

**DIETARY EFFECT OF CINNAMON ON THE GROWTH
PERFORMANCE OF BROILER**

A THESIS

BY

MD. RASEDUZZAMAN

Registration No. 1504084

Semester: July-December, 2022

MASTER OF SCIENCE (M.S.)

IN

POULTRY SCIENCE



**DEPARTMENT OF DAIRY AND POULTRY SCIENCE
HAJEE MOHAMMAD DANESH SCIENCE AND TECHNOLOGY
UNIVERSITY, DINAJPUR-5200**

DECEMBER, 2022

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**DEPARTMENT OF DAIRY AND POULTRY SCIENCE
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*Dedicated to
My
Beloved Parents
and
Teachers*

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The Author

ABSTRACT

This study was conducted to determine the efficacy of the dietary effect of different levels of cinnamon on growth performance and carcass traits of commercial broiler. The study was conducted at the Poultry farm of Hajee Mohammad Danesh Science and Technology University, Dinajpur during the period from 20 June to 18 July, 2023. A total of 120, day old broiler chicks (Hubbard-EP) were randomly and equally distributed to 4 groups having 3 replicates of 10 birds each. The birds were grouped as T₀, T₁, T₂ and T₃ group with normal feed, 0.5% cinnamon, 1% cinnamon, 2% cinnamon respectively. Body weight gains, Feed Conversion Ratio (FCR), mortality (%) and meat yield traits were recorded. The collected data were analyzed by using ANOVA with SPSS version 22. Feed intake (g/bird) was almost similar ($P>0.05$) among the dietary treatment groups. Body weight gain (g) and FCR were significantly ($P<0.05$) differed among the dietary treatment groups. The highest body weight was found in T₃ (1501.00g $\pm$ 8.74) followed by T₁ (1456.67g $\pm$ 2.33), T₀ (1363.00g $\pm$ 23.39) and T₂ (1359.00g $\pm$ 12.58), respectively. The lowest FCR was found in T₀ (1.48 $\pm$ 0.51) and the highest FCR in T₀ (1.63 $\pm$ 0.09), the intermediate in T₁ (1.62 $\pm$ 0.07) and T₂ (1.58 $\pm$ 0.87), respectively. It was found that there was significant ($P<0.05$) difference among the dietary treatment groups in case of live weight (g), carcass weight (g), breast weight (g), liver weight(g), but there was almost similar ($P>0.05$) among the dietary treatment groups in case of heart weight (g), spleen weight (g), thigh weight (%), head weight (g), intestine weight (g). Live weight carcass weight, thigh muscle, breast meat weight and breast meat was significantly ($P<0.05$) higher in treatment T₃ group compared to control group T₀. Mortality was found in T₁ (3.33%) and in T₂ (3.33%) dietary treatment groups during experimental period. Therefore, 2% cinnamon powder 2gm /kg feed may be used in broiler diet as growth promoter and it may also serve as an antioxidant.

Key words: Cinnamon, Broiler performance, Meat yield, mortality

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CHAPTER I

INTRODUCTION

The main sources of animal protein in the human diet worldwide are poultry meat and eggs (Nkukwana, 2018). Chickens reared for their meat rather than their ability to lay eggs are referred to as "broilers" in this situation. Chickens raised for broiler production have been chosen for their quick rate of growth and high carcass yields (Meluzzi and Sirri, 2009).

The demand for poultry meat and meat products has increased in recent years. The global production of chicken meat reached about 137 million tons in 2020, making poultry the most consumed meat in the world. Therefore, the poultry industry contributes significantly to animal protein consumption and to human nutrition and global food security (Diaz *et al.*, 2019).

Previous study, however, has shown that utilizing synthetic medications and vaccines in chicken feeds is not economically viable since it raises manufacturing costs and diminishes profit margins (Oluyemi and Roberts, 2000). It has also been known to be hazardous to the health of both birds and humans (Ali *et al.*, 2021; Mahfuz *et al.*, 2021; Sah *et al.*, 2021).

In recent years, the global chicken industry has faced rising challenges, including the demand for more sustainable and natural alternatives to conventional growth-promoting chemicals in broiler diets.

As consumer awareness of food safety and health concerns grows, so does interest in developing novel dietary supplements that can boost broiler chicken growth performance and overall health while using natural and eco-friendly methods.

Antibiotics are the principal growth promoting substances for poultry. However, the use of antibiotic as feed additives is risky due to cross resistance amongst pathogens and residues (Schwarz *et al.*, 2001). Antibiotic growth promoters (AGPs) have been banned in the poultry business due to rising bacterial resistance to synthetic antibiotics and more transparency on health and food safety issues (Reuben *et al.*, 2021) Now this practice is being followed by many countries. Use of antibiotic produce residual effect and increase the bacterial resistance against other human antibiotics, making severe concern to public

health. The antibiotic residue in poultry meat may produce a negative effect in human health, therefore the alternative to antibiotic, the growth promoters to improve health and production performance in broiler have been important. Thus, the poultry industry searched for economically viable alternative attempts for restriction on the use of antibiotics in birds norms by international health organizations (FDA, 1998). As a result , aromatic plants and essential oils extracted from these plants are becoming more important due to their antimicrobial effects (Valero and Salmeron, 2003) and their stimulating effect on animal digestive systems (Jamroz and Kamel, 2002).

