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Effect of Aqueous Ginger (*Zingiber officinale*) Extract on Growth Performance, Nutrient Digestibility and Economy of Feed Conversion of Broiler Chickens

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ABSTRACT

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A study was conducted to determine the effect of aqueous ginger extract (AGE) on growth performance, nutrient digestibility and economy of feed conversion of broiler chickens. A total of 192 day-old Marshal broiler chicks were randomly allocated to six treatments each consisting of four replicates with eight birds per replicate in a completely randomized design. The treatments were tagged $AGE_{0,}$ $AGE_{25,}$ $AGE_{50,}$ $AGE_{75,}$ AGE_{100} and AGE_{125} whereinthe birds of the different groups were administered aqueous ginger extract orally at 0, 25, 50, 75, 100 and 125 ml/L, respectively,via drinking water. The experiment lasted for 49d. The results showed that the AGE supplementation had positive effects ($P<0.05$) on total feed consumed, final BW and feed conversion ratio. The aqueous ginger extract supplementation level of 127.49 ml/L maximized daily weight gain while FCR was maximized at an inclusion level of 88.79 ml/L. The AGE supplementation had no effect ($P>0.05$) on the digestibility of DM, CP, EE and NFE. However, digestibilityof crude fibre were affected ($P<0.05$) by AGE.Aqueous ginger extract also had effect ($P<0.05$) on total cost of feed consumed and cost/weight gain. Cost of feed per kilogram was not influenced by the treatment. These results suggest that AGE in drinking water of chickens could replace synthetic antibiotics and could be regarded as natural feed additives in poultry diets.

Keywords: Digestibility, Extract, Feed, Ginger, Performance.

INTRODUCTION

The animal protein consumption of the vast population of developing nations across the world is inadequate (George *et al.,* 2013). Poultry production can proffer faster and cheaper means of arresting this menace in developing countries (Kehinde *et*

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al., 2011). However, poultry production is faced with constraints such as disease and competition between man and livestock for grains which had led to high cost of production (Daudu, 2012). Recently, the use of in-feed antibiotics has been banned in many countries due to their residual side effect in animal product and the development of antibiotic-resistant bacteria pathogen (Hosseinzadeh *et al.*, 2014). Consequently, some authors have investigated alternatives to antibiotics (Yahya *et al.*, 2014; Joseph *et al.,* 2015).

Herbs and spices have recently emerged as alternatives to antibiotics in animal production. Ginger spice, a natural growth promoter, contains several compounds such as shogaols, gingerdione, gingerol, phenolic and gingerdiol (Zhao *et al.*, 2011). Ali *et al.* (2008) reported that these compounds in ginger enhanced weight gain and had pharmacological effects on broiler chicken's health. However, reports on the influence of plant extract on broiler chickens are inconsistent. Some author found that feeding of herbs and spices had positive effects on livestock (Ali *et al.,* 2008; Zhao *et al.*, 2011; Joseph *et al.,* 2015), whereas others did not find clear evidence (Naeemasa *et al.*, 2015). Thus, the objective of the study was to evaluate the effect of aqueous ginger extract on growth performance, nutrient digestibility and feed conversion ratio in broiler chickens.

MATERIALS AND METHODS

The study was conducted at the Poultry Unit of Bache Farm, Minna, Niger State, Nigeria. Fresh ginger rhizome (root) was purchased from Kure Modern Market Minna, Niger State, Nigeria and broiler chicks were obtained from ArewaFarm, Zaria, Kaduna State. The commercial hybrid feed super starter and finisher feeds were bought from an agrochemical company, Minna, Niger state.

Fresh ginger rhizomes were thoroughly washed, peeled, cut into chips, air dried at an average room temperature of 23.1°C for 61d. The ginger was then ground with hammer mill of 2-mm diameter into coarse powder and stored in air tight polythene bag. The aqueous ginger extract (AGE) was prepared by adding one litre of boiled hot water into 14g of ground ginger in a container. The mixture was left to infuse and cooled at room temperature for 12h. The extract was filtered using muslin cloth, and stored in a refrigerator at 4°C. The extraction of ginger was carried out weekly according to the method of Joseph *et al.* (2015).

