Effect of *Nigella sativa* seeds on growth performance, blood parameters, carcass quality and antibody production in Japanese quails

B. Shokrollahi* and B. Sharifi

Department of Animal science, Agriculture School, Sanandaj branch, Islamic Azad University, Sanandaj, Iran
*Corresponding author: Email: Borhansh@iausdj.ac.ir, Borhansh@gmail.com; Phone: +98 8733288661; Fax: +98 8733288677

Journal of Livestock Science (ISSN online 2277-6214) 9: 56-64
Received on 8/12/2017; Accepted on 06/4/2018

Abstract

To evaluate the effects of different levels of *Nigella Sativa* Seeds (NSS) in Japanese quail rations on performance, some blood parameters, carcass quality and antibody production to sheep red blood cells (SRBC), totally, 240 one-day old quails were allocated to four dietary treatments (with 4 replicates of 15 quail chicks each) in 4 levels of NSS (basal diet with 0% (control), 0.5% (treatment 1), 1% (treatment 2) and 1.5% (treatment 3)) for 6 weeks. Blood samples were collected for biochemical and hematological analysis at 42 days of age. Two birds per replicate were slaughtered for determination of carcass and organ weights at 28 and 42 days of age. Weight gain and feed conversion ratio were significantly different among treatments at all stages of the experiment ($P<0.05$). Treatment 3 chicks had the higher feed intake in comparison with other treatments at 0-21 days ($P<0.05$) but there were not any differences in feed intake at 21-42 or 0-42 days ($P>0.05$). Cholesterol and triglycerides levels were significantly decreased in treatments 2 and 3 ($P<0.05$). Significantly lower LDL amounts and higher RBC counts were observed in chicks given NSS compared to control group ($P<0.05$). The concentrations of albumin, total protein, HDL, VLDL, Hb and PCV and the relative weight of internal organs (except Bursa at 42 days) were not significantly affected by the NSS ($P>0.05$). The relative weight of Bursa and antibody titers to SRBC significantly increased at 42-days ($P<0.05$). It is concluded that NSS had significant effects on weight gain, FCR, LDL, RBC and weight of Bursa of quail chicks.

Keywords: *Nigella Sativa* seeds, blood parameters, antibody, quail; *Cotumix japonica*

Introduction

The risk of acquiring antibiotic-resistant bacteria and the likelihood of transmission to humans led to prohibition of antibiotic use in livestock and poultry nutrition. Therefore, animal nutrition scientists worked on alternative materials. Studies have shown that herbs improved feed conversion rate (Lee *et al.*, 2003), immunity (Akhtar *et al.*, 2003) and nutrient digestibility (Toghyani *et al.*, 2010) in poultry. *Nigella sativa* seeds (NSS) had been used by the ancient Egyptians and Greek physicians to treat headaches, asthma, allergies and improve immunity (Dattner, 2003). The NSS main ingredients are thymoquinine, thymohydroquinone, thymol and carvacrol (El-Fatatry, 1975; Morikawa *et al.*, 2004) which are the major secondary metabolites of terpenes. Thymoquinine is effective for treating of inflammatory disorders and cancer (Woo *et al.*, 2012) and has anti-bacterial (Ferdous *et al.*, 1992; Harzallah *et al.*, 2011) and anticonvulsant effects (Akhondian *et al.*, 2011) and also inhibitory effect on the end product of some biosynthetic pathways (Losso *et al.*, 2011) and has positive effects on the gastrointestinal tract (Magdy *et al.*, 2012). NSS is a source of essential fatty acids (mainly linoleic acid and oleic acid) (Nickavar *et al.*, 2003), vitamins, minerals, essential amino acids and carbohydrates (predominantly, glucose, xylose, arabinose and rhamnose) (Al-Jassir, 1992). NSS has shown many pharmacologic effects such as antibacterial (Ferdous *et al.*, 1992), antitumor (David *et al.*, 1998), anti-inflammatory effects (Houghton *et al.*, 1995; Mutabagani & El-Mahdy, 1997) and NSS is a reliever (Khanna *et al.*, 1993), hypoglycemic (Al-Hader *et al.*, 1993) and immune stimulating herb. NSS is a miraculous plant because of large number of pharmacological and therapeutic effects (Naz, 2011). NSS utilization has displayed some effects on broiler (Al-Homidan *et al.*, 2002; Guler *et al.*, 2006; Ziad *et al.*, 2008) and layer performances, egg quality (Akhtar *et al.*, 2003) and quails performance and carcass traits and blood parameters (Al-Hader *et al.*, 1993). But, the findings of different studies are contradictory.

