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Original Research Article

Evaluation of Black Pepper, Tumeric, Corriander and Their Blend as Supplementary Phytoadditives on Growth Performance and Meat Sensory Assessment of Broiler Chickens

Samuel, I[1*], Samuel, F. Y[2], Sule, A[1], Umar, M. I[1]

[1]Agricultural Science Education Department, Federal College of Education [Technical], Bichi-Kano, Nigeria
[2]Mathematics Department, Federal College of Education [Technical], Bichi-Kano, Nigeria

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Abstract: A feeding trial was conducted to determine the effects of black pepper, tumeric, corriander and their blend as supplementary phytoadditives in dosage 1 kg per ton of feed on the growth performance and meat sensory assessment of broiler chickens. A total of three hundred (300) day-old broiler chicks were used for the study. At the starter phase, the chicks were weighed at day old and randomly assigned to five dietary treatments in a completely randomized design (CRD). Feed and water was provided *ad libitum* during the trial period. The birds were weighed at the beginning of the trial and weekly thereafter. Weight gain, feed intake, left over feeds were measured and recorded, feed conversion ratio and feed cost per kilogramme weight gain were calculated and mortality rate recorded as they occurred. Medication and vaccine administration was carried out as required. Performance parameters calculated include feed intake, weight gain, feed to gain ratio, feed cost per kilogram gain and mortality. For the finisher phase, one hundred and five four weeks old chicks were allotted to five dietary treatments in a completely randomized design (CRD). The treatments were replicated three times with fifteen chicks per replicate. Performance parameters measured were the same as for the starter phase. The experimental study lasted seven weeks. Data obtained were subjected to analysis of variance using SAS (2008), while the significant differences between treatment means were separated by Duncan Multiple Range Test at a 5% level of significance. There were significant ($p<0.05$) differences in final weight, weight gain, feed consumption, feed conversion ratio, feed cost per gain and mortality. Birds fed corriander supplemented diet (T4) had significantly ($p<0.05$) higher final weight, weight gain and least cost of production which were at par with birds fed black pepper supplemented diet (T2). The least performance was observed for birds fed black pepper, tumeric and corriander blend (T5) supplemented diet which was at par with birds fed control diet. The least performance was observed for birds fed black pepper, tumeric and corriander mixture (T5) supplemented diet which were at par with birds fed control diet. The birds fed T4 supplemented diet had higher feed consumption which was similar to those of birds fed T2 and T3. The results obtained followed the same trend as that of the starter phase. It showed that black pepper supplemented diet (T2) and corriander supplemented diet (T4) promoted a significantly ($p<0.05$) better body weight gain and FCR and decreased cost of production. Three samples of breast and thigh muscles were collected for nutritional sensory evaluation per treatment. The observed results for meat assessment revealed that there were significant differences in most of the sensory parameters measured. The taste, flavour, tenderness, juiciness and acceptability were significantly better for birds fed corriander supplemented diet (T4). The colour was not significant across dietary treatments. Black pepper, tumeric, corriander and their blend improved growth performance and meat sensory characteristics of broiler chickens. Therefore, supplementary black pepper and corriander is recommended in broiler diets for enhanced performance and meat qualities.

Keyword: Broiler chickens, growth performance, meat sensory characteristics, phytoadditives.

***Corresponding Author:** Samuel, I
Agricultural Science Education Department, Federal College of Education [Technical], Bichi-Kano, Nigeria

1. INTRODUCTION

The concerns created by antibiotic resistance had made nutritionists resulted to seeking alternative feed additive sources with growth-promoting effects. These additive sources are expected to have no potential side effects or induce resistance to bacteria in animals. The use of phytoadditives as potential alternatives to antibiotic growth promoters had attracted a lot of attention in animal nutrition (Wang *et al.*, 2021). Phytoadditives originated from plants or botanicals with potential use as feed additives in poultry nutrition. These antioxidants, antimicrobial, antiparasitic, antifungal and antitoxigenic-containing substances are natural, free of residue and ideal for poultry (Mandey and Sompie, 2021). However, their application in poultry nutrition is limited largely due to lack of understanding of their mode of action and inconsistent efficacy. The efficacy of these substances and their application in poultry nutrition depended on genetics, composition and level of inclusion in poultry diets. The use of phytoadditive substances in poultry have been reported to cause increased feed consumption, feed efficiency, stimulation of digestion, growth performance, reduced disease incidence and increased profitability (Mandey and Sompie, 2021). Yitbarek (2015) suggested phytogenic feed additive use as alternative feed additive in poultry nutrition because they are non-harzadous, eco-friendly, have no negative or residual effects and maximized performance.

