Dietary effect of cinnamon powder on haematology and serum biochemistry indices of cockerel chickens

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Citation: Adedeji, O. S., Oyetoro, B. A., Ifanegan, O. D., & Sanni, D. A. (2022). Dietary effect of cinnamon powder on haematology and serum biochemistry indices of cockerel chickens. *Zhivotnovadni Nauki*, *59*(3), 26-31 (Bg).

Abstract

The experiment was conducted to investigate the blood indices of cockerel chickens fed varying inclusion levels of cinnamon powder. A total bird of 150 day old ISA Brown strain was used for the study and was randomly distributed to five treatments of 30 birds each with three replicate of 10 birds per replica. The dietary treatments consisted of T_1, T_2, T_3, T_4, and T_5 with 0 g, 0.5 g, 1.0 g, 1.5 g, and 2.0 g supplementation of cinnamon powder in 4 litters of water. The experiment lasted for 16 weeks. At the end of the 16th week, the birds were starved of feed overnight. Blood samples for analysis were taken from three birds per treatment from the venipuncture of wing vein and were collected into two different set of bijou bottles. The first set of bottles contain Ethylene-diamine-tetra-acetic acid (EDTA anti-coagulant) while the other set was without EDTA. Blood sample were labelled according to name and number of test/replicate and were sent to the laboratory for analysis on Red Blood Cell (RBC), White Blood Cell (WBC), Packed Cell Volume (PCV), Lymphocytes, Heamoglobin (HB), Mean Corpuscular Volume (MCV), Total protein (TP), Albumin (ALB), Globulin (GLO), cholesterol (CHO), Aspartate Aminotransferase (AST), Alkaline Phosphate (ALP), Alanine aminotransferase (ALT) and Glucose. The result showed that cinnamon supplementation affected all the blood parameters significantly ($p < 0.05$). It can be concluded that chickens on T_5 (2.0 g of cinnamon in water) had an improved haematological parameters while cockerels on T_5 (4.0 g of cinnamon in water) had an enhanced serum biochemical parameters.

Key words: Cockerel, ISA brown, cinnamon, haematological indices, serum biochemistry

Introduction

In recent years, there has been an upsurge in demand for poultry meat and meat products. In 2020, worldwide chicken meat output is at 137 million tons, making poultry the most consumed meat on the planet. As a result, the poultry business makes an important contribution to animal protein consumption, human nutrition, and global food security (Rashid et al., 2020). Significant advancements in poultry health and performance have been accomplished in recent years (Diaz Carrasco et al., 2019).

Antibiotic growth promoters (AGPs) were previously utilized to control gastrointestinal infections and alleviate the effects of stress on gut function. However, rising consumer awareness of the negative effects of antibiotics on human health, as well as increased bacterial resistance and food safety concerns, has resulted in restrictions on antibiotic usage in chicken farming. As a result of this circumstance, academics and industry are looking for alternatives to AGPs, with an emphasis on developing more long-term nutritional interventions to improve poultry gut flora and general health. PFAs (phytogenic feed additives) have emerged as a viable alternative to AGPs in the poultry business (Cottrell et al., 2021). As a result, natural items such as cinnamon have been investigated as potential substitutes for synthetic substances, with the goal of providing mankind with safe and healthful food (Fellenberg and Speisky, 2006).

Cinnamon (Cinnamomum zeylanicum), often known as ”dalchini”, is an ancient medicinal plant that is widely used in India as a spice. It is a highly prized spice that is used all over the world. Sri Lanka and South India are home to C. zeylanicum (Jakhetia et al., 2010). Cinnamon is utilized in Ayurvedic and ethnomedicine in many forms. Cinnamon's scent, which can be blended into a variety of meals, fragrances, and medical products, makes it popular in the aroma and essence sectors (Huang et al., 2007).

Cinnamon has appetite and digestion stimulant properties (Taback et al., 1999), antibacterial properties (Chang et al., 2001), improved performance and feed efficiency (Isabel and Santos, 2009; Al-Kassie, 2009; Kamel, 2001), increased pancreatic and intestinal lipase activity (Kim et al., 2010), increased breast meat yield (Isabel and Santos, 2009), and improved health status (Isabel and Santo, 2009; Al-Kassi, 2009; Kamel, 2001). Cinnamaldehyde, transcinnamaldehyde (Cin), and euginol are the main chemical elements of cinnamon, and they are present in the essential oil and contribute to the smell and different biological activities (Chang et al., 2013). (E)-cinnamaldehyde, a key ingredient of essential oil isolated from C. zeylanicum, displays anti-tyrosinase action (Marongiu et al., 2007), with cinnamaldehyde being the main molecule responsible for this activity (Chou et al., 2013).