The present experiment was performed to study the effects of powdered NSS on performance, some blood parameters, carcass characteristics and antibody production against Sheep Red Blood Cells (SRBC) of Japanese quail chicks.

Materials and Methods

Experimental treatments and management

This experiment was carried out in a quail farm in Sanandaj with latitude (35.3N) and longitude (46.9E). Totally, 240 one-day old quails were distributed among 4 treatments with 4 replicates of 15 quail chicks in each based on a completely randomized design. The experimental groups consisted of control (basal diet + 0% Nigella powder), treatment 1 (basal + 0.5 % Nigella powder), treatment 2 (basal diet +1% Nigella powder), and treatment 3 (basal + 1.5% Nigella powder). NSS was crushed after drying completely and mixed with other dietary components based on NRC 1994 nutritional requirement calculations (Table 1). During the experimental period (42 days), quail chicks had *ad libitum* accessibility to feed and water. Environmental temperature was decreased from 33°C from day 1 to 20°C (±1) on day 21 and kept at this temperature until slaughter.

Data collection and samplings

This study conducted for 42 days and the weightings of birds were done weekly and daily gain and feed conversion rate were calculated. Mortality was recorded as it occurred. At the age of 28 and 42 days, 2 chicks per replicate were randomly selected and slaughtered and weight of carcass, breast, thigh, bursa of fabricius, liver, spleen, heart and gizzard were measured with a digital scale with an accuracy of 0.001. To test humoral immunity of quail chicks against SRBC, the blood sampling was taken from three sheep in EDTA tubes. After separation, red blood cells were washed three times in phosphate-buffered saline and finally a 5% suspension was prepared in PBS. Injections of SRBC were performed on 14 and 28 days of age, so all the chicks were given 0.025 ml of the above solution intramuscularly and the antibody titers were measured by Hemagglutination Inhibition test. Antibody titers against SRBC were evaluated 7 and 14 days after injections. On 42 days of age, blood samples were collected randomly from 2 birds per replicate in plane tubes. Serum isolated using centrifugation (1300 g) and stored at 4 °C until analysis. At the same age two other birds per replicate were selected and blood samples were collected by syringes containing EDTA to avoid blood clump formation for measuring the red blood cell (RBC), hematocrit (PCV) and hemoglobin (Hb) contents.

Table 1. Ingredient and nutrient composition (g/kg) of the experimental diets

	Control	1	2	3
Ingredients				
Corn	489.95	488	486	484.08
Soybean meal	447.7	445.51	443.3	441.2
Soybean oil	28.62	27.95	27.22	26.61
Dicalcium phosphate	14.11	14.09	14.1	14
Black seed	0.00	5	10	15
CaCO3	8.83	8.64	8.55	8.26
Salt	3.45	3.45	3.45	3.45
Mineral–vitamin premix[1]	5.00	5.0	5.0	5.0
Lysine	1.22	1.24	1.26	1.28
DL-Methionine	1.12	1.12	1.12	1.12
Nutrient composition				
Metabolizable energy kcal/kg	2900	2900	2900	2900
Crude protein	240	240	240	240
Calcium	8	8	8	8
Available phosphorus	3	3	3	3

[1]Provided per kg of diet: Beta-carotene: 5.4 mg; Cholecalciferol: 0.5 mg; Tocopherol: 30 mg; Thiamin: 1.1 mg; Riboflavin: 4.5 mg; Niacin: 30 mg; Pyridoxine: 2 mg; Biotin: 0.5 mg; Folic Acid: 0.5 mg; Cyanocobalamin: 12 mg; Calcium Pantothenate: 10 mg; Choline Chloride: 550 mg; Ferrous sulfate: 50 mg; Copper sulfate: 10 mg; Manganese oxide: 70 mg; Zinc Oxide: 50 mg; Cobalt: 0.2 mg; Calcium iodate: 0.1 mg; Selenium: 0.3 mg per 1 kg of diet.

