OPEN ACCESS
Advances in Animal and Veterinary Sciences

Research Article

Effect of Dietary Sunflower Oil Incorporation on Laying Performances and Egg Quality of Japanese Quail (*Coturnix japonica*)

Guenaoui Mohamed[1]*, Khelil Sofiane Raouf[2], Berrani Abdelkader[3]

[1]Department of Nature and Life Sciences, Agronomy Environment Research Laboratory, University of Tissemsilt, Algeria; [2]Department of Agronomic Sciences, Faculty of Nature and Life Sciences, University of Akli Mohand Oulhadj Bouira, Algeria; [3]Faculty of Nature and Life Sciences University of Tiaret, Algeria.

Abstract | The addition of oils in animal nutrition improves growth performances and the quality of products obtained as meat, milk and eggs by providing essential fatty acids. In poultry and especially in layers, vegetables oils are used widely to increase energy in food. In this study, we aimed to evaluate the effects of dietary sunflower oil incorporation on laying performances and egg quality of Japanese quail. A basal diet SF0 was formulated to meet the nutritional requirements for laying quails. Two other foods SF5 and SF10 were obtained by the incorporation of 5 and 10% of sunflower oil in the control food SF0. We used a total of 300 females of quail, aged 42 days old. Quails were housed in cages. They were randomly assigned to the three experimental diets (100 Quails per diet). In total, 30 cages (10 cages/treatment) were used and each cage contained 10 quails. The results showed that the addition of sunflower oil to the feed of quails during the laying period improved the growth performances of quails by increasing the live weight, reducing the feed conversion index, and therefore ensuring early maturity of females. For egg quality, dietary supplementation with 10% sunflower oil affects positively the weight of eggs, yolk, and albumen without any effect on the rate of these later. On the other hand, the laying rate was not affected by the type of diet. However, the addition of sunflower oil can improve the shape index, haugh unit, and the yolk color score. Dietary sunflower oil supplementation at 10% improves the laying performances of quails without any negative effect on the health status of animals. Supplementing the quails' diet with sunflower oil improves egg quality as haugh unit and yolk color score.

Keywords | Albumen, Diets, Egg weight, Feed intake, Laying quails, Yolk

Received | March 13, 2024; **Accepted** | April 29, 2024; **Published** | May 18, 2024
***Correspondence** | Guenaoui Mohamed, Department of Nature and Life Sciences, Agronomy Environment Research Laboratory, University of Tissemsilt, Algeria; **Email:** guenaoui.mohamed@univ-tissemsilt.dz
Citation | Mohamed G, Raouf KS, Abdelkader B (2024). Effect of dietary sunflower oil ıncorporation on laying performances and egg quality of Japanese quail (*Coturnix japonica*). Adv. Anim. Vet. Sci., 12(7):1281-1285.
DOI | https://dx.doi.org/10.17582/journal.aavs/2024/12.7.1281.1285
ISSN (Online) | 2307-8316

INTRODUCTION

Throughout the world, poultry has mainly been concerned with broiler production and poultry eggs. Broiler and laying hens present the most sources of animals protienes in our diets, recently quails began very important in offering consumers new taste choices of meat and eggs Ukashatu *et al.* (2014). Feed accounts for almost 60% of the total cost of poultry production, as for all other types of animal production Shamna *et al.* (2013). In Algeria, most quail breeders (coturniculteurs) generally use feed intended for hens because of the unavailability of special commercial feed formulas for quail in the livestock feed industry. Several authors show that given its rapid growth, the protein and energy needs of quail are significantly higher than those of hens Djitie *et al.* (2015). Therefore, the formulation of feed for quail for the production of meat or eggs is essential to develop this type of breeding.

Oils are used in formulating diets to increase energy in feed for laying hens because of their positive effect on feed intake, palatability, immunity and inhancing health of animals Gopi *et al*. (2014). The addition of fats and oils to feeds for layers improves the metabolizable energy (ME) content of feeds and optimizes the performance of the number of eggs. However, In laying quails eggs production and quality are particularly influneced by the type of oil supplemented to the diet. Therefore, the objective of this study was to study however the supplementation with different levels of sunflower oil affect growth performance, egg production, and egg quality of Japanese quail.

