

## Effects of Ethanolic Cinnamon (*Cinnamomum cassia*) Extract on Performance of Broiler Chickens.

Odutayo, O.J.,<sup>\*1</sup> Adewole F.A.,<sup>1</sup> Adeyemo, A.A.,<sup>1</sup> Ibigbami, D.J.<sup>1</sup> Iyanda, A.I.<sup>1</sup> and Sogunle, O.M.<sup>1</sup>

<sup>1</sup>Department of Animal Production and Health, College of Animal Science and Livestock Production, Federal University of Agriculture, P. M. B. 2240, Abeokuta, Ogun State, Nigeria.

\*Corresponding author: [odutayooj@funaab.edu.ng](mailto:odutayooj@funaab.edu.ng); Telephone Number: +2349115730202

**Target Audience:** Small, large-scale broiler chicken producers and extension officers

### Abstract

A total of 200-day-old chicks were used to investigate the effect of ethanolic cinnamon extract (ECE) on the performance of broiler chickens. **The** chicks were brooded collectively for two weeks and thereafter balanced for weight and assigned to six treatments replicated four times (10 birds/replicate) in a completely randomized design. Treatments consist of positive control (broad spectrum antibiotics); negative control (no antibiotics/cinnamon extracts); 20, 40 and 60ml millilitres of ethanolic extract into 1 liter of drinking water, respectively. Data collected on the response variables were subjected to One-way Analysis of Variance. Result revealed that birds on 20 to 60 ml ECE had improved MCHC which ranges between 33.50 to 33.55 g/dl; heterophils was increased in birds under 20ml (42.00 %) and 60ml (41.50 %) ECE. Serum total proteins were significantly elevated due to administration of 20 ml (8.50 g/dl) and 60ml (9.00 g/dl) ECE relative to other treatments; globulin value was enhanced due to 60ml (4.50 g/dl) ECE. In conclusion, for improved productive performance indices (haemato-biochemical indices) in broiler chickens the utilization of ethanolic cinnamon extract at the rate of 60ml thrice a week is appropriate.

**Keywords:** cinnamon; ethanolic-extract; broilers and performance

### 1. Description of problem

The poultry sector, in particular broiler chicken production, is essential to global food systems due to its ability to transform feed into high-quality protein. However, the intensive farming practices required for maintaining this sector frequently encourages challenges such as high incidences of diseases, stress, and poor feed utilization. Antibiotic growth promoters have been commonly deployed to promote growth and protect health of the poultry birds. However, their indiscriminate and

inappropriate application in feed has led to controversial issue worldwide due to the occurrence of resistant strain of bacteria (1). Consequently, their use in poultry feed has been restricted in several countries of the world.

Arising from negative human health implications associated with wrong antibiotics use in animal production, in recent years, there has been a marked trend towards the incorporation and adopting of natural plant based feed additives to improve poultry productivity and health, with the

motives of decreasing or possibly eliminating farmers' reliance on synthetic antibiotics.

Cinnamon (*Cinnamomum cassia*), is a common spice known for its medicinal properties due to its bioactive components such as cinnamaldehyde, eugenol, and other polyphenols. These phytochemicals have dominant antimicrobial, antioxidant, and anti-inflammatory properties, which can positively impact poultry productivity arising from its influence on the intestinal tract, nutrient absorption capacity, and ability to modify the immunological systems. (2). Cinnamon ethanolic extracts may provide a concentrated version of these beneficial chemicals, making them a good natural additive in poultry feeding

Previous studies have highlighted the benefits of phytogetic feed additives, including cinnamon extracts, in improving the growth performance and health of broilers. For example, research by (3) indicated that cinnamon supplementation in broiler diets significantly improved body weight gain and feed conversion ratio (FCR), while also enhancing immune responses. Similarly, (4) demonstrated that cinnamon extract positively affected gut microbiota composition, leading to enhanced nutrient utilization and overall health in broilers. Cinnamon extract supplementation resulted in improved growth performance and immune responses in broilers (5). Also, (6) observed that cinnamon essential oil promoted feed efficiency with a positive impact on blood lipid profiles and antioxidant status in broiler chickens. However, (7, 8) found no significant effect of cinnamon bark powder on growth performance of broiler chicken.

Arising from inconsistent outcomes with

respect to utilization of cinnamon as phytobiotics in poultry production, investigating the potential impact of ethanolic cinnamon extract on the growth performance and blood profile of broiler chickens is significant. This is due to the fact that there is a possibility for ethanolic cinnamon extract, to offer an improved level of bioavailability of the bioactive components in cinnamon. This form of cinnamon supplementation may provide improved benefits compared to other forms as it is in accordance with the concept of sustainable animal production in terms of the utilization of natural feed additives in animal production. This study aims to evaluate the role of ethanolic cinnamon extract on the performance of broiler chickens.