Control treatment (no addition supplementation); 1= Treatment diet supplemented with 0.5% NSS; 2= Treatment diet supplemented with 1% NSS; Treatment diet supplemented with 1.5% NSS

Albumin and total protein concentrations were determined using a spectrophotometer and the kit package constructed by Pars Azmoon Company, Tehran, Iran. Levels of cholesterol, high-density lipoprotein (HDL), low-density lipoprotein (LDL), very low-density lipoprotein (vLDL), cholesterol, and triglycerides were measured by using the kit package manufactured by Pars Azmoon Company, Tehran, Iran. RBC counts were determined by a hemocytometer method using Natt-Herricksolution; PCV and hemoglobin (Hb) values were measured by microhematocrit and cyanmethemoglobin methods (Kececi *et al.*, 1998).

Statistical analysis

Data were analyzed using a completely randomized design by General Linear Model procedures of SAS 9.1. Duncan's multiple range test was used for mean comparison.

Results

Feed intake, weight gain, and FCR

Differences in weight gain and FCR were statistically significant among treatments at all stages of the experiment. Feed intake was significantly differed at 0-21 days (Table 2), the highest feed intake was observed in treatment 3 ($P<0.05$), but there were not any considerable differences in feed intake at 22-42 or 0-42 days. Treatment 2 showed a significantly greater weight gain and better FCR compared to other treatments at all stages of the experiment ($P<0.05$; Table 2). FCR in quail chicks receiving NSS was approximately lower than control in the entire of the experimental period and treatment 2 had the lowest FCR compared to other treatments.

Serum biochemical factors and hematology factors

Cholesterol and triglycerides levels were significantly decreased in treated groups compared to control treatment ($P < 0.05$). Treatment 2 and 3 had the lowest amount of cholesterol and triglycerides, respectively (Table 3). LDL concentrations were significantly decreased in NSS treated chicks in comparison with control treatment ($P < 0.05$). RBC counts substantially increased in treatments 2 and 3 ($P < 0.05$). There were no significant differences in amounts of albumin, total protein, HDL, VLDL, Hb and PCV among various treatments ($P > 0.05$) although treated chicks had higher concentration of HDL.

Table 2. Feed intake, weight gain and feed conversion ratio (FCR) of quails receiving either control or NSS diets in different periods of the experiment

Performance parameters	Treatments				P-value
	Control	1	2	3	
(0 to 21days)					
Feed Intake (g)	9.6^{b}±0.14	9.5^{b}±0.01	9.3^{b}±0.13	10^{a}±0.07	0.04
Weight gain (g)	3.5^{b}±0.10	3.5^{b}±0.04	4.2^{a}±0.02	3.9^{a}± 0.10	0.01
FCR	2.7^{a}±0.04	2.7^{a}±0.03	2.2^{c}±0.04	2.5^{b}±0.07	0.02
(22 to 42days)					
Feed Intake (g)	18.2±0.08	18.3±0.19	18.5±0.26	18.0±0.15	0.27
Weight gain (g)	5.2^{c}±0.15	5.9^{b}±0.12	6.8^{a}±0.05	5.5^{bc}±0.19	0.02
FCR	3.5^{a}±0.18	3.1^{b}±0.09	2.7^{c}±0.10	3.2^{b}±0.07	0.03
(22 to 42days)					
Feed Intake (g)	18.2±0.08	18.3±0.19	18.5±0.26	18.0±0.15	0.27
Weight gain (g)	5.2^{c}±0.15	5.9^{b}±0.12	6.8^{a}±0.05	5.5^{bc}±0.19	0.02
FCR	3.5^{a}±0.18	3.1^{b}±0.09	2.7^{c}±0.10	3.2^{b}±0.07	0.03
(0 to 42days)					
Feed Intake (g)	14.0±0.03	14.0±0.09	13.9±0.19	14.0±0.10	0.18
Weight gain (g)	4.4^{c}±0.05	4.6^{b}±0.05	5.5^{a}±0.01	4.7^{b}±0.01	0.03
FCR	3.2^{a}±0.03	3.0^{b}±0.01	2.5^{c}±0.02	2.9^{b}±0.04	0.02

Means sharing the different superscript are significantly different from each other (P< 0.05)
Control treatment (no addition supplementation); 1= Treatment diet supplemented with 0.5% NSS;
2= Treatment diet supplemented with 1% NSS; Treatment diet supplemented with 1.5% NSS

Table 3.Serum biochemical and hematology factors of quails receiving either control or NSS diets at the age of 42 days

