The Effect of Adding Different Types of Vegetable Oils and Waste Frying Oil on the Productive and Reproductive Performance of Japanese Quail

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Abstract

This study was carried out to evaluate the effect of adding different types of vegetable oils in improving production and reproduction performance and egg quality of Japanese quail. A total number of 112 birds of the 6-weeks Japanese quail were used and randomly distributed on four treatments with 4 replicates per 7 birds (2 males and 5 females). The bird were fed by treatments the following treatment: the first treatment (a control 2.5 % commercial oil (a mixture of soybean oil, sunflower oil and cotton seed oil)), the second (2.5% corn oil), third (2.5% sunflower oil), and fourth (2.5% waste frying oil -frying fish-(commercial oil)). Body weight (BW), body weight gain (BWG), feed consumption (FC), feed conversion ratio (FCR), egg production, egg weight, egg mass, fertility, hatchability, weight of chicks at hatch, egg quality, and relative economic efficiency (REE) were estimated for the whole experimental period (10 weeks).

There was no significant effect on egg number, egg mass, egg laying rate, feed intake and FCR, except for egg weight, which was higher for birds fed sunflower oil and waste frying oil compared to the second group (corn oil). Lipid sources evaluated had no significant difference ($p > 0.05$) for yolk weight, yolk percentage, albumen percentage, eggshell percentage, shape index, yolk index, Haugh unit (HU), shell thickness and SWUSA between the treatments applied. However, albumen weight, eggshell weight, and width of egg increase significantly ($P > 0.05$) due to addition sunflower oil compared with addition of corn oil, and increase significantly ($p > 0.05$) shell strength and ESA comparing corn oil group or control group. There were insignificant differences in fertility and hatchability rate between the experimental treatments. However, body weight of chicks at hatch increased significantly ($p > 0.05$)) due to addition sunflower oil comparing the other treats and increase significantly due to waste oil by comparing the control treat and corn oil treat. It was observed that treatment the quail birds with different types of vegetable oils have no significant effect on body weight of these birds during the experimental period. Replacement of commercial oil with waste frying oil has led to higher economical efficiency. However, addition of corn oil has led to lower economical efficiency.

Keywords: Vegetable Oils , Waste Frying Oil ,Performance of Japanese Quail

Introduction

Fat and oil are an energy source of all nutrients in food, a component that contributes significantly to the total cost of animal feed. The nutritional quality of eggs and the amount of fatty acids found in egg yolk can be adjusted according to the sources of fat (vegetable oils) used in diets to feed laying hens. However, it is important to note that in addition to the diet, the strain and age of the laying hen may also alter the lipid composition in egg yolks. (Mazalli et al., 2004a; Wu et al., 2005; Ribeiro et al., 2007). The source of fat did not affect on feed intake, egg production, egg mass, egg weight, feed conversion, yolk color, Haugh units, yolk index, yolk and albumen percentages, and eggshell thickness (Mazalli et al., 2004b). Merkel et al., 2002 found that the number of eggs weighing greater than 54.3 g increased significantly each time the corn oil was added to the diet. Egg weight was increased after corn oil had been added to the diet for 2 wk. Adding corn oil to the diet increased daily energy intake and body weight but did not affect egg production. The highest percentage of large and above eggs for the entire experiment was produced when corn oil was added at 26 wk of age. Peebles et al., 2002 found that Added fat type (poultry fat or corn oil), poultry fat level (1.5 or 3.0%), in the diets of young (29-wk-old) breeder hens had no effects on subsequent embryogenesis, hatchability, or post hatch grow out performance of broiler offspring. It was concluded that 1.5 and 3.0% added poultry fat or 3.0% added corn oil may be effectively used to adjust ME between low and high levels in the diets of young breeder hens without subsequent effects on broiler embryogenesis and grow out performance. Bozkurt et al., 2008 found that Body weights of hens and males were not affected by dietary treatments during the experimental period. Tallow supplementation to breeder diet significantly decreased hen-day egg production and cumulative settable egg yield when compared with other treatments. Hens fed with tallow and sunflower oil-added diets produced significantly heavier settable eggs than control and fish oil treatments. However, settable egg weight of hens fed with fish oil was lower than other dietary treatments. Egg yolk weight, albumen weight, and eggshell weight were not affected by dietary treatments. These data suggest that supplementation of different fat sources at a level of 1.5% to the corn-soybean meal diet may affect egg production performance, fertility, egg weight, chick weight, hatch of eggs set, and specific gravity without any adverse effects on body weight and settable egg characteristics. Thus, this study evaluated the addition of oil sources to the diet of laying Japanese quail in relation to production and reproduction performance and egg quality.

