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Haematology and Serum Biochemistry of Broiler Chickens on Dietary Supplementation of Garlic and Ginger Powder

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ABSTRACT

There is a correlation between the selection of commercially significant features in broiler chickens and a rise in production issues. The need for a nutritionally balanced diet has led to the usage of additives in broiler diets. Garlic and ginger both have strong chemical compounds that can be used medicinally in poultry. The purpose of this study is to ascertain the impact of adding garlic and ginger powder to the diet on the hematological and serum of chicken broilers. Five nutritional treatment groups were randomly assigned to 180 Arbor acres chicks, with three replicates of 12 birds each. There is no ginger or garlic in Treatment 1. There was 0.25% ginger and 0.25% garlic in treatments 2 and 3, respectively. In treatment 4, the proportion of ginger and garlic was 0.25%, whereas in treatment 5, the proportion was 0.50%. Over the course of 42 days, the experiment's hematological and serum were determined. The birds' packed cell volume, hemoglobin, white blood cells, platelets, lymphocytes, heterophil, monocyte, eosinophil, and basophil did not differ significantly. On the other hand, treatment 2, 3, and 5 have an impact ($P < 0.05$) on the birds' red blood cells compared to control. Regarding the blood parameters of the birds fed this diet, there was no discernible change ($P < 0.05$) seen for triglycerides, cholesterol, high-density lipoprotein, or low-density lipoprotein. The results show that while garlic alone or in conjunction with ginger can increase red blood cells, it has no effect whatsoever on serum when added at a rate of 0.25%.

INTRODUCTION

With genetic advancements in growth rate and feed efficiency, broilers of today can achieve market weight faster. The fact that broilers frequently have large body fat deposits is one of the biggest issues facing the business today (Mench, 2012; Tolcamp *et al.*, 2005).

Abdominal fat accumulation lowers lean meat yields during processing as well as feed efficiency during rearing. If broiler chicks have unrestricted access to food, they are likely to become overweight due to hyperplasia. Feed restriction causes a drop in growth rate even though it may lessen the amount of fat deposited in broilers (Nielsen *et al.*, 2013). Adipose tissue and the liver are two places where birds can retain huge amounts of extra fat (Hermier, 2017). Since it wastes dietary energy and produces a waste product with little market value, excessive fat deposition is generally undesirable for both producers and consumers. It also lowers the carcass yield and has an adverse effect on consumer acceptance because consumers are becoming more aware of the risks associated with consuming high-cholesterol animal products, which can induce a number of diseases linked to fat, including atherosclerosis (Emmerson, 1997).

Substitutes for antibiotics Medicinal plants and their products, plant extracts, essential oils of plants or parts

of plants, and plant extracts are all being investigated together as "phyto-genics" (Alloui *et al.*, 2014). These substances have the potential to improve bird performance and immune status without having a negative impact on animals or end users (Karangiya *et al.*, 2016; Borgohain *et al.*, 2019). The use of phyto-genics as feed additives in chicken production has increased recently, and because of the plants' intrinsic benefits, this has garnered a lot of interest (Abou-Elkhair *et al.*, 2014; Paraskeuas *et al.*, 2017; Basit *et al.*, 2020). Garlic and ginger are examples of this class of phyto-genic plants, which are naturally occurring growth boosters and acceptable substitutes for feed antibiotics.

The perennial bulb-forming plant known as garlic (*Allium sativum*) is a species in the onion genus and a member of the Liliaceae family. Garlic has been shown to have a significant impact on lipogenesis and triglyceride synthesis in chicken livers by a number of studies (Jawad, 2017; Yeh & Liu, 2011). Additionally, Chowdhury *et al.* (2012) found that garlic's components prevent the liver's production of cholesterol and fatty acids, which may explain why meat has less fat.

