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Performance of Broilers during Winter Season on Diet Supplemented with Black Cumin Seed Powder

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ABSTRACT

A total of 120 Cobb-400 strains of broiler chicks were distributed into four treatments having five replications of six birds each. The birds in control group (Group 1) were offered standard broiler starter and finisher diets from 0–21 and 22–42 days of experiment, respectively. The birds of other three groups were also provided the same diets as in Group 1 along with black cumin seed powder @ 1.0% (Group 2), 2.0% (Group 3) and 3.0% (Group 4), respectively. Average values of body weight, gain in weight, feed intake and feed conversion efficiency did not differ significantly irrespective of the treatments. There was no mortality. Liveability was 100 % in all the groups. The values for performance index, haemoglobin, white blood cells, low density lipoprotein, high density lipoprotein and cholesterol was higher in group 3 than other groups. Dressing %, carcass weight and organs yield were higher in treated groups; red blood cells were unaffected; packed cell volume was higher in group 1; monocytes and basophils were nil. The values for heterophils and eosinophils were significant; however, lymphocytes count was unaffected. The value for net profit per kg weight gain of the broiler was highest in group 1. It can be concluded that dietary supplementation of 2.0% black cumin seed powder had shown better body weight, body weight gain, feed efficiency, performance index as well as haematological and biological constituents of the blood than control. So, supplementation of 2% black cumin powder in diet can be advocated.

KEYWORDS: Growth, performance index, haemoglobin, RBC, HDL, LDL, cholesterol, economics

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1. INTRODUCTION

The poultry industry in India has made a remarkable growth and is presently emerging as a sunrise sector with a growth rate of 8.51 and 7.52% in egg and broiler production (BAHS, 2019).It provides employment to over five million people in the Country (Pawariya and Jheeba, 2015). Within the poultry sector, broiler and layer segment constitutes about 65.3 and 34.7% with the monthly turnover of 400 million chicks and 8,400 million eggs (ICRA, 2020). Changing food habits, rising income of the middle-class Indian, presence of private players and rising market demand of the Indian poultry produce in the export market are some of the contributing factors to the growth of the industry (Malarvizhi et al., 2015). In spite of rapid growth, the industry suffered many setbacks due to rising cost of feed. As a result, feed additives were used in broiler rations to reduce feed cost, enhance broiler performance and improve the quality of the product. Herbs and spices stimulate feed intake by the secretion of endogenous enzymes, antibacterial effect and antioxidant potential resulting in enhanced absorption of nutrients from the gut (Lee et al., 2015). Various herbal products are being used as growth promoters in the poultry rations one of which is black cumin seed. The active constituents of black cumin are the volatile oil (thymoquinone, dithymoquinone, thymohydroquinone and thymol - both have antitumor properties, carvone - unsaturated ketone, terpene or d-limonene also called carvene, α-pinene, p-cymene and nigellone). Utilization of nutrients may increase due to supplementation of BCS (Saleh, 2014 and Kumar et al., 2017). Yatoo et al. (2012) reported higher dry matter (DM) digestion compared with the control when the diet was supplemented with 1% BCS or 0.5% each of fenugreek and BCS in combination. Kumar et al. (2017) found that nutrient utilization of CP, ether extract and non-starch carbohydrate increased in broiler chickens due to supplementation of BCS at 0.5 to 2.0 % in the diets. Black cumin bears an excellent potential as an alternative to antibiotics to improve immunity and to reduce mortality in poultry. It also has detoxifying actions that improve liver's ability and functioning. Benefit of black seed can be seen in treatment of many diseases and some positive effect on broiler chicks were such as performance, weight gain, feed conversion ratio, feed intake, internal organ weight percentages, thigh and breast weight percentages as well as dressing weight percentage (Khan et al., 2012). Addition of N. sativa in feed increased bile flow rate results in increased emulsification that activates the pancreatic lipases which then aid in fat digestion and absorption of fat- soluble vitamins. Extract of black seeds might have more diverse effects in growth performances and serum metabolites due to presence of a variety of active substances which can be observed in activities of different heart and liver related serum enzymes and in blood biochemistry (Nasir and Grashon, 2010). The favourable effects of N. sativa on performance might be due to high nutritive value and presence of active substances. Black seeds contain mixture a of essential fatty acids, particularly oleic, linoleic and linolenic acids that cannot be synthesized in the body. Considering the above facts in view, the present study was formulated to find the effect of black cumin seed powder on overall performance, blood profile and economics of rearing of broiler chicken during winter season in Nagaland.

