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The Use of Sesame Meal in Diets of Japanese Quail

Research Article

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ABSTRACT

This study was conducted to investigate the effect of different levels of sesame meal (SM) on performance and carcass characteristics of Japanese quail. One hundred sixty day-old Japanese quail chick were equally distributed into 16 cage pens and reared form 10 to 42 days of age. The treatments consisted of SM0, SM50, SM100 and SM150. The diet for SM0 treatment had no SM (control), while those for treatments SM50, SM100 and SM150 included 50, 100 and 150 g/kg of SM, respectively. Each dietary treatment was fed *ad libitum* to four replicate groups of 10 birds at the beginning of experimental period. Chicks and feed were weighed on days 10, 24 and 42 and carcass characteristics were measured on day 42. Results indicated that daily weight gain, feed intake and feed efficiency were not significantly affected by experimental treatments. However, diet containing 150 g/kg SM improved the weight gain and feed conversion ratio of Japanese quail, numerically. The highest carcass weight was recorded for quails fed SM50. As well as, diets containing SM increased more the weight of gizzard and intestinal than control diet ($P<0.05$). Thus, SM can be used as an alternative feedstuff in Japanese quail diets, at inclusion levels up to 150 g/kg without negative effects on performance and carcass traits.

KEY WORDS carcass, Japanese quail, performance, sesame meal.

INTRODUCTION

Sesame meal (SM) is the residue after extracting the oil from the seed. It is an excellent source of protein and has an amino acid composition similar to that of soybean meal (Mamputu and Buhr, 1995). An average crude protein content of 400 g/kg and crude fiber content of 65 g/kg are typical for expeller-extracted SM, but these values may vary widely depending on the variety used, degree of decortications and method of processing. SM is an excellent source of methionine, cystine and tryptophan but is deficient in lysine, indicating that it cannot be used effectively as the sole protein supplement in poultry diets (Daghir and Kevorkian, 1970; Ravindran and Blair, 1992). Additionally, it consists of polyunsaturated fatty acids such as linoleic acid, oleic acid and saturated fatty acids such as palmitic acid and stearic acid (Dan, 2005). It is also a rich source of minerals; however, mineral availability from SM may be lower due to the presence of high levels of oxalates (35 mg/100 g) and phytate (5 g/100 g) in the hull fraction of the seed.

Moreover, high amount of phytate may be reduced the protein availability in poultry diets (Maga, 1982; Hossain and Jauncey, 1989; Farran *et al.* 2000). Removal of hull not only improves mineral availability, but also reduces the fiber content of SM and increases the protein level and availability in poultry diets (Ravindran and Blair, 1992). Daghir *et al.* (1967) reviewed the very early work on the nutritive value of SM and the extent to which it can replace soybean meal in broiler rations. Studies showed that SM could be partially replacing by soybean meal in poultry diet (Bell *et al.* 1990). Ravindran and Blair (1992) proposed that use of SM in starter diets should be limited because of its high fiber content and possible availability problems associated with phytates and oxalates. Bell *et al.* (1990) reported that SM might provide an acceptable alternative to soybean meal in broiler diets when the substitution level is 150 g/kg or less.

Other research also showed that good-quality SM can be included up to 150 g/kg in poultry diets, but for optimal growth and feed conversion efficiency, it should be supplemented with high-lysine ingredients such as soybean meal or fishmeal (Ravindran and Blair, 1992). Mamputu and Buhr (1995) reported that growth performance of broiler chicks fed diet containing 150g/kg SM was not different from chicks fed the control diet; however, at dietary inclusion level of 300g/kg chick's performance was depressed. In addition, Yamauchi *et al.* (2006) showed that up to 200g/kg SM could be incorporated into diets fed to male birds of laying strains in the developer period.

Although there was some research about of SM and its effects on broiler chicks performance; however, there are no reported studies on the effect of use the SM in Japanese quail diets. Therefore, in the present study, our aim was to investigate the effect of different levels of sesame meal on performance and carcass characteristics of Japanese quail.

MATERIALS AND METHODS

Ingredient analysis

Sample of sesame meal (SM) was obtained from commercial plant and was analyzed for DM by drying at 102 ˚C for 16 h in a forced air oven, and for crude protein (CP), crude fat, crude fiber, ash, calcium and phosphorus (Table 1) according to methods 976.06, 920.39, 978.10, 942.05, 968.08 and 965.17, respectively, of AOAC (1990).

