59.00^{a}±0.58	7.00^{b}	43.00^{a}	15.00^{a}	67.00^{a}±0.58
T_0	57.00^{b}±0.58	7.00^{b}	42.33^{a}±0.33	13.00^{b}±0.58	64.67^{b}±0.67
Mean±SE	57.53±0.31	7.47±0.13	41.87±0.36	14.27±0.32	65.67±0.29

Here, T_0 = (Negative Control), T_1=Positive Control (Control with antibiotic) T_2= (1% Aloevera gel of drinking water), T_3 = (1% Garlic mesh of drinking water), T_4 = (0.5% Aloevera and 0.5% Garlic of drinking Water). Values are Mean ± SE (n=15).

- Mean with different superscripts are significantly different (P<0.05)
- Mean within same superscripts don't differ (P>0.05) significantly
- SE= Standard Error
- Means significant at 5% level of significance (P<0.05)
- Here * = % of live weight, ** = % of Eviscerated weight

Table 10: Eonomic impact of treatment on broiler production

Parameters	Treatments					
	T_1	T_2	T_3	T_4	T_0	Mean±SE
Feed Cost Per bird	102.80^{c}±0.61	105.20^{bc}±0.08	107.16^{ab}±0.23	109.27^{a}±1.67	106.18^{b}±0.32	106.12±0.65
Cost of treatment	1.81	22.22	11.25	16.74	0	10.404±2.28
Common Exp/Bird	47	47	47	47	47	47
Total Exp / Bird	151.61^{c}±0.61	159.61^{bc}±7.33	165.41^{ab}±0.23	173.01^{a}±1.67	153.18^{c}±0.32	160.56±2.47
selling price (BDT) per bird (140 TK/ Kg live weight)	247.23^{b}±4.24	250.80^{ab}±5.47	253.73^{ab}±1.82	265.54^{a}±7.76	251.80^{ab}±4.6	253.82±2.56
Profit per bird (BDT)	95.62±3.65	91.19±12.69	88.32±1.59	92.53±6.22	98.62±4.56	93.26±2.77
Benefit Cost Ratio	1.63±0.02	1.58±0.10	1.53±0.01	1.53±0.03	1.64±0.03	1.58±0.02

Here, T_0 = (Negative Control), T_1=Positive Control (Control with antibiotic) T_2= (1% Aloevera gel of drinking water), T_3 = (1% Garlic mash of drinking water), T_4 = (0.5% Aloevera and 0.5% Garlic of drinking Water). Values are Mean ± SE (n=15).

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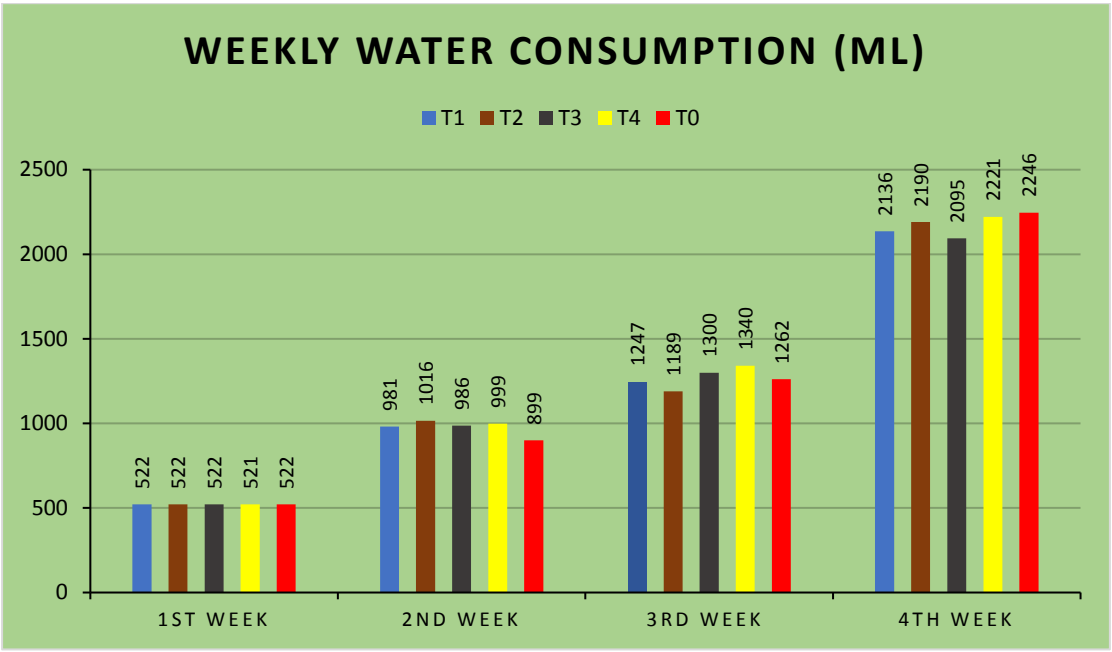

