Effect of Feeding Neem (*Azadirachta indica*) Kernel Meal on Growth, Nutrient Utilization and Physiology of Japanese Quails (*Coturnix cotrnix japonica*)

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ABSTRACT : The present study was conducted to investigate the feasibility of feeding neem kernel meal (NKM) containing diet to growing Japanese quails, which was incorporated into a standard quail diet at 0, 50, 75 or 100 g/kg in place of soyabean meal and deoiled rice bran. Each diet was offered to 30 quail chicks housed in battery cages from day one to five weeks of age. The chicks fed NKM diets gained 123.3, 122.6 and 121.6 g mean body weight, respectively, and which were significantly ($p<0.05$) lower than that of 129.9 g gained by those of birds fed the control diets. The feed intake and feed conversion ratio of birds in different dietary groups were not significantly altered due to dietary variations. Mean values for retention of dietary energy, N and Ca were found to insignificantly differ ($p>0.05$) among the treatment groups but P retention was significantly ($p<0.01$) lower for quails fed 100 g/kg NKM than those in other groups. Blood biochemical constituents, carcass characteristics and organoleptic test for meat also were not found to vary significantly ($p>0.05$) due to dietary treatments. The histopathology of liver and kidney tissues from NKM fed quails revealed mild degenerative changes. It could be concluded that inclusion of NKM in quail diet reduced the growth besides inducing mild pathological changes in liver and kidney tissues. (*Asian-Aus. J. Anim. Sci. 2000. Vol. 13, No. 9 : 1272-1277*)

Key Words : Quails, Neem Kernel Meal, Growth, Nutrient Retention, Carcass Traits, Histopathology

INTRODUCTION

The inadequacy in quality and availability of feed and its escalating cost are some of the major constraints in way of efficient quail production in the developing countries. In general, quails require rations that are composed of high protein feed stuffs like the soyabean meal and fish meal which are usually expensive. The animal and poultry nutritionists are therefore, in constant search for alternative feed stuffs like the neem kernel meal (NKM), a byproduct of oil industries obtained after solvent extraction of dehulled neem seed .The product is available in India in sizable quantities (Singh, 1993) and has normally been employed to enrich soil fertility due to the presence of certain bitter triterpenoids which has restricted its use as feed for livestock and poultry (Devakumar and Sukh Dev, 1993).

Growth of broiler chicks was insignificantly depressed when raw neem seed meal was fed at graded levels of 25, 50 or 75 g/kg diet but not that of the solvent extracted meal employed at the same dietary levels (Sadagopan et al., 1981). Chand (1987) noticed significantly progressive depression in weight gain of chicks fed diets containing raw neem seed meal at 100, 200 or 300 g/kg . Significant depression in body weight gains of White Leghorn cockerel chicks was also reported by Reddy and Rao (1988) who fed diets containing expeller or solvent extracted undecorticated cake replacing peanut meal at levels equivalent to 50 or 100% nitrogen. Jana (1997) reported lowered body weight gain and feed conversion efficiency when the broiler chicks were fed NKM up to 150 g/kg level in diet from day old to six weeks of age. In view of the above information, further work was carried out to investigate growth response of Japanese quails fed diets containing graded levels of NKM up to 100 g/kg from day one to five weeks of age.

MATERIALS AND METHODS

One hundred and twenty Japanese quails hatched and of uniform body weight were divided at random into four groups, each subdivided into 3 replicates of 10 each and housed in electrically heated battery cages fitted with feeders, waterers and dropping trays. They were offered *ad libitum* diets (D_1 to D_4) respectively containing 0, 50, 75 or 100 g/kg of NKM (table 1) from day one to five weeks of age. Clean and fresh drinking water was provided *ad libitum* daily. Feed consumption and body weights were recorded at weekly intervals throughout the experimental period.

A nutrient balance study lasting for four days was carried out at 24 days of age employing all birds in a group and adopting total fecal collection procedure. Daily weighed quantity of feed was offered and the residue weighed on the last day to arrive at the total

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Table 1. Ingredient and nutrient composition of grower diet

Attribute	Dietary group			
	D_1	D_2	D_3	D_4
Ingredient composition (g/kg)				
Basal mixture[1]	645.0	645.0	645.0	645.0
Soyabean meal (SBM)	245.0	207.0	188.5	170.0
Deoiled rice bran (DORB)	11.0	98.0	91.5	85.0
Neem kernel meal (NKM)	-	50.0	75.0	100.0
Nutrient composition (g or MJ/kg), calculated				
CP	223.1	223.2	223.4	223.6
ME	11.32	11.30	11.30	11.29
Lys	12.58	12.37	12.28	12.19
Met	4.25	4.33	4.38	4.42
Nutrient composition (g or MJ/kg), determined				
CP	225.2	226.2	221.5	222.8
ME	11.62	11.22	11.21	11.24
Ca	12.5	12.8	12.2	12.5
P	9.45	9.33	9.05	9.40

Basal mixture (g/kg diet) consisted of : maize, 515; fish meal, 100; dicalcium phosphate, 14.3; ground limestone, 10; common salt, 3; trace mineral supplement[a], 1; vitamin mix.[b], 1.7.