Plant bioactive substances, such as phytochemicals, are becoming increasingly popular in poultry diets due to their potential antioxidant and anti-microbial benefits (Hashemi and Davoodi, 2011).

Cinnamon is a different organic additive that can be added to poultry feed as a nutritional booster to improve nutrient digestibility, hypocholesterolemia, blood physiological heat stress by maintaining water and electrolytic stability and feed consumption (Ali et al., 2021). Recently have seen increased interest from researchers in cinnamon, one of the most popular spices, as a natural good for poultry. Because of above mentioned properties, as well as their capacity to trigger digestive enzymes in the gut, cinnamon natural oils in especially are of importance. The main focus of this research is to find out the effects of using cinnamon powder on performance of broiler chickens. Ashraf *et al.* (2020)

Cinnamon a well-known and economically valuable spice, derived from the bark of trees belonging to the *Cinnamomum* genus, has a long history of medicinal effects on human health and culinary use due to its distinctive flavor and aroma (Bakkali *et al.*, 2008). Cinnamon has received attention in recent scientific studies as a viable dietary supplement in poultry nutrition due to its promising benefits in boosting growth performance and supporting general well-being . The main compounds of cinnamon oil are cinnamaldehyde, benzaldehyde, limonene, linalool and eugenol (Baratta *et al.*, 1998); the major constituent of cinnamon bark oil is cinnamaldehyde and, on the other hand, cinnamon leaf is rich in eugenol (Ranasinghe *et al.*, 2002). It has antioxidant properties and its action is mainly attributed to cinnamaldehyde and eugenol, substances that react with lipid and hydroxyl radicals converting them into stable products through their hydrogen donating ability (Jayaprakash *et al.*, 2007). Cinnamon has been attributed to

various health benefits in humans and animals. Among these potential benefits, there is increasing interest in understanding the dietary effects of cinnamon on broiler growth performance (Alagawany *et al.*, 2015).

The study also comprehensively investigating the dietary effects of cinnamon on broiler growth performance and carcass characteristics, This study aims to provide useful information for the poultry business. Furthermore, it aims to encourage sustainable poultry production practices that take advantage of the potential of natural feed additives like cinnamon to increase broiler performance while ensuring the supply of safe and high-quality poultry products to consumers.

In conclusion, this research endeavors to shed light on the dietary effects of cinnamon on broiler growth performance and carcass characteristics, contributing to the ongoing efforts to enhance poultry production and the rising demand for poultry meat in a sustainable and responsible manner. Hence, an experimental plan was designed to examine the effect of the inclusion of cinnamon powder extract in broiler feed and assess its potential as a dietary herbal supplement in broiler birds, with the following objectives:

1. To investigate the effect of cinnamon powder on the growth performance of broilers
2. To determine carcass characteristics of commercial broilers by supplementation with cinnamon powder.

CHAPTER 2

REVIEW OF LITERATURE

It is conceivable that herbal agents could serve as safer alternatives to AGP because of their suitability and preference. It lowers production costs, reduces toxicity risks, and reduces health threats. Growth promoters are feed additives that increase feed conversion by increasing the rate and uniformity of broiler growth. As a result, there is an impressive amount of interest in creating natural alternatives to AGP in order to maintain both the performance and health of birds. Cinnamon has been used in herbal therapy to reduce stress reactions, improve health performance, and boost immunological function. This summary evaluated the potential benefits of supplementing diets with cinnamon to optimize growth, carcass traits, and survivability to replace antibiotics as AGP.

2.1 Chemical properties of cinnamon

Senanayake *et al.* (1978) showed that Cinnamon consists of a variety of resinous compounds, including cinnamaldehyde, cinnamate, cinnamic acid, and numerous essential oils. Tung *et al.* (2008) reported the presence of a wide range of essential oils, such as trans-cinnamaldehyde, cinnamyl acetate, eugenol, L-borneol, caryophyllene oxide, β -caryophyllene, L-bornyl acetate, E-nerolidol, α -cubebene, α -terpineol, terpinolene, and α -thujene.

2.2 Cinnamon Nutrient Information per 8g (About 2 Cinnamon Sticks)

Principle	Nutrient Value	Dietary Reference Index (RDI)	Daily Value (%)
Energy	19.76 Kcal		
Carbohydrates	6.45 g	111.7 g	5.77%
Protein	0.32g	4.05 g	0.79%
Total Fat	0.10 g	31 g	0.32%
Cholesterol	0 mg	0%	0%
Dietary Fiber	4.2 g	31 g	13.5%
Vitamins			
Folate DFE	0 µg	N/A	0%
Niacin	0.107 mg	11.1 mg	0.97%
Riboflavin	0.003 mg	1 mg	0.3%
Thiamin	0.002 mg	1 mg	0.2%
Vitamin A, µg	1 µg	520 µg	0.19%%
Vitamin C	0.3 mg	58 mg	0.51%
Vitamin E	0.19 mg	11 mg	1.72%
Vitamin K	2.5 µg	67.56 µg	3.7%
Electrolytes			
Sodium, Na	0.8 mg		
Potassium	34 mg		
Minerals			
Calcium, Ca	80 mg	1000 mg	8%
Iron, Fe	0.67 mg	5 mg	10.63%
Magnesium	5 mg	275 mg	1.81%
Manganese	1.39 mg	1.88 mg	73.93%
Phosphorus	5 mg	71 mh	0.70%
Zinc	0.15 mg	8 mg	1.87%
Lipids			
Fatty Acids, total saturated	0.028 g	--	
Fatty acids, total monounsaturated	0.020 g		
Fatty acids, total polyunsaturated	0.005 g	--	
Cholesterol	0 g	--	
Other			
Caffeine	0 g		

