GROWTH PERFORMANCE AND NUTRIENTS DIGESTIBILITY OF BROILER STARTER CHICKS FED DIETS CONTAINING GRADED LEVELS OF GINGER MEAL (*Zingiber officinale*) SUPPLEMENTED WITH AND WITHOUT ORGANIC ACID.

ABSTRACT

An experiment was conducted to investigate the effect of diets containing ginger root meal (Zingiber officinale) supplemented with and without organic acids on the growth performance and nutrients digestibility of broiler chicks. A total of two hundred and fifty (250) day old broiler chicks was used. Basal diet which served as the control (T1) contained no organic acid was formulated, while diets 2, 3, 4, 5, 6 and 7 respectively contained ginger meal at 15g (T2), 30g (T3) and 45g (T4) without organic acid supplementation, 15g (T5), 30g (T6) and 45g (T7) supplemented with organic acids. Each treatment was replicated three times with 12 birds per replicate in a completely randomized design (CRD). The experiment lasted for 4 weeks. Results showed that final weight, weight gain, and feed conversion ratio of birds differed non-significantly (P>0.05) across all the treatment groups. However, total feed intake and daily feed intake were significantly (P<0.05) higher in birds fed the control diet (988.23g, 35.39g) but were similar to those fed ginger meal based diets T2 (901.93g, 32.21g), T3 (968.91g, 34.60g) and T4 (920.73g, 32.88g) without organic acid when compare to those in organic acid groups. Apparent nutrient digestibility of the birds revealed a significant (P<0.05) variation in all parameters across the dietary treatments. Dry matter digestibility was statistically (P<0.05) higher in birds fed ginger based diets without organic acid while other parameters did not follow a particular trend. It was therefore concluded that feeding of diets containing ginger meal with or without organic acid had no adverse effect on the performance and nutrients digestibility of broiler starter chicks.

Keywords*:* *Broiler starter, performance, apparent nutrient digestibility, ginger meal, organic acid, chick starter*

INTRODUCTION

Research on the world's meat output shows that poultry is the livestock industry that is expanding the quickest, particularly in emerging nations (Chang, 2007). Due to the short generation time of broiler chicks, poultry production, particularly the production of chicken, continues to be one of the most reliable methods for producing a rapid and sustainable supply of high-quality protein to serve the growing need of Nigeria's teeming population (Nkwocha, *et al.*, 2014). A key barrier to the development of the chicken business in Nigeria and most developing countries of Africa, however, has been recognized as the severe scarcity and high cost of feed ingredients, particularly protein and energy sources (Fasuyi, 2005). As a result, scientists are searching for more affordable, accessible, and secure protein and energy sources. Due to the improper and inappropriate use of antibiotics, the sectors responsible for the production of poultry must also deal with the issue of antibiotic-resistant bacteria. The utilization of phytobiotics, also known as phytogenic feed additives, as well as other natural antibacterial components, is therefore being researched and investigated by scientists.

Phytobiotics (PFAs) are compounds made from plants that are added to feed to improve digestibility, nutrient absorption, and the removal of pathogens that are present in the animal's gut (Balunas and Kinghorn, 2005). These feed supplements have been shown to improve broiler performance, carcass traits, and meat quality (Schleicher *et al.,* 1998). Evidence also suggested that garlic, onion, cinnamon, cloves, thyme, and other spices could prevent gram-positive and gram-negative food-borne bacteria, yeast, and mold (Smith Palmer *et al.,* 1998).

There have been reports that PFA, like ginger (Zingiber officinale Roscoe), can stop the buildup of lipids like neutral fats and cholesterol (Bamidele and Adejumo, 2012). Some herbs, spices, and extracts may have anti-helminthic qualities, according to recent studies (Susdarashan *et al.,* 2010). Most of the tropics contain ginger, which has significant medical and commercial value. The bioactive substances in ginger have anti-oxidant, anti-inflammatory, anti-carcinogenic, and antibacterial properties (Aeschbach *et al.,* 1994; Minghetti *et al.,* 2007 Susdarashan *et al.,* 2010). Ginger-containing diets for broilers resulted in larger carcass weights, higher dressing percentages, and better carcass quality (Zhang *et al.,* 2009). It would be very important to discover an appropriate replacement, especially through the use of phytogenics, given the current perception of the risks of having drug-resistant microorganisms from the use of antibiotics as feed additives and the current restriction on using antibiotics in animal feeds by some nations. A further factor against the use of inorganic feed additives in animal feeds is the development of modern organic agriculture. Ginger, also known as Zingiber officinale, is a perennial plant. Due to the several active components that ginger has been claimed to have, it may function as a pro-nutrient.