[a] supplied mg/kg diet: Mg, 300; Mn, 55; I, 0.4; Fe, 56; Zn, 30; Cu, 4.

[b] supplied per kg diet: Vit. A, 8250 IU; vit. D_3, 1200 ICU; vit. K, 1 mg; vit. E, 40 IU; vit. B_1, 2 mg; vit. B_2, 4 mg; vit. B_{12}, 10 mg; niacin, 60 mg; pantothenic acid, 10 mg; choline, 500 mg.

feed consumed by the respective lot of birds. The daily feces were collected and the four days collections were pooled together to arrive at the total fecal output. The feed and pooled faecal samples were processed and analysed for proximate principles, Ca, P (AOAC, 1990) and GE (Ballistic bomb calorimeter).

At the end of five weeks of age, six quails per dietary group were fasted for 12 h and sacrificed by standard procedure for evaluating carcass characteristics in terms of yield of eviscerated carcass, weights of liver, heart, gizzard, and organoleptic evaluation of pressure cooked meat on 7 point Hedonic scale by semi-trained judges. Before sacrificing the birds, blood was also collected in heparinized (20 IU/ml) glass vials from 6 quails per dietary group for the estimation of haemoglobin (Schalm et al., 1975), total erythrocyte (TEC) and total leucocyte counts (TLC) (Natt and Harrick, 1952). Concomitantly, blood samples were drawn into separate vials without any anticoagulants to seperate serum which were stored at -20℃ for the analysis of protein (Hiller and Van, 1927), cholesterol (Wynbenga and Pileggi, 1970), alanine amino transferase (ALT, EC 2.6.1.2, Reitman and Frankel, 1957), aspartate amino transferase (AST, EC 2.6.1.1, Reitman and Frankel, 1957) and alkaline phosphatase (ALP, EC 3.1.3.1, Kind and King, 1954) but the glucose (Cooper and Mc Daniell, 1970) estimation was carried out immediately.

The tissues of target organs were examined for gross and histopathological changes to evaluate the effects of feeding NKM, if any. The feed cost for body weight gain by quails was computed on the basis of prevailing market prices for such feed ingredients in India.

Data were subjected to statistical analysis employing one way analysis of variance for completely randomised design and tested for statistical significance among the dietary treatment means (Snedecor and Cochran, 1989).

RESULTS

The NKM contained 382 g CP; 33 g ether extract; 132 g crude fibre and 118 g total minerals per kg DM. Quails fed diets containing NKM irrespective of the level employed recorded significantly ($p<0.05$) lower body weight at five weeks of age than those of birds fed the control soyabean meal diet. The total feed intake and feed conversion ratio of birds in various dietary groups, however, remained insignificantly ($p>0.05$) different from each other (table 2).

The differences in the retentions of dietary dry matter, GE, N and Ca were found to be of no statistical significance among the treatment groups, the retention of dietary P by quails fed the NKM diets decreased significantly ($p<0.01$) as compared with those fed the control diet (table 2). Data on the blood haematological and biochemical characteristics in terms of haemoglobin, TEC, TLC, glucose, protein and

Table 2. Growth performance and nutrient retention by quails

Attribute	Dietary group				SEM
	D_1	D_2	D_3	D_4	
Growth performance (0-5 wk)					
Body weight gain (g/b)	129.9[a]	123.3[b]	122.6[b]	121.1[b]	2.52
Feed intake (g/b)	447.0	454.6	428.7	419.2	7.61
Feed conversion ratio (feed : gain)	3.43	3.61	3.43	3.46	0.06
Percent nutrient retention (24-27 d)					
DM	64.0	59.5	59.5	61.5	0.85
GE	57.9	59.6	58.8	55.7	1.48
N	41.7	39.2	39.3	44.2	0.59
Ca	36.6	35.2	35.1	34.9	0.70
P	25.2[A]	21.4[B]	20.2[B]	23.3[AB]	0.84

Means bearing different superscripts differ significantly.
[a,b] ($p<0.05$); [A,B] ($p<0.01$).

cholesterol (table 3) also revealed no significant differences ($p>0.05$) due to dietary treatments. As for the activity of various enzymes studied, the ALP activity was significantly ($p<0.05$) higher for quails in control than the NKM fed groups, whereas the activity of ALT and AST appeared to have not been altered (table 3).

