



Phytogenic Potentials of Black Pepper (*Piper Nigrum*) Seed Meal on Growth Performance of Broiler Chicken

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Abstract

A study was conducted at the Teaching and Research Farms of Oyo State College of Agriculture and Technology, Igboora with two hundred and fifty-six (256) male day-old broiler chicks purchased from a reputable hatchery, randomly allotted into 4 groups of 64 birds in completely randomized design (CRD) which were further subdivided into 8 replicates of 8 birds. Each group had an inclusion level of 0.0%, 0.4%, 0.8% and 1.2% black pepper seed meal (BPSM) for a period of 6 weeks. Parameters collected on growth performance (final body weight (FBW), weight gain (WTG), feed intake (FI), feed conversion ratio (FCR) and mortality were subjected to ANOVA using SAS 2012 software, significant means were separated using Duncan's Multiple Range Test. The result obtained showed that BPSM in the diet significantly ($p < 0.05$) affected FBW, WTG, FI and FCR. FBW was observed to be highest at T1 (2070.54g) followed by T2 (1963.39g) while there was no difference between T3 (1612.50g) and T4 (1511.61g). Similarly, WTG was highest at T1 (2021.39g) followed by T2 (1915.39g) although, there was no difference between WTG of T3 (1563.23g) and T4 (1462.41g). FI however, showed a reducing trend with increase in BPSM levels from T1 (4898.09g) to T4 (4222.39g). FCR showed that BPSM at 0.4% (2.38) was lowest, which was however not different from T1 (2.43) but different from T3 (2.77) and T4 (2.89). Other parameters had statistically similar means which were within acceptable range for poultry birds. It can be concluded that black pepper seed meal as a phytogenic agent can be used up to 0.4% level of inclusion in the diet for improved growth production without any negative effect on broiler chicken.

Keywords: Black pepper seed meal, feed intake, weight gain, FCR, Broiler chicken

Introduction

Commercial broilers are genetically engineered birds that can attain a body weight (above 2 kg) within a short growing time interval of 35 days. They are however faced with much stress during their growing period; thus, poultry farmers have aided the stress by adding relieving medicines to feed and water in order to ease the stress and improve their body weight at the same time. Thus, the use of growth promoters such as antibiotics, hormones and enzymes were promoted and embraced as they improved the performance of animals (Plail, 2006). Despite this, their potential side effects became a real public health concern globally (Donoghue, 2003) and eventually led to the ban of the products in the European Union (Demir *et al.*, 2005; Plail, 2006 and Akinleye *et al.*, 2008). As a result, poultry nutritionists are trying to rectify this problem through supplementation with phytoadditives, which contain antibiotic and antibacterial properties since the large proportion of these medicinal plants do not have residual effects

(Tipu *et al.*, 2006). Currently, most research attention is geared towards identifying and defining the most useful of all these spices, vegetables, fruits, herbs and plant extracts to quantify the magnitude of their reliability in livestock production, as well as to control the negative effect of antibiotics on health and the environment (Damme, 1999; El-Husseiny *et al.*, 2002). In Nigeria, a good number of different herbs, plant extracts, seeds and tree barks exist, one of such is the black pepper seed (*Piper nigrum*). Black pepper (*Piper nigrum*), as one of the most popular spices, is a flowering vine of the *Piperaceae* family that is cultivated for its fruit, which is usually dried and used as a spice and seasoning. In dried form the fruit is referred to as peppercorns. It is a native of south India and popularly known as "King of Spices". The principal bioactive constituent of black pepper is "piperine" which increases the bioavailability (Shoba *et al.*, 1998; Mehta *et al.*, 2012) of many phytochemicals present in food items. Piperine also stimulates the release of epinephrine (Kawada and Sakabe 1988) and



elevates the level of circulating thyroid hormones (Tripathi and Tripathi 1989). Its extract has also been found to be a good source of antioxidant activity (Andrade and Ferreira 2013.). This study therefore aims at harnessing antibiotic potentials of black pepper as an additive to be used in broiler feeds to improve broilers production performance.

Materials and methods

Location of the study

The experiment was carried at the Poultry Unit of the Teaching and Research Farm, Oyo State College of Agriculture and Technology, Igboora

Procurement and preparation of test ingredient

Black pepper seed was purchased from local markets in Ibadan, the seed was separated from the stalk with other dirt and impurities handpicked, it was then blended into a fine powdery form and stored in an air tight dry container till further use.

