



Performance of Broiler Chicken on Diet Supplemented with Black Pepper (*Piper Nigrum*) Powder on Haematological and Biochemical Parameters

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Article History	Abstract
Received: 06 June 2023 Revised: 05 Sept 2023 Accepted: 06 Nov 2023	The present research work was conducted with the aim to find the different levels of black pepper powder supplementation on the performance in terms of growth, feed intake, carcass characteristics, blood parameters, overall performance and cost of rearing of broiler chicken. For this, a total of 120-day old, broiler chicks of hybrid Cobb-400 strain, were equally distributed into four treatments (T_1, T_2, T_3 and T_4) with five replications per treatment following Randomized Block Design. The birds were reared for 42 days. The birds in control group (T_1) were provided with standard diets of broiler starter and broiler finisher. However, the diets of other groups were supplemented with black pepper powder @7.5, 10.0 and 12.5 g/kg feed for T_2, T_3 and T_4 groups, respectively. Feed intake was recorded daily and weekly body weight was recorded replication wise. Gain in weight and feed conversion efficiency was calculated accordingly. The inputs of all items were precisely recorded for calculation of economics of rearing. On the 42nd day, from each treatment three birds were selected for collection of blood analysis viz. Hb, WBC, RBC, HDL, LDL and Cholesterol. No mortality was observed for all the treatments. The results showed no significant difference in body weight, body weight gain, feed intake, feed conversion efficiency, overall performance index and net profit per bird. In terms of blood constituents viz, RBC, WBC, Cholesterol were better in T_1 group.
CC License CC-BY-NC-SA 4.0	Keywords: Broiler chicken, Carcass, Haematological, Biochemical.

1. Introduction

In animal agriculture, poultry is among the most organized sector worth rupees one lakh crores. The broiler production has gone to 3.8 million tons from nowhere, within a span of 25 years 6-8 percent thriving in egg production and 10-12 percent in broiler production per annum. India stands third-largest egg producer after China and USA and the fourth largest chicken producer after China, Brazil and USA. Per capita consumption of egg has gone up from 31 to 67 and the chicken from 400g to 2.6/kg. Nutritionists suggest 180 eggs and 10/kg chicken per year. Many countries consume over 240 eggs and 20/kg chicken. Mostly 75 percent of poultry produce is consumed in the urban areas by about 28-30 percent of population. Poultry is an important tool, which provides household nutritional security and supplementary income.

Black pepper is referred as “king of spices”; containing chemical compounds, having disease preventing and health promoting properties such as medicinal value and relative abundance of black pepper (BP) gave the interest to study its effect on the growth performance of broilers (Chuparan *et al.*, 2016). Black pepper is used as medicine, because of its ingredient called piperine. The compound has potential application as a natural additive which directed to animal production; having many advantages, it highlights the fact that it is a natural product that can be found in large quantities at low production cost. Black pepper contains minerals like potassium, calcium, zinc, manganese, iron and magnesium (Cohen, 2009). Black pepper has potential metabolism, which leaves no residue in the animal organism, it is different from use of antibiotics, which have anti-apoptotic, anti-oxidative, and cell recovery activities, in conditions of compromised immune system suggesting therapeutic use (Cardoso *et al.*, 2009). Administration of piperine in the diet for broilers did not cause mortality or changes in the general

condition of the birds. With the administration of 1.12 mg piperine per kg body weight for 14 days show no toxic effect for broilers and stimulate the number of heterophile. There are histopathological changes in the tissues analyzed at higher doses, significant increase and specific number of leukocytes (Cardoso *et al.* (2009).