The yield of various carcass traits such as eviscerated carcass, liver, gizzard and heart was almost comparable in all the dietary groups (table 4). The sensory evaluation of meat as judged by semi-trained panel on 7-point Hedonic scale, failed to reveal any untoward characteristics with respect to appearance, tenderness, flavour and overall acceptability (table 4). No morbidity and mortality were noticed during the experimental feeding of NKM. No gross pathological lesions could be observed in liver, lungs, kidneys, spleen and heart of quails fed different diets. The histopathology of tissues drawn from liver paranchyma showed a mild degree of degenerative changes in the form of cloudy swelling, congestion and fatty infiltration in those of birds fed the NKM containing diets. The hepatocytes were swollen with rounded edges. The cell cytoplasm stained slightly more intense with eosin and were more granular than normal. Varying sizes of droplets of fats appeared in the cytoplasm of hepatocytes and as the fat droplets accumulated in the cell they coalesced and pushed the nuclei gradually towards laterally (figure 1). The kidney tissues also showed a mild to moderate degree of inflammatory changes in the tubular epithelium along with mild congestion. The veins and capillaries were distended with blood and they contained erythrocytes and clotted blood. Erythrocytes were also seen in the intertubular spaces (figure 2). The tissues from other organs of quails fed NKM as well as all the vital organs of quails fed control diet, however, revealed no appreciable change due to dietary

Table 3. Haematological and biochemical profile of quails

Attribute	Dietary group				SEM
	D_1	D_2	D_3	D_4	
Hb (g/dl)	12.5	11.3	11.9	11.8	0.99
TEC ($x10^6/mm^3$)	2.72	2.68	2.73	2.69	0.31
TLC ($x10^3/mm^3$)	18.6	18.8	18.9	19.5	0.31
Glucose (mg/dl)	249.3	253.6	244.0	240.6	14.8
Protein (g/dl)	3.08	2.84	2.75	3.08	0.20
Cholesterol (mg/dl)	158.3	158.3	160.3	149.3	10.2
ALT (U/L)[1]	21.4	24.9	23.7	23.6	0.75
AST (U/L)[1]	114.8	112.1	106.2	102.5	5.43
ALP (U/L)[2]	45.1[a]	34.4[b]	41.4[ab]	35.8[b]	3.06

Means bearing different superscipts differ significantly ($p<0.05$).
[1] μ mol pyruvate produced / l / min.
[2] μ mol phosphate produced / l / min.

Table 4. Carcass characteristics and organoleptic evaluation of meat

Attribute	Dietary group				SEM
	D_1	D_2	D_3	D_4	
Carcass characteristics (% of live weight)					
Eviscerated	65.8	65.3	64.2	65.3	0.53
Liver	1.81	1.89	2.00	2.03	0.06
Gizzard	2.52	2.31	2.12	2.49	0.07
Heart	0.95	0.98	0.98	1.02	0.05
Organoleptic evaluation of meat					
Appearance	5.84	5.35	5.30	5.84	0.30
Tenderness	5.61	5.61	5.46	5.81	0.29
Flavour	5.62	5.27	5.28	5.36	0.41
Overall acceptability	5.46	5.58	5.66	5.61	0.16

variation.

DISCUSSION

Feeding of NKM to growing quails depressed body growth (table 2), an observation also reported by earlier workers (Christopher et al., 1976; Chand, 1987; Reddy & Rao, 1988; Jana, 1996) in broiler chickens. However, Sadagopan et al. (1981) did not observe growth depression in broiler chicks fed the solvent extracted NKM. The growth response, however, may be related to the feed intake by birds or the pathological changes which may take place on feeding higher level of NKM in the diet.

Subbarayudu and Reddy (1975) noticed a reduced feed intake when NKM was included at a level beyond 50 g/kg diet but Sadagopan et al. (1981) noticed no difference in feed intake and feed : gain ratio of chicks when NKM was included up to 75 g/kg in diet. Similarly, in the present study also no significant differences in the feed intake and feed: gain ratio were observed (table 2). On the contrary, Reddy and Rao (1988) observed severe depression in feed conversion efficiency when the undecorticated expeller neem cake replaced more than 50% of the peanut meal nitrogen in diets of broiler chickens.This indicates that the NKM feeding at low levels does not decrease the feed intake and at higher NKM levels, the palatability may be affected, as in the present study also a decreasing trend for feed intake was observed.