2. MATERIALS AND METHODS

In order to carry out the trial, 120 Cobb-400 day-old chicks were procured and reared during winter season, 2019 in the poultry unit of the Instructional Animal Farm of the Department of Livestock Production and Management, School of Agricultural Sciences and Rural Development, Nagaland University, Medziphema Campus, Nagaland. The chicks were randomly divided into four groups with thirty chicks in each group having five replicates of six birds each. The chicks in the control group (T_1) were offered standard broiler starter ration from 0-3 weeks of age followed by broiler finisher ration from 4-6 weeks of age. The chicks of other three groups were also offered the same diet as in T_1 along with black cumin seed powder @ 1.0 (T_2), 2.0 (T_3) and 3.0 (T_4) per cent of ration, respectively. The birds were reared under strict hygienic condition. Initial body weight of the chicks was recorded on the day of arrival and thereafter on weekly basis till 42 days of age. The feed conversion efficiency (FCE) was calculated as the ratio of total body weight gain to quantity of feed consumed. Liveability per cent was calculated by subtracting the mortality per cent from 100. Performance Index (PI) was calculated by adopting the formula of Bird (1955). At the end of the experiment, four birds from each group were randomly selected and sacrificed for carcass evaluation studies. For blood profile, 2.0 ml blood samples were collected via wing vein from three birds from each treatment at the end of the trial. Plasma was separated and stored at -20°C. However, for estimation of red blood cells (RBC) and White blood cells (WBC) fresh whole blood was used. RBC or erythrocytes and WBC were counted by using an improved Neubauer Haemacytometer as per the method described by Sastry (1985). Haemoglobin (Hb) concentration was estimated by Cyanmethemoglobin method as described by Sahli (1909). Packed cell volume (PCV) was calculated as per the formula given by Velguth et al., 2010). Differential leukocytes count was determined by examining whole blood smears. The count includes relative percentages

of Lymphocytes, Heterophiles, monocytes, Basophiles and Eosinophils. The blood smear was examined using immersion lens (X100) magnification in the ideal area of the films to give representative sampling of all portions of the blood films. Total serum cholesterol (TC), high density lipoprotein (HDL) and low-density lipoprotein (LDL) were determined by using biochemical analysis kits from DIATEK HEALTH Care Pvt. Ltd. Total cholesterol concentration was estimated as per the method described by Richmond (1973). HDL was estimated as per the method described by Izawa et al. (1997) and LDL concentration was estimated as per the method described by Weiland and Seidel (1983). The economics of feeding black cumin powder was calculated on the basis of overall inputs, i.e., the cost of chicks, feeds, test material, labour, medicines and other miscellaneous cost and outputs, i.e., the gross return per bird. The data obtained were subjected to statistical analysis in order to draw a valid interpretation using ANOVA in a Randomized Block Design as described by Snedecor and Cochran (1998).

3. RESULTS AND DISCUSSION

3.1. Body Weight

The average body weight of the day-old chicks was recorded as 0.043, 0.044, 0.042 and 0.043 kg per bird, respectively for T_1, T_2, T_3 and T_4. The corresponding body weight in different treatment groups recorded at the end of the 6th week was 2.668±0.074, 2.690±0.075, 2.714±0.075 and 2.704±0.075 kg per bird. From the data, it was observed that there was no significant influence on the body weight of the birds. These findings were in agreement with the earlier findings of Isalam et al. (2011) who reported that dietary supplementation of Nigella sativa seed powder in hens at the rate of 0, 1.5, 3.5 and 4.5% for 10 weeks had no significant effects on body weight. On the contrary, El-Bagir et al. (2006) and Sogut et al. (2012) reported that a low level of BCS (3%) tended to improve broilers performance compared to a high level (7%). Variation in results might be due to factors like strain differences, differences in experimental conditions, type of feed, difference in levels of supplementation of black cumin seed and seasons, etc.