Source: USDA, National Institutes of Health

2.3 Antioxidative properties of cinnamon

Mastura *et al.* (1999) expressed that cinnamon is often used for medicinal purposes due to its unique properties. The essential oil from *Cinnamomum zeylanicum* bark is rich in trans-cinnamaldehyde with antimicrobial effects against animal and plant pathogens, food poisoning and spoilage bacteria and fungi).

Jayaprakasha *et al.* (2002) observed that until now, more than 300 volatiles were found as constituents of essential oils of cinnamon. The essential oil derived from cinnamon leaves is rich in eugenol, that from the roots in camphor and that from the buds shows a high amount of sesquiterpenes (α -bergamotene and α -copaene)

Tomaino *et al.* (2005) noticed that it has been established that the oils and extracts from cinnamon possess a distinct antioxidant activity, which is especially attributed to the presence of phenolic and polyphenolic substances. These main properties of cinnamon are astringent, warming, stimulating, carminative, antiseptic, antifungal, antiviral, blood purifying, and aiding digestion. All of these properties of cinnamon make it a good medicinal plant. Cinnamon is more often used as a non-essential addition to other remedies than as a remedy by itself. The medicinal effects of cinnamon oil are very powerful, and there are many uses for it. However, principally it is used as an aromatic to cover the unpleasant taste of other drugs. The various terpenoids found in the spice essential oil are thought to be the reason for cinnamon's medicinal properties. Eugenol and cinnamaldehyde are two very important terpenoids found in cinnamon. Cinnamaldehyde and cinnamon oil vapors act as potent antifungal agents. The diterpenes found in the cinnamon oil have shown antiallergenic activity. The numerous uses of cinnamon as a medicinal herb imply the wide spread appreciation of its healing effects by herbalists worldwide. Unfortunately, often there is no scientific research to back up the claims that cinnamon does in fact have healing powers. Along with the medicinal effects come the side effects and interactions that medicinal cinnamon causes. Recent trends and developments in the area of animal nutrition have been characterized by an increasing interest in the potential impact of plants, herbs and spices on the immune function and antioxidant status of humans and animals. Research activities have been intensified; however, understanding of the specific mode of action and the functional aspects of phyto-genic additives still needs many more in depth studies.

Fabian *et al.* (2006) expressed that *Cinnamomum zeylanicum* essential oil was tested for an effect on intestinal cell viability (Antioxidant activities of volatile extracts isolated from cinnamon were evaluated by various in vitro assays. Dhuley (1999) showed that the contents of glutathione (GSH) and lipid-conjugated dienes were studied in rats fed a high-fat diet along with cinnamon and it was reported that cinnamon stimulates the activity of antioxidant enzymes (In addition, the effect of cinnamate, a phenolic compound found in cinnamon bark and other plant materials, on lipid metabolism and antioxidant enzyme activities in rats fed a high cholesterol diet has been studied and indicated that cinnamon suppresses lipid peroxidation via the enhancement of hepatic antioxidant enzyme activities (Kamath *et al.* 2003) noticed In a study of the wound healing action of an ethanol extract of cinnamon, the significant increase in wound healing was attributed to the antioxidant activity). Dragland *et al.* (2003) expressed that cinnamon constituents possess antioxidant action and may prove beneficial against free radical damage to cell membranes). Ranjbar *et al.* (2006) researched that cinnamon has a marked antioxidant potential and may be beneficial in alleviating the complications of many illnesses related to oxidative stress in humans. Mancini-Filho *et al.* (1998) reported that Cinnamon extracts are used regularly as food antioxidants, also improving food palatability.

2.4 Effect of Cinnamon Powder on Body Weight of Broiler Chickens

Safa Eltazi (2014) studied the effect of feeding broiler chicks on diets containing different levels of cinnamon powder as natural feed additive on productive performance and carcass characteristics. A total of two hundred one day old, unsexed (Habbard) broiler chicks were randomly divided into four experimental groups. Each group was further subdivided into five replicates at the rate of ten chicks per pen in complete randomized design. The birds were fed on two basal diets (starter and finisher diets). The cinnamon powder (*Cinnamomum verum*) was added to the basal diets at level (0.0, 3.0, 5.0 and 7.0%) resulting in four formulae respectively to group A, B, C and D with group A serving as control group. The experimental diets were fed for 6-weeks duration.

Adedeji *et al.* (2022) observed that cinnamon supplementation affected the body weight, feed consumption, weight increase, feed conversion ratio, and mortality rate significantly ($p < 0.05$).

2.5 Effect of cinnamon on the carcass quality of broiler

Qaid *et al.* (2022) showed that cinnamon improved some physicochemical properties with some affecting meat quality, such as decreasing MFI and increasing toughness in cinnamon-treated groups. In summary, it can be concluded that CBP can enhance the shelf life, carcass, and quality of birds' meat by maximizing the productive performance efficiency and breast meat productivity of birds under coccidiosis infestation.