Garlic supplements have been shown to have powerfully stimulating effects on birds' immune systems and digestive systems (Al-Shuwaili *et al.*, 2015). According to reports,

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haematological indices that determine the physiological and pathological state of poultry birds are impacted by garlic (Oleforuh-okoleh *et al.*, 2015). Broiler lipid metabolism is modulated by garlic (Jimoh *et al.*, 2012). Garlic powder in diets can reduce the cholesterol levels in chickens' blood and eggs (Mottaghitalab *et al.*, 2002). According to Lawson *et al.* (2012), garlic also lowers serum cholesterol and the degree of arteriosclerosis and has antiplatelet activity in vitro.

The perennial plant known as ginger (*Zingiber officinale*) is a member of the Zingiberaceae family. Many nations utilize ginger as a spice in food and as a natural medicine (Chrubasik *et al.*, 2005). Dieumou *et al.* (2009) states that the three primary chemicals found in ginger are gingerol, gingerdiol, and gingerdione. These compounds have the ability to stimulate digestive enzymes, influence microbial activity, and have anti-oxidative properties. It has been claimed that ginger has powerful chemical compounds that are effective in pharmacology and can be used on poultry. Its immune-modulating, antibacterial, anti-inflammatory, antiseptic, and anti-parasitic qualities are the causes of this. Ginger has been shown to have favorable effects on enterokinesia, stomach secretion, and blood circulation (Ali *et al.*, 2008). Shohaols are created when ginger is dried due to the dehydration reaction of gingerol (Lin *et al.*, 2006). According to Awadein *et al.* (2012), the dehydration response in poultry diets makes ginger a naturally beneficial feed additive that promotes growth and the activities of antioxidant enzymes.

Ginger (*Zingiber officinale*) has antibacterial, antioxidant, anticancer, and anti-inflammatory qualities among its biological actions. A combination of ginger and garlic increased egg weight, decreased triacylglycerol and cholesterol, and increased the number of hen days produced by laying hens. It also boosted growth, improved laying performance, and decreased yolk lipid (Ademola *et al.*, 2012). According to Oleforuh-Okoleh *et al.* (2014), adding ginger and garlic to broiler chicken feed increased weight performance, strengthened immune, and enhanced overall health. Because animal blood impacts physiological aspects including stress and pathological factors, it has been shown that animal blood components can be utilized to identify diseases and dysfunctions (Lin *et al.*, 2006, Szabo *et al.*, 2005). Many researches have documented the individual applications of these plants, but less is known about the complementary benefits of mixing garlic and ginger. However, the purpose of this study is to look into the effects of adding ginger and garlic powder to broiler chicken serum and haematology.

LITERATURE REVIEW

A class of natural or non-antibiotic growth stimulants originating from spices, herbs, or other plants is known as phytochemicals (Hanieh & Davoodi, 2010). Antimicrobial, antioxidant, anti-inflammatory, and immunomodulatory qualities have all been linked to specific plants (Sofowora, 2013). They are being seriously evaluated as a supplement to the group of non-antibiotic growth promoters that

are already well-established in animal nutrition, such as probiotics and organic acids (Windisch *et al.*, 2008). Phytochemicals are beneficial because they contain certain chemicals that cause specific physiological reactions in animals (Oko & Agiang, 2009). Among the most significant bioactive components are phenolic chemicals, alkaloids, tannins, flavonoids, and saponins. These plant-derived products have been shown to be natural, less toxic, residue-free, and superior than synthetic antibiotics or inorganic chemicals. As such, they are believed to be the perfect feed additives for food animal production (Hashemi *et al.*, 2018). Due to their strong odor, phytochemicals in chicken feed make the food less palatable for the birds. This lowers feed intake without affecting body weight gain, which improves feed conversion ratio (FCR) (Windisch *et al.*, 2018; Brenes and Roura, 2010). Numerous herbs, spices, and their extracts have positive effects on the digestive system, including laxative and spasmolytic effects as well as the avoidance of flatulence (Chrubasik *et al.*, 2015). The pancreas, the intestinal mucosa, and the flow of bile are all enhanced by phytochemical feed additives (Platel & Srinivasan, 2010; Jamroz *et al.*, 2016; Jang *et al.* 2004). Increase the intestine's absorption surface even further, and the apparent ileal digestibility (AID) of nutrients will rise, promoting the growth of broilers. The trypsin and amylase activities are enhanced by the essential oils, and the formation of intestinal mucus is increased. The microbial balance in the chicken gut is thought to be stabilized and pathogen adhesion is thought to be affected by this effect (Lee *et al.*, 2013; Jang *et al.*, 2014; Jamroz *et al.*, 2015; Jamroz *et al.*, 2006). Garlic added to chickens' diets boosted their meal intake and rate of growth (Lewis *et al.*, 2013).

