Effect of feeding diets containing sesame oil or seeds on productive and reproductive performance of laying quail

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Abstract

This experiment was undertaken to investigate the effect of dietary supplementation with sesame oil and seeds on productive and reproductive efficiency of Japanese quail. Totally 120 female and 40 male Japanese quails, 10 weeks old were randomly divided into 5 treatments containing 24 females and 8 males each. Each treatment group contained 4 replicates, of 6 females and 2 males. Birds were fed for 12 weeks commercial diet containing 0% sesame oil or seeds (control group; C); 0.5% sesame oil (T1); 1% sesame oil (T2), 1% sesame seeds (T3); and 2% sesame seeds (T4). Parameters included in this experiment were body weight, feed consumption, egg weight, hen – day egg production, cumulative egg number, egg mass, feed conversion ratio, fertility, hatchability of eggs set, hatchability of fertile egg, and embryonic mortality. The data revealed that, birds fed diets containing sesame oil or seeds (T1; T2; T3; and T4) recorded the best results as concerns total means of egg weight, hen – day egg production, cumulative egg number, egg mass, feed conversion ratio, fertility, hatchability of total eggs, hatchability of fertile eggs, and embryonic livability when compared with control group (C). Whereas, there were no significant differences between treatment groups (C; T1; T2; T3; and T4) in relation to body weight and feed consumption. From this experiment it is concluded that dietary substitution of sesame oil and seeds resulted in significant improvement in productive and reproductive traits of Japanese quail. Thus, sesame oil or seeds can be used in laying quail diets at the levels mentioned above as an important tool for enhancing productive and reproductive performance of Japanese quail.

تأثير إضافة زيت أو بذور السمسم إلى العليقة في الأداء الإنتاجي والتناسلي لطير السلوى

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الخلاصة

أجريت هذه التجربة لبحث تأثير إضافة زيت أو بذور السمسم إلى العليقة في الأداء الإنتاجي والتناسلي لطير السلوى الياباني. واستخدم فيها 120 أنثى و40 ذكراً عمر 10 أسابيع، إذ تم توزيعها عشوائياً على 5 معاملات تحتوي كل منها على 24 أنثى و8 ذكور. وكانت كل معاملة تتكون من 4 مكررات وبواقع 6 إناث و2 ذكور. وتم تغذية الطيور لمدة 12 أسبوع على عليقة تجارية تحتوي على 0 % زيت أو بذور السمسم (مجموعة المقارنة C)؛ 0.5 % زيت السمسم (T1)؛ 1 % زيت السمسم (T2)؛ 1 % بذور السمسم (T3)؛ و2 % بذور السمسم (T4). وتم دراسة الصفات التالية: وزن الجسم واستهلاك العلف ووزن البيض ومعدل إنتاج البيض وعدد البيض التراكمي وكتلة البيض ومعامل التحويل الغذائي ونسبة الخصوبة ونسبة الفقس من البيض المرقد ونسبة الفقس من البيض المخصب ونسبة الأجنة الهالكة. أشارت نتائج التجربة إلى أن الطيور التي تغذت على علائق تحتوي على زيت أو بذور السمسم (T1; T2; T3; T4) سجلت أفضل النتائج فيما يتعلق بالمعدل العام لكل من وزن البيض ومعدل إنتاج البيض وعدد البيض التراكمي وكتلة البيض ومعامل التحويل الغذائي ونسبة الخصوبة ونسبة الفقس من البيض المرقد ونسبة الفقس من البيض المخصب كما أنها سجلت أقل المعدلات لنسبة الهلاكات الجنينية مقارنةً بطيور مجموعة المقارنة (C). من ناحية ثانية، لم تكن هناك فروق معنوية بين معاملات التجربة (T4 ;T3 ;T2 ;T1 ;C) فيما يتعلق بالمعدل العام لكل من وزن الجسم واستهلاك العلف. يمكن الاستنتاج من هذه التجربة أن

إدخال زيت أو بذور السمسم إلى العليقة يؤدي إلى تحسن معنوي في الصفات الإنتاجية والتناسلية لطير السلوى الياباني، وعليه فأن زيت أو بذور السمسم يمكن ان تستخدم في علائق طيور السلوى الياباني في مرحلة إنتاج البيض وبالمستويات المذكورة أعلاه كوسيلة مهمة لتعزيز الأداء الإنتاجي والتناسلي لهذه الطيور.

