Response of Growing and Laying Japanese Quails (*Coturnix japonica*) to Dietary Sunflower Seed Meal

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ABSTRACT : High fibre (CF, 242 g/kg) sunflower seed meal (SSM) was incorporated in standard grower and layer quail diets at 0, 50, 75 or 100 g/kg replacing part of the soybean meal (SBM) and deoiled rice bran (DORB). Each grower diet was offered to 30 quails housed in battery cages from day one to 5 weeks of age. At the end of the growing period, Twelve female quails from each of the four respective dietary groups were transferred to the individual laying cages and their laying performance from 7 to 20 weeks of age were evaluated on diets containing SSM at similar levels as that during the growing period. The results of growth bioassay revealed that the live weight gain, feed intake, nutrient retention and carcass characteristics of quails in different dietary groups did not vary significantly ($p>0.05$), although the quails fed SSM based diets utilized the feed less ($p<0.05$) efficiently than those fed the control diet. During the laying period, the egg production and egg quality traits remained unaffected due to dietary treatments but feed required per unit egg production increased ($p<0.05$) as the level of SSM in diet was increased to 100 g/kg. Although, the cost of feed per kg decreased due to the incorporation of SSM in diet but the same was not reflected in feed cost per unit gain, meat or egg production as such parameters were comparable on all the diets. It could thus be concluded that the SSM can be incorporated in quail diets upto 100 g/kg for part of SBM, an item usually expensive and also in short supply in developing countries including India. *(Asian-Aus. J. Anim. Sci. 2000. Vol. 13, No. 12 : 1726-1730)*

Key Words : Japanese Quails, Sunflower Seed Meal, Growth, Feed Efficiency, Nutrient Retention, Egg Production

INTRODUCTION

The use of sunflower seed meal (SSM) as a potential plant protein supplement to poultry diets is often restricted primarily owing to its high fibre content. The CP (25-40%) and crude fibre (10-30%) contents in commercially available SSM vary widely depending upon the degree of the dehulling process. Earlier studies in broiler chickens indicated that the SSM could replace part of the soybean meal (SBM) at dietary levels of 1015% in mash form without adversely affecting the growth and feed conversion efficiency (Waldroup et al., 1970; Rad and Keshavarz, 1976; Zatari and Sell, 1990). On the other hand, higher inclusion levels of SSM in combination with sesame oil meal was found to be not suitable in diets for growing Japanese quails (Mohan et al., 1990). High fibre SSM could be included upto 250 or 300 g/kg level in broiler diet provided that the diet was supplemented with oil or fat to balance the energy density (Musharaf, 1991). However, the study by Christaki et al. (1994) indicated that high fibre SSM can well be included upto 65 g/kg in diets for growing quails without affecting their performance. Although much work has been done with broiler chicks, the potential of feeding SSM has not been fully examined with quails. Thus, the present study was undertaken to investigate the feasibility of feeding SSM, by replacing either or both SBM and deoiled rice bran (DORB) at graded levels inorder to evaluate the growing and laying performance of Japanese quails.

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MATERIALS AND METHODS

Grower phase

***Housing*:** One hundred and twenty unsexed Japanese quail chicks as hatched, were employed in the growth phase involving four dietary groups. Each group was further replicated into 3 of 10 chicks each. Ten chicks were housed in each battery cage (52 cm $\times$35 cm$\times$30 cm) fitted with feeder, waterer and dropping tray. The mean temperature was maintained at 37℃ at start and gradually decreased to 22℃ by the end of 3 weeks.

***Feeds and feeding*:** Of the 4 groups, one was fed a soybean-rice bran based reference diet (D_1) to serve as control (table 1) and the rest of three groups were offered test diets containing, respectively 50 (D_2), 75 (D_3) or 100 g (D_4) of SSM per kg. The SSM contained 302 g protein; 33 g ether extract; 242 g crude fibre and 81 g total ash per kg DM. Body weight of individual quails and feed intake of quails per replicate, on ad libitum feeding were recorded at weekly intervals from 0-5 week of age. A four - day nutrient balance trail involving total collection was conducted from 24th day of age. The pooled-and oven-dried feed and faecal samples were analysed for