MATERIALS AND METHODS

Animals, treatments, and experimental design

Before starting the experiment all materials as cages and feeders were washed with water and desinfected with TH5. Quails were reared in metallic cages of 900 X 400 X 250 mm. Cages were equipped with a container for feed and eggs. Feed was distributed manually, while water was administered by pippets (4 pippets/Cage). Quails receive fresh water stored in cleaned tanks which are filled daily. Cages were equipped with metal bins for collecting droppings. The windows were covered with a metal mesh to prevent entering birds. Cleaning the entrance of the rearing house and eliminating droppings was done daily. No additives or antibiotics were used in experiment just a coccidiostat (clinacox) in feed.

We used 42 days -old female Japanese quails from the Poultry Experimental Base of the FAB GRAINS unit at Tiaret- Algeria. We assigned a total of 300 quails of 148±1.47 g and randomly divided them into three experimental groups of 100 quails (10 quails per cage). The control group SF0 was fed a basal diet with 0% sunflower oil, while the other two groups SF5 and SF10 received a basal diet supplemented with 5 and 10% sunflower oil respectively. Ambiantal conditions in the rearing house were maintained as follows; Tempreture at 25±2°C and relative humidity of 50% to 60% using heating and cooling systems combined with continued ventilation. The lighting schedule followed a 16 h light and 8 h dark cycle (16L:8D).

The whole experimental period lasted more than 30 days, comprising days before beginning laying a subsequent 30 days formal trial period (laying period for each group). Observations were made regarding egg production, feed intake, body weight, and the overall health of the laying quails during this period. Temperature and humidity conditions were respected in the housing according to quails performance. Quail's performances were controled daily so that they had an adequate supply of water and food each day. At the age of 65 days of quails, eggs were collected from each treatment group. These eggs were then analyzed directly to measure their internal and external quality.

Diets and composition

This study utilized sunflower oil as a supplement for experimental diets. Therefore, a basal diet was formulated to reach quail requirements in the laying period according to the National Research Council (NRC,1994). Sunflower oil was individually added to the basal diet. The nutritional composition of experimental diets shown in Table 1.

Table 1: Ingredients and composition of the experimental diets.

Ingredients (%)	Experimental diets[1]		
	SF0	SF05	SF10
Corne	51.55	40.55	31.55
Soybean meal	24	27.5	29
Wheat bran	05	15.5	20
Sunflower oil	0	5	**10**
Rapeseed expeller	10	2	0
Calcium carbonate	7	7	7
Dicalcium phosphate	1.4	1.4	1.4
Corrector [2]	1	1	1
Capteur de mycotoxines	0.05	0.05	0.05
Chemical composition			
Dry matter	95.1	92.4	90.2
Crude protien	18.20	18.25	18.26
AME by calculation (Kcal)	2888	2925	2980
Fat	3.2	3.18	3.26
Starch	33.7	32.9	29.9
Calcium	3.1	3.2	3.18
Available phosphorus	0.79	0.72	0.71

[1]SF0: Diet without sunflower oil, SF05: Diet with 5% sunflower oil, SF10: Diet with 10% sunflower oil. [2]Provided by Vitafit (Setif, Algeria), (mg/kg): Mn: 7000; Zn: 6500; Cu: 1500; I: 200; CO: 99; Fe: 6000; Niacin: 2000; Biotine: 20; Choline: 30000; Vitamin K: 250; Vitamin B1: 200; Vitamin B2: 500; Vitamin B6: 500; Vitamin A: 1000000 UI/Kg; Vitamin D3: 250000UI/Kg; Vitamin E(α-tocopherol acetate): 2000 UI/kg. 200 ppm de Clinacox 0.5%.

Laying and growth performances

Growth performances of quails were calculated according to the procedure of Akram *et al*. (2008), the average weight per cage was recorded at the first laying egg, and after 30 days of laying for each group, then daily weight gain (ADG) was calculated. Daily feed refusals per cage were weighted and daily feed intake (FI) was calculated accordingly. The day of laying the first egg per each group was recorded. Egg production was calculated by collecting and counting the eggs from each cage group every day across 30 days of the experiment. Growth and laying performances were

recorded by the evaluation of the average of each parameter per cage. The data were used to calculate feed conversion per kilogram of egg produced and feed consumption.