Introduction

Polyunsaturated fatty acids are essential for normal growth and development and may be play an important role in the prevention and treatment of coronary heart disease, hypertension, diabetes, arthritis, and other inflammatory and autoimmune disorders. Clinical and epidemiological studies have shown the cardiovascular protective effects of seeds and oils rich in polyunsaturated fatty acids (PUFA) (1,2). In particular, these substances have been reported to lower blood pressure and prevent the development of hypertension (3).

Sesame plant grows in tropical and subtropical regions with a dry and rainy season. It is grown in many parts of the world today for its important uses as edible oil, spices, insecticides, medicines, soap, green manure and ornaments (4). The oil of sesame seed, known as teel or benne oil is very resistant to rancidity especially after hydrogenation due to the presence of natural antioxidants such as sesamolin, sesamin, and sesamol. It is therefore useful in increasing the shelf life of margarine and other vegetable products(5). It has been suggested that sesame seed and oil could have a positive effect on cholesterol levels because of its remarkable antioxidant function. Also sesame seed and oil have a very high level of unsaturated fatty acids, which is assumed to have reducing effect on plasma cholesterol, as well as on coronary heart disease (6). Sesame seeds have a positive amino acid structure- high level of methionine and low level of lysine, this makes it an excellent protein component to other plant proteins (7). Sesame seeds have the highest level of calcium of any food in the world. Interestingly, they not only have a highly absorbable spectrum of vitamin E, they increase the bioactivity of vitamin E in the body (8). Comparing the many forms of vitamin E in sesame seed with the vitamin E in supplements it is like comparing a real horse to a toy horse. Sesamin, a sesame lignan has beneficial effects on hormonal status, raises antioxidant activity in body cells, decreases the risk of breast cancer, and lowers cholesterol (9). Therefore, this experiment was performed to investigate the effects of dietary supplementation with different level of sesame oil and seeds on productive and reproductive performance of laying quail.

Materials and Methods

This study was conducted at the Poultry Farm, Department of Animal Resources, College of Agriculture, University of Baghdad during the period from 23/ 7/ 2009 to 23/ 10/ 2009. A total of 120 females and 40 males Japanese quail (*Coturnix coturnix japonica*) of 10 weeks of age were individually weighed. The initial body weight was comparable. The birds were randomly assigned to 1 0f 5 treatments, with each treatment replicated 4 times randomly among the cages with 6 female and 2 male quails for replicate in the cage (89 × 60 × 44 cm). The birds were allowed free access to food and water.

All the birds were fed corn and soybean meal – based diets formulated to meet the nutrient requirements of laying quail hens. Diets were formulated to be isocaloric and isonitrogenous. The following 5 dietary treatments were used: Group not supplemented with additives served as control; T1 and T2: Control diet supplemented with 0.5% and 1% sesame oil, respectively; while T3 and T4 represented control diet supplemented with 1% or 2% sesame seeds, respectively.

A regime of 16 h constant lighting and continuous ventilation were provided and all birds were kept under uniform management conditions throughout the experimental period. The experiment was terminated when the birds were 22 weeks of age. The ingredients and chemical composition of the diets are presented in Table (1). However, the fatty acid composition of sesame oil used in the present experiment is presented in Table (2). Productive and reproductive traits involved in this experiment were body weight, feed consumption, egg weight, hen day- egg production percentage, cumulative

egg number, egg mass, feed conversion ratio, fertility, hatchability of total eggs, hatchability of fertile eggs, and embryonic mortality percentage.

Data were statistically analysis using the general linear model for analysis of variance of SAS (10). Test of significance for the difference between means of different levels within each classification was done by Duncan's multiple range test (11).

Results and Discussion

The effects of dietary supplementation with sesame oil and seeds on body weight are shown in Table (3). It was observed that treatment the quail birds with sesame oil and seeds have no significant effect on body weight of these birds during all periods of experiment. The absence of a response to the dietary inclusion of sesame oil and seeds on the body weight of quail ($p>0.05$) in this experiment confirmed the findings of Guclu et al. (12) who found no significant differences for dietary oil sources on body weight of laying quail and Shafey et al. (13) who found no significant effect for type of grain and oil supplement on the body weight of laying hens. Several studies suggest that in both birds and mammals, PUFA inhibit lipid synthesis (14, 15) and increase fatty acid oxidation (16) and diet- induced thermogenesis (17). These effects could explain why PUFA reduce abdominal fat, fat in other fat depots (18) and, consequently, total body fat when compared to saturated or monounsaturated fats.