The supply of healthy poultry meat and meat products is an important role of the poultry industry. Phytoadditives influenced meat quality, physiology of broilers and supported production of healthy meat (Mandey and Sompie, 2021), enhance performance, feed conversion ratio, carcass meat safety and quality (Dhama *et al*., 2014; Dhama *et al*., 2015). These natural antioxidants are excellent amino acid and fatty acid modulators in broiler meat (Waheed *et al*., 2018) protect against drip loss during prolonged storage and increases consumer acceptance of meat (Gopi *et al*., 2014). Ahmed *et al*., (2015) reported a lowering effect on serum-total lipid, triglycerides, cholesterol and improved growth performance when broiler chickens were fed phytoadditives rich in antioxidant (basil and chamomile) supplemented diets. An equal mixture of thymol and carvacrol reduced feed intake, improved feed efficiency and body weight gain. The additive also increased digestive enzyme activities and antioxidants, and improved the immune response which had positive effect on performance and health of broiler chickens (Hashemipour *et al*., 2013). Windisch *et al.*, (2008) reported an effect of impair adhesion of pathogens which resulted from stimulated intestinal secretion of mucus when broilers were fed phytogenic feed additives. Gopi *et al*., (2014) observed that bioactive molecules of some plants extracts possess antibacterial, antioxidant, digestive stimulant, hypolipidemic, growth promoter, immunomodulator, antimycotic, antiparasitic, antiviral and insecticidal properties. Cho *et al*., (2014) reported improved feed conversion ratio using anise and thyme as feed additive in the diet. There were significant improvement in live body weight, weight gain and feed conversion ratio of broiler when fed a mixture of Nigella sative, anise and thyme (Al-Beitawi and El-Ghousein, 2016). Hence, it is appropriate to evaluate some phytoadditives in order to determine their effects on performance and meat sensory qualities, considering the increasing consumers demand for poultry and the limited scientific studies that have been carried out in this regard. Therefore, to reduce the detrimental resistance effects of antibiotics in broiler chickens through exploration of novel growth promoters, alternatives that can efficiently replace antibiotic growth promoters, particularly in poultry feeds, must be sought.

The search for alternatives to antibiotics is receiving much attention in recent years. Phytoadditive substances consisting of large variety of active ingredients represent the most promising alternatives to antibiotic use in poultry nutrition. Some of these promising alternatives are black pepper, tumeric and corriander. Black pepper (*Piper nigrum*) is a flowering vine extracted from the core of a pepper plant, with antioxidant and radical scavenging properties that have been well documented (Gulcin, 2005). Nalini *et al*., (2006) reported that pepper have been found to have antioxidant properties and anti-carcinogenic effect. Al-Kassie *et al*., (2011) observed that the outer fruit layer of pepper contains important odour-contributing terpenes, including pinene, sabinene and limonene which gives tasty properties. Khalaf *et al.*, (2008) showed that piperine can increase the absorption of selenium, vitamin B complex, beta-carotene and curcumin as well as other nutrients. Turmeric (*Curcuma longa*) is an extensively used spice, food preservative and coloring material which has biological active and main ingredient curcumin, which was found to have antioxidant properties (Karami *et al.*, 2011). Coriander (*Coriandrum sativum*) is an important plant which yields both fresh herb and spice seed used primarily for culinary purposes and as a flavoring agent in the food and baking industry as a spice in bread, curry, fish, meat and confections, containing an essential oil up to 1%, linalool as potential antioxidant (Wangensteen *et al*., 2004), appetizing and stimulatory effects in the digestion process (Cabuk *et al*., 2003). In addition, some components present in the phytogenic feed additives could be critical to their activity which might have synergistic influence. Only few comprehensive studies have been conducted to evaluate the roles of these substances alone or as blend on growth performance and blood chemistry of broilers. The need for examining certain interactions of these substances because of the variability of their bioactive compounds was suggested by Brenes and Roura (2010), nutritional modifications (Attia *et al*., 2015) increase performance naturally (Haq *et al.*, 2016). Therefore, this study was designed to evaluate the effects of supplementary black pepper, turmeric, coriander powders and their blends on growth performance and meat sensory assessment of broiler chickens and to

generate more information about the individual effect and their blend in the diet of broilers.