Egg quality tests

A total of 150 eggs (50 eggs/treatment) were randomly collected at 65 days. After collecting eggs were analyzed directly to determine internal and external qualities. The egg shape index was determined using a Vernier caliper (Brand: Stainless, model: Hardned 0-15mm, precision: 0.01 mm) and calculated using the formula attributed by Reddy *et al* (1979): (egg length/ egg width) x 100. For egg weight we have used an electrical digital balance (Precision: 0.0001 and sensitivity: 510g, Brand: KERN, model: pls). After, The egg was broken and poured on a horizontal glass to determine Albumen height using a tripod micrometer (Baxlo Haugh Digital Micrometer), to be used next in calculating Haugh unit using the formula Haugh (1937) as follows:

$$= 100 \times \log (\text{albumen height} - 1.7 \times \text{egg weight}^{0.37} + 7.57)$$

For determination of yolk color score it was the DSM yolk color fan (The DSM Yolk Fan TM. Hoffmann-La Roche, Switzerland) by giving a color score ranging from 1 to 5. To determine Albumen weight yolk was separated frome albumen and weighed using an the same electrical digital balance.

Albumen weight was calculated as follows:

$$= \text{egg weight sample} - (\text{yolk weight} + \text{shell weight}).$$

Shell thickness (mm) was determined using a micrometer (Limit MIA, precision: 0.01mm) and calculated by the average value of three different measurements (upper, middle, and lower end). Shell weight (g) was determined by weighing the shell after air-drying overnight. At laste we calculated the rate of yolk, albumen, and shell weight relative to the egg weight sample.

Statistical analysis

The results obtained were analyzed as a completely randomized design where the type of diets was the main sources of variation, using the General Linear Model (GLM) procedure of SAS (2004). The mean number of quails per cage was used as the experimental unit in the analyses of productive performances. For egg quality analyses we use an analysis of variance considering the egg as the experimental unit and the type of feed as variable. Data was considered significant at $p < 0.05$. The model used was as follows:

$$Yik = \mu + Ti + eik$$

Where, Yik = An observation, μ = Overall mean, Ti = Effect of treatments, eik = random error.

RESULTS AND DISCUSSION

Growth and laying performances

The effects of dietary sunflower oil supplementation on the growth and laying performances of Japanese quails are shown in Table 2.

Table 2: Effects of dietary sunflower oil supplementation on laying performance of Japanese quails.

	Experimental diets[1]			SEM	P value
	SF0	SF5	SF10		
Age at first egg laid(d)	51[a]	49[b]	47[c]	.	<.0001
Final live weight (g)	201[c]	208[b]	220[a]	3.05	<.0001
Weight gain (g/bird)	53.0[c]	58.8[b]	71.4[a]	2.9	<.0001
Feed intake (g/bird/30d)	1107[b]	1065[a]	1051[a]	4.34	<.0001
Live weight at first egg (g/bird)	179	179	178	2.77	0.906
Egg production (%)	71.6	72.3	72	4	0.93
Egg mass (g/bird/30d)	253[b]	256[b]	284[a]	14.5	<.0001
Feed conversion ratio	4.39[a]	4.16[b]	3.7[c]	0.24	<.0001

[1]SF0: Diet without sunflower oil, SF05: Diet with 5% sunflower oil, SF10: Diet with 10% sunflower oil.

