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Performance of Broiler Chickens Fed Diets Containing Low Inclusion Levels of Black Cumin Seed

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Abstract: An overview of the literature indicates that lower rather than higher dietary concentrations of black cumin seed may have a positive influence on feed efficiency in broiler chickens. In this study, 4 day old broiler chickens were fed either a diet without or with black cumin seed at inclusion levels of 0.25, 0.50 or 0.75% for a period of 7 weeks. Body weight gain during the 1st, 4th and 7th week of the experiment was significantly decreased by each level of dietary black cumin. The diets containing black cumin seed did not significantly influence weight gain and feed efficiency as measured for the entire experimental period. However, the diets with either 0.25, 0.50 or 0.75% black cumin lowered group-mean weight gain by 4.7, 3.3 and 6.5%, respectively and raised the group-mean feed conversion ratio (g feed/g weight gain) by 3.7, 4.8 and 7.0%. The final weights of breast, thigh and drumstick were not affected by the composition of the diet. It is concluded that dietary black cumin seed may deteriorate feed efficiency in broiler chickens in a dose-dependent relationship. It is unclear why the present observation is opposite to the outcome of various earlier studies of other investigators.

Key words: Broilers, growth performance, meat production, black cumin, influence, inclusion

INTRODUCTION

Studies with laboratory rodents have shown that extracts of black cumin (*Nigella sativa*) seed have anti-bacterial (Hanafy and Hatem, 1991), anti-viral (Salem and Hossain, 2000) and anti-parasite activity (Mahmoud *et al*., 2002; Abu-El-Ezz, 2005; Ayaz *et al*., 2007). It is well-known that the feeding of anti-microbial agents and prevention of infectious diseases promote growth performance in broiler chickens kept in commercial settings. Thus it could be suggested that black cumin seed may act as a growth enhancer in broilers.

Various studies with broiler chickens fed black cumin seed have been reported but the influence of the feed additive in relation to its dose remains uncertain. The feeding of a diet with 0.1% black cumin significantly improved feed efficiency (Ashayerizadeh *et al*., 2009) but in other studies the effect of the same dose was not statistically significant (Al-Harthi, 2004) or even absent (Erener *et al*., 2010). A diet with 0.2% black cumin seed failed to improve feed efficiency but an inclusion level of 0.4% had a positive effect (Toghyani *et al*., 2010). Mahmood *et al*. (2009) found that a diet with 0.5% black cumin seed improved feed efficiency whereas a diet with 1.0% did not. However, in the study of Erener *et al*. (2010) the diet with 1.0% black cumin seed had a beneficial effect on feed efficiency. Guler *et al*. (2006) studied fed diets containing either 0.5, 1.0, 2.0 or 3.0% black cumin seed and observed that only the diet with 1.0% improved feed efficiency. Al-Homidan *et al*. (2002) found that dietary concentrations of 2.0 or 10.0% black cumin seed did not affect feed efficiency. Durrani *et al*. (2007) showed that diets with 2.0, 3.0 or 4.0% in the diet improved feed efficiency. In contrast, Al-Beitawi and El-Ghousein (2008) found a diet with 1.5% crushed black cumin seed improved feed efficiency whereas diets with inclusion levels of either 2.0, 2.5 or 3.0% did not.

The above-mentioned studies indicate that lower rather than higher dietary concentrations of black cumin seed may have a positive influence on feed efficiency in broiler chickens. This prompted us to undertake the present study. Broiler chickens were fed either a control

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diet or diets containing 0.25, 0.50 or 0.75% black cumin seed. Feed intake and weight gain were determined and at the end of the feeding period the production of breast, thigh and drumstick was assessed.

MATERIALS AND METHODS

Animals and diets: The experiment was carried out at the University of Khartoum in the months of November and December. During the experiment, the environmental temperature ranged between 19 and 34°C and relative humidity between 20 and 35%. For the experiment, 192 unsexed, 1 day old Lohman broiler chickens were used. The birds were housed in ground pens (1×1 m) with wood shavings as litter.

There were 8 birds per pen. Each pen was equipped with a feed trough, a fountain drinker and a 60 Watt bulb for heating and artificial lighting. After 2 weeks, the bulb was lit up during the dark period only. The pens were located in an open-sided poultry house but with the eastern en western sides covered with jute sacks to block direct sunrays.

