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Effect of Feeding Different Levels of *Nigella sativa* Seeds (Black Cumin) on Performance, Blood Constituents and Carcass Characteristics of Broiler Chicks

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Abstract: The effect feeding of different levels of crushed and uncrushed *Nigella sativa* seeds (*NSS*) on growth performance, blood constituents and carcass characteristics of Lohman broiler chicks was studied. An experiment with 900 day old chicks was conducted from one to 49 d of age at the poultry farm of Jordan University of Science and Technology. There were 9 dietary treatment groups: control (C), 1.5%, 2.0%, 2.5%, and 3.0%) crushed or uncrushed *Nigella sativa* seeds (C, T1, T2, T3, T4, T5, T6, T7 and T8) respectively. Results showed that chicks fed 1.5% crushed *NSS* had the higher ($P < 0.05$) live body weight (LBW), body weight gain (BWG) and the better ($P < 0.05$) feed conversion ratio (FCR). Feeding ration contains 3.0% crushed and uncrushed *Nigella sativa* seeds reduced ($P < 0.05$) plasma cholesterol and triglycerides concentration, meanwhile 3.0% crushed and uncrushed *NSS* increase ($P < 0.05$) plasma HDL level. Chicks fed 2.0% crushed *NSS* and control rations had the higher ($P < 0.05$) Total plasma protein, while, chicks fed 2.0% uncrushed *NSS* and control rations had the higher ($P < 0.05$) plasma albumin and globulin concentration. The inclusion of different levels of crushed and uncrushed *Nigella sativa* seeds failed to improve ($P < 0.05$) any of the carcass characteristics parameters.

Key words: Broiler, chicks, *nigella sativa*, growth, plasma, carcass

Introduction

The use of antibiotics as growth promoters has been an economically viable method of improving animal and poultry performance for many years (Younis, 1987). Indeed, the European Union (EU) has indicated its intention to remove all growth-promoting antibiotics by, 2006. Therefore, the search for alternatives to antibiotics as growth promoters that can give similar results in improving poultry performance particularly weight gain and feed efficiency or in the prevention or control of infectious diseases is the target of numerous lines of investigation. Medicinal plants such as *Nigella sativa*, *Fenugreek* and *Thymus valgaris*... etc., are economically important. Now a days, there is an increase demand for using these herbal plants in therapy instead of synthetic drugs, which may have adverse effects (Mandour *et al*., 1998). *Nigella sativa* seeds is one of the most popular plants used in this field. The composition and properties of *Nigella sativa* seeds (black cumin) have been fairly investigated and the results of these investigations were reviewed (Houghton *et al*., 1995; EL-Alfy *et al*., 1975; Mahfouz and EL-Dakhakhny, 1960). These researchers reported that *Nigella sativa* seeds, or their extracts have anti-microbial, anti-histaminic, anti-tumour, anti-hypertensive and anti-inflammatory effects. Proximate analysis of *Nigella sativa* seeds showed that carbohydrates content ranged from 23.5-33.2%, crude protein from 20-27% and lipids from 34.5-38.7% (Babyan *et al*., 1978; Abdel-Aal and Attia, 1993; Hedaya, 1996; Salem, 2001). Most properties of *Nigella sativa* seeds are mainly attributed to quinone constituent, compound. Quinonic alkaloids are likely to be involved in pharmaceutical properties. Therefore, *Nigella sativa* seeds appear to be potential multipurpose feed growth promoter and may be promising in improving broiler performance, particularly feed efficiency, weight gain and immune system. This study was mainly designed in order to evaluate the effect of the inclusion of different levels and forms of *Nigella sativa* seeds rations on body weight, body weight gain, feed consumption, feed conversion ratio, blood constituents and carcass characteristics of broiler chicks.

Materials and Methods

Birds, housing and feeding: An experiment with 900-d old unsexed Lohman broiler chicks was conducted from 1-49 d of age. Chicks were weighed and the average weight was recorded as day-old weight. Chicks were then randomly assigned into 9 treatment groups. Each group was divided into 4 equal replicates. The chicks were housed in floor pens (1.25 x 2 m each) in open sided house. Starter diets contain 22.03-22.26% crude protein with 2970.46-2978.11 K_{cal} ME were offered *ad-libitum* from 1-28 d of age. Then a finisher diets contains 18.39%-18.59% crude protein (CP) and 3171.21-3176.70 K_{cal} ME were offered *ad-libitum* from 29-49 d of age. All diets were formulated to cover the nutrient requirements of NRC (1994).