Results showed that the age of laying the first egg was significantly (P<0.05) different between the three groups; we observed that females of SF10 started laying eggs earlier than females of SF5 and SF0 (P<0.0001). On the other hand, Moula *et al*. (2014) obtained that the age of start laying was 42 days. Indeed, our results are in agreement with the results of Sauveur (1988) who reports that the start of laying in Japanese quail is between 6 and 7 weeks of age. According to Vieria Filho *et al*. (2016), the sexual maturity of Japanese quail can be influenced by genetic factors and body weight, which is why quails of the SF10 group (with 220g of weight) have an earlier sexual maturity in comparison with other groups. However, the addition of sunflower oil 10% in the diet improves the weight gain of quails. This is confirmed by Jalali *et al*. (2015) who found that the incorporation of soybean oil into chicken feed increases DWG and improves feed efficiency. Feed intake was also influenced by the addition of sunflower oil to the diet (P<.0001), where we found that the feed intake of quails in SF10 was lower than in groups SF0 and SF5. In contrast, Nobakht *et al*. (2011) found that feed intake increased with the addition of sunflower oil at 4% in the starter diet of broiler chicks. However, it was found that the addition of a mixture of sunflower and soybean oils reduces feed intake in broiler Jalali *et al*. (2015). Moreover, there was no effect of dietary treatment on egg production. Similar results were found in laying hens that received

diets supplemented with sunflower oil Alvarez *et al.* (2005). In the other hand, our results are higher than those of Karousa *et al.* (2015) who reported laying rates of 46.6% and 63.5% in quails of 6 to 12 weeks. Moreover, laying performances were affected positively by the addition of sunflower oil where we found an increase in egg mass and feed conversion for quails fed diet containing 10% sunflower oil.

Eggs quality

The effects of dietary sunflower oil supplementation on the external egg quality of Japanese quail are shown in Table 3. In the present study, all external egg quality parameters were influenced by feed type. The addition of 10% sunflower oil to the quail feed increased the egg weight compared to groups that received diets containing 0 and 5% sunflower oil (P<0.0001). Supplementation with linseed and soybean oil to the diet of laying hens improves egg weight Batkowska *et al.* (2021). Consequently, the shape index obtained for SF0 and SF5 is higher than that of SF10. These results are closest to those found by Ouaffai *et al.* (2018) who found values of 3,25 and 2,54 cm for length and width, so 78,2 for shape index. Also, feed supplementation with sunflower oil increased the length and width of quail eggs (P<0.0001) in agreement with results found by Lohmann (2018) when laying hens received diets supplemented with soybean oil.

Table 3: Effects of dietary sunflower oil supplementation on external egg quality of Japanese quails at 65 d of age.

	Experimental diets[1]			SEM	P value
	SF0	SF5	SF10		
N	50	50	50		
Egg weight (g/egg)	11.7[b]	11.8[b]	13.3[a]	1.077	<.0001
Egg length (cm)	3.03[b]	3.03[b]	3.31[a]	0.173	<.0001
Egg width (cm)	2.3[b]	2.3[b]	2.4[a]	0.09	<.0001
Egg shape index	75.9[a]	76.0[a]	72.7[b]	3.91	<.0001

[1]SF0: Diet without sunflower oil, SF05: Diet with 5% sunflower oil, SF10: Diet with 10% sunflower oil.

As shown in Table 4, dietary treatments did not affect yolk, albumen, and shell percentages but the other parameters were affected by the diet as yolk, albumen, shell weights, haugh unit, and yolk color score (P<0.0001). However, Yuan *et al.* (2019) found that supplementation of rapeseed oil in laying hens decreased the yolk color and yolk ratio and increased the albumen height and Haugh unit. The addition of 10% sunflower oil to the diet of quails during the laying period increased the albumen weight and yolk in eggs compared to groups fed SF0 and SF05 diets. Yuan *et al.* (2019) found that supplementing the diets of laying hens with rapeseed oil increases yolk weight. Our results can be justified by the hypothesis which says that the rate of hepatic synthesis of lipoproteins by hens is insufficient to provide the quantities of lipids necessary for optimal development of the egg yolk and that the exogenous lipids provided by the diet could help hens to meet these needs. Yolk pigmentation is significantly influenced by diet; thus the eggs from the SF0 and SF05 groups have less pigmented yolks than those from the SF10 group. In agreement with results found by Sangkaew *et al.* (2017) who found that the color of yolk became darker when laying hens received diets supplemented with sunflower oil. The type of diet that conditions this coloring Nys (2000), and in this study perhaps the addition of sunflower oil influences the pigmentation of the egg yolk. This may be due to the high level of pigment (β-carotene) in sunflower oil Topkafa *et al.* (2013). Otherway, it was found that yolk lycopene content and yolk color score could be increased by the addition of lycopene in the quails' diet (Sahin *et al.* 2008).