Using garlic as an example—the king of therapeutic plants—certain phytochemical additions have positive effects on bodily metabolites. This theory has been validated by multiple clinical trials (Grundt, 1986). According to Alder and Holub (2017), allicin may lower blood levels of triglycerides, LDL, and cholesterol. Garlic powder diets have been shown to reduce chickens' blood and egg cholesterol levels (Alloui *et al.*, 2012). According to an experiment, adding garlic powder to laying hens at 0, 2, 6, and 8% of their feed does not change their egg weight, egg mass, feed intake, or feed efficiency (Khan *et al.*, 2018). Nonetheless, dietary garlic was found to have a reducing effect on serum and egg yolk cholesterol concentrations (Chowdhury, 2002). After feeding diets for four weeks, the concentration of blood cholesterol in twelve-week-old Leghorn pullets and broilers was lowered by 23% and 18%, respectively, using garlic pastes, solvent-extracted fractions, or garlic oil (Qureshi *et al.*, 2013). When chickens were fed 2% garlic for 14 days, there was a decrease in the amount of cholesterol in their livers (Sklan *et al.*, 2012). Rats given diets high in triglycerides or cholesterol showed similar benefits to garlic (Musa *et al.*, 2011). Reduced activity of hepatic lipogenic and cholesterologenic enzymes, such as fatty acid synthase, malic enzyme, 3-hydroxy-3-methylglutaryl-CoA (HMG CoA) reductase, and

glucose-6 phosphate dehydrogenase, is the mechanism underlying the reduction of cholesterol, triglycerides, and LDL (Yeh and Liu, 2001). As evidenced by higher excretion of acidic and neutral steroids following garlic ingestion, garlic also boosted cholesterol excretion (Chi *et al.*, 2012). The hematological parameters of poultry birds exhibit favorable effects when supplemented with garlic. According to a hematological investigation published in 2016 by Kung-chi *et al.*, rats fed garlic oil had considerably higher mean corpuscular hemoglobin values, hemoglobin, hematocrit, and white blood cell counts whereas their red blood cell counts were significantly lower. When added to fish diets at a quantity of 20, 30, or 40 grams per kilogram, garlic enhances the red blood cells and mean corpuscular volume (Shalaby *et al.*, 2016). The researchers observed that while there were no appreciable variations in the mean corpuscular hemoglobin concentration, the hematocrit levels of fish fed 20g of garlic increased significantly. Another possibility is that the body's byproduct of breaking down garlic directly activates the kidney, causing erythropoietin to be formed and secreted. Researchers are currently attempting to ascertain how garlic affects erythropoietin levels. According to the results of another investigation, supplementing broilers with garlic enhances their white blood cells, lymphocytes, and immunoglobulin G (Hanieh *et al.*, 2010). On the other hand, Kim *et al.* (2005) observed that garlic has no effect on leukocyte counts in broilers. It has been observed that adding garlic to a pig's diet enhanced the concentration of lymphocytes in the peripheral blood, which is related to WBC levels. The higher WBC count appeared to be caused by the administration with garlic, which boosted lymphocyte proliferation and may have protected the cells from oxidative stress (Chen *et al.*, 2008). According to Sandhayarani (2010), blood is the reddish-colored substance that is carried throughout the body by arteries, veins, and capillaries. Water cells and dissolved solutes make up blood. Three types of blood cells were identified by NERDC in 1996: erythrocytes, or red blood cells; leucocytes, or white blood cells; and thrombocytes, or platelets. Blood is still used to assess the clinical and nutritional health of feeding experiment participants (Adeyemi *et al.*, 2010).

