SERUM ANTIOXIDANT ACTIVITY OF BROILER CHICKENS FED DIETS CONTAINING VARIED LEVELS OF GARLIC (*Allium sativum*) BASED DIETS

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ABSTRACT

An experiment was conducted to determine the serum antioxidant activity of broiler chickens fed diets containing varied levels of garlic supplementation. A total of one hundred and twenty (120) broiler finisher chickens of Cobb-500 strain were allocated to four isocaloric and isonitrogenous diets, each having ten chickens per replicate in a completely randomized design. Fresh garlic bulbs were chopped, dried and ground for dietary incorporation. Garlic was not supplemented in the control diet but in diets for treatments two, three and four at 1.0, 1.5 and 2.0% respectively. At the end of the 56-day feeding trial, two chickens were randomly selected from each replicate for the determination of lipid peroxidation and serum antioxidant activity (superoxide dismutase, catalase, malondialdehyde and glutathione peroxidase). Antioxidant activity was highest at 2% level of garlic supplementation while it was least in chickens fed the control diet. Lipid peroxidation significantly ($P<0.05$) reduced as the levels of garlic supplementation increased in the diets. The study concludes that garlic can be supplemented in broiler diets at 2.0% level of supplementation for its beneficial qualities to animal and human health.

Keywords: Garlic, Diets, Broiler, Antioxidant, Supplementation,

Introduction

The restriction on use of antibiotics in poultry nutrition has attracted the interest of poultry nutritionists to search for suitable herbal alternatives. Garlic has been reported to have beneficial effects on the physiology and growth performance of birds (El-Deek *et al*., 2003). Antioxidant properties have been documented in garlic from *in-vitro* studies conducted using poultry birds (Koch and Lawson, 1996). The authors reported that garlic constituents inhibit the formation of free radicals, support endogenous free radical scavenging mechanisms and enhance cellular antioxidant enzymes (Superoxide dismutase, catalase, glutathione peroxidase). Free radicals are produced during normal metabolism but can in turn induce cellular damage if they are present in excessive levels. Garlic is not widely used as human food because it gives a repulsive odour and the taste is pungent. Since monogastric animals are able to incorporate dietary components directly in their tissues (Scaife *et al*., 1994; Onibi *et al*., 2000), supplementation of garlic in broiler diets could mediate in getting the bioactive compounds in garlic, through broiler meat into the human food chain.

Materials and Methods

Experimental Site

The experiment was carried out at the Teaching and Research Farm, in the Poultry Unit, of the Department of Agricultural Technology, Federal College of Forestry, Jos-Plateau State. The farm is located on latitude 90 56'49.0" N and longitude 80 53'34.1" E, at an altitude of 1250m above sea level. The temperature of the area ranges between 21-25^{o}C depending on the season. The wet period in Jos is between April and November with annual rainfall between 1200 – 1500mm (FCF, 2019).

Source of Broiler Chicks

A total number of one hundred and twenty (120) day old broiler chicks of Arbor Acres strain were sourced from Agrited hatchery located in Ibadan, Oyo State, Nigeria.

Source of Fresh Garlic Bulbs

Fresh garlic bulbs were purchased from new market in Jos, Plateau State, after which they are processed for incorporation in the diets.

Processing of Fresh Garlic Bulbs

Fresh garlic bulbs were processed by chopping, drying and milling methods before incorporation in the diets.

Chopping and Drying Method

Fresh garlic bulbs (300g) were processed by removal of the outer coating using a sharp knife after which they are chopped into small pieces. They were spread in tray and allowed proper aeration under shade to dry to a constant weight (about 10% moisture content).

Crushing of Chopped and Dried Garlic

The chopped and dried garlic samples were further processed by crushing using a hand mortar and pestle into fine particles to pass through a 1mm sieve. The processed garlic floor was incorporated in the diets.

Experimental Diets

Four experimental broiler finisher diets were formulated to meet the nutrient requirement of the chickens. Chickens in the control group did not have garlic supplementation in their diet while it was supplemented in diets of chickens in treatments two, three and four at 1.0, 1.5 and 2.0% respectively. The experimental diets for broiler finisher chickens are presented in Table 1.

Experimental Design

A total of 120-day old broiler starter chicks were used in this experiment. They were assigned to four treatment groups each randomized thrice with ten chicks per replicate in a completely randomized design. All management practices required for broiler production were strictly adhered to during the feeding trial.

Determination of Antioxidant Activity of Broiler Finisher Chickens Post the Finisher Phase

At the end of the 56-day feeding trial two chickens were randomly selected from each replicate for determination of serum antioxidant activity. About 3 mils of blood sample was collected via the wing web of each chicken and transferred to sample bottles containing anti-coagulant (EDTA). Blood collection was done early morning at 7:00am. The samples were taken to the Biochemistry Laboratory, National Veterinary Research Institute Vom, Plateau State to determine antioxidant activities (Superoxide dismutase, catalase, malondialdehyde and glutathione peroxidase according to procedures described by Winterbourne *et al.* (1975), Placer *et al.* (1966) and Hafeman *et al*. (1974) respectively.

Statistical Analyses

Data obtained from the experiment was subjected to analysis of variance using the general linear model procedure of SAS (2001). Significant differences among treatment means will be separated using Duncan's multiple range test (Duncan, 1955).