Table 4: Effects of dietary sunflower oil supplementation on internal egg quality of Japanese quails at 65 d of age.

	Experimental diets[1]			SEM	P value
	SF0	SF5	SF10		
N	50	50	50		
Yolk weight (g)	3.86[b]	3.93[a]	4.46[a]	0.51	<.0001
Yolk percentage (%)	32.9	33.4	33.4	3.88	0.787
Albumen weight (g)	6.86[b]	6.82[a]	7.65[a]	1.02	<.0001
Albumen percentage (%)	57.9	57.4	57.4	5.23	0.859
Shell weight (g)	1.06[b]	1.06[b]	1.19[a]	0.115	<.0001
Shell percentage (%)	9.10	9.08	8.96	1.01	0.768
Haugh unit	54.1[a]	54.1[a]	51.7[b]	1.92	<.0001
Yolk color score	3.96[b]	3.98[b]	4.78[a]	0.64	<.0001

[1]SF0: Diet without sunflower oil, SF05: Diet with 5% sunflower oil, SF10: Diet with 10% sunflower oil.

CONCLUSIONS AND RECOMMENDATIONS

The use of sunflower oil 5 and 10% as supplementation in the diet of *Coturnix japonica* during the laying period was beneficial on its growth performances and laying parameters, as well as on the internal and external quality of eggs. The addition of sunflower oil improves egg weight and yolk color score.

ACKNOWLEDGEMENT

This study was funded partially by the University of Tissemsilt (Agronomy Environment Research Laboratory).

NOVELTY STATEMENT

The novelty of this study was the utilization of sunflower oil dietary supplement, which significantly improves the laying performances and egg quality of Japanese quails.

AUTHOR'S CONTRIBUTION

All authors contributed equally according to their tasks and approved the final manuscript.

Conflict of interest

The authors have declared no conflict of interest

REFERENCES

Akram M, Rehman ZU, Mahmood A, Javed K, Sahota AW, Jaspal MH (2008). Comparative productive performance of Japanese quail from different local and imported flocks. Proceedings of XXIII World Poultry Congress, 30th June-4th July, held at Brisbane, Australia

Alvarez C, García-Rebollar P, Cachaldora P, Méndez J, Blas JCD (2005). Effects of dietary conjugated linoleic acid and higholeic acid sunflower oil on performance and egg quality in laying hens. Br. Poult. Sci., 46: 80-86. https://doi.org/10.1080/00071660400023870

Batkowska J, Drabik K, Brodacki A, Czech A, Adamczuk A (2021). Fatty acids profile, cholesterol level and quality of table eggs from hens fed with the addition of linseed and soybean oil. Food Chem., 334: 127612. https://doi.org/10.1016/j.foodchem.2020.127612

Djitie KF, Kana JR, Ngoula F, Nana NFC, Teguia A (2015). Effet du niveau de protéines brutes sur la croissance et la carcasse chez la caille (*Coturnix* sp.) en phase de finition dans les Hautes Terres du Cameroun. Livest. Res. Rural Dev., 27(8): 1-10. https://www.lrrd.cipav.org.co/lrrd27/8/koua27155.htm

Gopi M, Karthik K, Vasanthachar MH, Tamilmahan P, Kesavan M, Dashprakash M, Lingaraju BB, Purushothaman MR (2014). Essential oils as a feed additive in poultry nutrition. Adv. Anim. Vet. Sci., 2(1): 1–7. https://doi.org/10.14737/journal.aavs/2014.2.1.1.7

Haugh RP (1937). Haugh unites for measuring egg quality. Poult. Mag., 43: 552.

Jalali SMA, Rabiei R, Kheiri F (2015) Effects of dietary soybean and sunflower oils with and without L-carnitine supplementation on growth performance and blood biochemical parameters of broiler chicks. Arch. Anim. Breed, 58: 387–394. https://doi.org/10.5194/aab-58-387-2015

Karousa MM, Souad AA, Elaithy SM, Eman AE (2015). Effect of housing system and sex ratio of quails on egg production, fertility and hatchability. Benha Vet. Med. J., 28(2): 241-247. https://doi.org/10.21608/bvmj.2015.32510

Lohmann (2018). La nutrition des poules pondeuses: Ajout de matieres grasses brutes. Copyright c 2017, Lohmann France.

