PERFORMANCE OF VANARAJA BIRDS ON DIET SUPPLEMENTED WITH BLACK PEPPER (*Piper nigrum*) POWDER

ABSTRACT

To the investigation of Vanaraja birds on diet supplemented with Black pepper *(Piper nigrum)* powder" was carried out to study the productive performance, carcass traits, mortality, performance index, blood parameters and economics of vanaraja birds. A total of one hundred and fifty (150) day-old vanaraja chicks were randomly divided into five treatment groups of thirty birds each namely T_1 (control), T_2, T_3, T_4 and T_5 with 5 replications per treatment having 6 birds in each replicate following Randomized Block Design. Standard broiler diet (0-28) days and finisher ration (29-63 days) were provided to the birds. Black pepper powder was supplemented at the rate of 0, 0.25, 0.5, 0.75 and 1g/kg feed in T_1, T_2, T_3, T_4 and T_5 respectively. Body weight, weight gain and feed conversion efficiency was recorded on weekly basis while feed intake was noted on daily basis. 5 birds from each treatment were killed on the 63rd day in order to evaluate the carcass and 5 birds from each treatment were selected for collecting blood samples for haematological and biochemical blood analysis. Black pepper supplementation at 0.25 g/kg of basal diet resulted in significantly ($P<0.05$) higher body weight. Feed intake was significantly ($P<0.05$) higher in T_2 (black pepper @0.25 %). The dressing and Liver weight was better in T_2 group. The performance index was better in T_3 group. Also blood constituents of Cholesterol, HDL, LDL and triglycerides were found to be lower in T_2 groups. The net profit per kg live weight of vanaraja was highest in T_1 compared to treatment groups. Based on the above findings, dietary supplementation of black pepper powder at the rate of 0.25 g/kg feed can be recommended under the agro- climatic condition of Nagaland.

Keywords: Vanaraja bird, black pepper powder, Blood constituents, net profit.

INTRODUCTION

In India total poultry production is 851.81 million and it increases at the rate of 16.81% during (Livestock Census 2019). In India backyard poultry population is 317.07 million and commercial poultry population is 534.74 million. Overall, 45.78 % increase in backyard poultry and commercial poultry has increased 4.5% in India. Tamil Nadu had highest poultry population in India. The vanaraja bird, or officially (*Gallus gallus domesticus*), is an important poultry farming animal because of its distinctive genetic makeup and contributions to sustainable farming.

The vanaraja is a hybrid of native Indian breeds that have been carefully cultivated to perform better under different climates and to be more tolerant of regional farming methods. The origins of this breed can be traced to attempts made in the middle of the 20th century to improve native chicken breeds in India. The main goals of the breeding program were to improve features like overall adaptability to rural farming situations, disease resistance, egg production and meat quality.

Vanaraja birds are distinguished genetically by a varied lineage that combines features from native Indian breeds with contemporary breeding methods, leading to variations in plumage colour, body size, and egg laying capacity. Their adaptability to various management techniques and durability are facilitated by their genetic variety, which renders them appropriate for an extensive array of agricultural systems. The socioeconomic circumstances in rural communities are improved since they are affordable and require little upkeep, making them available to farmers with little resources.

Patel *et al.* (2018) explained that vanaraja is a dual purpose multi-coloured bird for poultry production. The colour and feather pattern of vanaraja closely matches that of jungle fowl, which is raised in backyards in communities and tribal habitations. Some spices and herbs including turmeric, hot red pepper, ashwagandha, cinnamon,oregano, garlic, rosemary, and ginger are the most well investigated phytobiotics in the diet of vanaraja. (Kostadinovic and levic, 2012), (Puvaca *et al.* 2013)

Black pepper (*Piper nigrum*) is also known as ‘king of spices ’and ‘black gold’ is native to India within the family piperaceae, genus piper and species nigrum. This woody perennial vine clings to trees, trellises, and other structures. Black pepper's main ingredient, piperin, is what gives it its pungent and stinging properties Three categories of chemicals can be found in black pepper (*Piper nigrum*).The components in the first group determine how sharp black pepper is the compounds in the second group determine how fragrant black pepper is; and the compounds in the third group include fiber, starch, polyphenols, mineral salts, and lipids, among other compounds. (Aleksandra *et al*., 2021).

Black pepper is medicinally used medicinally for a variety of conditions, such as antibacterial, antifungal, antiapoptotic, antidepressant, antidiarrheal, anti-inflammatory, antimutagenic, antioxidative, antipyretic, antispasmodic, antitumor, enhancing appetite and digestive function, treating dyspnea, colds, coughs, throat infections, treating intermittent fever, treating colic, treating dysentery and getting rid of worms and piles. (Ahmad *et al*., 2012), (Islam *et al*., 2015). Glutathione peroxidase and glucose-6-phosphate dehydrogenase have been demonstrated to be abundant in black pepper (Karthikeyan and Rani, 2003).