Data from blood profiles has been demonstrated to be useful in improving chicken stocks (Ladokun et al., 2008). Such information can aid in the diagnosis of specific poultry infections and could be used as a foundation for immunology and comparative avian pathology research (Bonadiman et al., 2009). The results of haematology and serum analysis are commonly utilized to determine an animal's health state. Haematological and serum biochemistry measures are good markers of an animal's physiological status, and variations in these parameters are useful in evaluating an animal's response to various physiological settings (Khan and Zafar, 2005). Changes in haematological markers are also frequently used to assess stress in animals as a result of environmental, dietary, and/or pathogenic causes (Afolabi et al., 2000).

2 Materials and methods

2.1 Experimental site

The experiment was carried at Poultry Unit II of the Teaching and Research Farm, Ladoke Akintola University of Technology (LAUTECH), Ogbomoso, Oyo State, Nigeria.

2.2 Experimental Animal and Management

A total bird of 150 day old ISA BROWN strain cockerel was procured from CHI Farm at Lagos–Ibadan express way, Nigeria. The birds were weighed prior to commencement of the experiment and were randomly distributed into five dietary treatment groups of three replicates each, with each replicate having five birds in a completely randomized design experiment. The birds were managed intensively on deep litter system in pens having natural ventilation via all sides, with each cell measuring (125 cm x 150 cm x 160 cm). The pen was cleaned, disinfected, fumigated and cover with wood shaving before the arrival of the chicks. Adequate temperature was maintained in the brooding house, clean drinking water and commercial starter mash were provided *ad-libitum*. Where necessary prophylaxis and vaccination were administered.

2.3 Experimental Diet

A chick mash meal containing 19% Crude Protein, 2650 Kcal/Kg of metabolizable energy for 8 weeks, followed by grower diet containing Crude Protein of 17%, Metabolizable Energy of 2500 Kcal/Kg was fed to the birds ad libitum.

2.4 Test ingredient and diet formulation

The test ingredient used was cinnamon. It contains 92 g per bottle. It was procured in BAYONNE, NJ 07002, U.S.A. It was added to their drinking water.

Certain measured quantity of cinnamon will be dissolved into 4 litters of water per treatment and replicates respectively. The layout goes thus:

T_1: 0 g cinnamon/4 litres of water;
T_2: 2.5 g cinnamon/4 litres of water;
T_3: 3.0 g cinnamon/4 litres of water;
T_4: 3.5 g cinnamon/4 litres of water;
T_5: 4.0 g cinnamon/4 litters of water.

It is to be noted that this formation was used from day-old till the end of the experiment.

2.5 Data collection

Blood samples for analysis were taken from all replicates. Blood were collected from the chickens by venipuncture of wing vein at their 8^{th} and 16^{th} week of age. Blood sample were collected into two different sets of bijou bottles. The first set of bottles contain Ethylene-diamine-tetra-acetic acid (EDTA anti-coagulant) while the other set was without EDTA. Blood sample were labelled according to name and number of test/replicate.

The set with EDTA was used to determine Red Blood Cell (RBC), White Blood Cell (WBC) using the improved Neubaucerhaemocytometer, as described by Dacie and Lewis, (1991). Packed Cell Volume (PCV) was determined using the microhaematocrit method and heamoglobin (HB) using cyanomethaemoglobin method according to Coles (1986). Means Corpuscular Volume (MCV), were determined as described by Jain et al. (2000).

The set of samples bottle without EDTA were centrifuged in a micro centrifuge to generate centrifuge for serum for biochemical analysis. Total protein was determined using the Biuret method as described by Doumas et al. (1981). Albumin, using dye-binding technique with bromocresol green as described by Doumas and Biggs (1972). Globulin, by different (total protein minus albumin) total cholesterol by enzymatic method as described by Allain et al. (1974). Serum glucose by enzymatic method of Kaplan and Szabo (1983).

2.6 Statistical analysis

Data collected were analyzed using one-way Analysis of Variance of the General Linear Model of SAS (2009) and the means was compared using Duncan's Multiple Range Test of the same statistical package.

