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Effect of Adding Different Dietary Levels of Black Cumin (*Nigella sativa* L.) Seed on Productive Performance of Laying Hens

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ABSTRACT

Using natural product in poultry nutrition has lately been increased. This study was conducted to evaluate the effect of adding different dietary levels (0.0, 1.0, 2.0 and 4.0%) of Black Cumin Seed (BCS) on productive performance of layer hens over an 8-week trial period. Two hundred 52 week old Hysex laying hens with similar body weight and laying rate were randomly distributed among 4 treatments with 5 replicates with 10 hens each. Results showed that body weight gain for hens fed a layer diet containing 2.0% BCS was significantly lower than those fed 1.0% BCS. Feed consumption was significantly lower for hens fed a layer diet containing 4.0% BCS than those fed both 0.0 and 2.0% BCS. Feed conversion ratio was significantly better for hens fed a layer diet containing 4.0% BCS than those fed both 0.0 and 1.0% BCS. Egg weight per hen increased significantly for hens fed a layer diet containing 4.0% BCS compared to those fed 1.0% BCS. Hens fed a layer diet containing 2.0 and 4.0% BCS showed significantly darker egg yolk color than those fed both 0.0 and 1.0% BCS. It was concluded that adding BCS into layer diets up to 4.0% could improve the productive performance of laying hens in respect to feed consumption, feed conversion ratio and egg weight.

Key words: Black cumin seed, egg production, laying hens, productive performance

INTRODUCTION

Recently, using the natural feed additives produced from edible plants as antibiotic alternatives in poultry diets have received considerable attention to avoid their harmful effects on animal and human health (Wegener *et al*., 1998; Hertrampf, 2001; Humphrey *et al*., 2002; Shea, 2003). One of the alternatives used as feed additives is black cumin (*Nigella sativa* L.) seed (BCS) grown in Asian and Mediterranean countries. BCS has been used for centuries in many countries for edible and medicinal purposes for human (El Tahir *et al*., 1993).

On the other hand, BCS is used in poultry diets as a feed additive due to their available essential nutrients and a variety of bioactive compounds known such as nigellone (Mahfouz and El-Dakhakhny, 1960); thymoquinone (El-Dakhakhny, 1963) and thymohydroqinone (El-Fatatry, 1975).

These compounds have been reported to have many biological effects including antibacterial, antifungal, antihelminthic, bronchodilator, immune enhancing and antiparasite (El-Kamali *et al*., 1998; Mouhajir *et al*., 1999; Mahmoud *et al*., 2000; Nair *et al*., 2005), antioxidant, hypolipidemic and hypoglycemic effects (Khodary *et al*., 1997; El-Ghmry *et al*., 1997; Swamy and Tan, 2000; Salem, 2005; Ayaz *et al*., 2007; Ragheb *et al*., 2009).

There are a limited number of published studies have investigated the effects of dietary supplementation of BCS on the productive performance of laying hens (Akhtar *et al*., 2003; Aydin *et al*., 2006; El Bagir *et al*., 2006). Therefore, the objective of the present study was carried out to evaluate the effects of adding different dietary levels (0.0, 1.0, 2.0 and 4.0%) of BCS powder on productive performance over an 8-week trial period during the late phase (52-60 week) of laying hens.

MATERIALS AND METHODS

This study was conducted from January till March 2013 at the Experimental Station belonging to Collage of Agriculture and Food Sciences, King Faisal University, Kingdom of Saudi Arabia. Commercial ground BCS powder was purchased from local market, Al Ahsa, Kingdom of Saudi Arabia.

Experimental design: The present study was conducted to evaluate the effect of adding different dietary levels of BCS powder on productive performance of laying hens over a 8-week trial period (52-60 week of age). Two hundred 52 week old Hysex laying hens with similar body weight and laying rate were weighed and randomly distributed in battery group cages (100×60×30 cm^3) among 4 dietary treatment groups with 5 replicates with 10 hens per each replicate in a close sided laying hen house. Hens were fed a layer diet containing 0.0, 1.0, 2.0 and 4.0% BCS. The layer diets used in this study were calculated to be isocloric and isonitrogenus with an average of 2813 kcal metabolizable energy per kg of feed and 18.04% CP (Table 1). Feed and water were provided to all laying hens *ad libitum*. All hens received a 16L:8D light program throughout the whole experimental period.