According to Herbs (2011), the volatile oils borneol, camphene, citral, eucalyptol, linalool, phellandrene, zingiberine, zingiberol (gingerol, zingerone, and shogaol), and resin are found in ginger. The compounds that give gingers their distinctive flavor, most notably gingerol and shogaol, also include some of their therapeutic effects. To lower the pH of the intestinal system in chickens, which favors beneficial microorganisms and suppresses pathogenic microbes, organic acids are utilized. This eliminates the need for antibiotics. For a long time, the chicken feed has been treated with antibiotic feed additives as growth promoters to stabilize the intestinal microbial ecology, enhance general performance, and avoid some specific intestinal pathologies (Herbs, 2011). The elimination of antibiotics has affected poultry performance, increased feed conversion, and increased the prevalence of specific animal diseases such as (subclinical) necrotic enteritis (Zhang *et al.,* 2009). Due to this circumstance, researchers are now investigating the use of additional non-therapeutic alternatives as feed additives in the production of chicken, such as organic acids, enzymes, probiotics, prebiotics, herbs, essential oils, and immunostimulants.

There are a variety of organic acids with different physical and chemical characteristics, and many of them are employed as feed additives or as supplements to drinking water (acidifiers). In addition, many are offered as sodium, potassium, or calcium salts (and/or partially esterified). Due to their overall lack of smell and ease of handling throughout the feed preparation process, salts have an advantage over acids.

They may also be more water soluble and less corrosive. By enhancing nutrient uptake, growth and feed conversion efficiency, and competitive exclusion, the usage of organic acids safeguard young chicks as well.

Numerous research showed that organic acids could boost chickens' inborn immunological responses. Determining the impact of feeding ginger meal-based diets supplemented with or without organic acids on the growth performance and nutrient digestibility of broiler starting chicks is the purpose of the current study.

MATERIALS AND MEHODS

Experimental site

The research was carried out at the poultry Unit of the Teaching and Research Farm, Taraba State University, Jalingo. The city is located within the Northern Guinea Savannah zone of Nigeria. It lies between latitude 8^0 50^0 N and longitude 11^0 31^0 E of the equator (Encarta, 2009). Elevation of 364m above sea level. The area is characterized by an average rainfall (April - October) and a dry season period (November - March). The annual rainfall is between 1000 - 1500mm with an average minimum temperature of 38^0c and maximum of 41^0c depending on the season (Taraba State Dairy, 2008).

Source of test ingredients and Processing

Organic acids were purchased from Nutrivitas Limited, 27 Morrison Crescent Oregun Ikeja Lagos. Ginger roots were purchased from commercial dealers at Kasuamata main market Jalingo. Fresh ginger roots procured were washed and sliced for effective drying. The sliced ginger roots undergone air drying for 10 days in an open ventilated space away from sunlight. The air-dried ginger was milled into fine particles using a local milling machine. The ground samples (ginger meal) were stored in an air tight container and stored under room temperature (23.1^0 C – 24.6^0C).

Experimental birds and management

A total number of two hundred and fifty (250) day old unsexed broiler chicks of commercial strain (Marshall Broiler) were purchased from a reputable hatchery. The chicks were weighed and allotted to seven dietary treatment groups of three replicates each in a completely randomized design. Each replicate consists of 12 chicks and 36 birds per treatment group. The birds were brooded for two weeks. Birds were reared on deep litter housing system. The experiment lasted for 4 weeks. Routine vaccinations and medications were strictly followed. Feed and water were supplied *ad libitum.*

Experimental diets

The experimental diets were formulated to meet NRC (1994) minimum nutrient requirement. The diets consist of maize-based diet (control), 15, 30 and 45g of ginger meal supplemented with and without organic acids designated as T1 (Control), T2, T3, T4, T5, T6 and T7. The organic acid was supplemented at 0.2mg/kg of the diets. The experimental diet is as presented in Table 1.

