THE DIETARY EFFECT GINGER (*Zingiber officinale*) AND GREEN TEA (*Camellia sinensis*) POWDER ON THE GROWTH AND MEAT YIELD PERFORMANCE OF BROILER

A THESIS
BY

SHAMOL TIRKI

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DEPARTMENT OF DAIRY AND POULTRY SCIENCE

HAJEE MOHAMMAD DANESH SCIENCE AND TECHNOLOGY UNIVERSITY, DINAJPUR-5200

DECEMBER, 2023

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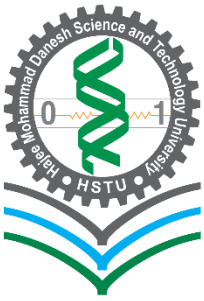

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DECEMBER, 2023

DEDICATED

TO MY BELOVED

FAMILY MEMBER

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The author

ABSTRACT

This study was conducted to determine the efficacy of the dietary effect of different levels of Ginger (*Zingiber officinale*) and green tea (*Camellia sinensis*) powder on growth performance and carcass traits of commercial broiler. The study was conducted at the Central Poultry farm of Hajee Mohammad Danesh Science and Technology University, Dinajpur during the period from 23 June to 20 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 T_0, T_1, T_2 and T_3 group without Ginger and Green tea powder (control group), Ginger powder 0.5gm/kg feed, Green tea powder 0.5gm/kg feed and (Ginger powder 0.25g and Green tea powder 0.25g)/kg feed 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 20. Feed intake (g/bird) was significantly ($P<0.05$) differed among the dietary treatment groups. The highest feed intake was significantly ($P<0.05$) higher in T_3 (2190.16±33.22), followed by T_1 (2176.97±41.4), T_0 (2127.96±20.72) and T_2 (2070.74±12) respectively. Body weight gain (g) and FCR were significantly ($P<0.05$) differed among the dietary treatment groups. The highest body weight gain (g) was observed significantly ($P<0.05$) higher in T_2 (1561.63±16.79), followed by T_3 (1509.51±6.11), T_1 (1496.66±19.88) and T_0 (1416.93±8.64), respectively. The highest FCR was found in T_0 (1.50±2.40) and the lowest FCR in T_2 (1.33±0.66), the intermediate in T_1 (1.48±0.06) 1.45±2.08) and T_3 (1.45±5.44), 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), thigh meat weight (g), but there was almost similar ($P>0.05$) among the dietary treatment groups in case of head weight (g), shank weight (g), liver weight (g), heart weight (g), spleen weight (g), intestine weight (g). Live weight, carcass meat weight, breast weight thigh weight was significantly ($P<0.05$) higher in treatment T_2 group compared to control group T_0. Mortality was found in T_0 (3.33%) and in T_2 (3.33%) dietary treatment groups during experimental period. Based on the result it could be concluded that green tea powder 0.5gm/kg feed may be used in broiler diet as growth promoter and it may also serve as an antioxidant.

Key words: Ginger, powder, Green Tea powder, Broiler performance, Meat yield.

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CHAPTER 1

INTRODUCTION

Poultry meat is regarded by the UN Food and Agricultural Organization as a commonly available and inexpensive food that is rich in nutrients (Ravindran *et al.*, 2013). Therefore, it is produced in many countries of the world.

Broiler meat production has been growing faster since the 1960s and it becomes the fastest growing sector in meat production through worldwide (Taha, 2003). Broiler meat has significant contribution to the human diet (Capita *et al.*, 2002). Broiler meat is one of the most important protein sources for Bangladeshi people.

In Bangladesh, broiler meat is popular in the consumer market because of its easy digestibility and as a low-cost source of animal protein. The broiler industry in Bangladesh is developing rapidly and its success depends on how rapidly a bird attains maximum marketable weight. The principle of poultry production is to achieve high level of performance through efficient utilization of feed keeping survivability as maximum as possible. The main objective of adding feed additives are increasing their growth rate, better-feed conversion efficiency, greater livability and lowered mortality in poultry birds. These feed additives are termed as "growth promoters" and often called as non-nutritive feed additives (Singh and Panda, 1992). Growth promoters are chemical and biological substances, which are added to livestock feed with the aim to improve the growth of chickens in fattening, improve the utilization of feed and in this way realize better production and financial results. Their mechanism of action varies. Positive effect can be expressed through better appetite, improved feed conversion, stimulation of the immune system and increased vitality, regulation of the intestinal micro-flora, etc.

The green tea is the most important medicinal plant. Green tea powder (GTP) is obtained from green tea leaves (*Camellia sinensis*), stems and fruits (Uuganbayar *et al.*, 2005, 2006). Green tea leaves contain many polyphenolic compounds such as epicatechin (EC), epicatechin 3 gallate (ECG), epigallocatechin (EGC), and epigallocatechin 3 gallate (EGCG) (Biswas and Wakita, 2001). They contain certain anti-viral and anti-bacterial properties that inhibit growth. In this study, 1% green tea and modified lipophilic green tea polyphenols (GTP and LTP) were used in combination with the most commonly prescribed antibiotics to study their effects on gram-positive, gram-negative,

and acid-fast bacteria. The results indicated that 1% GTP and 1% LTP provided different synergistic effects on several antibiotics in various bacteria. These results suggest that 1% GTP and 1% LTP provide beneficial effects on selected antibiotics against microbial growth and are able to reverse the antibiotic resistance to susceptible. Green tea polyphenols could serve as natural alternatives to combat against antibiotic resistance pathogens (Haghjoo *et al.,* 2013). Green tea which is also popular beverage is taken from a non-oxidized and unfermented leaves of the evergreen plant *Camellia sinensis* that produce mainly in tropical and subtropical climates (Cao *et al.,* 2005). The chemical composition of poultry meat has a crucial role for a health driven market or gourmet market due to this color changes, fat contents are an important factor influencing the quality and acceptability of meat and meat products (Carpenter *et al.,* 2007). Therefore, a common approach to maintain host health is to increase the number of desirable bacteria in order to inhibit colonization of invading pathogens (Guo *et al.,* 2004). It was reported that green tea and its chemical components show antibiotic-like effects of non-selectively decreasing total counts of all micro-flora (Cao *et al.,* 2005). Considering above circumstances, the present research aimed to examine the effect of different levels of green tea powder as a substitute for an antibiotic in broilers diets on productivity, carcass and meat quality, to evaluate the effect of powder of green tea on lipid profile of blood plasma of broiler chicken and to find out appropriate green tea probiotics for chicken.

Ginger (*Zingiber officinale*) is a perennial herb which is used widely as a spice, for pickles, candies, preservatives and many medicinal purposes. The plant belongs to the family Zingiberaceae; which are aromatic herbs with fleshy, tuberous or nontuberous rhizomes and, often have tuber bearing roots (Ke *et al.,* 2000). The rhizome contains a spectra of biologically active compounds such as curcumin, 6 gingerol i.e., [5-hydroxy-1-4-hydroxy-3-methoxy phenyl), 6-shogoals, zingiberene, bisaboline and several other types of lipids that confers on ginger the characteristic medicinal properties of being pungent and a stimulant (Bliddal *et al.,* 2000). The major components of ginger are zingiberen and zingerol that can stimulate the digestive system by controlling the digestive pH and the activity of digestive enzyme including microbial activity. Ginger has also been known to have antioxidant activity due to presence of gingerol-related compounds and diarylheptanoids (Kikuzaki and Nakatani, 1993). Ginger as a natural feed additive may be of immense benefit and value in poultry nutrition especially for broilers due to their antibacterial, anti-inflammatory, antiseptic, anti-parasitic and

immunomodulatory properties (Onu, 2010). Ginger is one of the natural plants which can be used as phytobiotic to improve broiler's performance.

The significant biological properties of ginger powder make it a potential substitute for in feed antibiotics in livestock diets. A number of studies have been conducted to evaluate its effect on the performance of broiler chickens, laying hens and rabbits. There is growing interest in developing natural alternatives to antibiotic growth promoters in order to maintain both bird's performance and health. In the last decade, ginger has been extensively used in poultry diets. Wide range medicinal properties of this plant have been advocated. In poultry feed, ginger has been extensively used in different concentrations, dosages and durations.

Considering the above things, the objectives of the present study are:

1. To assess the effect of supplementation of green tea powder and ginger powder on body weight, feed intake and feed conversion ratio of broiler.
2. To assess the effect of supplementation of green tea powder and ginger powder on carcass characteristics of broiler.

CHAPTER 1

REVIEW OF LITERATURE

2.1 Composition and Nutritional value of Ginger

In Bangladesh, ginger is widely used as spice, it has high medicinal value and used in Allopathic and Hamdard medicine.

The bulk of ginger produced is often exported from the producing areas in processed form as dried ginger powder and extracts (Badreldin *et al.,* 2008). In world trade, the quality of ginger rhizome is majorly based on its aroma, pungency; the primary chemical components of ginger responsible for these sensory quality attributes are the volatile (essential oils) and non volatile (oleoresin). Other constituents are fat, protein, carbohydrate, vitamins (C and B) and minerals (potassium, calcium, magnesium). Ginger rhizomes also contain proteolytic enzyme called zingibain (Stewart and Wood, 1991). These chemical components are influenced by factors such as the specie, variety, maturity and processing conditions.

According to Jakes and Susan (2007), dried ginger is traded traditionally in whole split form is used in wide range of foods when grounded into powdery form and used for preservation of meat, baking spice, soups and puddings. Most of the world's ginger is processed into concentrates for the manufacture of ready-to-serve ginger drinks which can be alcoholic or non-alcoholic (Yiljep *et al.,* 2005; Jakes and Susan, 2007). Yiljep *et al.,* (2005) Oven dried sliced ginger gave the highest quantity of volatile oil (1.36%) which is in agreement with result from that dried ginger yield 1-3% volatile oil. Pruthi (2000), found that dry ginger has the composition of moisture 6.9%, protein 8.6%, fat 6.4%, fibre 5.9, carbohydrate 66.5%, ash 5.7%, calcium 0.1%, phosphorus 0.15%, iron 0.011%, sodium 0.03%, potassium 1.4%, vitamin A175 IU/100 gm, vitamin B1 0.05 mg/100 gm, vitamin B2 0.13 mg/100 gm, niacin 1.9%, vitamin-C 13 mg/100 gm and calorific value (food and energy) 380 kcal/100 gm.

Anonymous (1999) reported that the proximate nutrient composition of (per 100 gm) ginger are moisture 80.9 gm, minerals 1.2 gm, fiber 2.4 gm, energy 67 kilocalories, protein 2.3 gm, fat 0.9gm, calcium 20 mg, iron 2.6 mg, carotene 40 µgm, vitamin B1 0.06mg, vitamin B2 0.03mg, vitamin-C 6mg.

Purseglove *et al.,* (1998) found that the crude fiber content of unpeeled may be as high as 10 percent (on a dry basis), but in commercial dried ginger it is usually 1-3 percent. The volatile oil content of commercial dried gingers has been reported to be 0.5-4.4 percent, but for the major types the range is usually 1-3 percent. The abundance of the pungent constitute, the gingerols, in dried ginger is less certain owing to inadequacies in current analytical methods, but it is probably in the range of 1-2 percent for freshly prepared commercial dried ginger.

Nobrega *et al.,* (1997) reported the chemical composition of ginger (*Zingiber offcinale* roscoe) essential oils extracted either with ethanol, isopropanol or supercritical CO_2 was determined and compared. Frozen ginger was cut, ground in a domestic foods processor and dried to 14% moisture particle size distribution was determined in a sieve shaker with 648 mesh sieves organic.