The bioactive molecule present in pepper has major pharmacological impact on the neurons and neuromuscular system; it helps in digestion (Great, 2003). Piperine has an impact on the nervous system; helping in the digestion and increasing absorption of selenium, vitamin B complex, beta carotene and curcumin and other nutrients (Moorthy *et al.*, 2009). With regard to the level of BP used, the piperazine citrate in the broiler diet can affect the flow of digestive juices across the stomach (Galib *et al.* 2011). Black pepper is also rich in glutathione peroxides and glucose-6-phosphate dehydrogenase and increases involvement of selenium, vitamin B complex, beta carotene and curcumin and other nutrients (Khalaf *et al.*, 2008). It has antioxidant properties and anti-carcinogenic effect, comparing to chili (Nalini *et al.*, 2006). The search is in process and plant materials known as photogenic have been suggested to be good alternatives (Ndelekwute *et al.*, 2015). Black pepper in broiler diet reduces abdominal fat percentage (Shahverdi *et al.*, 2013).

2. Materials And Methods

The present study was undertaken to examine the effect of dietary supplementation of black pepper on the growth pattern, feed intake, feed conversion ratio, mortality/liveability, carcass characteristics, blood parameters and economics of the broiler chickens following the standard management practices. The study was carried out in the Poultry Unit, Instructional Animal Farm of the Department of Livestock Production and Management, School of Agricultural Sciences and Rural Development, Nagaland University, Medziphema-campus, Nagaland. The farm is located at 93.20°E to 95.15°E longitude and latitude between 25.6° NS at an elevation of 310 meter above the sea level (MASL).

A total of 120-day old, commercial broiler chicks of hybrid Cobb-400 strain obtained from a single hatch were procured from M/S Royal Enterprise, Arouse Road, Dimapur, Nagaland. Each bird was weighed individually on arrival and randomly assigned to one of the dietary treatment groups. Each treatment had five replications consisting of six birds each on a Randomized Block Design. The dietary treatment included feeding of basal diet to control and the other treatment groups were fed with different levels of black pepper powder at the rate of 7.5, 10 and 12.5 g/kg feed. The broiler chicks were fed with standard broiler diet. The feeding was done in two phases, i.e. standard broiler starter ration (0-21 days) and finisher ration (22-42 days). The standard ration was procured from a reputed commercial feed manufacture, M/S Royal Enterprise, Arouse Road, Dimapur, Nagaland. Precise quantity of black pepper @ 7.5, 10 and 12.5 g/ kg feed was added and stored in separate bags as T₁ (Control), T₂, T₃ and T₄ as treatment groups. Treatment wise weighed amount of feed from the respective treatment groups was offered daily to the chicks, to ensure *ad libitum* feeding. Clean water was made available to the birds throughout the experiment period.

The birds were reared in deep litter system during the brooding stage and later, on the third week they were transferred to cages. Black pepper was procured from the local market in Dimapur, Nagaland. The black pepper was bought and was sun dried. Later on, it was grounded into powder using commercial blender. The powdered black pepper sample was stored in air tight container until needed for use. At the end of the feeding trail, three birds in each treatment were randomly selected from any three replicate groups for the blood collection. The blood was collected from the brachial vein of the birds by sterilizing and rubbing an area with disinfectant and cotton wool and then collecting about 2ml of blood with the use of sterile needles into well labelled sterilized tubes. Serum samples were used for measurement of various haematological parameters including HDL, LDL, Cholesterol and the sample to be used for measurement of WBC, RBC, Haemoglobin (Hb) were collected in a sterilized tube containing Heparin as anticoagulant. The result of experiment were subjected to statistical analysis in order to draw a valid interpretation and to see the effect of different treatments on various parameters using ANOVA in a Randomized Block Design as described by Snedecor and Cochran (1998).

3. Results and Discussion

Body weight

The growth performances of experimental birds were accessed by recording weekly body weight of birds. The average weight of broiler chicks (Table 1) on the day of arrival were 0.046, 0.046, 0.045 and 0.045 kg in T₁, T₂, T₃ and T₄ groups, respectively. The corresponding body weight at 6th week was 2.647, 2.521, 2.596 and 2.537 kg/bird. The overall mean body weight was 1.255, 1.205, 1.221 and 1.210 kg/bird/week in T₁, T₂, T₃ and T₄ groups, respectively. From the data, it was disclosed that the values of average body weight differed significantly ($P < 0.05$) up to 3rd week of experimental period and was