Table 1 Chemical composition of sesame meal[1]

Nutrients	Amount (g/kg)
Moisture	63
Crude protein	351
Crude fat	110
Ash	80
Crude fiber	150
Available phosphorus	3
Calcium	19

[1] Sesame meal was analyzed for dry matter, crude protein, crude fat, crude fiber, ash, calcium and phosphorus according to AOAC (1990).

Bird management and dietary treatments

One hundred sixty 10-day-old male Japanese quail chicks were obtained from a commercial hatchery. Quails with similar initial weight (75.64±2 g), were randomly divided into four groups of 16 cages (cage dimensions: 50 cm wide×50 cm long×40 cm high) in a curtain-sided house. Four replicate pens of 10 birds per pen were allotted for each dietary treatment group. During the 32 days experimental period, from 10 to 42 days of age, all chicks in the four treatments received four different diets (Table 2), according to nutrient requirements of Japanese quail as given by NRC (1994). The diet for SM0 treatment had no SM (control), while those for treatments SM50, SM100 and SM150 included 50, 100 and 150 g/kg of SM, respectively. All diets were isonitrogenous and isoenergetic (240 g/kg CP; 2900 kcal ME/kg), having the same level of the amino acids lysine, methionine and cystine, according to NRC (1994) nutrient composition values (Table 2). During the experimental period, conventional management procedures were employed, natural and artificial light was provided for 23 h per day, ambient temperature was controlled and birds were fed and watered *ad libitum*.

Table 2 Composition of experimental diets (as fed basis)

Ingredient composition (g/kg)	Treatment[1]			
	SM0	SM50	SM100	SM150
Yellow corn	528.9	519.0	510.2	500.8
Soybean meal (440 g/kg CP)	396.0	357.5	316.6	276.9
Sesame meal (350 g/kg CP)	0.0	50.0	100.0	150.0
Fish meal (642 g/kg CP)	30.0	30.0	30.0	30.0
Vegetable oil	18.1	18.1	19.5	20.2
HCl-lysine	0.5	1.4	2.3	3.2
DL-methionine	1.0	0.8	0.5	0.3
Dicalcium phosphate	4.4	4.2	4.0	3.8
Limestone	12.1	10.1	8.0	5.9
Salt	3	2.9	2.9	2.9
Vitamin premix[2]	2.5	2.5	2.5	2.5
Mineral premix[3]	2.5	2.5	2.5	2.5
Multi enzyme[4]	1.0	1.0	1.0	1.0
Calculated analysis (g/kg)[5]				
AMEn (kcal/kg)	2900	2900	2900	2900
Crude protein	240	240	240	240
Crude fiber	39.7	44.2	48.8	53.2
Lysine	14.0	14.0	14.0	14.0
Methionine	5.0	5.0	5.0	5.0
Methionine + cystine	8.8	8.8	8.8	8.8
Calcium	8.0	8.0	8.0	8.0
Phosphorous	3.0	3.0	3.0	3.0
Sodium	1.5	1.5	1.5	1.5

[1] SM0: control treatment; SM50: treatment with 50 g/kg sesame meal; SM100: treatment with 100 g/kg sesame meal and SM150: treatment with 150 g/kg sesame meal.
[2] Provided per kg of diet: vitamin A: 9000 IU; vitamin D: 2000 IU; vitamin E: 18 IU; vitamin K_3: 3 mg; vitamin B_1: 1.78 mg; vitamin B_2: 6.6 mg; vitamin B_6: 3 mg; vitamin B_{12}: 0.015 mg; Niacin: 30 mg; Pantothenic acid: 10 mg; Biotin: 0.15 mg and Choline: 1500 mg;.
[3] Provided per kg of diet: Cu: 10 mg; I: 0.99 mg; Fe: 50 mg; Mn: 100 mg; Se: 0.08 mg and Zn: 100 mg.
[4] Contain lipase, betaglucanase, phytase, Kemin Industries Inc, Belgium.
[5] All values were calculated from NRC (1994).

Performance and carcass traits

Quails were weighed at 10, 24 and 42 d of age and feed intake (FI, g) was determined at 24 and 42 d of age. At the end of experiment, six birds per treatment were randomly selected for carcass measurements. Quails were fasted for approximately 8 h and then individually weighed, sacrificed, de-feathered and eviscerated. Whole carcass, breast, thigh, intestine, pancreas and gizzard were weighted. Daily feed intake (DFI, g), average daily gain (ADG, g), body weight (BW, g), feed efficiency (FE, g feed/g weight gain), and carcass weight and organs were also calculated. Data from DFI and ADG were adjusted for mortality and carcass weight and parts calculated as percentage of BW.