Figure 1. Effects of AVG on consumption of water (ml) by broiler

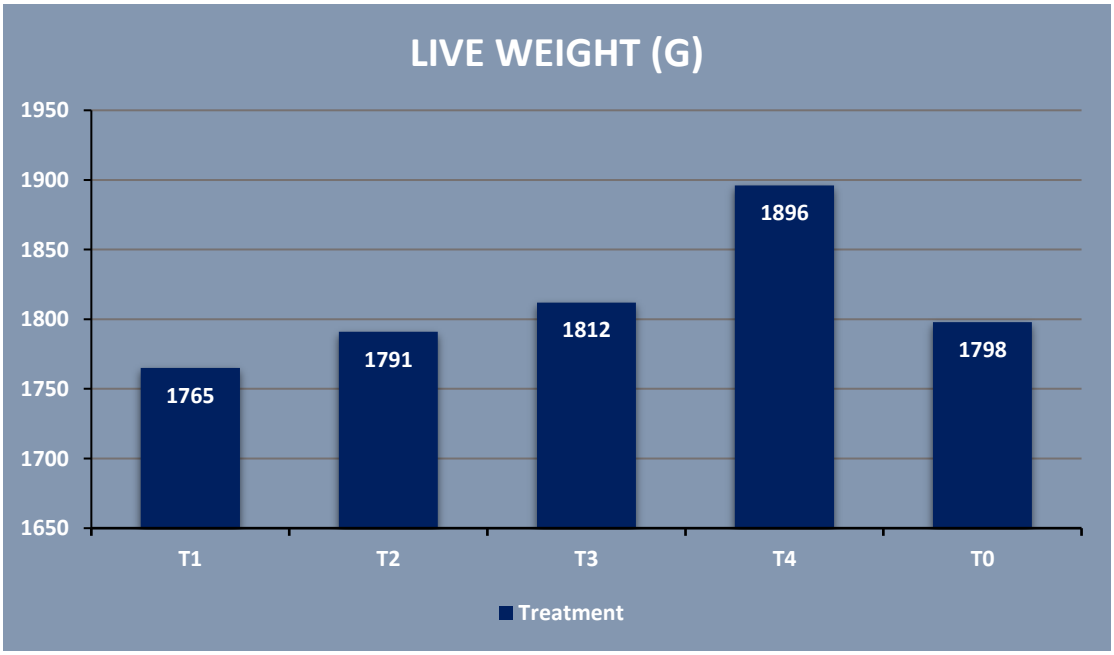

Figure 2. Effects of AVG on live weight (g) of broiler

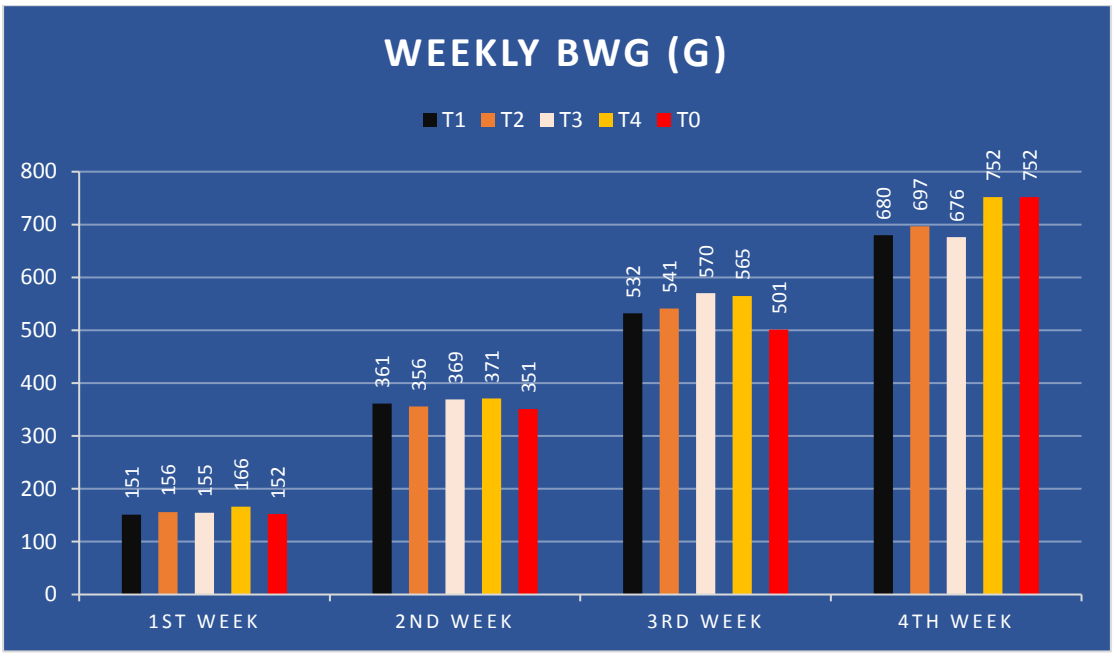

Figure 3. Effects of AVG on BWG (g) of broiler at different weeks

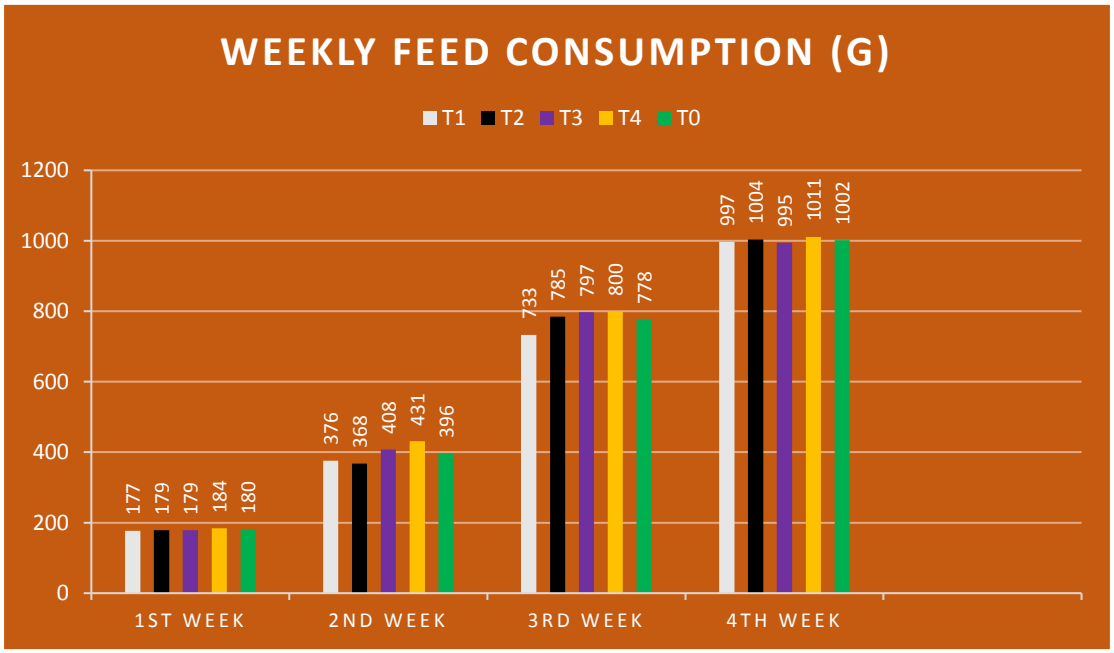

Figure 4. Effects of AVG on feed consumption (g) of broiler at different weeks

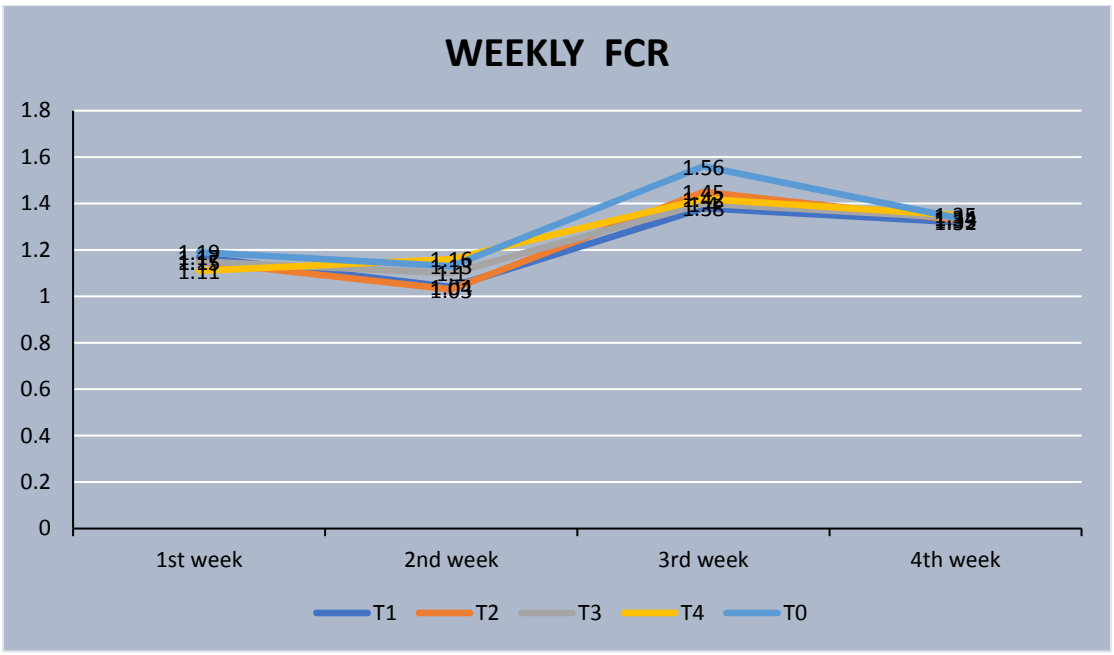

Figure 5. Effects of AVG on FCR of broiler at different weeks

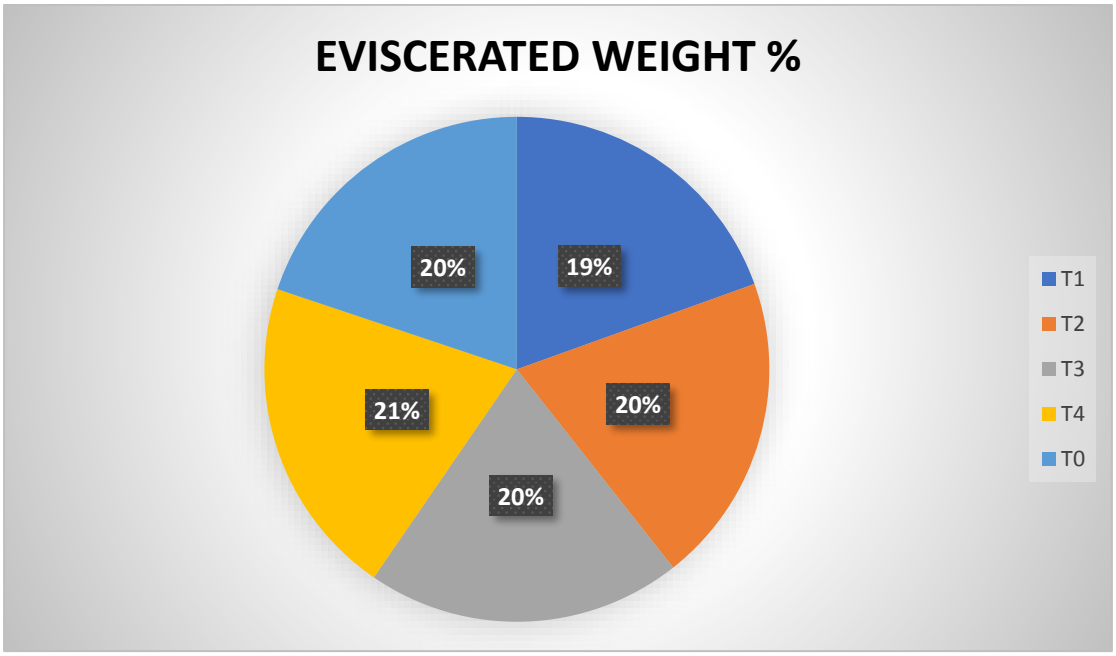

Figure 6. Effects of AVG on eviscerated weight (%) of broiler

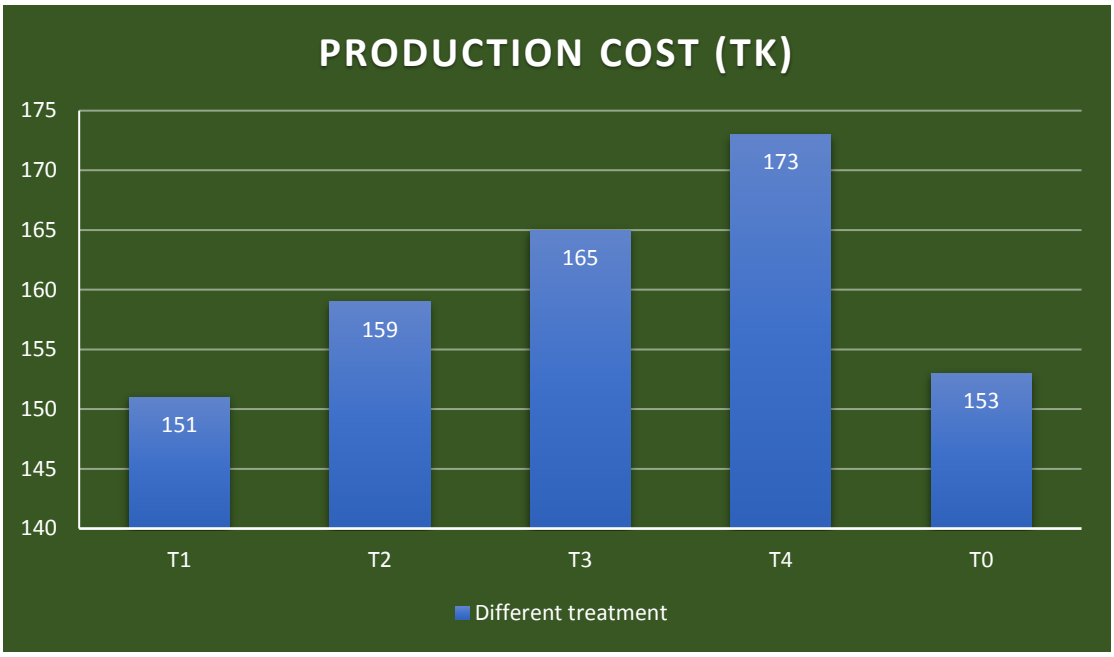

Figure 7. Effects of AVG on production cost (TK) per broiler

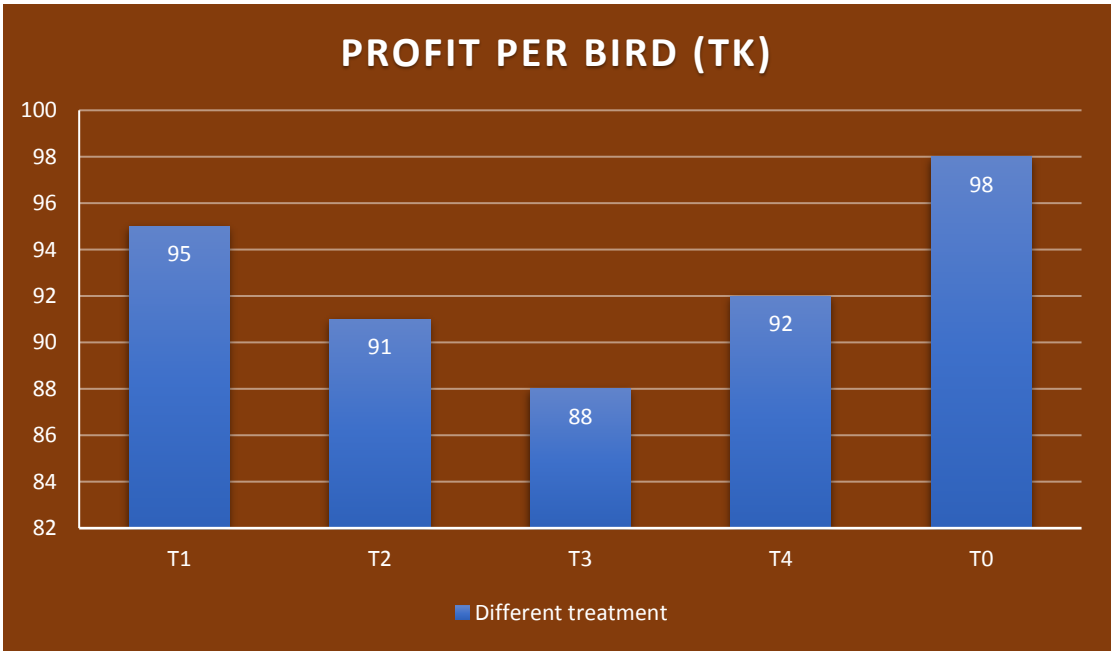

Figure 8. Effects of AVG on profit (TK) per broiler

CHAPTER 5

SUMMARY, CONCLUSION & RECOMMENDATION

The present study was conducted at the Poultry Farm of Sher-e-Bangla Agricultural University (SAU) for a period of four weeks using *Aloe barbadensis miller* and *Allium sativum* extract in drinking water. The experiment was performed to study different concentration of AVG extract with drinking water on broiler. The specific objectives of this study were undertaken to determine the efficacy of AVG extract i) To assess the level of consumption of drinking water containing aloevera and garlic by bird, ii) To evaluate