Dietary supplementation with sesame oil and seeds (T1; T2; T3; T4) did not differ significantly from C group regarding feed consumption during all periods of experiment and as regards cumulative feed consumption for these treatment groups (Table 4).

As shown from Tables 5 and 6 there were significant ($p<0.05$) increases in egg weight and hen- day egg production during all periods of experiment and in the total means of these two traits for birds treated

Table (1) Ingredients and calculated composition of the diets fed to the laying quails

	Control diet (C)	0.5% sesame oil (T1)	1% sesame oil (T2)	1% sesame seeds (T3)	2% sesame seeds (T4)
Ingredients (%)					
Yellow corn	31	31	31	58.8	57.4
Soybean meal (44%)	18.7	18.7	18.7	21.9	22.3
Wheat	32	32	32	-	-
Protein concentrate*	10	10	10	10	10
Hydrogenated vegetable fat	1	0.5	-	1	1
Sesame oil	-	0.5	1	-	-
Sesame seeds**	-	-	-	1	2
Lime stone	7	7	7	7	7
Salt	0.3	0.3	0.3	0.3	0.3
Calculated composition***					
ME kcal / kg	2803	2803	2803	2801	2801
Crude protein (%)	19.6	19.6	19.6	19.58	19.59
Lysine	0.96	0.96	0.96	0.96	0.97
Methionine	0.35	0.35	0.35	0.36	0.37
Methionine + Cystine	0.64	0.64	0.64	0.68	0.69
Calcium (%)	3.63	3.63	3.63	3.64	3.66
Available phosphorus (%)	0.30	0.30	0.30	0.32	0.33

***Tabarak Abu – Al –Deek protein concentrate provided per kg: 42% crude protein; 2200 ME / kg; 9% crude fat; 4.5% crude fiber, 9% calcium, 2.3% available phosphorus; and other nutrients (vitamins + minerals) meet with NRC (1994) specification.**

**** Sesame seeds contain 49% total fat; 22.1% linoleic acid; 20.6% oleic acid; 6.4% stearic acid, 6.94% total saturated fatty acids; 21.8% total polyunsaturated fatty acids; 18.7% mono unsaturated fatty acids; 0% cholesterol; 0.45% total omega – 3 fatty acids; 25% total omega – 6 fatty acids and 55.5 omega - 6 / omega – 3 fatty acids ratio.**

*****Calculated composition was according to NRC (19).**

Table (2) Fatty acids composition (%) of sesame oil included in the diets of quails

Numeric name	Common name	Fatty acids content (%)
C12:0	Lauric acid	0.016
C14:0	Myristic acid	0.64
C15:0	None	0.04
C16:0	Palmitic acid	18.72
C17:0	Margaric acid	0.14
C18:0	Stearic acid	2.69
C20:0	Arachidic acid	0.24
C21:0	None	0.01
C22:0	Behenic acid	0.22
C23:0	None	0.02
C24:0	Lignoceric acid	0.11
C14:1	Myristoleic acid	-
C15:1	None	-
C16:1	Palmitoleic acid	0.49
C17:1	None	0.09
C18:1 n9	Oleic acid	20.34
C20:1 n9	Gadoleic acid	0.26
C22:1 n9	Erucic acid	-
C24:1 n9	Nervonic acid	0.06
C18:3 n3	Alpha linolenic acid	0.72
C20:3 n3	None	0.01
C20:5 n3	Eicosapentenoic acid (EPA)	0.20
C22:6 n3	Docosahexaenoic acid (DHA)	0.06
C18:2 n6	Linoleic acid	55.03
C18:3 n6	Gamma linolenic acid	0.05
C20:2 n6	11, 14 – Eicosadienoic acid	0.06
C22:2 n6	13, 16 – Docosadienoic acid	-
Total of saturated fatty acids		22.84
Total of mono unsaturated fatty acids		21.23
Total of polyunsaturated fatty acids		55.91
Total of omega – 3 fatty acids		0.984
Total of omega – 6 fatty acids		54.94
Total of omega – 6 / total omega – 3 fatty acids ratio		55.8

with sesame oil and seeds (T1; T2; T3; T4) as compared with control group (C).

Results of the present experiment asserted that laying quail fed the diets supplemented with sesame oil and seeds (T1; T2; T3; T4) surpass C group significantly ($p<0.05$) during periods 1, 2, 3, and 5 and for total mean of periods and highly significant ($p<0.01$) during periods 4 and 6 with relation to cumulative egg number (Table 7).