Table 1: Composition of Broiler Starter Diets Containing Ginger meal (GM) with and without Organic Acid Supplementation (0-4 weeks)

Ingredients	1 Control	2 15g GM	3 30g GM	4 45g GM	5 15g GM	6 30g GM	7 45g GM
Maize	52.50	52.50	52.50	52.50	52.50	52.50	52.50
Maize offal	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Soybean meal	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Groundnut cake	17.00	17.00	17.00	17.00	17.00	17.00	17.00
Fish meal	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Bone	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Common Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Vit. Premix*	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total (%)	100	100	100	100	100	100	100
Organic Acids	-	-	-	-	+	+	+
Calculated Analysis							
ME (KCal/Kg)	2916.21	2916.21	2916.21	2916.21	2916.21	2916.21	2916.21
Crude protein (%)	23.05	23.05	23.05	23.05	23.05	23.05	23.05
Crude Fibre (%)	3.28	3.28	3.28	3.28	3.28	3.28	3.28
Ether Extract (%)	4.65	4.65	4.65	4.65	4.65	4.65	4.65
Calcium (%)	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Avail Phosphorus (%)	0.64	0.64	0.64	0.64	0.64	0.64	0.64
Lysine (%)	1.22	1.22	1.22	1.22	1.22	1.22	1.22
Methionine (%)	0.56	0.56	0.56	0.56	0.56	0.56	0.56

*Biomix chick premix provided per kg of diet: Vit A. 10,000 I.U; Vit D_3 32,000 I.U; Vit E 23,000 mg; Vit K 2,000mg; Vit. B_1 1,800 mg; Vit. B_2 5,000mg; Pantothenic acid 7,500mg; Vit.B_{12} 150mg; Folic acid 750mg; Biotin 100mg; Choline chloride; 300,000mg; Cobalt 3,000mg; Iodine 1,000mg; Iron 20,000mg; Manganese 40,000mg; Selenium 200mg; Zinc 30,000mg; Antioxidant 1250mg. ME = Metabolizable Energy

Data collection

Performance characteristics

The initial weights of the birds will be taken on arrival. The live weights of the birds as well as the feed consumption of each replicate will be measured weekly. Feed conversion ratio for each replicate will be determined by dividing the feed intake by the weight gain.

Feed intake/bird (g) =

$$\frac{\text{Quantity of feed fed} - \text{Quantity of feed left over}}{\text{Number of birds x 28 days}}$$

Daily weight gain (g) =

$$\frac{\text{Final live weight} - \text{Initial weight}}{\text{Number of birds x 28 days}}$$

Feed conversion ratio =

$$\frac{\text{Quantity of feed consumed}}{\text{Weight gain}}$$

Nutrient digestibility

Metabolic trial was conducted at the 8th week of the study. A bird per replicate were randomly selected and housed separately in appropriate metabolic cage fitted with feeder and drinker. The birds were allowed to acclimatize for two days before the commencement of 4 days feeding and faecal collection. A known weight of feed was given and excreta collected were oven dry at 60^0C and used for analysis. Proximate composition of the feed and dried excreta were analyzed for dry matter, crude protein, ether extract, crude fibre and ash using standard method of AOAC (2000).

Statistical analysis

Data obtained were subjected to analysis of variance using general linear procedure of Statistical Analytical System SAS (2008). Significant treatment means were separated using Duncan Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

The results of effect of ginger root meal (GRM) supplemented with and with and without organic acid (OA) supplementation on growth performance of the broiler starter chicks is presented in Table 1. From the results, no significant (P>0.05) effect of dietary treatments was observed in all the parameters measured except total feed intake, daily feed intake and mortality (%). The final weight, total weight gain and daily weight gain of birds were statistically similar across all the treatments. However, birds on diet T4 (45g GRM) without organic acid supplementation were numerically higher in final weight (944.63g), total weight gain (590.50g) and daily weight gain (21.09g) compared to those in other treatment groups. The similarities and lack of significance (P>0.05) observed among the birds may suggest that ginger root meal inclusion in the diets of broilers did not adversely affect the development and performance of birds. This agrees with Onu (2010) and Habibollah (2013) who reported no detrimental effect of ginger powder on the performance of broilers.

