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Effect of Feeding Powdered Black Cumin Seeds (*Nigella sativa* L.) on Growth Performance of 4-8 Week-Old Broilers

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Abstract: An experiment was conducted in the poultry farm of Al-Shouback University College in the campus of Al-Balqa` Applied University to evaluate the effect of using a medicinal plant seed powder of black cumin (*Nigella sativa* L.) as a natural feed additive on the performance of 4-8 week-old broilers. Two hundred and forty growing broilers at 4 weeks of age were weighed and randomly distributed into four treatments, with 3 replicates. The seed powder of *N. sativa* was daily prepared and mixed with the broiler's finisher diets at rates of 1.0, 1.5 and 2.5% per km of broiler's finisher diet. Control group received a complete finisher diet free of *N. sativa* seed powder and any additive. The experimental diets of *N. sativa* seed powder were offered *Ad libitum* during the age 4-8 weeks of lohman broilers reared in an open-sided poultry house. The results showed that, feeding of the diets with 1 and 1.5% *N. sativa* seeds for a period of 4 weeks was significantly ($p<0.05$) increased the body gain of broilers by 10 and 14.5%, respectively. Broilers fed 1 and 1.5% of *N. sativa* had significantly ($p<0.05$) lower feed to gain ratio than other treatments, the best feed efficiency was achieved by broilers given 1.5% *N. sativa* in their diet. Increasing the feeding rate of *N. sativa* up to 2% was associated with a significant ($p<0.05$) decrease of -2 and -8% in body gain and body weight, respectively. Inclusion of *N. sativa* seeds in the diet reduced the cumulative rate of mortality. Based upon this study, it could be concluded that using the medicinal seed powder of black cumin (*Nigella sativa* L.) as a natural feed additive at a rate of 1.5% revealed positive effects on the performance and survivability of broilers grown at normal conditions in an open sided environment.

Key words: Broiler, essential oil, growth rate, *Nigella sativa*, performance

INTRODUCTION

The increasing cost of meat production is one of the most decremented factors affecting poultry industry in Jordan (Ministry of Agriculture, 2007). In 2007, the annual report of Animal Wealth Department indicated that, increasing the productive cost of meat is mainly due to the increasing cost of broiler feedstuffs which constituted about (80%) of the total productive cost. Therefore, the current research trend is to look for natural by-products of feed resources used as feed additives to increase feed efficiency and growth rate of broilers. In the past, the major growth promoters added to the feed of broilers were antibiotics. However, the current research is looking for natural alternatives to antibiotics because of their residues and subsequent occurrence of antibiotic-resistant bacteria (Clark, 1996; Lee *et al*., 2004; Gulert *et al*., 2006). At present, scientists are working to improve feed efficiency and growth rate of livestock animals using useful herbs (Gill, 1999; Banyapraphatsara, 2007) and some medicinal plant seeds such as black cumin (*Nigella sativa* L.) (Akhtar *et al*., 2003; Gulert *et al*., 2006).

Nigella (*Nigella sativa* L.) is an annual herbaceous plant belonging to the *Ranunculaceae* family (Al-Gaby, 1998). Seeds of *N. sativa* represent the useful product. They are angular, of generally small size (1-5 mg), dark grey or black color. They have been reported to possess a favorable effect on growth rate and health of human and animals (Akhtar *et al*., 2003). Gulert *et al*. (2006) concluded that, black cumin seeds could be considered as an alternative natural growth promoter for poultry instead of antibiotics. The chemical analysis of black seeds showed that, it is a significant source of essential fatty acids, proteins, carbohydrates and other vitamins and minerals. In addition, it stimulates bone marrow and immune cells, protects normal cells against cell destroying effects of viruses and raises the number of anti-bodies producing ß cells (Takruri and Dameh, 1998; Tierra, 2006;

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Salma *et al*., 2007; Durrani *et al*., 2007). Other properties of black cumin seeds are its ability to stimulate the activities of pancreatic digestive enzymes and stimulation of the liver to produce and secrete bile rich in bile acids (Platel and Srinivasan, 2001).