John and Ferreria (1997) reported statistically significant differences ($p<0.05$) in mass in fresh rhizomes, moisture and crude fiber content but not in the oleoresin and ginger oil content. In Brazilian ginger, the mass of fresh rhizomes with high moisture contents but lowest in the crude fiber on wet basis. In Taiwan ginger, they recorded that a high crude fiber content of 6.8% on dry basis the best results in terms of oleoresin (3.06%) and oil (0.52%) contents, however the dry ginger recovery was highest (27.5%) with West Indies ginger. Thus among these studied Brazilian ginger gave better results for early harvesting ginger industry for the drying and extraction industries respectively, the selection of West Indies ginger and Taiwan ginger are preferable.

Table 2.1 Composition of fresh ginger

Nutrient (Unit)	Nutrient content per 100 grams
Moisture	
Water (g)	78.89
Energy (kcalorie)	80
Energy (kj)	333
Protein (g)	1.82
Total lipid (fat) (g)	0.75
Ash (g)	0.77
Carbohydrate, by difference (g)	17.77
Fiber, total dietary (g)	2.0
Sugars, total (g)	1.70
Minerals	
Calcium, Ca (mg)	16
Iron, Fe (mg)	0.60
Magnesium, Mg (mg)	43
Phosphorus, P (mg)	34
Potassium, K (mg)	415
Sodium, Na (mg)	13
Zinc, Zn (mg)	0.34
Copper, Cu (mg)	0.226
Manganese, Mn (mg)	0.229
Selenium, Se (mcg)	0.7
Vitamins	
Vitamin C, total ascorbic acid (mg)	5.0
Thiamin (mg)	0.025
Riboflavin (mg)	0.034
Niacin (mg)	0.750
Pantothenic acid (mg)	0.203

Source: USDA National Nutrient Database (2006)

2.2 Antimicrobial and anti inflamatory properties of ginger powder

Herbs Hand Healing (2011) reported that ginger contains volatile oils like borneol, camphene, citral, eucalyptol, linalool, phenllandrene, zingiberine, zingiberol (gingerol, zingirone and shogaol) and resin. It was also reported to enhance antibacterial and anti inflammatory actions and it is thought to assist other antibacterials, such as antibiotics, by up to 50 percent.

Ginger as a natural feed additive may be of immense benefit and value in poultry nutrition especially for broilers due to their antibacterial, anti flammatory, antiseptic, anti-parasitic and immunomodulatory properties (Onu, 2010).

Ginger has been documented to possess essential oil and the antimicrobial capabilities (Martins *et al.,* 2001; Menon and Sasidharan, 2010; Zhao *et al.,* 2011).

Plants have various polyphenolic compounds (Balunas and Kinghorn, 2005; Kim *et al.,* 2005) and spices including ginger contain essential oils that have been shown to have antimicrobial properties (Suhad *et al.,* 2012).

Shareef *et al.,* (2016) concluded that Zingiber officinale possesses remarkable antimicrobial activity, which is mainly due to naphthalenamine, decanal, and alfa.-copaene. According to these findings, it could be said that the methanolic extract act as antibacterial agents.

2.3 Antioxidant properties of ginger powder

The use of ginger powder as herbal medicine has antioxidative properties and scavenges oxidative stress (Kota et al 2008 ; Mallikarjuna *et al.,* 2008) and in a study increased plasma non-enzymatic antioxidant capacity in rats (Afshari *et al.,* 2007)

Ginger powder contains many of compounds that had biological activities, including antioxidant (Nakatani *et al.,* 2000; Rababah *et al.,* 2004), antimicrobial (Akoachere *et al.,* 2002) and various pharmacological effects

Krishnakantha and Lokesh (1993) reported that ginger extract has antioxidative properties and scavenges superoxide anion and hydroxyl radicals.

Afshari *et al.,* (2007) also observed that, plasma antioxidant capacity is increased by consumption of ginger in rats and elevation of antioxidant capacity raises the antioxidant scavenging capacity of the body and attenuates free radical induced damage.

In support of the current study, the results of Zhang *et al.,* (2009) experiment showed that medical plant supplementation improve antioxidant statues in broilers. Also, Kota *et al.,* (2008) observed that ginger supplementation significantly improved SOD and GPX activity and reduced liver and kidney MDA in rat. These findings are consistent with the results of the present ex periment.

2.4 Effect of ginger powder on feed consumption and efficiency in poultry

Herawati and Marjuk (2011) used different levels of ginger powder 0.5, 1, 1.5 and 2% in the diets of 5 days old Hubbard strain broiler chicken, feed consumption was significantly ($P< 0.01$) decreased in a group fed 2% ginger compared to the control group being (3966.7 and 4180 g/bird) respectively through 5 weeks of experimental period, while feed consumption was significantly ($P< 0.01$) increased in the group received 0.5% being (4405.5g), but there were no significant differences in the feed consumption of groups fed 1 and 1.5% of ginger powder when compared to the control group.

Mohamed *et al.,* (2012) stated that feed consumption of broiler chickens was significantly ($P< 0.05$) decreased by the supplementation of dietary ginger powder at levels 0.1 and 0.2% compared to the control, being (2852.66, 2791.67 and 2909.62 g/bird) respectively over 42 days.

Also Arshad *et al.,* (2012) reported that using ginger extract (40 and 50) ml/liter through drinking water of broilers caused a significant ($P< 0.05$) decrease in the feed intake per bird compared to the control, being (2243g, 2302g and 2399g) respectively. Using 2 and 6% of ginger powder in the broiler diets did not affect the daily feed consumption during the period 1-6 week, but from 6 -7 weeks of age, the level 6% had a significant positive effect ($P< 0.05$) on the daily feed consumption compared to group 2% and the control, being (121g, 147.5g and 154g) respectively (Al-Homidan, 2005).

Tekeli *et al.,* (2011) showed that feed consumption increased significantly ($P< 0.05$) in groups fed on antibiotic and 240 ppm ginger compared to the group which fed control diet through the experimental period 1-42 days, (3970.13, 3909.71 and 3334.86 g/bird) respectively.

Moorthy *et al.*, (2009) concluded that using 0.2% ginger in the broiler diets did not affect the feed intake.

Similar results were found by El- Deek *et al.*, (2002) when they used 0.05% of ginger powder in broiler diets and did not find any effect on feed intake. The same researchers in the trial 2 used 0.1% of ginger powder in the broiler diets but there were no differences in the levels of feed intake between treatments and control. These results were in agreement with those of Ademola *et al.*, (2009) who reported that using 1, 1.5 and 2% of ginger powder in broiler diets had no significant effect on feed intake. Similar results were obtained by Kehinde *et al.*, (2011) when they used different levels of ginger 1.5, 3 and 4.5% and there were no differences in the levels of feed intake of cockerel chicks.

Onu (2010) reported that the addition of ginger (0.25%) broiler chicks in the basal diet of broiler chicks resulted in improved FCR although feed intake did not change. Ginger has been found to increase secretion of gastrointestinal enzymes including lipase, disaccharide and maltase (Zhang *et al.*, 2009).

Zhao *et al.*, (2011) reported that ginger enhances animal's nutrient digestion and absorption because of its positive effect on gastric secretion, enterokinesia and digestive enzyme activities.

An experiment was conducted by Barazesh *et al.*, (2013) on 192 commercial broiler chicks for 42 days. There were 4 treatments with 4 replicates and each replicate contained 12 chicks. The treatments T_1, T_2, T_3 and T4, contained 0.0, 0.50, 1.00, and 1.50% of ginger powder, respectively in the basal diet. The results showed that increasing levels of dietary ginger powder lead to a significant reduction in feed intake. The treatment with 0.50% ginger powder during the sixth week showed the highest feed intake (891.36 g) than the other groups 0.0 % (819.43 g), 1.00 % (732.11 g) and 1.50% (817.08 g) but the differences between treatments were not significant.

Elmakki *et al.*, (2013) evaluate the effect of ground ginger root (*Zingiber officinale*) addition in the diet of broiler chicks 160 day old boiler unsexed chicks (COBB strain) were reared till 42 days of age. Four experimental diets contained 0, 0.25, 0.50, and 0.75% ground ginger root powder. Dietary incorporation of ginger had no significant effect on feed intake in the first four weeks. Data revealed the significant decrease in

feed intake by broilers fed 0.50% ginger powder containing diet (841.0 g and 777.0 g in the 5th and 6th week, respectively) in comparison to other treatments, whereas the chicks fed 0.0 % (884.0 g and 835.0 g), 0.25 % (884.0 g and 938.0 g) and 0.75 % (928.0 g and 809.0 g) ginger powder in 5th and 6th week, respectively did not differ significantly ($p > 0.05$).

Arkan *et al.*, (2012) was conducted a study to explore the effect of incorporation of ginger at 0.0, 0.10 and 0.20 % levels in the diets on feed intake of broiler chicks One hundred and eighty, 3 weeks old broiler chicks (ROSS) were distributed into 3 treatment groups with three replicates per treatment and 20 birds per replicate (10 males + 10 females). The broilers received T_3 diet (0.20 % ginger) consumed significantly less feed (2791.67 ± 8.54 g) in comparison to diet T_2 (2852.66 ± 11.01 g) and control (2909.62 ± 10.12 g).

Herawati (2010) experiment was conducted to know the feed intake of broilers fed diet supplemented with red ginger (*Zingiber officinale* Rosc) as phytobiotic. Two hundred broiler chickens of 5 days old were divided into 5 different feed treatment groups, namely: control group without red ginger (R-0) and treatment groups containing 0.50 (R-0.50), 1.00 (R-1.00), 1.50 (R-1.50) and 2.00 % (R-2.0) of red ginger, respectively. Each group was divided into 5 sub groups as replication, consisted of 8 chickens under each. The chickens were raised for five weeks. Feed consumption was daily measured in each sub-group. The results showed that supplementation of red ginger reduced total feed intake ($p < 0.05$) at 1.00 % (4,108.00 g/head), 1.50 % (4,196.50 g/head), 2.00 % (3,966.70 g/head), but there was improvement in feed intake at level of 0.50% (4, 4054.50 g/head) as compared to control (4,180.00 g/head).

2.5 Effect of ginger powder on growth performance and body weight gain

A study was conducted on 3 weeks old 180 broiler chicks by Arkan *et al.*, (2012) which were raised up to 6 weeks of age. The ginger powder was supplemented at the rate 0.10 and 0.20% level in their diets under T_2 and T_3, respectively while T_1 served as control. The differences for body weight gain were significantly higher (1467.42 ± 11.08 g) for broiler chicks fed diet with 0.20 % ginger as compared to control (1289.17 ± 13.10 g).

In another study supplementation of ginger powder at 1.50 % (459.96 g) level in diet significantly increased body weight gain as compared to control (357.00 g) at fifth weeks of age in broilers (Barazesh *et al.*, 2013).

Similar findings were also observed by Herawati (2010) for body weight gain in broilers when 1.50% level of ginger powder was supplemented ($p < 0.05$) in their diet (1,955.53 g/head) in comparison to the broilers received the control (1,899.71 g/head) diet while the other treatments containing 0.50 % (1,888.44 g/head), 1.00 % (1,858.25 g/head) and 2.00 % (1,859.50 g/head) level of ginger powder did not differ significantly. Elmakki *et al.,* (2013) reported that weight gain in broilers was affected by inclusion of different levels of ginger in their diet for three weeks at the levels of 0.0, 0.25, 0.50 and 0.75 %. Total weight gain of the group at 0.75 % (1918 g) was significantly lowered than control (2035 g). While the weight gain in other two groups was similar to control group i.e. 2035 g.