Measurements: The initial body weight of laying hens was individual measured at the beginning of the experimental study at 52 week of age and the finial body weight was recorded at the end of the experimental study at 60 week of age to calculate the body weight gain. Mortality rate, egg production as number or percentage for each hen, feed consumption (g), feed conversion ratio expressed as total feed consumed (g)/ total egg mass (g) for each replicate were recorded at biweekly intervals from 52-60 week of age. Eggs produced during the last 3 consecutive day at biweekly intervals for each replicate were individually weighed to the nearest 0.01 g to measure egg weight. Collected eggs were stored overnight in the same room before egg specific gravity was determined using the floating method (Harms *et al*., 1990), in which solutions of specific gravity ranged from 1.060 to 1.10 g mL^{-1} in increments of 0.005 were used. Albumen height was measured with an Ames micrometer (model S-6428, Ames, Waltham, MA) at a point halfway between the yolk and the edge of the widest expanse of albumen (USDA, 2000). Haugh units were calculated as follows:

$$\text{Haugh unit} = 100\times\log (H + 7.57 - 1.7W^{0.37})$$

where, H is albumin height of the inner thick albumen (mm) and W is egg weight (g) (Panda, 1996). Egg yolk color was measured using Roche color fan.

Statistical analysis: Data obtained were subjected to one-way ANOVA using the GLM procedure of a statistical software package (SPSS, 2010). Experimental units were based on replicate averages. Treatment means were expressed as Mean±Standard Error of Means (Mean±SEM) and separated ($p\leq 0.05$) using the Duncan's multiple range test (Duncan, 1955).

Table 1: Composition of isocaloric and isonitrogenous layer diets[1] containing 0.0, 1.0, 2.0 and 4.0% Black Cumin Seed (BCS), respectively from 52-60 week of age

	Dietary treatments (BCS)			
Ingredients (%)	0.0%	1.0%	2.0%	4.0%
Corn	65.90	65.20	64.50	63.00
Black cumin seed[2]	0.00	1.00	2.00	4.00
Dehulled soybean meal (48.5%) CP	23.60	23.30	23.00	22.50
Limestone	8.25	8.25	8.25	8.25
Dicalcium PO_4	1.50	1.50	1.50	1.50
Salt	0.25	0.25	0.25	0.25
Trace minerals[3]	0.25	0.25	0.25	0.25
Vitamins[4]	0.25	0.25	0.25	0.25

[1]Average calculated analysis of isocaloric and isonitrogenous layer diets was as followed: CP, 18.49%, ME: 2,859 kcal kg^{-1}, Ca: 3.54%, non-phytin P: 0.40%, methionine: 0.44%, lysine: 1.25%, threonine: 0.77%, tryptophan: 0.28%. [2] The black cumin seed nutrient matrix used was CP: 20.24%, ME: 4067.49 kcal kg^{-1}, EE: 32.86%, CF: 13.93%, starch: 14.90%, sugar: 6.00%, ash: 6.73%. [3]Trace minerals premix added at this rate yields: 149.60 mg Mn, 16.50 mg Fe, 1.70 mg Cu, 125.40 mg Zn, 0.25 mg Se, 1.05 mg I kg^{-1} diet. [4]Vitamin premix added at this rate yields: 11,023 IU vitamin A, 46 IU vitamin E, 3,858 U vitamin D_3, 1.47 mg minadione, 2.94 mg thiamine, 5.85 mg riboflavin, 20.21 mg pantothenic acid, 0.55 mg biotin, 1.75 mg folic acid, 478 mg choline, 16.50 µg vitamin B_{12}, 45.93 mg niacin, and 7.17 mg pyridoxine per kg diet

RESULTS AND DISCUSSION

Body weight and body weight gain: The initial and final body weight of laying hens at 52 and 60 week of age, respectively were not significantly differed among all dietary treatment groups (Table 2). Results published about the effects of dietary BCS on body weight of laying hens were controversial. These results were in agreement with the findings of Aydin *et al.* (2006, 2008) who noted that adding dietary BCS at the levels of 1.0 and 2.0% had no effects on live body weight.