Materials and Methods

The experiment was performed at the Poultry Research Farm, Faculty of Agriculture, Assiut University to evaluate the effect of adding different types of Vegetable oil and waste frying oil on the productive and reproductive performance of Japanese quail (Coturnix coturnix Japonica), One hundred and twelve Japanese quail, aged 6 weeks, were housed in galvanized wire cages with nutritious nipples and feeders in a traditional shed with galvanized wire mesh. Were randomized in four treatment groups (20 females and 8 males each) with four replicates (5 females and 2 males each). All quails were grown in batteries under the same hygienic and environmental conditions throughout the entire experimental period which lasted for 10 weeks.

The treatments were as follows: Control group fed basal diet with 2.5 % commercial oil (a mixture of soybean oil, sunflower oil and cotton seed oil), the second treatment contained 2.5% corn oil, the third treatment contained 2.5% sunflower oil, and the fourth contained 2.5% waste frying oil -frying fish-(commercial oil)). Experimental diets were based on corn and soybean meal, prepared according to the National Research Council guidelines for the development of Japanese quail (NRC, 1994). Table 2 shows the composition and analysis of the calculated base diet. The feed and water were available ad libitium and had a light system of 17/7 light / dark hours throughout the experimental period.

Measurements:

Egg production and laying performance:

Production performance characteristics (egg laying rate, feed intake, feed conversion and viability) were measured during the 70-day trial Changes in body weight (CBW) and feed consumption (FC) were recorded at the beginning and end of the experiment for each replicate. Daily egg weight was recorded. Feed conversion ratio was determined from the relationship between the feed intake and the Egg mass (kg kg^{-1}). Viability of birds, expressed in percentage, considered the mortality during the experimental period.

Egg quality measurements:

Twenty eggs were collected randomly from each treatment every four weeks (5 eggs/ replicate) in the last three days of each cycle, weighed individually to determine subsequent egg quality measurements; eggshell thickness with the shell membrane was measured in three locations on the egg (air cell, equator and sharp end) in micrometers. Eggshell weight albumen height, Haugh unit, and albumen height per egg weight value, was calculated using the method of (Eisen et al 1962). Yolk index was obtained by the ratio between height and diameter of the yolk (Nesheim, Austic, & Card, 1979).

Equation 1:

$$HU = 100*\log (H + 7.57 – 1.7 W^{0.37})$$

Where:

H = albumen height (mm) and W = egg weight (g).

A micrometer sensitive in 0.001 mm was used for measuring the eggshell thickness. Variables i.e. egg index (EI), Egg surface area (ESA) was expressed in cm2 using formula of Carter (1975), and egg shell weight per unit surface area (SWUSA) were investigated by following equations:

$$EI=W/L*100$$

$$ESA (cm2) =3.9782W^{0.7056}$$

$$SR=SW/EW*100$$

$$SWUSA (grcm^{-2}) =SWESA$$

Where: EI is egg index; W is egg width; L is egg length; EW is egg weight; ESA is egg surface area; SR is shell ratio; SWUSA is shell weight per unit surface area; and SW is shell weight.

Fertility and hatchability of eggs:

All eggs from each treatment were collected daily for 7 days (weeks 5 and 10 of treatment) and incubated at 37.6 °C with 60% relative humidity for 14 days. They were then transferred to hatching trays in the last 3 days of incubation and were maintained at 37.2 ° C and 75% relative humidity until hatch. After being hatched, chicks were counted; weighed and non-hatched eggs were broken to determine the percentages of fertility and hatchability.