Table 1. Ingredient and nutrient composition of grower diets

Attribute	Dietary group			
	D_1	D_2	D_3	D_4
Ingredient composition (g kg^{-1})				
Basal mixture[1]	645.0	645.0	645.0	645.0
Soybean meal (SBM)	245.0	217.5	205.0	190.0
Deoiled rice bran (DORB)	110.0	87.5	75.0	65.0
Sunflower seed meal (SSM)	-	50.0	75.0	100.0
Nutrient composition (g or MJ kg^{-1}), calculated				
CP	223.1	223.3	223.8	223.6
ME	11.32	11.29	11.28	11.26
Lys	12.58	12.21	12.05	11.83
Met	4.25	4.40	4.47	4.54
Nutrient composition (g or MJ kg^{-1}), determined				
CP	225.2	225.5	222.2	223.2
ME	11.62	11.52	11.34	11.18
Ca	12.5	13.0	14.0	12.2
P	9.45	9.22	9.05	10.14

[1] Basal mixture consisted of : maize, 51.5; fish meal, 10; dicalcium phosphate, 1.43; ground limestone, 1.0; common salt, 0.3; trace mineral supplement[a], 0.1; vitamin mix.[b], 0.17%.

(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 mcg; niacin, 60 mg; pantothenic acid, 10 mg; choline, 500 mg.

Table 2. Ingredient and nutrient composition of layer diet

Attribute	Dietary group			
	D_1	D_2	D_3	D_4
Ingredient composition (g kg^{-1})				
Basal mixture[1]	720.0	720.0	720.0	720.0
Soybean meal (SBM)	220.0	192.5	177.5	165.0
Deoiled rice bran (DORB)	60.0	37.5	27.5	15.0
Sunflower seed meal (SSM)	-	50.0	75.0	100.0
Nutrient composition (g or MJ kg^{-1}), calculated				
CP	186.1	186.3	186.1	186.6
ME	11.27	11.24	11.22	11.21
Lys	9.80	9.43	9.22	9.06
Met	3.34	3.49	3.55	3.63
Nutrient composition (g kg^{-1}), determined				
CP	186.9	182.2	183.9	181.5
Ca	28.8	27.5	28.5	28.8
P	9.33	9.65	9.21	9.45

[1] Basal mixture consisted of maize, 59.0; fish meal, 5; dicalcium phosphate, 1.43; ground lime stone, 3.0; oyster shell, 3.0; common salt, 0.3; trace mineral supplement[a], 0.1; vitamin mix.[b], 0.17%.

(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 mcg; niacin, 60 mg; pantothenic acid, 10 mg; choline, 500 mg.

proximate principles, calcium and phosphorus (AOAC, 1990) and gross energy (Ballistic bomb calorimeter).

Carcass traits: At the end of 5th week of age, 2 representative male quails of uniform body weight from each replicated treatment groups after a 12-hr fasting period were sacrificed as per standard procedure for estimation of carcass characteristics including the eviscerated carcass yield, weight of the liver, heart and gizzard of quails.

Layer phase

Feeds and feeding: At the end of grower phase i.e. after 5th week of feeding, 12 representative female quails from each diet were picked up and continued on the same diet upto 20 week of age, except that the dietary concentration of CP and Ca were adjusted to approximately 18.6 and 2.5 per cent, respectively (table 2). The birds were housed individually in metal cages (19 cm×25 cm×20 cm) fitted with feeder, waterer and dropping tray. The mean ambient temperature during the period ranged between 8° and 25℃. The net feed intake and daily egg production for each quail was recorded during the experimental feeding period of laying phase from 7-20 week of age.

Egg quality: Ten eggs from quails in each dietary group were collected on first two consecutive days of 11th, 15th and 19th week of experimental feeding (i.e. 10×3×4=120) for egg quality measurements. Each egg was examined for shape index (100 times the ratio of width to length of an egg), albumen index (the ratio of average albumen height to the average of the width and length), yolk index (the ratio of yolk height to its average width), internal quality unit (IQU) as per Kondiah et al. (1981), shell weight and shell thickness.

Cost economics: The feed cost per unit live weight gain and meat & egg production in Japanese quails during the growing and laying phases were computed on the prevailing market prices in India for various feed ingredients.