Results also denoted that adding sesame oil and seeds to laying quail diets resulted in significant ($p<0.05$) increase concerning egg mass during periods 2, 3 and 4 in the total mean of this trait and highly significant increase ($p<0.01$) during periods 1, 5 and 6 in comparison with control group (Table 8).

Birds fed diet containing sesame oil and seeds (T1; T2; T3; T4) showed better ($p<0.05$) feed conversion ratio than control group during all periods of experiment and as regards total mean of this trait (Table 9).

Results obtained in this experiment revealed that supplementing the bird diets with sesame oil and seeds (T1; T2; T3; T4) led to significant ($p<0.05$) increase with respect to fertility, hatchability of total eggs, hatchability of fertile eggs and embryonic livability percentages as compared with control group (Table 10).

It can be speculated that the improvement in productive and reproductive characteristics probably resulted from the high linoleic acid content of sesame oil and

seeds (55.03; 22.1, respectively). El – Yamany et al. (20) concluded that enrichment the quail diet with vegetable oils rich in linoleic acid and linolenic acid get a higher economic efficiency without adverse effects on the performance and improve the physiological parameters. Balevi et al. (21) found significant improvement in fertility, hatchability, and embryonic livability rates when used sunflower oil as a source of linoleic acid in laying quail diet. Aydin et al. (22) showed that dietary conjugated linoleic acid (CLA) influenced egg production and fatty acid composition of egg yolk of Japanese quail in a dose – and time – dependent mode. It was also reported that inclusion of CLA in quail diet at a level of 2% and higher affected egg weight significantly compared to control group. Previous data suggested that the inclusion of CLA in the diets of chicken *vs.* Japanese quail affected fatty acid composition and egg fertility parameters differently (23). Diarra and Usman (4) reported that replacing soybean meal with soaked sesame seed meal at 12.5% in the diet of laying hens will meet their methionine requirement without adverse effects on performance and health status. Dalton (24) indicated that feeding Japanese quail with soybean oil as a source of linoleic acid significantly decreased early embryonic death.

Table (3) Effect of dietary supplementation with sesame oil and sesame seeds on body weight (g) (Mean ± SE) of laying quail

Periods	Treatments					Level of significance
	C	T1	T2	T3	T4	
1	203.00 ± 2.89	198.56 ± 0.99	197.67 ± 0.51	199.83 ± 2.17	198.50 ± 0.96	N.S.
2	206.17 ± 2.65	201.33 ± 0.73	200.33 ± 0.33	199.72 ± 0.74	200.89 ± 0.48	N.S.
3	205.56 ± 3.38	200.67 ± 0.67	201.22 ± 0.62	197.50 ± 2.66	201.50 ± 0.76	N.S.
4	207.22 ± 2.90	202.11 ± 1.06	203.39 ± 1.93	196.67 ± 2.37	203.22 ± 0.97	N.S.
5	206.67 ± 4.33	202.42 ± 0.29	203.56 ± 0.99	199.69 ± 1.45	205.51 ± 0.73	N.S.
6	206.89 ± 3.37	202.67 ± 0.51	204.17 ± 0.48	200.28 ± 1.26	203.41 ± 1.93	N.S.

Each period represented 14 days.
C: Control diet; T1 and T2: Diet supplemented with 0.5% or 1% sesame oil, respectively; and T3 and T4: Diet supplemented with 1% or 2% sesame seeds, respectively.
N.S. : Not significant.

Table (4) Effect of dietary supplementation with sesame oil and sesame seeds on feed consumption (g) (Mean ± SE) of laying quail

Periods	Treatments					Level of significance
	C	T1	T2	T3	T4	
1	26.21 ± 0.019	25.17 ± 0.774	26.28 ± 0.108	27.37 ± 0.344	26.12 ± 0.036	N.S.
2	28.71 ± 0.143	29.18 ± 0.343	29.74 ± 0.021	29.76 ± 0.004	28.55 ± 0.024	N.S.
3	28.69 ± 0.120	29.48 ± 0.172	29.23 ± 0.378	29.77 ± 0.013	27.92 ± 0.059	N.S.
4	28.12 ± 0.372	28.88 ± 0.516	29.17 ± 0.344	29.76 ± 0.005	28.55 ± 0.345	N.S.
5	29.57 ± 0.526	29.49 ± 0.174	29.76 ± 0.004	30.35 ± 0.344	30.04 ± 0.516	N.S.
6	31.70 ± 0.375	31.30 ± 0.518	30.69 ± 0.516	30.95 ± 0.341	31.17 ± 0.191	N.S.
Cumulative feed consumption	172.02 ± 0.595	173.50 ± 2.495	174.87 ± 1.341	117.97 ± 1.031	172.34 ± 0.689	N.S.