Fertility% = (Number of fertile eggs / Number of set eggs) × 100. Hatchability%=(Number of hatched chicks/Number of fertile eggs) ×100.

Statistical analysis:

The data collected were analyzed by analysis of variance (ANOVA) using general linear model procedure (GLM) of SAS software (SAS institute, 2009). Percentage values were transformed using arcsine before statistical analysis. Significant differences between treatments means were determined using Duncan multiple range test (Duncan, 1955). The following model was used:

$$Y_{ijk} = M + T_i + R_j + E_{ijk}$$

Where;

Yijk = observation

M = overall mean

Ti = treatment effect, i (1 to 4)

Rj = replicate effect, j (1-4)

Eijk = random error

Table 1. Composition and calculated values of laying diet.

Ingredient	Control	Corn oil	Sunflower oil	waste frying oil
Yellow corn	58.8	58.8	58.8	58.8
Soya bean meal, 44%	23.4	23.4	23.4	23.4
Protein concentrate (1)	10	10	10	10
Oil	2.5	2.5	2.5	2.5
limestone	4.5	4.5	4.5	4.5
mono- cal- phosphate	0.8	0.8	0.8	0.8
		Calculated values, %²		
AME(kcal/kg)	2973.1	2973.1	2973.1	2973.1
Crude protein	19.97	19.97	19.97	19.97
Crude fiber	3.18	3.18	3.18	3.18
Ether extract	5.106	5.106	5.106	5.106
methionine %	0.53	0.53	0.53	0.53
Lysine %	1.10	1.10	1.10	1.10
Arginine %	1.06	1.06	1.06	1.06
sodium %	0.15	0.15	0.15	0.15
Price (LE/kg diet)	6.47	6.648	6.573	6.148

1-Protein concentrate provided per kg: 45% crude protein; 2615 ME / kg; 1.85% crude fat; 1.83% crude fiber, 5.84% calcium, 3.06% available phosphorus; and other nutrients (vitamins + minerals) meet with NRC (1994).
2-According to NRC (1994) except the AME values of the tested ingredients which were calculated according to Fisher (1982), Analyses of tested ingredients were carried out according to A.O.A.C (1990).

Results and Discussion

The effects of dietary supplementation with adding different types of Vegetable oil on egg traits are shown in Table 2. It was observed that have no significant effect on egg number, egg mass, egg laying rate, feed intake and FCR. As shown from Table 2 there were significant ($P<0.05$) increases in egg weight during experiment for birds treated with sunflower oil and waste oil as compared with corn oil. Bohnsack et al (2002) found that the increase in egg weight was significantly greater with the addition of corn oil when compared to the addition of poultry fat.

Regarding characteristics of egg quality of laying quails fed different type of oil, the results are presented in Table 3. There was no significant difference ($p > 0.05$) for yolk weight, yolk percentage, albumen percentage, eggshell percentage, shape index, yolk index, Haugh Unit (HU), shell thickness and SWUSA between the treatments. However, albumen weight, eggshell weight, and width of egg increase significantly ($P >0.05$) due to addition sunflower oil comparing the addition of corn oil, and increase significantly ($p > 0.05$) the shell strength and ESA comparing corn oil or control group.

It is shown from the data in table 4 that there were insignificant differences in fertility and hatchability rate between the experimental treatments However, body weight of chicks at hatch increased significantly ($p > 0.05$)) due to addition sunflower oil compared with other treats and increase significantly due to waste oil by compared with control treat or corn oil treat. Bozkurt et al 2008 found that the different fat sources did not influence performance or eggshell quality, but lipid profile of the egg yolk changed as a function of dietary fat sources. In general, the best changes, such as lower level of saturated fatty acids, higher levels of α-linolenic acid and DHA, and lower linoleic acid levels, were promoted by the addition of canola oil, but it did not promote enrichment of the eggs with polyunsaturated fatty acids.