All birds were fed the base diet for 3 days. Then, they were allocated to either the control (base) diet or to one of the three experimental diets. Each dietary group consisted of 48 birds with six replicates, each replicate representing 8 animals per pen.

The base diet consisted of (g/100 g): sorghum, 61.75; groundnut cake, 15; sesame cake, 15; high-protein concentrate, 6; oyster shell, 2; salt, 0.25. To produce the experimental diets, the base diet was mixed with 0.25, 0.50 or 0.75% black cumin seed. The birds had free access to feed and water throughout the experiment period which lasted 7 weeks.

Measurements: The macronutrient composition of the diets was determined by the Weende method. Broilers were individually weighed at the beginning of the experiment and then weekly. Feed intake per cage was measured. At the end of the experiment, the birds were fasted overnight and subsequently slaughtered manually. They were scalded using boiling water, hand picked, washed and left to dry. Selected organs and body parts were removed and weighed. The right side of the carcass was cut into breast, thigh and drumstick and the individual parts were weighed and separated into meat and bone components.

Data analysis: The results are presented as group means and SEM for 8 experimental units per treatment. Statistically significant differences between group means were identified with the use of Duncan's multiple range test. The level of statistical significance was pre-set at $p<0.05$.

RESULTS AND DISCUSSION

Table 1 shows the analyzed composition of the control diet and the diets containing black cumin seed. The addition of up to 0.75% black cumin seed to the control diet had no major impact on the macronutrient composition of the experimental diets.

The diets containing black cumin seed did not significantly influence weight gain and feed efficiency (Table 2). However, the experimental diets produced a decrease in group-mean weight gain. When compared with the control diet, the diets with 0.25, 0.50 or 0.75% black cumin seed lowered weight gain by 4.7, 3.3 and 6.5%, respectively. Furthermore, the experimental diets raised the group-mean feed conversion ratio in a dose-dependent fashion by 3.7, 4.8 and 7.0% when compared with the control diet.

When body weight gain of the broilers was considered during the 1st, 4th and 7th week of the experiment, the experimental diets induced a significant decrease (Table 3). There was no dose dependency of the inhibitory effect of black cumin seed on body weight gain. Contrary to the control group, the groups fed black cumin showed a lower body weight gain during week 7 than during week 4.

There was no diet effect on the weight of internal organs and selected body parts. The average weights of the organs and body parts were as follows (% of live weight): liver, 1.72; spleen, 0.11; bursa, 0.23; abdominal fat, 1.13; head, 2.94; shanks, 27.39; viscera, 8.39.

Table 1: Ingredient and analyzed macronutrient composition of the experimental diets

	Dietary black cumin seed (%)			
Items	0	0.25	0.50	0.75
Ingredient (g/100 g)				
Base diet	100.0	99.75	99.50	99.25
Black cumin seed	0.0	0.25	0.50	0.75
Macronutrient (g/100 g)				
Dry matter	92.4	92.30	92.80	95.00
Crude protein	27.5	27.50	28.20	24.90
Crude fat	4.9	5.80	7.60	6.10
Crude fiber	3.7	3.60	3.20	3.10
Ash	7.0	7.80	7.20	8.70
Carbohydrates (NFE)	49.3	47.60	46.60	52.20

Table 2: Performance of the broiler chickens fed the experimental diets

	Dietary black-cumin seed (%)				
Variables	0	0.25	0.50	0.75	SEM
Initial body weight (g)	51.0	50.9	50.9	51.5	6.27
Final body weight (g)	2164	2064	2095	2026	56.5
Weight gain (g)	2113	2013	2044	1975	56.6
Feed intake (g)	3952	3897	4013	3950	57.9
Feed conversion ratio (g feed/g gain)	1.87	1.94	1.96	2.00	0.06

Table 3: Body weight gain of the broiler chickens fed the experimental diets

	Dietary black-cumin seed (%)				
Duration	0	0.25	0.50	0.75	SEM
Weight gain g week^{-1}					
Week 1	111.1^{a}	96.3^{b}	100.0^{b}	100.4^{b}	2.51
Week 4	367.4^{a}	357.7^{b}	358.1^{a}	346.4^{a}	10.75
Week 7	381.8^{a}	299.8^{b}	337.8^{c}	298.2^{b}	5.40

Means within the same row not sharing a common superscript letter are significantly different