Experimental Animal Managements

A total number of two hundred and fifty-six (256) Marshal® day-old male broiler chicks were purchased from a reputable hatchery. Prior to arrival of these birds; the experimental pen was washed clean, disinfected, fumigated and allowed to rest for a period of 10 days. Tray feeders and fountain drinkers with other brooding equipment were cleaned and disinfected as well. Chicks were reared on floor pen (1.50m × 1.50m) with the use of wood shavings (7 cm) as the bedding materials. On arrival, chicks were carefully removed from their box and randomly allotted into experimental groups. Water and feed were supplied ad libitum. Chicks were vaccinated against the most common diseases such as Newcastle Disease (ND) and Infectious Bronchitis (IBD) as at when due while no other medications were administered for the period of study. The black pepper served as source of antibiotic for the treatment groups except the control. The feeding program consisted of the compounded starter diet that was used until 21 days of age and a finisher diet until 42 days of age. All diets for each period were prepared with the same batch of ingredients and all diets with the same composition.

Experimental Design

The chicks were randomly allotted into 4 treatment groups of 64 birds each in a completely randomized design (CRD). Each

group was subdivided into 8 replicates of 8 birds each placed on a deep litter pen of fresh wood shavings measuring 1.50m x 1.50m.

Treatment was as follows:

Diet 1: compounded diet with 0.0 % black pepper seed meal

Diet 2: compounded diet with 0.4 % black pepper seed meal

Diet 3: compounded diet with 0.8 % black pepper seed meal

Diet 4: compounded diet with 1.2 % black pepper seed meal

The study lasted for a period of 42 days

Data Collection

Growth Performance Characteristics

(a) Feed intake

Feed consumption per week was obtained by weighing a known quantity of feed for all the replicates in a well labeled container at the beginning of the week. The left over at the end of each week was weighed to obtain the feed consumed for the corresponding week by difference.

(b) Body weight

The initial weights of the birds were taken at the commencement of the experiment. Subsequent weight was taken on weekly basis and difference between mean weights for two successive weeks was taken to obtain the average weight gain of birds per week.

(c) Feed conversion ratio

Feed conversion ratio was calculated as a ratio of feed consumption to the body weight gained

$$\text{Feed Conversion} = \frac{\text{feed intake}}{\text{Weight gain}}$$

Statistical Analysis

All data collected during the study were subjected to analysis of variance (ANOVA) using the Statistical Analysis System (SAS 2012) software. Significantly different means were separated using Duncan's Multiple Range Test (DMRT) of the same software

Experimental Model

$$Y = \mu + T + e_{ij} \quad ij \quad ij$$

Y = Effect of jth birds fed ith levels of black pepper seed meal ij

μ = Overall mean

T = ith effect of treatment at varying levels of black pepper seed meal i

e = Random residual error

Results

The results on performance characteristics of broiler chicken fed



black pepper seed meal (BPSM) at the starter phase is presented in Table 2.

Black pepper seed meal (BPSM) inclusion in the diet significantly ($p < 0.05$) affected final body weight (FBW), weight gain (WTG), feed intake (FI) and feed conversion ratio (FCR). FBW was observed to be highest at 0% (T1) lowest at 1.2% (T4) BPSM levels of inclusion. WTG was however highest at 0.4% (T2) followed by 0.0% (T1), 0.8% (T3) and 1.2% (T4) respectively. FI also showed a reducing trend with increase in BPSM inclusion levels, although, there were no differences between FI of T2 (0.4%) and T3 (0.8%). Mean values for FCR showed that BPSM at 0.4% (T2) had the lowest FCR, which was however not different from the control (0.0%) but different from T3 (0.8%) and T4 (1.2%) ($P < 0.05$)

The results on performance characteristics of broiler chicken fed black pepper seed meal (BPSM) at the finisher phase is presented in Table 3.