Ingredients and the composition of the experimental diets are shown in Table 1. First group served as a control, while, the other groups fed diets contains 1.5%, 2.0%, 2.5% and 3.0% crushed or uncrushed *Nigella sativa* seeds (black cumin).

Standard management practices of commercial broiler production were applied. Chicks were vaccinated against New-castel disease (ND) and Infectious Bronchitis (IB) in mixed vaccine at 7 and 21 d of age and against Infectious Bursal disease (IBD) at 13 d of age. Anticoccidial compounds were used as a preventive dose from 22-29 days of age.

Rations and *nigella sativa* seeds analysis: Randomized samples from each formulated rations and *Nigella sativa* seeds were taken, grounded and 0.5 g were used for the chemical determination of nitrogen (N), ether extract (EE), dry matter (DM) and ash using the procedure described by AOAC (1990). Crude protein was calculated by multiplying N content by 6.25. Results are shown in Table 2. Body weight gain (BWG) and feed conversion ratio (FCR) were then calculated. Mortality was recorded daily and mortality rate (MR) at the end of the experiment was calculated.

Blood constituents assay: Total plasma cholesterol was assayed by a JENWAY, 6105µ v/v spectrophotometer with commercial Kits (Bio Mereuxas, France). Triglycerides was also assayed by using the same spectrophotometer with commercial Kits (Triglyceride-GPO method) Biolabosa, France. Triglyceride is determined after enzymatic hydrolysis with lipase. Indicator is quinoneimine formed from hydrogen peroxide, 4-aminoantiyring and 4-chlorophenol under catalytic influence of peroxidase. High density lipoprotein (HDL) was obtained using commercial Kits (Labkit, Chemelex, SA, Barcelona). Plasma total proteins were analyzed by using commercial Kits (Biuret Method, Chemelex, SA, Barcelona). The total protein determination is that protein gives an intensive violet-blue complex with copper salts in an alkaline media. Iodine was included as antioxidant the intensively of color formed is proportional to the total protein concentration in the sample. Commercial kits also used for albumin determination (Bromocresol green test, Labkit, Chemelex, SA, Barcelona).

Carcass characteristics:

Dressing percentage: At the end of the experiment 5 chicks from each replicate within each treatment (15 chicks/treatment) were randomly selected and weighed to obtain live body weight, then slaughtered by a sharp knife for complete bleeding and feather was plucked. Head, viscera and shanks were removed. Carcass was left for one hour to remove excess water and allowed for over night in refrigerator at 4±1°C and weighed. Dressing percentage was calculated without giblets using the following equation:

$$\text{Dressing percentage} = \frac{\text{Carcass weight}}{\text{Live body weigt}} \times 100$$

Carcass was then portioned. Breast and legs were obtained and weighed. Data from these measurements were used to calculate the percentage of part to the carcass weight. Breast and leg meat were chemically analyzed for moisture, crude protein (CP), total lipids according to AOAC, 1990 and the values were expressed on dry matter basis.

Heart, gizzard and liver were weighed and the weight of each part was calculated as percentage of the carcass weight.

Statistical analysis: All data were analyzed using the General Linear Models procedures of SAS (SAS Institute, 1990). Duncan's New Multiple Range Test was used to test mean differences at ($P < 0.05$).

Results

Growth performance: Table 3 presents the mean±SE of live body weight (BW), body weight gain (BWG), cumulative feed consumption (CFC) and feed conversion ratio (FCR) of broiler chicks fed different levels of crushed and uncrushed *Nigella sativa* seeds rations at 49 days of age.

Results showed that chicks fed 1.5% crushed *NSS* had the higher ($P < 0.05$) live body weight, body weight gain and improved ($P < 0.05$) feed conversion ratio compared with the control group or other dietary treatments. Meanwhile, chicks fed 2.5% uncrushed *NSS* had higher ($P < 0.05$) cumulative feed consumption compared with the other dietary treatments (control, 1.5%, 2.0%, 2.5%, 3.0% crushed *NSS* and 1.5%, 2.0% and 3.0% uncrushed *NSS*.