Statistical analysis

Data were subjected to ANOVA in a one way classification for completely randomized design and tested for statistical significance among the dietary treatments by Duncan multiple range test (Snedecor and Cochran, 1989).

RESULTS

Growth performance

No significant ($p>0.05$) difference could be observed due to the graded levels of dietary incorporation of SSM on body weight gain and feed intake of growing quails (table 3). However the quails fed SSM utilized feed less ($p<0.05$) efficiently as compared with those on soybean meal containing reference diet.

The quails fed reference and test diets during the growing phase retained dry matter, nitrogen and energy almost to a similar extent without showing any significant differences due to dietary treatment (table 3). But when the level of SSM in diet was increased to 100 g/kg, the retention of Ca ($p<0.05$) and P ($p<0.01$) by quails were appeared to have been significantly depressed.

The yield of eviscerated carcass, the weight of liver, gizzard and heart also did not vary significantly due to the dietary treatments (table 3).

Table 3. Growth performance, nutrient retention and carcass characteristics of grower quails

Attribute	Dietary group				SEM
	D_1	D_2	D_3	D_4	
Growth performance (0-5 wks)					
Live weight gain (g/b)	129.9	125.8	122.9	128.1	2.05
Feed intake (g/b)	447.0	454.7	447.9	470.2	10.19
Feed conversion ratio (feed:gain)	3.43^{b}	3.61^{a}	3.64^{a}	3.66^{a}	0.05
Percent nutrient retention (24-27 d)					
DM	64.0	63.9	62.7	57.6	0.72
GE	67.4	68.0	66.4	64.2	0.72
N	41.7	40.6	40.2	35.9	1.08
Ca	36.6^{a}	34.5^{ab}	35.6^{a}	33.3^{b}	0.79
P	25.2^{A}	24.4^{A}	24.5^{A}	19.3^{B}	1.18
Carcass characteristics (% of live weight)					
Eviscerated	65.8	65.1	64.9	64.7	0.52
Liver	1.81	1.80	1.88	1.97	0.07
Gizzard	2.52	2.48	2.46	2.21	0.07
Heart	0.95	0.97	0.99	0.94	0.06

Means bearing different superscripts differ significantly ^{a,b} ($p<0.05$) ; ^{A,B} ($p<0.01$) from each other.

Laying performance

The egg production declined gradually and insignificantly ($p>0.05$) as the level of inclusion of SSM in diet increased despite of the comparable feed intake by quails in different dietary groups (table 4). However, the feed intake per unit egg production was significantly ($p<0.05$) higher when level of SSM in diet was enhanced to 100 g/kg. The mean egg weight in different groups remained almost similar. Quails in all the dietary groups had positive growth but with no significant ($p<0.05$) differences in body weights due to dietary treatments. The egg quality characteristics in terms of shape index, shell thickness, shell weight, albumen index, IQU and yolk index at 11th, 15th and 19th week of feeding remained almost similar (table 4)

The marginal decline in feed cost due to inclusion of SSM in quail diets was not reflected in the feed cost per unit weight gain, meal and egg production but tended to be higher for SSM fed quails in comparison to those fed SBM (table 5).

DISCUSSION

Grower phase

Quails in the SSM fed group accumulated comparative body weight gain with higher consumption of feed. This probably reflected in lower efficiency of gain in comparison to quails in the control group. The studies of Ibrahim and El Zubeir (1991) evidenced no

Table 4. Laying performance and egg quality of quails

Attribute	Dietary group				SEM
	D_1	D_2	D_3	D_4	
Production performance (7-20 wk)					
Hen day production (%)	88.9	87.4	86.5	85.9	1.40
Feed intake (g/b/d)	27.0	27.6	27.4	28.0	0.65
Feed:egg	2.62^{b}	2.75^{ab}	2.77^{ab}	2.88^{a}	0.05
Egg wt (g)	11.6	11.5	11.5	11.4	0.25
Live wt change (g/b)	26.2	22.1	19.6	20.5	3.26
Egg quality traits					
Shape index	77.9	76.9	78.1	77.7	1.05
Shell thickness (mm)	0.193	0.200	0.197	0.193	0.012
Shell weight (%)	10.5	10.4	10.2	10.4	0.40
Albumen index	0.129	0.132	0.129	0.131	0.006
IQU	62.3	62.6	62.9	63.2	2.06
Yolk index	0.478	0.478	0.482	0.477	0.014

Means bearing different superscipts differ significantly ($p<0.05$) from each other.

