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Effect of Inclusion of Black Pepper Powder as Natural Feed Additive on the Performance of Japanese quail

V. Sri Divya, D. Srinivas Kumar* and E. Raghava Rao
Department of Animal Nutrition,
NTR College of Veterinary Science, Gannavaram – 521102, Andhra Pradesh, India

ABSTRACT

This study was conducted to determine the effect of inclusion of black pepper (BP) powder in the diet on nutrient digestibility, production performance, and carcass characteristics of Japanese quail. One hundred and fifty, day-old quail chicks were randomly allotted into five experimental groups, each with 3 replicates of 10 chicks and were offered respective diets for 5 weeks. BP was ground and was included at 0% (T_1; Control), 0.25 (T_2), 0.50 (T_3), 0.75 (T_4) and 1.0 (T_5) percent levels in iso-caloric and iso-nitrogenous broiler quail diets to meet the nutrient requirements. Results indicated increased body weight gain ($P<0.05$), decreased overall feed intake ($P<0.01$) and improved feed conversion ratio (FCR) ($P<0.01$) with inclusion of BP at 1.0% in the diet as compared to the control.There was a significant increase ($P<0.01$) in the digestibility of gross nutrients and fibre fractions with incorporation of BP at 1.0% in the diet as compared to the control group. Similarly, incorporation of BP at 1.0% level in the diet had increased the carcass yield, ready to cook yield ($P<0.05$), dressing percentage and meat to bone ratio ($P<0.01$) in quails as compared to the control. However, incorporation of BP upto 1.0% level in the diet had no effect ($P>0.05$) on feed cost/kg gain. Thus, it is concluded that BP can be included at 1.0% level in quail diets as natural feed additive without any adverse effects.

Keywords: Black pepper, Carcass characteristics, Nutrient digestibility, Production performance, Quail

INTRODUCTION

Dietary additives have an important role in animal production as growth and health promoters. Black pepper (BP) is one such alternative growth promoter. Black pepper (*Piper nigrum*) is a well-known medicinal plant and has many therapeutic effects like anti-ache effect (Moorthy *et al.,* 2009), anti-oxidant and anti-bacterial effects (Gulcin, 2005). It is a good source of dietary protein and fatty acids for consumption by human and animals. The active principle, piperine present in BP has hepatoprotective and gastroprotective properties and can increase absorption of selenium, vitamin B-complex, β- carotene, curcumin and other nutrients (Khalaf *et al.,* 2008). BP as an alternative to antibiotic growth promoters has been recommended for feeding broilers (Ghaedi *et al.,* 2013; Valiollahi *et al.,* 2013) while some other report observed no significant improvement in body weight gain and FCR (Puvaca *et al.,* 2014).

Quail is considered a prolific meat and egg producer with dual production capacity and thus attained a valuable status in commercial enterprises. They are popular for their high protein (26%) and less fatty (3%) meat (Shinde *et al.,* 2014). However, studies on the feeding value of BP in Japanese quails are very limited. Hence, the present investigation was conducted to study the effect of BP powder inclusion at varying levels in the diet on growth performance, nutrient digestibility, carcass characteristics and cost economics in Japanese quails.

MATERIALS AND METHODS

One hundred fifty, day-old Japanese quail chicks were weighed individually (mean BW, 7.42 ± 0.38 g), wing banded and randomly divided in to 5 equal groups of 3 replicates each with 10 chicks/replicate. The experiment was carried out for 5 weeks in a completely randomized design (CRD). During the experiment, BP seed was ground and included at 0% (T_1; control), 0.25 (T_2), 0.50 (T_3), 0.75 (T_4) and 1.0 (T_5) percent levels in iso-caloric and iso-nitrogenous quail diets (Table 1) to meet the nutrient requirements (NRC, 1994). All the chicks were housed in battery brooders under uniform management conditions. Feed and water were provided *ad libitum*. The feed offered and feed left over was