However, El Bagir *et al.* (2006) and Yagoub *et al.* (2010) showed that dietary BCS at the level of 1.0% significantly increased final body weight of laying hens. They concluded that BCS may not have toxic effects at the levels used and they suggested that the increase in body weight in the hens fed BCS is explained by the storage feed energy not used for egg production. Other studies reported that adding BCS to diets elevated body weight in laying hens (El-Kaiaty *et al.*, 2002) and in growing and laying Japanese quail (Zeweil, 1996). In contrast, El-Sheikh *et al.* (1998) and Akhtar *et al.* (2003) noted that adding the BCS into the layer hen diet significantly decreased body weight.

Adding BCS at the level of 2.0% into laying hens diet resulted in a reduction in the body weight gain compared with those fed 1.0% BCS. However no significant differences in body weight gain were observed among laying hens fed either 0.0% or 4.0% BCS and the other two remaining treatments (Table 2). These results were in disagreement with the observations of Yalcin *et al.* (2009) who noted that adding 1.0% BCS into diet did not significantly affect body weight.

Mortality rate: There were no significant differences in mortality rate among all the dietary treatments for the entire experimental period (unshown data) and these findings were in agreement with the observation of Yalcin *et al.* (2012) who noted that adding BCS at the level of 1.5% into layer hen diet for 18 week did not affect mortality rate. However, Akhtar *et al.* (2003) reported that mortality rate decreased from 16.67 to 4.17% by adding BCS into laying hen diet.

Table 2: Productive performance of 52-60 week old layer hens fed 0, 1, 2 and 4% Black Cumin Seeds (BCS)

	Dietary treatments (BCS)			
Parameters	0.00%	1.0%	2.0%	4.0%
Initial body weight (g)	1480.20±33.67	1405.20±45.66	1495.00±32.87	1457.00±39.48
Final body weight (g)	1480.20±33.67	1405.20±45.66	1495.00±32.87	1457.00±39.48
Body weight gain (g)	-89.99±38.73^{ab}	-3.11±40.16^{a}	-142.03±43.35^{b}	-78.88±25.60^{ab}
Egg No. produced per hen	33.80±1.36	33.79±2.79	36.29±1.52	38.44±1.70
Percentage of egg produced per hen	60.37±2.42	60.37±4.99	64.80±2.71	68.63±3.04
Feed consumption (g)	5781. 00±8.66^{a}	5555.96±85.14^{ab}	5703.88±91.21^{a}	5397.92±80.20^{b}
Feed conversion ratio (g feed consumed: g egg mass produced)	2.54±0.09^{a}	2.54±0.18^{a}	2.33±0.10^{ab}	2.04±0.07^{b}
Egg weight (g)	67.73±0.87^{ab}	66.20±0.40^{b}	68.00±0.86^{ab}	69.07±1.18^{a}
Egg mass (g)	2287.14±78.31	2241.39±198.65	2465.19±94.07	2650.88±107.86
Specific gravity	1.07±0.00	1.07±0.00	1.07±0.00	1.07±0.00
Haugh unit	8.09±0.44	8.47±0.22	8.78±0.37	7.67±0.33
Egg yolk color	4.67±0.15^{a}	2.93±0.13^{c}	3.87±0.25^{b}	3.93±0.34^{b}

Means±SEM within a row that do not share a common superscript are significantly different at $p\leq 0.05$

Egg production: There was no significant difference in egg number and percentage produced per hen among all the dietary treatment groups for the entire experimental period (Table 2). Adding BCS into diet had inconsistent effect on the egg production of laying hens. These results were similar to the findings of Yalcin *et al.* (2009) and Yagoub *et al.* (2010) who mentioned that egg production percentage was not significantly influenced by adding 1.0% BCS into layer diet. Aydin *et al.* (2006) noted that adding 1.0 or 2.0% BCS into layer diets had no effects on egg production. Yalcin *et al.* (2012) noted that inclusion of BCS at the level of 1.5% into layer diet for 18 week did not affect egg production.