Plasma metabolites: The results of plasma total protein, albumin, globulin, HDL, cholesterol and triglycerides are summarized in Table 4.

The present results showed that chicks fed the control and 2.0% crushed *NSS* had the higher ($P < 0.05$) total plasma protein values compared with the other dietary treatments with the exception of 2.5% crushed *NSS* and 1.5% uncrushed *NSS*. On the other hand chicks fed control and 2.0% uncrushed *NSS* recorded the higher ($P < 0.05$) albumen and globulin concentration compared with all other dietary treatments.

Nevertheless, the present results showed that feeding broiler chicks 3.0% crushed *NSS* and uncrushed *NSS* reduce ($P < 0.05$) plasma cholesterol and triglycerides compared with broiler chicks fed control, 1.5%, 2.0% and 2.5% crushed *NSS*. Meanwhile, chicks fed ration contains 3.0% uncrushed *NSS* recorded the higher ($P < 0.05$) HDL.

Table 1: Ingredients and composition of experimental rations

	Starter rations					Finisher rations				
Ingredients	control	1.5%	2.0%	2.5%	3.0%	control	1.5%	2.0%	2.5%	3.0%
Yellow corn	60.25	59.75	59.25	59.25	59.70	65	65	63.75	64.25	64.35
S.B.M	33.5	32.5	32.25	32	32.75	25	24.75	24.75	24	23.90
Concentrate	2	2	2	2	2	2	1.5	1.5	1.5	1.5
Nigella sativa	0	1.5	2	2.5	3	0	1.5	2	2.5	3
Sunflower oil	0.5	1	1.25	1.25	1.15	3.3	3.5	4	4	4
Dicalcium phosph	1	1	1	0.75	0.7	1.45	1	1	1	0.75
Vit. M Premix	1.25	1	1	1	0.7	1.5	1	1	1	1
$CaCo_3$	1.25	1	1	1	0.75	1.5	1.5	1.5	1.5	1.25
NaCl	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100	100	100	100	100
Feeding value:										
a) Calculated:										
C.P%	22.26	22.08	22.04	22.03	22.05	18.59	18.56	18.56	18.39	18.43
ME/kg	2976.32	2978.11	2977.06	2970.67	2970.46	3176.7	3171.21	3175.6	3173.06	3173.83
b) Analyzed:										
C.P%	22.25	22.25	22.3	22.21	22.25	18.57	18.57	18.53	18.60	18.55

Table 2: Proximate analysis of *Nigella sativa* seeds (as fed)

Nutrient	%
Moisture%	4.40
Dry matter%	95.60
Crude protein (CP)%	22.75
Ether extract (EE)%	36.25
Ash%	4.45

*Values in the table represent an average of three samples.

The effect of feeding different levels (1.5%, 2.0%, 2.5% and 3.0%) crushed or uncrushed *NSS* on dressing, breast, leg and internal edible organs percentage (liver, heart and gizzard) are summarized in Table 5. Results of the present experiment showed that the inclusion of 1.5%, 2.0%, 2.5% and 3.0% crushed and uncrushed *NSS* failed to improve ($P < 0.05$) any of the measured parameters. However, feeding broiler chicks rations contains 3.0% uncrushed *NSS* gave numerically the higher dressing and breast percentage, while, 2.5% uncrushed *NSS* gave numerically the higher leg percentage. Moreover, chicks fed ration contains 2.0% uncrushed *NSS* had numerically the higher liver and gizzard percentage. On the other hand chicks fed ration contain 2.5% crushed *NSS* had numerically the higher heart percentage.

Table 6 represents the chemical composition of breast and leg meat of broiler chicks fed different dietary treatments (control, 1.5%, 2.0%, 2.5% and 3.0% crushed or uncrushed *NSS*). The tabulated results showed that breast meat of broiler chicks fed rations contains 1.5% crushed or uncrushed *NSS* had the higher ($P < 0.05$) dry matter and protein percentage. Compared with control, 1.5%, 2.0%, 2.5%, 3.0% crushed *NSS*, 2.5% and 3.0% uncrushed *NSS*. Meanwhile, breast meat of chicks fed rations contains 2.0% crushed *NSS*, 1.5% and 3.0%uncrushed *NSS* had the higher ($P < 0.05$) crude protein percentage. Moreover, breast meat of chicks fed rations contain 2.5% crushed *NSS*, 1.5% and 2.0% uncrushed *NSS* had the higher ($P < 0.05$) ether extract percentage.