The result of a study conducted by Ahmed *et al.,* (2014) in broilers reveled no significant differences ($p > 0.05$) in the final body weight (1103.3 g, 1140.2 g, 1141.2 g and 1146.9 g) as well as body weight gain (1064.3 g, 1101.2 g, 1102.2 g and 1107.8 g) among the four treatments supplemented with graded levels of ginger root powder at 0.50, 0.75 and 1.00 %.

Kehinde (2011) elicited that ginger supplementation at 0.0 (23.37 ± 1.24 g), 1.50 (23.70 ± 1.41 g), 3.00 (24.67 ± 1.38 g) and 4.50 % (23.37 ± 1.40 g) had no significant effect on weekly weight gain.

Onu (2010) reported that the addition of ginger (0.25%) broiler chicks in the basal diet of broiler chicks resulted in higher body weight and lower FCR.

2.6 Effect of ginger powder on feed conversion ratio (FCR)

Feed conversion is an index associated with both feed consumption and weight gain and well known that broiler chickens are more efficient in conversion feed than other farm animals. Many medicinal herbs used in human diet which are known as "spices" and improve digestibility. The same property can be used in poultry to increase the FCR which results in increasing body weight and more profit (Moorthy *et al.*, 2009). Herawati and Marjuk, (2011) stated that feed conversion ratio was significantly improved ($P< 0.05$) when different levels of dietary ginger powder used in broilers 0.5.

1, 1.5 and 2% compared to the control group, being (2.15, 2.20, 2.15, 2.14 and 2.27) respectively during 35 days, which are in agreement with those of Mohamed *et al.*, (2012) who found that feed conversion ratio of broilers was significantly improved ($P< 0.05$) by the supplementation of dietary ginger powder 0.2% compared to the group 0.1% and the control, which were (1.90, 1.98 and 2.25) respectively through 42 days of experimental period. On the other hand, Moorthy *et al.*, (2009) did not observe any differences in the FCR of broilers fed 0.2% ginger powder compared to the control.

Also El-Deek *et al.*, (2002) did not find any differences between FCR of the treatments and the control in the trial (1) and (2) when used 0.05 and 0.1% ginger powder respectively in broilers diets.

Ademola *et al.*, (2009) noted that using high dose of ginger powder 2% had a highly significant negative impact ($P< 0.01$) on the broilers FCR compared to the treatments 1%, 1.5% and the control, (3.14, 2.71, 2.67 and 2.56 respectively) during 56 days of age, while there were no differences in the FCR of broilers fed 1 and 1.5% ginger compared to the control group.

Using different levels of ginger powder 1.5, 3 and 4.5% statistically did not affect the feed conversion ratio of cockerel chicks (Kehinde *et al.*, 2011), which is in agreement with that of Tekeli *et al.*, (2011) who used different percentages of ginger and propolis extract (ginger 240 ppm, propolis 1000 ppm, ginger 120+ propolis 500 ppm, ginger 240 + propolis 1000 ppm, ginger 360+ propolis 1500 ppm) as alternatives for antibiotic growth promoter, but they did not observe any significant differences between the treatments and the groups of control and antibiotic.

Mohammed and Yusuf (2011) carried out a study to evaluate the effect of ginger (*Zingiber officinale*) inclusion as a feed additive. Eighty four- day old Anak strain broiler chicks were fed on various levels of supplemental ginger in addition to a control diet (treatmenT_1) without ginger. The FCR was 2.65, 2.50 2.45 and 2.44 for broilers received the diet containing 0, 250, 500 and 750 g ginger per 100kg feed, respectively. No significant difference was observed for FCR between treatments containing various levels of ginger in comparison to control.

The effect of ginger powder supplementation @ 250 (G1), 500 (G2) and 750 (G3) g/q in the feed of broilers reared for 42 days of age was studied by Wadhwa *et al.*, (2011). The

broilers were fed different treatment diets G1, G2 and G3 with different levels of ginger showed 21.91, 34.04 and 17.71 % better feed conversion ratio in comparison to broilers received control diet.

Zomravi *et al.,* (2011) reported that there were no significant differences ($p > 0.05$) in feed conversion ratio among all dietary treatments containing 0.00 % (2.18), 0.50% (2.19), 1.00% (2.15) and 1.50 % (2.24) of ginger powder.

2.7 The Effect of ginger powder on carcass cuts and visceral organs

Studies have been concentrating on improvement of broiler carcass in order to meet the customer's desire. This improvement accomplishes through genetic selection, nutrition and breeding technology to produce high carcass weight with limited abdominal fat. Herawati and Marjuki (2011) noted when compared between control and four levels of red ginger powder that diets supplementation with 1, 1.5 and 2% red ginger powder had significant ($P< 0.05$) higher carcass percentage (dressing %) (62.9, 62.9 and 64.9%) respectively than those received 0.5% and control diet being (59.6 and 57.8%), abdominal fat percentage decreased significantly ($P< 0.05$) in broilers fed diets supplemented with red ginger powder 0.5, 1, 1.5 and 2% compared to those broilers fed the basal diet, (1.87, 1.85, 1.81, 1.75 and 2.56) respectively.

Ademola *et al.,* (2009) showed that there were no significant differences in the relative weights of (neck, thighs, breast and back) when used 1 and 1.5% ginger powder in broilers diets but relative weight of wings was positively affected ($P< 0.001$) compared to the control group, which were (9.21, 9.00 and 8.55%) respectively, while using 2% of ginger caused a significant ($P< 0.001$) decrease in relative weight of (breast and back) being (12.86 and 12.23%) respectively compared to the control group, (14.59 and 13.06%) respectively, but did not affect the relative weights of (neck, thighs and wings), relative weight of abdominal fat pad decreased significantly ($P< 0.001$) when using different levels of ginger 1, 1.5 and 2% compared to the control, being (0.85, 0.56, 0.45 and 1.88%) respectively.

Moorthy *et al.,* (2009) noted that adding 0.2% ginger powder into the broilers diet did not affect the weights of carcass, gizzard, liver, heart and dressing percentage. El-Deek *et al.,* (2002) found no differences in dressing percentage, abdominal fat and

liver relative weights of broilers fed diets supplemented with 0.05 and 0.1% ginger powder.

Zhang *et al.,* (2009) observed that birds fed ginger produced higher carcass weights compared to untreated birds .He suggested that improved carcass quality of broilers may be associated with the antioxidant effect of ginger which enhances protein and fat metabolism.

Dressing percentage, breast weight and leg weights increased significantly in response to an aqueous extract of a plant mixture containing ginger at 5g/liter water (Javed *et al.*, 2009).

Barazesh *et al.,* (2013) suggested that inclusion of ginger powder at different levels (0.0, 0.50, 1.00 and 1.50 %) in diets had no significant change in the weight of liver (3.62, 3.45, 3.02, 3.12), gizzard (3.52, 3.17, 2.84, 3.59) and spleen (0.18, 0.17, 0.17, 0.21) as % of live weight respectively among the four treatments.

Elmakki *et al.,* (2013) reported that carcass weight was higher for birds fed with 0.25% level of ginger (1591 g), in comparison to control (1562 g). The dressing percentage was also found to be numerically higher in 0.25% ginger powder supplemented group (75%) and in comparison to control (74.4 %) and did not differ statistically. A study was conducted by Zomrawi *et al.,* (2012) had recorded significant decrease ($p< 0.05$) in pre-slaughter weight of birds fed 0.50 % ginger root powder (1310.28 g/bird) in comparison to control (1489.06 g/bird). No significant differences were observed in dressing percentage by supplementing of 0.50% level of ginger root powder (75.91 %) when compared with control (75.88%).

Ebrahimnezhad *et al.,* (2014) conducted an experiment to study the effects of ginger (Z. officinale) processed to different levels on carcass characteristics in broiler chickens. A total of 360 one-day-old broilers (Cobb Cobb 500) were allotted to 6 equal experimental groups in a complete randomized design, with different levels of ginger (0.0, 5.0, 10.0, 15.0, 20.0, and 25.0 g/kg of diet) for 42 days. Carcass traits (relative weights of carcass, liver, abdominal fat, fat around gizzard and intestine) were assessed on day 42. The carcass characteristics were not altered significantly altered except relative weight of eviscerated carcass for different level of supplementation of ginger as 62.56, 62.59, 59.19, 62.59, 62.03 and 62.70 g, respectively.

2.8 Mortality rate

Mortality rate is defined as the death of birds as a result of many factors; for example, by disease, injury, physiological system failure or unidentified causes, which show that the welfare has been poor, so increasing in mortality rate will lead to decrease the number of birds at marketing age and finally will lower the income of project. For this reason, many researchers tried to minimize the percentage of mortality using different feed additives including medicinal plants.

Al-Hamadani *et al.,* (2010) used two levels of ginger powder 0.4 and 0.8% and they reported that mortality rate was zero in the group fed 0.8% ginger powder compared to the 0.4% ginger, antibiotic and control groups which were (2.27, 2.27 and 6.82 %).

Thayalini *et al.,* (2011) mentioned that there was no significant difference in mortality rate of broiler chickens fed on dried *Zingiber officinale* rhizomes supplement 2% compared to the control, which is in agreement with the finding of Mohamed *et al.,* (2012) who did not observe any mortality case during 42 days of experimental period when used 0.1 and 0.2% ginger powder through diet in broiler chickens. Also Zomrawi *et al.,* (2012) who used different levels of ginger root powder 0.5, 1 and 1.5% in broilers diets did not find significant differences in mortality rate when compared to the control group.

2.9 Composition of green tea

The medically important components of green tea are the polyphenols, most importantly the flavonoids. The main flavonoids in tea are the catechins, making up 30–40% of the water-soluble solids in green tea (Wang and Ho, 2009; Roowi *et al.,* 2010).

The different types of tea vary in the amount of catechins that they contain, with green tea containing the most, then Oolong tea, then black tea. The initial steaming process in the production of green tea destroys the enzyme polyphenol oxidase, thus protecting the polyphenol content. There are four main catechins in tea. (-)-epicatechin (EC), (-)-epicatechin-3-gallate (ECG), (-)-epigallocatechin (EGC), and (-)-epigallocatechin-3-gallate (EGCG). In green tea, EGCG is the most abundant, representing approximately 59% of the total catechins. EGC is next, making up approximately 19%. Then ECG, at 13.6%; and EC, at 6.4% (Cabrera *et al.,* 2006; Jigisha *et al.,* 2012).

In addition to the type of tea, the amount of catechins can be affected by: where on the plant the leaves are harvested, leaf processing, geographical location, growing conditions, and tea preparation (Fernandez *et al.,* 2002; Lin *et al.,* 2003; Cabrera *et al.,* 2006).

2.10 Nutritive value of green tea powder

The main constituents of green tea leaves belong to the polyphenols, accounting for 25–35% on a dry weight basis. Important and characteristic tea polyphenols are the flavanols, of which catechins are predominant, with the content of 14–25% of dry tea (Yao *et al.,* 2006). These compounds contribute to the bitterness, astringency and sweet aftertaste of tea beverages (Hara, Luo, Wickremashinghe, & Yamanishi, 1995a). Tea contains 3–4% amino acids which play an important role in the briskness taste characteristics of green tea (Hara *et al.,* 1995a). Caffeine, comprising about 2–4% of the dry matter, is believed to involve in the bitterness of tea brew through complex with flavanols (Yao *et al.,* 2006). The water-soluble carbohydrates have been investigated to contribute to the sweet taste of tea brew. Additionally, green tea also provides useful amounts of vitamins (e.g., C, E, B) and trace elements (e.g., Ca, Mg, Zn) to the diet (Hara, Luo, Wickremashinghe, & Yamanishi, 1995b). Those components have been considered as an important quality parameter for the evaluation of tea quality (Khokhar & Magnusdottir, 2002). Therefore, the quality of green tea could be influenced with the change in those components during processing.