On the other hand, there is little published data concerning with using black cumin as a natural feed additive in poultry nutrition. Therefore, information on the nutritional and healthy benefits of black cumin seeds is of great value and quite in need especially for broiler growers and for those interested in broiler production in Jordan. The objective of this experiment is to evaluate the effect of a medicinal plant seed powder of *N. sativa* used as a natural feed additive on the performance of 4-8 week-old broilers.

Table 1: Ingredients and calculated composition of the basal diets

Ingredients and composition	Starter (%)	Finisher (%)
Yellow Corn	63.8	72.2
Soy bean meal (44% CP)	28	21.5
Fish meal (72% CP)	5	3
Lime stone	1.6	1.6
Dicalcium phosphate	1	1.2
Premix (Vitamin + Minerals)*	0.1	0.1
DL-Methionine	0.2	0.1
Sodium Chloride	0.3	0.3
Coccidiostat	0.05	0.05
Calculated Composition		
Metabolizable Energy (kcal kg^{-1})	2921	2994
Crude Protein (%)	21.4	18.1
Lysine (%)	1.19	0.93
Methionine (%)	0.55	0.33
Methionine and Cystine (%)	0.89	0.62
Calcium (%)	1.09	1.08
Total Phosphorus (%)	0.98	0.68

* Supplies the required vitamins and micro minerals

MATERIALS AND METHODS

Study area: An open-sided poultry house located in the poultry farm of Al-Shouback University College located in the campus of Al-Balqa` Applied University was used in this study. The house consists of 12 identical pens. Each pen measures 2.750×1.40 m, supplied with a trough feeder and automatic-cup drinker. Artificial light, during the night was used which was controlled by the automatic-clock timer switched on at 00190 h and off at 0500 h during the morning time. Environmental conditions inside the house were not controlled and thus varied with the outside natural conditions.

Experiment: A total of 300-day-old lohman broiler chicks were obtained from a local hatchery and reared from 1-4 weeks of age as a group using the standard brooding practices. They reared on litter with feed and water provided *ad libitum* in the brooding house and fed a commercial standard starter diet from zero to 4 weeks of age (Table 1).

At 4 weeks of age, 240 chicken broilers were weighed and moved from the brooding house to the experimental room. Birds were distributed in the different treatments at random basis in a Complete Randomized Design (CRD). There were 3 replicates of 20 birds each, for each treatment in the room; with 10 birds m^{-2}. The birds were allotted to 1 of 4 dietary treatments for a period of 4 weeks.

Mature black cumin (*Nigella sativa* L.) seeds were obtained from a local herbal market. Limited amount of black cumin seeds were milled in a heavy-duty grinder. The powder of black cumin seed was mixed with the Basal-finisher diet (Table 1) at levels of 1.0, 1.5 and 2%. The product diets mixed with the black cumin seed powder were prepared every day and provided to the different broiler treatment groups as a source of feed supplied with different concentrations of a natural feed additive of black cumin seed powder throughout the experimental period that was lasted for 4 weeks. Control group received a complete finisher diet free of black cumin seed powder and any additive (Table 1). All the experimental feed treatments and drinking water were given *Ad libitum* consumption throughout the experimental period.

Chemical composition of black cumin seeds: The proximate analysis of whole mature Nigella seeds showed that the moisture content ranged from 5.52-8.50%, crude protein from 20-26.7%, ash from 3.77-4.86%, total carbohydrates from 23.5-33.2% and ether-extractable lipid from 34.49-38.72% (Takruri and Dameh, 1998; Salma *et al*., 2007).

Statistical analysis: All the means of experimental treatments were analyzed by ANOVA using the General Linear Model (GLM) procedure of Statistical Analysis System (SAS). When a significant *F* statistic was noted, treatment means were separated using Least Significance Differences (LSD) (SAS Institute, 1987).