Piperine- the active ingredient of black pepper to increases absorption of Serum, Vitamin B, beta carotene and other nutrients, favourably stimulating the digestive enzymes of pancreas, enhance the digestive capacity and significantly reduces the gastrointestinal food transit time (Srinivasan, 2007). Black pepper is also for culinary as well as medicinal purpose around the world. It increases digestion through digestive enzymes of stomach and eradication of infectious bacteria (Hosseini, 2011). Toghyani *et al.* (2010) explained that piperine had bio molecular

functions similar to various compounds, including vitamin K, to reduce the use of phytogenic substances presenting active bio molecular compounds with similar functions to synthetic compounds. They have the potential to boost poultry production by assisting in the control of certain metabolic processes.

According to Moorthy *et al*. (2009), piperine affects the neurological system, aiding in digestion and boosting the body's absorption of minerals including beta carotene, vitamin complex, and selenium. Feed additives serves as catalysts in digestion and metabolism of nutrients. It also improves digestibility (Acker, 1983). Piperine have antiache effect (Mahady *et al*., 2008).The bioactive compound in pepper aids in digestion and has a significant pharmacological effect on neurons and the neuromuscular system (Great, 2003). Being a natural commodity, black pepper may be produced at a minimal cost and in big numbers.

2. MATERIALS AND METHODS

2.1. Location of the study

The research was conducted at Nagaland University's Instructional Livestock Farm, Department of Livestock Production and Management, School of Agricultural Sciences, Medziphema Campus, Nagaland. The farm's coordinates are 93.20º E to 95.15º longitude, 25.6º N latitude, and height of 310 meters above sea level (MSL).

2.2. Materials

A total of 150 commercial vanaraja chicks from a single hatch were obtained from the ICAR Medziphema, Nagaland. When the birds arrived, they were individually weighed and randomly assigned to one of the dietary treatment groups with 30 birds in each group. The dietary treatments comprised feeding a basal diet as a control, while the other treatment groups were fed varied quantities of black pepper powder at rates of 0.25, 0.5, 0.75, and 1g per kg of feed. Vanaraja chicks were fed a normal diet. The feeding was divided into two phases: normal starter ration (0-28 days) and finisher ration (29-63 days). The standard ration was obtained from a reputed commercial feed manufacturer in Dimapur, Nagaland. A precise amount of black pepper at 0.25, 0.5, 0.75, and1g/kg feed was added and held in separate bags as T1 (Control) and T2, T3, T4, and T5 as treatment groups, respectively. To guarantee *ad libitum* feeding, the chicks received a weighed amount of feed from each treatment group on a daily basis. The birds were provided with fresh and clean water throughout the trial. The birds were nurtured in a deep litter system during the brooding period, and subsequently, on the fifth week, they were transferred to cages. Black pepper powder was obtained from the Dimapur new market in Nagaland. The purchased black pepper was pounded into powder using an industrial blender and then kept in airtight containers until required.

2.3.Treatment and Feeding

Completely Randomized Block Design (CRD) was followed in the execution of the experiment. A total of 150 chicks were randomly assigned to five (5) distinct groups (referred to as T1, T2, T3, T4, and T5) with each group consisting of thirty (30) chicks that each had five replicates of six (6) birds. The chicks were raised in deep litter systems until they were 28 days old, after which they spent 35 days in cages in the finisher house. Standard starter was fed to the chicks from 1-4 weeks of age, while finisher was provided from 5-9 weeks of age. The basal diet was given to Group 1 (T1), which was the control group. The chicks in the other five treatment groups were also provided with the same basal diet as in T1 but supplemented with different levels of black pepper powder. The details of distribution of chicks and their treatment are summarized below.

Table 1. Details of the distribution of chicks and their treatment.

Group	Total no. of birds	Quantity of black pepper to basal diet
T1 (control)	30	Basal diet
T2	30	Basal diet + 0.25g black pepper /kg feed
T3	30	Basal diet + 0.5g black pepper /kg feed
T4	30	Basal diet + 0.75g black pepper /kg feed
T5	30	Basal diet + 1g black pepper /kg feed