2. MATERIALS AND METHOD

2.1 Source of Experimental Birds

The experimental birds were obtained from a reputable hatchery in Ibadan, Oyo State, Nigeria.

2.2 Design and Management of Experimental Birds

A total of three hundred (300) day-old broiler chicks were used for the study. They were reared on deep litter, in an open sided wire mesh poultry house. Additional heat sources were provided using electric bulbs, kerosene stoves, and lanterns for brooding. The open sided nets were covered with tarpaulin sheets to conserve heat for the first two weeks of age. At the starter phase, the chicks were weighed at day old and randomly assigned to five dietary treatments in a completely randomized design (CRD). Feed and water was provided *ad libitum* during the trial period. The birds were weighed at the beginning of the trial and weekly thereafter. Weight gain, feed intake, left over feeds were measured and recorded, feed conversion ratio and feed cost per kilogramme gain were calculated and mortality rate recorded as they occurred. Vaccine administration was carried out as required. Performance parameters calculated include feed intake, weight gain, feed to gain ratio, feed cost per kilogram gain and mortality rate. For the finisher phase, one hundred and five four weeks old chicks were allotted to five dietary treatments in a completely randomized design (CRD). The treatments were replicated three times with fifteen chicks per replicate. Performance parameters measured were the same as for the starter phase. The period for the experimental study lasted 49 days.

2.3 Experimental Diet

The black pepper, turmeric and coriander seeds to be used in this study were purchased from local farmers in Kano in their raw form. It was then cut into smaller pieces and dried sufficiently in the sunlight. After drying, required amount of black pepper, turmeric and coriander seeds were prepared by fine grinding and passing through 1 mm sieve in Agricultural Education Department Feed mill and premixes were sourced from nutrient feedstuffs and premixes distributor, while other ingredients were sourced from a reputable Feed Millers in Kano, Nigeria. Five isonitrogenous and isocaloric diets each containing 23 % CP; 2881 Kcal/kg ME and 21 % CP; 2929 Kcal/kg for the starter and finisher phases, respectively were formulated as follows:

Control = basal diet with no supplementary phytoadditives
T2 = basal diet plus 1% black pepper (BP)
T3 = basal diet plus 1% turmeric (TM)
T4 = basal diet plus 1% coriander seeds (CR)
T5 = basal diet plus a blend of BP, TM, and CR

All diets were formulated to meet nutrient requirement standards of broilers (NRC, 1994).

Plate 1	**Plate 2**	**Plate 3**
		
Tumeric (*Curcuma longa*), Black Pepper (*Piper nigrum*), Coriander (*Coriandrum sativum*)		

2.4 Meat sensory assessment

The meat samples were prepared with 0.25mg of salt. After cooking, samples were cut into relatively uniform portions and kept in a thermal counter until they were served. The samples were presented in petric dishes with a glass of water to rinse the mouth to twenty (20) randomly selected panelists comprising of both academic staff from Agricultural Education, Home Economics department and undergraduate students constituted at the Food Laboratory, Home Economics Department, Federal College of Education [Technical], Bichi. The panelists were asked to compare each sample on the following attributes (appearance, colour, flavour, tenderness and juiciness) according to the 9-point hedonic scale as described by Duscosky (2007).

3. STATISTICAL ANALYSIS

Data obtained were subjected to analysis of variance using SAS (2008), while the significant differences between treatment means were separated by Duncan Multiple Range Test at a 5% level of significance ($P<0.05$).