the production performance and carcass characteristics of broiler, iii) to estimate the economical utility in broiler rearing. A total of 120 day-old "Lohman strain (Indian River)" broiler chicks were purchased from Kazi Agro Complex Limited, Savar, Dhaka Bangladesh. The experimental broilers were allocated randomly to 3 treatments and 2 control groups with three replications having 8 broilers per replication. The experiment lasted for 4 weeks and the treatment of various groups consisted of 1% Aloevera gel of DW in DW (T_2), 1% Garlic of DW in DW (T_3), 0.5% Aloevera gel + 0.5% Garlic of DW in DW (T_4) and the group without AVG supplementation was control (T_0 and T_1) i.e. antibiotic negative Control group & antibiotic positive Control group, respectively. The parameters evaluated in this study were measurement of the broiler's water consumption level, the bird's performance like body weight, feed consumption, FCR, survivability, carcass characteristics and economic impact on broiler rearing that includes production cost, profit per bird (PPB) and benefit cost ratio (BCR).

Results demonstrated that the average water intake in treated groups and untreated group were insignificant ($P>0.05$). However, water intake was comparatively higher in T_2 group at 2nd week, T_4 group at 3rd week and in control group at 4th week. A statistically significant difference ($P<0.05$) was noted on body weight, feed consumption, BWG and FCR value of the birds treated with AVG. Significant ($P<0.05$) final live weight was found highest in T_4 (1896.70g) and the lowest was in T_1 (1765.92g). T_4 consumed higher amount of feed (2428.10g±37.09) significantly ($P<0.05$) and T_1 consumed lower (2284.52g±13.55), whereas T_3, T_0 and T_2 consumed 2381.21g±5.13, 2359.47g±7.02and 2337.82g±1.72 respectively. Up to 3rd week they showed significant differences in feed intake. At the end of the experiment, T_4 and T_3

had higher body weight gains and other groups had the average. The lowest (1.31±0.02) feed conversion ratio (FCR) was found in birds, supplemented with AVG (T_4) than any other groups. Results revealed that the survivability in the treatment groups were higher (statistically insignificant) than the control groups. Dressing percentage was significantly ($P<0.05$) higher in all groups. Edible portion of birds were found significantly ($P<0.05$) higher in T_4 (67.00%±0.58) than T_2 (66.00%±0.58), T_3 (65.67%±0.33), T_1 (65.00%) and control T_0 (64.67%±0.67). Giblet percentage was significantly ($P<0.05$) higher in T_2 and T_1 groups and the lowest were in T_4 and T_0 group. Total expenditure per bird was significantly higher ($P<0.05$) in treated groups T_4, T_3 and T_2 than control group. Feed cost was comparatively higher in T_4 and T_3 groups which were statistically significant ($P>0.05$).

PPB and BCR were higher in control groups than treatment group, yet among the treatment groups T_2 performed better. The combination of aloevera and garlic and their single usage in DW, were not cost effective than control groups due to the treatment cost. Where, the antibiotic positive and the antibiotic negative control groups were cost effective. However, negative control had been found with higher mortality than the antibiotic and AVG (Aloevera and Garlic) treated group. It has been reviewed that antibiotic promotes the growth, though such type of practice reduces the natural improvement of gut environment as well as disease fighting capability, a reason behind reducing production in broiler industry. After all, the AVG combined group satisfied us much in respect of the production performance let alone the economic utility. Therefore, the application of AVG will help naturally, in production without resistance.

Finally, addition of 0.5% aloe+ 0.5% garlic in drinking water had best effect on broiler performance at 28 days of age.

However, Aloevera & Garlic induced treatments (T_2, T_3, T_4) lead to less BCR and profit than controls (T_1, T_0). It is recommended that T_4 (0.5% Aloe+ 0.5% Garlic) can be used for safe broiler meat production rather than using antibiotics.

