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Research Article

Assessment of Ginger and Black Pepper as Feed Additives on Growth Performance and Carcass Traits of Broiler Chickens

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This study examined the growth and carcass characteristics of broiler chickens fed diets with ginger (*Zingiber officinale L)* and black pepper *(Piper guineense Schum & Thonn)* additives. A total of 240 day old unsexed Anak-2000 broiler chicks were allotted to four treatments in a completely randomized design. Treatment 1 was the control with no additive, Treatment 2 had 0.5% ginger powder, Treatment 3 had 0.5% black pepper powder, while Treatment 4 had a mixture of 0.25% ginger and 0.25% black pepper. From the results obtained, the ginger, black pepper and their combination diets were significantly different ($p<0.05$) in weight gain from the control diet, with the ginger diet recording the highest value of 2299.09g per bird, as against 1821.77g per bird from the control. Average feed intake was highest in the ginger diet with 5130.14g as against the control diet that had the least with 4420.71g. The ginger and combination diets gave better feed conversion ratio of 2.23 and 2.28 respectively, which was also significantly different from the control. Mortality recorded in the control treatment was highest with 5.00% and significantly different from the other treatments. Plucked weight of experimental birds was highest in diet 2 with 2165.53g and least in the control diet with 1710.31g. It can be concluded that the addition of the natural plant additives improved the measured parameters in comparison to the control diet and thus suggest that they hold considerable potential as growth promoting agents in broiler production.

Keyword: ginger, black pepper, growth performance, broiler chickens, carcass traits.

INTRODUCTION

Feed additive are important materials that can improve the efficiency of feed utilization and animal performance. The possibility of using new natural alternative additives instead of antibiotics and hormone in animal diets has been extensively researched for the past three decades. Some plants, containing various secondary metabolites, have been used as alternative remedies by some researchers (Ceylan *et al.*, 2003). Some studies have indicated that various plants extracts can improve feed conversion ratio, improve carcass quality, decrease the market age of broiler and reduce their rearing cost (Muhammed *et al.*, 2009).

Environmental stress such as heat exposure and coccidiosis has been regarded as one of the major factors negatively affecting performance of birds in the intensive poultry industry particularly in the tropics and as a main factor in the pathogenesis of several serious diseases (Dalloul *et al.,* 2006). This gave rise to the supplementation with synthetic antioxidants (e.g., α-tocopheryl or butylated hydroxytoluene) to mitigate the oxidative stress. Recently though, the use of plant parts as natural additives is gaining increasing interest because of the global trend of restriction in use of synthetic substances (Ahn *et al.,* 2002). A considerable number of studies have documented that herbs, spices and various plant extracts have digestion-stimulating and antimicrobial effects (Amad *et al.* 2011; Khan *et al.* 2012). Herbs and spices stimulate feed intake by the secretion of endogenous enzymes, antibacterial effect and antioxidant potential (Lee *et al.* 2015; Shahid *et al.* 2015), resulting in enhanced absorption of nutrients

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from the gut (Tehseen *et al.* 2016). Such natural feed additives have been reported to exert a wide range of beneficial effects on the production performance in broilers in respect to weight gain, feed conversion and meat quality (Aji *et al.*, 2011).

Ginger (*Zingiber officinale*) rhizome (ginger root) is widely used as a spice or condiment and medical treatment for certain diseases (Tapsell *et al.,* 2006). Ginger may act as a pro-nutrient because of the vast active ingredients it has been reported to contain such as gingerol, gingerdione and gingerdiol that also possess strong antioxidant activity (Kikuzaki and Nakatani, 1996). Herbs Hands Healing (2011) reported that ginger contains a protein digesting enzyme (Zingibain) which is believed to improve digestion as well as kill parasites and their eggs.

Piperine (1-piperoyl-piperidine) is a major alkaloid component of black pepper, and is responsible for its pungent and biting taste (Dogra *et al.*, 2004). Among its chemical-biological activities, piperine exhibits antimicrobial (Reddy *et al.,* 2004), anti-inflammatory (Pradeep and Kuttan, 2004) and antioxidant (Mittal and Gupta, 2000) properties.