Table 4: Right carcass cuts of the broiler chickens fed the experimental diets

	Dietary black-cumin seed (%)				
Parameters	0	0.25	0.50	0.75	SEM
Breast weight (g)	207.00	216.00	215.00	207.00	10.4
Thigh weight (g)	125.00^{a}	117.00^{a}	142.00^{b}	125.00^{a}	5.8
Drumstick weight (g)	117.00	104.00	118.00	102.00	6.5
Meat:bone ratio	4.88^{a}	5.54^{b}	4.22^{c}	4.77^{a}	0.21

Means within the same row not sharing a common superscript letter are significantly different

The weights of breast and drumsticks were not affected by the composition of the diet (Table 4). The diet containing 0.5% black cumin seed significantly increased thigh weight and lowered the meat:bone ratio of the right carcass cuts. The meat:bone ratio was significantly raised after feeding the diet with 0.25% black cumin seed.

This study shows that broiler chickens fed diets containing either 0.25, 0.5 or 0.75% black cumin seed showed less weight gain and higher feed conversion ratio than their counterparts fed the control diet. Thus, the addition of black cumin seed had a negative impact on growth performance. For the entire feeding period of 7 weeks, the diet with 0.25% black cumin lowered weight gain by 4.7% and raised the feed conversion ratio by 3.7%. Although the effects did not reach statistical significance, they are relevant from the point of view of commercial broiler production. First, the magnitude of the negative effect on weight gain and feed efficiency would have a major economic impact. Secondly, the negative effect of black cumin on group-mean feed efficiency is substantiated by the observation that there was dose-dependent relationship. Thirdly, the negative effect of black cumin seed on weight gain was statistically significant when the influence during weeks 1, 4 and 7 was considered.

The outcome of this study with broiler chickens is at variance with that of other investigations using diets with similar, low inclusion levels of black cumin. Toghyani *et al.* (2010) used diets based on corn and soybean meal. For the feeding period of 42 days, the feed conversion ratios were 1.74, 1.64 and 1.58 for the control diet and the diets with 0.2 or 0.4% black cumin seed, respectively. Thus, in the study of Toghyani *et al.* (2010) the feeding of black cumin improved feed efficiency improved feed efficiency in a dose-dependent fashion. Mahmood *et al.* (2009) used a commercial diet without or with 0.5% black cumin and fed the diets to broiler chickens between the age of 1 and 6 weeks. The administration of black cumin seed was found to lower the feed conversion ratio from 2.25-1.99 and thus improved feed efficiency. Al-Harthi (2004) reported that black cumin seed at a dietary concentration of 0.1% enhanced the feed conversion ratio by 16.2%. Guler *et al.* (2006) found that broiler chickens fed a diet with 1% black cumin seed ameliorated the feed conversion ratio by about 5%. Abu-Dieyeh *et al.* (2008) found in broiler chickens within the age span of 4-8 weeks that the addition of 1.0% black cumin seed powder to the diet lowered the feed conversion ratio from 2.37-2.17. It appears that in five different studies a dietary concentration of 1.0% or less improved feed efficiency in broiler chickens.

The comparison of the experimental conditions of this study and those of the five studies showing opposite results (Toghyani *et al.*, 2010; Mahmood *et al.*, 2009; Al-Harthi, 2004; Guler *et al.*, 2006; Abu-Dieyeh *et al.* 2008) does not provide clues to explain the different outcome. Al-Beitawi and El-Ghousein (2008) found that dietary black cumin seed at high inclusion levels diminished feed efficiency in broilers. The diets were fed for 49 days were based on corn and soybean meal and contained 1.5, 2.0, 2.5 or 3.0% intact black cumin seed. The feed conversion ratio for the control diet was 2.10 and for the diets with increasing levels of black cumin seed it was 2.06, 2.22, 2.19 and 2.16, respectively. Thus, the publication of Al-Beitawi and El-Ghousein (2008) supports this study in that the feeding of black cumin seed can have a negative effect on feed efficiency.

CONCLUSION

In this study, the feeding to broiler chickens of black cumin seed at low dietary inclusion levels was found to deteriorate feed efficiency in a dose-dependent relationship. This observation is opposite to the outcome of various published studies in which similar dietary concentrations of black cumin seed had been used. Possibly, the experimental conditions and dietary black cumin seed interact, leading to either a positive or negative influence on feed efficiency in broiler chickens.

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