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Dietary Addition of Black Cumin (*Nigella Sativa*) Seed on the Performance of Broiler Chicken during Summer Season

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ABSTRACT

A experiment was conducted with a total number of 120 Cobb-400 strains of broilers were selected and subjected to four dietary treatments with 30 birds each having five replications per treatment. The birds of control group 1were offered standard broiler starter diet till 21 days and thereafter standard finisher diet up to 42 days. The birds of other groups were also offered the same diet as in group 1 along with black cumin seed powder supplementation at the rate of 1.0 (Group 2), 2.0 (Group 3) and 3.0 (Group 4) % of the diet. The values for average body weight, gain in weight, feed consumption,feed conversion efficiency, performance index and carcass weight per bird during the summer season had not shown any impact irrespective of treatments but it had significant (p<0.05) effect on haemoglobin, red blood cells, white blood cells, packed cell volume, low density lipoprotein, high density lipoprotein and Cholesterol. There was no mortality and hence liveability percentage was 100 % in all groups. The dressing percentage, carcass yield and organ weight was found to be best in treatment groups than control. The haematological and biochemical parameters were found to have positive effect in the treatment groups than control. However, the control group had the highest net profit return than treatment groups. Hence, it was concluded that using of black cumin seed as herbal feed additive helps in the improvement of health condition of the birds.

KEYWORDS: Cholesterol, economics, growth, HDL, LDL, performance index, RBC, WBC

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1. INTRODUCTION

The Indian poultry sector with 7.3% growth has witnessed one of the fastest annual growths of about 6% in eggs, 10% in meat production and 8.35% in broiler production over the last decade amongst all animal based sectors. Poultry sector provides employment to over five million people in the Country, Pawariya and Jheeba.(2015). Poultry farming plays an important role in economic growth of any country, Tarhyel et al. (2012). Changing food habits, rising income of the middle class Indian, 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). Broiler and layer segment constitutes about 65.3 and 34.7% with the monthly turnover of 400 million chicks and 8,400 million eggs, respectively, Anonymous (2020). In spite of rapid growth, the poultry industry suffered many setbacks in recent times due to rising feed cost, emergence of new or re emerging of existing diseases, fluctuating market price of egg and broilers, etc. As a result, feed additives were being in use 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 (Lee et al., 2015), resulting in enhanced absorption of nutrients from the gut. Such natural feed additives have been reported to exert a wide range of beneficial effects on the production performance in broilers in respect to weight gain, feed conversion and meat quality (Aji et al., 2011). The primary mode of action of photobiotic as potential growth promoters is attributed to their ability to inhibit the growth of harmful intestinal microflora in gastrointestinal tract (Lopez et al., 2005) and by stimulating the function of digestive organs (Jang et al., 2004). Various herbal products are being used as growth promoters in the poultry rations; one of which is black cumin seed. Black cumin seed has hepatoprotective (Janbaz et al., 2003) and antioxidant properties (Mansour et al., 2002) which results in improved broiler performance (Al-Beitawi et al., 2009), weight gain and feed conversion ratio (Al-Harthi, 2004 and Khan et al., 2012), improve carcass quality, decrease the market age of broiler and reduce their rearing cost (Muhammed et al., 2009). The major unsaturated fatty acids are linoleic acid (49.2–50.3%) followed by oleic acid (23.7–25.0%), while the main saturated fatty acid is palmitic acid (17.2–18.4%) (Cheikh-Rouhou et al., 2007). The active components of black cumin are the volatile oils thymoquinoline and dithymo quinoline, both of which have antitumor properties (Zahoor et al., 2004). Under active constituents, i.e. Volatile oil also consists of carvone, an unsaturated ketone, terpene or d-limonene (carvene), α-pinene, p-cymene and nigellone (Ramadan, 2007). The black cumin seed have been reported to have many biological properties including antiparasitic, antidiabetic (Meral et al., 2001), antidiarrheal (Gilani et al., 2001) and diuretic effects (Zaoui et al., 2000). A few studies showed that black cumin seed also had antibacterial (Nair et al., 2005), anti-oxidative and anti-microbial activities (Nasir and Grashorn, 2010). Utilization of nutrients may increase due to supplementation of BCS (Saleh, 2014 and Kumar et al., 2017). Any stimulating effect of essential oils on digestive system can result in better utilization of nutrients and performance of birds (Wenk, 2003). Considering the above facts, the present study entitled "Dietary addition of black cumin (*Nigella sativa*) seed on the performance of broiler chicken during summer season" was postulated to see the effect of BCS on overall performance, blood profile and economics of rearing of broiler chicken during summer season in Nagaland.