Black pepper seed meal (BPSM) inclusion in the diet significantly ($p < 0.05$) affected the initial bodyweight (IBW), final body weight (FBW), weight gain (WTG), feed intake (FI) and feed conversion ratio (FCR). IBW was observed to be highest at 0.0% (T1) followed by 0.4% (T2) BPSM inclusion levels although; there were no difference between IBW of T3 (0.8%) and T4 (1.2%). Similarly, FBW was also observed to be highest at 0% (T1) followed by 0.4% (T2) where T3 (0.8%) and T4 (1.2%) showed no difference as well. WTG was however observed to be highest but with no difference in T1 (0.0%) and T2 (0.4%) as well as in T3 (0.8%) and T4 (1.2%). FI also showed a reducing trend with increase in BPSM inclusion levels, although, there were no differences between FI of T3 (0.8%) and T4 (1.2%). Mean values for FCR showed that BPSM at 0.4% (T2) had the lowest FCR followed by T1 (0.0%), while T3 (0.8%) showed no difference between T1 (0.0%) and T4 (1.2%)

The results on performance characteristics of broiler chicken fed black pepper seed meal (BPSM) at starter and finisher phase is presented in Table 4.

The result obtained showed that black pepper seed meal (BPSM) inclusion in the diet significantly ($p < 0.05$) affected overall final body weight (FBW), weight gain (WTG), feed intake (FI) as well as the feed conversion ratio (FCR). FBW was observed to be highest at 0% (T1) followed by 0.4% (T2) while there was no

difference between T3 (0.8%) and T4 (1.2%). Similarly, WTG was highest at T1 (0.0%) followed by T2 (0.4%) although, there was no difference between WTG of T3 (0.8%) and T4 (1.2%). FI however, showed a reducing trend with increase in BPSM inclusion levels from T1 (0.0%) to T4 (1.2%). FCR showed that BPSM at 0.4% (T2) had the lowest FCR, which was however not different from the control (0.0%) but different from T3 (0.8%) and T4 (1.2%)

Discussion

From the results obtained for performance of the birds, the reduction in live weight at 1.2 % level of the black pepper seed meal inclusion at the starter phase signifies that at a higher level, black pepper could become detrimental to growth of the birds which may largely depend on the palatability and pungency (caused by piperine in black pepper) of the feed. Abaza *et al.* (2008) reported improvement in live weight and weight gain of broiler chickens feed 0.1 % black pepper oil at 4 weeks of age, confirming the importance of black pepper as growth promoting additive.

However, in this study, reduction in feed intake at 1.2 % inclusion of BPSM could be linked to the poor growth recorded at that level. Similarly, Abaza *et al.* (2008) reported lower overall feed intake in chicks fed higher level of black pepper and further more stated in an earlier study, that black pepper at 0.25 % improved feed conversion ratio (Abaza *et al.* 2003).

In our study at the starter phase there were improvements in weight gain, final body weights and average weight gain with black pepper at 0.4 %, inclusion than the control. Even though FCR was not different between the control and 0.4 % but was better at this phase. The improvement observed may be due to the ability of the diets to supply the required nutrients to the birds as piperine is capable increasing absorption of selenium, vitamin B, beta-carotene and bud stimulation as a feedback loop for digestion process. These results were in line with the finding of Hosseini (2011) who reported that, black pepper increases digestion through arousing digestive liquids of stomach and eradication infectious bacteria. It affects the absorption power, decrease material transit velocity and increase digestive enzymes as well as weight gain in chicks. Additionally, Al-Kassie *et al.* (2011) found that, according to the level of black



