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Dietary Cumin (*Cuminum cyminum*) Seed Powder Supplementation Had No Adverse Effects on Growth Performance and Carcass Traits of Japanese quail, *Coturnix coturnix japonica*

Orhan Çetinkaya[1,a], Gökhan Filik[1,b,*]

[1]*Department of Agricultural Biotechnology, Faculty of Agriculture University of Kırşehir Ahi Evran, 40100 Kırşehir, Turkey*
[*]*Corresponding author*

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ABSTRACT

The present study was conducted to explore the usage of different levels of cumin (*Cuminum cyminum)* seed powder (CSP) in quail nutrition as a natural growth promoter. One hundred (one-day-old) unsexed quail chicks were randomly divided into five groups of similar mean weight (8.8 g), each with five replicates of four chicks. The control group received a basal diet. For the other groups, the basal diet was supplemented with 1, 2, 4 and 8 g/kg CSP. The observed variables included growth performance, carcass parts and internal organ weights. Results showed that CSP did not affect the observed variables statistically. However, the best FCR ratio was observed in an 8 g/kg CSP group. Similarly, the highest live weight among the animals slaughtered in all groups in the study was again in the same group (8 g/kg CSP: 304.9 g), but no statistical difference between was observed with all groups. There was no incidence of any mortality or any signs of the adverse effects of CSP during the experimental period. Dietary CSP supplementation had not any adverse effects on growth performance and carcass parts weight. Consequently, further studies are needed to investigate the effects of CSP on the meat quality and digestive system in poultry.

Tavukçuluk Araştırma Dergisi 17(1): 15-21, 2020

Japon Bıldırcınlarında Rasyona Kimyon (Cuminum cyminum) Tohumu Tozu İlavesinin Büyüme Performansı ve Karkas Özellikleri Üzerine Etkisi Yoktur

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ÖZ

Mevcut çalışmada, doğal büyüme teşvik edici japon bıldırcınlarının beslenmesinde farklı seviyelerde kimyon (*Cuminum cyminum*) tohum tozunun (CTT) kullanımını araştırmak amaçlanmıştır. Bir günlük yaşta benzer canlı ağırlık ortalamasına sahip (8,8 g), karışık cinsiyette 5 farklı gruba ayrılmış olup, her grupta 4 bıldırcın civcivi olan 5 paralelden oluşmaktadır. Kontrol grubu bazal yemle beslenmiş olup, diğer gruplar ise bazal yeme 1, 2, 4 and 8 g/kg CTT ilave edilmiştir. Çalışmada performans parametreleri, karkas parçaları ve iç organ ağırlıkları belirlenmiştir. Kimyon tohumu tozunun bıldırcınların gelişimi ve karkas özellikleri üzerine istatistiksel olarak herhangi bir etkisi olmamıştır. Fakat çalışmamızda en iyi yemden yararlanma oranı bazal yeme 8 g/kg CTT ilave edilen grupta belirlenmiştir. Benzer şekilde çalışmada kesilen hayvanların içinde en yüksek canlı ağırlık yine aynı grupta gerçekleşmiş (8 g/kg CTT: 304,9 g), fakat istatistiksel bir farklılık gözlemlenmemiştir. Çalışma süresi içinde herhangi bir ölüm gözlemlenmemiştir. Bazal yeme CTT ilavesinin Japon bıldırcınlarının büyüme performansı ve karkas parçalarının ağırlıkları üzerinde herhangi bir olumsuz etkisi olmamıştır. Sonuç olarak, CTT'nin kümes hayvanlarında et kalitesi ve sindirim sistemi üzerindeki etkilerini araştırmak için daha fazla çalışmaya ihtiyaç vardır.