4. RESULTS AND DISCUSSION

Table 1 showed the performance of broiler chicks fed black pepper, tumeric, corriander and their blend as supplementary phytoadditives. There were significant ($p<0.05$) differences in final weight, weight gain, feed consumption, feed conversion ratio, feed cost per gain and mortality. Birds fed corriander supplemented diet (T4) had significantly ($p<0.05$) higher final weight, weight gain and least cost of production

which were similar with those of birds fed black pepper supplemented diet (T2). The least performance was observed for birds fed black pepper, tumeric and corriander mixture (T5) supplemented diet which were at par with birds fed control diet. The observed significant increase in final body weight and body weight gain was in line with Wang *et al*., (2021) who reported increased body weight gain during the starter phase when broilers were fed supplemented phytogenic feed additives. The present result was further corroborated by Oleforuh-Okoleh *et al*., (2015) who reported significant increase in final body weight, higher feed intake and better feed conversion ratio when broiler chickens were fed red ginger supplemented diet. Minh *et al*., (2010), Al-Moramadhi (2010) and Onu (2010) reported similar improved performance when dried ginger was fed to broiler chickens. Hafeez *et al*., (2016) also reported enhanced performance in broiler chickens when fed diet supplemented with phytoadditives (thymol and carvacrol) in powdered form. The increased feed consumption observed in birds fed T4 supplemented diet which was similar to those of birds fed T2 and T3 explained the superior body weight gain for birds fed those treatment diets. The better feed conversion values recorded might be due to the stimulant, carminative, digestion and antimicrobial properties found in hot pepper (Harithi, 2008; El-Husseiny, 2008). Similar performance was observed in birds fed T2 supplemented diet in this study which was in line with Al-Harthi (2006) that broilers fed hot pepper supplemented diet showed improved feed conversion. Wang *et al.,* (2021) reported reduced feed conversion ratio throughout the growth period.

Table 2 showed the performance of broiler finisher chickens fed black pepper, tumeric, corriander and their blend as supplementary phytoadditives. There were significant ($p<0.05$) differences in final weight, feed consumption, feed conversion ratio, feed to gain and mortality. Birds fed corriander supplemented diet (T4) had significantly ($p<0.05$) higher final weight, weight gain, better feed conversion and least cost of production which were similar with those of birds fed black pepper supplemented diet (T2). The better final weight and weight gain observed in this study implied that birds fed black pepper supplemented diet (T2) and corriander supplemented diet (T4) diet had adequate nutrients from the diets which resulted in effective absorption and utilization of the nutrient for increased body weight gain. This was corroborated by Zumbaugh *et al*., (2020) that inclusion of Phytogenic feed additives improved body weight gain, and improved performance (Pendal *et al*., 2020). Sadek *et al.,* (2014) and Murugesan *et al.,* (2015) reported improved feed efficiency when broilers were fed Phytogenic feed additives. The least performance was observed for birds fed diet supplemented with blend of black pepper, tumeric and corriander (T5) which were similar with those of birds fed control diet. The results obtained followed the same trend as that of the starter phase. It showed that black pepper supplemented diet (T2) and corriander supplemented diet (T4) promoted a significantly ($p<0.05$) better body weight gain and FCR and decreased cost of production. The better weight gain might be due to the digestibility property of black pepper and antioxidant property of corriander included in the diets. It implied that there was high activity of piperizine citrate due to the level of black pepper used which might have affected the flow of digestive juice across the stomach. This was corroborated by the report of Al-kassie *et al.,* (2011) that mean body weight of broilers differed ($p<0.05$) significantly when fed inclusion levels of dried black pepper in the diet. Wang *et al*., (2021) reported improved feed conversion ratio which corroborated the findings of this study. However, the result from this study were in contrast with Paraskeuas *et al*., (2016) who reported that supplementation of Phytogenic feed additives did not have effect on growth performance of broiler chickens. The observed differences in the results might be attributed to variability is sources of phytoadditives plant sources, processing methods of bioactive compound extraction and their mechanisms. Paraskeuas and Mountzouris (2019), and Zumbaugh *et al.,* (2020) noted that differences in results from feeding poultry species phytogenic feed additives were associated with their effects on broilers through antioxidation, stimulation of digestive enzymes or regulating immune response mechanisms. The least performance observed for birds fed phytoadditives blend (T5) might be an indication that there were no synergestic effect between the three supplementary phytoadditives. This agreed with Oleforuh-Okoleh *et al*., (2015) who reported that mixture of two herbs were not as beneficial as sole treatment in all parameters measured when broiler chickens were fed ginger and garlic. Feed consumption was significantly ($p<0.05$) high for the control, and birds fed tumeric supplemented diet (T3). The observed beneficial effects of the phytoadditives used in this study on the performance parameters of broiler chickens might be associated with the anti-inflammatory and antioxidant compounds in phytoadditives-containing plants (Wang *et al*., 2021). Omolere and Alagbe (2020) observed that phytoadditives have the ability to stabilize the intestinal environment and provide positive advantages to the colonization and proliferation of Lactobacilli and reducing pathogenic organisms.