Statistical analysis

Data from chick assay was subjected to GLM for completely randomized designs using SAS (1994). Statistical significance of differences among treatments was assessed using the Duncan's test (Steel and Torrie, 1980). Regression analysis was also used to determine linear and quadratic relationships in the chick assay.

RESULTS AND DISCUSSION

Growth performance

The results for performance of Japanese quail are presented in Table 3. No significant differences were noted between treatments for quail ADG, FE and DFI at 10 to 24 d and 24 to 42 d. Moreover, no significant differences were observed in quail performance parameters from 10 to 42 d of age. However, ADG and FE in diets containing SM (especially at inclusion levels of 150 g/kg) were improved numerically, compared with control diet. There were linear trend in ADG and FE by increasing level of SM, but poor linear or quadratic regression was observed between DFI and dietary SM concentration. In addition, in contrast comparison for performance, there was no significant difference in comparison of diets containing SM vs. control diet for ADG, FE and DFI (Table 3). This result can be attributed to the similar energy, protein and amino acid contents in the diets of all treatments (Table 2). Moreover, similar performance of quails fed diets containing SM compared to control diet, showed that the SM sample that used in this study might be lower in phytates or oxalates. Additionally, all experimental diets, the multi enzyme supplementation containing phytase enzyme was used that may be decrease the detrimental effect of phytate or fiber content of SM. Our results shows that ADG, FE and DFI of quails were not affected by the increasing level of SM are in agreement with earlier studies in broiler and layers chicks (Bell *et al.* 1990; Ravindran and Blair, 1992; Mamputu and Buhr, 1995; Yamauchi *et al.* 2006) that SM could safely be used up to 150 g/kg in the broiler diets without negative effect on performance. In contrast, Farran *et al.* (2000) reported that weight gain of broiler chick in diet containing 120 g/kg SM was reduced than that control diet. These researchers concluded that an increase in oxalate and phytate of the diet containing SM could decrease the weight gain. It seems that, this inconsistency in weight gain between last study, with a diet with 120 g SM/kg, and our study, with a diet with 150 g SM/kg, may be due to the addition of phytase enzyme to diets in our study.

Carcass traits

The results for final BW and carcass characteristics and organ (as percentage of BW) of Japanese quail are presented in Table 4. No significant difference was observed between treatments for quail final BW; however there was significant difference in comparison of diets containing SM vs. control diet for final BW. Moreover, at the end of the experiment (42 d), thigh, breast and pancreas weight were similar among all treatments. However, there were significant differences in carcass, intestine and gizzard weight (P<0.05).

The highest and lowest carcass weights were observed in treatments SM50 and SM150, respectively. Additionally, gizzard and intestine weights in diets containing SM were higher than those of the control diet (P<0.05). Moreover, in contrast comparison, there was no significant difference in comparison of diets containing SM vs. control diet for carcass, breast, thigh and pancreas weight, but this difference

Table 3 The effect of diets containing sesame meal on performance of Japanese quail

Treatment[1]		Average daily gain (g/bird)			Daily feed intake (g/bird)			Feed efficiency (g feed/g gain)		
		10-24 d	24-42 d	10-42 d	10-24 d	24-42 d	10-42 d	10-24 d	24-42 d	10-42 d
SM0		5.03	6.38	5.79	18.09	25.57	22.30	3.39	4.17	3.89
SM50		5.41	6.38	5.90	18.29	26.32	22.81	3.38	4.19	3.86
SM100		5.37	6.53	5.99	16.89	25.15	21.69	3.15	3.85	3.62
SM150		6.15	6.50	6.03	16.42	24.60	21.02	2.74	3.78	3.48
SEM		0.207	0.073	0.060	0.307	0.379	0.265	0.101	0.078	0.191
Probability		0.292	0.648	0.538	0.065	0.472	0.075	0.060	0.124	0.482
Independent comparison		Probability								
SM0 *vs.* other[2]		0.211	0.776	0.224	0.158	0.813	0.389	0.151	0184	0.984
Effect of SM on production parameters										
Linear	P	0.09	0.16	0.01	0.91	0.27	0.17	0.07	0.08	0.03
	r^2	0.82	0.69	0.96	0.82	0.52	0.68	0.85	0.83	0.93
Quadratic	P	0.35	0.31	0.10	0.31	0.42	0.42	0.29	0.28	0.25
	r^2	0.87	0.90	0.98	0.90	0.82	0.81	0.91	0.92	0.93