pepper used that reflect the high activity of Piperazine citrate included in the broiler's diet which may have affected the flow of digestive juices across the stomach. These results are in agreement with those reported by El Husseiny *et al.* (2002) who stated that, chicks fed on hot pepper diets had significantly higher body weight and digestion coefficient of crude protein, nitrogen free extract, total digestible nutrients and metabolizable energy than those fed the control diet. The potentials of Black pepper to stimulate feed intake, especially in young animals have also been reported in several studies with broiler chicks and weanling pigs (Ertas *et al.*, 2005; Giannenas *et al.*, 2003; Gunther *et al.*, 1998). Growth enhancement through the use of phytogenics is probably the result of the synergistic effects among complex active molecules existing in phytobiotics (Gauthier, 2002). It was noted that at the finisher phase, final body weight, weight gain and feed intake were significantly reduced when black pepper was added up to 0.8% and 1.2 %. But final body weight and weight gain at the finisher at 0.4 % had no negative effect but the best FCR can still be noted here. As reviewed by Windisch *et al.*, (2008), the inclusion of Phytogenics in broiler diets may reduce feed consumption at fairly unchanged body weight gain, hence resulting in improved feed conversion. The black pepper could have constituted the main factor that significantly influenced the final live weight at the finisher phase. There were two clear reasons for these assertions. First, the live weight produced by 0.4 % at the starter phase was numerically higher than the control, but at the end of the experiment it became significantly lower to the control indicating no added advantage of adding black pepper at 0.4 %. Secondly, 0.4 % at the starter phase produced live weight which was similar to the control, but at the end of the finisher phase it was significantly lower than the control. Based on this, it could be said that prolong feeding of black pepper at 0.8 % and 1.2 % could be detrimental to growth of broilers. It was reported that several Phytogenic feed additives have an impact on feed palatability, depending on the applied dosage of the respective ingredients also that performance parameters largely depend on their inclusion level in the finished feed or drinking water (Cross *et al.*, 2007). Also from available reports, not much have been said concerning the use of black pepper seeds meal in poultry diets, but the result on final body weight, weight gain, feed intake and feed

conversion ratio especially at 0.4 % was consistent with some reports on other spices (Windisch *et al.* 2007); herbs (Lee *et al.* 2004); plant extracts (Chand *et al.* 2005; Ndelekwute *et al.*, 2012; Javed *et al.* 2009) and essential oils (Abaza *et al.* 2008). Overall performance (combined starter and finisher): FCR of group fed 0.4 % black pepper seed meal was similar but better when compared with the control. Lee *et al.* (2003) and Windisch *et al.* (2007) reported that spices and essential oils could be used to aid digestion in monogastric animals. Jang *et al.* (2004) attributed better nutrient digestion to antimicrobial property. However, at higher levels beyond 0.4 %, final body weight, weight gain, feed intake and FCR, the birds showed a reducing trend in the various parameters. The negative effect of black pepper at higher levels could be due to the presence of ant nutritional factors and terpenoids reported to be contained in black pepper which could result in poor growth (Abaza *et al.* 2008). There is scarcity information in the current study of literature concerning the use of black pepper seeds in poultry diets, but the results on performance is consistent with some reports on other spices (Windisch *et al.* 2007); herbs (Lee *et al.* 2004); plant extracts (Chand *et al.* 2005; Mushtag *et al.*, 2007; Javed *et al.* 2009) and essential oils (Abaza *et al.* 2008). The lower feed intake at higher levels of (0.8 and 1.2 %) BPSM could be due to the pungent characteristic of the spice and also it could also be ascribed to strong taste produced by black pepper (black pepper taste hot) in the feed. Lee *et al.* (2004) reported that spices produced feed aversion in rodents due to their pungency. The performance of birds fed diet containing 0.4 % black pepper over the control could be attributed to odour reported for growth promoting properties inherent in black pepper. These properties include stimulation of digestive enzymes, saliva, hydrochloric acid and mucus; anti-oxidation effect, ability to improve the number and height of villi, reduction in crypt depth, anti-flatulence ability and anti-microbial activity (Mathe, 1996; Jang *et al.* 2004; and Sirinivasan 2007) of the essential oil in black pepper. Sirinivasan (2007) linked it to the ability of black pepper to induce saliva secretion, hydrochloric acid and mucus production. Other studies have shown that the spices or their active ingredients have positive effect on bile acid secretion while the pungent properties of black pepper stimulated digestive enzymes activities (Platel and Sirinivasan 2000).



Table 1: Ingredients and nutrients composition of starter and finisher diet (%)

Ingredient	Starter (1-28 days)	Finisher (29-56 days)
Maize	58.00	63.80
Soybean meal	34.50	28.40
Soya oil	3.30	3.70
Di-calcium phosphate	1.70	1.70
Limestone	1.80	1.70
Salt {NaCl}	0.25	0.25
Methionine	0.15	0.15
Premix*	0.30	0.30
Total	100	100
Calculated composition (%)		
Crude protein	22.10	19.18
Energy (MEKcal/kg)	3030	3100
Ether extract	5.79	6.34
Crude fibre	2.62	2.51
Calcium	1.04	1.00
Phosphorous	0.46	0.45
Methionine	0.53	0.45