2.6 Effect of cinnamon on Body Weight Gain

Alagawany *et al.* (2015) reported that the inclusion of cinnamon powder in broiler diets significantly improved body weight gain compared to the control group. Similarly, Khosravinia and Rostami (2017) found that cinnamon supplementation resulted in higher body weight in broilers when compared to the non-supplemented group. The mechanisms through which cinnamon powder enhances body weight gain in broilers are not fully elucidated. However, some researchers suggest that the antioxidant and anti-inflammatory properties of cinnamon may play a role in improving nutrient absorption and utilization, leading to enhanced growth rates in broiler chickens.

2.7 Antibacterial and Antimicrobial Properties

Alagawany *et al.* (2015) reported that Cinnamon has demonstrated significant antibacterial and antimicrobial effects against various pathogens. Its ability to inhibit the growth of harmful bacteria and fungi can positively influence gut health in poultry. Several studies have indicated that cinnamon supplementation in broiler diets reduces the presence of pathogenic bacteria, leading to improved gastrointestinal health.

2.8 Antioxidant and Anti-inflammatory Properties

Ashraf *et al.*, 2020) observed that the bioactive compounds found in cinnamon possess strong antioxidant and anti-inflammatory properties. These effects may aid in reducing oxidative stress and inflammation in poultry, contributing to improved immune responses and overall health. As a result, broilers receiving cinnamon supplementation may exhibit enhanced disease resistance and better growth performance.

2.9 Influence on Nutrient Digestibility

Khosravinia *et al.* (2017) noticed that Cinnamon has been suggested to enhance nutrient digestibility in broilers. The presence of cinnamaldehyde and other active compounds in cinnamon may promote the secretion of digestive enzymes, leading to increased nutrient absorption and utilization. Consequently, broilers fed with cinnamon-supplemented diets may show improved feed conversion efficiency and growth rates.

2.10 Gut Health and Microbiota Modulation

Windisch *et al.* (2008) showed that maintaining a balanced gut microbiota is crucial for optimal poultry health and performance. Cinnamon's antimicrobial properties can reduce the population of harmful bacteria in the gut, allowing for a more favorable microbial composition. This modulation of the gut microbiota may positively affect nutrient absorption, immune function, and overall gut integrity in broiler chickens.

CHAPTER-III

MATERIALS AND METHODS

3.1 Statement of the research work

The experiment was conducted at the poultry farm of Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur, to investigate the effect of different levels of cinnamon on the growth performance of broilers.

3.2 Collection of Experimental birds

A total of 120 one-day-old straight-run Cobb-500 commercial broiler chicks were used for this research work. The duration of the research work was 29 days (from June 20 to July 18, 2023). The broiler chicks (Cobb-500) were purchased from Aftab Hatchery Limited, Sadar, Dinajpur, Bangladesh.

3.3 Layout of the experiment

The day-old chicks were reared at brooder house to adjust with the environmental condition up to 7 days. After 7 days, chicks were randomly divided into four dietary treatment groups having three (3) replications in each and 10 birds per replications. The layout of the experiment is shown in Table 1.

Table 3.1: Layout of the experiment

Groups	Diatery Treatment	No. of chicks per Replication			Total Number
		R1	R2	R3	
T ₀	Basal Diet	10	10	10	30
T ₁	Basal Diet+0.5%Cinnamon powder	10	10	10	30
T ₂	Basal Diet+1%Cinnamon powder)	10	10	10	30
T ₃	Basal Diet+2%Cinnamon powder	10	10	10	30
Total					120

R= Replication

3.4 Procurement of feed ingredients

The required amounts of feed ingredients for making the experimental diets was procured from the local market of Dinajpur.

3.5 Collection of Cinnamon

Cinnamon were collected from local area of Dinajpur.



Figure 3.1: Cinnamon

3.6 Preparation of Cinnamon

For the preparation of the dust, the cinnamon was sun-dried for 10 days, followed by an oven at 55–60 °C for 2 days. The dried cinnamon was pulverized with a blender. A 25-unit mesh sieve was used to obtain the fine dust; after that, the dust was preserved in an airtight plastic container until it was directly used for screening and the preparation of water extract.



Figure 3.2: Cinnamon powder

3.7 Preparation of the Experimental Diet

Ready feed was used for the experimental study. At first, the required amount of ready-feed ingredients was weighted by a digital weighing balance. The experimental period was divided into two phases (broiler starter and broiler grower). The broiler chicks were fed broiler starter for 0 to 14 days and broiler grower for 15 to 28 days of age. The drinking water was measured with a beaker, and the first treatment group, T₀, supplied water without cinnamon, while the T₁, T₂, and T₃ groups were daily supplied with 0.5 g cinnamon per liter, 1 g cinnamon per liter, and 2 g cinnamon per kg of feed, respectively. During the time of mixing, cross-mixing was applied. Mixing was done manually.

3.8 Care and control of the experimental birds

During the study period, the treatment groups all received the same care and management. Each chick was weighed separately before the experiment began, recording their original body weight. The following management procedures were used during the entire study period, and they were the same for all food groups.

