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Effect of seasons and levels of black cumin (*Nigella sativa*) seed powder on performance of broiler chicken

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Abstract
A total of 120 Cobb-400 strains of broilers were reared each in summer (S_1), monsoon (S_2) and winter (S_3) seasons by subjecting them to four dietary treatments with 30 birds each having five replications per treatment. The birds of control group 1(T_1) were 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 $T_{1\ along}$ with black cumin seed powder supplementation at the rate of 1.0 (Group 2, T_2), 2.0 (Group 3, T_3) and 3.0 (Group 4, T_4) per cent of the diet. From the data, it was perused that the body weight, gain in weight and feed intake was significantly (p<0.05) higher during summer season followed by winter and the least in monsoon season; however, the feed conservation efficiency and performance index was better in winter season followed by monsoon and the least in summer season. The levels of black cumin supplementation had no effect on these parameters. The various seasons and different levels of black cumin supplementation had similar effect on carcass characteristics and liveability of the birds. The haematological and biochemical constituents of blood were positive effect in the treatment groups as compared to control group and were relatively better during summer season as compared to other seasons. Hence, it may be concluded that dietary supplementation of black cumin seed powder as herbal feed additive helps in the improvement of health condition of the birds and so it can be advocated to be added in diet of birds.

Keywords: Black cumin, Growth, Feed Conversion Efficiency, Performance index, RBC, PCV, Hb, HDL, LDL, Cholesterol

1. Introduction
Poultry sector provides employment to over five million people in the Country (Pawariya *et al*., 2015) [1]. Changing food habits, rising income of the middle class Indian, presence of private players, 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) [2]. 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, respectively (ICRA, 2020) [3]. India is the third largest egg producing and fourth largest broiler producing country in the world with an estimated production of 103.3 billion eggs and 4.1 million tons of broiler meat (BAHS, 2019) [4]. However, the poultry industry suffered many setbacks in recent times due to rising cost of feed in particular. 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. One of the major determinants in the use of feed additives is its availability; however, the positive effects of herbal products is that herbal agents could serve as safer alternatives as growth promoters due to their suitability and preference, lower cost of production, reduced risks toxicity and minimum health hazards. Recent biological trials had shown that herbs and spices stimulated feed intake by the secretion of endogenous enzymes, antibacterial effect and antioxidant potential (Lee *et al*., 2015) [5], resulting in enhanced absorption of nutrients from the gut (Saleh, 2014[6] and Kumar *et al*., 2017[7]). 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)[8]. Various herbal products are being used as growth promoters in the poultry rations, one of which is black cumin seed (*Nigella sativa*). Pharmacologically, the active components of black cumin are the volatile oils thymoquinoline and dithymoquinoline, both of which have antitumor properties (Zahoor *et al*., 2004) [9] and have many biological properties including antiparasitic, antidiabetic (Meral *et al*., 2001) [10], antidiarrheal (Gilani *et al*., 2001) [11] and diuretic effects (Zaoui *et al*., 2000) [12].

The composition and properties of black cumin seed are considered to be a good source of protein, crude fat, crude fibre and macro minerals. BCS contain a yellowish volatile oil (0.5- 1.6%), a fixed oil (28-42%), proteins (23 to 37%), ash (4.41 to 4.86%), total carbohydrate (33 to 40%) and different phytochemicals (Ramadan, 2007[13]; Cheikh- Rouhou *et al*., 2007[14]). 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[14]). Dietary supplementation of black cumin seed has revealed some of its positive effect on broiler chick performance (Guler *et al*., 2006[15]; Abu-Dieyeh and AbuDarwish, 2008[16]; Al-Beitawi *et al*., 2009[17]), weight gain, feed conversion ratio (Khan *et al*., 2012)[18], feed intake, internal organ weight percentages, thigh and breast weight percentages (Durrani *et al*., 2007) [19] as well as dressing weight percentage (Durrani *et al*., 2007) [19]. In view of the above facts, the present study was conceived with the aim to assess the effect of seasons and levels of black cumin (*Nigella sativa*) seed powder on performance of broiler chicken in Nagaland.

2. Materials and Methods

In order to carry out the trial, 120 Cobb-400 day old chicks were procured and reared each during summer (S_1), monsoon (S_2) and winter (S_3) seasons. 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) [20]. 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) [21]. Haemoglobin (Hb) concentration was estimated by Cyanmethemoglobin method as described by Sahli (1909) [22]. Packed cell volume (PCV) was calculated as per the formula given by Velguth *et al*., (2010) [23]. 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) [24]. HDL was estimated as per the method described by Izawa *et al*. (1997) [25] and LDL concentration was estimated as per the method described by Weiland and Seidel (1983) [26]. 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) [27].