In contrast, Khodary *et al.* (1997) elicited that feeding hens a diet containing 3.0% BCS caused a significant reduction in egg production. Also, El Bagir *et al.* (2006) found that adding 1.0% BCS to laying diet caused a reduction in egg production from 67-61% while a dietary level of 2.0% BCS further decreased egg production to 56%.

However, El-Sheikh *et al.* (1998) and Aydin *et al.* (2008) observed that adding of BCS into layer hen diet raised egg production. Khodary *et al.* (1997) found that feeding hens a diet containing 1.0% BCS for 65 days resulted in significant increase of egg production. Also, Soltan (1999) concluded that adding of 1.0% BCS into quail diet improved egg production percentage. Akhtar *et al.* (2003) reported that the supplementation of BCS into layer diet at the level of 1.5% significantly increased egg production from 59 to 77%. Aydin *et al.* (2008) noted that the inclusion of BCS at the level of 3.0% in the diet significantly improved egg production compared with the control. Khan *et al.* (2013) noted that adding BCS at the level of 4.0% into layer diets revealed higher egg production than control group.

According to the negative relationship reported in several studies between increasing body weight of laying hens and egg production, Akhtar *et al.* (2003) and El Bagir *et al.* (2006) noted that the reduction of body weight in laying hens fed diets supplemented with BCS can be considered as a favorable factor in increasing egg production. Conversely, although the body weight gain of layer hens fed 2.0% BCS was lower than those fed 1.0% BCS, no significant differences in egg productin were observed between both of them in the present study.

Feed consumption: Feed consumption was significantly lower for hens fed 4.0% BCS than those fed both 0.0 and 2.0% BCS. However, there were no significant differences in feed consumption between hens fed 1.0 % BCS and the remaining dietary treatment groups (Table 2). These results were in agreement with the findings reported by Aydin *et al.* (2006) who noted that adding 1.0 or 2.0% of BCS into layer diet had no effects on feed consumption. In addition, Aydin *et al.* (2008) found that diets supplemented with 1.0 or, 2.0% BCS had no significant effects on feed consumption. Also, Yalcin *et al.* (2009) showed that adding 1.0% into layer diet did not significantly affect feed consumption. Yalcin *et al.* (2012) found that adding BCS at the level of 1.5% into layer diet did not affect feed consumption.

Feed conversion ratio: Feed conversion ratio was significantly better for hens fed 4.0% BCS than those fed both 0.0 and 1.0%. However, there were no significant differences in feed conversion ratio between hens fed 2.0% BCS and the remaining dietary treatment groups (Table 2). These results were in agreement with the findings of Aydin *et al.* (2006, 2008) who found that adding 1.0 or 2.0% of BCS into layer diet had no effects on feed conversion ratio. Also, Yagoub *et al.* (2010) noted that adding BCS to laying hens did not affect feed conversion.

In contrast, Soltan (1999) concluded that adding the BCS at the level of 1.0% into quail diet improved feed conversion ratio. Similarly, Abdo (1998) and Tollba *et al.* (2005) noted that adding BCS into diets enhanced feed conversion ratio. In addition, Akhtar *et al.* (2003) reported that adding BCS at the level of 1.0% into laying hen diets significantly improved feed conversion ratio per kilogram of egg mass from 2.90 to 2.22. Also Yalcin *et al.* (2009) noted a significant improvement after adding dietary BCS at the levels of 1.0% as a result to increase the efficiency of feed utilization due to its antimicrobial effects in the digestive system, having essential oils. However, El-Sheikh *et al.* (1998) found an increase (worse) in feed conversion ratio after feeding laying hens a diet containing 2.0% of BCS.