[a] orhancetinkaya824@gmail.com https://orcid.org/0000-0002-5077-8924 | [b] gfilik@ahievran.edu.tr https://orcid.org/0000-0003-4639-3922

Introduction

Antibiotics have not been used for more than two decades, especially as a growth-promoting agent in poultry nutrition. Besides, it is well known that it protects animals against diseases while creating resistance against antibiotics in people who consume their products. In general, natural herbal sources or extracts have a growth-stimulating or digestive system structure in animals (Granados-Chinchilla, 2017). After the banning of antibiotics, researchers are working on different alternatives. The importance of natural herbal resources has increased due to some different positive properties that encourage growth in poultry feed. The natural herbal plants were used in the nutrition of poultry as feed additives due to their antioxidant (Allahghadri et al., 2010), antimicrobial (Shalaby et al., 2006), antifungal (Khosravi et al., 2011), antipyretic (Ali et al., 2010), antidiabetic (Sowbhagya, 2013) and similar effects. Previous studies showed that plants took advantage of phytochemical compound(s) found in their leaves, flowers, seeds, stems, or roots, and their powder, oil, or aqueous extracts generally play an important role (Ali et al. 2010; Hajati et al., 2014; Aćimović et al., 2016). Several studies, also, reported that the spices like black cumin or pepper, red pepper, mint, rosemary, sumac, and fenugreek improved health status, growth performance and/or disease resistance in poultry nutrition (Khosravifar et al., 2014; Hajati et al., 2014; Singh et al. 2015; Kheiri et al., 2015; Florana et al., 2017). Another of these spices is Cumin (*Cuminum cyminum*) from the Apiaceae family (Jang, 2011; Alimohamadi et al., 2013). According to 2017 data, cumin, which produces 300-400 thousand tons worldwide, exports $ 274.8 million (Arslan, 2019a). Cumin is mainly cultivated in Asia, especially Algeria, China, Japan, India, Indonesia, Iran, Morocco, southern Russia, and Turkey (Bettaieb et al., 2011). In Turkey, 72 kg/da yield of cumin production of 19.175 tons in 2017, while the price is around a 3 kg / $ (Arslan, 2019b). Cumin is widely used by the foods, beverages, liquors, medicines, toiletries and perfume industries (Kumar et al., 2015). 100 g cumin seed contains 93.9 g dry matter, 11.5 g crude fat, 37.2 g crude fiber, 9.3 g ash, 15.7 g crude protein, and 20.1 g nitrogen-free extract (El-Ghorab et al., 2010). Cumin seed contains molecules such as alkaloid, anthraquinone, coumarin, flavonoid, glycoside, protein, resin, saponin, steroid, and tannin (Al-Harbi, 2019). In addition, cumin affects systems such as aldose reductase (Lee, 2005), analgesic (Bhat et al., 2014), anti-amyloidogenic (Morshedi et al., 2014), anticancer (Sowbhagya, 2013; Anu et al., 2016), antidiabetic (Sowbhagya, 2013), anti-inflammatory (Srinivasan, 2018), antimicrobial (Bokaeian et al., 2014; Belal et al., 2017; Al-Harbi, 2019), anti-osteoporotic (Samani and Farrokhi, 2014), antioxidant (Bettaieb et al., 2011, Koppula and Choi, 2011), antiplatelet aggregation (Sowbhagya, 2013), bronchodilator (Boskabady et al., 2005), contraceptive (Gupta et al., 2011), gastroprotective (Sowbhagya, 2013), hypotensive (Moradi et al., 2016), immunological (Chauhan et al., 2010), insecticidal (Negahban et al., 2012), alpha-glucosidase and tyrosinase inhibitory effects (Lee, 2005), protective and central nervous system (Al-Snafi, 2016). With all these features, cumin seed powder (CSP), its essential oil (CEO) and meal (CSM) were used to improve meat, egg or breeding performances during the feeding of poultry (Mansoori et al., 2006; Aami-Azghadi et al., 2010; Ali et al., 2011; 2012; Al-Anbari et al., 2013; Singh et al., 2015; Ali et al., 2018; Alkattan, 2019). Although cumin has an important place in human nutrition, cumin is generally among the spices studied by researchers in order to increase the performance of animals. However, there is no satisfactory source of CSP and doses added as a growth promoter and performance enhancer in quail nutrition, which is a model animal, during the depth literature review. Also, there have been no records whether the used dietary CSP doses had any adverse effects on growth and body components of quails or not. Therefore, this study was aimed to investigate the possibility of using the different doses of CSP as a natural growth promotion and its effects on some of the body components of quails.