3. Results and Discussion

3.1 Season and levels of black cumin on performance

From the Table 1, the average final body weight of the birds during summer (S_1), monsoon (S_2) and winter (S_3) season was 2.892, 2.440 and 2.694 kg per bird, respectively. The corresponding values for gain in weight were 2.845, 2.403 and 2.649 kg per bird. Feed intake for S_1, S_2 and S_3 groups was 4.547, 3.725 and 4.126 kg per bird, respectively while the feed conversion efficiency for the respective seasons was 0.674, 0.587 and 0.610.The overall performance index was recorded to be 170.55, 164.95 and 175.29 for S_1, S_2 and S_3 groups, respectively. From the data, it was observed that the values for body weight, gain in weight, feed intake and feed conversion efficiency were significantly ($p<0.05$) higher in S_1 group followed by S_3 and the least in S_2 group. The value for performance index was significantly ($p<0.05$) higher during the S_3 followed by S_1 and the least in S_2 season. The findings of the present results were well corroborated with the observations of Hermes *et al*. (2009) [28] who had also reported that the thermal humidity index played role on the performance and it became inferior during non – comfortable level and probably the summer season when temperature and humidity index was best suited to the broiler during the experiment in the present agro climatic zone.

From the Table 1, it was also seen that the highest and lowest overall mean values for body weight as influenced by different levels of black cumin seed supplementation was 2.719 kg in T_3 and 2.631 kg in T_2 groups, respectively. Similarly, the corresponding values for the total gain in weight per bird were 2.674 kg in T_3 and 2.586 kg T_2 groups. The values for feed intake was maximum (4.209 kg) in T_3 and lowest (4.076 kg) in T_2 groups. The feed conversion efficiency was best (0.628) in T_1 followed by T_2 (0.626), T_3 (0.620) and the least in T_4 (0.619) groups. The highest performance index was observed in T_3 (173.94) followed by T_4 (171.87), T_1 (168.42) and the least in T_2 (166.80) groups. However, from the data, it was observed that the values of either overall body weight, total gain in weight, feed intake, feed conversion efficiency or performance index showed no significant effect due to black cumin seed supplementation. The findings of the present results were well corroborated with the observations of Isalam *et al*. (2011) [29] and Al – Mufarrej (2014) [30] who had also reported no variations on the above parameters due to black cumin seed supplementation at different levels.

3.2 Interaction effect of season and levels of black cumin on performance

From Table 2, it was observed that the average value of body weight due to the interaction effect of season and treatment was significantly ($p<0.05$) highest (2.949 kg) in S_1T_4 and lowest (2.392 kg) in S_2T_2, respectively. The corresponding values for the total gain in weight were significantly ($p<0.05$)

highest (2.904 kg) in S_1T_4 and lowest (2348.39 kg) in S_2T_2. The overall feed intake per bird was significantly ($p<0.05$) highest (4.613 kg) in S_1T_3 group and the least (3.642 kg) in S_2T_2 group. The overall FCE value was significantly ($p<0.05$) maximum (0.693) in S_1T_1 and the least (0.575) in S_2T_2 group. The performance index was best (180.42) in S_3T_3 group and poor (160.29) in S_2T_4 group. Statistical analysis had revealed that season x black cumin seed levels (interaction effect) had significant effect on the overall body weight, total gain in weight, feed intake and feed efficiency of broilers. Hence, productive performance of broiler birds in terms of body weight, weight gain, feed intake and feed efficiency had significant effect due to black cumin seed supplementation. The findings of the present results were well corroborated with the observations of Hermes *et al*. (2009) [28] who had reported that the thermal humidity index played very important role on the performance and it became inferior during non – comfortable level and the summer season when temperature and humidity index was best could had suited to the broiler during the experiment in the present agro climatic zone.

3.3 Season and levels of black cumin on liveability and carcass characteristics

Irrespective of the seasons and treatment groups, the mortality percentage was zero per cent while liveability was recorded as 100 per cent which could be due to good management practices, good quality feed, suitable strain and favourable agro-climatic condition. The average dressing percentage of broiler birds at the end of sixth week during summer (S_1), monsoon (S_2) and winter (S_3) seasons was 85.83, 84.42 and 88.44 per cent, respectively. Hence, dressing percentage was observed to be higher during S_3 followed by S_1 and the least in S_2 group. The average carcass yield was observed to be higher during S_1 followed by S_3 and the least S_2 group. With respect to the organs weight (heart, liver, gizzard and spleen), the values were observed to be higher during S_3 followed by S_1 and the least in S_2 group.