Blood parameters	Treatments				P-value
	Control	1	2	3	
Cholesterol (mg /dl)	251.7^{a}±11.49	225.0^{ab}±16.29	197.4^{b}±15.59	198.0^{b}±10.40	0.02
Triglycerides(mg/dl)	148.7^{a}±5.15	139.0^{ab}±4.75	122.8±4.18^{c}	128.1^{bc}±4.80	0.02
Albumin (g/dl)	1.12±0.061	1.00±0.053	1.26±0.145	1.26± 0.147	0.32
Total protein (g/dl)	3.41±0.128	3.25±0.121	3.81±0.319	3.65±0.239	0.43
LDL(mg /dl)	174.3^{a}±11.12	105.5^{b}±9.69	108.5^{b}±11.33	114.8^{b}±16.50	0.01
HDL(mg /dl)	67.5±5.50	75.2±5.61	82.5±5.80	79.3±4.79	0.39
VLDL(mg /dl)	17.3±1.02	23.8±1.26	15.2±0.94	28.8±1.30	0.27
RBC (n×106/µl)	2.80^{b}±0.097	3.01^{ab}±0.09	3.30^{a}±0.114	3.27^{a}±0.157	0.03
Hemoglobin(mg /dl)	12.74±0.371	12.54±0.432	13.87±0.523	13.37±0.374	0.57
PCV (%)	38.2±1.11	37.6±1.29	41.6±1.56	40.1±1.12	0.61

Means sharing the different superscript are significantly different from each other (P < 0.05)
Control treatment (no addition supplementation); 1= Treatment diet supplemented with 0.5% NSS;
2= Treatment diet supplemented with 1% NSS; Treatment diet supplemented with 1.5% NSS

Carcass characteristics

The relative weight of bursa was significantly lower in treatment 2 and 3 in comparison with treatment 1 or control treatment at 42 days of age (P<0.05; Table 5) but not at 28 days of age. The weight of carcass, breast, thigh, spleen, liver, heart and gizzard were not markedly affected by NSS at 28 or 42 days (P>0.05; Tables 4 and 5).

Antibody titers against SRBC

The effect of NSS on antibody titers against SRBC was tested four times during the experimental period. No significant differences were observed at 21, 28 and 35 days of the experiment (P>0.05) but treatment 2 had significantly higher antibody titers against SRBC compared to control or treatment 1 at the 42 days of age (P<0.05; Table 6).

Table 4.Carcass characteristics of quails receiving either control or NSS diets at the age of 28 days

Carcass characteristics	Treatments				P- value
	Control	1	2	3	
Carcass%[1]	59.8±1.88	58.5±1.29	61.5±1.26	59.4±2.32	0.89
Breast%[2]	38.6±1.08	40.9±4.77	45.4±2.14	40.5±1.94	0.62
Thigh %[2]	25.0±1.43	26.8±3.25	23.5±1.25	25.0± 1.30	0.23
Bursa%[1]	0.12±0.02	0.11±0.020	0.09±0.001	0.08±0.004	0.09
Spleen%[1]	0.05±0.003	0.05±0.002	0.07±0.10	0.08±0.019	0.16
Liver %	3.1±0.28	3.2±0.26	2.5±0.13	3.0±0.23	0.25
Heart%[1]	0.93±0.083	0.93±0.044	0.96±0.008	0.86±0.070	0.42
Gizzard%[1]	2.26±0.054	2.53±0.266	1.97±0.116	2.27±0.227	0.28

1 percentages are relative to live body weight on 42th day; 2 cut up percentages are relative to carcass weight
Control treatment (no addition supplementation); 1= Treatment diet supplemented with 0.5% NSS;
2= Treatment diet supplemented with 1% NSS; Treatment diet supplemented with 1.5% NSS

Table 5.Carcass characteristics of quails receiving either control or NSS diets at the age of 42 days

Carcass characteristics	Treatments				P- value
	Control	1	2	3	
Carcass%[1]	60.2±1.69	55.6±1.19	60.7±1.74	59.6±3.63	0.23
Breast%[2]	43.4±2.84	42.6±2.80	44.6±1.26	44.0±1.87	0.19
Thigh %[2]	25.2±1.87	24.9±2.20	25.6±0.93	23.8± 0.74	0.18
Bursa%[1]	0.10^{a}±0.011	0.08^{ab}±0.003	0.07^{b}±0.010	0.06^{b}±0.002	0.02
Spleen%[1]	0.05±0.005	0.06±0.016	0.05±0.014	0.06±0.018	0.13
Liver %	2.5±0.24	2.5±0.31	3.0± 0.06	2.6±0.32	0.69
Heart%[1]	0.9±0.03	1.1±0.8	1.1±0.13	0.9±0.06	0.53
Gizzard%[1]	1.8±0.07	1.9±0.16	1.7±0.10	1.8±0.04	0.42