3.2. Gain in body weight

The average gain in weight for the treatment groups T_1, T_2, T_3 and T_4 was in the range of 156.13 to 520.43, 152.77 to 537.17, 140.50 to 567.00 and 148.73 to 527.03 g per bird, respectively. Statistical analysis revealed that there was no significant difference in weight gain due to black cumin seed supplementation probably due to the level of black cumin seed used which was not sufficient enough to cause a significant effect on weight gain. Similar findings were reported by Dwivedi et al. (2015) also found lower body weight gain in birds on diet supplemented with 1.0 % black cumin seed powder mixture and no significance difference in body weight gain in birds whose diet was supplemented with 0.5% black cumin seed powder mixture. On the contrary, Bhardwaj et al. (2012) and Khadr and Abdel–Fattah (2006) stated that supplementation of herbal product containing Nigella sativa in broiler ration at 0.5 and 2% level improved broiler performance (p<0.05) in terms of gain in body weight. Variation in the findings might be due to differences in experimental conditions, type of feed and its composition, level of black cumin seed, agro-climatic differences and seasons, etc.

3.3. Feed intake

Total feed intake during the entire trial period for T_1, T_2, T_3 and T_4 groups was 4.138±0.012, 4.090±0.011, 4.127±0.011 and 4.150±0.012 kg per bird, respectively. Statistically, it was revealed that there was no significant difference between the control and the birds fed with black cumin seed treated feed. Hence, it was indicative that within the given level of black cumin seed supplementation, feed consumption of the birds was unaffected. The result was in line with the findings of Guler et al. (2006) who reported no significant change in dietary intake of broiler by consuming feed containing black cumin and antibiotics.

3.4. Feed conversion efficiency

The mean feed conversion efficiency of broiler birds in different groups at the end of sixth week was recorded as 0.614±0.01, 0.617±0.01, 0.597±0.01 and 0.612±0.01 for T_1, T_2, T_3 and T_4, respectively. Statistical analysis revealed that there was non- significant (p>0.05) difference in feed conversion efficiency probably due to the level of black cumin seed used in the present study which might not have been sufficient enough to cause any significant effect. The result of the present study corroborated with the findings of Abbas and Ahmed (2010) who found that poor feed efficiency was observed in broiler chicks fed diet supplemented with 1 and 2% black cumin seeds.

3.5. Mortality/Liveability and performance index

Irrespective of the treatment, the mortality percentage of broiler birds was zero per cent. Hence, liveability percentage was recorded to be 100% in all the groups which might be attributed to favourable climatic condition, good quality feed and proper management practices. It was also indicative that supplementation of black cumin seed did not have adverse effect on the survivability of the birds. The performance index at 0, 1, 2, and 3% black cumin seed was 172.41, 172.98, 180.43 and 175.34, respectively. The values for performance index were observed to be higher in groups fed with black cumin seed-based diet. Numerically,

the higher value of performance index was found in T_3 followed by T_4, T_2 and the least in T_1 group. Similar to the present findings, Singh and Kumar (2018) reported that inclusion of black cumin seed powder at the rate of 0.5, 1.0 and 1.5 % resulted in highest broiler performance efficiency index (BPEI).