The results of the present study were well corroborated with the findings of Guler *et al*. (2006) [15] and Toghyani *et al*. (2010) [31] 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) [17] and Ismail (2011) [32] 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 of black cumin seed in the diet, species differences of the broiler birds and agro-climate of the experimental site.

3.4. Season and levels of black cumin on haematological and biochemical constituents of blood

From the perusal of Table 3, it was perused that except the PCV and LDL values, the values of other constituents, i.e. Hb, WBC, RBC, HDL and Cholesterol did not show any difference irrespective of various seasons. The overall values for PCV during summer, monsoon and winter seasons were 33.86, 31.49 and 28.80 per cent, respectively. The value of PCV was significantly ($p<0.05$) higher during summer season followed by monsoon season and the least in winter season. Similarly, the overall mean values for low density lipoprotein (LDL) were 79.53, 94.21 and 90.54 mg/dl during summer, monsoon and winter seasons, respectively. The value of LDL was significantly ($p<0.05$) higher during monsoon season followed by winter season and the least in summer season. However, the difference between season S_1 and S_3 and season S_2 and S_3 was found to be non- significant. The overall mean values for haemoglobin (g/dl) for summer, monsoon and winter seasons are 10.76, 9.74 and 10.45, respectively. The perusal of Table 4 revealed that there was no significant result between the seasons due to black cumin seed supplementation. The overall WBC (10^3 /mm^3) values for summer, monsoon and winter season was 25.53, 28.52 and 22.03, respectively. The corresponding values for RBC (10^6/mm^3) were 2.65, 3.05 and 2.66. The perusal of Table 4. revealed that WBC (10^3 /mm^3) and RBC (10^6/mm^3) were unaffected by season. The overall high density lipoprotein (HDL) during summer, monsoon and winter season was 68.18, 67.94 and 58.97 mg/dl, respectively. Statistically, no significant result was observed in all the three seasons by black cumin seed supplementation. The values for cholesterol (mg/dl) were 87.11, 112.45 and 107.40 during summer, monsoon and winter season, respectively. The perusal of Table 4 revealed that cholesterol were unaffected by season.

Further, from the Table 3, it was observed that the values for Hb, WBC, RBC, PCV, LDL, HDL and Cholesterol improved in groups fed with black cumin seed based diet as compared to the control. The values for WBC and RBC was higher in groups fed with diet scontaining 2 and 3 per cent black cumin seed powder while the control group obtained the lowest values for WBC parameter. Haemoglobin value was found higher in treatment group containing 1 per cent black cumin seed powder. The results of the present studies were well corroborated with the observations of Bhardwaj *et al*. (2012) [33] and Khan *et al*. (2012) [18] who also reported that supplementation of herbal product had higher ($p<0.05$) haematological values in the birds fed diets containing high levels of black cumin seed (5.0%) than birds fed 1.25% black cumin seed diets, antibiotic or the unsupplemented diet. The values for LDL was highest in T_2 (1%) lowest in control (T_1). The level of PCV, HDL and cholesterol was least in groups fed with highest level of black cumin seed powder (3%) and highest in control group (T_1). However, dietary supplementation of black cumin seed had no significant effect on WBC, RBC, Hb, PCV, LDL, HDL and cholesterol and no specific trends were observed. The results of the present study was in agreement with the findings of researches such Sohail *et al*. (2012) [34] 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 results for HDL in the present study was not in agreement with the findings of Sonia *et al*. (2014) [35] who found highest HDL value in birds fed with 3% black cumin as compared to control group. The value of cholesterol was higher in control group as compared to the black cumin treated groups which was in agreement with the findings of Al- Beitawi *et al*. (2009) [17] 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.

3.5. Interaction effect of season and levels of black cumin on haematological and biochemical constituents of blood

From the Table 5, it was observed that the values of WBC (10^3 /mm^3) was significantly (p<0.05) higher (30.60) in group S_1T_4 and the lowest (19.33) in S_3T_1 while the values of RBC (10^6 /mm^3) was highest (3.20) in S_2T_1 and the least (2.23) in S_1T_1 group. The values of haemoglobin (g/dl) were highest (11.91) in S_1T_2 and the lowest (9.44) in S_2T_1 group. The highest (35.33) and the lowest (25.93) PCV (per cent) values were recorded in S_1T_2 and S_3T_4 groups, respectively. The highest (97.60) and lowest (68.11) values for LDL (mg/dl) were in S_2T_3 and in S_1T_1 groups, respectively. Higher HDL (mg/dl) was recorded in S_2T_1 (76.88) and lowest HDL in S_3T_4 (56.91) while the corresponding values for cholesterol (mg/dl) was 117.65 in S_2T_4 and 61.97 in S_1T_4 groups. The perusal of data had revealed that interaction effect of season x treatment had significant effect on the blood parameters of broiler chickens with respect to WBC, RBC, Haemoglobin, PCV, LDL, HDL and cholesterol.

