Indian J. Anim. Nutr. 2021. 38 (2): 195-200
doi: 10.5958/2231-6744.2021.00028.1

Indian Journal of
Animal Nutrition

Performance and Carcass Characteristics of Japanese Quail fed Dietary Cumin *(Cuminum cyminum)* Seed Powder as Natural Feed Additive

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ABSTRACT

An experiment was conducted to evaluate the effect of dietary inclusion of cumin seed (CS) powder on growth, carcass characteristics and cost economics in Japanese quails. One hundred and fifty, day-old quail chicks were distributed randomly to five dietary groups each with three replicates of ten chicks and were offered experimental diets to meet the nutrient requirements (NRC, 1994). During the experiment, cumin seed powder was included at 0.0% (T_1: Control), 0.50% (T_2), 1.0% (T_3), 1.5% (T_4) and 2.0% (T_5) level. Chemical analysis indicated that cumin seed powder contained 18.26% CP, 14.02% EE, 30.02% CF, 27.96% NFE, 7.79% TA and 0.42% AIA. Results indicated that body weight gain, performance index ($P<0.05$) and PER ($P<0.01$) increased significantly, feed consumed / kg gain ($P<0.01$) decreased significantly while there was no effect ($P>0.05$) on feed intake with inclusion of CS powder in the diet. Further, carcass yield (g), dressing percentage and ready to cook yield (g) increased ($P<0.01$) significantly while there was no effect ($P>0.05$) on weight of heart, liver, gizzard and giblet. The feed cost/ kg gain decreased by ₹ 4.08 in T_2 and ₹ 7.69 in T_3 while it is increased by ₹ 2.70 in T_4, and ₹ 8.70 in T_5 groups of quails as compared to the control (T_1). Thus, it was concluded that cumin seed powder can be included up to 1.0% level in the diet for improved performance of Japanese quail.

Key words: Carcass Characters, Cost economics, Cumin, Growth, Japanese Quail

INTRODUCTION

Several phyto-biotic additives have been examined as alternatives to antibiotic growth promoters (AGP) in broiler production, while many researchers believe that herbs, medicinal plants and spices can be considered as suitable alternatives for promoting animal health. Cumin, cardamom, anise, ginger, black pepper, and clove are a group of aromatic plants that are used widely due to their positive effects on growth and health of poultry, probably as a result of their immune stimulatory properties (Chowdhury *et al.,* 2018).

Cuminum Cyminum Linn. (cumin) is a popular aromatic spice in the world, and its vernacular name in India is Zeera. It is native to Egypt and extensively grown in India. Cumin seed is a well-known spice in human nutrition and feed industries (Hajlaoui *et al.,* 2010). Cumin seeds in whole or ground form and its essential oil have long been used in traditional medicine for the treatment of various diseases, particularly digestive disorders (Muthamma *et al.,* 2008). Cumin seeds contain several phytochemicals which possess carminative and anti-flatulent properties. In addition, antioxidant, antibacterial, antifungal and anti-inflammatory properties of cumin have also been reported earlier (Gachkar *et al.,* 2007; Einafshar *et al.,* 2012). Cuminaldehyde, cymene, terpenoids, polyphenols and flavoids are the major bioactive components of cumin (Bettaieb *et al.,* 2011). Consumption of cumin seed would increase appetite, taste perception and digestive activities of the intestine (Mnif and Aifa, 2015).Positive effects of cumin on growth, feed conversion ratio (Al-Kassi *et al.,* 2010; Jang *et al.,* 2011; Ali-Mohammadi *et al.,* 2013; Rafiee *et al.,* 2014; Ali *et al.,* 2018; Shafiee *et al.,* 2020), and carcass characteristics (Al-Kassi *et al.,* 2010; Jang *et al.,* 2011) were reported earlier in broilers, whereas, studies in Japanese quails (Cetinkaya and Filik, 2020) are very limited. Hence, the present study was conducted to evaluate the effect of inclusion of cumin seed powder at varying levels in the diet on growth and carcass

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characteristics of Japanese quail.

MATERIALS AND METHODS

Cumin seeds, de-oiled rice bran, maize, soybean meal, fish meal, mineral mixture and salt were procured from the local market. All the ingredients were ground and mixed to prepare a basal diet to meet the nutrient specifications as per NRC (1994). During the trial, cumin seed (CS) was ground and was included at 0.0% (T_1: Control), 0.50% (T_2), 1.0% (T_3), 1.5% (T_4) and 2.0% (T_5) level in iso-nitrogenous and iso-caloric broiler quail diets.