Means sharing the different superscript are significantly different from each other ($P < 0.05$)
1 percentages are relative to live body weight on 42th day; 2 cut up percentages are relative to carcass weight
Control treatment (no addition supplementation); 1= Treatment diet supplemented with 0.5% NSS; 2= Treatment diet supplemented with 1% NSS; Treatment diet supplemented with 1.5% NSS

Table 6. Anti-SRBC titer of quails receiving either control or NSS diets

Treatments	Sampling days			
	21	28	35	42
Control	0.5±0.18	0.4±0.18	1.2±0.31	1.4^{b}±0.18
1	0.7±0.16	0.6±0.26	1.2±0.31	1.5^{b}±0.26
2	0.7±0.16	1.0±0.37	1.4±0.46	2.4^{a}±0.32
3	0.5±0.18	1.1±0.29	2.2±0.36	1.9^{ab}±0.22
P-value	0.32	0.16	0.25	0.03

Means sharing the different superscript are significantly different from each other ($P < 0.05$)
Control treatment (no addition supplementation); 1= Treatment diet supplemented with 0.5% NSS;
2= Treatment diet supplemented with 1% NSS; Treatment diet supplemented with 1.5% NSS

Discussion

Growth performance

In the current experiment, considerably positive effect of NSS on weight gain and FCR was observed. Quail chicks receiving 1.5% NSS had higher feed intake compared to other treatments at 0-21 days of the experiment but significant differences were not seen in feed intake among treatments at 21-42 or 0-42 days of the experiment. In consistent with our results, Denli *et al.* (2004) reported that 60 mg/kg diet of Nigella essential oils had significant effect on performance traits in quails. Moreover, in other studies in broiler chicks (Bölükbasi *et al.*, 2009; Miraghaee *et al.*, 2011; Shewita & Taha, 2011) and quails (Tufan et al., 2015), no effect of Nigella on feed intake has been detected at 0-42 days period. On the other hand, in accordance with these results, AL-Beitawi & EL-Ghousein (2008) suggested that feed intake, weight gain and FCR was improved by Nigella supplementation The body weight in the broilers fed diet with NS was significantly higher than in the control group, but final body weight was not affected. Contrarily, Guler *et al.* (2006) and Saleh (2014) reported that *Nigella sativa* had not any remarkable effect on feed intake at 1-21 days in broilers but enhanced feed intake and improved FCR at 1-42 days period. Al-Mufarrej (2014) and Ghasemi

et al. (2014) suggested that *Nigella Sativa* powder had no effect on different performance traits. The favorable effects of *Nigella Sativa* on growth are thought to be due to high nutritive value as well as pharmacologically active components exist in the seeds (Azeem *et al.*, 2014). NSSs have combination of essential fatty acids, particularly oleic, linoleic and linolenic acids that cannot be made in the body. There are fifteen amino acids make up the proteins of *Nigella Sativa* out of which eight are essential (Takruri & Dameh, 1998). Jamroz & Kamel (2002) stated a stimulating effect of black seeds on digestive system, resulting in better absorption and performance. Inclusion of *Nigella Sativa* in feed increased bile flow rate results in enhanced emulsification that activates the pancreatic lipases which then support fat digestion and absorption of fat soluble vitamins (Mahmoud *et al.*, 2002). The increased growth rate might also be due to antimicrobial effects of the active ingredients of black seed (Gilani *et al.*, 2004).

Serum biochemical factors and hematology factors

Hypocholesterolemic and hypolipidemic properties of black seeds have been reported in animal studies (Toghyani *et al.*, 2010). Current results showed that cholesterol and triglycerides reduced in quail chicks given NSS. In agreement with our results, 10 g NSS/kg diet (Miraghaee *et al.*, 2011; Shewita & Taha, 2011), 10 and 15 g NSS/kg diet (AL-Beitawi & EL-Ghousein, 2008; Yalçın *et al.*, 2012) led to decrease in the amounts of cholesterol and triglycerides. Likewise, Bölükbasi *et al.* (2009) suggested that NSS decreased the level of triglycerides. The sharp decrease in serum triglycerides may be related to the volatile oils of NSS (Thymoquinone and dithymoquinone) (Swamy & Tan, 2000). The choleretic activity of NSS can decrease serum cholesterol and triglycerides concentration (El-Dhakhny *et al.*, 2000) via either lessening synthesis of triglycerides and cholesterol by hepatocytes or by reducing its fractional reabsorption from the small intestine (Brunton, 1996).