Based on the above findings, it was observed that season S_1 had higher WBC, Hb and PCV values and least RBC, LDL and Cholesterol values. Season S_2 had higher RBC, LDL, HDL and the least Hb. While season S_3 had lowest WBC, PCV and HDL values. Hence, season had significant influence on the blood haematology and biochemical parameters of broiler chicken.

Table 1: Effect of different seasons on growth performance

ITEMS	Body weight (kg bird^{-1})	Gain in weight (kg bird^{-1})	Feed intake (kg bird^{-1})	FCE (gain: feed)	Performance index
Seasons					
S_1	2.892_a± 0.01	2.845_a± 0.01	4.547_a± 0.02	0.674_a± 0.011	170.55_{ab}± 2.98
S_2	2.440_c± 0.01	2.403_c± 0.02	3.725_c± 0.01	0.587_b± 0.011	164.95_b± 2.98
S_3	2.694_b± 0.01	2.649_b± 0.02	4.126_b± 0.01	0.610_b± 0.011	175.29_a± 2.98
Treatments					
T_1	2.664 ± 0.01	2.619 ± 0.01	4.088 ± 0.03	0.628 ± 0.002	168.42 ± 1.61
T_2	2.631 ± 0.01	2.586 ± 0.01	4.076 ± 0.03	0.626 ± 0.002	166.80 ± 1.61
T_3	2.719 ± 0.01	2.674 ± 0.01	4.209 ± 0.03	0.620 ± 0.002	173.94 ± 1.61
T_4	2.687 ± 0.01	2.651 ± 0.01	4.158 ± 0.03	0.619 ± 0.002	171.87 ± 1.61

[a, b, c] Means bearing different superscript within the column differ significantly (p<0.05)

Table 2: Interaction effect of season and treatment on performance

S x T	Body weight (kg bird^{-1})	Total gain in weight (kg bird^{-1})	Feed intake (kg bird^{-1})	FCE (gain: feed)	Performance index
S_1T_1	2.898^b	2.850^b	4.467^{abc}	0.693^a	166.20
S_1T_2	2.811^c	2.764^c	4.496^{ab}	0.688^a	162.36
S_1T_3	2.910^b	2.863^b	4.613^a	0.666^{ab}	173.62
S_1T_4	2.949^a	2.904^a	4.613^a	0.651^{ab}	180.01
S_2T_1	2.728^h	2.385^h	3.659^f	0.578^c	166.65
S_2T_2	2.392^i	2.349^j	3.642^f	0.575^c	165.06
S_2T_3	2.533^g	2.941^g	3.886^{def}	0.599^{bc}	167.77
S_2T_4	2.408^i	2.388^i	3.712^{ef}	0.596^{bc}	160.29
S_3T_1	2.668^f	2.621^f	4.138^{bcd}	0.614^{bcd}	172.41
S_3T_2	2.690^e	2.646^e	4.090^{cde}	0.617^{cde}	172.98
S_3T_3	2.715^d	2.669^d	4.127^{bcd}	0.597^{bcd}	180.43
S_3T_4	2.704^{de}	2.661^d	4.150^{bcd}	0.612^{bcd}	175.29
S.Em (±)	0.458	0.347	9.456	0.012	1.880
CD(P=0.05)	3.176	2.413	65.644	0.070	

[a, b, c, d, e, f, g, h, i, j] Means bearing same superscript in the column do not differ significantly (p<0.05)

Table 3: Liveability and carcass characteristics of broiler birds during the different seasons

Parameters	Summer	Monsoon	Winter
Livability (%)	100	100	100
Dressing (%)	85.83	84.42	88.44
Carcass weight (kg bird^{-1})	2.285	1.996	2.197
Heart (g bird^{-1})	14.18	12.50	16.68
Liver (g bird^{-1})	64.94	48.47	55.42
Gizzard (g bird^{-1})	50.71	46.63	46.71
Spleen (g bird^{-1})	3.53	3.38	3.34

Table 4: Haematological and biochemical constituents of blood during the different seasons/ treatments