Green tea powder (GTP) is defined as grinded green tea, with particle size less than 76 μm. As most other food powders, the chemical composition of GTP is also very complex (Fitzpatrick and Ahrne, 2005). It almost keeps the whole chemical composition of native green tea, such as tea polyphenols, amino acids, saccharide and caffeine. Meanwhile, its morphological properties experience great changes during grinding process, and result in a narrow and uniform particle size distribution, possessing more food processing property (Barbosa-C, 2005). Nowadays GTP has been widely applied in drinks and foods (e.g., yoghurt, ice cream, bread, cake, etc.) with green tea flavor (Kurita *et al.,* 2004).

2.11 Anti-oxidant properties of green tea powder

The antioxidant properties of green tea are attributed to its polyphenol content, which scavenge free radicals and subsequently stabilise cell wall, protect cell molecules and delay or inhibit the onset of lipid peroxidation (Ramadan *et al.,* 2003; Sahin *et al.,* 2010). The antioxidant capacity of green tea was reported to be much higher than that of α to copherol, ascorbic acid (Vastag, 1998) and BHT (Chen and Ho, 1995).

Green tea is regarded as potential valuable sources of good nutrients and antibiotic re placement and safe natural antioxidants for both human and animals (Cyril & Jozef, 2017; Hamer, 2007; Khan & Mukhtar, 2007; Liao *et al.,* 2001).

MDA, the product of the oxidative degradation of polyunsaturated fatty acids, was used as an indicator for the degree of lipid peroxidation. The current study reported a reduction in the MDA level of broilers fed on GTE- or BHT supplemented diets. Similar reductions in the MDA level of liver and meat tissue were reported by other researchers (Biswas and Wakita, 2001; Eid *et al.,* 2003; Sahin *et al.,* 2010) when green tea poly phenols were included in broiler or quail diets.

Yang *et al.,* (2003) reported about 75% increase in the antioxidant status (a decrease in the MDA level) of broiler meat due to dietary inclusion of green tea by-products at levels ranging from 5000 to 20 000 mg/kg. Biswas and Wakita (2001) concluded that tea catechins can be transported to meat tissues from the feed and thus protect them against oxidative deterioration

Green tea is very healthy and non-toxic nutritious; it has been found that green tea contains large amounts of beneficial antioxidants (Wolfram, 2007)

Green tea contains catechins, commonly called polyphenols, which show strong antioxidant potential. Functional features referred to green tea include antioxidant, anti-diabetogenic and cholesterol-lowering proper ties, which results in lean poultry meat and increased performance (Shahid *et al.,* 2013 and Ueda, 2001). On the other hand, green tea is rich in polyphenols, mainly catechins, and studies in other species points the existence of antimicrobial activity and of anti-oxidant protective effects, which are particularly valued in immune mediated diseases, cancer or cardiovascular diseases (Gramza *et al.,* 2005 and Ueda and Shigemizu, 2001).

The possibility for improved anti-oxidant status in green tea powder fed broilers is supported in earlier scientific reports of improved anti-oxidant status in broilers fed either green tea powder (Biswas and Wakita 2001) or green tea extracts (Sahin *et al.*, 2010, Sahin *et al.*, 2013).

Simoyi suggest that green tea powder exerts a positive influence on plasma lipid (LDL and LDL/HDL ratio) and uric acid, which is related to improved anti-oxidant status in broiler chickens (Simolyi *et al.*, 2002).

2.12 Antimicrobial properties of green tea powder

Recent investigations demonstrate that supplementation of diets fed to broilers and layers with by-products of green tea can enhance production performance and reduce the amount of choles terol in egg yolk and blood serum, besides the impact on egg quality. Supplementation of feeds with by-products derived from green tea minimizes the numbers of microflora in the caecum as a result of the anti- microbial effect of green tea (Khan, 2014).

It was reported that green tea and its chemical components show antibiotic-like effects of non-selectively decreasing total counts of all micro-flora (Cao *et al.*, 2005).

It has been reported that tea catechins have antibacterial activity against various pathogenic bacteria. The results indicate that 1% GTP and LTP provide different synergistic effects on several antibiotics in various bacteria. It was found that 1% GTP works the best synergistically against enterobacter aerogenes, making the resistant strain susceptible to 8 out of 12 antibiotics used. 1% LTP appeared to inhibit E coli, E. aerogenes, S marescens and M smegmatis which are gram-negative micro-organisms (Bobak Haghjoo *et al.*, 2013).

The inclusion of green tea in broiler diets had positive effects on growth performance and lean meat production (Kaneko *et al.*, 2001) and showed positive effects on the increase of lactic acid bacteria and aerobic bacteria counts in ruminants

Tea has been shown to inhibit the growth of *C. jejuni* strains within 4 hours (Diker et al, 1991) emphasizing their antimicrobial properties. Green tea is made from the leaves of *Camellia sinensis* and is prepared by preventing the “enzymatic oxidation of catechins” by firing or by steaming (Wang *et al.*, 2000). The major constituent of green tea is

polyphenols of which flavonoids is believed to have health benefits (Taylor *et al.*, 2005). Polyphenols like flavan-3-ols, flavonols and tannins have shown higher antimicrobial activity as compared to others and also work well with antibiotics (Daglia, 2012).

Research conducted by Friedman *et al.,* 2006 involving evaluation of antimicrobial activity of green tea catechins against Bacillus cereus revealed that "most compounds were more active than were medicinal antibiotics such as tetracycline and vancomycin at comparable concentrations".

2.13 Anti-inflamatory properties of green tea

The major polyphenolic compounds in green tea include epicatechin (EC), catechins, epicatechin-3-gallate (ECG), and epigallocatechin-3-gal late (EGCG), and EGCG is the most abundant form found in green tea (Wolfram 2007, Kim 2008, Thielecke and Baschmann 2009). It has been suggested that EGCG has anti-diabetic, anti-obesity, and anti-inflammatory effects (Polychronopoulos *et al.,* 2008).

Green tea powder and extracts also have been shown to have anti-influenza viral effects in chickens (Lee *et al.,* 2012). Additionally, green tea has been credited with anti-inflam matory, anti-oxidative, and anti-mutagenic effects (Benelli *et al.,* 2002), which are believed to contribute to reduction in h eart disorders (Weisburger and Chung 2002).

The most abundant Erener *et al.,* (2011) Asian-Aust. J. Anim. Sci. 24 (8):1128-1135 1129 constituent of green tea extracts (GTE) is catechins which has antibacterial activities (Cao *et al.,* 2005; Hara-Kudo, 2005), as well as antitumorigenic, anti-inflammatory, antiproliferative, antiviral, anti-parasitic and antioxidative properties (Crespy and Williamson, 2004; Fujiki, 2005; Jang *et al.,* 2007).

2.14 Anticancer properties of green tea

Laboratory studies showed that the catechins extracted from tea are non-toxic, relatively inexpensive, and anti-cancer and are considered as antioxidants (Yamane *et al.,* 1991). According to Kuroda and Hara (1999), tea polyphenols have anti-mutagenic and anticancer activity, and the mechanisms involved in it prevent mutation and cancer through extracellular and intracellular activity, as well as preventing the spread of disease and induction of programmed cell death (apoptosis).

GT and GT extracts have received much attention because of their diverse beneficial effects such as antimutagenic (Krul *et al.*, 2001), antioxidant (Henning *et al.*, 2004), anticancer (Sommer *et al.*, 2010), anti osteoporotic (Shen *et al.*, 2009), and above all, antihyperlipidemic (Suzuki *et al.*, 1998) properties as well as antibacterial, antitoxin, antiviral, and antifungal effects (Friedman, 2007) in vivo or in vitro.

CHAPTER 3

MATERIALS AND METHODS

3.1 Statement of the research work

The experiment was conducted at the Central poultry farm of Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur, to investigate the effect of supplementation of different levels of Ginger and Green Tea powder on growth performance and meat yield traits of broilers (Hubbard EP) during the period from 23 June to 20 July, 2023.

3.2 Experimental birds

A total of 120, day-old broiler chicks (Hubbard EP) were purchased from Aftab Hatchery Limited, from a local dealer of 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 allocated in four dietary treatment groups having three (3) replications in each and 10 birds per replications. The layout of the experiment is shown in Table 3.1.

Figure 3.1: Experimental unit

Table 3.1: Layout showing the distribution of experimental broilers

Dietary treatment groups		Number of broilers in each replication			Total
		R_1	R_2	R_3	
GROUP A Control (without Ginger and Green Tea powder)	T_0	10	10	10	30
GROUP B (GP 0.5g/kg)	T_1	10	10	10	30
GROUP C (GTP 0.5g/kg)	T_2	10	10	10	30
GROUP D (GP0.25g+0.25gGTP)/kg	T_3	10	10	10	30
Total No. of broilers					120

3.4 Procurement of feed ingredients

Required amounts of feed ingredients for making the experimental diets will be procured from the local market of Dinajpur town.

3.5 Collection of Ginger and Green Tea

Ginger and Green Tea (Kazi & Kazi) were collected from local market of Dinajpur.

3.6 Preparation of Ginger and Green Tea powder

After buying, Ginger was properly cleaned with fresh water, sliced with knife and then dried. After dried it properly Ginger was blend with electric blender to make powder. Then Ginger powder was preserved in airtight container until the use as feed additives.

Green Tea was blend with electric blender to make powder. Then Green Tea powder was preserved in airtight container until the use as feed additives.

Figure 3.2: Ginger

Figure 3.3: Green Tea

Figure 3.4: Ginger Powder

Figure 3.5: Green Tea Powder

3.7 Preparation of the experimental diet

Ready feed was used for the experimental study. At first required amount of ready feed ingredients were weighted by 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 measured with beaker and the first treatment group T_0 supplied feed without ginger and green Tea powder. T_1, T_2 and T_3 groups were daily supplied with GP 0.5gm/kg, GTP 0.5gm/kg and (GP 0.25 gm+0.25 gm GTP)/kg feed, respectively. During the time of mixing cross mixing was applied. Mixing was done manually.

Table 3.2: Calculated composition of experimental diets:

Nutrients	Amount (kg/100kg feed)	
	Starter (1-14 days)	Grower (15-28 days)
Crude protein (%)	22	21
Crude fiber (%)	3	3
Crude fat (%)	5	5-6
Lysine (%)	1.30	1.25
Methionine (%)	0.52	0.50
Calcium (%)	1	0.90
Phosphorus (%)	0.50	0.48
Moisture (%)	11	11
Metabolizable Energy, ME (k Cal/kg)	3000	3100

3.8 Management of the experimental birds

Similar care and management in all treatment groups throughout the experimental period was practiced. At the initiation of the experiment, chicks were individually weighed recorded as initial body weight. The following management practices were followed during the whole experimental period and these management practices were identical for all dietary groups.