However, the present results showed that the leg meat of chicks fed rations contains 2.0% crushed *NSS* had the higher ($P < 0.05$) dry matter percentage. The same results showed that leg meat of broiler chicks fed 1.5%, 2.0% crushed and 1.5% uncrushed *NSS* had the higher ($P < 0.05$) crude protein percentage. Moreover, broiler chicks fed 205% and 3.0% crushed or uncrushed *NSS* gave the higher ($P < 0.05$) ether extract in leg meat compared with control and 1.5% and 2.0% crushed or uncrushed *NSS*.

Discussion

Results of the present study showed that the inclusion of 1.5% crushed *NSS* in broilers ration improved live body weight (LBW), body weight gain (BWG) and feed conversion ratio (FCR). The obtained results confirmed the previous findings of several researchers (Ghazala and Ibrahim, 1996; Abou-Egla *et al.*, 2001; EL-Ghammry *et al.*, 2002; Tollba and Hassan, 2003). Furthermore, Hassan *et al.*, 2004 reported that broiler chicks fed rations includes 0.2% crushed *NSS* had the higher final live body weight and body weight gain at 49 days of age compared with control group. Such improvement may be attributed to the biological functions of *NSS* components such as *nigella*, *thymoquinone* and *thymohydoquinone*, which shown to posses anti-microbial and pharmacological activities (Mahfouz and EL-Dakhakhny, 1960). Moreover, *NSS* had potent effect towards protection from decrease in hemoglobulin and leucocytes count and its inhibitor against aflatoxin formation (Nair *et al.*, 1991).

However, the improvement in LBW, BWG and FCR noticed in the present study from feeding rations contains low level (1.5%) of crushed *NSS* was in harmony with finding of Mandour *et al.* (1998), who reported that low doses of *NSS* increased thyroxin concentration, which means that *NSS* had an effect on thyroid gland hormones which known to increase the metabolic rate.

Table 3: Means ±SE of live body weight, body weight gain, cumulative feed consumption and feed conversion ratio of broiler chicks fed different levels of *Nigella sativa* seeds either crushed or uncrushed

Treatment	Live body weight	Body weight gain	Cumulative feed consumption (g)	Feed conversion ratio (g)
Control	1842.2^{b}	1803.7^{b}	3872.50^{ab}	2.10b^{c}
Crushed *NSS*				
1.5% (T1)	1931.36^{a}	1892.86^{a}	3785.80^{abc}	1.95^{d}
2.0% (T2)	1812.95^{bc}	1774.45^{bc}	3735.40^{d}	2.06^{cd}
2.5% (T3)	1821.57^{bc}	1783.07^{bc}	3810.20^{cd}	2.09^{c}
3.0% (T4)	1836.15^{b}	1797.65^{b}	3825.40^{c}	2.08^{c}
Uncrushed *NSS*				
1.5% (T5)	1817.35^{bc}	1778.85^{bc}	3745.65^{c}	2.06^{cd}
2.0% (T6)	1715.25^{d}	1676.75^{d}	3805.40^{cd}	2.22^{a}
2.5% (T7)	1793.81^{bc}	1755.30^{bc}	3927.50^{a}	2.19^{a}
3.0% (T8)	1775.30^{c}	1736.80^{c}	3835.35^{bc}	2.16^{ab}
±SE	30.05	30.05	30.60	0.04

^{a,b,c,d}Means ±SE with different superscripts in the same column are significantly different at ($P < 0.05$).