On the other hand, total feed intake and daily feed intake differed significantly (P<0.05) and followed similar trend across all the treatment groups. These were significantly (P<0.05) higher in birds fed the control diet T1 (988.23g), 35.39gg) but similar to those in T2 (15g GRM), T3 (30g GRM) and T4 (45g GRM) without organic acid when compared to those diets with organic acid supplementation. The increased daily consumption observed in birds fed diets T1, T2, T3 and T4 supplemented without organic acids stimulate appetite and has digestive properties, enhancing feed intake and digestion. Platel and Scrinivasan (2000) in their findings reported that ginger increased appetite by stimulating digestive juices such as bile, salivary, gastric, pancreatic and internal secretions. The increase in feed intake observed in this study agreed with the findings of Ademola *et al.* (2009) who reported increase in feed intake of broilers fed diets containing ginger. It was also observed that broilers response to feed additives may be influenced by factors such as species, age and stage of production, nutrition, environment, management practices, additive type and dosage (Ademola *et al.*, 2009). The improved feed intake in this study may be attributed to the improved palatability of the diets. This observation agrees with the findings of Niddaulah *et al*. (2010) who reported that smell and taste were critical traits in food selection. Feed conversion ratio (FCR) differed non-significantly P>0.05) across all the treatments. The similarity observed in FCR of birds across the dietary treatments could be attributed to balanced and improved rate of utilization of the dietary nutrients and conversion to gains. This observation agrees with the findings of Gebhart and Kabanov

(2001) who reported that better feed conversion ratio signified that more feed was retained in the animals and less waste to the environment. No mortality was observed in birds in the control group. However, mortality was moderately in birds across all the ginger based treatments with or without organic acid supplementation.

Table 2 Growth performance of starter broiler chicks fed diets containing *ginger* root meal (0 – 4 weeks)

PARAMETERS	Dietary treatments							SEM
	T1 (0% GRM)	**T2 GRM + OA 15g**	**T3 GRM OA 15g**	**T4 GRM + OA 15g**	**T5 GRM + OA 15g**	**T6 GRM OA 15g**	**T7 GRM + OA 15g**	
Initial Weight (g/bird)	153.89	152.43	153.86	154.13	152.63	154.13	154.13	0.00
Final Weight (g/bird)	733.33	733.23	731.67	744.63	718.13	698.33	693.93	47.61
Total Weight Gain (g/bird)	579.44	580.80	577.81	590.50	565.50^{a}	544.20	539.80	46.70
Daily Weight Gain (g/bird/day)	20.69	20.75	20.64	21.09	20.19	19.44	19.28	1.67
Total Feed Intake (g/bird)	988.23^{a}	901.93^{abc}	968.91^{a}	920.73^{abc}	823.50^{bc}	886.63^{bc}	772.73^{c}	79.60
Daily Feed Intake (g/bird/day)	35.39^{a}	32.21^{abc}	34.60^{ab}	32.88^{abc}	29.40^{bc}	31.66^{bc}	27.59^{c}	2.31
FCR	1.71	1.57	1.67`	1.55	1.45	1.62	1.42	0.66
Mortality (%)	0.00^{b}	5.53^{ab}	2.77^{ab}	2.77^{ab}	10.99^{a}	11.13^{a}	2.77^{ab}	0.00

^{abc} Mean in the same row with different superscripts are significantly different (P<0.05), SEM= Standard Error of Mean, FCR= feed conversion ratio

Nutrients Digestibility

The result of the apparent nutrients digestibility trials of birds fed diets containing ginger root meal supplemented with organic acid is presented in Table 3. The result showed significant (P<0.05) variation in the apparent nutrients digestibility by broiler chicks fed diets containing ginger meal with or without organic acid (OA) supplementation. Percentage dry matter and crude protein digestibility by birds fed diet T1 (control), T2 (15g GRM) and T3 (30g GRM) without organic acid were comparable and significantly (P<0.050) higher than those in other treatment groups supplemented with organic acid. It was observed that the dry matter digestibility of birds fed diets containing 15g and 30g ginger meal without organic acid respectively (T2 and T3) improved more compared to other dietary treatments supplemented with OA. The observed similarity and higher percentage dry matter digestibility observed in birds across the treatments T1 (control), T2 and T3 compared to other dietary treatments may be attributed to the beneficial effect of ginger root meal.

