

RESEARCH ARTICLE

Effect of Dietary Inclusion of Neem Leaf Powder on Growth Performance, Nutrient Utilization, and Haemato-Biochemical Parameters of Japanese Quail

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ABSTRACT

A feeding trial was conducted to discern the influence of dietary incorporation of neem (*Azadirachta indica*) leaf powder on growth performance and haemato-biochemical parameters of Japanese quail for 6 weeks. A metabolic trial was conducted during the last week of the feeding trial to assess nutrient utilization. A total number of 144-day-old chicks of Japanese quail were randomly assigned into four treatment groups, with 36 Japanese quail per treatment having three replicates of 12 birds each. Birds of treatment T1 (control group) were fed a basal diet (starter and finisher), whereas in treatment groups T2, T3, and T4, the basal diet was incorporated with 0.25%, 0.50%, and 1.00% neem leaf powder, respectively. Results showed supplementation of 0.25% neem leaf powder improved the performance of Japanese quail in terms of body weight gain and performance index during the whole trial period. Nutrient utilization among various treatment groups was similar. The hematological values showed no significant alterations in different groups. The biochemical attributes among the treatment groups were similar, but a considerable decrease in the level of cholesterol and glucose was observed with an increasing level of neem leaf powder in the diet. Activities of ALT, AST, and ALP were lowest in the T4 group. It can be concluded that 1 percent neem leaf powder can be supplemented in feed for good health status and desired performance of the birds.

Keywords: Growth performance, Haemato-biochemical parameters, Japanese quail, Neem leaf powder, Nutrient utilization.

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INTRODUCTION

Poultry is the most efficient converter of low-value food into high-value nutritional food for human consumption. It is becoming an important part of the farm economy because of its enormous potential for rapid economic growth, low investment and high job opportunities for the weaker sections of the society. Poultry comprises of chicken, turkey, guinea fowl, duck, geese, quail etc. People prefer Japanese quail for meat and eggs, which may be used as an alternative for broiler and layer chicken because of its low-fat content. Phytochemicals, also known as phytobiotics or phytogenics, are natural bioactive molecules produced from plants that can be added to animal feed to increase production (Gadde et al., 2017). Because of their antimicrobial properties on various pathogenic bacteria, phytochemicals in the diet alter and strengthen the intestinal microbiota and reduce toxic microbial metabolites in the gut, resulting in relief from an intestinal challenge and immune stress and thus improving performance (Kim et al., 2015). Neem leaf powder has an inhibitory action on a wide spectrum of microorganisms and hepatoprotective actions. Supplementation of neem leaf as feed additives in the diet of poultry may improve the performance in terms of growth and nutrient utilization. It may decrease serum cholesterol levels and enhance the health status of birds. So, the present study was planned to investigate the effect of dietary incorporation of neem leaf powder on growth performance, nutrient utilization, and haemato-biochemical parameters of Japanese quail.

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MATERIALS AND METHODS

A total number of 144-day-old chicks of Japanese quail, as approved by the Institutional Animal Ethics Committee (IAEC), were randomly distributed into four treatment groups. Each treatment comprised of three replicates consisting of

12 Japanese quails per replicate. For the experiment, two types of basal diets were prepared to meet the nutrient requirement of Japanese quail i.e., starter (0-3 weeks) and finisher (3-6 weeks) as per ICAR (2013). The four dietary treatments were T1 (control) basal diet, T2, T3, and T4, incorporating 0.25, 0.50, and 1.00% neem leaf powder in a basal diet. The feeding trial was carried out for a period of 6 weeks. A metabolic trial was conducted in the last week of the feeding trial for 7 days to assess nutrient utilization in which nine Japanese quail were randomly selected from each treatment. Japanese quail were reared in a cage system using standard management and health care practices.

The required quantity of neem (*Azadirachta indica*) leaves was air-dried in the shade, followed by drying in a hot air oven at 60°C for 3 to 4 days, and then finely ground to powder using a laboratory mill and stored in a closed and dry container and then mixed with basal feed at varying levels. The dry matter, crude protein, ether extract, crude fiber, total ash, and nitrogen-free extract content for the Japanese quail's starter feed were 91.60, 25.02, 4.24, 4.96, 6.82, and 58.96%, respectively, and finisher feed were 92.30, 21.44, 4.56, 4.34, 7.48 and 62.18% respectively.