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APPENDICES

Appendix 1: Recommended level of nutrients for broiler

Components	Starter	Grower
ME (kcal/kg)	3000	3100
CP%	22	20
Ca%	1.0	0.85
P(available) %	0.5	0.4
Lysine%	1.2	1.0
Methionine%	0.5	0.45
Tryptophan%	0.21	0.18

Source: Broiler Management Guide

Appendix 2: Nutrient composition of the ingredients used to formulate experimental diets

Ingredients	DM	ME (K.Cal/kg)	CP %	CF %	P %	Lys %	Meth %	Tryp %
Soybean meal	90	2710	44.5	7.5	0.23	2.57	0.76	0.57
Maize	89.5	3309	9.2	2.4	0.40	0.18	0.15	0.09
DCP					17.21			
Soybean oil	100	8800						
Protein Concentrate (jeso-prot)	91.64	2860	63.3	8.1	3.24	3.87	1.78	0.53
Meat and Bone meal	95.5	1044	14.6	2.5	12.11	0.66	0.24	0.12

Source: Broiler Management Guide

Appendix 3: Recorded Temperature & Relative Humidity% During Experiment

Age in weeks	Period	Average Temperature ^{0}C	Average Humidity %
1st	27.08.19-03.09.19	31.125	79
2nd	04.09.19-10.09.19	30	78.5
3rd	11.09.19-17. 09.19	29.64	78
4th	18.09.19-24.09.19	30.857	76.87

Appendix 4: Consumption of water (ml) under different treatments

Day	T_1			T_2			T_3			T_4			T_0		
	R_1	R_2	R_3	R_1	R_2	R_3	R_1	R_2	R_3	R_1	R_2	R_3	R_1	R_2	R_3
1	195	195	195	195	195	195	195	195	195	195	195	195	195	195	195
2	290	290	290	290	290	290	290	290	290	290	290	290	290	290	290
3	484	484	484	484	484	484	484	484	484	484	484	484	484	484	484
4	565	574	579	545	549	545	557	561	547	556	565	565	574	579	545
5	686	635	671	672	675	641	680	682	669	665	659	686	635	671	672
6	667	665	670	700	710	705	685	685	711	715	690	667	665	670	700
7	779	790	765	760	757	780	765	762	758	750	776	779	790	765	760
8	820	780	700	700	500	680	680	900	830	880	680	620	780	600	610
9	730	832	780	862	770	780	685	790	650	800	810	850	800	630	620
10	750	825	770	875	790	780	700	800	660	800	805	870	800	610	610
11	780	835	785	880	800	790	710	850	700	750	750	890	820	650	650
12	1350	1230	1150	1350	1320	1300	1410	1360	1390	1250	1210	1410	1250	1270	1280
13	1365	1250	1100	1375	1350	1320	1330	1330	1250	1285	1250	1050	1350	1050	1000
14	1380	1280	1120	1400	1380	1350	1250	1300	1150	1400	1200	1430	1240	1156	1100
15	900	720	1300	1200	1120	920	1300	1200	1070	1250	1150	1300	1120	1200	1100
16	1100	1000	1350	1320	1360	978	1320	1300	1215	1340	1275	1380	1170	1280	1170
17	1220	1380	1400	1370	1230	880	1285	1350	1300	1410	1400	1415	1220	1370	1300
18	1150	1350	1420	1420	1100	900	1250	1405	1250	1400	1320	1330	1330	1260	1150
19	1250	1400	1340	1400	1200	1250	1300	1450	1320	1420	1300	1350	1380	1420	1200
20	1270	1350	1330	1330	1220	1150	1350	1400	1335	1450	1240	1360	1350	1410	1167
21	1300	1340	1320	1230	1200	1210	1330	1350	1230	1440	1300	1310	1370	1400	1140
22	2250	2200	1800	1685	2150	1800	2150	2200	2050	1900	2100	2100	2280	2250	1900
23	2550	2450	2000	2450	2600	2150	2220	2000	2650	2300	2600	2020	2700	2700	2650
24	2000	2100	1900	2200	2250	2300	1700	1900	2100	1700	1700	1700	2480	1950	2270
25	2560	2250	1925	2500	2250	2000	2250	2300	2200	2450	2450	2700	2260	3000	2450
26	1900	2000	1960	1950	2150	1950	1600	2170	2000	1700	1950	2250	2200	2070	1700
27	2000	2250	2250	2350	2250	2200	2100	2000	2100	2200	2650	2700	1950	1950	2200
28	1990	2270	2250	2300	2270	2250	2100	2100	2120	2150	2700	2630	2000	1950	2260

Appendix 5: Weekly average water consumption (ml) by birds

Treatments	Replications	1st week	2nd week	3rd week	4th week
T_1	R_1	523	1025	1170	2179
	R_2	522	1005	1220	2217
	R_3	521	915	1351	2012
T_2	R_1	523	1063	1324	2205
	R_2	524	987	1204	2274
	R_3	519	1000	1041	2093
T_3	R_1	522	966	1305	2017
	R_2	521	1047	1351	2096
	R_3	523	947	1246	2174
T_4	R_1	520	1024	1387	2057
	R_2	522	958	1284	2307
	R_3	523	1017	1349	2300
T_0	R_1	522	1006	1277	2267
	R_2	522	852	1334	2267
	R_3	523	839	1175	2204