Egg weight: Egg weight per hen increased significantly for hens fed 4.0% BCS compared to those fed 1.0%. However, there were no significant differences in egg weight between hens fed either 0.0 or 2.0% and those fed 1.0 or 4.0% BCS. These results were in agreement with the observations noted by Khan *et al.* (2013) who noted that adding BCS at the levels of 4.0% into layer diets revealed greater egg weight than the control group. Also, El-Sheikh *et al.* (1998) and Yagoub *et al.* (2010) reported that egg weight was not significantly affected by adding 1.0% dietary BCS into layer diet. In contrast, Akhtar *et al.* (2003) and Yalcin *et al.* (2009) reported that the inclusion of BCS at the level of 1.0% into laying hen diets significantly increased egg weight. Aydin *et al.* (2008) noted that the egg weights from hens fed a diet containing 2.0% BCS were significantly higher than those fed 0.0 or 1.0% BCS.

Egg mass and egg specific gravity: There were no significant differences in egg mass and egg specific gravity among all the dietary treatment groups for the entire experimental period (Table 2). These results are in contrast to the findings reported by Soltan (1999) who revealed that adding of 1.0% BCS into quail diet enhanced egg mass. Also, Khan *et al.* (2013) noted that adding BCS at the level of 4.0% into layer diets exhibited lager egg mass than the control group.

Haugh unit: There were no significant differences in the Haugh unit values among all the dietary treatment groups for the entire experimental period (Table 2). These results are in agreement with the findings reported by Yalcin *et al.* (2009) and Yagoub *et al.* (2010) who found that Haugh unit was not significantly affected by adding 1.0% BCS into layer diet. In similar, Aydin *et al.*, 2006 noted that adding 1.0 and 2.0% of BCS into layer diet had no significant effect on the Haugh unit. In contrast, adding dietary BCS into layer diet at the level of 1.5% increased the Haugh unit (Akhtar *et al.*, 2003). Also, Khan *et al.* (2013) noted that Haugh units of eggs from hens that were fed diets containing 4.0% BCS were significantly higher than those fed control diet. However, El-Sheikh *et al.* (1998) reported that the adding BCS into layer diet reduced the Haugh unit.

Egg yolk color: Although hens fed 0.0% of BCS showed significantly the highest egg yolk color, there were no significant differences in egg yolk color between hens received either 2.0 or 4.0% of BCS (Table 2). These results were in disagreement with the findings reported by Yagoub *et al.* (2010) who noted that egg yolk color was not significantly affected by adding BCS into layer diet at the level of 1.0%.

The differences in the results obtained about the effects of adding BCS into diets on the productive performance of laying hens might be attributed to the differences in the nutritional value of the BCS used. Babayan *et al.* (1978) reported that BCS contains about 21.0% crude protein, 35.0% crude fat and 5.5% nitrogen free extract. Whereas, Abd El-Aal and Attia (1993) found that BCS contains about 21.0% crude protein, 38.7% crude fat, 13.9% crude fiber, 14.9% starch, 6.0% soluble sugars and 4.9% ash. In the other study, Takruri and Dameh (1999) noted that BCS contains about 92.30% dry matter, 30.20% crude protein, 13.0% fat, 9.0% crude fiber, 9.2% ash and 38.6% carbohydrates. Atta (2003) and Yalcin *et al.* (2009) also noted that BCS contains about 19.6% crude protein and 33.0% crude fat. Yagoub *et al.* (2010) noted that BCS contains about 95.0% dry matter, 9.4% crude protein, 44.6% crude fat, 18.9% crude fiber and 6.1% ash.

CONCLUSION

The results obtained from the present study can conclude that adding BCS into layer diets up to 4.0% can improve the productive performance of laying hens in respect to feed consumption, feed conversion ratio and egg weight. Further research may be required to identify the active principle chemical compounds in BCS and their effects on the productive performance of laying hens.

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