Percentage digestibility of crude protein by birds was higher (P<0.05) in diets T2 (15g GRM + OA) and T3 (30g GRM + OA) and was similar to those in T1 (control), T5 (15g GRM) and T6 (30g GRM). However, birds on T4 (45g GRM + OA) and T8 (45g GRM without OA) had the least crude protein digestibility values (85.99 and 88.57%) respectively.

The higher similarity in crude protein digestibility by birds in T1, T2, T3, T5 and T6 compared to those in other treatment groups may be an indication of equal and balanced nutrients utilization of birds across the treatment groups. Crude fibre digestibility by birds on diet T2 was similar to those on diet T1 (control), T3, T4 and T5 and these were significantly (P<0.05) higher compared to those on other diets. The comparable values obtained for crude fibre digestibility observed in birds fed diets T1, T2, T3, T4 and T5 was an indication that the crude fibre content of the diets was reduced drastically, thus improved nutritional value of the diets. However, ether extract digestibility by birds were significantly (P<0.05) higher but similar across all the dietary treatments except those in T3 group which had the least value (46.00%). This is an indication of good and balanced nutrients utilization.

Table 3: Effects of Diets containing Ginger Root Meal with Organic Acids Supplementation on Nutrients Digestibility by Broiler Chicks (0 – 4weeks)

Parameters	T1 (Control)	T2 GRM + OA 15g	T3 GRM + OA 30g	T4 GRM + OA 45g	T5 GRM 15g	T6 GRM 30g	T7 GRM 45g	SEM
Dry Matter	84.29^{a}	82.77^{a}	81.00^{ab}	77.59^{b}	78.97^{b}	79.17^{b}	78.13^{b}	1.84
Crude Protein	91.83^{ab}	93.55^{a}	92.07^{a}	85.99^{c}	91.52^{ab}	91.40^{ab}	88.57^{bc}	1.17
Crude Fibre	87.34^{ab}	88.69^{a}	84.75^{ab}	86.00^{ab}	83.56^{b}	85.98^{ab}	82.56^{b}	1.83
Ether Extract	70.20^{a}	62.00^{ab}	46.09^{b}	53.43^{ab}	59.54^{ab}	52.70^{ab}	58.07^{ab}	6.09
Ash	83.53^{ab}	85.01^{ab}	86.29^{a}	80.57^{b}	85.68^{ab}	82.94^{ab}	86.68^{a}	3.36
NFE	76.88^{ab}	74.72^{ab}	75.22^{ab}	71.29^{b}	70.97^{b}	80.70^{a}	69.31^{b}	2.61

NFE = Nitrogen Free Extract, abc = Means with different superscripts are significantly different (P<0.05), SEM = Standard Error of Means, GRM = Ginger Root Meal, OA = Organic Acid

The percentage ash digestibility by birds were significantly (P<0.05) higher across all the treatments except those in T4 group which had the least value (80.57 %). The significantly (P<0.05) higher percentage ash digestibility observed in birds fed the control diet (T1), T2, T3, T5, T6, T7 and T8 compared to those in T5 group is an indication of good nutrient utilization.

Nitrogen free extract digestibility by birds was significantly (P<0.05) higher in birds fed the control diet (T1), T2, T3 and T6 compared to those in other treatments. This observation suggests that ginger meal produced more soluble fraction in the diets and also enhanced the digestibility of the soluble carbohydrates.

CONCLUSION

In view of the results obtained in this study, it was observed that dietary inclusion of ginger meal with organic acid supplementation did not significantly improved digestibility and had little effect on performance of broiler chicks. It was therefore concluded that feeding of diets containing ginger meal supplemented with or without organic acid had no adverse effect on the performance and digestibility of nutrients by broiler starter chicks.

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