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AMELIORATIVE EFFECTS OF DIETARY GINGER SUPPLEMENT ON SERUM ANTI-OXIDATIVE STATUS AND ELECTROLYTES BALANCE OF BROILER CHICKENS FED DIET CONTAINING MONOSODIUM GLUTAMATE

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ABSTRACT

This study was to assess the serum anti-oxidative status and electrolytes balance of broilers fed high monosodium glutamate (MSG) diets with ginger meal (GM). A total of seventy two day-old broiler chickens were randomly selected and distributed into the four dietary treatments. Each treatment was replicated three times with six birds per replicate in a completely randomized design (CRD). Dietary treatments prepared were: A (Control/Basal), B (Basal+ 1.25 g MSG/kg), C (Diet B+ 1.25 g GM/kg), and D (Diet B+ 2.50 g GM/kg). At the end of the experiment (8 weeks), three birds/replicate were randomly selected and fasted overnight prior to blood collection from the jugular veins. The blood samples were used for the preparation of serum. The serum antioxidative enzymes and electrolytes were analyzed according to standard procedures using commercially available auto analyzer. All data collected were subjected to one way analysis of variance. Catalase was significantly ($P<0.05$) higher in diets C and D when compared with diet B and the control group. Glutathione peroxidase was significantly ($P<0.05$) higher in diet D when compared with diets B and C. Superoxide dismutase was significantly ($P<0.05$) higher in diet D when compared with other groups. Serum potassium (K^+) and sodium (Na^+) concentrations were not significantly ($P>0.05$) affected by the inclusions of MSG and varied ginger levels. However, inclusion of MSG was found to significantly ($P<0.05$) increase the serum chloride (Cl^-) concentration above what were obtainable on other diets. Inclusion of 1.25 g GM/kg diet significantly ($P<0.05$) reduced the serum Cl^- when compared with diet B. Therefore, it could be concluded that dietary inclusion of ginger supplement could enhance the anti-oxidative status of broiler chickens against possible oxidative stress that high inclusion of MSG might cause.

Keywords: Broilers, serum, antioxidant enzymes, electrolytes, ginger

INTRODUCTION

The success of broiler chicken production depends largely on feed utilization and conversion ratio. A feed factor that should be considered in achieving this is feed palatability and acceptability. Quality deterioration of raw materials, especially, the by-products such as rice and maize offals stored over a long period of time will produce off flavours and odours that are not acceptable by the birds. Addition of taste enhancing additives, such as MSG, could be of great benefit in improving the palatability and acceptability of such feed. Monosodium glutamate is a universal additive which can enhance the palatability of food and feed (Khalil and Khedr 2016). Since the market share of broiler chicken meat has increased in recent years and several reports have reviewed the potency of MSG in improving the feed intake and weight gain of birds, utilizing it as feed flavour enhancer in the poultry industry will be great gain (Olarotimi *et al.*, 2019). However, there have been growing concerns in recent years on the safety of MSG in the food industry due to its perceived negative implications on the health of the consumers (Eweka 2007). For instance, Diniz *et al.* (2004) reported that chronic administration of MSG induced oxidative stress in the tissues of young rats. It has also been reported that MSG inclusion above 0.75g/kg diet significantly increased the serum sodium and potassium concentrations of the broiler chickens (Olarotimi, 2020). It was also observed that MSG at 1.00 g/kg diet and above lowered the daily sperm production and sperm production efficiency of cocks (Olarotimi *et al.*, 2020). On the other hand, the



immuno-modulatory and growth performance of phyto-additives, such as ginger, on broiler chickens have been demonstrated (Karangiya *et al.*, 2016)). Therefore, harnessing the antioxidative potentials of ginger in diets of broilers containing high level of MSG could be a novel approach in ameliorating the negative impacts of MSG. Therefore the aim of this study is to assess the effects of ginger meal as feed additive on the serum anti-oxidative enzymes and electrolyte balance of broilers fed high level MSG.

MATERIALS AND METHODS

The study was carried out at the Poultry Unit, Teaching and Research Farm Adekunle Ajasin University, Akungba-Akoko (AAUA), Nigeria. Basal diets for starter (0 to 28 days of age) and finisher (29 to 56 days of age) phases were formulated to meet the broiler's manual requirement (Table 1). Seventy two day-old broiler chickens were randomly selected and distributed into the four dietary treatments. Each treatment was replicated three times with six birds per replicate in a completely randomized design (CRD). Dietary treatments were: A (Control/Basal), B (Basal+ 1.25 g MSG/kg), C (Diet B+ 1.25 g GM/kg), and D (Diet B+ 2.50 g GM/kg). At the end of the experiment (8 weeks), from each replicate, three birds were randomly selected for blood sampling. The birds were fasted overnight and blood samples were collected from the jugular veins into dry, clean and plain sample bottles without any coagulant. The serum was separated for determination of serum electrolytes and antioxidant enzymes concentration. The harvested serum samples were kept frozen at -20°C until the determination of serum glutathione peroxidase (GSH-Px), catalase (CAT), superoxide dismutase (SOD), sodium (Na⁺), potassium (K⁺), and chloride (Cl⁻) concentrations. The serum antioxidative enzymes and electrolytes were analyzed according to standard procedures using commercially available auto analyzer.

Statistical Analysis

All experimental data obtained were subjected to one way analysis of variance (ANOVA) using SAS (version 9.2). Significant differences between the treatment means were separated using Duncan Multiple Range Test of the same software at 5% level of significance.

Table 1: Gross composition of basal diet for the experimental birds.