The body weights of chicks were taken on the first day of arrival. Thereafter, on a weekly basis, the average body weight was taken in the morning prior to feeding and watering. A digital weighing balance having a maximum capacity of 10 kg was used for the entire experiment for weighing the birds. During the first four weeks, the average weight of the chicks was recorded in groups. This was done by placing 5-10 chicks each in a pre-weighed carton box. From 5^{th} weeks onwards, the birds were weighed individually at weekly intervals till they attained nine weeks of age i.e. 63 days of age. This information was used to determine the average daily and weekly feed intake, reported in grams, for each bird in each group. The formula below was utilized to calculate the feed conversion efficiency (FCE) of the various experimental. At the end of the feeding trial, two birds were randomly selected from each treatment for the blood collection. The blood was collected from the wing vein of the birds by sterilizing and rubbing an area with disinfectant and cotton wool and then collecting about 2 ml of blood with the use of sterile needles into well labelled heparinised sterilized tubes. Sample were used for measurement of various blood parameters including HDL, LDL, Cholesterol, triglyceride and the sample to be used for measurement of WBC, RBC, Haemoglobin (Hb) and PCV were collected in a sterilized tube containing Heparin as anticoagulant. Mortality was recorded daily during the period of investigation and was expressed in percentage. Mortality was calculated by using the following formula. Liveability percentage was calculated by subtracting the mortality percentage from 100. Performance index (PI) was calculated by adopting the formula of Bird (1955). Following the trial, three birds were chosen at random for carcass evaluation studies from each group. Prior to slaughter, the live weight

of each individual bird was noted. Using the Standard Method, slaughtering was carried out. After the bird was completely bled and its feathers removed, its dressed weight was determined. The average weight of the heart, liver, spleen, and (empty) gizzard was noted for each of the five groups. These organs were also weighed separately. The following calculation was used to get the percentage of dressed weight.

3. RESULT AND DISCUSSION

3.1. Body Weight

The average body weights of day old chicks for T_1, T_2, T_3, T_4 and T_5 groups were 31.66, 31.40, 30.40, 32.20 and 32.20 g per bird, respectively. The corresponding body weight for the various treatments groups was 1695.20, 1738.20, 1719.60, 1717.60 and 1714.20 g per bird at the end of ninth week. The overall mean of the body weight were 800.54, 830.43, 816.63, 822.80 and 822.54 g/bird/week for T_1, T_2, T_3, $T_4$and T_5groups, respectively. From the statistical analysis, it had revealed that supplementation of black pepper had significant effect on the final body weight. The treatment group T_2 had significantly ($P<0.05$) higher body weight followed by T_3, T_4, T_5 the least in the control group. However, the difference among T_3, T_4 and T_5 was found to be non-significant. The result of the present study were well corroborated with the findings of Al-Kassie *et al*. (2011), Tazi *et al*. (2014) and Aikpitanyi *et al.* (2019) who had also reported significantly higher body weight due to supplementation of black pepper as compared to control group. Higher body weight in the black pepper supplemented group might be due to the presence of piperine, the active ingredient of black pepper which caused increased absorption of Serum, Vitamin B, betacarotene and other nutrients, favourably stimulating the digestive enzymes of pancreas, enhance the digestive capacity and significantly reduces the gastrointestinal food transit time (Srinivasan 2007). In addition, it may be due to increased enzymes of stomach and eradication of infectious bacteria (Hosseini, 2011).

3.2. Gain in Body Weight

From the table 2. it was observed that average weight gain during first week for vanaraja birds was 49.97, 48.95, 53.88, 53.97 and 48.10g per bird for T_1, T_2, T_3, $T_4$and T_5groups respectively. The corresponding weight gain of the birds on the 9th week of age was 255.80, 247.20, 253.20, 251.20 and 243.80 g/bird. From the perusal of data, the values for gain in weight was significantly higher ($p<0.05$) in T_1 group followed by T_3, T_4, T_2 and T_5 group who had the lowest weight gain values. However, there was non-significant difference between $T_4$and T_5 groups. The results were in close agreement with the findings of Ndelekwute *et al*. (2015), Sindhu *et al*. (2018) and Dozo *et al.* (2023) who had also reported non-significant effect of black pepper on body weight gain. On the other hand, the findings of the present study were contradicting to the observations of Abou-Elkhair *et al*. (2014), Tazi *et al*. (2014) and Aikpitanyi *et al.* (2019) who observed increased weight gain when supplemented with black pepper.

3.3.Feed Intake

From the data given in Table 2, it was perused that the total feed intake during the experiment was 4075.40, 4192.93, 4125.21, 4132.00 and 4139.80g/bird for T_1, T_2, T_3, T_4 and T_5groups respectively. The corresponding mean feed intake was recorded as 452.82, 465.88, 458.36, 459.11 and 459.98 g/bird/week, respectively. From the perusal of data, it was observed that the average value of feed intake was significantly ($P<0.05$) highest in T_2 followed by T_5, T_4, T_3 and lowest in T_1 group. However, the difference amongst T_1, T_3 and T_4 was found to be non- significant. The present findings were well corroborated with the reports Al-Kassie *et al*. (2011) and Tazi *et al*. (2014) who had observed increased feed intake as a result of black pepper supplementation. Contrary to the present findings, Ndelekwute *et al*. (2015) and Dozo et al. (2023) had reported that supplementation of black pepper did not show any significant effect on feed intake. It may be due to increased regulation of various metabolic function which might have increased intake and productivity of the animal Toghyani *et al.* (2010).