3.9 Management practices

3.9.1 Housing and equipment

Twelve cages, each with a floor area of 120 by 76 centimeters, made up the experimental home. The cages were thoroughly cleaned, washed, and bleached to sterilize them. The test home was thoroughly cleaned and scrubbed with hose-pipe-forced water. Then a solution of bleaching powder was used to sterilize the space. The room was cleaned with Virkon solution (50 ppm) after 15 days. A week before the arrival of the chicks, all feeders, plastic buckets, waterers, and other necessary equipment were also thoroughly cleaned, washed, and disinfected with bleaching powder solution.

3.9.2 Litter control

For the first seven days of the experiment, clean newspaper was used to cover the litter, and as the newspaper became soiled, it was taken off. After that, the birds were raised on a floor covered in 4 centimeters of rice husks. Calcium carbonate was put on the floor prior to the use of the litter. After the first week, the upper portion of the litter that contained the droppings was regularly removed and mixed three times a week until the experiment's conclusion. Every other day, Virocid® solution was used to disinfect the

litter. To avoid the buildup of ammonia and other dangerous gases, litter materials were removed when they were discovered to be damp for any cause. Litter was disturbed to break up its compactness at the end of each week.

3.9.3 Brooding control

The experiment was carried out during the summer (April to May 2019). When necessary, additional heat was delivered to brood the chicks. The brooding temperature was held at 34°C for the first week of age and subsequently dropped until they were adjusted to the usual environmental temperature of the house, with a final temperature of 28°C at the end of the experiment. A 200-watt electric light was installed in the center of the pen, about 12 inches above the floor, to offer additional heat. The height of the bulbs was increased by progressively lifting them as the temperature required. To defend against cold and severe winds, paper was used on two sides of the house and in ventilators. These sheets were partially or entirely removed, especially later in the finishing process when the surrounding climate seemed favorable. A thermometer was used to record the daily room temperature (°C) every six hours.



Figure 3.3: Brooding management

3.9.4 Lighting Control

Throughout the trial, all birds were subjected to 23 hours of continuous brightness and one hour of darkness per day. The dark period was used to familiarize the broilers with the possibility of darkness due to an electrical failure. An electric lamp set at a height of 2.8 meters was used to offer additional lighting at night.

3.9.5 Temperature

For the first week, the house temperature was kept at 34°C. During the trial period, the temperature gradually declined from 34°C to 32°C during the first week, 32°C to 30°C during the second week, 32°C to 28°C during the third week, and remained practically constant until the trial ended.

3.9.6 Floor, feeder, and water space

Each pen was given an area of 10 square feet for 10 birds, giving each bird 1 square foot of floor space. For eight birds, each pen had one round feeder and one round drinker; the amount of feeding and drinking area was determined by the number of birds in each replication.

3.9.7 Water and feed management

Feedings were given to the chicks on clean newspapers every three hours during the first three days. During the brooding stage, a linear feeder and a spherical plastic drinker were utilized. Following that, the linear feeder was replaced by a spherical plastic drinker. Feeds were weighted using a measuring balance and given three times per day (once in the morning, once at noon, and once at night) in treatments T_0 , T_1 , T_2 , and T_3 . Water was supplied twice daily (once at morning, and again at night). Feeders were cleaned at the end of each week and drinkers were washed daily.



Figure 3.4: Feeding of broiler



Figure 3.5: Watering of broiler

3.10 Routine administration

During the experiment, the following normal management processes are followed:

- litter management

- Bird floor space management
- Temperature management (broiler lighting)
- Feed and water management

At a depth of roughly 3cm, fresh and dry rice husks were employed as litter material. After 14 days, all of the old litter was replaced with new rice husks. To ensure the birds' comfort, the floor space allowed for each bird was one square foot. Because the study was conducted during the summer, when the ambient temperature exceeded 350 degrees Celsius, additional heat was not required. Despite the fact that the provision for brooding was maintained, it was not ready for an emergency meeting. To counteract adverse climatic conditions, gunny bags and jute fabric were placed around the broiler area.

3.11 Bird immunization

As part of a disease prevention initiative, birds were immunized against prevalent infectious diseases. At the ages of 5, 10, 17, and 21, all of the experimental broilers were vaccinated against New Castle disease (Ranikhet) and Infectious Bursal Disease (IBD) (Gumboro). All vaccines were given as directed by the manufacturer (one drop in each eye) during the colder portion of the day (morning). Vaccines were administered in accordance with the manufacturer's instructions, and the following schedule was followed:

Table 3.2: Vaccination schedule

SL. No	Age of vaccination	Name of vaccines	Trade Name	Company	*Doses	Method of vaccination
1	5 th day	IB+ND	Cevac IBD L	ACI	1000	Eye drop
2	10 th day	Gumboro	Hipra GM97	Hipra	Do	Drinking water
3	17 th day	ND	Cevac IBD L	ACI	Do	Do
4	21 st day	Gumboro	Hipra GM97	Hipra	Do	Do

*As per manufacturer's instructions

3.12 Clinical observation

The birds were critically observed twice a day for clinical signs if any (slow movement, infrequent sitting, lack of appetite, significant changes in feathering, paralysis, etc.).

3.13 Prescription medication

The chicks were given glucose and vitamin C immediately after being unpacked from the chick boxes to decrease stress during shipping. Water-soluble vitamins and normal saline were also supplied for the first three days of brooding. To combat the stress generated by the high exterior temperature (33 to 35°C), electrolytes and vitamin C were introduced into the drinking water.