significantly ($P<0.05$) highest in T₁ group but did not differ significantly with T₃ and T₄ groups. The final body weight did not differ significantly between the control and treatment groups. The findings of the present study was well corroborated with the observations of Ndelekwute *et al.* (2015) who had also reported a non-significant difference in the final body weight of broiler chicks on diet supplemented with black pepper at 0.5, 0.25, 0.50 and 1 per cent of feed level. Whereas, some contrarily results have been reported by Al-Kassie *et al.* (2012); Ghaedi *et al.* (2013); Mohamed *et al.* (2014); Puvaca *et al.* (2015) and Tazi *et al.* (2014) who observed that the body weight was significantly higher on black pepper supplemented diet as compared to control group. The differences in the observation in the present study might be due to the levels and species of black pepper, birds and agro-climatic conditions of the study area.

Table 1: Production performance of broiler chicken with the supplemented Black Pepper on the different group of treatment.

Parameter	Treatments				
	Week	T1	T2	T3	T4
Body wt (Kg/Birds/wk)	onset	0.046	0.047	0.045	0.045
	6 th	2.647	2.521	2.596	2.537
Gain in body wt (g/birds/wk)	1 st	108.0c	104.0b	103.0a	109.0d
	6 th	592.0	543.0	599.0	587.0
Feed intake (Kg/Birds/wk)	Total	4.210	4.124	4.132	4.099
	Mean	0.702	0.688	0.689	0.683
FCR	1 st	1.097a	1.269b	1.151a	1.137a
	6 th	1.957	2.074	1.96	2.001
Liveability (%)	6 th	100	100	100	100
Performance Index	6 th	409.85	373.91	402.77	387.54
Dressing (%)	6 th With edible organs	76.9	77.7	77.7	79.3
	6 th Without edible organs	69.2	70.3	70.3	72.4
Carcass Wt. (g)	6 th	2.0	2.1	2.1	2.3
Heart (g)	6 th	15.6	15.0	16.0	15.0
Liver (g)	6 th	51.3	52.3	60.3	59.3
Gizzard (g)	6 th	47.6	50.3	47.6	48.3
Spleen(g)	6 th	2.6	4.0	2.6	3.0

a,b,c,d Means bearing different superscripts in a column differ significantly ($P<0.05$)

Body Weight Gain:

The average weekly gain in body weight and total gain in weight in different treatment groups was 2601, 2475, 2551 and 2492 g/bird/week for T₁, T₂, T₃ and T₄ respectively. The corresponding average gain in weight during the study was 433.5, 412.50, 425.17 and 415.33 g/bird/week. From the result it was concluded that the values of average gain in body weight differed significantly ($P<0.05$) up to third week of experimental period and was significantly ($P<0.05$) higher in T₁ group followed by T₄, T₃ and least in T₂ group. However, during the 5th week, body weight gain was numerically higher compared to the other weeks. The findings were well corroborated with the results of Ndelekwute *et al.* (2015) and Sindhu *et al.* (2017) who reported that gain in body weight did not differ significantly on diet supplemented with BP powder at 0.5 per cent of feed level. However, some counterstatements have been reported by Shahverdi *et al.* (2013); Ghaedi *et al.* (2013); Mohamed *et al.* (2014); Puvaca *et al.* (2015) and Tazi *et al.* (2014) who observed that the body weight gain was significantly higher on black pepper supplemented diet as compared to control group. The variations in the result might be due to the levels of use in the diet and species differences of broiler birds and agro-climatic conditions of the study area.

Feed intake

The average weekly feed intake and total feed intake of different experimental groups up to six weeks of age during the trial period are presented in Table 1. The total feed intake during the entire period of the experiment was 4.210, 4.124, 4.132 and 4.099 kg/bird for T₁, T₂, T₃ and T₄ respectively. The results of feed intake did not show significant difference and corroborating with the results of Ndelekwute *et al.* (2015) on the diet supplemented with black pepper at 1.0 and 0.5 per cent of feed level as compared to zero, 0.25 and 0.50 per cent of feed level. Contrary to these, Al-Kassie *et al.* (2011); Tazi *et al.* (2014) and Mohamed *et al.* (2014) have observed significantly better with feed intake in broiler birds supplemented with black pepper as compared to control group.

