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EFFECT OF GARCINIA KOLA (BITERKOLA) AS FEED ADDITIVE ON SERUM METABOLITES AND MEAT QUALITY OF BROILER CHICKEN

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Abstract

Efficacy of *Garcinia kola* as antibiotics growth promoter was evaluated in assessing serum metabolites and meat quality of broiler chicks, Total of 96 day-old broiler birds were used within eight weeks, Four experimental diets were formulated such that diet T1 (control) contained no bitter kola while diets T2, T3, T4, contained varying levels of bitter kola at 0.25, 0.50, 0.75% respectively. The broiler chicks were weighed and allotted to four dietary treatments of 24 birds each, They were replicated 6 times in a completely randomized design for 4 birds per replicate, The parameters determined were lipid peroxidation, catalase activity, Glutathione and peroxidase activities, supplement of graded level of bitter kola had significant ($p<0.05$) value of 8785±28.41, catalase 173.84±0.00, Glutathione 214±0.02, lipid peroxidation, different birds fed 0.75%had significant levels of lipid peroxidation and catalase. At day 56, two birds were randomly selected from each replicate. 2ml of blood was collected and centrifuged to separate the serum from the blood. Serum parameter were assessed. Significant differences ($P<0.05$) were observed among the treatments in all the parameters except in AST, ALT, total protein and globulin. In cholesterol, similar ($P>0.005$) values were obtained between treatment 1 and 2, 2 and 3, as well as 3 and 4. The total protein are similar ($P>0.05$) in treatment 1 and 2 and in treatments 2,3 and 4 with treatment 1 having the highest and significant ($P<0.05$) value. Also globulin was highest in treatment 1 at 24.60±1.63mmol/L which differed ($P<0.05$) from the similar ($P>0.05$) value obtained in treatments 2, 3 and 4. It can be concluded that Bitter kola as an additive in broiler diets confers antioxidative properties on the birds and it is therefore recommended to be incorporated in broiler chicken rations to enhance the shelf life of meat produced.

Keywords: Garcinia kola, broiler, sterile bottles, Antioxidant

Introduction

The use of synthetic or natural antioxidants in the chicken industry has lately attracted increased interest because to its impact on oxidative stress and meat quality (Estevez and Petracci, 2019). Meat and skin color are acknowledged to the broiler business as key quality factors for meat selection by market consumers (Dominguez *et al.*, 2019). Manipulation of meat color is a contemporary problem in order to meet market demands. To the best of our knowledge, no thorough investigations have been conducted on the antioxidant activities of dietary astaxanthin in a dose-dependent manner not only on meat quality but also on the immune system of broiler chickens under acute heat stress. Because of its high polyunsaturated fatty acid content, poultry flesh is especially susceptible to oxidative degradation (Igene and Pearson, 2019; Hargis and VanElswyk, 2013). The recognition and utilization of herbs and their extracts as natural feed additives in poultry diets have increased in recent years due to their inherent multi-bioactive properties and ability to enhance performance traits, reduce pathogenic bacteria and decrease antibiotic residues in meat (Dhama*et al*., 2015).

With an increasing human population, most African countries are concerned about a meat and other animal product supply shortage (Schonfeld and Hall, 2012). Many of the available agricultural and animal protein sources in Nigeria are often insufficiently generated to supply the minimal daily protein demands of an average adult (Schonfeld and Hall, 2012).

Phytogenics, also referred to as plant secondary metabolites, phytochemicals, phytobiotics or botanicals, are plant-derived products/extracts and include a wide range of substances such as herbs, spices, and essential oils reported to exhibit growth promoting and/or therapeutic properties (Pirgozliev*et al.*, 2015).The use of phytogenics as an alternative prevent the risk of pathogens resistant to antibiotics in poultry(Karadas*et al.*, 2014).

Garcinia kola has been dubbed a "wonder plant" since every component of it has been discovered to be medicinally beneficial (Dalziel, 2012). Because of its reputed aphrodisiac effects, it is also known as bitter cola and male kola. It is generally referred to as "Orogbo" in Yoruba, "Akuilu" in Igbo, and Namijingoro in Hausa (Dalziel, 2017). Garcinia kola seed powder has been shown in studies with broiler chicks to promote growth, which is ascribed to its antibacterial properties (Ugwu*et al.,* 2021). The effect of dietary *Garcinia kola* on pullet chick body weight, haematology, and survival rate demonstrated better weight gain and white blood cell proliferation (Ugwu*et al.,* 2021; Adedeji *et al.*, 2006). *Garcinia kola* protects against a range of experimental hepatotoxins that may affect growth (Iwu, 2015). In order to uncover natural compounds and alternatives to medicines in animal production, this study was undertaken to assess the effect of bitter kola (*garcinia kola*) as a feed supplement on antioxidant activity in broiler meat.

Materials and Methods

The research was conducted at the site of Agricultural Technology Department, Federal Polytechnic, Ado-Ekiti, Ekiti State, Nigeria.