3.6. Dressing percentage, carcass yield and organ weight

From the Table 1, it was observed that the average dressing percentage of broiler birds at the end of sixth week was 87.03, 88.46, 90.80 and 87.50 in T_1, T_2, T_3 and T_4 groups, respectively. The highest dressing percentage was recorded in T_3 group followed by T_2 and T_3, and the least in T_1 group, respectively. The average carcass weight of broiler birds was recorded as 2.107, 2.160, 2.157 and 2.365 kg bird^{-1} for T_1, T_2, T_3 and T_4 groups, respectively. The average weight of carcass was highest in T_4, T_2 and T_3 group and lowest in T_1 group. The average heart weight was recorded as 14.47, 16.65, 17.20 and 18.40 g per bird for T_1, T_2, T_3 and T_4 groups, respectively. The heart weight was highest in T_4 group followed by T_3, T_2 and the lowest in T_1 group. The average liver weight was 51.27, 56.62, 57.00 and 56.80 g per bird for T_1, T_2, T_3 and T_4 groups, respectively. The liver weight was highest in T_3 group followed by T_4, T_2 and the lowest in T_1 group. The average gizzard weight was 40.40, 46.00, 46.82 and 53.65 g per bird for T_1, T_2, T_3 and T_4 groups, respectively. The value of gizzard weight was highest in T_4 group followed by T_3, T_2 and the lowest in T_1 group. The average spleen weight was 2.90, 3.52, 3.12 and 3.82 g per bird for T_1, T_2, T_3 and T_4 groups, respectively. The spleen weight was highest in T_4 group followed by T_2, T_3 and the lowest in T_1 group. From the result, it was observed that the value for dressing percentage was better in black cumin seed supplemented group as compared to control group, the values did not follow the linear trend; however, the value was numerically the highest at the higher level of black cumin seed supplementation. The result of the present study corroborated with the findings of Guler et al. (2006) and Toghyani et al. (2010) who reported that carcass yield, liver, abdominal fat, breast, thigh, wing and neck weights in broilers was increased in broilers chicken fed 1 per cent black cumin seed in the diet. Conversely, Al-Beitawi et al. (2009) and Ismail (2011) found that carcass characteristics of broiler birds was not increased by feeding different levels of crushed as well as uncrushed *Nigella sativa* seed in broilers, however, breast percentage was found to be increased significantly. Variation in the results might be due to different levels use of black cumin seed in the diet, species differences of the broiler birds and agro-climatic of the experimental site.

Table 1: Production performance of broiler birds in different treatment groups

Parameters	Week	T_1	T_2	T_3	T_4
Body wt (kg bird^{-1} wk^{-1})	Onset	0.046	0.044	0.045	0.044
	6th	2.668±0.074	2.690±0.075	2.714±0.075	2.704±0.075
Gain in body wt (g bird^{-1} wk^{-1})	1st	156.13	152.77	140.50	148.73
	6th	520.43	537.17	567.00	527.03
Feed (kg bird^{-1} wk^{-1})	Total	4.138±0.011	4.090±0.011	4.127±0.011	4.150±0.012
	Mean	0.690	0.682	0.688	0.692
FCE	6th	0.614±0.01	0.617±0.01	0.597±0.01	0.612±0.01
Liveability (%)	6th	100	100	100	100
Performance Index	6th	172.41	172.98	180.43	175.34
Dressing (%)	6th	87.03	88.46	90.80	87.50
Carcass wt (g)	6th	2.107	2.160	2.157	2.365
Heart (g)	6th	14.47	16.65	17.20	18.40
Liver (g)	6th	51.27	56.62	57.00	56.80
Gizzard (g)	6th	40.40	46.00	46.82	53.65
Spleen (g)	6th	2.90	3.52	3.12	3.82

3.7. Haematological parameters

The mean values for haemoglobin (g/dl) were 10.51±0.35, 11.60±0.38, 9.98±0.33 and 9.73±0.32for T_1, T_2, T_3 and T_4 respectively. The corresponding values for total white blood cells (10^3/mm^3) were 19.33±0.64, 21.40±0.71,

