Antioxidant Status of Broiler Chickens on Oral Administration of Tomato (*Lycopersicum esculentus,* mill.) Fruit Extract

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Abstract

One hundred and ninety-two (192) unsexed day-old Arbor Acres broiler chicks were used in a 42-day trial to investigate the effect of oral administration of tomato fruit extract (TFE) on antioxidant status of broiler chickens. The birds were weighed and randomly allotted into four treatment groups (0 ml/L TFE, 10 ml/L TFE, 20 ml/L TFE and 30 ml/L TFE) comprising 48 birds, replicated four times with 12 birds each in a completely randomized design. Birds on 0 ml/L were given antibiotics while birds in other groups were administered 10 ml, 20 ml and 30 ml tomato fruit extract (TFE) per litre of fresh clean water thrice weekly on every other day at weeks 1, 2 and 5 of the experiment. Blood samples were collected on the 42nd day to determine the antioxidant status of the birds. Data were subjected to One-way Analysis of Variance and significant (P<0.05) differences among means were separated using Tukey's HSD test. Results obtained showed that malondialdehyde, glutathione peroxidase and catalase activities were not significantly affected (P>0.05). However, superoxide dismutase activity was significantly (P<0.05) elevated in birds on oral administration of 20 ml/L (1.90 U/L) and 30 ml (2.05 U/L) TFE compared with the birds on 0 ml/L (0.41 U/L) and 10 ml/L (0.54 U/L). The study concluded that oral administration of tomato fruit enhanced superoxide dismutase activity, suggesting a potential role in oxidative stress reduction in broiler chickens. The study recommends that up to 30ml/L of tomato fruit extract should be used to alleviate oxidative stress in broiler chickens.

Keywords: *Lycopersicum esculentus, mill,* oral administration and antioxidant

Description of Problem

Broiler chicken production is a fast-growing livestock enterprise that provides high-quality meat within a short production cycle, making it an important income source for small-scale farmers [1]. However, broiler chicken's performances can be negatively affected if they are not raised in thermo-neutral zones [2]. Chickens are exposed to many different stressors during the rearing period. Oxidative stress is one of the most important stressors challenging poultry production. Synthetic antioxidants such as butylated hydroxytoluene, butylated hydroxyanisole, and ethoxyquin are widely used to mitigate oxidative damage [3], but safety concerns have increased demand for natural alternatives. Tomato (*Solanum lycopersicum*) is rich in bioactive compounds including lycopene, a potent antioxidant linked to reduced oxidative stress [4]. Tomato products also contain essential amino acids, fatty acids, flavonoids, and minerals [5]. Despite evidence of antioxidative and physiological benefits of tomato in poultry, the effects of oral tomato extract administration on the antioxidant status of broiler chickens remain largely unexplored. This study therefore evaluated its effects on antioxidant status of broiler chickens.

Materials and Methods

Experimental site

The experiment was carried out at the Directorate of University Farms, (DUFARMS), Federal University of Agriculture, Abeokuta, Ogun State, Nigeria. The farm lies within latitude 7°10'N. Longitude 3°2'E and Altitude 76mm above the sea level [6].

Source and preparation of test ingredient

Fresh tomato fruits (*Platinum F1* variety) were sourced from a reputable tomato farmer in Abeokuta. The fruits were thoroughly rinsed with clean water to remove adhering dirt and debris. Five-hundred-gram (500 g) portion of the fresh tomatoes was homogenized using a food processor and transferred into an aluminium foil-covered flask containing 1 L of ethanol. The mixture was left to stand at room temperature for 48 h to allow extraction. Subsequently, it was filtered through filter paper to separate the liquid extract from the residual pulp. The filtrate was concentrated using a rotary evaporator, after which a 20% solution was prepared with deionised water. The extract was stored in an amber bottle to prevent photodegradation and refrigerated until use [7].