The study was therefore undertaken to evaluate the growth performance and the carcass and internal organs characteristics of broiler chickens fed diets with natural (ginger and black pepper) feed additives.

MATERIALS AND METHODS

This experiment was approved by the Departmental Board of Animal Science, Ambrose Alli University, Ekpoma, Nigeria.

Experimental location and Animal management: The experiment was conducted at the poultry unit of the Teaching and Research Farm of the Faculty of Agriculture, Ambrose Alli University, Ekpoma, Nigeria. A total number of 240 Anak-2000 strain broiler chicks were used for the experiment. The chicks were managed in a deep litter system and after brooding for 2 weeks, they were transferred into individual pens measuring $20ft^2$ for each replicate. Feed and water were provided *ad libitum* with appropriate routine medication and vaccination. The vaccination and medication program was planned and strictly followed in accordance with the immunoprophylactic and preventive guide for broilers recommended by FAO (2005). Dosages were given according to the specifications of the manufacturers. Gumboro vaccine was administered orally on the 8^{th}, 18^{th} and 28^{th} day, while new castle disease vaccine was administered on day 14^{th} and 35^{th}. Coccidiostat was orally administered on day 10^{th} and 24^{th}.

Preparation of test ingredients and experimental diets: The dried ginger and black pepper were obtained from a local market and milled into powder. The milled ginger and black pepper were weighed and used in formulating four balanced broiler starter and finisher diets according to the recommendations of Olomu (2010), as shown in tables 1. The experimental treatments had the additives as: Treatment 1 was the control with no additive; treatment 2 had ginger powder at 0.5% (5g/1kg of feed); treatment 3 had black pepper powder at 0.5% (5g/1kg of feed); while treatment 4 had a mixture of 0.25% ginger and 0.25% black pepper (2.5g each/1kg feed). The feeding trial began from the third week, up to the end of eighth week, when the experiment was terminated.

Table 1: composition of experimental broiler starter and finisher diets

INGREDIENTS (%)	starter diets				finisher diets			
	1	2	3	4	1	2	3	4
Maize	55.20	55.20	55.20	55.20	54.00	54.00	54.00	54.00
Soybean meal	28.00	28.00	28.00	28.00	20.80	20.80	20.80	20.80
Palm kernel cake	9.00	8.50	8.50	8.50	12.40	12.40	12.40	12.40
Wheat bran	-	-	-	-	7.00	6.50	6.50	6.50
Fish meal	4.00	4.00	4.00	4.00	3.00	3.00	3.00	3.00
Bone meal	3.00	3.00	3.00	3.00	2.00	2.00	2.00	2.00
Common salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Vitamin/mineral Premix	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Black pepper	-	0.50	0.50	0.25	-	0.50	0.50	0.25
Ginger	-	-	-	0.25	-	-	-	0.25
Total	100	100	100	100	100	100	100	100
Calculated composition								
Crude protein (%)	23.10	23.04	23.00	23.04	20.62	20.56	20.52	20.56
Metabolizable energy (Kcal/Kg)	**3240.04**	**3232.54**	**3214.94**	**3232.54**	**3088.15**	**3080.65**	**3063.05**	**3080.65**

Experimental design

The experimental design used was a completely randomized design (CRD) with a total of 240 Anak-2000 broiler chicks. After brooding, the birds were randomly allotted to the four (4) experimental groups with 60 birds each, replicated 4 times to give 15 birds per replicate.

Collection of data

Measured parameters (weight, feed offered) were taken on weekly basis from the end of the third week, up to the end of the eighth week. The data obtained were used in computing weight gain, daily weight gain, feed intake, daily feed intake and feed conversion ratio. Mortality was recorded and used to compute percent mortality for the duration of the experiment. At the end of the eighth week, carcass and internal organs analysis was performed. Feed was withdrawn overnight and one bird with live weight close to pen's mean weight was selected from each replicate pen to give a total of 16 birds from the experiment. They were slaughtered, scalded and eviscerated. The carcasses were thereafter cut into parts and the parts weighed on a weighing balance.