26.76±0.89 and 20.66±0.68, respectively. Similarly, the corresponding values for total red blood cells (10^6/mm^3) for the groups T_1, T_2, T_3 and T_4 was 2.50±0.08, 2.63±0.08, 2.76±0.09 and 2.76±0.09, respectively. The packed cells volume recorded for the treatment groups T_1, T_2, T_3 and T_4 was 30.40±1.01, 29.03±0.96, 29.86±0.99and 25.93±0.86, respectively. The value for heterophils was 38.60±1.28, 37.33±1.24, 36.33±1.21 and 38.33±1.27 for T_1, T_2, T_3 and T_4, respectively. The corresponding values for eosinophils were 1±0.03, 3±0.10, 3±0.10and 2±0.06, respectively. Similarly, the values for lymphocytes for T_1, T_2, T_3 and T_4 were 45±1.50, 44±1.46, 42±1.40 and 44±1.46, respectively. However, monocytes and basophils were recorded as nil for all the groups. The values for haemoglobin was significantly higher for groups fed with 1% (T_2) black cumin seed followed by T_1, T_3 and the least was in T_4 (3%). However, the difference between the groups T_3 and T_4, T_1 and T_2 and the groups T_1 and T_3 was found to be non-significant. The white blood cells count was significantly higher for the groups fed with 2% (T_3) black cumin seed powder followed by T_4, T_2 and the least was in control (T_1). However, the difference between T_2 and T_4 and the group T_1 and T_4 was found to be non- significant. The red blood cells count was not affected by the supplementation of black cumin seed. The values for packed cells volume were recorded to be significantly higher in control group as compared to treatment groups. However, the difference between T_1 and T_3 and the group T_2 and T_3 was found to be non- significant. Bhardwaj et al. (2012) observed that supplementation of herbal product improved hemato-biochemical level in the chicken. Similarly, Khan et al. (2012) also reported that the birds fed diets containing high levels of BCS (2.5 or 5.0%) had higher (p<0.05) haematological values than birds fed 1.25% BCS diets, antibiotic or the unsupplemented diet.

3.8. Biochemical constituents

From Table 2, it was observed that the mean value for low density lipoprotein (mg dl^{-1}) was 92.11±3.07, 91.03±3.03, 89.89±2.79 and 89.16±2.97for T_1, T_2, T_3 and T_4, respectively The values for LDL were observed to be significantly (p<0.05) higher in T_1 followed by T_2, T_4 and the least was in T_3. However, the variation between the groups fed with 0 and 1 % and between the groups fed with 2 and 3 %t black cumin seed powder was found to be non- significant. The results of the present study was in agreement with the findings of researches such Sohail et al. (2012) who found that serum LDL cholesterol decreased significantly with supplementation of black cumin seed at 4 and 5 % levels probably due to presence of active substance in black cumin seed which acted and helped in lowering Low Density Lipoprotein (bad lipoprotein) in the blood of the chicken to produce healthy productivity. The mean values for High Density Lipoprotein (mg/dl) were 63.91±2.13, 57.25±1.90, 57.84±1.92 and 56.91±1.89 for T_1, T_2, T_3 and T_4, respectively. The value for HDL was significantly (p<0.05) higher in T_1 group followed by T_3, T_2 and the least in T_4 group. However, the variation between T_2, T_3 and T_4 group was non- significant. The results of the present study was not in agreement with the findings of Sonia et al. (2014) who found highest HDL value in birds fed with 3% black cumin as compared to control group. The mean values for Cholesterol (mg dl^{-1}) were 117±3.90, 97.68±3.25, 107.53±3.58 and 107.19±3.57 for T_1, T_2, T_3 and T_4, respectively. Statistically, Cholesterol was significantly (p<0.05) higher in control group as

Table 2: Haematological and biochemical parameters of blood of broiler birds in different treatment groups

Parameters	Treatments			
	T_1	T_2	T_3	T_4
Haemoglobin (g dl^{-1})	10.51^{ab}±0.35	11.60^{a}±0.38	9.98^{b}±0.33	9.73^{b}±0.32
WBC (10^3 mm^{-3})	19.33^{c}±0.64	21.40^{b}±0.71	26.76^{a}±0.89	20.66^{bc}±0.68
RBC (10^6 mm^{-3})	2.50±0.08	2.63±0.08	2.76±0.09	2.76±0.09
PCV (%)	30.40^{a}±1.01	29.03^{b}±0.96	29.86^{ab}±0.99	25.93^{c}±0.86
Monocytes (%)	0	0	0	0
Basophiles (%)	0	0	0	0
Heterophils (%)	38.60^{a}±1.28	37.33^{bc}±1.24	36.33c±1.21	38.33^{ab}±1.27
Eosinophils (%)	1.0^{c}±±0.03	3.0^{a}±0.10	3.0a±0.10	2.0^{b}±0.06
Lymphocytes (%)	45.0±1.50	44.0±1.46	42.0±1.40	44.0±1.46
LDL (mg dl^{-1})	92.11^{a}±3.07	91.03^{a}±3.03	89.89^{b}±±2.79	89.16^{ab}±2.97
HDL (mg dl^{-1})	63.91^{a}±2.13	57.25^{b}±1.90	57.84^{b}±1.92	56.91^{b}±1.89
Cholesterol (mg dl^{-1})	117.21^{a}±3.90	97.68^{c}±3.25	107.53^{b}±3.58	107.19^{b}±3.57