3.4. Feed Conversion Efficiency

From the table 2, it was observed that the average value of feed conversion efficiency of vanaraja birds during first week was 0.80, 0.77, 0.88, 0.88 and 0.83.At the end of ninth week, the values were recorded as 0.33, 0.31, 0.32, 0.31 and 0.30 for T_1, T_2, T_3, T_4 and T_5 groups, respectively. The overall mean feed conversion efficiency of vanaraja birds was 0.48, 0.48, 0.48, 0.49 and 0.49 for T_1, T_2, T_3, T_4 and T_5 groups, respectively. From the perusal of data, it was observed that there was no significant difference amongst T_2, T_3, T_4 and T_5 groups. The present findings were well corroborated with the reports of Ndelekwute *et al*. (2015) who also observed that inclusion of black pepper did not show any significant effect on feed conversion efficiency. Contrary to the present findings, Al-Kassie *et al*. (2011) and Shahverdi *et al*. (2013) observed that feed conversion efficiency was better in group fed with black pepper as compared to control group.

3.5. Mortality and Morbidity

The mortality, liveability percentage and performance index (PI) from day old to nine weeks old age for the different treatment groups are shown in table 2. The mortality percentage at 9^{th} week for T_1, T_2, T_3, T_4 and T_5 are 6.66, 6.66, 3.33, 0.00 and 3.33 percent, respectively. The values of mortality were within standard limit. It was however the mortality was not due to Black pepper feed supplementation but due to external forces. And as a result, Liveability percentages were recorded to be 93.34, 93.34, 96.67, 100.00 and 96.67, respectively. Highest performance of vanaraja birds was observed in T_3 followed by T_4, T_1, T_5, and lowest in T_2 group. Rahimian *et al*. (2016) had reported similar findings that the supplementation of black pepper powder had good effects on the performance of chickens compared to the control group. However, variation in the observation might be due to

differences in species of birds, level of black pepper powder, inclusion and agro-climatic condition.

3.6. Carcass yield, dressing percentage and organ weight

The mean weight of carcass weight of vanaraja birds in different experimental groups was 1057.80, 1125.00, 1073.00, 1135.40 and 1142.60g/bird for T_1, T_2, T_3, T_4 and T_5 respectively. The highest carcass weight was in T_5 followed by T_4, T_2, T_3 and T_1 group. However from the Statistical analysis, the carcass weight was significantly ($P<0.05$) higher in T_5 and lowest in T_1. The average dressing percentage at the end of 9^{th} week of different treatment groups T_1, T_2, T_3, T_4 and T_5 were recorded as 67.51, 72.17, 71.11, 66.41 and 69.30 percent respectively. The dressing percentage was found higher in T_2 followed by T_3, T_5, T_1 and T_4 groups. From the statistical analysis, the dressing percentage was significantly ($P<0.05$) higher in T_2 (72.17%) but there was non-significant difference between T_4 and T_5. The average liver weight was 37.60, 43.40, 43.40, 41.20 and 40.80 for T_1, T_2, T_3, T_4 andT_5 groups respectively. Highest liver weight was recorded in T_2 followed by T_3, T_4, T_5 and lowest in T_1 group. The average weight of spleen for T_1, T_2, T_3, T_4 and T_5 groups was 2.08, 2.14, 2.16, 3.00, 2.78g, respectively. The spleen weight was higher in T_4, T_5, T_3 T_2 and T_1 respectively. Statistical analysis revealed that T_4 was significantly ($P<0.05$) higher than T_1. In T_1, T_2, T_3, T_4 and T_5 groups, respectively, the average gizzard weight was 26.00,30.60, 31.00,30.80 and 27.80 g. Higher gizzard weight was observed in T_3 group followed by T_4, T_2,T_5 and T_1 respectively. Statistical analysis revealed that the gizzard weight was significantly ($P<0.05$) higher in T_3 and lowest in T_1 but there was non-significant difference between T_2, T_3 and T_4. The average heart weight for T_1, T_2, T_3, T_4 and T_5 groups was 8.40, 8.60, 9.60, 10.60 and 9.80g. Highest heart weight was found in T_4 and subsequently T_5, T_3, T_2 and least inT_1 group. Statistical analysis revealed that the heart weight was significantly ($p<0.05$) higher in T_4 but there was non-significant difference between T_1, T_2, T_3 and T_4. The present findings were well collaborated with the reports of Mansoub (2011), Tazi *et al*. (2014),Singh (2014), Rahimian *et al.*(2016) and Puvaca *et al.* (2019) were similar, where observations of carcass yield, dressing percentage and organ weights increased after black pepper was supplemented into the feed.