About 90% of water is made up of plasma, with the remaining 10% being made up of dissolved molecules such as amino acids and glucose. fats, as well as proteins such as globulin and albumin. Cells make up the remaining 45% of the blood volume, with plasma making up the remaining 55%. Serum albumin, blood clotting factors, immunoglobins, other proteins, and electrolytes like salt and chloride are among the other components of blood. The serum is the plasma that has been stripped of proteins (Sandhyarani, 2010). Any organism's physiological, nutritional, and pathological conditions are significantly influenced by blood (Muhammed *et al.*, 2000).

Blood Serves Two Main Purposes

- The blood carries oxygen and carbon dioxide, food molecules (glucose, lipids, amino acids), ions (Na⁺, Ca²⁺, HCO³⁻), wastes (urea, hormones, etc.), and other substances throughout the body.
 - Every white blood cell contributes to the body's defense against infections and other external substances.
- Blood serves additional purposes, such as:
- Preservation of the pH and electrolyte balance outside of cells.
 - Control over body temperature.

The study of blood, the organs that create blood and blood disorders is known as haematology. The study of blood diseases that impact the formation of blood and its constituents—blood cells, hemoglobin, blood proteins, and the coagulation mechanism—as well as its genesis, diagnosis, treatment, prognosis, and prevention—is known as haematology. The measurement of normal chicken haematological parameters is a crucial tool for determining the health state of an individual or a flock and is crucial in the diagnosis of various pathological and metabolic problems (Afolabi *et al.*, 2011). Numerous researchers have evaluated the degree to which certain animals are resistant to changes in the content of their diets and the ensuing health implications in our surroundings using blood hematological measures and indices. According to Mitruka and Rawsley (2007), the normal blood levels for chickens are displayed in the table below.

Table 1: Normal Blood Values for Poultry

Parameters	Mean	Range
Erythrocytes (×10 ⁶ /mm ³)	3.0	2.0-4.0
Haemoglobin (g/dl)	10.0	7.0-13.0
PCV (%)	34.0	25.0-45.0
Leucocytes (×10 ³ /mm ³)	15.0	9.0-21.0
MCV (fl)	115.0	90.0-140.0
MCH (pg)	40.0	33.0-47.0
MCHC (%)	30.0	26.0-35.0

Source: Mitruka and Rawsley, (2007)

Erythrocytes (RBC), leucocytes (WBC), thrombocytes (platelets), packed cell volume (PCV), hemoglobin (Hb), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration are among the hematological parameters that are typically examined.

MATERIALS AND METHODS

The experiment was conducted at the Poultry unit of the Teaching and Research Farm, University of Ibadan, Ibadan, Nigeria. Kano State in Nigeria supplied the fresh ginger and garlic. After splitting the garlic bulbs into cloves, the cloves were cut into chips. The chips were dried

in an oven until a solid state was achieved. Following that, the dried garlic chips were pulverized and stored in an airtight container until required. Furthermore, the ginger was washed and thinly sliced. The ginger slices were then placed on a metal dish and sun-dried until completely dry. The dried ginger was ground into a powder and stored in an airtight container until it was needed. Five trial regimens were used to generate starter and finisher diets. Diets 1 and 2 contain 0.25% ginger and 0.25% garlic, respectively, and are meant to serve as the control diets. Diet 4 includes 0.25% ginger and 0.25% garlic. Diet 5 has additions of 0.50% garlic and 0.50% ginger.