Materials and Methods

Animals and Feeds

One-day-old, 100 Japanese quail chicks were divided into 5 treatment groups, according to 0, 1, 2, 4, or 8 g cumin seed powder (CSP) supplementation to basal diets. Each group included 20 birds kept in 5 cages each included 4 chicks. The supplemented doses were determined based on the previous studies. Basal diets were (a) starter (233.2 g crude protein (CP) and 3000 Kcal ME kg^{-1}), (b) grower (215.0 g CP and 3100 Kcal kg^{-1}), and (c) finisher (195.0 g CP and 3200 Kcal ME kg^{-1}) (Table 1). The quail diets were ordered to prepare by a local company according to NRC (1994) recommendations. CSP was obtained from a private species shop in Kayseri, Turkey. Feed and water were offered daily *ad libitum*.

Experimental Conditions

The experiment was performed by using twenty-five 50×75 cm cages within the Poultry Unit of the Agriculture Faculty of Kırşehir Ahi Evran University. Artificial illumination was provided in the experimental room by white fluorescent lamps and a thermostatically controlled infrared electric heater for floor heating. Ambient temperature was maintained at 33°C during the first week of life and was then gradually reduced by 3°C weekly according to age until it reached 24°C between 21 to 42 days. The relative humidity was maintained at 55% throughout the rearing period. During the trial period, the animals were given a 23-hour light/1-hour dark schedule for the first three days in case of a power interruption during the trial, and 24 hours for the other 39 days according to commercial conditions.

Experimental Parameters

Apart from the initial and final body weight (BW), body weight gain (BWG) and feed intake (FI) were determined weekly. The feed conversion ratio (FCR) was determined by the ratio of total FI to the final BW. Before slaughtering, quails were fasted for 12 hours to empty their digestive tract. At the end of the experiment (42 days), four quails were taken from each treatment group and slaughtered to determine carcass traits heart, liver, thigh, breast, wing, back-neck, abdominal fat, carcass weights.

Table 1. Composition of the starter, grower, and finisher diet (g/kg)

Ingredients	Starter Diet 0 to 10 days	Grower Diet 11 to 24 days	Finished Diet 25 to42 days
Maize (7.5% CP)	467.2	544.1	584.8
Soybean meal (46% CP)	387.9	366.1	320.5
Sunflower seed meal (36% CP)	40.0	-	-
Soybean oil	59.8	49.5	59.9
DL-methionine (99%)	3.5	3.0	2.7
Salt	2.6	2.3	2.9
Marble powder	11.8	8.5	7.6
DCP (18%)	20.3	18.3	16.3
Vitamin Premix*	2.0	2.0	2.0
Mineral Premix**	1.0	1.0	1.0
L-Lysine HCl	2.2	3.2	1.3
L-Threonine	0.9	0.6	0.3
Sodium sulphate	0.8	1.4	0.7
Total (kg)	1000.0	1000.0	1000.0
Calculated Analysis, g/kg			
Dry matter	880.0	876.8	876.7
Crude protein	233.2	215.0	195.0
ME (kcal/kg)	3000	3100	3200
Crude fiber	43.2	36.9	34.9
Ether extract	83.2	75.2	86.4
Ash	64.2	56.8	52.2
Ca	10.5	8.7	7.8
P	4.8	4.4	3.9
Lysine	12.8	12.7	10.2
Methionine	6.6	5.8	5.3

Premix provided per kg of diet: * Vitamin A, 12.000 IU; Vitamin D3, 2.400 IU; Vitamin E, 30 mg; Vitamin K3, 4 mg; Vitamin B1, 3 mg; Vitamin B2, 7 mg; Vitamin B6, 5 mg; Vitamin B12, 15 µg; niacin, 25 mg; ** Fe, 80 mg; folic acid, 1 mg; pantothenic acid, 10 mg; biotin, 45 mg; choline, 125000 mg; Cu, 5 mg; Mn, 80 mg; Zn, 60 mg; Se, 150 mg

Table 2. The effect of added *Cuminum cyminum* seed powder to diet on quail performance