[1] SM0: control treatment; SM50: treatment with 50 g/kg sesame meal; SM100: treatment with 100 g/kg sesame meal and SM150: treatment with 150 g/kg sesame meal.
[2] Single degree of freedom contrasts were not significant (P>0.05) for average daily gain, daily feed intake and feed efficiency for control diet *vs.* diets containing SM (treatment SM0 *vs.* treatments SM50, SM100 and SM150).
SEM: standard error of the means.

Table 4 The effect of different levels of sesame meal on carcass traits of Japanese quail

Treatment[1]	Final BW (g)[2]	Carcass weight (%)[3]	Breast weight (%)	Thigh weight (%)	Gizzard weight (%)	Intestine weight (%)	Pancreas weight (%)
SM0	255.3	56.21[ab]	21.55	13.03	2.022[b]	4.26[b]	0.23
SM50	265.6	57.40[a]	20.83	12.61	2.192[a]	5.25[a]	0.24
SM100	267.7	56.53[ab]	21.66	12.81	2.200[a]	5.32[a]	0.24
SM150	269.9	55.06[b]	21.18	12.60	2.345[a]	4.96[a]	0.25
SEM	2.240	0.315	0.162	0.081	0.0376	0.120	0.004
Probability	0.077	0.0482	0.2712	0.2022	0.0078	0.0001	0.7887
Independent comparison				Probability			
SM0 *vs.* other[4]	0.014	0.837	0.382	0.069	0.012	0.0001	0.469

The means within the same column with at least one common letter, do not have significant difference (P<0.05).
[1] SM0: control treatment; SM50: treatment with 50 g/kg sesame meal; SM100: treatment with 100 g/kg sesame meal; SM150: treatment with 150 g/kg sesame meal.
[2] The linear and quadratic effect of SM on final BW was P= 0.08, r^2= 0.84 and P= 0.05, r^2= 0.99, respectively.
[3] Carcass traits calculated as a proportion of weight to live weight.
[4] Single degree of freedom contrasts were not significant (P>0.05) for carcass, breast, thigh and pancreas weight, but were significant for final BW, intestine and gizzard weight for control diet *vs.* diets containing SM (treatment SM0 *vs.* treatments SM50, SM100 and SM150).
SEM: standard error of the means.

were significant for intestine and gizzard weight (Table 4). Carcass weight in diets containing SM was similar to that found for control diet, but it decreased more in SM150 than in SM50. In agreement with our results, Rama Rao *et al.* (2008) showed that the use of sesame meal in broiler diet leads to an increase in the size of digestive system and thus it decreases the carcass weight. The pancreas weight in diets containing SM was similar to control diet (P>0.05), but there was a tendency to increase in pancreas weight in quail fed on SM diets than control diet. It seems that the small increase in pancreas weight for quails fed diets containing SM could be related to an increase in endogenous enzyme activities and secretion volume required to digest SM. As well as, intestine weight in diets containing SM was higher than that observed in the control diet. High intestine weight in quails fed on SM diets can be attributed to high dietary fiber level in diets containing SM than the control diet (Table 2). Intestine result partly supported by increasing of pancreas weight of quails fed on SM diets. Studies showed that high levels of fiber increased the size of the digestive system of birds and the length of intestine and the cecum increased with dietary fiber level (Jørgensen *et al.* 1996; Yasar, 2003; Rama Rao *et al.* 2008). Finally, the larger gizzards observed in quails fed on SM diets as compared with gizzards of quails fed the control diet were in accordance with results reported earlier with high fiber feedstuffs in broiler chicks (Forbes and Covasa, 1995; Abdul Rahman *et al.* 2009). This result is a consequence of the increased grinding activity of the gizzard.

CONCLUSION

Inclusion of SM at levels up to 150 g/kg in diets of Japanese quail from 10 to 42 days of age numerically improved ADG and FE compared to the control and resulted in similar traits, relative to carcass, thigh, breast and pancreas weight. Thus, SM can be used as an alternative feedstuff in Japanese quail diets, at inclusion levels up to 150 g/kg without negative effects on performance and carcass traits.

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