## Materials and method

### *Experimental site*

The experiment was carried out at the Poultry Unit of the Directorate of University Farms (DUFARMS), Federal University of Agriculture, Abeokuta, Ogun State, located within Latitude 70° 15' 59.66" N, Longitude 30° 26' 13.64" E (9). The climate is humid with a mean annual rainfall of 1037mm and mean temperature of 34.7 and 83% relative humidity, respectively.

### *Source of test material and preparation of ethanolic extract of Cinnamomum cassia*

Dried barks of cinnamon (*Cinnamomum cassia*) were purchased from a local market in Abeokuta, Ogun State, Nigeria. The barks were ground with the aid of hammer mill into powdery form. The ethanolic extract of cinnamon was thereafter prepared by weighing 60g *Cinnamomum cassia* powder into 1 liter of ethanol; the prepared solution was left for 24 hours after which the extract

was collected into plastic container and kept securely in the refrigerator before administration in drinking water of the experimental birds.

***Experimental Birds management; description of treatment and design***

A total of 200 Cobb-500 one day old broiler chicks were purchased from Zartech farm, Ibadan, oyo state, Nigeria, and used for the study for 6 weeks period. Prior arrival of the chicks from the hatchery, the pen was cleaned, washed, and disinfected. Feeders, drinkers, and other equipment necessary for management were provided. The day-old chicks were brooded for 2 weeks in which they were provided with a source of light, feeds and heat source to help maintain their body temperature and ensure proper growth of body tissues. The birds were intensively managed in a deep litter system with the provision of feed and water ad-libitum. The birds were fed with commercially produced starter (2800 kcal/kg Metabolizable energy, 21.00 % crude protein, 4.00 % ether extract, and 5.00 % crude fibre) and finisher (2900 kcal/kg Metabolizable energy, 18.00 % crude protein, 4.28 % ether extract, and 4.64 % crude fibre) diets.

**After brooding for two weeks**, the birds were weighed and allocated into the 5 treatments (40 birds per treatment and 4 replicate with each consisting of 10 birds) in a completely randomized design. Ethanolic cinnamon extract administration in the chick's drinking water commenced immediately after brooding. Descriptions of the treatments are thus: positive control (antibiotics added to the water administered); negative control (nothing was added to the water administered); 20mls of ethanolic

extract into 1 liter of water; 40mls of ethanolic extract into 1 liter of water; 60mls of ethanolic extract into 1 liter of water and 80mls of ethanolic extract into 1 liter of water. Birds on positive control received antibiotics administered in drinking water three consecutive days a week (the withdrawal period was observed as recommended by the manufacturer). Also, birds subjected to ethanolic cinnamon extract treatment groups received treatments administration for three consecutive days in a week, similar to the birds that received antibiotic.

**Data collection**

***Growth performance parameters***

The following growth performance indices were measured and recorded on weekly basis

***Feed intake:*** This was measured weekly and recorded for each replicate. Feed left over were subtracted from the amount of feed offered to the birds weekly to determine the feed intake.  $\text{Feed intake} = \text{total feed offered} - \text{total leftover feed}$

Average feed consumed by a bird were calculated by the formula:  $\text{Average feed intake (g/bird)} = \text{feed intake} / \text{Number of birds per replicate}$

***Water intake:*** This was measured daily and recorded for each replicate. Water left over will be subtracted from the amount of water offered to the birds weekly to determine the water intake.  $\text{Water intake} = \text{total water offered} - \text{total leftover water}$

Average water consumed by a bird were calculated by the formula:  $\text{Average water intake (g/bird)} = \text{water intake} / \text{Number of birds per replicate}$

***Body weight gain:*** Average weight gain per bird was calculated by deducing the difference between the final body weight and

initial body weight and dividing this value by the number of birds per replicate

Average body weight gain (g/bird) = Final weight (g) – initial weight (g) /Number of birds per replicate

**Feed conversion ratio (FCR):** The feed conversion ratio was calculated by dividing the feed intake by the weight gain. FCR = Total feed consumed (g) /Body weight gain (g)

**Mortality Percentage:** The number of dead birds per replicate was expressed as a percentage of the total number of birds alive to obtain the percentage mortality.