3 Results and discussion

The influence of cinnamon powder on the blood haematological parameters of cockerels was indicated in Table 1. Between the dietary treatment and the parameters examined, there were significant variations ($p < 0.05$). White blood cell (WBC) counts were highest (206.38 103 L) in chickens fed diet 5 (2.0 g cinnamon in water), and lowest (116.28 103 L) in cockerels fed diet T_2 (0.5 g of cinnamon powder in water). The maximum red blood cell (RBC) count (2.32 106 L) was found in birsd fed T_5, whereas the lowest RBC count (1.54 106 L) was found in chickens fed diet T_2. The maximum hemoglobin (HGB) (9.00 g/dL) was found in hens fed T_1, whereas the lowest HGB (6.20 g/dL) was found in chickens fed diet T_2. Chickens fed diet T_3 (1.0 g of cinnamon in water) had the highest mean corpuscular volume (159.62 fL), while cockerels fed diet T_1 had the lowest MCV value (153.32 fL). The chickens fed diet T_5 had the highest mean corpuscular haemoglobin (MCH) (41.28 pg), while chicks fed diet T_3 had the lowest MCH (38.56 pg). Cockerels fed diet T5 had the greatest MCHC (26.70 g/dL), followed by chickens fed diet T_4 (1.5 g of cinnamon in water) with (26.52g/dL), and cockerels fed diet T_3 had the lowest (24.36 g/dL). Cockerels fed diet T_1 had the highest Lymphocytes (LYM) (98.18 percent), followed by cockerels fed diet T_5 (98.04 percent), and hens fed diet T_3 had the lowest (93.38 percent).

The findings of this study revealed that cockerel haematological features differ significantly depending on the dietary treatments. The haematological features of chickens fed diet T_1 (control) showed that they had better haematological characteristics than the cinnamon groups. This finding was in line with Chowlu et al., (2018), who found that adding cinnamon to the feed of broiler chickens at varied levels had a substantial impact on blood profile.

Sura (2018) found that using ceylon cinnamon (*Cinnamomun zeylanicum*) powder in the feed of broiler chickens resulted in a substantial rise in red blood cell, white blood cell, mean corpuscular volume, and hemoglobin.

Table 2 shows the influence of cinnamon powder on the biochemistry of blood serum in cockerel birds. Between the dietary regimens and the parameters examined, there were significant variations ($p < 0.05$). Birds fed diet T_5 (2.0g of cinnamon powder in water) had the highest alanine aminotransferase (ALT) value (38.29 U/L), followed by chickens fed diet T_2 (37.93 U/L), and chickens fed diet T_3 had the lowest ALT value (31.12 U/L). Cockerels fed diet T_4 had the greatest aspartate aminotransferase (AST) (144.94 U/L), while cockerels fed diet T_3 had the lowest ALT (64.31 U/L). Alkaline phosphatase (ALP) levels were highest in birds fed diet T_5 (38.68 U/L), and lowest in chickens fed diet T_3 (20.11 U/L). Total protein (TP) was highest (3.96 g/dI) in cockerels on diet T_1, and lowest (2.70 g/dI) in cockerels

Table 1. Effect of cinnamon powder on haematological indices of cockerel chickens

Parameters	Diets					SEM
	T_1 (0.0 g)	T_2 (0.5 g)	T_3 (1.0 g)	T_4 (1.5 g)	T_5 (2.0 g)	
WBC (x10^3 µL)	204.06^{ab}	116.28^{c}	176.42^{b}	203.92^{ab}	206.38^{a}	2.55
RBC (×10^6 µL)	2.09^{ab}	1.54^{c}	1.70^{b}	2.11^{ab}	2.32^{a}	0.06
HB (g/dL)	9.00^{a}	6.20^{c}	6.60^{b}	8.64^{ab}	8.62^{ab}	0.18
MCV (fL)	153.32^{c}	154.72^{bc}	159.62^{a}	154.82^{bc}	155.36^{b}	0.68
MCH (pg)	39.32^{b}	40.00^{b}	38.56^{c}	41.04^{a}	41.28^{a}	0.38
MCHC (g/dL)	25.74^{b}	25.86^{b}	24.36^{c}	26.52^{a}	26.70^{a}	0.20
LYM (%)	98.18^{a}	97.26^{ab}	93.38^{c}	96.04^{b}	98.04^{a}	0.42

^{abc}*Means along the same row with different superscripts are significantly ($p < 0.05$) different. WBC = White blood cell, RBC = Red blood cell, HGB = Hemoglobin, MCV = Mean corpuscular volume or cell volume. MCH = Mean corpuscular hemoglobin, MCHC = Mean corpuscular hemoglobin concentration, LYM = Lymphocytes. T_1 = 0.0 g also of cinnamon, also called Control. T_2 = 0.5 g of cinnamon, T_3 = 1.0 g of cinnamon, T_4 = 1.5 g of cinnamon, T_5 = 2.0 g. SEM = Standard error of mean.*