compared to the black cumin treated groups which was in agreement with the findings of Al- Beitawi et al. (2009) who observed decreased plasma cholesterol level in broiler chickens probably due to the high content of unsaturated fatty acids contained in *Nigella sativa* seeds that resulted in stimulation of the cholesterol excretion into the intestine. Hence, addition of black cumin seed had positive effect on haematological and biochemical profile which could be due to rich in nutritional and phytochemicals.

3.9. Economics

Average cost of production for T_1, T_2, T_3 and T_4 was 235.59, 251.38, 270.38 and 289.56 rupees per bird, respectively. Corresponding values for average cost of production was 88.33, 93.48, 99.62 and 107.08 rupees kg^{-1} live weight of bird, respectively. Profit was 112.48, 99.55, 83.80 and 36.32 rupees per bird, respectively for T_1, T_2, T_3 and T_4 groups while the corresponding values for net profit was 42.17, 37.02, 30.87 and 13.43 rupees per kg live weight of bird, respectively. From the results, it was found that the total cost of production per broiler was comparable in all the groups; however the cost of production per kg live weight was lowest (Rs. 88.33) in T_1 followed by T_2, T_3 and the highest (Rs. 107.08) in T_4 group. The net profit per kg live weight of broiler was highest (Rs. 42.17) in T_1 and the lowest (Rs. 13.43) in T_4 group. From the results, it was found that the values of total cost of production or net profit (Rs. Per bird or Rs. Per kg live weight of bird) were comparable in all the treatment groups and they did not differ significantly. The value of net profit was highest in control group and lowest in treatment group supplemented with 3 per cent level of black cumin seed in the diet of broiler birds (Table 3). The findings of the present study were contrary to the observation of Khadr and Abdel-Fattah (2006) who had observed higher economical returns from the broiler bird reared on diet supplemented with black cumin seed at different levels as compared to control diet. Variation in the observation might be due to differences in the level of supplementation of black cumin seed, species of broiler birds, agro-climatic conditions etc.

Table 3: Economics of broiler production (Rs. $bird^{-1}$) in different treatment groups

Sl. No.	Items	Treatment Groups			
		T_1	T_2	T_3	T_4
1.	Cost of broiler	41.00	41.00	41.00	41.00
2.	Cost of feed	157.20	155.42	156.82	157.66
3.	Cost of black cumin seed	-	17.58	35.17	53.52
4.	Cost of medicine	4.78	4.78	4.78	4.78
5.	Cost of labour	12.60	12.60	12.60	12.60
6.	Miscellaneous cost	20.00	20.00	20.00	20.00
7.	Cost of production (Rs) $bird^{-1}$	235.59	251.38	270.38	289.56
8.	Average weight of broiler (kg)	2.667	2.689	2.714	2.704
9.	Cost of production kg^{-1} wt (Rs)	88.33	93.48	99.62	107.08
10.	Sale of broiler (Rs)	346.71	349.57	352.82	351.52
11.	Sale of gunny bags (Rs)	1.333	1.333	1.333	1.333
12.	Total receipt (Rs) $bird^{-1}$	348.07	350.93	354.18	352.88
13.	Profit $bird^{-1}$ (Rs)	112.48	99.55	83.80	36.32
14.	Net profit kg^{-1} wt gain (Rs)	42.17	37.02	30.87	13.43
15.	Benefit cost ratio	1.47	1.39	1.30	1.21

1 US$= INR 70.96 (Average dollar rupees value during the month of sale)

4. CONCLUSION

Average values for body weight, gain in weight, feed intake, FCE, liveability, performance index, dressing %, carcass weight, organs yield, haemoglobin and total WBC were higher in T_3 group though was unaffected. The mean values for LDL, HDL and cholesterol were significantly better in T_3 than other groups. Net profit was highest in T_1 and least in T_4 group. So, dietary supplementation of 2.0% black cumin seed powder in the diet of broiler ration can be advocated.

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