Experimental birds, design and management

One hundred and ninety-two (192) unsexed day-old Arbor Acres broiler chicks were purchased from a reputable hatchery in Ibadan. They were weighed and randomly assigned to four treatment groups of 48 birds each containing 12 birds per replicate of 4 were reared for six weeks (starter: 0–3 weeks; finisher: 4–6 weeks) in an open-sided pen. Feed and water were provided *ad libitum*. Treatments included 0 ml TFE/L as control (antibiotics: floxinor), no tomato fruit extract (TFE)) and groups administered 10 ml, 20 ml, and 30 ml TFE/L, three times weekly on every other day at weeks 1, 2, and 5 of the experiment. On the 42nd day, one bird from each replicate was selected and 3ml of blood was collected from them via the wing vein into a plain bottle for the determination of antioxidant activities. The parameters were measured as follows: catalase (CAT) by Aebi's [8] method, based on H_2O_2 decomposition at 240 nm; glutathione peroxidase (GPx) by the modified [9] method, monitoring NADPH oxidation at 340 nm; and superoxide dismutase (SOD) by the pyrogallol autoxidation method [10] at 325 nm. Lipid peroxidation was estimated by determining malondialdehyde (MDA) concentration via the thiobarbituric acid reactive substances (TBARS) method, involving serum reaction with TBAR reagent, heating, centrifugation, and absorbance measurement at 535 nm. Data collected were subjected to One - Way Analysis of Variance (ANOVA). Significant ($P<0.05$) differences among means were separated using Tukey's HSD test as contained in the Minitab® 21.4.1 [11].

Results and discussion

The Effect of oral administration of tomato fruit extract on blood antioxidant status of broiler chickens is presented in Table 1. All parameters measured were not significantly ($p>0.05$) influenced except superoxide dismutase (SOD). Similar ($p>0.05$) SOD values were obtained in birds on oral administration of 20 ml (1.90 U/L) and 30 ml (2.05 U/L) of tomato fruit extract. These values were significantly ($p<0.05$) higher than the values obtained in birds in the control group (0.41 U/L) and those on oral administration of 10 ml (0.54 U/L) tomato fruit extract. Prior research has shown that tomato waste juice can provide antioxidants in broiler diets, supporting organ development and overall health [12], [13]. Tomatoes are rich in ascorbic acid, zinc, and selenium, making them potential antioxidant supplements [14]. Lycopene, the main tomato carotenoid, scavenges harmful free radicals, inhibits reactive oxygen species (ROS) production, and protects lipids, proteins, and DNA from oxidative damage [15]. It also activates antioxidant enzymes such as glutathione peroxidase (GSH-Px), catalase (CAT), and superoxide dismutase (SOD) via Electrophile/Antioxidant Response Element (EpRE/ARE) signaling [16], [17]. In this study, CAT, MDA and GSH-Px values were not significantly affected, while SOD increased following oral tomato fruit extract administration corroborating the reports by [18] who observed similar effect in quail breeders on dietary supplementation of tomato pomace. However, unlike [18], who observed higher GSH-Px and lower malondialdehyde (MDA), this study found no such changes. Similarly, [19] reported increased SOD but unchanged CAT in broilers, consistent with the present findings, though these authors also observed higher GSH-Px. Such discrepancies may be due to the differences in the mode of administration and polyphenolic content of tomato used in the studies. Earlier study by [20] reported the polyphenol content of tomato varies with tomato varieties.

Table 1: Effects of oral administration of tomato fruit extract on blood antioxidant status of broiler chickens

	Tomato fruit extract (ml/L)				SEM	p-value
Parameters	**0**	**10**	**20**	**30**		
MDA (nmol/ml)	1.43	1.46	1.08	1.72	0.31	0.585
SOD (U/L)	0.41[b]	0.54[b]	1.90[a]	2.05[a]	0.13	0.002
GSH-Px (U/L)	23.20	19.55	16.80	18.30	2.21	0.335
CAT (U/L)	0.63	0.61	0.16	0.87	0.34	0.574

[ab] Means on the same row having different superscripts are significantly ($p<0.05$) different
SEM - Standard error of mean; T - Treatment; MDA – Malondialdehyde; SOD - Superoxide dismutase; GSH-Px - Glutathione peroxidase; CAT - Catalase

Conclusion and application

This study concluded that MDA, GSH-Px and CAT were not influenced by oral administration of tomato fruit extract, however, SOD increased with the inclusion of tomato fruit extract. It is recommended that oral administration of tomato fruit extract of up to 30 ml/L should be used to mitigate oxidative stress in broiler chickens.

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