CINNAMON-ZINC SUPPLEMENTATION EFFECT ON VISCERAL ORGANS OF BROILER CHICKENS REARED IN NIGERIA

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ABSTRACT
Broiler production has been challenged by excessive heat production due to climatic change. This has resulted into oxidative stress , depressed weight gain and growth performance. Phytogenic supplements have been reported to enhance antioxidant enzymes which improves the ability of broilers to cope with stress conditions. Therefore this study was designed to evaluate the visceral organ weights of broiler chicks given cinnamon-zinc supplementation in Nigeria. Two hundred and forty (240) arbor acre broiler chickens with an average initial weight of 40g +_2 were grouped into five treatments (48 chicks/treatment) and randomly replicated thrice with 16 chicks per replicate. Experimental design included T1 (modified cooler environment), T2 no administration (Control), T3-800 mg of Cinnamon powder/kg basal diet, T4-800 mg of Cinnamon powder+40mg Zinc/kg basal diet and T5-1000 mg Cinnamon powder+40mg Zinc/kg basal diet. This study was carried out for 10 weeks with environmental temperature and relative humidity of 30OC and 70% respectively. Parameters measured include; live, liver, lungs, spleen, kidney, gizzard, heart, and small intestine weights. Result revealed a significant ($p<0.05$) increase in relative organ weights of the lung and liver in birds given 1000 mg/kg of Cinnamon powder + 40mg of Zinc per kg basal diet, compared to values across other treatments, while the observed abdominal fat weights reduced in birds given 800 mg/kg basal diet. This revealed that cinnamon-zinc supplementation could be safely used to improve the performance of birds during environmental stress.

Keywords: Broiler chickens, Cinnamon, Zinc, Heat-stress, organ weight

INTRODUCTION

Poultry production represents a means of preventing protein deficiency, predominant among populace in most developing countries, especially Nigeria. The protein intake of an average Nigerian is about 53.8 g with only 6.0-8.4 g/head/day from animal origin, which spans below the recommended level of 27 g/head/day (Wahyono *et al.,* 2018). Although, poultry meat is well sought-for, among Nigerian populace because of its low amount of saturated fatty acids, rich protein, vitamins, minerals content and its white meat (Ashour et al., 2020), however, the undeniable effect of climate change in birds, have resulted into inability to dissipate heat, marked by a struggle to regulate the body temperature. This Results into over production of reactive oxygen species (ROS) such as peroxides, superoxide, hydroxyl radical, singlet oxygen and alpha-oxygen. This is usually accompanied by depressed feed intake, weight gain and elevated feed conversion ratio, in addition to physiological and biological disorders (Shakeri *et al*., 2020).. There is a noticeable shift in the useage of herbal supplements, as they are considered safe for human health and tends to improve livestock performance, among which is Cinnamon bark powder. The combined Ayurvedic medicine relevance, in addition to culinary usage of the bark showed that it serves as supplements to boost the immune system and performance of livestock (Sadeghi *et al.,* 2018; Vallish *et al.,* 2022). A study on *Cinnamomum osmophloeum* indicated that the essential oil from cinnamon leaves contains a high level of bioactive constituents, including C*innamaldehyde* and *trans*-cinnamaldehyde (Cin) essential oils, which represent beneficial antioxidants contributing to its various biological activities (Saeed *et al.,* 2018; Shakeri *et al.,* 2020). The potential effect of cinnamon powders (0.05%) on growth performance under heat stress was evaluated in an experiment conducted by Sadeghi and Moghaddam (2018), reports showed increased weight gain and feed intake as compared to control group. Paucity of information exist on the true effect of herbal ameliorative methods, when co-supplemented with zinc, on the visceral organ weight of experimental livestocks, therefore this study was designed to evaluate this using broiler chicken reared under heat stress.

MATERIALS AND METHODS

The study was carried out at the Teaching and Research Farm, Malete, Kwara State. with latitude of 8.7°N and longitude of 4.46667°E, with relative humidity of 70% and daily temperature of 30°C. The study was carried out from February to May, during the late dry season in Nigeria.