3.9 Managemental practices

3.9.1 Housing and equipment

The experiment was conducted in a semi-monitor type open-sided house. Net was used to divide the shed into 12 similar size pens each of 15 square feet (5 feet x 3 feet). There were three sections to the shed. The central section served as a walkway, while the remaining two sections housed experimental birds. The section were properly cleaned, washed and disinfected with bleaching powder. The experimental house was properly cleaned and washed by forced water using a hose-pipe. Then, the room was disinfected by bleaching powder solution. After 15 days, the room was disinfected with KMnO4 solution. At the same time, all feeders, plastic buckets, waterers and other necessary equipment's were also properly cleaned, washed and disinfected with

bleaching powder solution, subsequently dried and left them empty for a week before the arrival of chicks.

3.9.2 Litter management

During the experiment period for the first 7 days litter was covered by clean newspaper and newspaper was removed when it becomes dirty. After that period the birds were reared on rice husk littered floor having a depth of 4 cm. Before use of litter calcium carbonate was spread on the floor. After first week, upper part of the litter with droppings were removed regularly and stirred three times a week up to the end of the experiment. The litter was disinfected with Virocid® solution in every other day. Litter materials, when found damp for any reason, were removed to prevent accumulation of ammonia and other harmful gases. At the end of each week, litter was stirred to break its compactness and maintain proper moisture. At the end of 2nd and 3rd weeks of age, dropping were cleaned from the surface of litter.

3.9.3 Brooding of chick

The experiment was conducted in summer (23 June to 20 July, 2023). Additional heat was provided to brood the chicks when it was necessary. Brooding temperature was kept nearly at 34°C at first 1 week of age and decreased gradually until they were adjusted to normal environmental temperature of the house and final temperature was 28°C at the end of experiment. Additional heat was provided by fitting 200-watt electric bulb at the center of the pen about 12 inches above the floor from the 7-day old. The height of the bulbs was increased by raising the bulb gradually as per need of temperature. Paper was used on two sides of the house and in ventilators to protect cold and stormy wind. These sheets were removed partly or completely particularly at the later stage of finishing period when room temperature was found favorable. Daily room temperature (°C) was recorded every six hours with a thermometer.

Fig. 3.6: Brooding management

3.9.4 Lighting management

All birds were exposed to continuous lighting of 23 hours and one hour dark period per day throughout the experimental period. The dark period was practiced to make the broilers familiar with the possible darkness due to electricity failure.

3.9.5 Temperature

The house temperature was maintained nearly at 34°C for the first week. In the course of the trial period, the temperature was gradually reduced from 34°C to 32°C during first week, 32°C to 30°C in the second week, 32°C to 30°C in the third week and there after remain almost constant until the end of the trial.

3.9.6 Floor, feeder and water space

An area of 15 sq feet was allotted for 10 birds in each pen; therefore floor space for each bird was 1.5 sq. feet. One round feeder and one round drinker were provided in each pen for 10 birds; required feeding and drinking space was providing according to the number of birds in each replication.

3.9.7 Feed and water management

At the first week feeds were supplied to the chicks on clean newspapers at three hours interval for the first 3 days. Linear feeder and round plastic drinker were used during brooding period. After that linear feeder was replaced by round plastic drinker. Feeds were weighted with measuring balance and supplied twice daily (once at morning and at night) in treatment T_0, T_1, T_2 and T_3, Feed was supplied without Ginger and Green tea powder in T_0 group. T_1, T_2 and T_3 group received GP 0.5gm/kg feed, GTP 0.5gm/kg feed

and (GP 0.25 gm+0.25 gm GTP)/kg feed respectively. Feed was given twice daily with Ginger and green Tea powder (once at morning and at night). Feeders were cleaned at the end of each week and drinkers were washed daily.

Fig. 3.7: Feeding of broiler

3.9.8 Sanitation

Adequate sanitary measures were taken during the experimental period. The entrance point and veranda were kept clean and solution of bleaching powder and potassium permanganate ($KMnO_4$) was kept in foot bath alternatively.

3.9.9 Immunization

All birds were vaccinated against Baby Chick Ranikhet Disease and Infectious Bronchitis at day one by the company. The birds were vaccinated against Ranikhet and Infectious Bursal (Gumboro) diseases by following schedule at the evening.

3.9.10 Applied vaccination program

Table 3.3: Vaccination schedule

Diseases	Old (day)	Vaccine	Dose	Method of vaccination
ND	4	BCRDV	1 drop in one eye	Eye drop
IBD	11	Gumboro vac	1 drop in one eye	Eye drop
IBD	17	Gumboro vac	Drinking water	Drinking water
ND	22	NDLasota	Drinking water	Drinking water

3.9.11 Clinical observation

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

3.9.12 Medication

Immediately after unloading from the chick boxes the chicks were given Glucose and Vitamin C to prevent the stress occurring during transport. Water soluble vitamin and normal saline were also provided for the first 3 days of brooding. During the course of experimental period, electrolytes and vitamin-C were added with the drinking water to combat stress due to high environmental temperature (33 to 35°C).

3.10 Data collection and record keeping

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

i. Live weight
ii. Feed consumption.
iii. Feed conversion ratio.
iv. Mortality.
v. Temperature: Five 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.

3.10.1 Live weight gain

Birds were weighed in a group at the beginning of the trial and then every week at the age of 7, 14, 21, 28 days. The weighting was done using pan balance.

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

3.10.2 Feed intake

Feed offered daily and refusal at the end of each week was recorded. Feed intake was calculated as the total feed consumption in a replication divided by number of birds in each replication.

Feed intake (g/bird)=feed intake per replication/No. of birds per replication

3.10.3 Feed Conversion Ratio

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

FCR=Feed intake (kg) ÷ Weight gain (kg)

3.10.4 Temperature and relative humidity

During the experimental period the temperature and the Relative Humidity (RH) of the experimental house and pens at chick level were recorded two times a day (8AM and at 5 PM) with the help of an automatic thermo hygrometer.

3.10.5 Mortality

Mortality was recorded daily treatment wise when occurred.

Mortality rate (%) = (No. of dead chickens ÷ Total no. of birds as a group) × 100

3.10.6 Processing of broilers

After termination of the experiment, one bird weighing average of 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 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 feather of the carcasses and weighed again. Breast meat, thigh meat were separated from the carcass. Finally, processing was performed by removing head, shank, viscera, oil gland, kidney and giblets. As soon as these were removed the gall bladder was removed from the liver and 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 knife, emptied and washed and the lining removed by hand.

Fig. 3.8: Live weight

Fig. 3.9: Carcass weight

Fig. 3.10: Drum stick weight

Fig. 3.11: Shank weight

Fig. 3.12: Liver weight

Fig. 3.13: Gizzard weight

3.10.7 Dressing yield

Dressing yield is based on the relationship between the dressed carcass weight and live bird weight after things like the skin and internal organs have been removed. Dressing yield can be calculated by taking weight of the carcass divided by weight of live bird.

$$\text{Dressing yield (\%)} = \frac{\text{Weight of the carcass}}{\text{Weight of the live birds}} \times 100$$

3.11 Economy of broiler production

The cost of broiler production for each treatment group was calculated based on the market price of feed ingredients, cost of chicks, citric acid and acetic acid and management cost (labor, medicine, electricity and litter depreciation) to produce per kg of live broiler at the time of trial. The income from per kg of live broiler in different treatment groups was calculated by the selling price of per kg live broiler.

3.12 Statistical analysis

Data on different variables were subjected to analysis of variance (ANOVA) in a Complete Randomized Design (CRD) (Steel and Torrie, 1980). The significant differences between the treatment means were calculated from analysis of variance (ANOVA) Table. All analyses were performed by using "IBM SPSS statistics 22" Programme.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Performance of broiler of experimental birds

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

4.2 Effect of Ginger and Green Tea powder on body weight gain

The effect of Ginger and Green Tea powder on body weight gain of broiler is shown in Table 4.1. The present study revealed that there was no significant ($P>0.05$) variation of initial body weight (g/broiler) among the treatment groups. The initial body weight (g/broiler) in T_0, T_1, T_2 and T_3 group was 40.45±0.35, 40.08±0.52, 40.19±0.17, 40.35±0.10 respectively. At 7 days of age, the body weight was almost similar in different dietary treatment groups. The body weight was significantly ($P<0.05$) varied among the treatment groups during 14th, 28th days of age. The highest body weight was found in T_2 (1561.63±16.79) followed by T_3 (1509.51±6.11), T_1 (1496.66±19.88) and T_0 (1416.93±8.64), respectively.

Birds on dietary group T_0 showed the lowest ($P<0.05$) weight gain and dietary group T_2 showed the highest ($P<0.05$) weight gain among dietary treatment groups. Dietary groups T_2 showed improved growth when administration of Green tea powder 0.5gm/kg feed was added.

Onu (2010) reported that the addition of ginger (0.25%) broiler chicks in the basal diet of broiler chicks resulted in higher body weight and lower FCR.

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

Parameters	Dietary treatment groups				Level of Significance
	T_0	T_1	T_2	T_3	
Initial Body Weight	40.45±0.35	40.08±0.52	40.19±0.17	40.35±0.10	NS
7 days	163.38±3.78	168.01±3.64	159.60±1.77	155.08±2.37	NS
14 days	$247.51±6.78^{c}$	$261.76±2.18^{bc}$	$286.16±5.63^{a}$	$268.40±6.34^{ab}$	*
21 days	$429.46±8.86^{b}$	$462.37±10.03^{a}$	$482.99±8.83^{a}$	$471.80±11.50^{a}$	*
28 days	$576.91±6.98^{b}$	$599.86±6.65^{ab}$	$618.88±7.88^{a}$	$611.89±11.84^{a}$	*
Final Body Weight Gain (1-28 days)	$1416.93±8.64^{c}$	$1496.66±19.88^{b}$	$1561.63±16.79^{a}$	$1509.51±6.11^{b}$	*
Mortality rate (%)	3.33	0.00	3.33	0.00	NS

Where

T_0 = Control diet (without Ginger powder and Green Tea powder)

T_1 = Control diet + GP 0.50gm/kg

T_2 = Control diet + GTP 0.50gm/kg

T_3 = Control diet + (GP 0.25gm+GTP 0.25gm)/kg

±= Standard error

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

*= 5% level of significance

NS= Non significant

4.3 Effect of ginger and green tea powder on feed intake

The effect of ginger and green tea powder on feed intake of broiler is shown in Table 4.2. Feed intake (g/broiler) was significantly (P<0.05) differ among the dietary treatment groups. The feed intake (g/broiler) was highest in T_3 (2190.16±33.22) followed by T_1, T_0 and T_2 was (2176.97±41.4), (2127.96±20.72) and (2070.74±11.12) respectively.

Mohamed *et al.,* (2012) stated that feed consumption of broiler chickens was significantly (P< 0.05) decreased by the supplementation of dietary ginger powder at levels 0.1 and 0.2% compared to the control, being (2852.66, 2791.67 and 2909.62 g/bird) respectively over 42 days.

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

Age in days /Parameters	Dietary treatment groups				Level of Significance
	T_0	T_1	T_2	T_3	
7 days	193.46±0.96^{a}	193.33±3.21^{a}	182.34±2.45^{b}	190.52±2.24^{a}	*
14 days	350.73±7.72	360.68±8.23	347.51±1.18	369.56±9.82	NS
21 days	666.51±10.32	673.27±15.97	642.08±5.14	681.87±14.00	NS
28 days	917.26±1.72^{b}	949.69±14.02^{a}	898.81±2.35^{b}	948.21±7.16^{a}	*
Final Feed Intake (1-28 days)	2127.96±20.72^{b}	2176.97±41.4^{ab}	2070.74±11.12^{c}	2190.16±33.22^{a}	*

Where

T_0 = Control diet (without Ginger powder And Green Tea powder)

T_1 = Control diet + GP 0.50gm/kg

T_2 = Control diet + GTP 0.50gm/kg

T_3 = Control diet + (GP 0.25gm+ GTP 0.25gm)/kg

±= Standard error

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

*= 5% level of significance

NS= Non significant

4.4 Effect of ginger and green tea powder on feed conversion ratio

The Feed Conversion Ratio (FCR) of the experimental birds is shown in Table 4.3. The lowest FCR was control group T_0 (1.50±2.40) and highest in dietary group T_2 (1.33±0.66) at 28th day (4 weeks) of age. From the table it is found that green tea powder 0.5gm/kg feed treated group (T_2) showed better FCR and control diet treated group (T_0) showed lowest FCR.