Statistical analysis

All data generated were subjected to a one-way analysis of variance (ANOVA) with the aid of the General Linear Model procedure of the Statistical Analysis System (SAS, 2004). Where significant treatment effects were observed, differences between treatments means were compared by Duncan's multiple range test as outlined by Steel and Torrie (1997). The level of statistical significance was pre-set at $P < 0.05$.

RESULTS

Growth performance results obtained from the study is presented in Table 2 below. The result of average final weight showed that birds fed the ginger diet had the highest value of 2434.12g and was significantly different ($p<0.05$) from the least value obtained from the control diet (1957.16g). Despite numerical differences among treatments 2, 3, and 4, there were no significant differences between them. The same pattern of significance was observed in the average weight gain and average daily weight gain.

Average total feed intake by the control treatment was numerically least and significantly different from the other treatments with a value of 4420.71g. The average feed intake for birds fed the ginger diet was highest with 5130.14g but was not significantly different ($p<0.05$) from the black pepper and combination diets. This pattern was also repeated in the average daily feed intake. Feed conversion ratio showed significant differences among the treatment diets. The ginger diet gave a better feed conversion ratio of 2.23 which was significantly different from the control diet (2.43). Percentage mortality as recorded during the feeding trial shows that the control treatment had the highest and significant value of 5.00%. The ginger treatment had the least mortality rate of 1.67%, though not significantly different from the black pepper and combination treatments.

Table 2: Effect of experimental feed additives on growth performance of broiler chickens

Parameters	Control	0.5% ginger	0.5% BP	0.25% ginger + 0.25% BP	SEM
Initial weight (g)	135.39	135.03	136.50	132.12	2.85NS
Final weight (g)	1957.16^{c}	2434.12^{a}	2335.42^{b}	2337.28^{b}	8.32*
Weight gain (g)	1821.77^{c}	2299.09^{a}	2198.92^{b}	2205.16^{b}	8.11*
Daily weight gain (g)	43.38^{c}	54.74^{a}	52.36^{b}	52.50^{b}	0.18*
Feed intake (g)	4420.71^{b}	5130.14^{a}	5091.60^{a}	5021.19^{a}	8.57*
Daily feed intake (g)	105.26^{b}	122.15^{a}	121.23^{a}	119.55^{a}	0.31*
Feed conversion ratio	2.43^{a}	2.23^{b}	2.31^{ab}	2.28^{b}	0.34*
Mortality (%)	5.00^{a}	1.67^{c}	3.33^{bc}	3.33^{bc}	1.51*

a,b,c; means in the same row with different superscript are significantly different ($p<0.05$)
*BP = black pepper, NS= Not significant, * = significant difference

Result of carcass analysis of the experimental birds is given in Table 3. The result shows that the plucked weight was least and significantly different in the control diet (1710.31g), while the highest value was recorded in the ginger diet (2165.53g). The ginger diet also gave the highest value with an average eviscerated weight of 1825.50g and significantly different from the least value of 1385.22g obtained from the control diet.

Table 3: carcass characteristics of experimental birds

Body parts (g)	Control	0.5% ginger	0.5% BP	0.25% ginger + 0.25% BP	SEM
Live weight	2057.29^{c}	2566.51^{a}	2460.82^{b}	2464.99^{b}	66.72*
Plucked weight	1710.31^{a}	2165.53^{b}	2124.94^{b}	2072.17^{b}	155.01*
Eviscerated weight	1385.22^{c}	1825.50^{a}	1775.86^{b}	1725.79^{b}	47.31*
Breast	478.50	548.00	544.00	490.00	91.62NS
Back	191.00	228.50	217.00	226.50	14.22NS
Thighs	226.00	257.00	236.00	240.00	59.10NS
Drum sticks	181.00	212.00	195.00	190.50	35.50NS
Wings	178.50	185.50	191.00	180.00	27.75NS

NS = Not significant (P > 0.05) * = significant difference

The weights of the internal organs of the experimental chickens are presented in Table 4 below. The internal organs as shown in the table were not significantly influenced by the treatment diets. The control diet had similarities with the other treatment diets.