Table 2. Effect of cinnamon powder on blood serum of cockerel chickens

Parameters	Diets					SEM
	T_1 (0.0 g)	T_2 (0.5 g)	T_3 (1.0 g)	T_4 (1.5 g)	T_5 (2.0 g)	
ALT (U/L)	32.63^{bc}	37.93^{a}	31.12^{c}	33.49^{b}	38.29^{a}	0.48
AST (U/L)	68.46^{d}	120.15^{b}	64.31^{d}	144.94^{a}	79.21^{c}	1.98
ALP (U/L)	21.71^{bc}	25.63^{b}	20.11^{c}	21.54^{bc}	38.68^{a}	1.10
TP (g/dl)	3.96^{a}	3.54^{ab}	2.70^{c}	2.96^{b}	3.64^{ab}	0.09
ALB (g/dl)	2.27^{a}	2.13^{b}	2.12^{b}	1.97^{bc}	1.77^{c}	0.12
CHO (mg/dl)	47.67^{b}	60.21^{ab}	45.73^{bc}	64.01^{a}	43.18^{c}	4.26
GLO (g/dl)	1.61^{ab}	1.44^{b}	0.56^{d}	1.01^{c}	1.84^{a}	0.10

^{abcd}*Means along the same row with different superscripts are significantly ($p < 0.05$) different. ALT = Alanine aminotransferase, AST = Aspartate aminotransferase, ALP = Alkaline phosphate, TP = Total protein, ALB = Albumin, CHO = Cholesterol, GLO = Globulin, T_1 = 0.0 g of cinnamon, also called Control. T_2 = 0.5 g of cinnamon, T_3 = 1.0 g of cinnamon, T_4 = 1.5 g of cinnamon, T_5 = 2.0 g. SEM = Standard error of mean.*

on diet T_3. Chickens fed diet T_1 had the greatest albumin (ALB) (2.27 g/dI), while chickens fed diet T_5 had the lowest (1.77 g/dI) (2.0 g of cinnamon powder in water). Diet T_4 gave cockerels the greatest cholesterol (64.01 mg/dI), while diet T_5 gave them the lowest (43.18 mg/dI). The highest globulin (GLO) value (1.84 g/dI) was found in birds fed diet T_5, while the lowest value (0.56 g/dI) was found in birds fed diet T_3.

The blood serum biochemistry features of cockerel birds showed a substantial difference between diet regimens. The blood serum characteristics of chickens fed diet T_1 (control) showed that they had better blood serum characteristics than the cinnamon group. This discovery supported the findings of Chowlu (2018), who found that adding cinnamon to broiler chicken diets at varied levels has a substantial impact on blood profile. Ali et al. (2018) also found that adding cinnamon powder to the food of broiler hens improved their aspartate aminotransferase, total protein, albumin, and cholesterol levels significantly. This was also in line with the findings of Ciftci et al. (2010), who found that using cinnamon oil supplementation in broiler chicks reduced blood cholesterol levels significantly. Talib et al. (2015) found a substantial difference in blood cholesterol levels when cinnamon powder was added to the diet of broiler chickens. Toghyani (2015) found a substantial difference in blood alanine aminotransferase levels when cinnamon and garlic were added to the broiler's feed (ALT).

However, the findings of Toghyani (2015), Ali et al. (2018), and Koochaksaraie et al. (2011) refuted this study's conclusion that Cinnamon powder improved blood serum biochemical properties in a non-significant way. The effect of cinnamon powder on blood metabolites in broilers, according to Koochaksaraie et al. (2011), had no effect on blood serum characteristics. Ali et al. (2018) also found that alanine aminotransferase (ALT) had no effect on the physiological responses and reproductive performance of broiler chicks fed diets enriched with various doses of cinnamon powder. Toghyani (2015) found a non-significant rise in aspartate aminotransferase, alkaline phosphatase, total protein, albumin, and cholesterol in broiler chickens when cinnamon and garlic were used as growth promoters.

4 Conclusion

From the study, it can be concluded that there were significant variations among the dietary treatments, blood hematology and serum biochemistry parameters measured. Chickens on diet T_5 (2.0 g of cinnamon in water) had an improved white blood cell, red blood cell, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration, lymphocytes, alanine aminotransferase, alkaline phosphate, cholesterol, and globulin.

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