3.7. Haematological and Biological parameter

i. Total leucocytes count

From the table 3, it was revealed that the values of the average TLC concentration of Vanaraja birds at 9^{th} week in T_1, T_2, T_3, T_4 and T_5 groups were 222.51, 225.90, 233.30, 231.05 and 225.62 cumm, respectively. The values of TLC was significantly ($P<0.05$) higher in T_3 and the least in control group

ii: Haemoglobin

The average values of Haemoglobin (Hb) on the 9th week of age were 14.40, 15.05, 15.85, 15.30 and 13.85 g/dl for T_1, T_2, T_3, T_4 and T_5 groups, respectively. The value of haemoglobin in T_3 group was significantly ($p<0.05$) higher than the other groups. However, the haemoglobin levels did not show significant differences among the treated groups and control group. This finding was similar to Al-Kassie *et al*. (2011) who also observed no significant increase in Hb level in treated group as compared to control group. On the contrary, Ndelekwute *et al.* (2017) found significant increase in haemoglobin concentration when supplemented with black pepper powder.

iii. Red blood cell

The average values for Red Blood Cell (RBC) obtained were 2.64, 2.53, 2.63, 2.35 and 2.29 10^6/ul for T_1, T_2, T_3,T_4 and T_5 groups, respectively. The value of RBC was numerically higher in T_1 group followed by T_3, T_2, T_4 and lowest in T_5 group. However, the values obtained showed that there was no significant difference amongst the groups. The findings were similar to Al-Kassie *et al*. (2011) who also observed no significant increase in RBC level in treated group as compared to control group. The results of present study were in contrary to findings of Ndelekwute *et al.* (2017) who reported increased RBC count on diet supplemented with black pepper powder.

iv. Packed Cell Volume

The values of the average HCT (PCV) values of vanaraja birds 30.45, 29.40,31.22, 29.15 and 29.65 for T_1, T_2, T_3, T_4 and T_5 respectively. The value of HCT was numerically higher in T_3 followed by T_1, T_5, T_2 and the lowest in T_4. However, the values obtained showed no significant difference amongst the group. Al-Kassie *et al*. (2011) who also observed no significant increase in PVC level in treated group as compared to control group. In Contrary, the findings observed in the present study Ndelekwute *et al*. (2017) reported that there was increase in PCV value of the treated group.

v. Total Cholesterol

The average values of Total Cholesterol in T_1, T_2, T_3, T_4 and T_5 groups were 183.30, 163.46, 173.49, 172.79 and 181.03 mg/dl, respectively. The value of Total Cholesterol was significantly ($P<0.05$) higher in T_1 followed by T_5, T_3, T_4 and the least in T_2 groups. Similar finding was also observed by Al-Kassie *et al*. (2011), Rahimian *et al*. (2016)) and Mansoub. (2011) who reported that supplementation of black pepper decreased cholesterol level than control group.

vi. High Density Lipoprotein (HDL)

The average values of HDL Cholesterol of vanaraja birds in different treatment groups were 38.64, 32.88, 33.29, 33.99 and 36.94 mg/dl for T_1, T_2, T_3, T_4 and T_5 groups, respectively.

The value of HDL was significantly ($P<0.05$) highest in T_1 followed by T_5, T_4, T_3 and the lowest in T_2 group. However, the values obtained showed no significant distinction between T_2, T_3, T_4 and T_5 groups. The present study's conclusion was strongly supported by the observations of Al-Kassie *et al*. (2011) who also reported decreased level of HDL than control group with diet supplemented with black pepper.

vii. Low Density Lipoprotein (LDL)

The average values of LDL Cholesterol 125.56, 110.15, 105.29, 114.72 and 120.36 mg/dl for T_1, T_2, T_3, T_4 and T_5 groups, respectively. The value of LDL was significantly ($P<0.05$) higher in T_1 followed by T_5, T_4, T_2 and the lowest in T_3 groups. The findings of the present study were strongly supported with the observations of Rahimian *et al*. (2016) who also reported decreased level of LDL than control group with diet supplemented with black pepper.

viii. Triglyceride

It was observed that the average values of triglycerides in T_1, T_2, T_3 and T_4 groups were 124.81, 118.79, 121.88, 122.41 and 123.22 mg/dl, respectively. The value of triglyceride was significantly ($P<0.05$) higher in T_1 followed by T_5, T_4, T_3 and the lowest in T_2 group. The finding of the present study was well corroborated with the observations of Rahimian *et al.* (2016) who also reported that the triglyceride value decreased with feed containing supplement with black pepper.