3.14 Data collection and record keeping

The following records were kept during 28 days of rearing period:

- i. Feed consumption.
- ii. Feed conversion ratio.
- iii. Live weight
- iv. Mortality.
- v. Temperature: Three times daily during the experimental period.
- vi. Dressing yield: At the end of the experiment one broiler was slaughtered from each replication to estimate dressing yield.

3.15 Live weight gain

Birds were weighed in groups at the start of the trial and then every week at 7, 14, 21, and 28 days. A pan A balance was used for weighing. The average body weight gain of each replication was obtained by subtracting the birds' initial body weight from their end body weight.

$$\text{Body weight gain} = \text{Final weight} - \text{Initial weight}$$



Figure 3.6: Weighting of birds

3.16 Feed consumption

Feed was offered daily, and refusals were recorded at the conclusion of each week. The total feed consumption in a replication was divided by the number of birds in each replication to determine feed intake.

3.17 Feed Conversion Ratio

In each replication, the Feed Conversion Ratio (FCR) was measured by dividing total feed consumption by weight increase.

$$\text{CR} = \text{Feed intake (kg)} \div \text{Weight gain (kg)}$$

3.18 Temperature and relative humidity

During the experiment, the temperature and relative humidity (RH) of the experimental house and pens at chick level were measured twice a day (9 a.m. and 8 p.m.) using an automatic thermo hygrometer.

3.19 Mortality

Mortality was recorded daily treatment wise when occurred.

$$\text{Mortality rate (\%)} = (\text{No. of dead chickens} \div \text{Total no. of birds as a group}) \times 100$$

3.20 Processing of Broilers

After termination of the experiment, one bird weighing the average pen weight from each replication was selected randomly. Feed was withdrawn from the pens 24 hours prior to slaughter, but water was available to facilitate proper bleeding. Birds were slaughtered according to the halal method. Following slaughter, broilers were allowed to bleed for about 2 minutes. Then the birds were scaled in hot water (55–65 °C) for about 120 seconds in order to loosen the feathers of the carcasses, and weighed again. Breast meat, thigh meat, and drumstick meat were separated from the carcass. Finally, processing was performed by removing the head, shank, viscera, oil gland, kidney, and giblets. As soon as these were removed, the gall bladder was removed from the liver, and the pericardial sac and arteries were cut from the heart. Cutting it loose in front of the

proventriculus and then cutting with both incoming and outgoing tracts removed the gizzard. Then, it was split open with a knife, emptied and washed, and the lining removed by hand.



Figure 3.8: Carcass weight

3.21 Broiler production economics

The cost of broiler production for each treatment group was calculated using the market price of feed materials, the cost of chicks, citric acid, and acetic acid, as well as management costs (labor, medicine, electricity, and litter depreciation) at the time of the trial. The selling price per kg of live broiler was used to compute the income per kg of live broiler in each treatment group.

3.22 Statistical Analysis

In a Complete Randomized Design (CRD), data on various variables were subjected to analysis of variance (ANOVA) (Steel and Torrie, 1980). The analysis of variance (ANOVA) table was used to calculate the significant differences between the treatment means. All analyses were carried out with the "IBM SPSS Statistics 22" program.

CHAPTER IV

RESULTS AND DISCUSSION

This experiment was held under the department of Dairy and Poultry Science, Faculty of Veterinary and Animal Science, HSTU, Dinajpur. Day old chicks were randomly divided into 4 groups (T₀, T₁, T₂ and T₃) after 7 days for assessing the efficacy of Cinnamon as growth promoter on broiler birds.

4.1 Performance of broiler of experimental birds

This experiment was conducted to study on feed consumption, feed conversion ratio, live weight gain of birds and carcass traits were used as criteria of response of broiler to different dietary levels of Cinnamon presented in different tables and discussed under the following subheadings.

4.2 Effect of cinnamon on body weight gain

The effect of Cinnamon on body weight gain of broiler is shown in Table 4.1. The present study revealed that there was significant ($P>0.05$) variation of initial body weight (g/broiler) among the treatment groups. The initial body weight (g/broiler) in T₀, T₁, T₂ and T₃ group was 39.73 ± 0.64 , 38.97 ± 0.58 , 39.67 ± 0.73 and 40.57 ± 0.43 , respectively. The body weight was significantly ($P<0.05$) varied among the treatment groups during 7th, 14th, 21st, 28th days of age. The highest total body weight was found in T₃ (1471.57 ± 19.01) followed by T₂ (1424.34 ± 41.24), T₁ (1338.97 ± 6.68) and T₀ (1260.41 ± 15.14), respectively. The results of the present study are in line with the findings of Safa Eltazi (2014) who reported that dietary inclusion of cinnamon in the rations was more beneficial in broiler production. Similar results have also been reported by Bahera *et al.* (2020), who reported that broilers fed on rations with added turmeric, fetched more profit than those using rations without supplementation of this herbal growth promoter. Increase in the profit margin of the birds fed rations containing herbal growth promoter may be attributed to the better efficiency of feed utilization, which resulted in more growth and better feed conversion ratio, ultimately leading to higher profit margin in the broiler reared on polyherbal supplemented rations.