2. MATERIALS AND METHODS

A trial was conducted using 120 Cobb-400 day- old chicks during summer season (April–May 2018) 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 farm is located at 93.20°E to 95.15°E longitude and latitude between 25.6°N at an elevation of 310 meter above mean sea level (MSL). 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 fed with 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 LDLconcentration 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. Production performance

3.1.1. Body weight

From the Table 1, it was observed that the values of body weight of broiler birds at day-old were 0.046, 0.047, 0.048 and 0.046 kg bird^{-1} in T_1, T_2, T_3 and T_4 groups, respectively. The values of corresponding body weight at the end of the 6th week were2.898±0.08, 2.811±0.08, 2.910±0.08 and 2.949±0.08 kg bird^{-1}, respectively. Analysis of variance revealed that there was no significant difference in the average body weight among the different treatment groups under the prevailing agro-climatic condition. The findings of the present studies were in agreement with the observations of Isalam et al. (2011) who reported that dietary supplementation of *Nigella sativa* seed powder at the rate of 0, 1.5, 3.5 and 4.5% had no significant effects on body weight. 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 season, etc.

3.1.2. Gain in body weight

From the Table 1, the values of average gain in body weightat 6th week were 737.46, 713.23, 656.13 and 724.06 g bird^{-1} week^{-1} for the groups T_1, T_2, T_3 and T_4, respectively. It was revealed that gain in weight did not vary significantly due to black cumin seed supplementation. Similar findings were reported by Dwivedi et al. (2015) who also observed no significant effect on body weight gain of broilers on diet supplemented with either 0.5 or 1.0% black cumin seed powder. On the contrary, Bhardwaj et al. (2012) 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. Variations in the findings might be due to the high fibre contents of the black cumin seed that resulted in no significant effect on gain in body weight.

3.1.3. Feed intake

From the Table 1, it was observed that the values of the total feed intake during the entire trial period was 4.467±0.01, 4.496±0.01, 4.613±0.01 and 4.613±0.01kg bird^{-1}for T_1, T_2, T_3 and T_4 groups, respectively. From the data, it was revealed that the values did not differ irrespective of treatments. The results of the present studies were well corroborated with the findings of Guler et al. (2006) who also reported no significant change in dietary intake of broiler by consuming feed containing black cumin and antibiotics. The differences in the results might be due to the differences in experimental conditions such as type of feed, level of black cumin seed, agro-climatic differences, season etc.

3.1.4. Feed conversion efficiency

As per the data in Table 1, the value of average FCE was 0.693±0.01, 0.688±0.01, 0.666±0.01 and 0.651±0.01for the treatment groups T_1, T_2, T_3 and T_4, respectively. From the data, it was revealed that the values did not differ irrespective of treatments. The results of the present study were well corroborated with the findings of Abbas and Ahmed (2010) who found that poor feed conversion efficiency was observed in broiler chicks fed diet supplemented with 1.0 and 2.0% black cumin seeds. Variations in the findings might be due to higher levels of black cumin seed used that resulted in no significant effect on feed conversion efficiency.

3.1.5. Mortality/liveability and performance index

The mortality (%) of broiler birds was recorded zero irrespective of treatments. Hence, liveability was 100% in all the groups. The result might be attributed to proper management practices, favourable climatic condition and good quality feed. It was also indicative that supplementation of black cumin seed did not have adverse effect on the survivability of the birds.The performance index (PI) at 0, 1, 2, and 3% black cumin seed was 166.20, 162.37, 173.63 and 180.01, respectively. Numerically, the values for PI were higher in T_4 followed by T_3, T_1 and the least in T_2 group. Similar findings had been observed where inclusion

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

Parameters		Treatments			
	Week	T_1	T_2	T_3	T_4
Body wt (kg bird^{-1} wk^{-1})	Onset	0.046	0.047	0.048	0.046
	6th	2.898±0.08	2.811±0.08	2.910±0.08	2.949±0.08
Gain in body wt (g bird^{-1} wk^{-1})	1st	110.80	101.70	109.70	114.80
	6th	737.46	713.23	656.13	724.06
Feed intake (kg bird^{-1} wk^{-1})	Total	4.467±0.01	4.496±0.01	4.613±0.01	4.613 ±0.01
	Mean	0.745	0.749	0.769	0.769
FCE	6th	0.693±0.01	0.688 ±0.01	0.666±0.01	0.651±0.01
Liveability (%)	6th	100	100	100	100
Performance Index	6th	166.20	162.37	173.63	180.01
Dressing (%)	6th	86.06	85.08	85.60	86.61
Carcass Wt (g)	6th	2.220	2.250	2.250	2.420
Heart (g)	6th	12.97	14.15	13.55	16.05
Liver (g)	6th	60.62	62.22	63.30	73.62
Gizzard (g)	6th	45.60	46.60	55.12	55.55
Spleen (g)	6th	3.08	3.12	3.75	4.30

of black cumin seed powder at the rate of 0.5, 1.0 and 1.5% resulted in highest broiler performance efficiency index (BPEI) and 100% liveability. The positive result might be due to the active ingredient (thymoquinone) in Black seed that had hepato-protective effects which results in a sound healthy chicken with strong immune system that leads to low mortality.