Feed Conversion Efficiency (FCE)

The average weekly feed conversion efficiency and cumulative feed conversion efficiency of the different experimental groups up to six weeks of age are depicted in Table 1. The cumulative feed conversion efficiency (total mean weight gain/mean feed intake) of broiler birds in different group at the end of 6th week was 1.511, 1.576, 1.508 and 1.531 for T₁, T₂, T₃ and T₄ respectively. The results showed that the values of feed conversion ratio differed significantly ($P < 0.05$) up to 4th week of experimental period. Although, during the 6th week feed conversion efficiency was numerically higher compared to other weeks. The results were in agreement with the findings of Shahverdi *et al.* (2013); Tazi *et al.* (2014); Ghaedi *et al.* (2013); Mohamed *et al.* (2014) and Rahimian *et al.* (2016) who observed that the feed conversion efficiency was significantly higher on black pepper supplemented diet as compared to control group. The variations in the result might be due to the levels of use in the diet and species differences of broiler birds and agro-climatic conditions of the study area.

Mortality/Liveability and Performance Index

The average mortality, liveability (%) and performance index (PI) from day old to six weeks of age are given below from the above table 1, it was observed that there was no mortality from day one till the end of the experiment. Similar findings were found by other workers Tazi *et al.*, (2014) and Chuparan *et al.*, (2016) who reported that there was no significant difference with the supplementation of black pepper in broiler diet as compared to control group. The values of performance index were recorded as 409.85, 373.91, 402.77 and 387.54 for T₁, T₂, T₃ and T₄ respectively. Numerically, the best performance index was found in T₁ followed by T₃, T₄ and the least in the group T₂, respectively. Variations in the result might be due to difference in the variety of black pepper, its level of use in the diet, species differences of the broiler birds and agro-climatic of experimental site.

Dressing percentage, Carcass yield and Organ weight

At the end of the 6th week, three birds from each treatment groups were taken for the study of carcass characteristics. The average carcass weight of broiler birds recorded was 2.0, 2.1, 2.1 and 2.3 kg/bird for T₁, T₂, T₃ and T₄ groups, respectively. The highest average weight of carcass was found in T₄ followed by T₂ and T₃, and the least in T₁ group. The average gizzard weight of broiler birds recorded was 47.6, 50.3, 47.6 and 48.3 g/bird for T₁, T₂, T₃ and T₄ groups, respectively. The highest value of gizzard was found in T₂ group followed by T₄, and the least in T₁ and T₃ groups, respectively. The average heart weight of broiler birds recorded was 15.6, 15.0, 16.0 and 15.0 for T₁, T₂, T₃, and T₄ groups, respectively. The weight of heart was highest in T₃, followed by T₁, and the least in T₂ and T₄ groups, respectively. The average liver weight of broiler birds recorded was 51.3, 52.3, 60.3 and 59.3 in T₁, T₂, T₃ and T₄ groups, respectively. The highest weight of liver was found in T₃ followed by T₄, T₂ and the least was found in T₁ groups, respectively. The average spleen weight of broiler birds recorded was 2.6, 4.0, 2.6 and 3.0 in T₁, T₂, T₃ and T₄ groups, respectively. The highest weight of spleen was found in T₂ followed by T₄, and the least was found in T₁ and T₃ groups, respectively.

From the results, it was observed that the values for dressing percentage were comparable in supplemented group with control group followed increasing trend with increased level of BP powder in the diet of broiler chicken, also the value was numerically highest at the higher level of BP powder supplementation. Similar findings were also reported by Al-Kassie *et al.* (2012) and Tazi *et al.*, (2014) who have observed higher dressing percentage on the diet supplemented with BP powder as compared to control group. The average weight of gizzard and liver showed increasing trend compared to heart and spleen with on BP powder supplementation. The results were in support with Tazi *et al.* (2014) and Moradi *et al.* (2016) who reported that the organ weight increased with the increase of diet supplemented with BP powder as compared to control group.