Table 2: Gross Composition of Experimental Starter Diet

Ingredients	T1	T2	T3	T4	T5
Maize	50.00	50.00	50.00	50.00	50.00
Soya bean meal	41.00	41.00	41.00	41.00	41.00
Fish meal	1.00	1.00	1.00	1.00	1.00
Soya oil	2.00	2.00	2.00	2.00	2.00
Wheat offal	2.00	2.00	2.00	2.00	2.00
Bone meal	2.05	2.05	2.05	2.05	2.05
Limestone	1.00	1.00	1.00	1.00	1.00
Vit-min premix	0.30	0.30	0.30	0.30	0.30
DL methionine	0.25	0.25	0.25	0.25	0.25
L lysine	0.10	0.10	0.10	0.10	0.10
Table salt	0.30	0.30	0.30	0.30	0.30
Total	100	100	100	100	100
Calculated values					
Crude protein (%)	23.12	23.12	23.12	23.12	23.12
ME (kcal/kg)	3007.1	3007.1	3007.1	3007.1	3007.1
Crude fibre (%)	3.82	3.82	3.82	3.82	3.82
Fat (%)	4.01	4.01	4.01	4.01	4.01
Calcium (%)	1.21	1.21	1.21	1.21	1.21
Phosphorus (%)	0.71	0.71	0.71	0.71	0.71

T1: Basal diet, T2: Basal diet + 0.25% ginger, T3: Basal diet + 0.25% garlic, T4: Basal diet + 0.25% ginger & 0.25% garlic, T5: Basal diet + 0.50% ginger & 0.50% garlic.

Table 3: Gross Composition of experimental finisher diet

Ingredients	T1	T2	T3	T4	T5
Maize	55.00	55.00	55.00	55.00	55.00
Soya bean meal	34.00	34.00	34.00	34.00	34.00
Wheat offal	4.00	4.00	4.00	4.00	4.00
Soya oil	3.00	3.00	3.00	3.00	3.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.00	1.00	1.00	1.00	1.00
Vit-min premix	0.25	0.25	0.25	0.25	0.25
DL methionine	0.25	0.25	0.25	0.25	0.25
L-lysine	0.25	0.25	0.25	0.25	0.25
Table salt	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100
Calculate values					

Crude protein (%)	20.92	20.92	20.92	20.92	20.92
ME (kcal/kg)	3208.5	3208.5	3208.5	3208.5	3208.5
Crude fibre (%)	3.89	3.89	3.89	3.89	3.89
Fat (%)	3.90	3.90	3.90	3.90	3.90
Calcium (%)	1.15	1.15	1.15	1.15	1.15
Phosphorus (%)	0.65	0.65	0.65	0.65	0.65

T1: Basal diet, T2: Basal diet + 0.25% ginger, T3: Basal diet + 0.25% garlic, T4: Basal diet + 0.25% ginger & 0.25% garlic, T5: Basal diet + 0.50% ginger & 0.50% garlic.

A respectable commercial hatchery in Ibadan was the source of one hundred and eighty-one-day-old arbor acre chicks that were purchased. In a fully randomized design, the birds were divided into five dietary treatment groups, each consisting of three replicates, each with 12 birds. Water and food were given freely, and all prescribed drugs and care procedures were followed. Three birds at 42 days old were chosen at random for hematological and serum testing from each replication. A sterilized hypodermic needle and syringe were used to bleed the birds via the jugular vein. At the conclusion of the experiment, 10 milliliters of blood sample were taken.

A volume of 5 milliliters of blood was introduced into the sample bottles that contained EDTA acid as an anticoagulant. The bottles were vigorously shaken to guarantee that the blood was well mixed with the acid and to avoid coagulation.

In order to extract serum, the final 5 milliliters of blood samples were put into sample vials without the anticoagulants. The icepack-sealed vials with the blood samples were transported to a conventional laboratory for examination. Each time a bird was killed, blood samples were gathered and analyzed in a lab to determine the concentration of different blood components.