Moula N, Philip F, Ait Kaki A, Touazi L, Antoine Moussiaux N, Leroy P (2014). Laying and eggs quality of quails in semi-intensive conditions in Eastern Algeria. Arch. Zoot., 63(244): 696. https://doi.org/10.4321/S0004-05922014000400013

Nobakht A, Tabatbaei S, Khodaei S (2011). Effects of different sources and levels of vegetable oils on performance, carcass traits and accumulation of vitamine in breast meat of broilers. Curr. Res. J. Biol. Sci., 3: 601–605.

NRC (1994). National research council nutrient requirements of poultry, Ninth Revised Edition. J. Appl. Poult. Res., 3: 101. https://doi.org/10.1093/japr/3.1.101

Nys Y (2000). Dietary carotenoids and egg yolk coloration. Arch. Gefl Ugelkunde, 64: 45–54.

Ouaffai A, Dahloum L, Fassih A, Milagh M, Halbouche M (2018). Performances de croissance, de ponte et qualité de l'œuf chez la caille Japonaise (*Coturnix coturnix japonica*). Arch. Zoot., 67(258): 168-176. https://doi.org/10.21071/az.v67i258.3651

Reddy PM, Reddy VR, Reddy CV, Rap PSP (1979). Egg weight, shape index and hatch ability in Khaki Campbell duck egg. Indian. J. Poult. Sci., 14: 26-31.

Sahin N, Akdemir F, Orhan C, Kucuk O, Hayirli A, Sahin K (2008). Lycopene-enriched quail egg as functional food for humans. Food Res. Int., 41(3): 295-300. https://doi.org/10.1016/j.foodres.2007.12.006

Sangkaew M, Rahman M, Koh K (2017). Effects of high oleic acid sunflower oil on egg quality and fatty acid composition of egg yolk in laying hens. J. Adv. Agric. Technol., 4(2). https://doi.org/10.18178/joaat.4.2.180-184

SAS (2004). SAS/DSTAT user's guide: Statistics, Release 6.04, SAS Institute, Inc., Cary, NC., USA.

Sauveur B (1988). Reproduction des volailles et production d'oeufs, INRA, Paris, P 449.

Shamna TP, Peethambaran PA, Jalaludeen A, Joseph L, Aslam MKM (2013).Broiler characteristics of Japanese quails (*Coturnix coturnix japonica*) at different levels of diet substitution with *Azolla pinnata*. Anim. Sci. Rep., 7(2): 75-80

Topkafa M, Ayyildiz HF, Arslan FN, Kucukkolbasi S, Durmaz F, Sen S, Kara H (2013). Role of different bleaching earths for sunflower oil in a pilot plant bleaching system. Polish J. Food Nutr. Sci., 63(3): 147-154. https://doi.org/10.2478/v10222-012-0077-1

Ukashatu S, Bello A, Umaru MA, Onu JE, Shehu SA, Mahmuda A, Saidu BA (2014). Study of some serum biochemical values of Japanese quails (*Coturnix Coturnix japonica*) fed graded levels of energy diets in Northwestern Nigeria. Sci. J. Microbiol., 3(1): 1-10.

Vieria Filho JA, Edivaldo AG, Andréa BM, Tiago ADS, Ibiara CLP, Grace AAB (2016). Productivity of Japanese quails in relation to body weight at the end of the rearing phase. Acta Scient. Anim. Sci., Maringá, 38(2): 213-217. https://doi.org/10.4025/actascianimsci.v38i2.29858

Yuan N, Wang JP, Ding XM, Bai SP, Zeng QF, Su ZW, Xuan Y, Peng HW, Fraley GS, Zhang KY (2019). Effects of supplementation with different rapeseed oil sources and levels on production performance, egg quality, and serum parameters in laying hens. J. Metab. Nutr., pp. 1697–1705. https://doi.org/10.3382/ps/pey494