Parameters Studied

Feed offered was recorded daily, and body weight was recorded replicate-wise weekly for 6 weeks. Further, weekly feed intake, body weight gain, performance index, and feed conversion ratio (FCR) for each treatment group were calculated. Blood samples were taken at the end of the experiment for haemato-biochemical analysis. Nutrient utilization by the birds was estimated from the results of proximate analysis of feed samples and samples of droppings collected in the metabolism trial.

Statistical Methods

The experimental data obtained in the present study were analyzed statistically by applying One Way ANOVA using SPSS software version 21 (Snedecor and Cochran, 1994). The significant mean differences were calculated by Tukey post-hoc analysis with a significance level of $p < 0.05$.

RESULTS AND DISCUSSION

Production Performance

The average production performance of Japanese quails in terms of feed intake, body weight gain, feed conversion ratio, and performance index of different groups during the feeding trial are presented in Table 1. During the starter phase (0-21 days), it was observed that the T2 group (0.25 % neem leaf powder supplementation) and T3 (0.50 % neem leaf powder supplementation) group had significantly ($p < 0.05$) higher feed intake as compared to T4 (1% neem leaf powder supplementation) The mean values of body weight gain, feed conversion ratio, performance index were

statistically similar among all the treatment groups during the starter phase (0-21 days). During the finisher phase (21-42 days) of the feeding trial, maximum and significantly ($p < 0.05$) higher body weight was seen in T2 (0.25% neem leaf powder) followed by T3 and significantly ($p < 0.05$) lower body weight gain was detected in T4 (1% neem leaf powder supplemented group) and T1 (control group). It was observed that T2 and T3 had significantly ($P < 0.05$) higher feed intake as compared to T4. The T2 group had significantly ($p < 0.05$) better FCR as compared to the T1, T3, and T4 groups, in which it was statistically similar. The T2 group had a significantly ($p < 0.05$) higher performance index than the T1, T3, and T4 groups, whereas it was statistically similar in the T1, T3, and T4 groups. During the whole feeding trial period (0-42 days) the cumulative average body weight gain of T2 was maximum and significantly higher ($p < 0.05$) followed by T3, while significantly ($p < 0.05$) lower weight gain was seen in T4. Statistically, similar weight gain was detected in the T1 group as compared to T3 and T4. It was observed that T2 and T3 had significantly ($p < 0.05$) higher feed intake as compared to T4. The feed conversion ratio in Japanese quail of different treatment groups was statistically similar among all the groups. The performance index in the T2 group where the diet of Japanese quail was supplemented with a 0.25 percent level of neem leaf powder was significantly ($p < 0.05$) better as compared to other groups.

The present findings are in agreement with that of Ansari *et al.* (2012), who reported improved weight gain and better FCR in Japanese quail-fed diets supplemented with 2.5 g/kg of neem leaf meal than those fed diets with 1.25, 5.0 g/kg of neem leaf meal and controls. Our observations corroborate with the reports of Tipu *et al.* (2002) and Hossain *et al.* (2021). The higher weight gain could be due to the presence of macro and micro minerals in *Azadirachta indica* leaf meal, (Ansari *et al.*, 2012). The deficiency of these macro- and micro-minerals results in anorexia, osteoporosis and retarded growth in birds.

In the present study, it was also noted that the body weight gain, feed intake and performance index of Japanese quail decreased as the inclusion level of neem leaf powder increased to 0.50 and 1.00%. This reduction in growth rate in birds can be attributed to the presence of anti-nutritional factors contained in neem leaf meal, i.e., phenolic compounds, oxalates, and triterpenoids (bitter in taste). At higher levels low feed intake may be due to bitter and astringent taste resulting in insufficient consumption of digestible nutrients, particularly protein and energy required to sustain growth. Similar adverse effect on put . after growth performance was noted by Salawut *et al.* (1994) who found that lowest dose level of neem leaf meal in the diet of rabbits was better for growth performance than higher levels. Ogbuewu *et al.* (2010) also reported that different bio-active components of leaf meal might be responsible for depression in nutrient utilization and growth in rabbits at a higher level.