Red blood cells (RBC), white blood cells (WBC), packed cell volume (PCV), hemoglobin concentration, mean corpuscular hemoglobin concentrate (MCHC), and mean corpuscular volume (MCV) are among the hematological characteristics that were investigated. The improved Neubauer hemocytometer (Kelly, 1979) was used to measure the red blood cells (RBC) and white blood cells (WBC). Wintrobe's microhaematocrit (Kelly, 1979) was used to measure the packed cell volume

(PCV), and cyanometamoglobin techniques (Mitraka & Rawnsley, 1977) were used to measure the hemoglobin. According to Jain's (1986) description, mean corpuscular haemoglobin concentration and mean corpuscular volume were computed from hemoglobin concentration, PCV, and RBC.

Triglycerides, low-density lipoprotein (LDL), high-density lipoprotein (HDL), and cholesterol were measured in the serum samples. Centrifugation was used to separate the serum for ten minutes at 3000 rpm, total cholesterol, including both HDL and low-density lipoprotein (LDL). According to Doumas *et al.* (1981), Reinhold (1953), Reitman & Frankel (1957), Kind & King (1954), Sidney & Barnard (1973), Giorgio *et al.* (1974), and Trinder (1969), the very-low-density lipoprotein (VLDL, computed), triglycerides, and glucose levels were measured. SAS (2000) was used to do an analysis of variance on the given data.

RESULTS AND DISCUSSION

Table 4 shows the haematological profile of broilers fed a diet supplemented with garlic and ginger. All other parameters measured revealed no significant difference in mean values due to food treatment, with the exception of red blood cells, which displayed significant variability in treatment mean values ($P < 0.05$). T3 has a greater therapeutic value (31.0%) for PCV than other therapies. Compared to other treatments, the birds in T3 have a higher treatment value of hemoglobin (9.93g/100ml). Compared to other treatments, the birds fed the basal diet (T1) and the diets comprising the basal diet + 0.25% ginger & 0.25% garlic (T4) had a larger significant value. There is, however, no specific to the rise or fall in the therapies' noteworthy value.

Table 4: Hematological parameters of broilers chickens as influenced by the diets

Parameters	T1	T2	T3	T4	T5	SEM	Pvalue
Packed Cell Volume (%)	28.33	30.67	31.00	28.33	28.00	0.55	0.24
Hemoglobin (g/100mL)	8.90	9.77	9.93	8.90	9.07	0.19	0.23
Red Blood Cell($10^3/mm^3$)	3.22 ^a	3.29 ^{ab}	3.33 ^b	3.21 ^a	3.27 ^{ab}	0.01	0.03
White blood cells ($10^3/mm^3$)	14.98	15.72	15.85	14.45	15.02	0.23	0.28
Platelets ($1/10^4$)	16.833	17.533	14.833	14.567	12.900	10.771	0.73
Lymphocytes (%)	58.67	61.67	61.33	59.67	59.67	0.59	0.50
Heterophils (%)	35.00	32.33	32.67	33.33	32.33	0.63	0.71
Monocyte (%)	3.33	2.67	3.00	2.67	2.67	0.17	0.69
Eosinophil (%)	3.00	3.33	3.00	4.00	4.67	0.29	0.31

Basophil (%)	0.00	0.00	0.00	0.33	0.67	0.11	0.17
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a'b: Mean within rows having different superscripts are significantly different ($p < 0.05$)

T1: Basal diet, T2: Basal diet + 0.25% ginger, T3: Basal diet + 0.25% garlic, T4: Basal diet + 0.25% ginger & 0.25% garlic, T5: Basal diet + 0.50% ginger & 0.50% garlic.

The results for the blood biochemistry of broilers fed a diet supplemented with garlic and ginger are displayed in Table 5. For every metric examined, no discernible variations were found between the dietary treatments.

T2 has the greatest treatment mean value for cholesterol (217.00g/dl), followed by T1 (213.00g/dl), and T5 (201.33g/dl) has the lowest treatment mean value. On the other hand, when it comes to triglycerides, the birds in T1 have the highest mean treatment value—98.67g/

dl—followed by T2 (97.67g/dl), T4 (96.00g/dl), T3 (89.33), and T5 (83.00g/dl), which has the lowest mean values.