Source and processing of tested ingredient

The bitter kola seeds were purchased from a local market in Ikole, Ekiti State. The seeds were sliced into small sizes, spread on a concrete floor and air dried slices seeds were pulled together and grinded into powdered.

Experimental birds and management

A total number of 96 birds of commercial breeds were used for the experiment. The birds were purchased from a reputable hatchery for the study. The chicks were brooded for two weeks for acclimatization using electric bulb as source of light and heat in the pen. In the brooder house, enough provision was made for space, ventilation, polythene was also used to cover the pen to provide warmth, and the protection against predators and cold extreme weather.They were fed the experimental diets giving the starter diet up to 28th days of age and finisher diets from the 29th to 56th days. Proper and adequate management practices were undertaken. Vaccinations and medications were given appropriately.

Experimental diet

The experimental diets were formulated with the inclusion of *Gracinia kola* (bitter kola).
The diets were formulated for broiler starter (0-28) days and finisher phase (29-56) days. The basal diets were divided into 4 diets.
Diet 1- control (without supplement)
Diet 2 - 0.25% of *Gracinia kola*
Diet 3 - 0.50% of *Gracinia kola*
Diet 4 - 0.75% of *Gracinia kola*
The table below shows the experimental diets for the birds at Starter phase

Table 1: Composition of experimental diets (g/100g) for broiler starter (0 - 28) days

Ingredient	**Inclusion level of *Garcina kola***			
	T1 (0%)	T2 (0.25%)	T3 (0.50%)	T4 (0.75%)
Maize	56	56	56	56
Soybean Meal (SBM)	26	26	26	26
GNC	16	16	16	16
Fish Meal	2	2	2	2
Bone Meal	6	6	6	6
Oyster Shell	3	3	3	3
Premix	0.3	0.3	0.3	0.3
Methionine	0.3	0.3	0.3	0.3
Lysine	0.2	0.2	0.2	0.2
Salt	0.2	0.2	0.2	0.2
TOTAL	**100**	**100**	**100**	**100**
Calculated analysis				
ME kcal/kg	2920.83	2920.83	2920.83	2920.83
Crude protein (%)	23.15	23.15	23.15	23.15
Crude fibre (%)	4.01	4.01	4.01	4.01
Ether Extract (%)	3.74	3.74	3.74	3.74

Table 2: Composition of experimental diets (g/100g) for broiler finisher (28 - 56) days

Ingredient	Inclusion level of *Garcina kola*			
	T1 (0%)	T2 (0.25%)	T3 (0.50%)	T4 (0.75%)
Maize	56	56	56	56
Soybean Meal (SBM)	18	18	18	18
GNC	15	15	15	15
Fish Meal	2	2	2	2
Bone Meal	5	5	5	5
Oyster Shell	3	3	3	3
Premix	0.3	0.3	0.3	0.3
Methionine	0.3	0.3	0.3	0.3
Lysine	0.2	0.2	0.2	0.2
Salt	0.2	0.2	0.2	0.2
TOTAL	100	100	100	100
Calculated analysis				
ME kcal/kg	2920.83	2920.83	2920.83	2920.83
Crude protein (%)	23.15	23.15	23.15	23.15
Crude fibre (%)	4.01	4.01	4.01	4.01
Ether Extract (%)	3.74	3.74	3.74	3.74

Experimental design

A total number of 96-day old broiler chicks were used in the experiment. The birds were allotted to 4 treatments and replicated 6 times, 4 birds per replicate in a randomized design.

Data collection

At day 56 (8 weeks), two birds were randomly selected from each replicate, About 100g of the meat were excised from the breast meat for determination of the following parameters, Meat cholesterol, Lipid peroxidation: Catalase activity, Glutathione Peroxidase activity and.At day 56 (8 weeks),two birds were randomly selected from each replicate, 2ml of blood was collected and centrifuged immediately at the rate of 3,500 revolution per fifteen minutes in order to separate the serum from the blood; the serum was sent to the laboratory to access the following parameters; Aspartate aminotransferase (AST), Alanine aminotransferase (ALT), Cholesterol, Total protein, Albumin, and Globulin

Statistical Analysis

All data collected in this study were subjected to Analysis of Variance using SPSS. Duncan's Multiple Range test of one way ANOVA was used to analyze the mean differences of the same parameter. Significant differences were considered where necessary at a level of ($P<0.05$)

Results and discussion

Results

The antioxidant activities in broiler chicken meat which include the catalase, GST and LPO are shown in Table 3. All the parameters across the treatments showed statistical similarities ($p>0.05$). Antioxidants are compounds that inhibit oxidation, a chemical reaction that can produce free radicals and chain reactions that may damage the cells of organisms.