In a 5 weeks duration trial, one hundred and fifty, day-old quail chicks were purchased locally and used for conduct of the trial. All the chicks were weighed individually (av. body wt. 8.09 ± 0.03 g), wing-banded and were divided into five equal treatments, each treatment contained three replicates with ten birds per replicate allotted at random. All the chicks were housed in battery brooders throughout the experiment. Irrespective of the treatments, all the chicks were fed *ad libitum* 2 times a day with respective broiler quail diet from 0-5 weeks of age. Fresh and clean drinking water was made available at all the time. B-complex vitamins were offered in water for 3 days during first week. Except for feeding experimental diets, other managemental practices were uniform throughout the experimental period.

The chemical composition of cumin seed powder and other feed ingredients used in the experiment and the experimental diets were analyzed as per AOAC (2007). The individual body weight of quails was recorded at weekly interval up to 5 weeks of age. The feed offered and feed leftover was weighed daily, to quantify the feed utilized. Daily feed consumption was recorded replicate wise and feed efficiency was calculated weekly. Performance index (PI) was calculated for each treatment by dividing the average weight gain by the feed conversion ratio, while protein efficiency ratio (PER) was calculated by dividing the weight gain by protein consumed.

At the end of study period (5th week), two birds per replicate and thus a total 6 birds per treatment were randomly selected, weighed and slaughtered. The data on dressing percentage, carcass yield, ready-to-cook yield and percent weight of heart, liver, gizzard and giblet were recorded. Economics were worked out basing on the prevailing market price of ingredients and feed efficiency of birds. The data was analyzed statistically (Snedecor and Cochran, 1994) and tested for significance using Duncan's multiple range test (Duncan, 1955) using SPSS 24.0 version.

RESULTS AND DISCUSSION

The chemical composition of cumin seed (CS) powder used in the present study was 90.34, 92.21, 18.26, 14.02, 30.02, 27.96, 7.79, 0.42, 0.94 and 0.50 per cent, for DM, OM, CP, EE, CF, NFE, TA, AIA, Ca and P, respectively (on DM basis except for DM). The chemical composition of quail diets containing CS powder at varying levels is presented in Table 1.

The results on body weight gain, feed intake, FCR, PI and PER of different dietary treatments are presented in Table 2. The body weight gain was higher ($P<0.05$) in quails fed diets containing 1.0% CS powder as compared to the control (Table 2). In line with the present findings, Al-Kassi (2010) reported that supplementation of cumin seed powder at 1.0% level resulted in improved body weight gain in broiler chicks. Similarly, Shafiee *et al.* (2020) reported that supplementation of CS powder at 0.25 and 0.75% in the diet had resulted in increased ($P<0.01$) body weight in broiler chicken. The increased body weight gains observed in quails upon feeding CS powder in the diet might be attributed to the biological functions of cumin that are essential for growth. Further, it can be attributed to its stimulant, carminative, digestive and antimicrobial properties. On the other hand, the slight depression in growth rates observed at higher levels (2.0%) of inclusion could be attributed to the damage caused to the intestine, liver and kidneys as explained by the mechanisms by which the plant constituents may cause a damage to body tissues (Ibrahim *et al.,* 2007). Similarly, increased body weight gains upon feeding diets containing CS powder were reported by Al-Anbari *et al.* (2013), Elagib *et al.* (2013) and Rafiee *et al.* (2014) in broiler chicken and Ali *et al.* (2018) in laying Japanese quail. In contradiction to the present findings,

Ali *et al.* (2011) reported decreased (P<0.05) body weight gain in broilers fed CS at 0.2% level in the diet as compared to the control. However, no effect (P>0.05) on body weight gain upon feeding CS powder in the diet were also reported earlier in broilers (Sharifi *et al.,* 2013; Alimohamadi *et al.,* 2013; Berrama *et al.,* 2017; Amiri *et al.,* 2020; Cetinkaya and Filik, 2020) and laying hens (Saleh *et al.,* 2020).