Table 4: Means ± SE of plasma metabolites of broiler chicks fed rations contain different levels of crushed and uncrushed *Nigella sativa* seeds at 49 days of age

Treatment	Cholesterol mg/dl	Triglycerides mg/dl	HDLmg/dl	Total Protein mg/dl	Albumen mg/dl	Globulin mg/dl
Control	154.65^{a}	78.95^{b}	68.15^{d}	3.15^{a}	1.37^{a}	1.77^{a}
Crushed *NSS*						
1.5% (T1)	130.55^{c}	88.25^{a}	69.35^{d}	2.65^{b}	1.08^{bc}	1.48^{b}
2.0% (T2)	127.37^{c}	85.76^{a}	76.35^{c}	3.10^{a}	1.08^{bc}	1.35^{b}
2.5% (T3)	136.50^{bc}	87.75^{a}	47.25^{e}	2.89^{ab}	1.18^{b}	1.50^{ab}
3.0% (T4)	112.75^{d}	45.20^{e}	52.00^{e}	2.15^{c}	1.03^{c}	1.05^{c}
Uncrushed *NSS*						
1.5% (T5)	131.80^{c}	62.40^{bc}	65.12^{d}	2.76^{ab}	1.00^{c}	1.03^{c}
2.0% (T6)	143.20^{b}	89.35^{a}	66.37^{d}	2.39^{bc}	1.40^{a}	1.85^{a}
2.5% (T7)	120.30^{cd}	57.15^{c}	82.50^{b}	2.62^{b}	1.17^{b}	1.07^{bc}
3.0% (T8)	118.15^{d}	42.50^{e}	89.45^{a}	2.57^{b}	1.21^{b}	1.47^{b}
±SE	6.85	7.15	4.10	0.35	0.15	0.25

^{a,b,c,d,e}Means ±SE with different superscripts in the same column are significantly different at ($P < 0.05$).

On the other hand EL-Alfy *et al*. (1975) reported that the cholorelic effect of crushed *NSS* oil produce a definite increase in bile flow. Nevertheless, bile flow is an emulsifying agent and because it activates pancreatic lipase, it aids in the digestion and absorption of fat and fat-soluble vitamins (Crossland, 1980). Similar results were also reported by previous authors (Horton *et al*., 1991; Nasser *et al*., 1998; Hassan *et al*., 2004). Moreover, the improvement in LBW, BWG and FCR may be due to the presence of fat-soluble unidentified factors and vit. F group (a mixture of essential fatty acids including linolenic, linoleic and arachidonic acid) in supplemented herbal feed additives, which have been essential for growth (Murray *et al*., 1993). Atta, 2003 reported that the fatty acid profiles of plant glycolipids fractions from *Nigella sativa* seeds is linoleic acid (C 18:2 n-6) was the dominant fatty acid, followed by olic acid (C 8:1 n-9).

In a recent study on Japanese quails Abu-EL-Soud (2000) demonstrated that birds fed on a ration supplemented with 2.0% crushed *NSS* and 1.0% *Nigella sativa* oil had the higher final body weight, total weight gain at 49 days of age, which protect the present findings. This improvement may be due to the antimicrobial effect of *NSS* (Rathee *et al*., 1982; Hanafy and Hatem, 1991).

On the other hand, Osman and EL-Barody (1999) found that the inclusion of *NSS* in broiler chicks ration failed to improve their growth performance. This result was in harmony with that Sultan (1999) but not with our present results.

Sultan (1999) reported insignificant effect of *Nigella sativa* cack as a feed additive on body weight of broiler chicks.

Blood constituents: The present results showed that broiler chicks fed ration contains 3.0% crushed or uncrushed *NSS* had significantly the lower Plasma cholesterol and triglycerides. Meanwhile, broiler chicks fed ration contains the higher plasma HDL concentration when compared with the other dietary treatments (control, 1.5%, 2.0% and 2.5% crushed and uncrushed *NSS*).

Mandour *et al*. (1998) and EL-Ghammry *et al*. (2002) stated that there was a decrease in plasma cholesterol for chicks fed diets contains 0.5% *NSS*. Moreover, the same author reported a decrease in plasma HDL concentration resulted from feeding chicks the same level (0.5%) of *NSS*.