Parameters	CSP (g/kg)					SD	P	Effects		
	0	1	2	4	8			L	Q	C
Initial body weight (g/bird)	8.8	8.8	8.7	8.8	8.8	0.01	0.246	0.275	0.128	0.163
Final body weight (g/bird)	313.8	301.0	325.2	332.0	347.0	9.68	0.649	0.452	0.670	0.598
Body Weight Gain	305.0	292.2	316.5	323.2	338.2	9.68	0.648	0.451	0.671	0.596
Feed Intake (g/ 42 days per bird)	1042.1	1074.4	1010.6	1021.1	1051.6	14.26	0.628	0.392	0.734	0.264
Feed Conversion Ratio	3.4	3.7	3.2	3.2	3.1	0.07	0.186	0.127	0.337	0.168

Statistical Analysis

The data obtained in the experiment were analyzed by using General Linear Models (GLM), Duncan's multiple range test procedures, and orthogonal polynomials in SAS Software (SAS, 1996). Means differences were considered significant at ($P<0.05$).

Results

The addition of different doses of CSP to quail diets as growth stimulants did not affect final BW ($P>0.05$). The weekly BWG, FI, and FCR were not statistically significant and are not included in the tables. In addition, treatments did not affect FI and FCR ($P>0.05$) (Table 2). The FI was the highest in the 1 g/kg CSP group, whereas the lowest in the final BW was in the same group. Therefore, FCR was also the worst in the 1 g CSP added group (Table 2). Similarly, the highest body weight among the slaughtered animals was again in the same group, but no statistical difference was observed between the groups in terms of carcass weights ($P>0.05$) (Table 3). CSP added to the quail rations did not affect the weights of carcass parts of animals ($P>0.05$). Treatments also did not affect carcass weight ($P>0.05$).

Discussion

CSP did not affect the health status of experimental animals, showing it has no adverse effects on their health since there was no any mortality or signs of illness at all. In the detailed literature review, positive and negative effects of increasing doses of cumin, which are investigated in a wide range of values between 0.01 and 50 g/kg, are given in Table 4. However, the effect of cumin addition in the range of 0.01 to 2 g / kg varied, including in our current study. The final body weight increased in the groups with 4 and 8 g / kg CSP added to quail rations supports the results of (Alimohamadi et al., 2013). On the contrary, (Golian et al., 2010)'s study had a negative effect on the final body weight in the same groups. Contrary to our study, Retnani et al. (2010) reported that the use of 0.2, 0.4, and 0.6% CSP in broiler rations reduced the broiler meat fat composition. Supporting our study, Shaban (2012) and Dawood and Al-Douri (2014) reported that the performance parameters of the animals improved compared to the control group in their studies using 1 and 1.5 g/kg CSP. As can be seen in Table 4, cumin added to poultry feed in high amounts improved performance parameters (Mansoori et al., 2006; Golian et al., 2010; Jang, 2011; Elagib et al., 2013; Al-Anbari et al.,

2013; Rafeeq et al. 2016a; Florana et al., 2017; Ali et al., 2018). There was no statistical effect of CSP in different doses added to quail diets in order to improve growth stimulants, health protection, and some carcass characteristics in our study. This was supported by unchanged performance and carcass values with the following previous findings (Table 4).

Conclusion

Cumin seeds have been generally used in the feeding of poultry as powder, oil, or aqueous extract. Similarly, while cumin has a positive effect on animal performance, blood parameters, and carcass characteristics, some studies have not affected, as in our current study. As a result of our study, the highest BWG was achieved by 8 g/kg CSP supplementation. In the light of current results and literature, the authors are thought to need new studies investigating the effects of cumin seed powder on the meat quality and digestive system of quail in which gender factors are addressed.