**Survivability percent:** was obtained by subtracting mortality percent from 100%

**Determination of Haematological and serum biochemical indices**

Blood sample was collected at age 6 week of the birds. Two birds of average weight were selected from each replicate for bleeding. With a 5ml syringe fitted with a 24-gauge sterile hypodermic needle, 5ml of blood is carefully drawn from the left wing at the point of bifurcation of the vein. 3ml of the blood is placed in a sterilized bottle containing ethylene diamine tetra acetic acid (EDTA) while the remaining 2ml of the blood sample was placed into a sterilized bottle (without anticoagulants) for serum biochemical analysis. All blood samples were sent to the laboratory for analysis. Haematological parameters and serum biochemical indices were analyzed using standard procedure (10).

### Statistical analysis

The data collected were subjected to one way analysis of variance (ANOVA) using SPSS and treatments mean were compared using Duncan's multiple range tests at 95% significance level.

### Results

*Percentage phytochemical constituents of ethanolic cinnamon extract*

In Table 1, percentage phytochemical constituent of ethanolic cinnamon extract is presented. It is indicated that four predominant bioactive components in the extract are: cinnamaldehyde (62.53 %); cinnamyl acetate (1.95 %), bornyl acetate (1.23 %) and linalool (0.79 %) while others occurred in minutes quantities.

The effect of ethanolic cinnamon (*Cinnamomum cassia*) extract on growth performance of broiler chickens is presented on Table 2. In all the growth indices measured, ethanolic extract of cinnamon included does not significantly affect any of them.

In Table 3 effect of ethanolic cinnamon extract (ECE) on haematological parameters on broiler chickens at 6th weeks of age is presented. The result shows that there were significant ( $P<0.05$ ) differences in the parameters (Heterophils, Lymphocytes and MCHC). Significantly higher Heterophils of 42 and 41.50 % were observed in birds exposed to 20ml and 60ml ECE while the lower recorded observation was 33.50% which was found in birds under negative control. Significant differences ( $P<0.05$ ) in Lymphocytes was highest (65.50%) in birds exposed to negative control while the lower recorded observation was 55% which was found in birds offered 20ml ECE. The significantly higher MCHC values of 33.55, 33.54 and 33.50 %, respectively were recorded in birds subjected to 20, 40 and 60ml of ECE as against a lower value of 31.50 observed in birds under the negative control.

The effect of ethanolic cinnamon extract (ECE) on serum biochemical indices of

**Table 1: Percentage phytochemical constituents of ethanolic cinnamon extract**

Parameter	Percentage concentration
Cinnamaldehyde	62.53
Camphor	0.71
Bornyl acetate	1.23
Cinnamyl acetate	1.95
$\alpha$ -Copaene	0.49
Caryophyllene	0.29
Trans- $\alpha$ -Bergamotene	0.48
Caryophyllene Oxide	0.35
Linalool	0.79
Eugenol	0.15
Geraniol	0.19
$\alpha$ -cubebene	0.23

**Table 2: Effect of ethanolic cinnamon (*Cinnamomum cassia*) extract on growth performance of broiler chickens**

Parameters	Positive control	Negative control	20ml ECE	40ml ECE	60ml ECE	SEM
Initial body weight(g/bird)	464.63	460.74	460.48	462.41	462.59	2.48
Final body weight (g/bird)	2033.33	2040.00	2061.85	2095.56	2142.82	39.87
Total weight gain (g/bird)	1566.87	1577.41	1601.11	1633.15	1678.99	38.76
Average daily weight gain(g/bird)	44.77	45.07	45.75	46.66	47.95	1.11
Average water intake (ml/bird)	348.92	341.69	369.42	343.93	346.96	6.54
Total feed intake (g/bird)	3677.41	3710.37	3795.19	3814.63	3818.70	52.21
Average daily feed intake (g/bird)	105.07	106.01	105.43	108.99	109.11	1.49
Feed conversion ratio(FCR)	2.29	2.30	2.31	2.41	2.44	0.04
Survivability (%)	96.30	96.67	96.67	100.00	100.00	1.11

ECE: Ethanolic cinnamon extract

broiler chicken at 6 weeks of age is presented in Table 4. In all parameters measured, significant difference ( $P < 0.05$ ) were recorded is the total protein, globulin, triglyceride and urea. The highest total protein of 9.00 g/dl was recorded in birds subjected to 60ml ECE while the lowest value of 6.00 g/dl was recorded in birds on

the positive control. Similarly, highest globulin of 4.50 g/dl was recorded in birds on 60ml ECE relative to the lowest value of 1.50 and 2.50 g/dl was found in birds subjected to positive control as well as 40ml ECE. Significantly highest triglyceride of 278.00 g/dl was recorded in birds on negative control as against lower values of 140.50 and 145.50