Table 5. Feed cost of quail production during growing and laying periods[1]

Attribute	Dietary group			
	D_1	D_2	D_3	D_4
Weight gain and meat production				
Feed cost/kg (Rs)	6.61	6.49	6.44	6.37
Feed cost/kg gain (Rs)	22.67	23.43	23.44	23.31
Feed cost/kg meat (Rs)	29.48	31.34	31.36	31.59
Egg production				
Feed cost/kg (Rs)	6.19	6.07	6.00	5.95
Feed cost/kg egg mass (Rs)	16.22	16.69	16.62	17.14

[1] US dollor=42 Indian Rupees (Rs); UK pound=70 Indian Rupees (Rs).

adverse effect on growth and feed conversion efficiency of broiler chicks fed diets containing SSM even upto 300 g/kg provided the diet was supplemented with fat in order to compensate decreased energy concentration. But studies of Musharaf (1991) could not reveal any consistent results as the weight gain was significantly higher on 200 g/kg SSM with depressed feed utilization on 100 and 250 g/kg SSM but not on 150 and 200 g/kg which were found to be comparable to control. Christaki et al. (1994), on the other hand, did not observe any significant difference in terms of growth and feed efficiency in quails when fed high fibre (23%) SSM of almost similar chemical composition as used in the present study upto 650 g/kg in diet.

Inspite of the non-significant differences, the retention of diets DM, energy and nitrogen tended to be depressed with gradual increase in the dietary level of SSM incorporation (table 3) corroborating the findings of Ibrahim and El Zubeir (1991) who also noticed a decrease in energy and nitrogen retention due to the increase in SSM inclusion in broiler diets. However, the retention of Ca ($p<0.05$) and P ($p<0.01$) were significantly lowered when the diet contained SSM at 100 g/kg which might have been be due to their higher intake.

The carcass characteristics in terms of yield of eviscerated carcass, liver, heart and gizzard (table 3) were not adversely affected due to dietary treatment, in concurrence with the observations of Christaki et al. (1994).

Layer phase

Data on the performance of quails during the laying phase (table 4) corroborate the results of Deaton et al. (1979) in that these workers also noticed no significant effect on the body weight, egg production or egg weight even though the feed required per unit egg production tended to increase ($p<0.05$) with an increase in the dietary fibre and inturn a decrease in energy density, as is evidenced by feed: egg ratio. Hegedus and Fekete (1994) could successfully replace soybean meal with sunflower seed meal in the layer diet probably due to the maintenance of dietary amino acid (lysine and methionine) and energy levels. In the present study, no such substitutions were made with a view that the level of SSM incorporation was restricted to the maximum of 100 g/kg and thus had no drastic effect on density of dietary nutrients like the lysine, methionine and energy.

It was interesting to note that none of the egg quality traits (table 4) appeared to vary due to dietary variations with a finding similar to the observations of Mirza et al. (1993) who did not notice any significant change in the egg quality in terms of Haugh unit and yolk index. But these workers reported an improved egg shell thickness due to an increase in the level of SSM in diet. In contrary, Gawali and Khire (1995) reported a significantly lowered yolk index and higher Haugh unit on feeding diets containing both sunflower seed meal and soybean meal than when soybean meal alone was fed. In the present study, no such effects were observed due probably to a lower level of dietary SSM employed.

The feed cost for SSM diets was around 2.5% lower during the growing phase and 3% during the layer phase but although the feed cost per unit gain and meat or egg production was higher by 3% during growing and 4% during layer phase than for the quails fed on the control diet, however, the SSM can very well be included in the diet of quails whenever availability and cost are the deciding factor.

Based on growth and egg production performance on different dietary regimen, it could thus be concluded that the SSM can be incorporated in diet of quail upto 100 g/kg in order to partially spare the costly and scarce soybean meal whenever the situation so warrants.

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