Inclusion of CS powder up to 2.0% level in the diet had no effect (P>0.05) on feed intake of quails as compared to those fed control diet (Table 2).These results agree with the findings of Shafiee *et al.* (2020) who reported that supplementation of cumin seed powder at 0.25 and 0.75% levels in the diet had no effect (P>0.05) on feed intake in broiler chickens. Similarly, no effect (P>0.05) on feed intakes upon feeding diets containing cumin seed powder were also reported earlier in broiler chicken (Sharifi *et al.,* 2013; Elagib *et al.,* 2013; Alimohamadi *et al.,* 2014; Berrama *et al.,* 2017; Amiri *et al.,* 2020; Cetinkaya and Filik, 2020) and in laying Japanese quail (Ali *et al.,* 2018). In contrast, Rafiee *etal*. (2014) reported significantly increased (P<0.05) feed intake in broiler chicks fed cumin powder at 0.2% in the diet as compared to those receiving control diet while Saleh *et al.* (2020) reported decreased (P<0.05) feed intake in laying hens when cumin seed meal replaced wheat bran at 0, 50 and 100% wheat bran (4% in total ration) in the diet.

The FCR improved (P<0.01) significantly in quails with inclusion of CS powder up to 2.0% level in the diet as compared to the control (Table 2).The feed consumed/kg gain was lower (P<0.01) in quails fed diets containing CS powder at 1.0% level as compared to the other treatments (Table 2). In corroboration, Shafiee *et al.* (2020) reported significantly lower (P<0.05) feed consumed/kg gain in broiler chicken fed cumin seed powder up to 0.75% in the diet. The improved feed utilization upon feeding CS powder might be attributed to the improved gut function and balance of intestinal micro-flora resulting in enhanced efficiency and utilization of feed (Johri, 2011). Thus, better FCR in cumin fed birds may be attributed to its nutrient sparing effect. Further, the positive effect of cumin seed powder on body weight gain and the feed conversion ratio could be related to the increased efficiency of feed utilization. Similarly, several authors reported improved FCR upon feeding diets containing cumin seed powder (Mansoori *et al.,* 2006;Elagib *et al.,* 2013; Almohamadi

Table 1. Ingredient (%) and chemical composition (% DM basis) of quail diet

Constituent	T_1	T_2	T_3	T_4	T_5
Maize	47.8	47.4	47.1	46.75	46.5
De-oiled rice bran	5.80	5.85	5.80	5.80	5.65
Soybean meal	39.05	38.90	38.75	38.60	38.5
Fish meal	5.00	5.00	5.00	5.00	5.00
Cumin powder	0.00	0.50	1.00	1.50	2.00
Di-calcium phosphate	0.20	0.20	0.20	0.20	0.20
Shell grit	1.20	1.20	1.20	1.20	1.20
Salt	0.25	0.25	0.25	0.25	0.25
Trace mineral mixture	0.15	0.15	0.15	0.15	0.15
Feed additives	0.55	0.55	0.55	0.55	0.55
Total	100	100	100	100	100
Crude protein (%)	26.79	26.73	26.67	26.65	26.73
ME kcal/kg (calculated)	2900.91	2900.03	2900.31	2900.00	2901.10
Proten: Energy ratio	120.87	120.84	120.85	120.83	120.88
Feed cost/100 kg (₹)	2992.5	3089.8	3187.6	3285.1	3384.6

*Calculated value

Table 2. Effect of inclusion of cumin seed powder at varying levels in the diet on growth performance of quails

Treatment	Body weight gain (g)	Feed intake (g)	Feed conversion ratio	Performance index (g)	Protein efficiency ratio	Feed cost per kg gain (₹)
T_1	175.37^{a}±8.11	627.67±26.39	3.58^{c}±0.03	49.00^{a}±2.51	1.03^{a}±0.01	107.42^{bc}±0.89
T_2	185.63^{ab}±6.01	620.37±12.76	3.34^{b}±0.04	55.56^{ab}±2.46	1.10^{b}±0.01	103.34^{ab}±1.22
T_3	196.25^{b}±5.67	613.10±10.07	3.13^{a}±0.04	62.84^{b}±2.62	1.19^{c}±0.02	99.73^{a}±1.34
T_4	180.07^{ab}±4.22	603.33±9.13	3.35^{b}±0.04	53.75^{a}±1.80	1.09^{b}±0.01	110.12^{c}±1.22
T_5	173.75^{a}±4.63	595.57±8.52	3.43^{b}±0.06	50.72^{a}±2.14	1.06^{ab}±0.02	116.12^{d}±1.88
SEM	3.11	6.43	0.04	1.56	0.02	1.59
SS	*	NS	**	*	**	**

^{a,b,c}Values in column bearing different super scripts differ significantly; **(P<0.01); *(P<0.05); NS – Non significant

et al., 2014; Rafiee *et al.,* 2014; Berrama *et al.,* 2017; Saleh *et al.,* 2020) in broiler chicken. However, Sharifi *et al.* (2013) and Cetinkaya and Filik (2020) reported that feeding cumin seed powder in the diet had no effect (P>0.05) on FCR in broiler chicken.