The effect of phytoadditives on meat sensory evaluation of broiler chickens is shown in Table 3. The observed results from the hedonic scale revealed that there were significant differences in most of the sensory evaluation parameters measured. The taste was significantly better in meat of birds fed diet 4 than those fed other supplemented antioxidants diets which were similar. Similarly, the birds fed with diet 4 had significantly higher value of flavour, while those fed blend of black pepper, tumeric and corriander supplemented diet (T5) had the least value (5.80). These results corroborated reports by Akinboye *et al.,* (2018) that the treatment diets had effect on the sensory

attributes of the final products of broiler meat. The colours of meat from birds in this study were not significantly affected across the supplemented phytoadditives dietary treatments. However, the value obtained for birds fed corriander supplemented diet (T4) was better among treatment diets. The assessment revealed that tenderness of the meat from birds fed black pepper (T2), tumeric (T3) and corriander (T4) supplemented diets were significantly better than those fed control diet, while birds fed blend of black pepper, tumeric and corriander supplemented diet (T5) obtained the least value. The assessment for juiciness followed a pattern, where meat from birds fed diets black pepper supplemented diet (T2) and corriander supplemented diet (T4) were similar and better with respect to juiciness than those fed control and tumeric supplemented diet (T3), while meat from birds fed blend of black pepper, tumeric and corriander supplemented diet (T5) diet obtained the least value among dietary treatments. The assessment for general acceptability showed similar trend. Gopi *et al*., (2014) reported that antioxidant property of phytoadditives during prolonged low temperature storage provides protection against the drip loss which reduces loss for the meat and increases the acceptance by the consumers. The non significance observations made in this study for colour was corroborated by the reports of the studies by Zakaria *et al*., (2010), Dalólio *et al.*, (2015) and Zaki *et al.*, (2018) that enzyme additive supplementation in diets based on corn and soybean meal did not influence the colour parameters of chicken meat. The positive effects of individual phytoadditve as observed in this study showed that these phytoadditives could serve as alternative growth promoters, bridging the gap between poultry meat production and consumer food safety as well as reducing mortality (Omolere and Alagbe, 2020).

Table 1: Performance of broiler chicks fed black pepper, tumeric, coriander and their blend as supplementary Phytoadditives (0 - 4 weeks)

	Levels of Supplementary Phytoadditives and Blend					
	T1	**T2**	**T3**	**T4**	**T5**	**SEM**
Parameters	**Control**	**BP (1%)**	**TM (1%)**	**CR (1%)**	**BLD (1.5%)**	
Initial weight (g/b)	36.53	36.70	36.50	36.17	36.40	0.24
Final weight (g/b)	940.27^{b}	1092.13^{a}	1062.63^{ab}	1107.10^{a}	939.80^{b}	33.91
Weight Gain (g/b)	903.73^{b}	1055.43^{a}	1026.13^{ab}	1070.93^{a}	903.40^{b}	33.91
Feed Intake (g/b)	1339.73^{bc}	1540.92^{a}	1559.72^{a}	1531.43^{a}	1327.17^{bc}	31.91
FCR	1.49^{ab}	1.46^{ab}	1.52^{b}	1.43^{a}	1.47^{ab}	0.04
Feed cost (₦/kg gain)	226.75^{b}	212.78^{a}	220.70^{ab}	210.68^{a}	214.14^{ab}	4.19
Mortality (%)	1.88^{b}	1.11^{a}	1.98^{b}	0.98^{a}	2.29^{c}	1.77

[abc]Means in the same row with different superscript are significantly different. FCR: Feed Conversion Ratio; BP: Black pepper, TM: Tumeric, CR: Corriander, BLD: Blend of black pepper, tumeric and corriander