*Corresponding author Email: kumardhulipalla@gmail.com

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

Constituent	Groups					Cost/kg (₹)
	T_1	T_2	T_3	T_4	T_5	
Maize	47.5	47.5	47.5	47.0	47.0	16.00
De-oiled rice bran	7.5	7.25	7.0	7.25	7.0	13.50
Soybean meal	36.5	36.5	36.5	36.5	36.5	38.00
Fish meal	5.00	5.00	5.00	5.00	5.00	30.00
Black pepper	0.00	0.25	0.50	0.75	1.00	550
Oil	0.50	0.50	0.50	0.50	0.50	20.00
Di-calcium phosphate	1.00	1.00	1.00	1.00	1.00	26.00
Shell grit	1.00	1.00	1.00	1.00	1.00	0.00
Salt	0.25	0.25	0.25	0.25	0.25	3.00
Trace min mix	0.15	0.15	0.15	0.15	0.15	240.0
Feed additives	0.60	0.60	0.60	0.60	0.60	1116.00
Total	100	100	100	100	100	
ME* Kcal/kg	2899.56	2902.39	2905.21	2902.29	2905.11	
Crude Protein (%)	23.98	23.99	23.99	24.00	24.00	
Feed cost/100 kg (₹)	2616	2750	2885	3017	3152	

*Calculated Value

weighed daily, to quantify the feed utilized. The data for growth rate was recorded at weekly intervals.

During the last 3 days of the trial, faeces were collected of birds from all the 5 treatments which were previously fasted for 12 hours to empty the bird gut to mark the beginning and end of faeces collection. At the end of the collection period, the faecal samples collected from each treatment per day were pooled, ground and thoroughly mixed to obtain a homogenous mixture. Samples of feed and excreta samples were analyzed for proximate principles (AOAC, 2007). The retention of a nutrient was calculated by applying the following formula:

Nutrient retention (%) =

$$\frac{\text{Nutrient intake - nutrient excreted}}{\text{Nutrient intake}} \times 100$$

At the end of 5th week, two birds per replicate and thus six birds per treatment were randomly selected, weighed and slaughtered. The data on dressing percentage, carcass yield, meat bone ratio, ready-to-cook yield and per cent weight of heart, liver, gizzard and giblet were recorded. All the data were analyzed statistically (SPSS, version 17) as per Snedecor and Cochran (1993) and comparison of means was done using Duncan's multiple range tests (DMRT) (Duncan, 1955).

RESULTS AND DISCUSSION

The ingredient composition of quail diets formulated by incorporating BP at varying levels was shown in Table 1. The diets were iso-nitrogenous and iso-caloric with a protein: energy ratio of 1:120. Animal fat was added to the diets to make up the energy deficit. The CP (12.87%) content of BP reported in the present study was higher than the value (9.3%) reported by Bolanle *et al.* (2014) and lower than the value (25.45%) reported by Mohammed *et al.* (2013).

Body weight gain, feed intake and FCR under different dietary treatments are presented in Table 2. The mean body weight gain was higher ($P<0.05$) in quails fed diets containing BP at 0.5,0.75 and 1.0 % level as compared to the control group, but inclusion at 0.25% level in feed did not show any significant effect ($P>0.05$) on body weight gain over control group. The increased body weight gains observed in quails may be attributed to the stimulating effect of BP on the digestive system thus leading to improved body weight gain. Further, the level of BP used reflects the high activity of piperine citrate included in the diet which may have affected the

Table 2. Effect of dietary inclusion of black pepper on performance and feed cost

Parameter	Groups					Level of significance
	T_1	T_2	T_3	T_4	T_5	
Body weight gain (g)	187.73^{a}±3.57	195.04^{ab}±3.52	198.53^{b}±3.48	202.36^{b}±3.41	205.36^{b}±3.70	P<0.05
Overall feed Intake (g)	726.08^{e}±7.07	701.11^{d}±3.37	686.09^{c}±3.45	659.60^{b}±3.73	639.62^{a}±1.15	P<0.01
Feed conversion Ratio	3.90^{c}±0.07	3.63^{b}±0.07	3.46^{b}±0.07	3.26^{a}±0.06	3.11^{a}±0.07	P<0.01
Feed cost / kg gain (₹)	102.02±1.80	99.825±1.90	99.82±1.80	98.35±2.08	98.03±0.86	NS