The performance index (P<0.05) and protein efficiency ratio (P<0.01)) were higher in quails fed diets containing 1.0% cumin seed powder as compared to the control (Table 2). The increased PIa nd PER observed in quails with inclusion of CS powder at 1.0% level in the diet may be attributed to the increased body weight gains, reduced feed intakes and improved feed consumed/kg gain in quails at 1.0% inclusion level as observed in the present study.

Inclusion of CS powder at 1.0% level in the diet resulted in increased (P<0.01) carcass yield (g), dressing percent and ready to cook yield (g) of quails as compared to the control (Table 3). The increased carcass yield (g), dressing % and ready to cook yield observed in quails upon feeding cumin seed powder in the diet might be attributed to the fact that aromatic plants in poultry have stimulatory effects on the digestive system by increasing the production of digestive enzymes and improving utilization of digestive products *via* enhanced liver function (Hernandez *et al.,* 2004). However, several authors reported that feeding cumin seed in the diet had no effect (P>0.05) on carcass yield (Sharifi *et al.,* 2013; Habibi *et al.,* 2016; Rafeeq *et al.,* 2016; Berrama *et al.,* 2017; Cetinkaya and Filik, 2020) and dressing percentage (Elagib *et al.,* 2013) in broiler chicken. Inclusion of cumin powder up to 2.0% level in the diet had no effect (P>0.05) on weight

Table 3. Effect of inclusion of cumin seed powder at varying levels in the diet on carcass characteristics of quails

Treatment	Carcass yield (g)	Dressing %	Ready to cook yield (g)	Heart(g)	Liver(g)	Gizzard (g)	Giblet (g)
T_1	111.86^{ab}±3.81	62.42^{a}±0.43	122.97^{a}±4.34	2.18±0.10	4.35±0.27	4.59±0.19	11.12±0.55
T_2	118.32^{b}±2.91	63.25^{ab}±0.29	129.72^{a}±3.39	2.27±0.07	4.43±0.21	4.70±0.22	11.40±0.50
T_3	127.54^{c}±2.55	64.31^{b}±0.50	139.53^{b}±2.82	2.34±0.07	4.77±0.10	4.89±0.11	11.99±0.27
T_4	115.66^{ab}±3.19	63.21^{ab}±0.32	126.85^{a}±3.54	2.20±0.04	4.38±0.13	4.62±0.18	11.19±0.35
T_5	109.01^{a}±1.59	62.08^{a}±0.32	119.93^{a}±1.78	2.16±0.02	4.29±0.08	4.47±0.10	10.91±0.19
SEM	1.69	0.21	1.88	0.03	0.08	0.07	0.18
SS	**	**	**	NS	NS	NS	NS

^{a,b,c}Values in column bearing different super scripts differ significantly; **(P<0.01); *(P<0.05), NS – Non significant

of heart, liver, gizzard and giblet (g) in Japanese quails (Table 3). These results agree with Rafeeq *et al.* (2016) who reported that supplementation of cumin at 0.5 and 1.0% level in the diet had no effect (P>0.05) on weight of heart, liver and gizzard in broiler chicken. Similar findings were also reported earlier (Al-Kassie *et al.,* 2011; Sharifi *et al.,* 2013; Habibi *et al.,* 2016; Berrama *et al.,* 2017).

Inclusion of CS powder at 1.0% level in the diet had resulted in significant (P<0.01) decrease in the feed cost/kg gain in quails as compared to those fed diets containing CS powder at 0, 1.5 and 2.0% levels. The study indicated that the feed cost/kg gain decreased by ₹ 4.08 in T_2 and 7.69 in T_3 while it is increased by 2.70 in T_4 and 8.70 in T_5 groups of quails fed diets containing varying levels of CS as compared to the control (T_1).

CONCLUSION

It was concluded that cumin seed powder can be included at 1.0% level in the diet of quails for improved growth and decreased cost of production.

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Received on 07.09.2021 and accepted on 27.09.2021