Collection and Identification of Cinnamon

Dried Cinnamon stick sourced and purchased in Ibadan, Oyo State was identified and authenticated in Agricultural Laboratory, Kwara State University, Malete. It was broken and smashed into tiny pieces and further shade-dried for a period of two days. Dry weight was recorded, before and after blending (Qasa electric blender (China)) and stored in an airtight container until further use.

Experimental Animal and Management

Two hundred and forty Arbor acre broiler chickens with an average weight of 40g were used for the experiment. The chicks were brooded under strict and standard management conditions including strict adherence to vaccination practices. The feeders for pelleted ration and drinkers were provided ad-libitum. The chicks were initially reared for 3-week period to achieve physiological adaptation to the environment.

Experimental Design

At week 4 broiler chickens were randomly assigned into 5 (five) treatments (48 chicks in each treatment) and replicated thrice. The experimental diet was administered on treatment basis as follows:

T1 = Cooler environment temperature ($17^{O}C$)
T2 = heat stress with no administration
T3 = 800 mg cinnamon powder per kg basal diet (CN_{800})
T4 = 800 mg cinnamon powder + 40 mg of zinc per kg basal diet($CN_{800+}Z_{40}$)
T5= 1000 mg body weight of cinnamon powder + 40 mg of zinc per kg basal diet($CN_{1000+}Z_{40}$)

Data Collection

Visceral organ weights

At the end of the experiment, 2 birds per replicates were bled, lateral incision was made at the abdominal part caudal to the ribs. Complete evisceration was done with the lungs, kidney, gizzard, liver, heart, spleen, small intestine, bursa, and abdominal fats been carefully separated from the viscerals and weighed using sensitive measuring scale using appropriate records.

Statistical Analysis

Data relative organ weights were subjected to analysis of variance (ANOVA) in a completely randomized design (CRD) using SPSS (version 20) statistical package program and data were considered significant at 5% level of significance.

RESULTS AND DISCUSSION

Table 1 shows the effect of Cinnamon-Zinc supplementation on relative weights of broiler chickens reared under heat stress. Observation showed that there was significant ($p<0.05$) response in the relative lung, liver, kidney and heart of broiler chickens upon administration of 1000mg Cinnamon powder + 40 mg of Zinc per kg basal diet, compared to broiler

Table 1: Effect of Cinnamon and Zinc Supplementation on Relative Organ Weight of broiler chicken reared under heat stress

Parameter(g)	T1(Low temp(17^0C)	T2Control	T3 (CN_{800})	T4($CN_{800+}Z_{40}$)	T5($CN_{1000+}Z_{40}$)	SEM	P-VALUE
Liveweight	2626.4^{a}	2084.8^{bc}	2011.6^{c}	2222.0^{bc}	2269.4^{b}	81.93	0.001
Lungs	0.51^{ab}	0.47^{b}	0.42^{b}	0.38^{b}	0.60^{a}	0.04	0.011
Kidney	0.19^{c}	0.27^{ab}	0.30^{a}	0.20^{bc}	0.23^{bc}	0.03	0.010
Gizzard	2.33	2.29	2.58	2.49	2.72	0.17	0.32
Liver	1.14^{ab}	0.92^{b}	1.13^{ab}	1.24^{a}	1.29^{a}	0.08	0.033
Heart	0.41^{b}	0.36^{b}	0.40^{b}	0.43^{b}	0.70^{a}	0.06	0.003
Spleen	0.08	0.07	0.11	0.18	0.12	0.05	0.393
Small intestine	2.0	2.0	2.0	3.0	3.0	1.31	0.419
Bursa	0.08	0.11	0.19	0.19	0.19	2.13	0.42
Abdominal fat	0.40^{a}	0.24^{ab}	0.16^{b}	0.38^{ab}	0.37^{ab}	0.07	0.10

T1(cooler environment use of ice block), T2(heat stress with no administration), T3(800mg/kg of cinnamon powder), T4(800mg/kg of cinnamon powder +40mg/kg of zinc), T5(`1000mg/kg of cinnamon powder +40mg/kg of zinc), SEM (standard error means)

chickens reared under heat stress (T2). The relative lung and liver weights were noted to be significantly elevated, in birds given 1000 mg/kg of Cinnamon powder + 40mg of Zinc per kg basal diet, compared to other values across the treatments, while the observed abdominal fat weights reduced in birds given 800 mg/kg basal diet. No significant change was observed in the gizzard, spleen, small intestine and bursa of broiler chicken upon administration of experimental inclusions.