**Table 3: Effects of cinnamon (*Cinnamomum cassia*) ethanolic extract on haematological parameter of broiler chickens at 6 weeks of age.**

Parameters	Positive control	Negative control	20ml ECE	40ml ECE	60ml ECE	SEM
Packed cell volume%	32.50	39.50	34.50	38.50	33.50	1.30
Haemoglobin g/dl	11.00	12.50	11.50	12.00	11.55	0.34
Red blood cell X 10 <sup>12</sup> /L	2.50	3.50	3.00	3.00	2.50	0.18
White blood cell X 10 <sup>9</sup> /L	14.50	14.50	14.50	16.00	13.50	0.43
Heterophil (%)	38.50 <sup>ab</sup>	33.50 <sup>b</sup>	42.00 <sup>a</sup>	39.50 <sup>ab</sup>	41.50 <sup>a</sup>	1.16
Lymphocytes (%)	61.00 <sup>ab</sup>	65.50 <sup>a</sup>	55.00 <sup>c</sup>	57.00 <sup>bc</sup>	57.50 <sup>bc</sup>	1.33
Eosinophil (%)	0.00	0.5	1.00	1.50	0.50	0.26
Basophil (%)	0.00	0.00	0.50	0.00	0.00	0.10
Monophil (%)	0.50	0.50	2.00	2.00	0.50	0.31
MCV (fl)	121.00	112.50	119.50	126.00	128.00	3.05
MCH (pg)	40.50	36.00	40.00	40.00	42.50	1.18
MCHC (g/dl)	31.50 <sup>b</sup>	32.00 <sup>ab</sup>	33.55 <sup>a</sup>	33.54 <sup>a</sup>	33.50 <sup>a</sup>	0.33

ECE: Ethanolic cinnamon extract

<sup>a,b,c</sup>: Means with different superscript across the row are significantly (p<0.05) different

g/dl in birds on 40 ml and 60ml ECE negative as well as positive control relative to treatments. Highest values (38.50; 37.00 the lowest value of 28.50 g/dl recorded in g/dl) of urea were recorded in birds on birds exposed to 60ml ECE.

**Table 4: Effect of ethanolic cinnamon extract (ECE) on serum biochemistry of broiler chicken at 6 weeks of age**

Parameters	Positive Control	Negative Control	20ml ECE	40ml ECE	60ml ECE	SEM
Total protein (g/d)	6.00 <sup>c</sup>	7.00 <sup>b</sup>	8.50 <sup>a</sup>	7.00 <sup>b</sup>	9.00 <sup>a</sup>	0.40
Albumin (g/dl)	5.00	5.00	5.00	4.50	5.00	0.23
Globulin (g/dl)	1.50 <sup>b</sup>	3.00 <sup>ab</sup>	3.50 <sup>ab</sup>	2.50 <sup>b</sup>	4.50 <sup>a</sup>	0.39
Cholesterol (mg/dl)	141.50	125.00	210.00	174.50	214.00	23.08
Triglyceride (mg/dl)	206.50 <sup>ab</sup>	278.00 <sup>a</sup>	159.00 <sup>ab</sup>	140.50 <sup>b</sup>	145.50 <sup>b</sup>	20.38
AST (U/L)	82.50	86.00	149.00	141.00	199.00	22.05
ALT (U/L)	71.50	74.50	88.50	97.50	130.00	13.11
ALP (U/L)	38.00	37.00	54.50	49.50	64.00	7.86
Creatinine (mg/dl)	0.00	1.00	0.50	0.50	2.00	0.33
Glucose (mg/dl)	68.50	110.00	73.50	74.00	83.50	6.28
Urea (mg/dl)	38.50 <sup>a</sup>	37.00 <sup>a</sup>	30.00 <sup>b</sup>	34.50 <sup>b</sup>	28.50 <sup>c</sup>	1.40

ECE: Ethanolic cinnamon extract

<sup>a,b,c</sup>: Means with different superscript across the row are significantly (p <0.05) different;

SEM: Standard Error of Mean; AST: Aspartate aminotransferase; ALT: Alanine aminotransferase; ALP: Alkaline phosphatase

## **Discussion**

In the phytochemical screening of ethanolic cinnamon extract, four predominant bioactive components including cinnamaldehyde (62.53%), cinnamyl acetate (1.95%), bornyl acetate (1.23%), and linalool (0.79%) were identified. These percentage compositions were consistent with previous reports which confirm cinnamaldehyde as main constituent, responsible for antimicrobial and other bioactivities properties of cinnamon. The cinnamaldehyde concentrations which ranged from 55% to 65% in various cinnamon extracts (11) is similar with 62.53% recorded in this study. On the contrary, concentrations of other secondary compounds such as cinnamyl acetate and bornyl acetate varied and reasons for these variations can be attributed to techniques of extraction or media and cinnamon species among others. Also, (12) observed cinnamaldehyde content to be approximately 60%, alongside other minute bioactive like linalool and eugenol. Furthermore, linalool present at 0.79% in the phytochemical screening is consistent with the findings of (13), who reported comparable concentrations in cinnamon extracts.