4.8 Cost of production

The average production cost of vanaraja birds in different treatment groups. The average cost of production per bird was 280.82, 301.82, 313.68, 328.78 and 344.15 rupees/bird for groups of T_1, T_2, T_3, T_4 and T_5 respectively. The comparable figures for the average production cost per kg of live bird were 166.16, 174.46, 183.43, 183.67 and 201.25 rupees. The net profit per bird was 145.01, 134.76, 116.15, 118.15 and 86.43 rupees for groups of T_1, T_2, T_3, T_4 and T_5 respectively and the corresponding values for net profit per kg live weight was 101.40, 90.44, 80.10, 80.92 and 58.79 rupees. The benefit cost ratio was calculated as 1.51, 1.44, 1.37, 1.31 and 1.25 for T_1, T_2, T_3, T_4 and T_5 respectively. The Cost of production was maximum in T_5 (Rs.344.15) and the least in T_1 (Rs.280.82). The total cost of production per kg live weight of bird was recorded to be highest in T_4 (Rs.201.25) and lowest in T_1 (Rs.166.16). The net profit per bird and net profit per live kg was observed to be higher in T_1 (Rs.145.01 and Rs.101.40, respectively) and lower in T_5 (Rs.86.43 and Rs.58.79, respectively). The Benefit Cost Ratio was highest in T_1 followed T_2, T_3, T_4 and the lowest in T_5 group. From the results obtained in the present study, it may be concluded that the birds in control group had better economical return as compared to the birds supplemented with black pepper. Contrary to present findings, Tazi *et al*. (2014) and Dozo *et al*. (2023) found that the

birds supplemented with black pepper powder were found to be economical. The variation in the results might be due to differences in the species/ strains and agro-climatic condition.

Conclusion

The treatment group T_2 had significantly ($P<0.05$) higher body weight followed by T_3, T_4, T_5 the least in the control group and body weight gain in T_1 group. It was observed that the average value of feed intake was significantly ($P<0.05$) highest in T_2 followed by T_5, T_4, T_3 and lowest in T_1 group. However, the feed conversion was comparable irrespective of treatments. The performance index was better in T_3 group. The carcass weight was comparable by supplementation of black pepper while the higher dressing percentage and liver weight was found in T_2 group. The values of haematological blood parameters were highest in T_3 for TLC, Haemoglobin and HCT (PVC) However, the values for RBC was highest in T_1. The values of blood constituents were highest in T_1 for Cholesterol, HDL and triglycerides. However. These values were lowest in T_2 group. As for LDL it was found higher in T_3 and lowest in T_2. From the present experiment on the basis of above observations, it may be concluded that the performance of vanaraja birds in terms of body weight, feed intake, Dressing percentage, liver weight and biochemical constituents of blood were better in T_2 groups as compared to other treatments. Hence, on the basis of above findings, dietary supplementation of Black pepper (*Piper nigrum*) powder at the rate of 0.25 g/kg of basal can be advocated for better performance of vanaraja birds.

REFERENCES

Abou- Elkhair, R., Ahmed, H.A. and Selim, S. 2014. Effect of Black Pepper (*Piper nigrum)* Turmeric Powder (*Curcuma longa*) and Coriander Seeds (*Coriandrum sativum*) and Their Combinations as Feed Additives on Growth Performance, Carcass Traits, Some Blood Parameters and Humoral Immune Response of Broiler Chickens, *Asian-Australasians Journalof Animal Sciences*. **27**(6):847-854.

Acker, D.T. 1983. Englewood Cliffs. Prentice Hall Inc. *Animal Science and Industry*. 252.

Ahmad, N., Fazal H., Abbasi, B.H. and Seal, H. 2012. Chemical Investigation of Bioactive Compounds of Black Pepper. *International Journal of Pharmacognosy Sciences and Research.***6** (4): 1721-1726.

Aikpitanyi, K.U., Igwe, R.O. and Egweh, N.O. 2019. Assessment of Ginger and Black Pepper as Feed Additives on Growth Performance and Carcass Traits of Broiler Chickens. *International Journal of Veterinary Science and Animal Husbandry*. **5**(1): 033-038.

Aleksandra, N., Milenkovic,Lijiljana, P. and Stanojevic. 2021. Black pepper- Chemical Compositions and Biological Activities. *Advanced technologies*. **10**(2): 40-50

Al- Kassie, G.A.M., Mamdooh, A.M., Al-Nasrawi and Ajeena, S. J. 2011. Use of black pepper as feed additive in broilers diet. *Research Opinions in Animal and Veterinary Sciences*. **2221**: 1896.

Department of Animal Husbandry & Dairying (DAHD). 2019. 20th Livestock census. Ministry of Fisheries, Animal Husbandry & Dairying, Government of India.