Haematological and Biochemical Parameters

The values of haemoglobin (Hb), WBC and RBC of broiler birds estimated at 6th weeks of age are given in Table 2. The average values of the haemoglobin concentration of the broiler birds on the 6th week of age was 37.59, 28.32, 26.65 and 26.56 g/dl in T₁, T₂, T₃ and T₄ groups, respectively. From the table above, it is disclosed that the values of Hb concentration was significantly ($P < 0.05$) higher in T₁ followed by T₂, T₃ and T₄ group. The values showed in decreasing trend with increase in the levels of black pepper. The average values of RBC concentration of broiler birds in different group at the end of the 6th week were 4.30, 4.20, 4.34 and 4.42 @ 10⁶/mm³ in T₁, T₂, T₃ and T₄ groups, respectively. The value of RBC was highest in T₄ group, followed by T₃, T₁, and the least in T₂ group, respectively. The average values of WBC concentration of broiler birds in different group by the end of the 6th week were 14.22, 13.62, 14.78 and 14.34 @ 10⁶/mm³ in T₁, T₂, T₃ and T₄ groups, respectively. The value of WBC was highest in T₃ group, followed by T₄, T₁, and the least in T₂ group, respectively. These observations are in agreement with the data published by some authors Al-Kassie *et al.*, 2011 and 2012; who observed

that Hb values are either decreased or followed decreasing trend with dietary supplementation of black pepper at different level as compared to control diet. These observations are correlated with the data published by some authors Al-Kassieet *et al.*, 2011 and 2012; who observed that RBC values are either in decreased or followed decreasing trend with dietary supplementation of black pepper at different level as compared to control diet. Variation in the observation might be due to differences in species of black pepper, its level, species of broiler birds, agro climatic conditions etc. These observations are correlated with the data published by some authors Al-Kassie *et al.*, 2011 and 2012; who observed that WBC values are either in decreased or followed decreasing trend with dietary supplementation of black pepper at different level as compared to control diet. Variation in the observation might be due to differences in species of black pepper, its level, species of broiler birds, agro climatic conditions etc.

Table 2. Haematological and Biochemical parameters of broiler birds in different treatment groups.

Treatments	Haematological and Biochemical constituents					
	Hb(g/dl)	RBC (10 ⁶ /mm ³)	WBC (10 ³ /mm ³)	HDL (mg/dl)	LDL (mg/dl)	Cholesterol (mg/dl)
T ₁	37.59 ^b	4.30	14.22	44.42 ^a	99.98	66.66
T ₂	28.32 ^a	4.20	13.62	50.07 ^a	84.78	72.44
T ₃	26.65 ^a	4.34	14.78	74.08 ^c	65.70	93.12
T ₄	26.56 ^a	4.42	14.34	57.66 ^b	34.11	80.53

^{a,b,c}, Means bearing different superscripts in a column differ significantly (P<0.05)

The mean values of HDL, LDL, and Cholesterol of broiler birds estimated at 6th weeks of age are given in Table 2. It perused that the values of the average HDL concentration of the broiler birds in different group by the end of the 6th week were 44.42, 50.07, 74.08 and 57.66mg/dl for T₁, T₂, T₃ and T₄ groups, respectively. The value of HDL was significantly (P<0.05) low in T₁ and T₂, compared to T₃ and T₄. It shared an increasing trend of HDL with increased level of BP supplementation. the average LDL concentration of the broiler birds in different group by the end of the 6th week were 99.8, 84.78, 65.70 and 34.11mg/dl for T₁, T₂, T₃ and T₄ groups, respectively. The value of LDL was highest in T₁, followed by T₂, T₃ and the lowest in T₄. The values of LDL followed decreasing trend with increasing levels of black pepper supplementation in diet of broiler birds. The values of the average cholesterol concentration of the broiler birds in different groups by the end of the 6th week were 66.66, 72.44, 93.12 and 80.53 mg/dl in T₁, T₂, T₃ and T₄ groups, respectively. The value of cholesterol was highest in T₃, followed by T₄, T₂ and the lowest in T₁. The values of cholesterol followed increasing trend with increased levels of black pepper in supplementation in diet of broiler birds. The result well corroborated with the findings of the other workers, Ghaedi *et al.*, 2013; Puvaca *et al.*, 2015; Moradi *et al.*, 2016; who observed that HDL values were either increased or followed increasing trend with dietary supplementation of black pepper at different level as compared to control diet. The result well corroborated with the findings of the other workers, Ghaedi *et al.*, 2013; Moradi *et al.*, 2016; who observed that LDL values were either in decreased or followed decreasing trend with dietary supplementation of black pepper at different level as compared to control diet.