Each period represented 14 days.
C: Control diet; T1 and T2: Diet supplemented with 0.5% or 1% sesame oil, respectively; and T3 and T4: Diet supplemented with 1% or 2% sesame seeds, respectively.
N.S. : Not significant.

Table (5) Effect of dietary supplementation with sesame oil and sesame seeds on egg weight (g) (Mean ± SE) of laying quail

Periods	Treatments					Level of significance
	C	T1	T2	T3	T4	
1	9.39 ± 0.82 c	10.60 ± 0.46 b	11.12 ± 0.50 a	10.18 ± 0.30 b	9.86 ± 0.39 b	*
2	11.08 ± 0.80 b	11.30 ± 0.48 a	11.57 ± 0.54 a	11.50 ± 0.70 a	11.47 ± 0.31 a	*
3	10.84 ± 0.69 b	11.98 ± 0.20 a	11.41 ± 0.14 a	11.76 ± 0.28 a	11.33 ± 0.73 a	*
4	10.96 ± 0.66 c	12.38 ± 0.29 a	11.94 ± 0.92 b	12.05 ± 0.79 a	12.82 ± 0.90 a	*
5	11.79 ± 0.31 b	12.79 ± 0.25 a	12.73 ± 0.25 a	12.60 ± 0.13 a	12.44 ± 0.46 a	*
6	12.04 ± 0.31 c	13.04 ± 0.25 a	12.98 ± 0.25 b	12.85 ± 0.13 b	12.70 ± 0.46 b	*
Total mean	11.02 ± 0.31 c	12.01 ± 0.26 a	11.96 ± 0.25 b	11.82 ± 0.14 b	11.77 ± 0.46 b	*

Each period represented 14 days.
C: Control diet; T1 and T2: Diet supplemented with 0.5% or 1% sesame oil, respectively; and T3 and T4: Diet supplemented with 1% or 2% sesame seeds, respectively.
$^{a, b, c}$: Means within a row lacking a common superscript differ significantly.
* : p<0.05.

Table (6) Effect of dietary supplementation with sesame oil and sesame seeds on hen day egg production (%) (Mean ± SE) of laying quail

Periods	Treatments					Level of significance
	C	T1	T2	T3	T4	
1	86.11 ± 1.73 b	86.12 ± 0.79 b	89.68 ± 0.80 a	88.89 ± 0.40 a	86.13 ± 0.39 b	*
2	86.49 ± 1.05 c	90.08 ± 1.06	88.92± 0.79 b	91.27 ± 3.78 a	88.89 ± 3.79 b	*
3	83.29 ± 0.69 c	86.51 ± 1.07 b	87.70 ± 3.78 b	86.50 ± 1.04	90.08 ± 1.05 a	*
4	85.30 ± 1.05 c	88.49 ± 2.78 b	93.65 ± 0.40 a	88.32 ± 1.73 b	92.86 ± 0.70 a	*
5	80.92 ± 3.10 c	87.30 ± 2.80 b	90.87 ± 0.39 a	87.71 ± 1.19 b	90.08 ± 1.74 a	*
6	81.76 ± 2.06 c	87.31 ± 0.79 b	87.30 ± 0.81 b	85.73 ± 1.43 b	90.87 ± 2.77 a	*
Total mean	83.97 ± 1.38 c	87.63 ± 1.53 b	89.68 ± 0.66 a	88.07 ± 1.46	89.82 ± 0.24	*

Each period represented 14 days.
C: Control diet; T1 and T2: Diet supplemented with 0.5% or 1% sesame oil, respectively; and T3 and T4: Diet supplemented with 1% or 2% sesame seeds, respectively.
a, b, c : Means within a row lacking a common superscript differ significantly.
*** : p<0.05.**

Table (7) Effect of dietary supplementation with sesame oil and sesame seeds on cumulative egg number (egg / hen / 14 days) (Mean ± SE) of laying quail