The animal experiment was conducted in accordance with the regulations of Federal University of Technology Animal Ethics Committee. A total of 192 day-old Marshal broiler chicks were randomly allocated to six treatments consisting of four replicates with eight birds per replicates in a completely randomized design. The birds were managed on deep litter system for 49d at a temperature which was gradually decreased from 36 to 24°C. The diet was formulated to meet the requirements of broiler as recommended by NRC (2004). The ingredient and nutrient composition of the diet are presented in Table 1. Birds had access to feed and *ad libitum* water. The extract was administered orally to the chicks of the six dietary groups via drinking water at concentrations of 0, 25, 50, 75, 100 and 125 ml/L of water, respectively. The birds were

Table 1. Dietary ingredients and chemical composition of the basal diets during the starter and finisher periods

Attributes	Starter	Finisher
Ingredient composition(%)		
Maize	61.50	69.08
Soybean meal	28.75	22.50
Fish meal	6.00	4.83
Soybean oil	0.94	-
Di-calcium phosphate	0.66	1.23
$CaCO_3$	1.19	1.58
NaCl	0.37	0.26
Mineral and vitamin premix†	0.05	0.05
DL-Methionine	0.09	0.02
Analysed nutrients (%)		
Crude protein	23.0	20.0
Methionine+Cysteine	1.02	1.00
Lysine	1.18	1.09
Calcium	1.0	1.2
Phosphorus	0.43	0.48
ME (kcal/kg)	2800	3000

†Ingredients per kg diet: Mg, 56 mg; Fe, 20 mg; Cu, 10 mg; Zn, 50 mg; Co, 125 mg; I, 0.8 mg, vitamin A, 10,000 IU; vitamin D3, 2000 IU; vitamin E, 5 IU; vitamin K, 2 mg; riboflavin, 4.20 mg; vitamin B12, 0.01 mg; pantothenic acid, 5 mg; nicotinic acid, 20 mg; folic acid, 0.5 mg; choline, 3 mg.

vaccinated against infectious bronchitis (d1 and d7), Newcastle disease (d1 and d7), avian influenza (d1) and infectious bursal disease (d21).

Nutrient digestibility

At 42d, two birds were randomly chosen from each replicate and transferred to specially constructed metabolism cages. They were allowed 4-d acclimatization, thereafter, fasted overnight with *ad libitum* water was intake. The AGE treatments were supplied every morning to the broiler chickens for 3d. Their droppings were collected and oven-dried daily.

Economy of feed conversion

The live weights of the birds were measured at weekly interval. Feed consumed and feed conversion ratio was measured for growth performance indices. An appraisal of feed cost/ weight gain was conducted to determine the effect of AGE on feed cost/kg, total cost of feed consumed/ kg and cost of feed/kg weight gain of broiler chickens.

Chemical and statistical analysis

Proximate composition of the aqueous ginger extract feed and droppings was determined in line with the method of AOAC (2003). Data obtained on growth performance, nutrient digestibility and economy of feed conversion were analysed by one-way analysis of variance (ANOVA) using SAS (2014) version 9.3. Duncan's multiple range test was used to separate the treatments means where differences existed ($P<0.05$). The responses to AGE administered were measured using the following quadratic equation SAS (2014):

$$Y = a + b_1x + b_2x^2 + o$$

Where Y = growth performance characteristics, nutrient digestibility, economic of feed conversion; a = intercept; b_1 and b_2 = coefficients of the quadratic equation; x = level of aqueous ginger extract administered, and $-b/2b_2$ = x value for optimum response. The quadratic model was used because it gave the best fit.

RESULTS AND DISCUSSION

The result of the proximate composition of AGE showed that it had 93.34% DM, 8.05% CP, 3.00% crude fibre, 3.00% EE and 7.00% NFE, respectively. Adebiyi *et al*. (2014) also reported similar results. The aqueous ginger extract had positive effect ($P<0.05$) on total feed consumed, final BW and FCR. There were significant differences in all performance traits measured except for initial BW (Table 3). Chickens on AGE performed better than those in the control groups. Aqueous ginger extract at calculated levels of 127.49, 312.44, 88.79 and 54.46 ml/L optimized daily weight gain, feed consumed, FCR and ash digestibility, respectively (Table 4). The results showed that AGE had positive effect on the growth performance of broiler chickens. The improvement may be due to stimulatory effect of ginger extract on digestive juices, microflora and nutrient assimilation in digestive tract. The present results are in agreement with the findings of George *et al*. (2013) who observed that active compounds of ginger (shogaols, gingerdione, gingerol, phenolic and gingerdiol) stimulates feed intakes and improved feed conversion ratio leading to increase weight gain of the broiler chickens. Similar results were observed by Ademola *et al*. (2009), Arkan *et al*. (2012) and Talukdar *et al*. (2017). These authors reported an increased weight change with broilers chickens fed with ginger meal when supplemented at 2 and 6 percent levels in the ration. In contrast, Omage *et al*. (2007) and Wafaa *et al*. (2012) observed that aqueous extract of ginger did not influenced weight gain, feed intake and FCR of the broiler chickens. The differences may be due to lower dosage of AGE used in their study. Additionally, environmental and genetic factors influence the chemical composition of plant extracts (Brene and Roura, 2010). Other factors that could affect the results on *in vivo* experiments are species, geographical location, harvesting time and state of maturity of plants, parts of plant, extraction methods and duration of conservation of plant extracts (Brene and Roura, 2010).