Appendix 6: Weekly Feed Consumption (FC) (g/bird) under different treatments

Treatments	Replications	1st week	2nd week	3rd week	4th week	Total
T_1	R_1	178.58	369.81	725.91	990.00	2264.30
	R_2	177.24	385.00	742.50	1005.51	2310.25
	R_3	176.00	374.11	733.35	995.54	2279.00
T_2	R_1	179.78	372.70	791.70	994.35	2338.53
	R_2	178.37	365.68	775.61	1020.71	2340.37
	R_3	179.74	367.50	789.00	998.31	2334.55
T_3	R_1	179.52	419.81	800.25	991.00	2390.57
	R_2	178.88	392.21	803.00	998.80	2372.89
	R_3	179.76	414.42	788.37	997.62	2380.17
T_4	R_1	184.83	426.00	795.00	999.49	2405.32
	R_2	190.00	437.00	823.00	1050.62	2500.62
	R_3	178.51	431.00	783.50	985.35	2378.35
T_0	R_1	182.86	398.48	783.38	998.23	2362.94
	R_2	183.58	410.00	780.57	995.37	2369.52
	R_3	178.49	380.00	772.14	1015.32	2345.95

Appendix 7: Weekly Body weight Gain (BWG) (g/bird) under different treatments

Treatments	Replications	1st week	2nd week	3rd week	4th week	Total
T_1	R_1	143.13	348.13	493.75	688.00	1673.00
	R_2	161.25	377.50	521.25	717.88	1777.88
	R_3	151.25	357.50	581.25	636.88	1726.88
T_2	R_1	156.25	375.00	548.75	727.13	1807.13
	R_2	153.13	354.38	558.50	705.00	1771.00
	R_3	158.75	340.00	517.25	660.13	1676.13
T_3	R_1	158.75	361.25	580.00	694.88	1794.88
	R_2	151.25	365.00	569.75	663.88	1749.88
	R_3	156.25	382.50	562.25	671.25	1772.25
T_4	R_1	155.75	365.50	543.75	723.13	1788.13
	R_2	175.57	393.01	605.42	792.40	1966.40
	R_3	168.75	356.95	548.30	741.57	1815.57
T_0	R_1	165.00	357.50	562.50	738.38	1823.38
	R_2	148.75	351.25	466.00	751.88	1717.88
	R_3	143.75	345.00	477.25	768.50	1734.50

Appendix 8: Weekly Feed Conversion Ratio (FCR) of birds under different treatments

Treatments	Replications	1st week	2nd week	3rd week	4th week	Final
T_1	R_1	1.25	1.06	1.47	1.44	1.35
	R_2	1.10	1.02	1.42	1.40	1.30
	R_3	1.16	1.05	1.26	1.56	1.32
T_2	R_1	1.15	0.99	1.44	1.37	1.29
	R_2	1.16	1.03	1.39	1.45	1.32
	R_3	1.13	1.08	1.53	1.51	1.39
T_3	R_1	1.13	1.16	1.38	1.43	1.33
	R_2	1.18	1.07	1.41	1.50	1.36
	R_3	1.15	1.08	1.40	1.49	1.34
T_4	R_1	1.19	1.17	1.46	1.38	1.35
	R_2	1.08	1.11	1.36	1.33	1.27
	R_3	1.06	1.21	1.43	1.33	1.31
T_0	R_1	1.11	1.11	1.39	1.35	1.30
	R_2	1.23	1.17	1.68	1.32	1.38
	R_3	1.24	1.10	1.62	1.32	1.35

Appendix 9: Average live weight, eviscerated weight and dressing percentage of broiler under different treatments

Treatments	Replications	Live weight (g)	Eviscerated weight(g)	Dressing percentage (%)
T_1	R_1	2030.00	1144.00	65
	R_2	2105.00	1181.00	65
	R_3	1955.00	1107.00	65
T_2	R_1	2173.00	1243.50	66
	R_2	2190.00	1244.00	65
	R_3	2156.00	1243.00	67
T_3	R_1	2151.50	1243.00	66
	R_2	2135.00	1212.00	65
	R_3	2168.00	1274.00	66
T_4	R_1	2307.50	1359.00	67
	R_2	2395.00	1384.00	66
	R_3	2220.00	1334.00	68
T_0	R_1	2019.50	1151.50	64
	R_2	1989.00	1162.00	66
	R_3	2050.00	1141.00	64

Appendix 10: Production performances of broiler under different treatments

Treatments	Replications	Final live weight (g/bird)	Total FC (g/bird)	Total BWG (g/bird)	Final FCR	Survivability (%)
T_1	R_1	1713.00	2264.30	1673.00	1.35	100
	R_2	1817.88	2310.25	1777.88	1.30	100
	R_3	1766.88	2279.00	1726.88	1.32	100
T_2	R_1	1847.13	2338.53	1807.13	1.29	100
	R_2	1811.00	2340.37	1771.00	1.32	100
	R_3	1716.13	2334.55	1676.13	1.39	100
T_3	R_1	1834.88	2390.57	1794.88	1.33	100
	R_2	1789.88	2372.89	1749.88	1.36	100
	R_3	1812.25	2380.17	1772.25	1.34	100
T_4	R_1	1828.13	2405.32	1788.13	1.35	100
	R_2	2006.40	2500.62	1966.40	1.27	100
	R_3	1855.57	2378.35	1815.57	1.31	100
T_0	R_1	1863.38	2362.94	1823.38	1.30	87.5
	R_2	1757.88	2369.52	1717.88	1.38	87.5
	R_3	1774.50	2345.95	1734.50	1.35	87.5