Periods	Treatments					Level of significance
	C	T1	T2	T3	T4	
1	12.06 ± 0.24 b	12.05 ± 0.11 b	12.56 ± 0.11 a	12.44 ± 0.06 a	12.07 ± 0.05 b	*
2	12.10 ± 0.16 b	12.61 ± 0.15 a	12.44 ± 0.11 a	12.78 ± 0.53 a	12.44 ± 0.53 a	*
3	11.66 ± 0.10 c	12.11 ± 0.14 b	12.28 ± 0.54 b	12.12± 0.15 b	12.61 ± 0.14 a	*
4	11.94 ± 0.14 c	12.39 ± 0.39 b	13.11 ± 0.05 a	12.36 ± 0.24 b	13.00 ± 0.09 a	**
5	11.90 ± 0.43 c	12.22 ± 0.40 b	12.72 ± 0.05 a	12.27 ± 0.17 b	12.61 ± 0.24 a	*
6	11.44 ± 0.29 c	12.22 ± 0.11 b	12.22 ± 0.11 b	12.00 ± 0.20 b	12.72 ± 0.38 a	**
Total mean	11.48 ± 0.19 c	12.27 ± 0.21 b	12.55 ± 0.10	12.32 ± 0.21 b	12.57 ± 0.03 a	*

Each period represented 14 days.
C: Control diet; T1 and T2: Diet supplemented with 0.5% or 1% sesame oil, respectively; and T3 and T4: Diet supplemented with 1% or 2% sesame seeds, respectively.
$^{a, b, c}$: Means within a row lacking a common superscript differ significantly.
* : p<0.05; ** : p<0.01.

Table (8) Effect of dietary supplementation with sesame oil and sesame seeds on egg mass (g / hen) (Mean ± SE) of laying quail

Periods	Treatments					Level of significance
	C	T1	T2	T3	T4	
1	8.07 ± 0.38 c	9.12 ± 0.31 a	9.98 ± 0.51 a	9.05 ± 0.27 a	8.49 ± 0.31 b	**
2	9.58 ± 0.76 b	10.17 ± 0.31 a	10.28 ± 0.36 a	10.46 ± 0.42 a	10.20 ± 0.58 a	*
3	9.02 ± 0.67 b	10.37 ± 0.27 a	10.01 ± 0.43 a	10.18 ± 0.24 a	10.22 ± 0.76 a	*
4	9.34 ± 0.46 c	10.96 ± 0.50 b	11.19 ± 0.86 a	10.64 ± 0.84 b	11.89 ± 0.77 a	*
5	9.54 ± 0.11 b	11.15 ± 0.27 a	11.57 ± 0.28 a	11.05 ± 0.12 a	11.19 ± 0.27 a	**
6	9.84 ± 0.02 b	11.38 ± 0.13 a	11.34 ± 0.29 a	11.01 ± 0.18 a	11.51 ± 0.26 a	**
Total mean	9.23 ± 0.11 b	10.52 ± 0.15 a	10.72 ± 0.27 a	10.40 ± 0.18 a	10.57 ± 0.42 a	*

Each period represented 14 days.
C: Control diet; T1 and T2: Diet supplemented with 0.5% or 1% sesame oil, respectively; and T3 and T4: Diet supplemented with 1% or 2% sesame seeds, respectively.
$^{a, b, c}$: Means within a row lacking a common superscript differ significantly.
* : p<0.05; ** : p<0.01.

Table (9) Effect of dietary supplementation with sesame oil and sesame seeds on feed conversion ratio (g feed / g egg) (Mean ± SE) of laying quail

Periods	Treatments					Level of significance
	C	T1	T2	T3	T4	
1	3.62 ± 0.14 a	2.76 ± 0.04 b	2.64 ± 0.13 b	3.03 ± 0.11 b	3.23 ± 0.12 a	*
2	2.96 ± 0.23 a	2.87 ± 0.06 b	3.03 ± 0.10 a	2.85 ± 0.11 b	2.81 ± 0.17 b	*
3	2.99 ± 0.20 a	2.84 ± 0.08 c	2.93 ± 0.08 b	2.92 ± 0.07 b	2.76 ± 0.22 c	*
4	2.96 ± 0.18 a	2.64 ± 0.15 b	2.64 ± 0.22 b	2.93 ± 0.25 a	2.41 ± 0.14 b	*
5	2.96 ± 0.08 a	2.64 ± 0.07 bc	2.57 ± 0.06 c	2.81 ± 0.09 b	2.68 ± 0.05 bc	*
6	3.30 ± 0.03 a	2.75 ± 0.05 b	2.70 ± 0.06 b	2.87 ± 0.01 b	2.71 ± 0.06 b	*
Total mean	3.07 ± 0.02 a	2.75 ± 0.06 b	2.75 ± 0.06 b	2.90 ± 0.03 b	2.78 ± 0.10 b	*

Each period represented 14 days.
C: Control diet; T1 and T2: Diet supplemented with 0.5% or 1% sesame oil, respectively; and T3 and T4: Diet supplemented with 1% or 2% sesame seeds, respectively.
$^{a, b, c}$: Means within a row lacking a common superscript differ significantly.
* : $p<0.05$.