3.1.6. Dressing percentage, carcass yield and organ weight

From the Table 1, it was observed that the average dressing (%) of broiler birds at the end of sixth week was 86.06, 85.08, 85.60 and 86.61 in T_1, T_2, T_3 and T_4 groups, respectively. The average carcass weight of broiler birds was recorded as 2.220, 2.250, 2.250 and 2.420 kg bird^{-1} for T_1, T_2, T_3 and T_4 groups, respectively. The average heart weight was recorded as 12.97, 14.15, 13.55 and 16.05 g bird^{-1} for T_1, T_2, T_3 and T_4 groups, respectively. The average liver weight was 60.62, 62.22, 63.30 and 73.62 g bird^{-1} for T_1, T_2, T_3 and T_4 groups, respectively. The average gizzard weight was 45.60, 46.60, 55.12 and 55.55 g bird^{-1} for T_1, T_2, T_3 and T_4 groups, respectively. The average spleen weight was 3.08, 3.12, 3.75 and 4.30 g bird^{-1} for T_1, T_2, T_3 and T_4 groups, respectively. Similar to the present findings, Toghyani et al. (2010) reported that broilers fed with 1% black cumin seed in the diet had an increased carcass yield, liver, abdominal fat, breast, thigh, wing and neck weights as compared to control group.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.

3.2. Blood profile

3.2.1. Haematological parameters

From the Table 2, it was observed that the mean valuefor haemoglobin was 10.51±0.35, 11.60±0.38, 9.98±0.33 and 9.73±0.32 g dl^{-1} for T_1, T_2, T_3 and T_4 groups respectively. The corresponding values for total white blood cells (10^3 mm$^{3-1}$) 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$^{3-1}$) were 2.23±0.07, 2.33±0.07, 2.90±0.08 and 3.16±0.09, respectively. The packed cells volume recorded for the treatment groups T_1, T_2, T_3 and T_4 was 33.66±1.12, 35.33±1.17, 35.23±1.16 and 31.23±1.16%, respectively. The value for heterophils was 33.33±1.13, 39.00±1.30, 34.33±1.14 and 35.00±1.16 for T_1, T_2, T_3 and T_4%, respectively. The corresponding values for eosinophils were 1.66±0.05, 1.06±0.02, 1.66±0.05 and 1.33±0.04%, respectively. Similarly, the values for lymphocytes for T_1, T_2, T_3 and T_4 were 69.0±2.30, 70.0±2.33, 68.0±2.26 and 67.66±2.25%, respectively. However, monocytes and basophils were recorded as nil for all the groups. There was significant effect on haematological parameters due to inclusion of black cumin seed in broiler feed. A similar finding was reported by Bhardwaj et al. (2012) who observed that supplementation of herbal product improved hemato-biochemical level in the chicken. Also, Khan et al. (2012) reported that the birds fed diets containing high levels of BCS (2.5% or 5.0%) had higher (p<0.05) haematological

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})	10.80b± 0.35	11.91a± 0.39	10.12b± 0.33	10.23b± 0.34
WBC (10^3 mm^{-3})	19.66d± 0.65	23.33c± 0.74	28.56b± 0.95	30.60a± 1.02
RBC (10^6 mm^{-3})	2.23c± 0.07	2.33c± 0.07	2.90b± 0.08	3.16 a± 0.09
PCV (%)	33.66a± 1.12	35.33a± 1.17	35.23b± 1.16	31.23c± 1.16
Monocytes (%)	0.0	0.0	0.0	0.0
Basophiles (%)	0.0	0.0	0.0	0.0
Heterophils (%)	33.33b± 1.13	39.00a± 1.30	34.33b± 1.14	35.00b± 1.16
Eosinophils (%)	1.66± 0.05	1.06± 0.02	1.66± 0.05	1.33± 0.04
Lymphocytes (%)	69± 2.30	70± 2.33	68± 2.26	67.66± 2.25
LDL (mg dl^{-1})	68.11c± 2.27	89.86a± 2.99	84.86ab± 2.82	75.29bc± 2.51
HDL (mg dl^{-1})	61.10b± 2.03	70.53a± 2.35	72.15a± 2.40	68.97a± 2.29
Cholesterol (mg dl^{-1})	112.71a± 3.73	87.54ab± 2.91	86.22ab± 2.87	61.97b± 2.06

a, b, c: Means bearing different superscripts within the column differ significantly (p<0.05)

values than birds fed 1.25% BCS diets, antibiotic or the unsupplemented diet. Positive effect of *Nigella sativa* might be due to its protective action against hepatoxicity which led to higher utilization of nutrients in the feed.