Zomravi *et al.,* (2011) reported that there were no significant differences ($p > 0.05$) in feed conversion ratio among all dietary treatments containing 0.00 % (2.18), 0.50% (2.19), 1.00% (2.15) and 1.50 % (2.24) of ginger powder.

Table 4.3: Feed conversion ratio (wt gain/feed intake) of different birds of different dietary treatment groups

Age in days	Dietary treatment groups				Level of Significance
	T_0	T_1	T_2	T_3	
7 days	1.18±0.03	1.15±0.02	1.14±0.02	1.23±0.01	NS
14 days	$1.42±0.06^{a}$	$1.38±0.02^{ab}$	$1.21±0.03^{b}$	$1.38±0.06^{ab}$	*
21 days	$1.55±0.04^{a}$	$1.46±0.01^{ab}$	$1.33±0.02^{c}$	$1.45±0.04^{b}$	*
28 days	$1.59±0.02^{a}$	$1.59±0.03^{a}$	$1.45±0.02^{b}$	$1.55±0.02^{a}$	*
Final FCR (1-28 days)	$1.50±2.40^{a}$	$1.45±2.08^{ab}$	$1.33±0.66^{b}$	$1.45±5.44^{ab}$	*

Where

T_0 = Control diet (without Ginger powder And Green Tea powder)
T_1 = Control diet + GP 0.50gm/kg
T_2 = Control diet + GTP 0.50gm/kg
T_3 = Control diet + (GP 0.25gm+GTP 0.25gm)/kg
±= Standard error

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

*= 5% level of significance

NS= Non significant

4.5 Effect of ginger and green tea powder on meat yield traits

4.5.1 Carcass weight

The effect of ginger and green tea powder on carcass weight shown in Table 4.4. It shows that live weight (g), carcass weight (g), thigh weight, breast weight were significantly ($P<0.05$) differed among the dietary treatment groups. The highest live weight found in treatment group T_2 was (1589.49±16.87) followed by T_3 (1549.86±6.21), T_1 (1536.74±20.40) and T_0 (1457.38±8.99), respectively which are significantly ($P<0.05$) varied. T_2 (1058.26±13.51) group had significantly ($P<0.05$) higher carcass weight compared to T_0 (870.66±5.76) whereas T_3 and T_1 had (984.44±6.07) and (975.96±20.53).

Herawati and Marjuki (2011) noted when compared between control and four levels of red ginger powder that diets supplementation with 1, 1.5 and 2% red ginger powder had significant ($P< 0.05$) higher carcass percentage (dressing %) (62.9, 62.9 and 64.9%) respectively than those received 0.5% and control diet being (59.6 and 57.8%), abdominal fat percentage decreased significantly ($P< 0.05$) in broilers fed diets supplemented with red ginger powder 0.5, 1, 1.5 and 2% compared to those broilers fed the basal diet, (1.87, 1.85, 1.81, 1.75 and 2.56) respectively.

4.5.2 Breast meat weight

Breast meat weight differed significantly ($P<0.05$) among the dietary treatment groups shown in Table 4.4. The highest breast meat weight was in T_2 (407.67±3.84) and the lowest in T_0 was (317.67±2.91) whereas T_3 (388.00±3.06) and T_1 (384.67±3.53) respectively.

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

Parameter (g)	Dietary treatment groups				Level of Significance
	T_0	T_1	T_2	T_3	
Live weight	1457.38±8.99^{c}	1536.74±20.40^{b}	1589.49±16.87^{a}	1549.86±6.21^{ab}	*
Carcass weight	870.66±5.76^{c}	975.96±20.53^{b}	1058.26±13.51^{a}	984.44±6.07^{b}	*
Breast	317.67±2.91^{c}	384.67±3.53^{b}	407.67±3.84^{a}	388.00±3.06^{b}	*
Thigh	270.67±2.91^{c}	282.00±3.79^{b}	294.33±1.76^{a}	289.33±2.85^{ab}	*
Head	41.33±1.45	46.67±3.48	45.33±2.33	43.33±2.60	NS
Shank	46.67±1.20^{bc}	49.20±1.89^{ab}	52.00±1.53^{a}	43.33±1.45^{c}	*
Gizzard	51.00±1.15	42.33±2.33	48.67±3.38	52.67±1.86	NS
Liver	42.00±1.53	39.00±1.15	44.00±1.53	44.00±1.73	NS
Heart	6.37±0.03	6.36±0.09	6.45±0.25	6.70±0.09	NS
Spleen	3.50±0.04	3.52±0.06	3.51±0.08	3.58±0.02	NS
Intestine	117.00±1.15	114.00±3.21	117.33±2.33	117.00±0.58	NS

Where

T_0 = Control diet (without Ginger powder And Green Tea powder)

T_1 = Control diet + GP 0.50gm/kg

T_2 = Control diet + GTP 0.50gm/kg

T_3 = Control diet + (GP 0.25gm+GTP 0.25gm)/kg

±= Standard error

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

*= 5% level of significance

NS= Non significant

4.5.3 Thigh meat weight

Thigh meat weight was significant ($P<0.05$) among the dietary treatment group shown in Table 4.4. The highest thigh meat was in T_2 (294.33±1.76) and lowest was T_0 (270.67±2.91), whereas $T_3$was (289.33±2.85) and T_1 (282.00±3.79) respectively.

4.5.4 Effect of Ginger and green tea powder on weight of inedible meat weight

It is observed from the Table 4.4 that head weight (g), gizzard weight (g), intestine weight (g), heart weight (g) and spleen weight (g), liver weight (g) did not significantly ($P>0.05$) varied among different treatment groups. Shank weight differ significantly ($P<0.05$). The highest gizzard weight in T_2 (52.00±1.53) and lowest in T_3 (43.33±1.45) whereas T_1 and T_0 had (49.20±1.89) and (46.67±1.20) respectively.

CHAPTER 5

SUMMARY AND CONCLUSIONS

The study was carried out 120 day old Hubbard meat broiler chicks to evaluate the effect of supplementation of different levels of Ginger and Green tea powder on growth, feed intake, FCR and carcass characteristics of broiler. The experimental birds were distributed randomly to 4 dietary treatment groups namely T_0 (Control group), T_1 (Ginger powder 0.5gm/kg feed), T_2 (Green tea powder 0.5gm/kg feed), T_3 (Ginger 0.25g +green tea powder 0.25g)/kg 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 T_0 (1416.93±8.64), T_1 (1496.66±19.88), T_2 (1561.63±16.79) and T_3 (1509.51±6.11), respectively. Body weight gain was significantly ($P<0.05$) among the different treatment groups. Birds that received GTP 0.5gm/kg feed was gained highest T_2 (1561.63±16.79) body weight and lowest was found T_0 (1416.93±8.64) in control group.

The feed intake among different treatment groups were significant ($P<0.05$). The cumulative maximum feed intake was observed in treated T_3 group (2190.16±33.22) and minimum in T_2 group (2070.74±11.12). Feed efficiency of different treatment groups was statistically significant ($P<0.05$) compared treatment group T_3 to control group T_0. Respective feed efficiency was found T_0 (1.50±2.40), T_1 (1.45±2.08), T_2 (1.33±0.66) and T_3 (1.45±5.44). Green tea powder (GTP) 0.5gm/kg feed treated group (T_2) converted feed to meat most efficiently compared to T_1, T_3 and T_0 treatment groups, respectively. Mortality was found in T_0 (3.33%) and in T_2 (3.33%) dietary groups. Obtained data on meat yield parameters was no significant ($P>0.05$) difference among treatments groups except carcass weight, breast meat weight, thigh meat weight and shank weight was significantly ($P<0.05$) higher in T_2 group compared to control group T_0. The highest carcass weight was T_2 (1058.26±13.51) green tea powder 0.5gm/kg feed treated group and the lowest in T_0 (870.66±5.76) in control group.

Considering the above facts it may be concluded that supplementation of green tea powder 0.5gm/kg had positive significant effect on live weight, feed intake and feed conversion ratio (FCR) with no detrimental effect on meat yield traits. Therefore, green tea powder 0.5gm/kg feed may be used in broiler diet as growth promoter and it may also serve as an antioxidant.

REFERENCES

Ademola, S.G., G.O. Farinu and G.M. Babatunde (2009). Serum lipid, growth and hematological parameters of broilers fed garlic, ginger and their mixtures. World Journal of Agricultural Sciences. 5 (1): 99-104.

Afshari, A.T., A. Shirpoor, A. Farshid, R. Saadatian, Y. Rasmi, E. Saboory, B. Ilkhanizadeh and A. Lameh, 2007. The effect of ginger on diabetic nephropathy, plasma antioxidant capacity and lipid peroxidation in rats. Food Chemistry, 101: 148-153.

Akoachere, J.F.T.K., R.N. Ndip, E.B. Chenwi, L.M. Ndip, T.E. Njock and D.N. Anong, 2002. Antibacterial effect of Zingiber officinalea nd Garcinia kola on respiratory tract pathogens. East African Medical Journal, 79: 588-592.

Al-Hamadani, A. A., I. Nadhum and A. Nadhum (2010). The effect of diet supplementation with antibiotic and ginger on broiler performance. Al-Anbar Journal of Agricultural Sciences. 4 (8): 1 - 10.

AL-Homidan, A. A. (2005). Efficacy of using different sources and levels of allium cepa, allium sativum and zingiber officinale on broiler chick's performance. Saudi Journal of Biological Sciences. 12 (2): 96-102.

Anonymous 1999, C. E. Allen (1973). Ginger rhizome: A new source of proteolytic enzyme. J. Food Sci. 38:652–655.

Arkan, B. M.; Al-Rubaee, M. A. M. and Ali, Q. J. (2012). Effect of ginger on performance and blood serum parameters of broiler. Int. J. Poultry. Sci., 11(2): 143-146.

Arshad, M., A. H Kakar, F. R. Durrani, A. Akhtar, Shakirullah, Sanaullah and M. Niamatullah (2012). Economical and immunological impact of ginger (z. Officinale) extract on broiler chicks. Pakistan Journal of Science. 64(1): 46-48.

Badreldin, H.A., B. Gerald, O.T. Musbah and N. Abderrahim (2008). Some phyto-chemical, pharmacological and toxicological properties of ginger (zingiber officinale roscoe): a review of recent research. Food Chemistry and Toxicology. 46:409-420.

Balunas, M.J. and Kinghorn, A.D. 2005. Drug discovery from medicinal plants. Life Sciences 78(5): 431-441.

Barazesh, H.; Pour, M. B.; Salari, S. and Abadi, T. M. (2013). The effect of ginger powder on performance, carcass characteristics and blood parameters of broilers. Int. J. Adv. Biom. Res., 1(12): 1645-1651.