Nagalakshmi (1993) reported a lowered DM retention in chicks fed the treated neem seed kernel cake when peanut meal was replaced completely. Whereas, Elangovan et al. (1996) and Jana (1997) did not observe such an effect due to feeding of diets containing NKM at 100 or 150 g/kg, respectively, an observation also made in the present study (table 3). Although, Jana (1997) observed a lowered N retention in broiler chicks due to NKM feeding, no such differences were available either from the present or earlier studies (Nagalakshmi, 1993; Elangovan et al., 1996). The retentions of energy and Ca remained unaltered but P retention of NKM fed groups (D_2 and D_3) was significantly ($p<0.01$) lower as compared with the control diet (table 3) fed quails as also reported

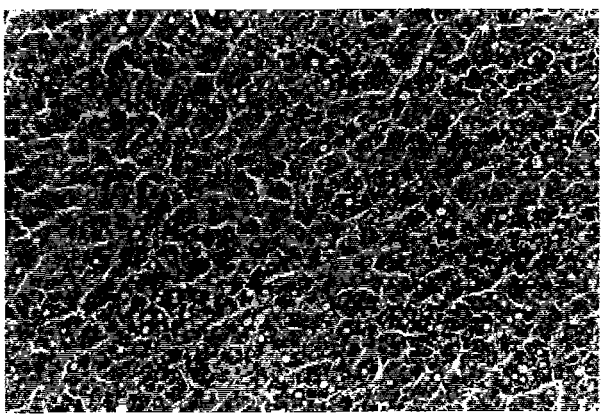

Figure 1. Mild fatty infiltration in the liver parenchyma of quails fed 50 g/kg NKM. H&E × 155

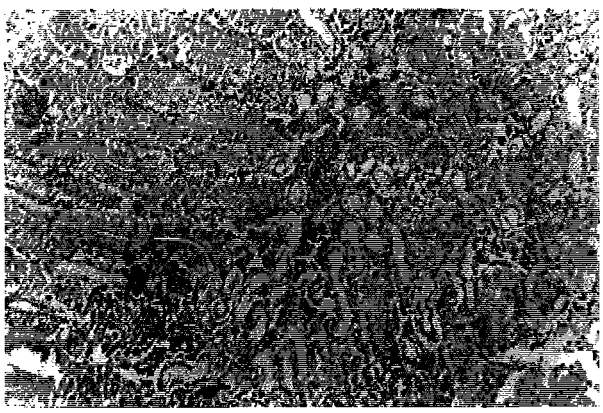

Figure 2. Mild congestion and haemorrhage in the kidney of quails fed 75 g/kg NKM. H&E × 155

by Jana (1997). As such the retention of various nutrients is not much influenced by the NKM inclusion in the diet of either broilers or quails suggesting that the bitter principles may not directly interfere with the metabolism of the nutrients.

Incorporation of NKM at 150 g/kg and beyond in the diet of chicks was reported to significantly reduce the Hb and TEC (Christopher et al., 1976; Chand, 1987; Jana, 1997; Gowda et al., 1998), although no significant effect could be noticed in the Hb, TEC and TLC in quails in the present study (table 3). Blood concentrations were of glucose, protein and cholesterol comparable among quails fed reference and test diets (table 3). Whereas, Jana (1997) reported a lower protein content in broiler chicks when NKM was incorporated at 150 g/kg in the diet. The blood AST, ALT and ALP activities were shown to be unaffected due to the dietary variation by Jana (1997) but in the present study, the ALP activity of the control diet fed birds was found to be significantly ($p<0.05$) higher than those fed NKM containing diet though the observed activities remained within the reported normal ranges (table 3). Thus, the effect on erythropoesis and the possible alteration of leucocytes and enzyme activities due to dietary inclusion of NKM was possibily not seen due to lower level of NKM.

The feeding of NKM neither affected the carcass characteristics in quails (table 4) and broiler chicks (Nagalakshmi et al., 1996) nor acceptability of meat of quails (table 4) and broiler chickens (Nagalakshmi et al., 1998). This indicated that the bitter taste of triterpenoids was not imparted to the meat. The absence of gross pathological lesions due to feeding of NKM to chickens (Sadagopan et al., 1982; Nagalakshmi et al., 1996; Jana, 1997) was similar to that of the present study. Although, feeding of NKM at higher levels affected the vital organs such as mild to severe hepatitis, nephritis and enteritis as has been observed in case of chicks (Sadagopan et al., 1982). However, in the present study, only mild histo-pathological changes were seen in liver and kidney tissues (figures 1 and2) due to probably lower level of inclusion. This clearly indicates that although NKM induces pathological changes in the vital organs of birds but at lower inclusion levels in diet, it is tolerated without any change in the the physiological function.

The cost of feed for weight gain by quails was reduced when NKM formed part of diet beyond 75 g/kg (table 5).

The study revealed that incorporation of NKM in the diet exerts a growth depressing effect in Japanese quails accompanied by mild pathological alterations in vital organs viz. liver and kidney.

Table 5. Feed cost for quail production during the growing phase

Attribute	Dietary group			
	D_1	D_2	D_3	D_4
Feed cost/kg (Rs)	6.61	6.37	6.25	6.23
Feed cost/kg body weight gain (Rs)	22.67	22.99	21.44	21.55

1 UK pound = 70 Indian rupees (Rs)

1 US dollar = 42 Indian rupees (Rs)

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