Table 4.1: Effect of cinnamon on body weight gain (g) and mortality in different dietary treatment groups of broiler

Age in day/ parameters	Dietary treatment groups (Mean±SEM)				Level of Significance
	T ₀	T ₁	T ₂	T ₃	
Initial body weight	39.73±0.64	38.97±0.58	39.67±0.73	40.57±0.43	NS
7 days	133.67±2.03 ^c	144.33±1.76 ^b	138.00±1.53 ^c	151.33±2.03 ^a	*
14 days	289.67±2.03 ^d	310.00±1.73 ^c	330.00±1.73 ^b	349.67±2.60 ^a	*
21 days	344.67±2.03 ^d	365.00±1.73 ^c	385.00±1.73 ^b	404.67±2.60 ^a	*
28 days	452.67±8.41 ^b	480.67±0.88 ^{ab}	531.67±35.52 ^a	525.33±11.35 ^a	*
Total body weight gain (1-28 days)	1260.41±15.14 ^d	1338.97±6.68 ^c	1424.34±41.24 ^b	1471.57±19.01 ^a	*
Mortality rate (%)	0.00	3.33	3.33	0.00	NS

T₀ = Control diet

T₁ = Control diet + 0.5% Cinnamon powder

T₂ = Control diet + 1% Cinnamon powder

T₃ = Control diet + 2% Cinnamon powder

Mean±SEM = Mean ± Standard error mean

^{abcd} means having different superscript in the same row differed significantly (P<0.05)

*= 5% level of significance

**= 1% level of significance

NS= Non significant

4.2 Effect cinnamon feed intake

The effect of cinnamon on feed intake of broiler is shown in Table 4.2. Feed intake (g/broiler) was significantly ($P<0.05$) varied among the treatment groups during 7th, 28th days of age and showed non-significant ($P>0.05$) among the treatment group during 14th and 21st days of age. The feed intake (g/broiler) in T₀, T₁, T₂ and T₃ was 2057 ± 46.79 , 2172.67 ± 20.48 , 2248.33 ± 77.05 and 2178 ± 28.65 , respectively. Feed intake was the lowest in dietary group T₀ (2057 ± 46.79) and the highest in dietary group T₂ (2248.33 ± 77.05). The cinnamon enhances the production of hydrochloric acid from stomach thus improving digestion through stimulation of histamine H₂ receptors. In addition, cinnamon has nutrient digestibility, hypocholesterolaemic, blood biochemical profile, gene expression, immunity, and particularly on gut health to alleviate the impact of disease and heat stress by maintaining water and electrolytic balance and feed intake (Ali *et al.*, 2021).

Table 4.2: Feed intakes (g) in different dietary treatment groups at different ages of birds

Age in day/ Parameters	Dietary treatment groups (Mean±SEM)				Level of Significance
	T ₀	T ₁	T ₂	T ₃	
7 days	197.00±5.77 ^c	242.67±1.45 ^a	234.67±0.67 ^{ab}	223.00±4.62 ^b	*
14 days	481.00±29.02	446.00±2.31	435.33±3.38	422.00±7.02	NS
21 days	609.33±8.82	632.33±0.88	677.33±46.49	681.00±15.01	NS
28 days	769.67±3.18 ^b	851.67±15.84 ^a	901.00±26.51 ^a	852.00±2.00 ^a	*
Final feed intake (1-28 days)	2057±46.79 ^c	2172.67±20.48 ^b	2248.33±77.05 ^a	2178±28.65 ^b	*

T₀ = Control diet

T₁ = Control diet + 0.5% Cinnamon powder

T₂ = Control diet + 1% Cinnamon powder

T₃ = Control diet + 2% Cinnamon powder

Mean±SEM = Mean ± Standard error mean

^{abcd} means having different superscript in the same row differed significantly (P<0.05)

*= 5% level of significance

**= 1% level of significance

NS= Non significant

4.3 Effect of Cinnamon powder on feed conversion ratio

The Feed Conversion Ratio (FCR) of the experimental birds is shown in Table 4.3. The lowest FCR was in dietary treatment group T₃ (1.48±0.51) and highest in dietary group T₀ (1.63±0.09) at 1-28th day (4 weeks) of age. From the table it is found that 2% cinnamon powder 2g/kg of feed treated group (T₃) showed better FCR.

Table 4.3: Feed Conversion Ratio (FCR) in different dietary treatment groups at different ages of birds

Age in day/ Parameters	Dietary treatment groups (Mean±SEM)				Level of Significance
	T ₀	T ₁	T ₂	T ₃	
7 days	1.47±0.07 ^b	1.68±0.03 ^a	1.70±0.03 ^a	1.47±0.01 ^b	*
14 days	1.66±0.10 ^a	1.44±0.01 ^b	1.32±0.01 ^{bc}	1.20±0.01 ^c	*
21 days	1.77±0.04	1.73±0.01	1.76±0.12	1.68±0.03	NS
28 days	1.70±0.03	1.77±0.04	1.71±0.13	1.62±0.04	NS
Final FCR (1-28 th Days)	1.63±0.09 ^a	1.62±0.07 ^a	1.58±0.87 ^b	1.48±0.51 ^c	*

T₀ = Control diet

T₁ = Control diet + 0.5% Cinnamon powder

T₂ = Control diet + 1% Cinnamon powder

T₃ = Control diet + 2% Cinnamon powder

Mean±SEM = Mean ± Standard error mean

^{abcd} means having different superscript in the same row differed significantly (P<0.05)