For both T3 and T4, HDL has the lowest value at 115.67 g/dl. T5 is next with a value of 115.33 g/dl, followed by T1 at 119.67 g/dl. T2 has the highest value at 122.33 g/dl. The values for LDL treatment span from T2, which has the highest value of 89.67g/dl, to T5, which has the lowest value of 81.00g/dl.

Table 5: Serum biochemistry of broilers fed diet containing ginger and garlic as additives

Parameters	T1	T2	T3	T4	T5	SEM	Pvalue
Cholesterol (g/dL)	213.00	217.00	210.00	208.00	201.33	2.27	0.27
Triglycerides (g/dL)	98.67	97.67	89.33	96.00	83.00	2.71	0.33
High density lipoprotein(g/dL)	119.67	122.33	115.67	115.67	115.33	1.23	0.28
Low density lipoprotein(g/dL)	88.33	89.67	89.33	87.33	81.00	2.05	0.73

T1= Control, T2=0.25% ginger, T3=0.25% garlic, T4= 0.25% ginger + 0.25% garlic, T5: 0.50% ginger + 0.50% garlic.

According to Okorie *et al.* (2011), the hematological indices offer a means of conducting clinical investigations on the existence of various metabolites and other components in an animal. With the exception of red blood cells, the outcome of these therapies indicates that there is no significant variation ($p < 0.05$) in any of the hematological parameters. The diets with 0.25% ginger (T3) have the least significant value, while the diets with 0.25% garlic (T1) and T4 (0.25% ginger and 0.25% garlic) have the greatest significant ($p < 0.05$) values. Shewita and Taha (2018) provide support for this finding. Additionally, Rehman and Muhammad (2015) discovered a significant difference ($p < 0.005$) in the red blood cell counts in their investigation of the impact of graded levels of ginger and garlic inclusion on broiler diets.

The effects of ginger in the diet on the haematological profile have been mostly inconsistent. Ademola *et al.* (2009) found no significant change ($P > 0.01$) in PCV, haemoglobin, and RBC, but a significant difference ($P < 0.01$) in TWBC when broiler chicks were fed diets containing ginger, garlic, and their mixture at 1.0, 1.5, and 2.0% inclusion rates. This agrees with the findings of the current investigation. However, Kehinde *et al.* (2011) found no significant difference ($P > 0.05$) in PCV, haemoglobin, RBC, TWBC, and lymphocytes when white cockerel chicks were fed a gingerized diet for two weeks. When ginger meal was added to the broiler diet at rates of 0.4% and 0.8%, Najafi & Taherpour (2014) found that there was a significant difference ($P < 0.05$) in RBC, hemoglobin, and lymphocyte but not in TWBC or heterophil ($P > 0.05$). However, Mitruka *et al.* (2007) noted that the animal's status affects the number of red blood cells in chickens, which could be a contributing

factor in fluctuation. Regretfully, little information is known on how adding herbs to broiler feed affects the blood parameters. The WBC value that this experiment produced was within the range of values that Mitruka *et al.* (2007) reported. It is implied that the chickens were not immunologically challenged since differential leucocytes were employed as sensitive biomarkers essential to immune functions and stress response indicators (Adeyemi and Sani, 2013). The hemoglobin levels throughout the course of the treatment fell short of the 9–13 g/dl range described by Merck (1979), but they were still within the normal range of 7.0–13.0 g/dl reported by Mitruka and Rawnsley (1977) and 6.5–9.4 g/dl reported by Ameen *et al.* (2007). Nonetheless, the results were consistent with findings from other studies (Aderemi and Alabi, 2013; Egbunike *et al.*, 2009).