Table 4: An Assessment of internal organs characteristics

Internal organs (g)	control	0.5% ginger	0.5% BP	0.25% ginger + 0.25% BP	SEM
Heart	19.00	17.50	17.50	17.50	8.09NS
Spleen	3.50	3.50	4.00	3.50	0.40NS
Lungs	20.00	21.50	19.00	18.50	15.11NS
Liver	51.45	56.00	50.50	57.00	69.25NS
Gizzard	57.00	64.00	72.00	70.50	81.03NS
Intestine	125.00	125.50	139.00	131.50	35.07NS

BP= black pepper, NS= Not significant

DISCUSSION

Attempts at combating stress and its attendant effects on broiler chickens' performance under tropical conditions, has made researchers focus attention on the exploitation of natural plant additives that are abundant in the tropics. In addition, the growing consumer concerns of the dangers associated with the consumption of broiler meat derived from birds fed synthetic feed addictive is intended to be addressed by the use of these plant derived additives. Khan *et al.* 2012 and Abudabos *et al.* 2016, suggest that the mechanism of action of phytogenics may be due to the enhanced feed intake, improved nutrient digestion, increased secretion of digestive enzymes and greater absorption in the intestines.

Based on the results from this research, it shows that the addition of ginger and black pepper to the diet of broiler chickens led to significant ($p < 0.05$) differences in weight and feed parameters. The experimental birds finished the preparatory brooding period with uniform body weight with no significant difference ($p > 0.05$). This suggests that differences observed among treatments in measured and estimated parameters were as a result of the experimental additives applied.

This study has shown that the addition of ginger and black pepper at the level administered has positive and significant effect on productive performance of broiler chickens, which is in agreement with the findings of Al-Kassie *et al.*, (2011) with the use of black pepper and Valiollahi *et al.*, (2013) with the use of black pepper and ginger in broiler chicken nutrition. Galib *et al.*, (2011) reported that addition of black pepper results in a high activity of piperazier citrate which may affect the flow of digestive juices across the stomach. Black pepper increases digestion through arousing digestive liquids of stomach and eradication of infectious bacteria (Mansoub, 2011). Galib *et al.*, 2011 and 2012, showed that according to the level of black pepper used, the activity of Piperazine citrate will influence the secretion of digestive juices across the stomach.

Abou-Elkhair *et al.* (2014) showed that the addition of black pepper and mixture of black pepper and turmeric powder to broiler chicken diet led to a higher final body weight of chickens during the fattening period of 35 days. Improvement of broilers body weight gain as a result of supplementation of black pepper powder was observed and reported by Ghazalah *et al.* (2007) and Mansoub (2011).

The most active component in black pepper, piperine, promotes pancreatic digestive enzymes such as lipase, amylase and proteases, which play important roles in the digestion process (Platel and Srinivasan, 2000). However, Al-Kassie *et al.* (2011) and Abou-Elkhair *et al.* (2014) with the use of black pepper powder in chicken nutrition did not record positive significant influence of the added spice on feed conversion ratio. It has been proposed that a way to strengthen the intestinal immune defense is the use of some phytogenic growth promoters, which have a positive

effect on animal health status, mainly through enhanced host mucosa immunity and improved resistance to pathogenic bacteria colonization (Cheng *et al.*, 2014). This can be deduced as one of the reasons for the significantly lower mortality percentage in the phytogenic treatment groups in this study.

As reported in this study, there was significant difference observed in the eviscerated weight of the experimental birds. This is contrary to the works of Al-Kassie and Witwit (2010) and Al-Kassie *et al.*, (2012) that reported that the use of herbal plants had no effect on the dressing percentage. In the current study, the higher dressing weight in the feed additive groups may be due to the better weight gain and feed efficiency in these groups. Additionally, the results obtained from the weights of the internal organs are in agreement with those reported by El-tazi *et al.*, (2014) and Al-Kassie *et al.*, (2011) were inclusion of different levels of black pepper had no significant effect (P>0.05) on the edible giblets (liver, heart and gizzard).

CONCLUSION

The beneficial effects on wellbeing, growth performance as well as nutrient and energy utilization are mainly the reasons why zootechnical additives are generally used. As observed in this study, ginger, black pepper and their combination had a positive effect on growth performance as well as some carcass traits. This gives credence to the scientific opinions that such natural additives holds great potential in improving overall productive performance of broiler chickens.

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