Nutrient Utilization

The average values of nutrient utilization of Japanese quail in terms of dry matter, crude protein, ether extract, and organic matter on adding neem leaf powder to the diet during the metabolic trial are presented in Table 2. There were insignificant variations in the utilization of dry matter, crude protein, ether extract, and organic matter in the Japanese quail-fed diet supplemented with varying levels of neem leaf powder. The results of the present study are in accordance with Elangovan et al. (2000), who reported that supplementation of varying levels of neem kernel meal to Japanese quail did not affect the retention of nutrients significantly, suggesting that bitter principles of neem might not directly interfere with the metabolism of nutrients up to the levels used in the present investigation.

Hematological Parameters

The hematological parameters in terms of hemoglobin,

PCV, TEC, TLC, MCV, MCH, and MCHC in Japanese quail-fed diets incorporated with neem leaf powder are summarized in Table 3. The hematological values viz. hemoglobin, total erythrocyte counts (TEC), total leucocyte counts (TLC) and packed cell volume (PCV) did not differ significantly due to the incorporation of varying levels of neem leaf powder in the diet of Japanese quail and were within the normal physiological range. These results are in agreement with the reports of Nodu et al. (2016), who also reported non-significant differences in hematological parameters of broilers who provided neem leaf extract at different levels.

Biochemical Parameters

The average values of biochemical parameters, namely blood glucose, total serum protein, serum albumin, serum globulin, serum cholesterol, serum triglycerides, and serum enzymes (ALT, AST, and ALP), are summarized in Table 4. The mean

Table 1: Effect of neem leaf powder (NLP) on weekly growth performance of Japanese quail

Parameters	Treatment/Groups			
	T1 (Basal diet)	T2 (Basal diet+ 0.25% NLP)	T3 (Basal diet+ 0.50% NLP)	T4 (Basal diet+ 1.00% NLP)
Starter Phase (0-21 days)				
Weight gain (g)	59.11±0.34	59.28±0.28	59.78±0.68	58.50±0.58
Feed intake (g)*	157.47±1.05 ab	158.24±0.17 b	161.68±0.76 b	153.14±1.76 a
Feed conversion ratio	2.66±0.03	2.67±0.10	2.70±0.03	2.62±0.06
Performance index	22.19±0.38	22.21±0.19	22.11±0.46	22.37±0.70
Finisher Phase (21-42 days)				
Weight gain (g)*	123.00±0.19 a	131.39±0.62 c	125.78±0.70 b	121.78±0.34 a
Feed intake (g)*	473.26±3.83 ab	480.52±3.58 b	480.81±2.39 b	465.61±0.22 a
Feed conversion ratio*	3.85±0.03 b	3.66±0.04 a	3.82±0.02 b	3.82±0.01 b
Performance index*	31.97±0.31 a	35.94±0.57 b	32.90±0.28 a	31.85±0.18 a
Whole Feeding Trial (0-42 days)				
Weight gain (g)*	182.11±0.53 ab	190.67±0.82 c	185.56±1.33 b	180.28±0.78 a
Feed intake (g)*	630.74±4.84 ab	638.76±3.41 b	642.49±3.14 b	618.75±1.98 a
Feed conversion ratio	3.46±0.03	3.35±0.03	3.46±0.02	3.43±0.03
Performance index*	52.59±0.60 a	56.92±0.78 b	53.59±0.66 a	52.53±0.61 a

Means bearing different alphabets in superscript in a row differ significantly *(p<0.05).

Table 2: Effect of neem leaf powder (NLP) on nutrient utilization (%) of Japanese quail

Parameters	Treatment/Groups			
	T1 (Basal diet)	T2 (Basal diet+ 0.25% NLP)	T3 (Basal diet+ 0.50% NLP)	T4 (Basal diet+ 1.00% NLP)
Dry matter	68.33±1.49	69.01±1.06	69.53±0.78	70.65±0.66
Organic matter	74.61±0.30	76.53±0.31	74.87±0.73	74.66±1.21
Crude protein	72.64±4.87	74.03±2.45	69.24±1.36	69.21±3.82
Ether extract	77.89±1.05	79.86±4.61	78.98±0.15	78.00±3.21

values of serum biochemical constituents in terms of total protein, albumin, globulin, and triglycerides in Japanese quail were statistically similar among all dietary treatments and in the normal physiological range. There was a significant decrease in glucose, cholesterol, and serum enzymes (ALT, AST, and ALP) in the T4 group as compared to the control group. Observations of present experiment for serum glucose corroborate with the reports of Dholi et al. (2011), Hag et al. (2018), and Nodu et al. (2016). The hypoglycemic action of neem leaves might be due to the cumulative effect of glycosides, terpenoids, and flavonoids. In the present study, a significant (p<0.05) decrease in serum cholesterol concentration was noted in T4 as compared to T1 group, which concurred with the results of Ogbuewu et al. (2010) in broiler chicken. The