Table 3: The antioxidant status of broiler chicken meat fed supplemented with bitter kola

	T1	T2	T3	T4
Catalase	87.85±28.41	93.37±5.53	131.46±6.29	112.04±13.14
(GSH)	173.84±0.00	171.59±1.25	173.34±0.00	173.34±1.00
LPO	2.14±0.02	2.00±0.02	2.18±0.07	2.44±0.36

Means with no superscript letter across the same column are similar ($P>0.05$)GSH (Glutathione S-Transferase);LPO (Lipid peroxidation).

Table 4 shows the effect of feed supplemented with bitter kola on serum metabolite of broiler chicken. The parameters investigated include aspartate aminotransferase (AST), alanine aminotransferase (ALT), cholesterol, total protein, albumin, and globuline. Significant differences ($p<0.05$) were observed among the treatments in all the parameters, except in AST, ALT, total protein and globulin.

In cholesterol, similar (p>0.05) values were obtained between treatments 1 and 2, and 3 and 4. However treatments 3 and 4 differed (P<0.05) from treatment 1 which has the highest value of 6.33±0.18 mmol/L. The total protein are similar (p>0.05) in treatments 1 and 2 and in treatments 2, 3 and 4 with treatment 1 having the highest and significant (P<0.05) value. Also globulin was highest in treatment 1 at 24.60±1.63mmol/L which differed (p<0.05) from the similar (p>0.05) values obtained in treatments 2, 3 and 4. The cholesterol, total protein and globulin were highest in treatment 1 and decreased progressively as *G. kola* level increased and later plateaued. Birds fed bitter kola had lower values cholesterol, total protein and globulin than the control group.

Table 4:Effect of *Gracinia kola* (bitter kola) as feed addictive on serum metabolite of broiler chicken.

	T1	T2	T3	T4
AST (IU/L)	56.17±2.27	57.47±2.27	62.13±7.85	63.87±4.47
ALT (IU/L)	40.37±.57	38.50±.26	40.77±2.19	40.40±1.31
CHOL (mmol/l)	6.33±0.18^{a}	6.20±0.15^{ab}	5.87±0.09^{bc}	5.60± 0.00^{c}
CrT (mmol/l)	38.60±2.40	35.00±2.40	50.70±7.55	44.63±4.83
TP (g/l)	43.43±0.59^{a}	34.90±1.30^{ab}	33.47±2.03^{b}	34.57±5^{b}.07^{ab}
ALB (g/l)	18.83±1.32	19.33±.20	21.17±1.94	19.57±1.24
GLO (g/l)	24.60±1.63^{a}	15.57±1.26^{b}	12.30±1.81^{b}	15.00±4.75^{b}

Discussion

Rapid growth, high lipid and protein feed, and high-density cage feeding are high-intensity stresses for broilers; these stresses can result in the production of a large number of free radicals, disrupting the steady-state balance of free radical production and clearance in the body, and thus inducing oxidative stress (Zu *et al*., 2012). This causes oxidative stress and harm to their body's basic biological activities. The processes of free radicals and oxidative stress that occur in living organisms have long piqued the interest of scientists. Oxidative stress has been demonstrated to be extremely harmful to avian health and performance in poultry (Kurutas, 2016). The number of free radicals circulating in the body determines the degree of oxidative stress. Excess free radicals would attack biological macromolecules including DNA and protein, resulting in the peroxidation and dysfunction of bio macromolecules, thus, reducing the transcription level of genes and affecting the normal growth and development of the body. All these challenges were similar among birds in all the treatments suggesting that the immunity and other factors in them were similarly challenged irrespective of the feed served.

Glutathione S-Transferase (GSH) is a multifunctional enzyme, involved in detoxification processes. This role is achieved by catalytic conjugation of glutathione with a large number of electrophilic toxins and carcinogens. Singha *et al.* (2015) found that glutathione S-transferases (GSTs) can reduce lipid hydroperoxides through their Se-independent glutathione-peroxidase activity and that these enzymes can also detoxify lipid peroxidation (LPO) end-products such as 4HNE. They strongly suggest that LPO products, particularly hydroperoxides and 4HNE, are involved in the mechanisms of stress-mediated signaling and that it can be modulated by the alpha-class GSTs through the regulation of the intracellular concentrations of 4HNE. The result obtained in this study shows that at GST locus, the diets induced no stress on the birds and the cholesterol, total protein and globulin were highest in treatment 1 and decreased progressively as *G.kola* level increased and later plateaued. Birds fed bitter kola had lower values cholesterol, total protein and globulin than the control group.Birds fed G. kola based diets exhibited similar blood creatinine and albumin levels. These lower levels could be due to the fact that amino acid composition of dietary treatments containing *Garcinia kola* was balanced. Amino acid imbalances in diets may result in their increases in the body (Applegate *et al*., 2018). Blood creatinine level most especially in monogastric animals is influenced by quality and quantity of feed mostly after consumption.

Conclusion

Bitter kola as an additive in broiler diets confers antioxidative properties on the birds and the effect of bitter kola supplement fed did not negatively affect the meat quality and blood serum parameters.

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