RESULTS

Data on growth performance of finisher-broiler birds are presented in Table 2. Growth rate of broilers given 1.0 and 1.5% of *N. sativa* seed powder was significantly ($p<0.05$) higher than control group and 2% treatment. The highest growth rate and body gain were achieved by broilers consumed 1.5% of *N. sativa* seed powder. Broilers given 2% of *N. sativa* had significantly ($p<0.05$) the lowest body weight and body gain however, they consumed the least quantity of feed and still the poorest

Table 2: Means±S.E of live body weight (gram/bird), body gain (gram/bird), cumulative feed consumption (gram/bird), cumulative Feed Conversion Ratio (FCR) and mortality rate of 8 week-old broilers fed different levels of Black Cumin *(Nigella sativa)* seed powder

	Black cumin (*N. sativa)* seed powder treatments			
Performance parameter	Control	1.0% *N. sativa*	1.5% *N.sativa*	2.0% *N. sativa*
Live body weight	2493.5^{b}±50	2800.0^{a}±57	2812^{a}±17	2284.0^{c}±4.0
Live body gain	1868.5^{b}±55	2055.0^{a}±22	2140.0^{a}±49	1836.5^{b}±19
Total feed consumption	4422.5^{ab}±27	4469.5^{ab}±69	4572.5^{a}±6.0	4317.0^{b}±67
Cumulative FCR	2.37^{a}±0.06	2.17^{b}±0.01	2.14^{b}±0.05	2.35^{a}±0.013
Cumulative Mortality rate	0.020^{a}±0.0	0.013^{a}±0.0	0.01^{a}±0.004	0.017^{a}±0.011

$^{a, b, c}$ Means with different superscripts in the same row are significantly different at ($p<0.05$)

in feed conversion to body gain when compared with the other *N. sativa* treatments. Cumulative feed to gain ratio was significantly ($p<0.05$) improved at rates of 1 and 1.5% of *N. sativa* seed powder; however the best feed efficiency was recorded in broilers given 1.5% of *N. sativa*. Mortality rate of broilers fed black cumin was lower than control birds.

DISCUSSION

The results of this experiment illustrate clearly positive effects of feeding powdered black cumin (*Nigella sativa* L.) seeds on growth rate, feed intake, feed to gain ratio and mortality rate of broiler birds. In general, broiler performance was significantly ($p<0.05$) improved at the 2 dietary levels of *N. sativa* seeds 1 and 1.5% by which growth rate was increased by 10 and 14.5%, respectively. Broilers supplemented with 1.5% of *N. sativa* in their ration had significantly ($p<0.05$) the highest body gain. It was 2140 Vs 1868.5 gram for the control group. These results are in agreement with the results obtained by Al-Harthi (2004), Manssori *et al.* (2006), Tollba and Hassan (2003), Gulert *et al.* (2006) and Durrani *et al.* (2007) in broilers and Akhtar *et al.* (2003) in layers.

The cumulative values of feed conversion ratios were 2.37, 2.17, 2.14 and 2.35 for broiler fed 0.0, 1.0, 1.5 and 2.0% black cumin, respectively. The results also showed that inclusion of *N. sativa* seed powder in the broiler diet improved feed to gain ratio from 2.37 to 2.14. It was observed that broilers supplemented with 1.5% of *N. sativa* seed powder in their ration had significantly ($p<0.05$) the best feed to gain ratio and were the most efficient in feed utilization than all other treatments, which, consequently, decrease the age of mature slaughtering weight. Al-Harthi (2004) found that the feed conversion ratio was improved by 16.2% of growing broilers supplemented with 0.15% *N. sativa* in their diet. Similarly, Guler *et al.* (2006) found that feed conversion ratio was significantly ($p<0.05$) improved by approximately 5% of broilers given 1% *N. sativa*. Soliman *et al.* (1999), Manssori *et al.* (2006) and Tollba and Hassan (2003) have also obtained similar results in broilers and Akhtar *et al.* (2003) in layers.