Present results showed a decreasing effect of NSS on serum concentration of LDL in quail chicks. In accordance with these results, Akhtar *et al.* (2003) reported that NSS could decrease the serum concentration of LDL in layer hens. Amounts of albumin, serum total protein, vLDL and HDL had not remarkable difference among treatments, although HDL non-significantly enhanced in NSS treated chicks. In contrary with our results, 1.5% NSS significantly increased the concentration of HDL (Akhtar *et al.*, 2003; AL-Beitawi & EL-Ghousein, 2008). In accordance with the results of current study, Tufan *et al.* (2015) found that black cumin seeds and oil had no effect on vLDL, HDL, LDL, albumin, globulin, total protein concentrations in quail chicks.

Blood serum proteins reflects the condition of an organism and the changes occurring to it under the influence of internal and external factors (Toghyani *et al.*, 2010). Serum total proteins and albumin did not influenced by NSS supplementation. The same results were found in the study conducted by Miraghaee *et al.* (2011) who reported that NSS has no significant effect on serum total proteins but in opposition NSS enhanced the amount of serum albumin in broilers. Likewise, plasma total protein, albumin and globulin of Hubbard broiler chicks fed on 4 g/kg black seeds were approximately similar to those of the control group (EL-Ghammry *et al.*, 2002).

RBC counts were significantly greater in quail chicks receiving 1% and 1.5 % NSS. Hb and PCV also were non-significantly higher in the same chicks. Therefore, based on these results, it could be inferred that NSS has probably hematopoietic effect. In harmony with current results, Toghyani *et al.* (2010) suggested that black seeds enhanced RBC, Hb and PCV levels in broilers. The positive effect of black seeds on hematology could be associated with highly active components particularly thymoquinone and thymohydoquinone which have robust antioxidant activities (Arslan *et al.*, 2005) and hence increasing RBC count in NSS treated quail chicks could be related to the dropped lipid peroxide in RBC membrane leading to a decreased susceptibility of RBC to hemolysis (Toghyani *et al.*, 2010).

Carcass characteristics

Results of slaughter characteristics revealed that only the relative weight of bursa at 42-days was significantly affected by 1% and 1.5% NSS. Weight of bursa at 28 days and carcass, breast, thigh, spleen, liver, heart and gizzard was not affected by NSS treatment at 28 and 42 days of age. In consistent with our results, inclusion of 1.5%, 2.0%, 2.5% and 3.0% crushed and uncrushed black seeds in broiler diet failed to have any impact on liver, heart and gizzard relative weights (Toghyani *et al.*, 2010; Yesuf *et al.*, 2017).

Similar to the results of current study, relative weight of bursa significantly enhanced by black seeds supplementation of broiler diets (Shewita & Taha, 2011; Alimohamadi *et al.*, 2014) but dressing percentage, relative weight of liver, spleen, heart and head did not affected by NSS supplementation (Shewita & Taha, 2011). The higher weight of lymphoid organs in chicks receiving NSS may be associated with positive effect of active components of NSS which have antioxidant, antibacterial and anti-inflammatory activities (Arslan *et al.*, 2005; Toghyani *et al.*, 2010).

Antibody titers against SRBC

Antibody titer against SRBC increased in chicks given basal diets with 1% NSS at 42 days, these results are in harmony with Yalçın *et al.* (2012) findings who reported that feeding diets containing yeast autolysate or black cumin seeds increased antibody titers against SRBC in laying hens. Increasing antibody titers may be related to *Nigella sativa* oil components such as thymoquinone, nigellimine, thymol, carvacrol and nigellicine which have beneficial effects in maintaining a physiological balance of immunopotent cells and therefore providing a healthy environment for the immune system.

Conclusions

The *Nigella Sativa* seeds (1%) used in the present study improved weight gain and FCR in quail chicks and also 1 and 1.5% of *Nigella Sativa* seeds had favorable effects on LDL and RBC levels and enhanced the relative weight of bursa and antibody titers against SRBC at 42 days of age. These findings showed that inclusion of 1 and 1.5% *Nigella Sativa* seeds to the diet have a positive effect on growth and some health indices in quail chicks.

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