The growth performance indices reflect that inclusion of ECE in the drinking water of the broiler chickens did not significantly affect the growth indices measured. However, a trend of improvement in growth performance with increasing levels of ECE was observed particularly at higher concentrations (40 ml and 60 ml per bird), though not significant. The insignificant impact of ECE on growth performance can be due to insufficient concentration/bioactivity of the phytochemicals to influence marked muscular growth rate in the broiler chickens.

Similar output were also reported by other authors including (14) who found that inclusion of cinnamon powder in broiler diets did not significantly improved body weight, feed conversion ratio and other growth performance indices. Similarly (15) also observed that dietary administration of cinnamon in broiler chicken did not bring about improvement in their growth rate. Additionally, (16) affirmed that cinnamon supplementation did not significantly affect growth performance but improve the gut health of broilers, which could indirectly contribute to better performance under certain conditions. With respect to haematological parameter, significant increase in the heterophils percentage (20 and 60 ml ECE treatment) is suggestive of an enhanced immune response due to the bioactive compounds present in cinnamon, predominantly cinnamaldehyde, which is known for its anti-inflammatory and antimicrobial attributes. Cinnamaldehyde present in the cinnamon extract have been implicated for modulation of immune responses by promoting cytokine production and white blood cells activity (17). This outcome is similar to the reports of (18) who observed that the inclusion of cinnamon in broiler diets resulted in increased heterophil counts. Elevated MCHC values implied improved erythropoiesis, which could lead to better oxygen transport and overall bird health. The increase in MCHC in birds exposed to 20-60 ml ECE is in tandem with the observation of (19) who stated that cinnamon extract could enhance red blood cell function by improving oxygen transport for effective cellular activity. However, reduction in lymphocyte counts in birds treated with ECE (20 ml/litre of water) is at variance with previous reports (20; 21; 22)

that observed that cinnamon extract enhanced lymphocyte proliferation in broiler chickens. This discrepancy may be attributed to differences in dosage/concentration, form of cinnamon administered or period of supplementation. Cinnamon supplementation can enhance certain immune indices in broilers, and its influence can vary depending on the forms or quantity administered (23). The observed increase in serum total protein levels in birds subjected to 60 ml of ECE compared to the positive control and this indicates enhanced dietary protein metabolism due to ECE supplementation. Also, improved globulin levels in birds exposed to 60 ml ECE group further implicates an enhanced immune response. These results are consistent with the findings of (24), who found that phytobiotic supplements, such as cinnamon, could improve immune function and protein synthesis in poultry. On the contrary, (25) observed only minimal increases in serum protein levels when cinnamon was incorporated in the diet, reflecting that the efficacy of the impact of cinnamon and other phytobiotics on physiological processes might be dose or physical form dependent. The significant reduction in triglyceride levels in broilers chickens administered at 40 and 60 ml of ECE highlights its hypolipidemic properties, which is similar to the reports of previous authors such as (26) who documented that cinnamon supplementation reduced triglyceride and LDL cholesterol levels in animals, attributing this to cinnamaldehyde inhibition effect on hepatic lipid synthesis. Improvement though numerical in liver enzyme activities with respect to AST, ALT, and ALP observed in birds subjected to ECE at 60 ml indicates an enhanced hepatic

activity. Insignificant variations were also observed in liver enzyme of broiler chickens exposed to tumeric supplementation (27). The reduction in urea levels in the 60 ml ECE treatment group relative to controls is an indication of improved renal function or better nitrogen metabolism. This finding aligns with the report of (28), who documented similar depressed urea levels as a result of the use of plant extracts with diuretic properties.

### Conclusion and Application

Administration of ethanolic cinnamon extract at 20 to 60ml per litre water resulted to improved percentage heterophil count and mean corpuscular haemoglobin concentration in the broiler chickens. Also, incorporation of ECE at 60 ml/litre of water promoted dietary protein metabolism as reflected in significantly high serum total protein and globulin as well reduced triglyceride and urea contents. Hence, for improved haemato-biochemical indices in broiler chickens 60ml Ethanolic cinnamon extract per litre of water is recommended.

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