Items	Hb (g/dl)	WBC (10^3 /mm^3)	RBC (10^6 /mm ^{3})	PCV (%)	LDL (mg/dl)	HDL (mg/dl)	Cholesterol (mg/dl)
Seasons							
S1	10.76±0.30	25.53±1.87	2.65±0.13	33.86^{a} ±0.39	79.53^{b}±1.55	68.18±3.03	87.11±7.74
S2	9.74±0.30	28.52±1.87	3.05±0.13	31.49^{ab}±0.39	94.21^{a}±1.55	67.94±3.03	112.45±7.74
S3	10.45±0.30	22.03±1.87	2.66±0.13	28.80^{b}±0.39	90.54^{ab}±1.55	58.97±3.03	107.40±7.74
Treatments							
T_1	10.25±0.25	23.12±0.88	2.64±0.08	32.24±0.56	83.91±1.95	67.29±1.27	113.56±4.03
T_2	11.05±0.25	24.79±0.88	2.68±0.08	31.78±0.56	92.00±1.95	63.58±1.27	97.44±4.03
T_3	9.96±0.25	26.79±0.88	2.83±0.08	31.80±0.56	90.78±1.95	67.08±1.27	102.67±4.03
T_4	10.02±0.25	26.75±0.88	3.00±0.08	29.72±0.56	85.69±1.95	62.18±1.27	95.60±4.03

[a, b] Means bearing different superscript within the column differ significantly (p<0.05)

Table 5: Interaction effect of season x treatment on haematological / biochemical constituents of blood

S x T	WBC (10^3 /mm^3)	RBC (10^6 /mm^3)	Hb (g/dl)	PCV (%)	LDL (mg/dl)	HDL (mg/dl)	Cholesterol (mg/dl)
S_1T_1	19.66^{g}	2.23^{f}	10.80^{bc}	33.66^{b}	68.11^{f}	61.10^{def}	112.71^{ab}
S_1T_2	23.33^{e}	2.33^{ef}	11.91^{a}	35.33^{a}	89.86^{bcd}	70.53^{b}	87.54^{c}
S_1T_3	28.56^{b}	2.90^{b}	10.12^{cde}	35.23^{a}	84.86^{cd}	72.15^{ab}	86.22^{c}
S_1T_4	30.60^{a}	3.16^{a}	10.23^{cde}	31.23^{de}	75.29^{e}	68.97^{bc}	61.97^{d}
S_2T_1	30.37^{a}	3.20^{a}	9.44^{e}	32.66^{c}	91.51^{abc}	76.88^{a}	110.10^{ab}
S_2T_2	29.66^{ab}	3.10^{a}	9.64^{de}	31.00^{e}	95.12^{ab}	62.96^{de}	107.10^{ab}
S_2T_3	25.06^{d}	2.83^{b}	9.78^{de}	30.33^{ef}	97.60^{a}	71.25^{ab}	114.28^{ab}
S_2T_4	29.00^{b}	3.10^{a}	10.11^{cde}	32.00^{cd}	92.64^{ab}	60.67^{def}	117.65^{a}
S_3T_1	19.33^{g}	2.50^{de}	10.50^{cd}	30.40^{ef}	92.11^{ab}	63.91^{cd}	117.21^{a}
S_3T_2	21.40^{ef}	2.64^{cd}	11.60^{ab}	29.03^{g}	91.03^{abc}	57.24^{ef}	97.67^{bc}
S_3T_3	26.76^{c}	2.76^{bc}	9.98^{cde}	29.86^{fg}	83.89^{d}	57.84^{ef}	107.53^{ab}
S_3T_4	20.66^{fg}	2.76^{bc}	9.73^{de}	25.93^{h}	89.15^{bcd}	56.91^{f}	107.19^{ab}
S.Em (±)	0.212	0.020	1.008	0.148	1.092	0.903	2.672
CD (P=0.05)	1.351	0.177	0.963	0.948	6.962	5.754	17.034

[a, b, c, d, e, f, g, h] Means bearing different superscript within the column differ significantly (p<0.05)

4. Conclusion

Positive impact of black cumin seed powder supplementation at 2 and 3 percent had been observed on body weight, weight gain, feed intake, feed efficiency, performance index, and carcass weight per bird irrespective of season; however, the impact was more during summer season. Net profit was the highest in control group as compared to black cumin supplemented groups at which positive effect of black cumin seed was not achieved in terms of economics. Effect of season on overall feed intake was significantly (p<0.05) higher during summer season (S_1) followed by winter (S_3) and the least in monsoon (S_2) season. The best feed efficiency and performance index was observed during the winter season followed by monsoon and the least was in summer. The body weight and gain in weight was observed to be in similar trend which was found to be significantly (p<0.05) higher during summer season followed by winter and the least in monsoon season due to effect of season on overall growth and feed parameters. Black cumin seed supplementation had positive influence on the haematology and blood profile of broiler chicken due to treatment effect on Haematological / Biochemical parameters.

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