Dozo, V., Savino, N., Vidyarthi, V. K., Zuyie, R., Nizamuddin, Rutsa, M. C. and Singh, R. 2023. Performance of Broiler Chicken on Diet Supplemented with Black Pepper *(Piper nigrum)* Powder on Haematological Parameters and Biochemical Parameters. *Journal of Advanced zoology*. **44**(4): 1040:1046

Great, H.H. 2003. Plants and plants extracts for improving animal productivity. *Proceeding of Nutrition Society*. **62**: 279:290.

Hosseini, N.M. 2011. Comparison of using different levels of black pepper with probiotic on performance and serum composition on broiler chickens. *Journal of Basic Application Science Research.***1** (11): 2425-2428.

Livestock Census, 2019. 20th Livestock Census, Ministry of fisheries, Animal Husbandry and Dairying. Dept of A.H and Dairy.

Mahady, G.B.,Pendi, S.L., Yun, G.S. and Lu, Z.Z. 2008. A ginger and the gingerols inhibit the growth of Cag A+strains of Helicobacter pylori. *Anticancer Research*. **23**: 3699-3702.

Moorthy, M., Ravikumar, S., Viswanathan, K. and Edwin, S.C. 2009. Ginger, pepper and curry leaf powder as feed additive in broiler diet. *International Journal of Poultry Science*. **8**: 779-782.

Ndelekwute, E.K., Afolabi, K., Uzegbu, H. and Unah, U.L. 2015. Effect of dietary Black pepper (*Piper nigrum*) on the performance of broiler. Bangladesh *Journal of Animal Science*. **44** (442): 120-127.

Ndelekwute, E.K., Enynihi, G.,Assam, E., Ufot, U. and Otu, O. 2015. Lime (*Citrus aurantifolia)* juice as a source of natural acids can improve the growth of broiler chickens. *British Society of Animal Science*. **6**(2): 80-98.

Puvaca, N., Stanacev, V., Glanocic, D., Levi, J., Peric, L. and Milic,D. 2013. Beneficial effects of phytoadditives in broiler nutrition. *Worlds Poultry Science Journal*, 69,27-34.

Puvaca, N., Pelic D.L., Cabarkapa, I., Popovic, S., Tomi, Z.and Nikolova, N. 2019. Quality of broiler chicken carcass fed dietary addition of garlic, black pepper and hot red pepper. *Journal of Agronomy Technology and Engineering Management*. **2**(1):218–27.

Rahimian, Y., Faghani, M., Davoodi, S.M., Rafiee, A., Davoodpoor, A. and Nezhad, M.H.G. 2016. Potential use of protexin probiotic and black pepper on Cobb 500 broiler chicks. *Azarian Journal of Agriculture*. **3**(6): 129-134.

Shahverdi, A., Kheiri, F., Faghani, M., Rahimian. and Rafiee, A.Y. 2013. The effect of use pepper (*Capsicum annuum L.*) and black pepper (*Piper nigrum L.*) on performance and haematological parameters of broiler chicks. *European Journal of Zoological Research.***2** (6):44-48.

Sidhu, N.S., Baloda, S., Dahiya, R., Promila and Singh, U. 2018. Effect of Supplementation of black pepper, Jaggery with or without Feed Restriction on Nutrient Digestibility and Carcass trait of broilers. *International Journal of Pure and Applied Bioscience*. **6** (3)**:** 302-312.

Singh, J. 2014. 'Herbal feed additives as alternatives to antibiotic growth promoters in broilers.' Ph.D. Dissertation, GADVASU, Ludhiana, India.

Snedecor G.W. and Cochran W.G.1994. Statistical Methods. 8th edition. Oxford and IBH Publication Company New Delhi, India.

Srinivasan, K. 2007. Black pepper and its pungent principle-Piperine: A review of diverse physiological effects. *Critical Reviews in Food Science and Nutrition* **47**: 735–748.

Tazi, S.M.A.E. 2014. Response of broiler chickens to diets containing different mixture powder levels of red pepper and black pepper as natural feed additive. *Animal and Veterinary Sciences*. **2**(3):81-86.

Tazi, S.M.A.E., Mukhtar, M.A., Mohamed, K.A. and Tabidi, M.H. 2014. Effect of using black pepper as natural feed additive on performance and carcass quality of broiler chicks. *International Journal of Pharmaceutical Research and Analysis*. **4**(2): 108-113.

Toghyani, M., Gheisari, A., Ghalamkhari, G. and Mohammadrezaei, M. 2010. Growth performance, serum biochemistry and blood haematology of broiler chicks fed different

levels of black seed (*Nigella sativa*) and peppermint (*Mentha piperita*). *Livestock Science*, **129** (1):173-178.