Discussion

Medicinal plants such as cinnamon are rich sources of antioxidants, acting as efficient agents for improving the production performance livestocks in tropical and subtropical regions (Basiouni et al., 2023). Cinnamon is an invaluable medicinal herb containing germane constituents like cinnamaldehyde, trans-cinnamaldehyde, eugenol, cinnamyl alcohol, cinnamyl acetate and carvacrol, found in its essential oil, which enhanced its fragrance, health benefits in addition to its antioxidant property (Newerli-Guz and Śmiechowska 2022). Zinc on the other hand plays a significant role in amino acid and macro nutrient metabolisms, as well as cell multiplication (Florez-Mendez *et al.,* 2022). According to observed Results in Table 1, significant changes in the evaluated visceral organ weights suggested that environmental stress as well as dietary interventions through use of co-supplements adversely affects the growth and organ weight of broiler chickens, particularly when compared with the two experimental controls (modified cooler environment suggested that addition of water significantly improved broiler performance under chronic heat stress. In accordance with the documentation of Ahlberg et al. (2018), water is a key nutrient that aids in temperature regulation, growth, digestion, metabolism, and excretion. Availability of cold water for birds in T1 might have greatly enhanced the dissipation of heat in the chickens via evaporative cooling, which would have improved their feed intake and consequently live weight, as observed in Table 1. This result is in tandem with the review of Cheng et al. (2022). The decrease in live weight observed in broiler chickens administered with 1000 mg cinnamon powder + 40 mg zinc per kg basal diet supplementation is at variance with previous studies by Qaid *et al.* (2021), who recorded an elevated live weight in the birds administered with dietary Cinnamon in their studies. The significant elevation in the relative kidney size noticed in broiler chickens administered with 800 mg of cinnamon powder / kg with the basal diet suggests that cinnamon powder supplementation might have positive influence on kidney development or function. Previous research by Sultana *et al*. (2021) indicated that dietary modifications can influence kidney morphology and possibly function in poultry. The elevation observed in lungs, kidney, liver, heart and abdominal fat weights, administered with 1000 mg/kg of cinnamon powder + 40mg/kg Zinc per basal diet (T5) could be an expression of a positive health impact, attributable to the synergistic effect of zinc-cinnamon, noted for its richness in antioxidants, when evaluated on visceral health, particularly under heat-stressed conditions. This might have enhanced metabolic processes or detoxification functions, heart health, potentially related to cardiovascular adaptation. This corroborates the finding by Chen *et al.* (2019) that dietary components like zinc, can promote viscera organs growth rate, including liver and heart, which would potentially enhance metabolic functions and potential relationship to cardiovascular adaptation during heat stress. A study by Hara *et al.* (2023) demonstrated that dietary additives rich in antioxidants, such as cinnamon, can improve lung function in poultry, when exposed to stressors, via improvement in the respiratory function or adaptation to heat stress. The increase in lung size in broiler chickens exposed to cinnamon powder and zinc under heat stress conditions suggests potential benefits for respiratory health. A study by Wang et al. (2023) have also highlighted the potential cardiovascular benefits of dietary antioxidants, reflecting that dietary interventions of cinnamon can positively influence cardiovascular health. The study reports a decrease in abdominal fat in broiler chickens when they were administered 800mg/kg of cinnamon powder with the basal diet. This outcome implies that the dietary intervention may contribute to a decrease in fat deposition in the abdominal region. The decrease in abdominal fat deposition in chickens is in agreement with the decreased abdominal fat in Qaid *et al.* (2022) study who reported elevated liver percentage and reduced the abdominal fat percentage after inclusion of cinnamon powder in broiler diet. A contrary observation was stated in

research by Ali *et al.* (2021) who reported that certain dietary additives such as cinnamon can lead to increased fat deposition in broiler chickens.

CONCLUSION AND RECOMMENDATION

The findings reflected the safe inclusion of cinnamon-zinc as a co-supplement at 1000mg + 40mg per kg basal diet for to enhance broiler performance during high environmental temperature.

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