Barbosa-Cánovas, G. V., Ortega-Rivas, E., Juliano, P., & Yan, H. (2005). Food powders: physical properties, processing, and functionality (Vol. 86, pp. 71-75). New York: Kluwer Academic/Plenum Publishers.

Benelli, R., Vené, R., Bisacchi, D., Garbisa, S., & Albini, A. (2002) Anti-invasive effects of green tea polyphenol epigallocatechin-3-gallate (EGCG), a natural inhibitor of metallo and serine proteases. Biol Chem, 383, 101-105.

Biswas, A.H. & Wakita, M. (2001) Effect of dietary Japanese green tea powder supplementation on feed utilization and carcass profiles in broilers. *The Journal of Poultry Science*, 38: 50–57.

Bliddal, H.; Rosetzsky, A.; Schlichting, P.; Weidner, M. S. and Andersen, L. A. (2000). A randomized, placebo-controlled, cross over study of ginger extracts and ibuprofen in osteoarthritis. Osteoarthritis Cartilage, 8(1): 9-12.

Cabrera C., Artacho R., Gimenez R. (2006). Beneficial effects of green tea – a review. *J. Am. Coll. Nutr*. 25, 79–99.

Cao, B. H., Y. Karasawa and Y. M. Guo. 2005. Effects of green tea polyphenols and fructo-oligosaccharides in semi-purified diets on broilers performance and caecal microflora and their metabolites. Asian-Aust. J. Anim. Sci. 18:85-89.

Capita, R., Calleja, C.A., Pietro, M., Fernandez, M., Del, C.G. and Moreno, B. (2002) Incidence and Pathogenicity of Yersinia spp. Isolates from Poultry in Spain. Food Microbiology, 19, 295-301. https://doi.org/10.1006/fmic.2002.0492

Carpenter R, O'Grady MN, O'Callaghan YC, O'Brien NM and Kerry JP (2007). Evaluation of the antioxidant potential of grape seed and bearberry extracts in raw and cooked pork. Meat Science 76: 604-610. 7

Chen, C.-W. & Ho, C.-T. (1995) Antioxidant properties of polyphenols extracted from green and black teas. Journal of Food Lipids, 2:35–46.

Crespy, V. and G. Williamson. 2004. A review of the health effects of green tea catechins in in vivo animal models. J. Nutr. 134:3431S-3440S.

Cyril, H., & Jozef, B. (2017). Effect of different levels of green tea (*Camellia sinensis*) on productive performance, carcass characteris tics and organs of broiler chickens. Potravinarstvo Slovak Journal of Food Sciences, 11, 623–628

Daglia, M. (2012). Polyphenols as antimicrobial agents. Current opinion in biotechnology, 23 (2), 174-181.

Diker, K. S., Akan, M. E. H. M. E. T., Hascelik, G., & Yurdakök, M. (1991). The bactericidal activity of tea against Campylobacter jejuni and Campylobacter coli Letters in Applied Microbiology, 12(2), 34-35.

Ebrahimnezhad, Y.; Azarakhsh, V. and Salmanzadeh, M. (2014). The effects of ginger root (Zingiber officinale) processed to different levels on growth performance, carcass characteristics and blood biochemistry parameters in broiler chickens. Bull. Env. Pharmacol. Life Sci., 3(5): 203-208.

El-Deek, A.A., Y.A. Attia, M. Maysa, and M. Hannfy. (2002). Effect of anise (Pimpinella anisum), ginger (Zingiber officinale Roscoe) and fennel (Foeniculum vulgare) and their mixture on performance of broilers. Arch. Geflugelkd. 67: 92-96

Elmakki, A. M.; Khadig A.; Dousa, B. M.; Elagib, H. A. A.; Huwaida E. E. M. and Khalid M. E. (2013). Effects of dietary ground ginger (Zingiber officinale) root additive on broiler performance. Global J. Animal. S. Res., 1(1): 76-83.

Fernandez P. L., Pablos F., Martin M. J., Gonzalez A. G. (2002). Study of catechin and xanthine tea profiles as geographical tracers. *J. Agric. Food Chem*. 59, 1833–1839.

Fitzpatrick, J. J., & Ahrné, L. (2005). Food powder handling and processing: Industry problems, knowledge barriers and research opportunities. *Chemical Engineering and Processing: Process Intensification*, *44*(2), 209-214.

Friedman, M. (2007). Overview of antibacterial, antitoxin, antiviral, and antifungal activities of tea flavonoids and teas. *Molecular nutrition & food research*, *51*(1), 116-134.

Friedman, M., Henika, P. R., Levin, C. E., Mandrell, R. E., & Kozukue, N. (2006). Antimicrobial activities of tea catechins and theaflavins and tea extracts against Bacillus cereus. Journal of Food Protection, 69 (2), 354-361.

Fujiki, H. 2005. Green tea: health benefits as cancer preventive for humans. Chem. Rec. 5:119-132.

Gramza A., Korczak J. & Amarowicz R. 2005. Tea polyphenols - their antioxidant properties and biological activ ity - a review. Polish Journal of Food and Nutrition Sciences. 14 (3): 219-235

Guo FC, Williams BA, Kwakkel RP, Li XP, Luo JY, Li WK and Verstegen MWA (2004). Effects of mushroom and herb polysaccharides, as alternatives for an antibiotic, on the cecal microbial ecosystem in broiler chickens. Poultry Science 83: 175-182.

Haghjoo, B., Lee, L. H., Habiba, U., Tahir, H., Olabi, M., & Chu, T. C. (2013). The synergistic effects of green tea polyphenols and antibiotics against potential pathogens. *Advances in Bioscience and Biotechnology*, *4*(11), 959-967.

Hamer, M. (2007). The beneficial effects of tea on immune function and inflammation: A review of evidence from in vitro, animal, and human research. Nutrition Research, 27, 373–379.

Hara, Y., Luo, S. J., & Wickremasinghe, R. L. (1995). Yamanishi T. Special Issue on Tea. *Food Reviews International*, *11*, 371-545.

Henning, S. M., Niu, Y., Lee, N. H., Thames, G. D., Minutti, R. R., Wang, H., & Heber, D. (2004), Bioavailability and antioxidant activity of tea flavanols after consumption of green tea, black tea, or a green tea extract supplement The American journal of clinical nutrition, 80(6), 1558-1564.

Herawati (2010). The effect of feeding red ginger as phytobiotic on body weight gain, feed conversion and internal organs condition of broiler. Int. J. Poult. Sci. 9: 963-967.

Herawati and Marjuki, (2011). The effect of feeding red ginger (zingiber officinale rosc) as phytobiotic on broiler slaughter weight and meat quality. International Journal of Poultry Science. 10 (12): 983-985.

Herbs Hands Healing (2011). Traditional Western Herbal Product Ginger Extracts from in a Nutshell 'Ginger' by Jill Rosemary Davies. www.herbs-hands-healing.co.uk. Accessed on 12 July, 2017.

Jakes, Susan (2007). Beverage of Champions. J. Food Chem., 101(1): 148-153.

Jang, S. I., M. H. Jun, H. S. Lillehoj, R. A. Dalloul, I. K. Kong, S. Kim and W. Min. 2007. Anticoccidial effect of green tea-based diets against Eimeria maxima. Vet. Parasitol. 144:172-175.

Javed, M., Durrani, F., Hafeez, A., Khan, R.U., & Ahmed, I. (2009) Effect of aqueous extract of plant mixtures on carcass quality of broiler chicks. ARPN Journal of Agricultural and Biological Science 4: 37-40.

Jigisha A., Nishant R., Navin K., Pankaj G. (2012). Green tea: a magical herb with miraculous outcomes. *Int. Res. J. Pharm*. 3, 139–148 Available online at: http://www.irjponline.com/admin/php/uploads/1083_pdf.pdf

John, R. P., & Ferreira, D. I. (1997). Yield and quality evaluation of five ginger (Zingiber officinale Roscoe) selections in the Northern Province of South Africa Journal of the Southern African Society for Horticultural Sciences, 7(1), 26-29.

Kaneko, K., Yamasaki, K., Tagawa, Y., Tokunaga, M., Tobisa, M., & Furuse, M. (2001). Effects of dietary Japanese green tea powder on growth, meat ingredient and lipid accumulation in broilers. Japanese poultry science, 38(5), J77-J85.

Ke, J., Delin, W., & Larsen, K. (2000). Zingiberaceae. Flora of China 24, 322-377.

Kehinde, A. S., C. O. Obun, M. Inuwa and O. Bobadoye (2011). Growth performance, haematological and serum biochemical indices of cockerel chicks fed ginger

(*Zingiber officinale*) additive in diets. Animal Research International. 8(2): 1398-1404.

Khan, N., & Mukhtar, H. (2007). Tea polyphenols for health promotion. *Life Sciences*, 81, 519–533.

Khan, S. H. (2014). The use of green tea (*Camellia sinensis*) as a phyto genic substance in poultry diets. Onderstepoort Journal of Veterinary Research, 81 (1), e1–e8.

Khokhar, S., & Magnusdottir, S. G. M. (2002) Total phenol, catechin, and caffeine contents of teas commonly consumed in the United Kingdom Journal of agricultural and food chemistry, 50(3), 565-570.

Kikuzaki, H. and Nakatani, N. (1993). Antioxidant effects of some ginger constituents. J. Food Science, 58: 1407-1410.

Kim JA. 2008. Mechanisms underlying beneficial health effects of tea catechins to improve insulin resistance and endothelial dysfunction. Endocrine, Metabolic and Immune Disorders: Drug Targets 8, 82-88.

Kim, Y.S., Hwang, C.S. and Shin, D.H. 2005. Volatile constituents from the leaves of Polygonum cuspidatum S. et Z. and their anti-bacterial activities. Food Microbiology 22(1): 139-144.

Kota, N., P. Krishna and K. Polasa, 2008. Alterations in antioxidant status of rats following intake of ginger through diet. Food Chemistry, 106: 991-996.

Krishnakantha, T. P., & Lokesh, B. R. (1993). Scavenging of superoxide anions by spice principles. Indian Journal of Biochemistry and Biophysics, 30, 133–134.

Krul C, Luiten-Schuite A, Tenfelde A, van Ommen B, Verhagen H, Havenaar R (2001) Antimutagenic activity of green tea and black tea extracts studied in a dynamic in vitro gastrointestinal model. Mutat Res 474:71–85

Kurita, T., Miyagishima, A., Nozawa, Y., Sadzuka, Y., & Sonobe, T. (2004). A dosage design of mitomycin C tablets containing finely powdered green tea. *International journal of pharmaceutics, 275* (1-2), 279-283.

Kuroda Y., Hara Y., 1999. Antimutagenic and anticarcinogenic activity of tea polyphenols. Mutation Research. 436: 69-97.

Liao, S., Kao, Y., & Hiipakka, R. A. (2001). Green tea: Biochemical and biological basis for health benefits. Vitamins and Hormones, 62, 1–94.

Lin Y. S., Tsai Y. J., Tsay J. S., Lin J. K. (2003). Factors affecting the levels of tea polyphenols and caffeine in tea leaves. *J Agric. Food Chem*. 51, 1864–1873.

Lu, T. M., Lee, C. C., Mau, J. L., & Lin, S. D. (2010). Quality and antioxidant property of green tea sponge cake. *Food chemistry*, *119*(3), 1090-1095.