Table 5: Means ±SE of dressing, breast, leg, liver, heart and gizzard percentage of broiler chicks fed different levels of crushed and uncrushed *Nigella sativa* seeds at 49 days of age

Treatment	Dressing%	Breast%	Leg%	Liver%	Heart%	Gizzard%
Control	68.15	14.50	15.36	3.20	0.72	2.65
Crushed *NSS*						
1.5% (T1)	68.35	15.20	15.05	3.42	0.70	2.55
2.0% (T2)	67.90	14.65	15.30	3.35	0.78	2.63
2.5% (T3)	66.95	14.75	15.27	3.20	0.85	2.70
3.0% (T4)	66.45	14.52	15.38	3.32	0.74	2.65
Uncrushed *NSS*						
1.5% (T5)	67.75	14.35	15.40	3.24	0.71	2.61
2.0% (T6)	68.50	14.75	15.00	3.57	0.76	2.86
2.5% (T7)	68.45	14.80	15.48	3.27	0.70	2.72
3.0% (T8)	69.00	15.25	15.06	3.22	0.75	2.57
±SE	1.35	0.45	0.40	0.15	0.05	0.08

Table 6: Means ±SE of chemical composition of breast and leg meat of broiler chicks fed different levels of crushed and uncrushed *Nigella sativa* seeds at 49 days of age

	Breast meat			Leg meat		
Treatment	Dry Matter%	Crude Protein%	Ether Extract%	Dry Matter%	Crude Protein%	Ether Extract%
Control	25.38^{bc}	22.11^{b}	2.06^{d}	24.40^{cd}	20.12^{ab}	5.22^{b}
Crushed *NSS*						
1.5% (T1)	27.20^{a}	23.14^{a}	2.03^{d}	25.55^{b}	20.71^{a}	4.95^{c}
2.0% (T2)	25.22^{c}	22.09^{bc}	2.34^{c}	26.34^{a}	20.67^{a}	4.86^{c}
2.5% (T3)	25.83^{bc}	21.39^{c}	2.64^{b}	26.13^{a}	19.72^{b}	5.34^{a}
3.0% (T4)	26.38^{ab}	21.51^{c}	3.15^{a}	24.83^{c}	19.87^{b}	5.98^{a}
Uncrushed *NSS*						
1.5% (T5)	27.63^{a}	23.39^{a}	2.34^{c}	25.44^{b}	20.40^{a}	5.15^{b}
2.0% (T6)	26.18^{b}	22.35^{b}	2.30^{c}	25.03^{c}	20.25^{ab}	5.57^{ab}
2.5% (T7)	25.93^{bc}	22.04^{bc}	2.94^{a}	25.63^{b}	19.12^{c}	6.14^{a}
3.0% (T8)	26.23^{b}	22.34^{b}	3.04^{a}	24.27^{cd}	18.05^{d}	5.92^{a}
±SE	0.45	0.35	0.25	0.49	0.38	0.34

^{a,b,c,d}Means ±SE with different superscripts in the same column are significantly different at ($P < 0.05$).

However, the decrease in plasma cholesterol level may be attributed to the high content of *NSS* from un-saturated fatty acids which may stimulate the cholesterol excretion into the intestine and the oxidation of cholesterol to bile acids (Khodary *et al.*, 1996). On the other hand Abou-Egla *et al.* (2001) revealed that the concentration of plasma cholesterol was decreased with feeding broiler chicks a ration contains high level (5%) of *NSS*.

Mandour *et al.* (1998), suggested that plasma HDL level was increased by feeding broiler chicks low levels (0.5% and 1.0%) *NSS* and decreased with high levels (4% and 5%). This result was disagree with that obtained by EL-Kaiaty *et al.* (2002), who reported that adding 1.0% of *NSS* to broiler chick rations decreased plasma HDL concentration by 23% compared with control group. These results were in harmony with that obtained by Mandour *et al.* (1998), who reported that feeding broiler chicks low levels of *NSS* for short duration has non-toxic effect on liver or kidneys as conformed by an improvements of enzymatic activities that decreased cholesterol and triglycerides concentration.

Moreover, results of the present study showed that broiler chicks fed rations contain 2.0% crushed and uncrushed *NSS* and control basal rations had the higher significantly plasma total protein compared with 1.5%, 2.5% and 3.0% crushed and uncrushed *NSS*. Meanwhile, chicks fed rations contains 2.5% crushed *NSS*, 2.0% uncrushed *NSS* and control basal rations recorded the higher significantly plasma albumin and globulin concentrations compared with 1.5%, 2.0% and 3.0% crushed and uncrushed *NSS*.