Table 3: Effect of neem leaf powder (NLP) on haematological parameters of Japanese quail

Parameters	Treatment/Groups			
	T1 (Basal diet)	T2 (Basal diet+ 0.25% NLP)	T3 (Basal diet+ 0.50% NLP)	T4 (Basal diet+ 1.00% NLP)
Haemoglobin (g/dL)	10.54±0.35	10.95±0.25	11.06±0.34	11.42±0.33
Packed cell volume (%)	36.00±1.29	34.83±1.30	36.00±1.63	37.67±2.03
Total erythrocyte counts(106/μL)	2.65±0.15	2.58±0.12	2.53±0.14	2.59±0.15
Total leukocyte counts(103/μL)	23.19±1.50	23.41±1.16	22.72±1.09	23.16±1.52
Mean corpuscular volume (fl)	137.94±8.53	135.99±4.98	144.00±8.74	145.90±5.53
Mean corpuscular haemoglobin(pg)	40.23±1.67	42.85±1.63	44.22±2.28	42.94±1.80
Mean corpuscular haemoglobin concentration (g/dL)	29.39±0.98	31.56±0.81	30.82±0.58	30.57±0.89

Table 4: Effect of neem leaf powder (NLP) on biochemical parameters of Japanese quail

Parameters	Treatment/Groups			
	T1 (Basal diet)	T2 (Basal diet+ 0.25% NLP)	T3 (Basal diet+ 0.50% NLP)	T4 (Basal diet+ 1.00% NLP)
Cholesterol (mg/dL)*	132.37±4.98 b	126.56±2.59 ab	119.17±9.44 ab	107.58±4.80 a
Triglyceride (mg/dL)	109.26±2.54	109.95±3.12	108.70±2.91	106.03±1.48
Glucose (mg/dL) *	271.67±10.06 b	242.83±10.09 b	225.83±3.77 ab	212.00±5.70 a
Total Protein(g/dL)	3.94±0.13	3.95±0.16	3.97±0.10	3.99±0.21
Albumin (g/dL)	1.46±0.07	1.41±0.06	1.27±0.06	1.30±0.10
Globulin (g/dL)	2.47±0.06	2.54±0.15	2.71±0.05	2.68±0.13
ALT (U/L)*	13.22±0.67b	10.13±0.88ab	9.85±1.16ab	9.10±0.71a
AST (U/L)*	106.36±1.65b	94.66±2.88a	92.34±2.45a	89.08±2.25a
Alkaline Phosphatase (U/L)*	85.24±1.39 b	80.19±1.29 ab	79.55±1.53 ab	77.47±1.59 a

Means bearing different alphabets in superscript in a row differ significantly *(p<0.05)

reduced serum content of total cholesterol may reflect the hypocholesterolemic properties attributed to the defatted part of the leaves, which are rich in fibrous content and may block intestinal cholesterol absorption (Ghazalah and Ali, 2008). In the present study, a significant (P<0.05) decrease in serum enzymes (ALT, AST, and ALP) concentration was noted in T4 as compared to T1 group. The findings of the present study are in agreement with Ansari *et al.* (2012), who reported a significant decrease in liver enzymes ALT, AST, and ALP when birds were supplemented with 1.25 g, 2.5 g, and 5.0 g of neem leaf powder per kg of feed as compared to birds fed the basal diet. According to Bhatti and Dil (2005), changes in serum enzyme activity under stress conditions occur due to malfunctioning of the liver, as degenerating and necrotic cells leak enzymes from the cytoplasm. The non-hepatotoxic nature of *Azadirachta indica* was proved in the study performed by Haque *et al.* (2006), who found unaltered and normal activities of serum AST, ALT, ALP as well as the retained architecture of liver after *Azadirachta indica* treatment.

CONCLUSION

In view of the above findings, it can be concluded that 1% neem leaf powder can be supplemented in feed for good

health status and 0.25% level for improvement of growth performance of the Japanese quail birds.

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