The results of this experiment showed that, there was a proportional increase in broiler performance by increasing the level of Nigella seed powder from 10-15 g kg^{-1} of the diet and inversely decreased when the level was increased up to 20 g kg^{-1}. Growth rate and body gain of broilers given 20g of *N. sativa* were significantly ($p<0.05$) decreased by -19 and -16% when compared with the growth rate and body gain of broilers supplemented with 15 g of *N. sativa* per kg of their diet. Guler *et al.* (2006), observed the same finding. They found that, broiler performance was inversely decreased by increasing the level of *N. sativa* from 1-3% in their diet. Durrani *et al.* (2007) were on the contrary, their results showed that, broiler performance at 4% of *N. sativa* was significantly ($p<0.05$) higher than 3 and 2%. Such differences in the optimum level of *N. sativa* supplement in broiler ration may be related to the variations of chemical composition, cultivated regions, geographical and climatic differences where Nigella seeds had been grown. It may also be due to the differences in rearing environment and the age of broiler birds used in the previous studies.

The positive effects of broiler performance in this experiment indicate the nutritive effect of black cumin seed powder, which is expected to be the main responsible factor for the development of growth performance during the finisher period. This might be due to rich nutrients content of unsaturated and essential fatty acids, essential amino acids and carotene in the black cumin seeds. It is also a source of calcium, iron, sodium and potassium that are considered essential cofactors in various enzyme functions (Takruri and Dameh, 1998; Tierra, 2006; Salma *et al*., 2007). In addition, there are other pharmacologically positive effects of *N. sativa* seeds on growth performance of broiler birds, which may also be attributed to its content of 'volatile oil' (Hay and Waterman, 1993) or essential oil (Oyen and Dung, 1999). It has been shown that, the essential oil of black cumin seeds has certain biological functions that could act not only as antibacterial, anti-oxidants (Al-Harthi, 2004) but also as a stimulant of digestive enzymes in the intestinal mucosa and pancreas, that

improve the digestion of dietary nutrients and feed efficiency, subsequently increasing the growth rate (Platel and Srinivasan, 1996; Lee *et al*., 2004).

The cumulative values of mortality rate showed that, feeding of powdered black cumin (*N. sativa*) seeds to growing broilers has been shown to lower mortality rate from 2-1%. The black cumin seed has also been reported to improve immunity, stimulates bone marrow and immune cells (Salem and Hossain, 2000; Al-Ankari, 2005) and increasing both the Packed Cell Volume (PCV) and Hemoglobin (Hb). Moreover, the oil has anti-inflammatory, analgesic, antipyretic, antimicrobial and antineoplastic activity and has a protection against nephrotoxicity and hepatoxicity induced by either disease or chemicals (Abdel-Wahhab and Aly, 2005; Durrani *et al*., 2007). In addition, it decreases blood pressure and increases respiration (Ali and Blunden, 2003). These results could be explained by the effects of pharmacologically active ingredients in the oil extract of *N. sativa*, i.e., Thymoquinone (TQ) and Dithymquinone (DTQ), which are believed to be nigellone, Thymohydroquinone (THQ) and Thymol (THY) (Osman and El-Barody, 1999).

The essential oil content of *N. sativa* seeds has been recognized because of their anti-microbial activity (Deans and Ritchie, 1987; Hammer *et al*., 1999). Helander *et al*. (1998) suggested that, the terpenoids and phenylpropanoids of oil content can penetrate the membrane of the bacteria and reach the inner part of the cell because of their lipophilicity but it has also been proposed that structural properties, such as the presence of the functional groups (Farag *et al*., 1989) and aromaticity (Bowles and Miller, 1993) are responsible for the antibacterial activity. It is thought that membrane perforation or binding is the principle mode of action leading to an increase of permeability and leakage of vital intracellular constituents resulting in impairment of bacterial enzyme systems (Farag *et al*., 1989).

CONCLUSION

In conclusion, the seed powder of *Nigella sativa* L. at a rate of 1.5% has positive effects on growth performance of 4-8 week-old broilers. Moreover, it will decrease the market age and mortality rate, which subsequently decrease the productive cost.

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