*premix supplied per kg diet: vitamin A 15,000 I.U, vitamin D3 13000 iu, thiamin 2mg, Riboflavin 6mg, pyridoxine 4mg, Niacin 40mg, cobalamine 0.05g, Biotin 0.08mg, choline chloride 0.05g, Manganese 0.096g, Zinc 0.06g, Iron 0.024g, Copper 0.006g, Iodine 0.014g, Selenium 0.24mg, Cobalt 0.024mg and Antioxidant 0.125g. NFE = Nitrogen free extract

Table 2: Effects of black pepper seed meal (BPSM) on performance of broiler at the starter phase

Parameters	T 1 (0.0 %) BPSM	T 2 (0.4 %) BPSM	T 3 (0.8 %) BPSM	T 4 (1.2 %) BPSM	SEM	P-value
IBW(g)	43.00	42.00	43.10	43.05	1.56	0.448
FBW(g)	693.44 ^a	695.78 ^a	635.16 ^b	576.56 ^c	7.79	0.001
WTG(g)	650.44 ^a	653.78 ^b	592.05 ^c	533.51 ^d	7.54	0.001
FI (g)	1378.5 ^a	1296.8 ^b	1276.8 ^b	1243.6 ^c	8.05	0.001
FCR	2.12 ^{bc}	1.98 ^c	2.18 ^b	2.34 ^a	0.03	0.003

^{abcd} = Means in the same row with different superscripts are significantly (p < 0.05) different

BPSM = Black pepper seed meal, **IBW** = initial body weight, **FBW** = final body weight, **WTG** = weight total gain, **FI** = feed intake, **FCR** = feed conversion ratio, **SEM** = standard error of the means

Table 3: Effects of black pepper seed meal (BPSM) on performance of broiler at the finisher phase

Parameters	T1 (0.0%) BPSM	T2 (0.4%) BPSM	T3 (0.8%) BPSM	T4 (1.2%) BPSM	SEM	P-value
IBW(g)	1114.29 ^a	1012.50 ^b	843.48 ^c	816.96 ^c	12.44	0.001
FBW(g)	2070.5 ^a	1963.4 ^b	1612.5 ^c	1511.6 ^c	18.25	0.001
WTG(g)	956.25 ^a	950.89 ^a	769.02 ^b	694.64 ^b	20.69	0.001
FI(g)	3322.7 ^a	3082.9 ^b	2858.1 ^c	2801.2 ^c	15.53	0.001
FCR	3.56 ^b	3.27 ^c	3.76 ^{ab}	4.05 ^a	0.08	0.015

^{abc} = Means in the same row with different superscripts are significantly (p < 0.05) different

BPSM = Black pepper seed meal, **IBW** = initial body weight, **FBW** = final body weight, **WTG** = weight total gain, **FI** = feed intake, **FCR** = feed conversion ratio, **SEM** = standard error of the means



Table 4: Effects of black pepper seed meal (BPSM) on performance of broiler at both starter and finisher phase

Parameters	T 1 (0.0 %) BPSM	T 2 (0.4 %) BPSM	T 3 (0.8 %) BPSM	T 4 (1.2 %) BPSM	SEM	P-value
IBW(g)	43.00	42.00	43.10	43.05	1.56	0.448
FBW(g)	2070.54 ^a	1963.39 ^b	1612.50 ^c	1511.61 ^c	18.26	0.001
WTG(g)	2021.39 ^a	1915.39 ^b	1563.23 ^c	1462.41 ^c	18.26	0.001
FI(g)	4898.09 ^a	4565.00 ^b	4317.27 ^c	4222.39 ^d	14.92	0.001
FCR	2.43 ^b	2.38 ^b	2.77 ^a	2.89 ^a	0.024	0.001

abcd = Means in the same row with different superscripts are significantly ($p < 0.05$) different

BPSM = Black pepper seed meal, **IBW** = initial body weight, **FBW** = final body weight, **WTG** = weight total gain, **FI** = feed intake, **FCR** = feed conversion ratio, **SEM** = standard error of the means

Conclusion and Recommendation

Black pepper seed meal was found to aid performance on growth, feed intake and feed conversion ratio of broiler chicken at 0.4 % level of inclusion at both starter and finisher phases. Thus, black pepper seed meal as a phyto-genic agent can be used up to 0.4% level of inclusion for improved production and performance without any negative effect on broiler chicken

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