^{abcde}Means with different superscripts in a row differ significantly

flow of digestive juices across the stomach (Al-Kassie *et al.,* 2011).The results of the present study corroborated with earlier workers who also reported increased body weight gain in quails (El-Tazi *et al.,* 2014; Valiollahi *et al.,* 2014) with incorporation of BP powder in the diet. In contradiction to the present findings, Ndelekwute *et al.* (2015) reported that the final live weight gain was improved (P<0.05) in broilers fed BP at 0.25% in diet while there was a negative effect when fed at 0.75 and 1.0% level. However, Puvaca *et al.* (2014) reported that feeding BP upto 1.0% level in the diet had no effect (P>0.05) on body weight gain in broilers. Feed intake for overall growth period (0-5 weeks) was lower (P<0.01) in quails fed diets incorporated with BP at 0.25, 0.5 and 0.75 % and 1.0% as compared to the control group. Herbal feed additives inhibit the growth and colonization of various pathogenic microorganisms including *E. coli* in the intestinal tract of chicken due to their antimicrobial activity (Galib *et al.,* 2010). When the number of harmful bacteria in the intestinal tract is low, more nutrients are absorbed by the birds. As a result, the birds gain higher weight with lower feed consumption. Another reason for decreased feed intake with the addition of black pepper in the diet might be due to strong and spicy flavour that could reduce the palatability of the feed (Windisch *et al.,* 2008).Similarly, decreased feed intake upon feeding diets containing BP powder were reported by Ndelekwute *et al.* (2015), Ghaedi *et al.* (2013) and Tripathi *et al.* (2013) in broiler chicken. In contrast, increased feed intake upon feeding diets containing BP were also reported earlier (Al-Kassie *et al.,* 2011; Shahverdi *et al.,* 2013; El-Tazi *et al.,* 2014). However, Moorthy *et al.* (2009), Akbarian *et al.* (2012) and Valiollahi *et al.* (2014) reported that feeding BP in broiler diet had no effect (P>0.05) on feed intake.

The FCR improved significantly (P<0.01) with increased level of inclusion of black pepper up to 1.0% level in the diet of quails as compared to those fed control diet. The improved feed conversion ratio observed in quails fed diets containing BP may be attributed to the presence of piperine citrate which probably enhances the secretion of digestive juices in the stomach leading to greater efficiency in utilization of feed resulting in enhanced growth (Al-Kassie *et al.,* 2011). These results corroborated with the findings of

Table 3. Effect of dietary inclusion of black pepper on nutrient digestibility

Parameter	Group					Level of significance
	T_1	T_2	T_3	T_4	T_5	
Dry matter	65.23^{a}±0.08	66.26^{b}±0.40	67.27^{c}±0.55	68.93^{d}±0.38	69.16^{e}±0.90	P<0.01
Organic matter	59.68^{a}±0.33	61.10^{b}±0.20	62.24^{c}±0.10	63.42^{d}±0.09	64.91^{e}±0.24	P<0.01
Crude protein	55.58^{a}±0.67	57.86^{b}±0.18	58.04^{c}±0.29	60.36^{d}±0.42	61.86^{e}±0.33	P<0.01
Crude fibre	47.06^{a}±0.22	49.98^{b}±1.5	50.71^{bc}±1.31	51.63^{bc}±1.91	52.83^{d}±0.39	P<0.01
Ether extract	49.87^{a}±2.33	50.82^{b}±2.19	55.58^{b}±0.49	60.39^{c}±2.12	62.07^{d}±1.15	P<0.01
NFE	50.00^{a}±0.45	51.66^{b}±0.11	52.97^{c}±0.16	54.10^{d}±0.19	55.07^{d}±0.16	P<0.01