Appendix 11: Effect of different treatment on carcass parameter of broiler

Treatments	Replications	Eviscerated weight (%)	Giblet (%)	Breast meat (%)	Drumstick (%)	Edible (%)
T_1	R_1	56	8	42	15	65
	R_2	56	8	42	15	65
	R_3	57	8	41	15	65
T_2	R_1	57	8	40	15	66
	R_2	57	8	41	16	65
	R_3	58	8	38	15	67
T_3	R_1	58	7	43	13	66
	R_2	57	8	43	14	65
	R_3	59	7	42	12	66
T_4	R_1	59	7	43	15	67
	R_2	58	7	43	15	66
	R_3	60	7	43	15	68
T_0	R_1	57	7	42	13	64
	R_2	58	7	42	14	66
	R_3	56	7	43	12	64

Appendix 12: Weight of internal organ (g) & dressing (%) under different treatments

Treatments	Replications	Liver	Spleen	Gizzard	Heart
T_1	R_1	68.50	2.13	36.00	9.57
	R_2	76.00	2.34	37.00	9.68
	R_3	61.00	1.92	35.00	9.45
T_2	R_1	75.50	2.93	37.50	12.22
	R_2	69.00	2.97	39.00	13.34
	R_3	82.00	2.88	36.00	11.09
T_3	R_1	62.00	1.64	35.50	11.60
	R_2	63.00	1.80	41.00	11.80
	R_3	61.00	1.47	30.00	11.40
T_4	R_1	70.00	2.23	35.50	12.14
	R_2	76.00	2.22	36.00	12.00
	R_3	64.00	2.23	35.00	12.27
T_0	R_1	54.00	2.22	34.33	8.35
	R_2	54.00	1.98	31.00	8.70
	R_3	64.00	2.46	37.66	10.00

Appendix 13: Economic impact of treatments on broiler production

Treatments	Replications	Feed cost per bird	Cost of treatment	Common expenditure per bird	Total expenditure per bird
T_1	R_1	101.89	1.81	47.00	150.70
	R_2	103.96	1.81	47.00	152.77
	R_3	102.55	1.81	47.00	151.36
T_2	R_1	105.23	22.22	47.00	152.23
	R_2	105.32	22.22	47.00	152.32
	R_3	105.05	22.22	47.00	174.27
T_3	R_1	107.58	11.25	47.00	165.83
	R_2	106.78	11.25	47.00	165.03
	R_3	107.11	11.25	47.00	165.36
T_4	R_1	108.24	16.74	47.00	171.98
	R_2	112.53	16.74	47.00	176.27
	R_3	107.03	16.74	47.00	170.77
T_0	R_1	106.33	0	47.00	153.33
	R_2	106.63	0	47.00	153.63
	R_3	105.57	0	47.00	152.57

Appendix 14: Production cost of the birds under different treatments

Parameter	**Amount (BDT)**
Day-Old chick Cost (120 No.)	2160
Feed Cost (Around 6 Bags)	15863
Medicine & vaccine Cost	1060
litter cost	975
Aloevera Cost (20 Leaves)	800
Garlic Cost (2.25 kg)	405
Others	1488
Total	**22751**

Appendix 15: Selling price of the birds under different treatments

Treatments	Replications	Average live body weight /bird (Kg)	Selling price (BDT) (140 TK/ Kg live weight of bird)	Selling price (TK) per replication (8 Birds)
T_1	R_1	1713.00	239.82	1918.56
	R_2	1817.88	254.50	2036.02
	R_3	1766.88	247.36	1978.90
T_2	R_1	1847.13	258.60	2068.78
	R_2	1811.00	253.54	2028.32
	R_3	1716.13	240.26	1922.06
T_3	R_1	1834.88	256.88	2055.06
	R_2	1789.88	250.58	2004.66
	R_3	1812.25	253.72	2029.72
T_4	R_1	1828.13	255.94	2047.50
	R_2	2006.40	280.90	2247.20
	R_3	1855.57	259.78	2078.24
T_0	R_1	1863.38	260.87	2086.98
	R_2	1757.88	246.10	1968.82
	R_3	1774.50	248.43	1987.44

Appendix 16: Net return of the birds under different treatments

Treatments	Replications	Receipt per bird when sold (130 BDT/ Kg live weight)	Profit per bird (BDT)	Benefit Cost Ratio
T_1	R_1	239.82	89.12	1.59
	R_2	254.50	101.73	1.67
	R_3	247.36	96.00	1.63
T_2	R_1	258.60	84.15	1.48
	R_2	253.54	79.01	1.45
	R_3	240.26	65.98	1.38
T_3	R_1	256.88	91.06	1.55
	R_2	250.58	85.56	1.52
	R_3	253.72	88.36	1.53
T_4	R_1	255.94	83.97	1.49
	R_2	280.90	104.64	1.59
	R_3	259.78	89.02	1.52
T_0	R_1	260.87	107.54	1.70
	R_2	246.10	92.48	1.60
	R_3	248.43	95.87	1.63