Digestibility of various nutrients by Marshal broiler chickens at 49d of age is presented in Table 2. The results indicated that AGE had no effect ($P>0.05$) on the digestibility of DM, CP, EE and NFE. However, digestibility of ash and crude fibre were affected ($P<0.05$) by AGE. The effect may be linked to phenolic compound present in ginger extract which enhances digestion by stimulating the endogenous enzyme in the guts of broiler chickens (Wafaa *et al.,*2012). Karangiya *et al*. (2016) and Hernandez

Table 3. Aqueous ginger extract (AGE) dosage levels for optimal growth performance and nutrient digestibility of Marshal broiler chickens at finisher phase

Traits	Formula	r^2	AGE dose (x)	Optimal level (Y)
Daily LW gain	$Y = 49.41 + 0.27x - 0.00x^2$	0.68	127.49	66.93
Daily feed consumed	$Y = 110.11 + 0.21x - 0.00x^2$	0.35	312.44	144.22
Feed conversion ratio	$Y = 2.21 - 0.00x + 3.62x^2$	0.81	88.79	1.92
Ash	$Y = 59.93 - 0.21x + 0.00x^2$	0.52	54.46	54.17

Table 2. Effect of aqueous ginger extract (AGE) on growth performance, nutrient digestibility and economy of feed conversionof Marshal broiler chickens (0-49 d) at finisher phase

Parameters	Treatments†						SEM	P value
	AGE_0	AGE_{25}	AGE_{50}	AGE_{75}	AGE_{100}	AGE_{125}		
Growth performance								
Initial LW, g	33.03	33.32	34.34	33.73	33.98	33.84	0.24	0.6734
Final LW, g	1667.0^{b}	1600.7^{b}	2000.5^{a}	1885.9^{a}	1950.7^{a}	2000.2^{a}	24.9	<0.001
Total feed consumed, g	2457.4^{b}	2040.9^{c}	2827.6^{a}	2546.4^{ab}	2726.7^{ab}	2744.1^{a}	36.42	0.0001
FCR	2.26^{a}	1.99^{b}	1.99^{b}	1.95^{bc}	1.98^{b}	1.94^{c}	0.14	0.0001
Nutrient digestibility (%)								
Dry matter	78.82	79.02	78.93	78.93	78.93	78.78	0.81	1.0000
Crude fibre	63.01^{a}	51.61^{c}	52.05^{bc}	58.90^{abc}	60.27^{abc}	61.64^{ab}	1.28	<0.001
Crude protein	70.65	67.93	69.56	68.47	68.47	68.47	1.05	0.9720
Ether extract	82.22	84.44	82.22	84.44	82.22	84.44	0.85	0.8880
NFE	87.01	88.74	90.04	88.09	87.87	87.87	0.97	0.9660
Ash	50.68^{ab}	56.16^{a}	47.94^{b}	53.42^{ab}	56.16^{a}	53.42^{ab}	1.04	0.0001
Economics								
Cost of feed (₦ /kg)	122.00	122.00	122.00	122.00	122.00	122.00	1.37	1.0000
Cost of feed consumed (₦ /kg)	431.18^{ab}	389.18^{b}	474.58^{a}	434.32^{ab}	452.62^{a}	461.16^{a}	6.02	<0.001
Feed cost/LW gain (₦ /kg)	273.34^{a}	240.23^{b}	239.68^{b}	233.50^{b}	242.04^{b}	235.25^{b}	1.87	<0.001

†Treatments included supplementation of aqueous ginger extract (AGE) via drinking water at concentrations of 0 (AGE_0), 25 (AGE_{25}), 50 (AGE_{50}), 75 (AGE_{75}), 100 (AGE_{100}) and 125 (AGE_{125}) ml/L.

[abc]Means in the same row not sharing a common superscripts are significantly different ($P < 0.05$).

et al. (2004) also reported that incorporation of garlic powder and or extract influenced ash and crude fibre digestibility of broilers chickens.

The aqueous ginger extract had effect on total cost of feed consumed and cost/ weight gain. However, cost of feed per kilogram was not influenced by AGE (Table 2). The effect may be attributed to the essential oils in ginger, which stimulates the activities of pancreatic enzymes in guts, thus, promoting digestion and absorption leading to high weight gain in broiler chickens. Similar results were also observed by Oleforuh-Okoleh *et al*. (2014). The correlationship between dose of AGE and growth performance indicated that the supplementation of AGE at 127.49 ml/L maximized daily weight gain while FCR was maximized at an inclusion level of 88.79 ml/L (Table 3).

CONCLUSION

On the basis of the above result, it may be concluded that administration of AGE generally improved production performance of Marshal broiler chickens. Aqueous ginger extract may, therefore, present an opportunity to enhance broiler performance when used as a dietary supplement.

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