Cost of rearing

The relative economics of broiler bird in different treatment groups is presented in Table 3. From the table we conclude that the average cost of production of broiler bird was 236.55, 264.54, 275.20 and 283.95 rupees per bird in T₁, T₂, T₃ and T₄ groups, respectively. The corresponding values for average cost of production per kg live weight of bird was 89.36, 104.93, 106.00 and 111.92 rupees.

Table 3: Relative economics (Rs/bird) of broiler birds in different treatment groups:

ITEMS	TREATMENT GROUPS			
	T ₁	T ₂	T ₃	T ₄
Cost of broiler	52.00	52.00	52.00	52.00
Cost of feed	142.8	140.21	140.49	139.37
Cost of black pepper	0.00	35.57	47.51	58.92
Cost of medicine	1.49	1.49	1.49	1.49
Cost of labour	13.44	13.44	13.44	13.44
Miscellaneous cost	29.59	29.59	29.59	29.59
Cost of production	239.32	272.30	284.52	294.81
Average weight of broiler bird (kg)	2.647	2.521	2.596	2.537
Cost of production per kg live weight (Rs)	90.41	108.01	109.59	116.20

Receipt through sale of broiler (@Rs 130 per kg live weight)	344.11	327.73	337.48	329.81
Total receipt	344.11	327.73	337.48	329.81
Net profit per bird	104.79	55.43	52.96	35.00
Net profit (Rs/kg live weight)	39.59	21.99	20.41	13.80
Benefit cost ratio	1.44	1.20	1.19	1.12

The net profit per bird was 104.79, 55.43, 52.96 and 35.00 rupees for T₁, T₂, T₃ and T₄ groups, respectively. And the corresponding values for net profit per kg live weight of bird were 39.59, 21.99, 20.41 and 13.80 rupees. The total cost of production per kg body weight was 90.41, 108.01, 109.59 and 116.20 in T₁, T₂, T₃ and T₄ groups, respectively. However, the cost of production per kg body weight of broiler was lowest in T₁ (Rs.90.41) followed by T₂, T₃ and the highest in T₄ group (Rs.116.20). From the results, it was found that the values of total cost of production or net profit (Rs/bird or Rs/kg live weight of bird) were comparable in all the treatment groups and they did not differ significantly. The values of net profit followed decreasing trend with increased level of black pepper supplementation in the diet of broiler birds. Similar findings had earlier been reported by some other workers Tazi, 2014 who have observed higher economical returns from the broiler bird reared on diet supplemented with black pepper at different levels as compared to control diet. Variation in the observation might be due to differences in species of black pepper, its level, species of broiler birds, agro climatic conditions etc.

4. Conclusion

From the result of the present study, it can be concluded that the performance of broiler birds in terms of body weight, body weight gain, feed intake, feed conversion efficiency, overall performance and net profit per bird did not show any significant result supplemented with black pepper powder. The blood constituents in terms of Hb, RBC, WBC, LDL, HDL and Cholesterol were also better and promising in T₁ group as compared to other groups. Further, the net profit per kg of live weight was also better in T₁ group. So, on the basis of above supplementation of black pepper powder @7.5, 10.0 and 12.5 g/kg was found to be not advisable on the performance of broiler birds.

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Conflict of interest

The authors of this manuscript declare that there is no conflict of interest.

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