Mallikarjuna, K., P.S. Chetan, K.S. Reddy and W. Rajendra, 2008. Ethanol toxicity: Rehabilitation of hepatic antioxidant defense system with dietary ginger. Fitoterapia, 79: 174 178

Martins, A.P., Salgueiro, L., Goncalves, M.J., Proenca da Cunha, A., Vila, R., Canigueral, S., Mazzoni, V., Tomi, F. and Casanova, J. 2001. Essential oil composition and antimicrobial activity of three zingiberaceous from S. Tome e Principe. Planta Medica 67(6): 580 584.

Menon, A.N. and Sasidharan, I. 2010. Comparative chemical composition and antimicrobial activity fresh and dry ginger oils (Zingiber officinale Roscoe). International Journal of Current Pharmaceutical Research 2(4): 40-43.

Mohamed, A. B., M. A. M. Al-Rubaee and A. Q. Jalil (2012). Effect of ginger (zingiber officinale) on performance and blood serum parameters of broiler. International Journal of Poultry Science. 11 (2): 143-146.

Mohammed, A. A. and Yusuf, M. (2011). Evaluation of ginger (Zingiber officinale) as a feed additive in broiler diets. Livestock Res. Rural Dev., 23(9): 1-5.

Moorthy, M., S. Ravi, M. Ravikumar, K. Viswanathan and S. C. Edwin (2009). Ginger, pepper and curry leaf powder as feed additives in broiler diet. International Journal of Poultry Science. 8 (8): 779-782.

Nakatani, N., 2000. Phenolic antioxidants from herbs and spices. Biofactors, 13: 141-146.

Natarajan, C. P., Bai, R. P., Krishnamurthy, M. N., Raghavan, B., Shankaracharya, N. B., Kuppuswamy, S., ... & Lewis, Y. S. (1972). Chemical composition of ginger varieties and dehydration studies on ginger. *Journal of food science and technology*, *9*(3), 120-124.

Nobrega, L. P., Monteiro, A R., Meireles, M. A. A., & Marques, M. O (1997). Comparison of ginger (Zingiber officiale Roscoe) oleoresin obtained with ethanol and isopropanol with that obtained with pressurized CO2. Food Science and Technology, 17, 408-412.

NRC (1994). National Research Council, Nutrient Requirements of Poultry. 9th Edition, National Academic Press, Washington. Okoleh, O. V. U.; Chukwu, G. C. and Adeolu, A. I. (2014). Effect of ground ginger and garlic on the growth performance, carcass quality and economics of production of broiler chickens. Global J. Biosci. & Biotechnol., 3(3): 225-229.

Onu PN (2010). Evaluation of two herbal spices as feed additives for finisher broilers. Biotechnol. Anim. Husb. 26(5-6):383-392.

Polychronopoulos E, A Zeimbekis, CM Kastorini, N Papairakleous, I Vlachou, V Bountziouka, DB Panagiotakos. 2008. Effects of black and green tea consumption on blood glucose levels in non-obese elderly men and women from Mediterranean Islands (MEDIS epidemiological study). European J Nutr 47, 10-16.

Pruthi 2000. Gai, and Y.F. Yang. (2008). Effect of superfine grinding on properties of ginger powder. J Food Eng., 91: 217-222.

Purseglove *et al.* (1998). Determination of the effects of z. Officinale and propolis extracts on intestinal microbiology and histological characteristics in broilers. International Journal of Poultry Science. 9 (9): 898-906.

Rababah, T.M., N.S. Hettiarachchy and R. Horax, 2004. Total phenolics and antioxidant activities of fenugreek, green tea, black tea, grape seed, ginger, rosemary, gotu kola and ginkgo extracts, vitamin E and tert-butylhydroquinone. Journal of Agriculture and Food Chemistry, 52: 5183-5186.

Ramadan, M.F., Kroh, L.W. & Mörsel, J.-T. (2003). Radicalscaven ging activity of black cumin (*Nigella sativa* L.), coriander (*Coriandrum sativum* L.) and niger (*Guizotia abyssinica* Cass.) crude seed oils and oil fractions. Journal of Agricultural and Food Chemistry, 51:6961–6969. doi:10.1021/jf0346713

Ravindran V. (2013). Poultry Feed Availability and Nutrition in Developing Countries. Poult. Dev. Rev. 2: 60–63.

Roowi S., Stalmach A., Mullen W., Lean M. E., Edwards C. A., Crozier A. (2010). Green tea flavan-3-ols: colonic degradation and urinary excretion of catabolites by humans. J. Agric. Food Chem. 58, 1296–1304.

Sahin K, C Orhan, M Tuzcu, S Ali, N Sahin, A Hayirli. 2010. Epigallocatechin-3-gallat prevents lipid peroxidation and enhances antioxidant defense system via modulating hepatic nuclear transcription factors in heat-stressed quail. Poult Sci 89, 2251-2258.

Sahin K, C Orhan, MO Smith, N Sahin. 2013. Molecular targets of dietary phytochemicals for the alleviation of heat stress in poultry. World's Poult Sci J 69, 113-123.

Shahid W., Ahmad A., Mangaiyarkarasi R., Omer M., Shahina N., Abdurraheem U., Rahmanullah S. & Zahra Y. 2013. Effect of polyphenolic rich, green tea extract as antioxidant on broiler performance during 0-4 weeks. Inter national. Journal of Advanced Research. 1 (9): 177-181.

Shareef, H. K., Muhammed, H. J., Hussein, H. M., & Hameed, I. H. (2016). Antibacterial effect of ginger (Zingiber officinale) roscoe and bioactive chemical analysis using gas chromatography mass spectrum. Oriental Journal of Chemistry, 32(2), 20-40.

Simoyi, M. F., Van Dyke, K., & Klandorf, H. (2002). Manipulation of plasma uric acid in broiler chicks and its effect on leukocyte oxidative activity. *American Journal of Physiology-Regulatory, Integrative and Comparative Physiology*, *282*(3), R791-R796.

Singh, M.P. and Panda, H. (1992). Medicinal herbs with their formulation. Volume 1-Allium sativum, Daya Publishing House, Delhi, 110035.

Sommer AP, Zhu D, Scharnweber T (2010). Extraordinary anticancer effect of green tea and red light. Photomed Laser Surg 28:429 430.

Steel, R. G. D. & Torrie, J. H. (1980). Principles and procedures of statistics: A biometrical approach, 2nd ed McGraw-Hill Book Coy Inc, New York.

Stewart, J. J., Wood, M. J., Wood, C. D., & Mims, M. E. (1991). Effects of ginger on motion sickness susceptibility and gastric function. *Pharmacology*, *42*(2), 111-120.

Suhad, A.A., Iman, J.I. and Hamssah, E.A.W. 2012. Study the antibacterial activity of Zingiber officinale roots against some of pathogenic bacteria. Al-Mustansiriya Journal of Science 23(3): 63-70

Taha, F.A. (2003) The Poultry Sector in Middle-Income Countries and Its Feed Requirements: The Case of Egypt. Outlook Report No. WRS03-02. Economic Research Service, USDA, Washing DC.

Taylor, P. W., Hamilton-Miller, J. M., & Stapleton, P. D. (2005). Antimicrobial properties of green tea catechins. Food science and technology bulletin, 2, 71.

Tekeli, A., H. R. Kutlu and L. Celik (2011). Effects of z. Officinale and propolis extracts on the performance, carcass and some blood parameters of broiler chicks. Current Research in Poultry Science. 1 (1): 12-23.

Thayalini, K., S. Shanmugavelu, P. M. Saminathan, M. S. Siti Masidayu, Y. Nor Idayusni, H. Zainuddin, C. A. Nurul Akmal, and H. K. Wong (2011). Effects of cymbopogon citratus leaf and zingiber officinale rhizome supplementation on growth performance, ileal morphology and lactic acid concentration in broilers. Malaysian Journal of Animal Science. 14:43-49.

Thielecke F, M Boschmann. 2009. The potential role of green tea catechins in the prevention of the metabolic syndrome- a review. Phytochemistry 70, 11-24.

Ueda H. & Shigemizu G. 2001. Feeding response to tea saponin in chicks given diet selection. Journal of Poultry Science. 38 (4): 333-342

Ueda H. 2001. Short-term feeding response in chicks to tea saponin. Journal of Poultry Science. 38 (4): 282-288.

USDA National Nutrient Database (2006). Ginger root nutrition facts source. USDA National Nutrient Database for Standard Reference, Release 19 (2006)

Uuganbayar D, Bae HI, Choi KS, Shin IS, Firman JD and Yang CJ (2005). Effects of green tea powder on laying performance and egg quality in laying hens. Asian-Australian Journal of Animal Science 18: 1769-1774.

Vastag, B. (1998). Tea therapy? Out of the cup, into the lab. JNCI Journal of the National Cancer Institute, 90: 1504–1505. doi:10.1093/jnci/90.20.1504-a

Wadhwa, D.; Kumari, M.; Sharma, K. S. and Sharma, V. K. (2011). Effect of ginger (Zingiber officinale) powder supplementation on growth performance of commercial broilers under field conditions. Himachal J. Agri. Res., 37(1): 75-80.

Wang Y., Ho C. T. (2009). Polyphenolic chemistry of tea and coffee: a century of progress. *J. Agric. Food Chem*. 57, 8109–8114.

Wang, H., Provan, G. J., & Helliwell, K. (2000). Tea flavonoids: their functions, utilisation and analysis. Trends in Food Science & Technology, 11 (4), 152-160.

Weisburger JH, FL Chung. 2002. Mechanisms of chronic diseases causation by nutritional factors and tobacco products and their prevention by tea polyphenols. Food Chem Toxicol 40, 1145-1154.

Wolfram, S. (2007). Effects of green tea and EGCG on cardiovascular and metabolic health. Journal of the American College of Nutrition, 6, 373 388.

Yamane T., Hagiwara N., Tateishi M., Akachi S., Kim M., Okuzumi J., Kitao Y., Inagake K., KuwataK.,Takahashi T., 1991. Inhibition of azoxymethane induced colon carcinogenesis in rat by green tea polyphenol fraction. Japanese Journal of Cancer Research. 82: 1336-1339.

Yang, C.J., Yang, I.Y., Oh, D.H., Bae, I.H., Cho, S.G., Kong, I.G., Uuganbayar, D., Nou, I.S. & Choi, K.S. (2003). Effect of green tea by-product on performance and body composi tion in broiler chicks. Asian-Australasian Journal of Animal Sciences, 16: 867–872. doi:10.5713/ajas.2003.867

Yao, L., Liu, X., Jiang, Y., Caffin, N., D'Arcy, B., Singanusong, R., ... & Xu, Y. (2006). Compositional analysis of teas from Australian supermarkets. *Food Chemistry*, *94*(1), 115-122.

Yiljep, Y. D., Fumen, G. A., & Ajisegiri, E. A. (2005). The effects of peeling, splitting and drying on ginger quality and oil/oleoresin content. *Agricultural Engineering International: CIGR Journal*, 7: 1-8.

Zhang, G. F., Yang, Z. B., Wang, Y., Jiang, S. Z. and Gai, G. S 2009. Effects of ginger root processed to different particle sizes on growth performance, antioxidant status, and serum metabolites of broiler chickens. Poult. Sci. 88:2159-2166.

Zhao, X., Yang, Z.B., Yang, W.R., Wang, Y., Jiang, S. Z. and Zhang, G. G. 2011. Effects of ginger root on laying performance and antioxidant status of laying hens and on dietary oxidation stability. Poultry Science 90: 1720 – 1727

Zomrawi WB, Abdel Atti KHA, Dousa BM, Mahala AG (2012). The effect of ginger root powder (Zingiber officinale) Supplementation on broiler chicks performance, blood and serum Constituents. J. Anim. Feed Res. 1(6):457-460.