*= 5% level of significance

**= 1% level of significance

NS= Non significant

Table 4.4: Meat yield traits of broilers of different dietary treatment groups (g)

Parameters	Dietary treatment groups (Mean±SEM)				Level of Significance
	T ₀	T ₁	T ₂	T ₃	
Live weight	1260.41±15.14 ^d	1338.97±6.68 ^c	1424.34±41.24 ^b	1471.57±19.01 ^a	*
Carcass weight	732.00±1.53 ^d	862.33±1.45 ^a	827.00±1.53 ^c	849.00±2.08 ^b	*
Breast	271.67±1.20 ^d	354.51±2.17 ^b	332.67±1.76 ^c	364.56±3.09 ^a	*
Thigh	246.00±1.00 ^a	250.67±1.45 ^a	233.17±3.22 ^b	248.46±2.72 ^a	*
Head	40.09±1.16	36.87±1.05	39.44±1.37	37.91±0.66	NS
Shank	42.98±1.52	43.33±0.88	47.21±0.98	42.53±1.87	NS
Gizzard	47.68±1.46 ^a	37.07±0.52 ^b	38.79±0.62 ^b	46.17±0.60 ^a	*
Liver	36.95±0.97 ^b	35.35±0.88 ^b	34.07±1.16 ^b	40.71±0.84 ^a	*
Heart	5.28±0.29	5.40±0.15	4.90±0.06	5.50±0.07	NS
Spleen	2.45±0.01 ^a	2.40±0.02 ^a	2.28±0.04 ^b	2.47±0.02 ^a	*
Intestine	114.20±0.94	107.23±0.72	109.46±2.56	108.50±1.67	NS

T₀ = Control diet

T₁ = Control diet + 0.5% Cinnamon powder

T₂ = Control diet + 1% Cinnamon powder

T₃ = Control diet + 2% Cinnamon powder

Mean±SEM = Mean ± Standard error mean

^{abcd} means having different superscript in the same row differed significantly (P<0.05)

*= 5% level of significance

NS= Non significant

Meat yield data are presented in Table 4.4 The analyzed data in the table indicates that the treatments had no significant effect ($p>0.05$) on Head, Shank, heart and intestine weight of the experimental birds. On the other hand, highly significant ($p<0.01$) differences were obtained in live weight, breast meat and carcass weight, gizzard, liver, spleen among different treatments. Highest and lowest breast meat weight was recorded in T₃ and control group respectively. There was a tendency of increased breast meat content with cinnamon which had highly significant ($p<0.01$) effect compared to control group.

CHAPTER V

SUMMARY AND CONCLUSIONS

The study was carried out 120 one-day-old straight-run Cobb-500 commercial broiler chicks to evaluate the effect of supplementation of different levels of cinnamon on growth, feed intake, FCR and carcass characteristics of broiler. The experimental birds were distributed randomly to 4 dietary treatment groups namely T₀ (Control group), T₁ (0.5% cinnamon powder /kg of feed), T₂ (1% cinnamon powder /kg of feed), T₃ (2% cinnamon powder /kg of feed) each with 3 replications each having 10 broilers. At the terminal stage of experiment the cumulative body weight gain of different treatment groups was T₀ (1260.41±15.14), T₁ (1338.97±6.68), T₂ (1424.34±41.24) and T₃ (1471.57±19.01). Body weight gain was affected significantly (P<0.05) among the different treatment groups. Birds that received T₃ (2% cinnamon powder /kg of feed) was gained highest (1471.57±19.01) body weight and lowest was found T₀ (1260.41±15.14) in control group.

The feed intake among different treatment groups were significant (P<0.05) in 7th day and 28 days of age and non significant in 14th day and 21th days of age. The cumulative maximum feed intake was observed in treated T₂ group (2248.33±77.05) and minimum in control group T₀ (2057±46.79). Feed efficiency of different treatment groups was statistically significant (P<0.05) in all groups. Respective feed efficiency was found T₀ (1.63±0.09), T₁ (1.62±0.07), T₂ (1.58±0.87) and T₃ (1.48±0.51). 1% cinnamon powder 1gm/kg feed treated group (T₂) converted feed to meat most efficiently compared to T₁, T₃ and T₀ treatment groups, respectively. Mortality rate was found non significant (P>0.05) in different dietary groups respectively found T₀ (0%), T₁ (3.33%), T₂ (3.33%), and T₃ (0%). Obtained data on meat yield parameters no significant (P>0.05) difference among treatments groups except live weight carcass weight, thigh muscle, breast meat weight and breast meat was significantly (P<0.05) higher in T₃ group compared to control group T₀. Liver weight was significantly (P<0.05) higher in T₃ group compared to T₀, the cinnamon treated group T₁, T₂ and T₃, respectively. The highest carcass weight was T₁ (862.33±1.45) 0.5% cinnamon powder 0.5gm/kg feed treated group and the lowest in T₀ (732.00±1.53) in control group.

Considering the above facts it may be concluded that supplementation of 2% cinnamon powder 2gm/kg feed had positive significant effect on live weight, feed intake and Feed

Conversion Ratio (FCR) with no detrimental effect on meat yield traits. Therefore, 2% cinnamon powder 2gm /kg feed may be used in broiler diet as growth promoter and it may also serve as an antioxidant.

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