Results and Discussion

Serum Antioxidant Activity of Broilers Chickens Fed Diets Containing Graded Levels of Garlic Supplementation

The serum antioxidant activity of broiler chickens fed diets containing graded levels of garlic supplementation is presented in Table 2. It was observed that catalase enzyme was significantly ($P<0.05$) higher in chickens fed 2.0% garlic based diet followed by those on 1.5% garlic based diet. Chickens fed 1.0% dietary garlic supplementation had significantly ($P<0.05$) higher serum catalase enzyme compared to chickens in the control group. Similarly, glutathione peroxidase enzyme was significantly ($P<0.05$) higher in chickens fed 2.0% garlic based diet. This was followed by chickens fed 1.5% garlic based diet. Chickens fed the control diet showed significantly ($P<0.05$) lower value compared to those on diet supplemented with 1.0% garlic. Superoxide dismutase enzyme was significantly ($P<0.05$) higher in chickens fed 2.0% garlic based diet followed by those on 1.0% garlic based diet. This was also followed by chickens fed 1.5% garlic based diet compared to others.

Chickens fed varying levels of garlic showed better results compared to the control group in all antioxidant parameters due to anti-oxidative enzymes (catalase, glutathione peroxidase, and superoxide dismustase) present in garlic. Pourali *et al.* (2014) studied the antioxidant effect of 0.5% garlic powder on *Eimeria* infected and uninfected broiler chickens. They found that the malondialdehyde (MDA) levels decreased in the group that was fed diet containing 0.5% garlic powder. Chung (2006) showed the efficacy of garlic preparations or extracts in lowering free radical damage to biological membranes. Pourali *et al*. (2014) showed no effect of garlic supplementation on superoxide dismustase and glutathione peroxidase activities in chickens. Lipid peroxidation was significantly ($P<0.05$) lower in chickens fed 2.0% garlic based diet compared to others. This oxidative deterioration increased across the treatments as the levels of garlic supplementation decreased with the control group showing the poorest result. Lipid peroxidation is a metabolic process in which

reactive oxygen species (ROS) cause oxidative deterioration of lipids especially the polyunsaturated fats (PUFA) as reported by Pourali *et al*. (2014). This may significantly affect cell membrane structure and functions. Malondialdehyde (MDA) used in this study is an indicator of lipid peroxidation. Hence low values of this parameter is indicative of better health as anti-oxidative enzymes lower the rate of oxidation.

Table 1: Composition of Broiler finisher Diets Containing Graded Levels of Garlic Supplementation (5-8 weeks)

		Inclusion Levels of Garlic (%)		
Ingredients	**Control**	**1.0**	**1.5**	**2.0**
Maize	62.90	61.40	60.60	59.80
GNC	6.00	5.90	5.90	5.90
Soya cake	24.00	24.00	24.00	24.00
Bone meal	2.90	2.90	2.90	2.90
Garlic	0.00	1.00	1.50	2.00
Limestone	1.20	1.20	1.20	1.20
Palm oil	1.05	1.65	1.95	2.25
Blood meal	1.00	1.18	1.00	1.00
Common Salt	0.30	0.30	0.30	0.30
*Vitamin Premix	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20
Total	100.00	100.00	100.00	100.00
Calculated analysis				
ME (Kcal/Kg)	3001.00	3003.00	3003.00	3004.00
Crude Protein (%)	20.06	19.96	19.93	19.90
Ether Extract (%)	5.30	5.79	6.03	6.27
Crude Fibre (%)	3.74	3.72	3.71	3.71
Calcium (%)	1.18	1.18	1.18	1.18
Available Phosphorus (%)	0.50	0.50	0.50	0.50
Lysine (%)	1.21	1.20	1.20	0.20
Methionine (%)	0.80	0.80	0.79	0.79
Feed cost/kg diet (₦/kg)	224.04	232.50	236.61	241.07

Biomix chick premix provide per kg of diet vit A, 10,000 I.U; vit D, 2000 I. U; vit E; 23mg; vit K, 2mg; calcium pantothenate, 7.5mg; B12, 0.015mg; folic acid, 0.75mg, choline chloride, 300mg; vit B1, 1.8mg; vit B2, 5mg; vit B6, 3mg; manganese, 40mg; iron, 20mg; zinc, 53.34mg; copper, 3mg; iodine, 1mg; cobalt, 0.2mg; selenium, 0.2mg; zinc, 30mg.

Table 2: Serum Anti-oxidant Activity of Broiler Chickens Fed Diets Containing Graded Levels of Garlic Supplementation

	Levels of Garlic (%)				
Parameters	0.0	1.0	1.5	2.0	SEM
Catalase	10.83^{d}	11.92^{c}	12.72^{b}	14.04^{a}	0.01
Glutathione Peroxidase	1.25^{c}	1.15^{d}	1.32^{b}	1.62^{a}	0.01
Superoxide Dismutase	41.24^{d}	47.64^{b}	45.02^{c}	53.92^{a}	0.01
Lipid Peroxidation	2.83^{d}	2.64^{c}	2.27^{b}	1.75^{a}	0.01

a, b, c, d=Means with different superscript on the same row differ significantly, SEM= Standard error of mean

Conclusion

The study observed that dietary garlic supplementation remarkably lowered lipid peroxidation due to the activity of its anti-oxidative enzymes which may improve poultry meat quality and in turn human health when the meat is consumed. The study concludes that garlic can be supplemented in broiler diets at 2.0% level of supplementation for its beneficial qualities to animal and human health.

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