Velguth, K., Payton, M.E. and Hoover, J. P, 2010. Relationship of Haemoglobin Concentration to Packed Cell Volume in Avian Blood Samples. *Journal of Avian Medicine and Surgery*. **24** (2):115-121.

Weiland, H. and Seidel, D. 1983. A simple method for precipitation of low densitylipoproteins. *Journal of Lipid research*. **24**: 904-909.

Zuyie, R., Sharma, V.B., Bujarbaruah, K.M. and Vidyarthi, V.K. 2011.Production Performance of Vanaraja Birds in Nagaland. *The Indian veterinary journal.* **88**(8):138-139.

Table: 2. Production performance of broiler chicken with the supplemented black pepper on the different treatments groups of Vanaraja Birds.

Parameter	Treatments					
	Week	T_1	T_2	T_3	T_4	T_5
Body weight (gram/bird/week)	Onset	31.66	31.40	30.40	32.20	32.20
	9th	1695.2[a]	1738.2[c]	1719.6[b]	1717.6[b]	1714.2[b]
	Total	7204.88	7473.9	7349.7	7405.2	7402.89
	Overall mean	800.54	830.43	816.63	822.80	822.54
Body Weight Gain	Onset	49.97	48.95	53.88	53.97	48.10
	9th	255.8[b]	247.2[ab]	253.2[b]	251.2[a]	243.8[a]
	Total	1649.92	1704.79	1630.86	1685.2	1673.56
	Overall mean	183.32	189.42	181.20	187.25	185.95
Feed Intake	Onset	62.20	63.40	60.60	61.20	58.13
	9th	785.2[a]	815.2[b]	798.2[a]	801.2[a]	807.6[ab]
	Total	4075.40	4192.93	4125.21	4132.0	4139.8
	Overall mean	452.82	465.88	458.36	459.11	459.98
Feed Conversion Efficiency	Onset	0.80	0.77	0.88	0.88	0.83
	9th	0.33[b]	0.31[a]	0.32[a]	0.31[a]	0.3[a]
	Total	4.38	4.40	4.33	4.42	4.42
	Overall mean	0.48	0.48	0.48	0.49	0.49
Mortality	1st -9th	6.66	6.66	3.33	0.00	3.33
Liveability (%)	9th	93.34	93.34	96.67	100.00	96.67
Performance index	9th	471.7	451.94	479.76	472.02	465.36
Dressing (%)	9th	67.5[ab]	72.17[b]	71.11[b]	66.41[a]	69.30[a]

Carcass weight (gram)	9th	1057.8a	1125.0ab	1073.0ab	1135.4b	1142.6c
Heart (gram)	9th	8.4a	8.6a	9.60a	10.6b	9.8a
Liver (gram)	9th	37.6a	43.4b	43.4b	41.2ab	40.8ab
Gizzard (gram)	9th	26.0a	30.6b	31.0b	30.8b	27.8ab
Spleen (gram)	9th	2.08a	2.14ab	2.16ab	3.00c	2.78b

a, b and c Mean bearing different superscripts in a column differ significant (P<0.05).

Table.3. Average blood biochemical constituents of vanaraja birds in different treatment groups.

Treatments	Biochemical Characteristics			
	Total Cholesterol (mg/dl)	HDL Cholesterol (mg/dl)	LDL Cholesterol (mg/dl)	Triglycerides (mg/dl)
(T_1)	183.30b	38.64b	125.56c	124.81b
(T_2)	163.46a	32.88a	110.15ab	118.79a
(T_3)	173.49ab	33.29a	105.29a	121.88ab
(T_4)	172.79b	33.99a	114.72ab	122.41ab
(T_5)	181.03b	36.94a	120.36b	123.22b
***SEm*±**	**3.53**	**1.41**	**2.65**	**0.97**
CD (p=0.05)	**13.88**	**5.55**	**10.41**	**3.82**

a,b,c means bearing different superscript in the column differ significantly (P<0.05)

Table.4. Average haematological characteristics of Vanaraja birds in different treatment groups.

Treatments	Haematological Characteristics			
	Total Leucocytes Count (TLC) (Cumm)	Haemoglobin (gm/dl)	Red Blood Cells (RBC)(10^6/ul)	HCT (PVC) (%)
(T_1)	222.51a	14.40a	2.64a	30.45a
(T_2)	225.90ab	15.05a	2.53a	29.40a

(T_3)	233.30[c]	15.85[a]	2.63[a]	31.22[a]
(T_4)	231.05[b]	15.30[a]	2.35[a]	29.15[a]
(T_5)	225.62[a]	13.85[a]	2.29[a]	29.65[a]
***SEm*±**	1.32	0.73	0.16	0.86
CD (p=0.05)	5.19	NS	NS	NS

a,b,c means bearing different superscript in the column differ significantly (P<0.05).