Hassan *et al.* (2004) demonstrated that feeding Hubbard broiler chicks rations supplemented with 0.2% crushed *NSS* caused insignificant decrease in total protein and significant decrease in plasma albumen concentration. These authors concluded that nigellones founded in *NSS* depressed protein content because of it is suppression effects on thyroid gland that decreased plasma albumin.

However, The increase in the total plasma protein and globulin resulted from feeding broiler chicks fed ration contains 2.5% uncrushed *NSS* was in agreement with Nasser *et al.* (1998), who reported that total plasma protein as well as albumin and globulin were higher significantly when broiler chicks fed rations contains 2% and 3% of *NSS* in hot climate. Meanwhile, those previous results were in harmony with results of our present experiment.

The increase in plasma albumin and globulin cleared in the present results from feeding broiler chicks rations

contains 2.5% crushed *NSS* and 2.0% uncrushed might be attributed to the immuno-stimulant effects of *NSS*. Moreover, the present results were also in agreement with those of EL-Ghamry *et al.* (2002) who indicated that plasma total protein, albumin and globulin of Hubbard broiler chicks fed on 0.4% *NSS* were closed to those of control group.

On the other hand Abou-Egla *et al.* (2001) reported opposite results with growing Japanese quail fed dietary crushed *NSS*.

Carcass characteristics: The present results showed that the inclusion of different levels (1.5%, 2.0%, 2.5% and 3.0%) of crushed or uncrushed *NSS* in broiler chicks rations did not affect significantly any of carcass characteristics parameters measured (dressing percentage, breast and leg meat percentage. The present findings were in agreement with previous finding of EL-Ghammry *et al.* (2002). These authors reported that feeding broiler chicks rations contain 0.2% or 0.4% crushed *NSS* did not improve breast meat percentage compared with control groups. Moreover, the same authors reported significant decrease in dressing percentage of chicks fed rations contains low levels (0.2% and 0.4%) of crushed *NSS*. The finding was also recorded by Abdel-Azeem *et al.* (1999); Abu-EL-Soud (2000). Nevertheless, Hassan *et al.* (2004) found that feeding Hubbard broiler chicks rations includes 0.2% mixture of 1:1:1 crushed *Thyme*, *Cinnamon* barks and *Niglla sativa* seeds increase significantly dressing percentage compared with control groups.

The same trends of results were also noticed with edible organs. The inclusion of 1.5%, 2.0%, 2.5% and 3.0% crushed or uncrushed *NSS* did not improve liver, gizzard and heart of broiler chicks. The present finding was in agreement with Nasser *et al.* (1998), who reported that no significant changes in liver, heart and spleen weight of Baladi chicks received different level of *Niglla sativa* seeds.

However, the present findings were not in agreement with previous findings of different authors (Abdel-Malak *et al.*, 1995; Abdel-Azeem, 1999; Tollba and Hassan, 2003), who reported that finding broiler chicks ratios contains different levels of *Niglla sativa* seeds had significant effect on the relative weight of liver and heart.

Breast and leg meat chemical composition: The present results showed that breast meat of broiler chicks fed rations contains 1.5% crushed and uncrushed *Niglla sativa* seeds had the higher ($P < 0.05$) dry matter and crude protein percentage compared with the other dietary treatments. While, 2.5% and 3.0% uncrushed *NSS* plus 3.0% crushed *NSS* gave the higher content of ether extract in breast meat.

Concerning leg meat chemical composition, it can be noticed from the present results that feeding chicks a ration contains 2.0% and 2.5% crushed *NSS* resulted in increasing dry matter percentage, while crude protein percentage increased by feeding broiler chicks 1.5%, 2.0% crushed *NSS* and 1.5% uncrushed *NSS*. Meanwhile, 2.5% and 3.0% of crushed and uncrushed *NSS* increased significantly ether extract level.

Unfortunately, from the viewpoint of broiler chicks carcass characteristics and chemical composition breast and leg meat there is a scarcity in information in the literature about these parameters.

However, it can be concluded that feeding low levels (1.5%) of *NSS* improved performance characteristics in terms of LBW, BWG and FCR. More studies required in this field to confirm the present results.

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