^{abcde}Means with different superscripts in a row differ significantly

Table 4. Effect of dietary inclusion of black pepper on carcass characteristics

Parameter	Group					Level of significance
	T_1	T_2	T_3	T_4	T_5	
Carcass yield (g)	118.33^{a}±2.7	123.83^{ab}±2.3	126.17^{b}±2.8	129.17^{b}±2.4	129.67^{b}±1.3	P<0.05
Dressing (%)	58.16^{a}±1.15	59.59^{b}±0.92	60.30^{b}±1.6	60.55^{b}±2.8	60.79^{b}±1.0	P<0.01
Ready to cook yield (g)	109.17^{a}±1.6	113.33^{ab}±2.1	115.50^{bc}±2.1	119.33^{c}±1.5	120.67^{c}±1.8	P<0.05
Meat: bone ratio	3.67^{a}±0.02	4.19^{b}±0.00	4.61^{c}±0.01	5.20^{d}±0.00	5.45^{e}±0.02	P<0.01
Heart (%)	1.50±0.22	1.52±0.22	1.54±0.22	1.67±0.21	1.90±0.16	NS
Liver (%)	4.00±0.40	3.83±0.30	3.67±0.40	3.49±0.20	2.83±0.40	NS
Gizzard (%)	3.83±0.30	4.00±0.02	4.17±0.30	4.33±0.20	4.76±0.20	NS
Giblet (%)	9.33±0.30	9.35±0.20	9.38±0.30	9.39±0.30	9.49±0.80	NS

^{abcde}Means with different superscripts in a row differ significantly

other researchers (Al-Kassie *et al.,* 2011; Ghaedi *et al.,* 2013; Shahverdi *et al.,* 2013; Tripathi *et al.,* 2013; El-Tazi *et al.,* 2014; Valiollahi *et al.,* 2014). In contradiction, Ndelekwute *et al.* (2015) reported poor feed conversion ratio in broilers upon feeding BP in the diet.

Incorporation of BP up to 1.0% level in the diet of quails resulted in increased (P<0.01) digestibility of DM, OM, CP, CF, EE and NFE (%) as compared to the control group (Table 3).The improvement in the digestibility of proximate constituents observed with the addition of BP in the diet might be attributed to the ability of BP to induce saliva secretion, hydrochloric acid and mucus production (Srinivasan *et al.,* 2007). On the other hand, Jang *et al.* (2004) attributed better nutrient digestion to antimicrobial property of the essential oil in BP. In line with the present findings, Ndelekwute *et al.* (2015) also reported increased (P<0.05) digestibility of DM, CP, EE and CF with inclusion of BP upto 1.0% in the diet of broilers.

Data results pertaining to carcass characteristics are presented in Table 4. Inclusion of BP up to1.0% level in the diet of quails resulted in increased carcass yield, ready to cook yield (P<0.05), dressing (%) and meat to bone ratio (P<0.01) as compared to the control. The increase in the carcass yield in quails observed in the present study may be attributed to the presence of essential oils in BP. Similarly, increased carcass yield (Ghaedi *et al.,* 2013; Shahverdi*et al.,* 2013) and dressing per cent(Al-Kassie *et al.,* 2011; El-Tazi *et al.,* 2014) were also reported earlier. However, Moorthy *et al.* (2009) reported that feeding BP powder at 0.2 % level in the diet had no effect (P>0.05) on dressed weight and ready to cook yield of broilers. Inclusion of BP up to 1.0% level in the diet had no effect (P>0.05) on per cent weight of heart, liver, gizzard and giblets in quails, which is in line with the findings of earlier workers (Moorthy *et al.,* 2009; Nath *et al.,* 2012; El-Tazi *et al.,* 2014).

The present study indicated that the feed cost/kg gain decreased by ₹ 2.19 in T_2, ₹ 2.20 in T_3, ₹ 2.67 in T_4 and ₹ 3.99 in T_5 group of quails fed diets containing BP at varying levels as compared to the control group (Table 2). Similarly, El-Tazi (2014) reported that inclusion of a mixture of red pepper and BP upto 1.0% level in broiler diets resulted in higher net profit/kg meat.

CONCLUSIONS

The results of the present study indicated that incorporation of BP powder at 1.0 % level in the diet of quails had improved the performance of quails as evidenced from increased body weight gains, improved FCR and increased digestibility of nutrients in comparison to the control group.Thus, it is concluded that black pepper can be incorporated up to 1.0% level in the diet of quails without any adverse effect.

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