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Table 3. The effects of added *Cuminum cyminum* seed powder to diet on the weights of carcass parts

Parameters (g)	CSP (g/kg)					SD	P	Effects		
	0	1	2	4	8			L	C	Q
BW	294.3	291.0	260.5	300.1	304.9	8.45	0.590	0.879	0.282	0.289
Hot Carcass Weight	164.3	175.0	160.9	176.8	188.5	3.88	0.245	0.553	0.773	0.200
Cold Carcass Weight	163.1	173.5	159.7	175.0	186.0	3.80	0.267	0.567	0.777	0.202
Carcass Yield	0.56	0.61	0.63	0.59	0.62	0.01	0.373	0.275	0.130	0.798
Thigh	35.2	37.3	36.3	39.7	41.7	0.77	0.088	0.113	0.706	0.358
Breast	62.5	68.4	65.5	74.1	79.6	2.72	0.156	0.167	0.790	0.394
Wing	7.6	9.4	8.4	9.9	8.7	0.39	0.354	0.117	0.852	0.216
Back-Neck	52.6	47.8	50.3	47.3	54.7	1.62	0.521	0.397	0.800	0.451
Liver	7.7	8.2	7.0	7.7	6.7	0.50	0.867	0.809	0.925	0.489
Heart	2.5	2.7	2.2	2.7	2.9	0.09	0.146	0.937	0.387	0.044
Abdominal Fat Weight	3.9	5.6	5.1	4.7	4.5	0.25	0.274	0.427	0.075	0.343

Table 4. Comparison of our study with the studies previously conducted

Previous studies	Parameters	Supplemental Doses	E	A/D
Mansoori et al. (2006)	growth performance	25 or 50 g/kg	I	DA
Retnani et al. (2010)	fat content	0.2, 0.4, and 0.6%	R	DA
Aami-Azghadi et al. (2010)	the relative organ weights, carcass yields	2 g/kg	U	A
Al-Kassie (2010)	performance	0.5 and 1%	IN	DA
Golian et al. (2010)	body weight	10, 20, 30, 40 and 50 g/kg	IN	DA
Golian et al. (2010)	body weight, abdominal fat	2, 4, 6, 8 and 10 g/kg	D	DA
Jang (2011)	growth performance, feed intake	2%	IN	DA
Amin (2011)	growth performance	0.5, 1, and 1.5%	IN	DA
Shaban (2012)	growth performance	0.15%	I	A
Elagib et al. (2013)	final body weight	2%	IN	DA
Alimohamadi et al. (2013)	final body weight	4 and 8 g/kg	IN	DA
Sharifi et al. (2013)	final live weight	15 g/kg	I	DA
Al-Anbari et al. (2013)	final live weight	45%	I	DA
Dawood and Al-Douri (2014)	LBW, BW and FCR	1 and 1.5 g/kg	IN	A
Bhaisare et al. (2014)	growth performance	0.5%	U	A
Mousa (2014)	mortality	1.25 ml/kg	D	DA
Torki et al. (2015)	BW, BWG, FCR	0.8 g/kg	IN	DA
Al-Mashhadani et al. (2016)	final body weight and weight gain	200, 400 and 600 mg/kg	IN	DA
Rafeeq et al. (2016a)	growth performance	0.5 and 1%	IN	DA
Rafeeq et al. (2016b)	growth performance	20 and 40 ml/L	I	DA
Habibi et al. (2016)	performance, visceral weight and carcass properties	100, 200, 300 ppm	U	A
Berrama et al. (2017)	carcass and viscera yields	0.2%	U	A
Florana et al. (2017)	growth performance	2%	IN	DA
Elradi et al. (2018)	growth performance	0.25, 0.50, and 0.75%	U	A
Ali et al. (2018)	final BW	1%	IN	DA

E: Effect, I: improved, R: reduced, U: unaffected, D: decreased, IN: increased, A/D: Agree/Disagree with the present study, A: Agree, DA: Disagree

Authors Contributions

Orhan Çetinkaya and Gökhan Filik designed and conducted the experiments. Orhan Çetinkaya conducted the laboratory analyses. Gökhan Filik supervised and coordinated the experiments. Orhan Çetinkaya and Gökhan Filik evaluated experimental data statistically. The manuscript was written and revised by Orhan Çetinkaya and Gökhan Filik.

Conflicts of Interest

There are no conflicts of interest to declare.

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Ethics in Animal Experiments Committee Approval

The study complied with an ethics document taken from the Animal Experiments Local Ethics Committee of Kırşehir Ahi Evran University, dated and numbered 02/10/2017-19-2.

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