Table 2: Performance of broiler chickens fed black pepper, tumeric, corriander and their blend as supplementary Phytoadditives (5 – 7 weeks)

	Levels of supplementary Phytoadditives and their blend					
Parameters	**T1**	**T2 BP**	**T3 TM**	**T4 CR**	**T5 BLD**	**SEM**
Initial weight (g/b)	940.27^{b}	1092.13^{a}	1062.63^{ab}	1107.10^{a}	939.80^{b}	33.91
Final weight (g/b)	2097.13^{b}	2288.67^{a}	2205.17^{ab}	2299.37^{a}	2039.10^{b}	68.81
Weight Gain (g/b)	1156.87	1196.53	1142.53	1192.27	1099.30	54.89
Feed Intake (g/b)	1945.33^{a}	1914.45^{ab}	1942.30^{a}	1883.79^{ab}	$1820.33a^{b}$	36.19
FCR	1.689^{ab}	1.60^{a}	1.70^{b}	1.58^{a}	1.66^{ab}	0.06
Feedcost (₦/kg gain)	283.36^{b}	234.24^{ab}	241.67^{ab}	229.42^{a}	236.64^{ab}	8.62
Mortality (%)	2.11^{b}	1.94^{ab}	1.98^{b}	0.98^{a}	3.11^{b}	1.87

[ab]Means in the same row with different superscript are significantly different. FCR: Feed Conversion Ratio, SEM: Standard error of mean, BP: Black pepper, TM: Tumeric, CR: Corriander, BLD: Blend of black pepper, tumeric and corriander

Table 3: Effects of black pepper, tumeric, corriander and their blend on sensory characteristics of meat from broiler chickens

	Levels of supplementary Phytoadditives and their blend					
Parameters	**Control**	**T2 BP**	**T3 TM**	**T4 CR**	**T5 BLD**	**SEM**
Taste	6.30b	6.80b	6.70b	7.20a	5.60b	0.60
Flavour	6.30bc	7.00ab	6.40bc	7.80a	5.80c	0.58
Colour	6.20	6.80	6.30	7.20	6.20	0.72
Tenderness	6.30b	7.50b	7.20a	7.20a	6.00c	0.54
Juiciness	6.10b	7.40ab	7.20abc	7.70a	6.00c	0.52
Acceptability	6.80bc	7.70a	7.50ab	7.90a	6.50bc	0.42

[abc]Means in the same row with different superscripts are significantly ($p<0.05$) different. SEM: Standard Error of Mean, BP: Black pepper, TM: Tumeric, CR: Corriander, BLD: Blend of black pepper, tumeric and corriander

5. CONCLUSION AND APPLICATION

The results in this study indicated that sole supplementation of broiler chicken diets with black pepper, tumeric or corriander was more beneficial with improved growth performance at both the starter and finisher phases than when supplemented with blend of black pepper, tumeric and corriander. However, black pepper, tumeric and corriander either as sole supplemented diet or as blend improved meat sensory characteristics of broiler chickens. Although, birds fed corriander (*Coriandrum sativum*) supplemented diet had better performance in terms of final weight, body weight gain and feed conversion ratio. However, in general terms, the supplementation of phytoadditives improved performance and sensory parameters studied. Therefore, it can be concluded that supplementation of phytoadditives black pepper (*Piper Nigrum*), tumeric (*Curcuma longa*) and corriander (*Coriandrum sativum*) supplemented diets improved performance and sensory attrinutes of broiler chickens. Generally, inclusion of the studied phytoadditives - black pepper (*Piper Nigrum*), tumeric (*Curcuma longa*) and corriander (*Coriandrum sativum*) in broiler diets is recommended in broiler chicken production for improved performance, nutritional and quality meat. Since the accessibility, affordability, and availability of these phytoadditives is guaranteed, their potentials should be fully exploited for use in broiler chicken's diets. This will promote sustainable animal protein source of the populace, increase consumer acceptance and consumption of poultry meat, decrease health-related crisis resulting from antiobiotics-resistance issues and finally encourage youth and women participation in poultry investment ventures and improve the efficiency of poultry industry, since they are cheaper and safer. Further studies are essential to investigate the individual bioactive compounds contained in the phytoadditives. This would be useful in corroborating our findings and establish their potentials as sustainable alternatives to antibiotics.

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