Haemoglobin measures an animal's ability to tolerate some level of respiratory stress (Sainsbury, 1983). Normal haemoglobin levels indicate efficient transfer of oxygen, glucose, and other feed nutrients throughout the body (Okorie *et al.*, 2011). Lymphocytes were the most common form of white blood cell, followed by heterophills, eosinophils, and monocytes (Afolabi *et al.*, 2011). The readings fell within the typical range of 36.0–77.4% for healthy chickens, as reported by Nowaczewski and Kontecka (2011) and 47.2–83% by Riddell (2011). Since lymphocytes are reactive cells in inflammation and delayed hypersensitivity, they are involved in the manufacture of antibodies (Banks, 2014). The birds were healthy, as indicated by normal lymphocyte values. According to Health and Olusanya (1985), the neutrophil levels were within the normal range of 20.0–40.0%. T4 did not differ significantly from the other therapy,

despite being at the upper end of the range. The values for monocytes, according to Nowaczewski and Kontecka (2011), were within the normal range of 0–7.76%. Since neutrophils are the most prevalent kind of WBC, their value is higher than that of other WBC types. According to Nowaczewski and Kontecka (2011), basophil levels were also within the lower bound of the normal range, ranging from 0 to 8.74; however, they were less than the 3.15–5.36% range described by Mitruka *et al.* (2007). According to Riddell (2011) and Nowaczewski and Kontecka (2011), the eosinophil readings fell between 1.83 and 3.0% and 0–11.0%, respectively. The results of neutrophils, basophils, eosinophils, and monocytes indicate that the birds are free of bacterial or viral infections because elevated neutrophil, basophil, monocyte, and eosinophil values are indicative of active infection.

The results for the measured serological parameters are displayed in Table 5. The data indicates that there is no significant difference ($p < 0.05$) in any of the serological measurements related to feeding broilers a diet that includes garlic and ginger as additions. The results showed that, in comparison to the control food, birds given additions of garlic and ginger had lower cholesterol. T5, which has the lowest cholesterol content and is supplemented with 0.50% garlic and 0.50% ginger, typically produces the best results. This could be attributed to the lipolytic properties of the ginger and garlic. T5 also tends to have the best result and has the lowest treatment mean value for triglycerides for all other parameters that are tested. This result is consistent with that of Qorbanpour (2018). In line with the current findings, (Rehman and Muhammad, 2015) also discovered in their investigation that adding garlic and ginger as additives at graded levels of 0%, 2%, 6%, and 8% had no influence on the subjects' blood values. While Zomrawi *et al.* (2012) found significant differences between control birds and birds fed ginger diets, the current study's results are consistent with those of Barazesh *et al.* (2013), who reported no significant differences in the triglyceride level of broilers fed ginger and garlic at graded levels. Dietary intervention did not significantly change the total serum cholesterol level. This outcome is consistent with studies by Barazesh *et al.* (2013), Tekeli *et al.* (2010), and Ebrahimnezhad *et al.* (2014) that found supplementing with ginger did not change serum cholesterol. On the other hand, research by Bhandari *et al.* (2005), Ademola *et al.* (2009), Zomrawi *et al.* (2012), and Saeid *et al.* (2010) revealed that ginger extracts had an impact on the levels of triglycerides and cholesterol in broiler serum. The body of research indicates that ginger does, in fact, have antilipidaemic and anticholesterolaemic properties in both humans and animals.

Secondly, dietary inclusion levels as high as 1% should trigger this anticipated response. In this study, this was not the case. Ginger's potency may have been diminished by the processing procedure. It is possible that during air drying, grinding, and storage, volatile, pungent components that are essential for the anticipated

physiological activity were lost. It could be best to crush fresh ginger and take the juice orally once a day.

CONCLUSION

Aside from the red blood cells, the hematology of the birds fed this diet were not considerably impacted either. It is also possible to conclude that the addition of garlic and ginger, up to a maximum of 0.50% each, to broiler diets has no influence whatsoever on the serum parameters that are tested for these birds. Additionally, studies should be conducted to ascertain the degree of toxicity associated with these two herbs added to the diet of poultry feed.

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