Table (10) Effect of dietary supplementation with sesame oil and sesame seeds on fertility, hatchability and embryonic mortality (%) (Mean ± SE) of laying quail

Periods	Treatments					Level of significance
	C	T1	T2	T3	T4	
Fertility (%)	83.69 ± 1.72 c	87.95 ± 1.38 b	88.69 ± 1.72 b	91.26 ± 14.78 a	92.86 ± 4.12 a	*
Hatchability of total eggs (%)	65.60 ± 4.47 c	71.17 ± 2.40 b	73.57 ± 2.06 b	80.83 ± 2.41 a	81.59 ± 4.47 a	*
Hatchability of fertile eggs (%)	81.82 ± 3.94 c	86.82 ± 1.84 b	85.97 ± 3.50 b	89.91 ± 13.32 a	90.05 ± 2.41 a	*
Embryonic mortality (%)	18.18 ± 3.94 a	13.18 ± 1.84 b	14.03 ± 3.55 b	10.09 ± 13.35 c	9.95 ± 3.48 c	*

Each period represented 14 days.
C: Control diet; T1 and T2: Diet supplemented with 0.5% or 1% sesame oil, respectively; and T3 and T4: Diet supplemented with 1% or 2% sesame seeds, respectively.
$^{a, b, c}$: Means within a row lacking a common superscript differ significantly.
* : $p<0.05$.

Bozkurt et al. (25) reported that supplementation of sunflower oil at a level of 1.5% as a source of linoleic acid to the corn- soybean meal diet of broiler breeder may affect egg production performance, fertility, egg weight, chick weight, hatch of egg set without any adverse effect on body weight and egg settable characteristics. Rama Rao et al. (3) reported that the biological effects of the n-6 fatty acids are largely mediated by their conversion to n-6 eicosanoids that bind to diverse receptors found in every tissue of the body. The conversion of tissue linoleic acid (18:2 n-6) to arachidonic acid (20:4 n-6) and then to n-6 prostaglandin and n-6 leukotriene hormones provides many targets for pharmaceutical drug development and treatment to diminish excessive n-6 actions in atherosclerosis, asthma, arthritis, vascular disease, thrombosis, immune – inflammatory processes and tumor proliferation.