3.2.2. Biochemical constituents

From Table 2, it was observed that the mean value for low density lipoprotein (LDL) was 68.11±2.27, 89.86±2.99, 84.86±2.82 and 75.29±2.51 mg dl^{-1} for the groups T_1, T_2, T_3 and T_4, respectively. The value for LDL was significantly (p<0.05) higher in T_2 followed by T_3, T_4 and the least in T_1group. However, the variation between the groups fed with 2 and 3% black cumin seed powder was non- significant. The results of the present study was in agreement with the findings of Sohailet al. (2012) who found that serum LDL cholesterol decreased significantly with supplementation of black cumin seed at 4 and 5% levels. The mean values for high density lipoprotein (HDL) was 61.10±2.03, 70.53±2.35, 72.15±2.40 and 68.97±2.29 mg dl^{-1} for T_1, T_2, T_3 and T_4 group respectively.The value for HDL wassignificantly (p<0.05) highest in T_3 group followed by T_2, T_3 and the least in T_1 group; however, the variation between T_3, T_4 and T_2 group was non- significant. The results of the present study were in agreement with the findings of Sonia et al. (2014) who also found highest HDL value in birds fed with 3% black cumin as compared to control group. The mean values for Cholesterol were 112.71±3.73, 87.54±2.91, 86.22±2.87 and 61.97±2.06 mg dl^{-1} for T_1, T_2, T_3 and T_4 groups respectively. The value of Cholesterol was significantly (p<0.05) higher in control group as compared to the black cumin treated groups which was in agreement with the findings ofAl-Beitawi et al. (2009) whoalso 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 secretion into the intestine.

3.3. Economics

Average cost of production per bird for T_1, T_2, T_3 and T_4 was 248.13, 268.56, 293.31 and 313.15 rupees $bird^{-1}$, respectively. Corresponding values for average cost of production kg^{-1} live weight of bird was 85.59, 95.54, 100.83 and 106.22 rupees, respectively. Profit was 130.10, 98.23, 86.22 and 71.45 rupees $bird^{-1}$ for T_1, T_2, T_3 and T_4 groups, respectively while the corresponding values for net profit kg^{-1}gain in weight were 44.88, 34.94, 29.63 and 24.24 rupees (Table 3). From the results, it was found that the total cost of production per broiler was comparable in all the

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

Sl. No.	Parameters	Treatments			
		T_1	T_2	T_3	T_4
1.	Cost of broiler	41.00	41.00	41.00	41.00
2.	Cost of feed	169.75	170.85	175.30	175.27
3.	Cost of black cumin seed	-	19.33	39.63	59.50
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	248.13	268.56	293.31	313.15
8.	Average wt of broiler (kg)	2.899	2.811	2.909	2.948
9.	Cost of production /kg wt (₹)	85.59	95.54	100.83	106.22

Table 3: Continue...

Sl. No.	Parameters	Treatments			
		T_1	T_2	T_3	T_4
10.	Sale of broiler (₹)	376.87	365.43	378.17	383.24
11.	Sale of gunny bags (Rs)	1.33	1.33	1.33	1.33
12.	Total receipt (₹)/ bird	378.23	366.79	379.53	384.60
13.	Profit / bird (₹)	130.10	115.63	121.90	125.02
14.	Net profit /kg wt gain (₹)	44.88	34.94	29.63	24.24
15.	Benefit cost ratio	1.52	1.36	1.29	1.22

groups; however, the cost of production kg^{-1} live weight was lowest (₹ 85.59) in T_1 followed by T_2, T_3 and the highest (₹ 106.22) in T_4 group. The net profit kg^{-1} live weight of broiler was highest (₹ 44.88) in T_1 and the lowest (₹ 24.24) in T_4 group. From the results, it was found that the values of total cost of production or net profit (₹ $bird^{-1}$or Rs. kg^{-1} 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 cumin seed supplementation in the diet of broiler birds. 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.

4. CONCLUSION

Average weight, weight gain, feed consumption, FCE, performance index and carcass weight had not any impact but it had significant effect on haemoglobin, RBC, WBC, PCV, LDL, HDL and Cholesterol. The liveability was 100% in all groups. The carcass characteristics, haematological and biochemical parameters had positive effect in the treatment groups. The control group had better netprofit than treatment groups. Hence, it was concluded that BCS as feed additive helps in the improvement of health condition of the birds.

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