Ingredients(kg)	Starter (1 to 28 days)	Finisher (29 to 56 days)
Maize	52.35	59.35
Wheat offal	7	0
Rice bran	0	6
Soybean meal	30	24
Fish meal	3	3
Soy oil	3	3
Bone meal	3	3
Limestone	0.5	0.5
Lysine	0.25	0.25
Methoinine	0.3	0.3
Salt	0.3	0.3
Premix	0.3	0.3
Total	100	100
Calculated Nutrient Composition		
ME (Kcal/kg)	3018.89	3108.1
Crude protein (%)	22.18	20.03

**RESULTS AND DISCUSSION**

Antioxidant enzymes and electrolytes balance of broilers fed with MSG and Ginger powder are presented in Table 2. Mean values of CAT were found to be significantly ($P < 0.05$) higher in diets C and D when compared with birds on diet B and the control where GM was not supplemented. On the other hand, diet B recorded the least significant ($P < 0.05$) mean for CAT when compared with birds on all other diets. Mean values of GSH-Px were found to be significantly ($P < 0.05$) higher in diet D when compared with birds on diets B and C but was not significantly different ($P > 0.05$) from the value presented by birds on the control diet. The birds on diet B recorded the least ($P < 0.05$) mean for GSH-Px. However, the means of birds on diets C and D were comparable ($P > 0.05$) with those on the control diet. Superoxide dismutase mean values were found to be significantly ($P < 0.05$) higher in diet D when compared with values recorded by birds on all other diets. The least ($P < 0.05$) mean value of superoxide dismutase was recorded in diet B while the values recorded by birds on diets A and C were significant ($P > 0.05$). The serum K^+ and Na^+ concentrations were not significantly ($P > 0.05$) affected by the inclusions of MSG and varied ginger levels. However, inclusion of MSG was found to significantly ($P < 0.05$) increase the Cl^- concentration above what were obtainable on other diets. Inclusion of 1.25 g Ginger powder/kg diet significantly ($P < 0.05$) reduced the serum Cl^- when compared with diet B. Doubling the inclusion of ginger powder in the diet significantly ($P < 0.05$) reduced serum Cl^- level further which was comparable ($P > 0.05$) with the control.

From the result of this study, the significant increase observed in the level of serum CAT among the broilers fed diets C and D as well as GSH-Px and SOD among birds on diet D indicated that serum antioxidant enzymes enhancing ability of ginger powder at inclusion rates of 1.25 to 2.50 g/kg diet while the significant decrease in serum antioxidant enzymes among birds in diet B indicated that high inclusion of MSG in broiler diets could predispose them to oxidative stress. We can, therefore, opine that ginger meal has antioxidant and ameliorative effects on the perceived cellular damaged that may be occasioned by high inclusion of MSG. This result agreed with Moreki and Gabanakgosi (2014) who recorded similar trend in dietary inclusion of moringa at 5 to 20% in broiler feeding. This is pointing towards the ability of phyto-additives in enhancing the antioxidant enzymes of chickens, thereby, protecting them against the possibility of oxidative stress. From this study, it was clear that higher inclusion of ginger powder, as observed among birds on diet D, proved to better enhance the serum antioxidant enzymes of the birds against oxidative stress occasioned by high inclusion of MSG. The body of animals including poultry contains a large variety of ions or electrolytes which perform a variety of functions. The ions in the blood plasma play important roles in osmotic balance that regulates the movement of water between cells and their environment (Olarotimi, 2020). In the present study, the elevated serum Cl^- level observed among the broilers on diet B was an indication that high dose of MSG in broiler diets could result in hyperchloremia. The results of this finding agreed with the report of Olarotimi (2020) who reported elevation in serum Na^+ , K^+ and Cl^- levels of broiler chickens fed with diets containing varied levels of monosodium glutamate (MSG). The present study differed with his report in that the inclusion of MSG used in this study did not significantly affect the serum Na^+ and K^+ concentrations. This might be due to the variation in nutritional compositions of the diet used in this study.

Table 2: Antioxidant Enzymes and Electrolytes Balance of the Broilers Chickens

Parameters	A	B	C	D	SEM	P-value
Serum Antioxidant Enzymes						
Catalase (mM/ml/min)	12.30 ^b	7.24 ^c	20.60 ^a	19.40 ^a	0.62	0.01
Glutathione peroxidase (µg/g)	220 ^{ab}	125 ^c	198 ^b	242 ^a	5.39	0.01
Superoxide dismutase (%)	67.51 ^b	50.50 ^c	65.86 ^b	76.79 ^a	2.44	0.01
Serum Electrolytes Balance						
Potassium (K^+) (mmol/L)	4.59	4.71	4.86	4.43	0.14	0.09
Chloride (Cl^-) (mmol/L)	97.20 ^{bc}	116 ^a	99.00 ^b	89.4 ^c	2.94	0.02
Sodium (Na^+) (mmol/L)	128	129	133	121	3.91	0.15

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Means in a row without a common superscript letter differ significantly ($P < 0.05$). Diets: A (Control/Basal), B (Basal+1.25 g MSG/kg), C (Diet B+0.25 g Ginger/kg), D (Diet B+0.50 g Ginger/kg). SEM (Standard Error of Means).

CONCLUSION AND RECOMMENDATION

It could be concluded from the results of this study that dietary inclusion of ginger meal could enhance the antioxidative status and maintaining the electrolyte balance of broiler chickens against the possible oxidative stress that high inclusion of MSG might cause. It was shown that inclusion of 2.50 g ginger/kg was capable of providing better results when fed to broiler chickens. It is therefore recommended that feeding 2.50 g/kg ginger meal in the diets of broiler chickens fed high MSG for taste enhancement would bring about optimal utilization of the feeds without any detrimental effects on the health status of the birds.

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