On the other hand, the positive effects with respect to productive and reproductive traits obtained in this experiment when laying quail fed diets containing sesame oil or seeds may be explained by their content of other active constituents. Snakar et al. (26) indicated that sesame oil and seeds have long been categorized as a traditional health food in India and other East Asian countries. Sesame oil and seeds have been found to contain considerable amounts of the sesame lignans: sesamine, episesamine, and sesamolin. Sesame also contains vitamin E (30- 50 mg/ 100 g), 40- 60 percent of PUFA, and 20- 40 percent MUFA. The lignans present in sesame are thought to be responsible for many of its unique chemical and physiological properties, including its antioxidant and antihypertensive properties. Moazzami and Kamal- Eldin (27) found that sesame oil and seeds had an average of 0.63 and 0.39 lignans, respectively, making them a rich source of dietary lignans. Lignans are phytoestrogens with estrogenic or anti- estrogenic activity. Lignans may also have antioxidant activity. Plant lignan compounds are converted in the intestine to form of lignans (enterolignans) the human and animal body can assimilate. Some studies have reported a positive association between high level of lignans in the body with reduced risks of prostate cancer, ovarian cancer, breast cancer, osteoporosis, and cardiovascular disease (28). Abdul- Rahman et al. (29) reported that treatment broiler breeder hens with sesame seed capsules (250 and 500 mg/ kg of body weight) given orally daily for 4 weeks enhanced erythropoiesis, FSH and LH activity and some productive parameters. Cooney et al.(8) showed that consumption of moderate amounts of sesame seeds appears to significantly increase plasma gamma-tocopherol and alter plasma tocopherol ratios in humans and is consistent with the effects of dietary sesame seeds observed in rats leading to elevated plasma gamma-tocopherol and enhance vitamin E bioactivity. Zhang et al. (30) indicated that CLA enhances the activity of antioxidant enzymes including total superoxide dismutase and catalase. Supplementation of CLA has been show to ameliorate the antioxidant balance and performance of chicks during oxidative stress. Sesame seed are loaded with powerful antioxidant: IP-6 (AKA: Phytate; one of the most powerful antioxidants yet found, and one of the most potent natural anti cancer substances, especially abundant in grain and sesame), lignans, sesamin, sesaminol, sesamolinol, sesamolin, pinoresinol, vitamin E, lecithin, myristic acid, and linoleate. Lignans are fat- soluble antioxidants such as, sesaminol, sesamolinol and sesamolin. They prevent free radical formation, and scavenge free radicals that already form (31). However, Fazel et al. (5) summarized the advantages of sesame antioxidants as follows: Sesamolin inhibits lipid peroxidation (free radical formation), sesame has a variety of effective antioxidants, antioxidant activity of sesaminol in defatted sesame flour protects against oxidative stress from dietary cholesterol, sesamine decreases formation of inflammatory prostaglandins, sesame enhances antioxidant activity of vitamin E. Sesame lignans have a sparing effect on vitamin E, preventing damage to vitamin E, DHA (from fish oils) decreases vitamin E level, sesame raises it, DHA (from fish oils) create lipid peroxidation (free radicals), damage red blood cells. Sesame decreases the damage to fats and red blood cells, raises vitamin E levels; sesamin decreases breakdown of vitamin E, sesame provides gamma-tocopherol (an especially helpful form of vitamin E). Sesame lignans lower cholesterol levels, flax lignans don't, sesame muffins significantly raised gamma- tocopherol levels. Muffins containing the same amount of gamma- tocopherol from soy or walnut didn’t do anything. Gamma tocopherol is a very effective form of vitamin E, sesaminol more effective antioxidant than alpha- tocopherol (most common form of vitamin E), sesame seed and oil contain several important antioxidants that are believed to promote the integrity of body tissues in the presence of oxidizing compounds. The antioxidants sesaminol and sesamolinol maintain fats, including low density lipoproteins (LDL), in

an unoxidized state. Sesamolin and sesamol are also antioxidants found in sesame seed oil, sesaminol and sesamin found in sesame seed and oil increases vitamin E activity dramatically, acting synergistically with vitamin E to provide antioxidant compounds known as eicosanoids, promote a balanced immune and auto- immune response, and sesame lignans may promote healthy liver and strengthen the heart and nervous system (32). Etches (33) indicated that vitamin E required for the testes, epididymis, vas deferens, and accessory sex gland to function. It accumulates in the membranes of sperm. Surai (34) found that the semen quality was best when the feed contained 40- 80 IU/ kg vitamin E. Blesbois et al. (35) found about 1.6 µg/ ml vitamin E in the semen of cockerels. The fertilizing capacity of the fresh undiluted semen was 93%. When they diluted the semen with a fluid containing 8 µg / ml vitamin E, fertilizing capacity after storing samples for 24 hours at 4 ºC was 90%. However, in females vitamin E accumulates in the granulose and theca cells. Like β – carotene and ascorbic acid, it breaks down proxyl radicals and other highly reactive oxygen species that are formed increasingly during maturation of tertiary follicles. HDL is closely involved in the transport of vitamin E into the ovaries. The number of HDL receptors in tertiary follicles is increased by LH hormone. Vitamin E is also required for the normal growth and development of embryos (36). Obiajunwa et al. (37) reported that sesame seed not only are very good source of manganese and cupper, but they are also good source of calcium, magnesium, iron, phosphorus, vitamin B1, tryptophan, methionine, zinc and dietary fiber. In addition to these important nutrients, sesame seeds contain two unique substances: sesamin and sesamolin. Both of these substances belong to a group of special beneficial fibers called lignans, and have been shown to have cholesterol-lowering effect, and to prevent high blood pressure and increase vitamin E supplies in human and animals. Sesamin has also been found to protect the liver and heart from oxidative damage (38).

The results obtain suggested that sesame oil and seeds supplementation into laying quail diets caused significant positive effects as regards productive and reproductive characteristics included in this experiment. Therefore, incorporation of these feed stuff into the diets of Japanese quail may have practical value in manipulating egg quantity and quality.

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