The effects of dietary supplementation with different types of vegetable oils on body weight (initial body weight, final body weight, body weight gain, and change body weight) are shown in Table 5. It was observed that treatment the quail birds with different types of vegetable oils have no significant effect on body weight of these birds during the experiment period. The absence of a response to the dietary inclusion of oils on the body weight of quail ($P>0.05$) in this experiment confirmed the findings of Guclu et al. (2008) who found no significant differences for dietary oil sources on body weight of laying quail and Harms, and Russell 2004, Hazim et al. (2010) found no significant effect on type of oil supplement on the body weight of Japanese Quails.

Economic efficiency:

The economical efficiency of treatment's diets as affected by experimental diets is shown in Table (6). The results indicate that the waste frying oil diet achieved the best value (108.6%). The lowest value of relative economical efficiency (82.8%) was recorded for corn oil group. However, the next to waste frying oil relative economic of efficiency value (100%) was recorded for control group (2.5% commercial oil). It can therefore be concluded that replacement of commercial oil with waste frying oil has led to higher economical efficiency supplementation. However, addition of corn oil has led to lower economical efficiency.

Table 2. Production performance characteristics of Japanese quails fed diets containing different lipid sources. ($\bar{X}$ ± SE).

Parameters	Treatment			
	control	**Corn oil**	**Sun flower oil**	Reused oil
Egg weight (g)	**13.6±0.19ab**	**13.2±0.14b**	**13.8± 0.08a**	13.8±0.11a
Egg number (egg/h/wk)	**5.66±0.35**	**5.34±0.35**	**5.79±0.35**	5.29±0.35
Egg mass (g/h/day)	**11.0±0.89**	**10.1±0.51**	**11.4±0.41**	10.4±0.82
Egg laying rate (%)	**81.0± 6.09**	**76.3±4.12**	**82.7±2.95**	75.5±6.09
Feed intake (g/h/d)	**32.2± 0.94**	**30.7±0.83**	**30.4± 0.42**	30.5±0.03
FCR (g feed/ g egg)	**2.99± 0.25**	**3.06±0.09**	**2.67± 0.10**	2.99±0.23

1 NS not significant, * Significant at (P≤ 0.05), ** Significant at (P≤ 0.01)
2 a, b, c and d: means in the same row having different letters are significantly different at (P≤ 0.05)

Table3. Characteristics of egg quality of quails fed diets containing different lipid sources. ($\bar{X}$ ± SE).

Parameters	Treatment			
	control	**Corn oil**	**Sun flower oil**	**Reused oil**
Yolk weight (g)	4.15±0.08	4.19±0.08	4.31±0.07	4.26±0.07
Albumen weight (g)	7.87±0.13ab	7.71±0.10 b	8.17±0.09 a	8.09±0.11 a
eggshell weight (g)	1.13±0.02ab	1.10±0.02 b	1.17±0.02 a	1.12± 0.02 b
Yolk percentage (%)	31.7±0.32	32.2± 0.27	31.6±0.35	31.6±0.32
Albumen percentage (%)	59.7±0.36	59.4±0.28	59.9±0.31	60.1±0.33
Eggshell percentage (%)	8.67±0.104	8.49±0.14	8.55±0.09	8.35±0.13
Egg length (mm)	34.2±0.24	34.5±0.24	34.5±0.15	34.4±0.17
Egg width (mm)	26.44±0.12ab	26.21±0.11b	26.72±0.10a	26.58±0.14a
Shape index	77.4±0.52	76.2±0.419	77.5±0.39	77.3±0.40
Yolk index	43.558±0.73	43.286±0.71	42.63± 0.96	42.71±1.08
Haugh units shell	89.23±0.545	89.04±0.72	88.39±0.79	89.10±0.89
Shell strength (kg/cm2)	1.183±0.60b	1.156±0.55b	1.382±0.75a	1.315±0.76ab
thickness (10^{-2} mm)	23.14± 0.23	23.14±0.237	23.77±0.28	23.23±0.28
ESA	24.36±0.24b	24.35±0.23b	25.16±0.18a	24.83±0.22ab
SWUSA	46.35±0.49	45.31±0.668	46.42±0.51	45.02±0.64

1 NS not significant, * Significant at (P≤ 0.05), ** Significant at (P≤ 0.01)
2 a, b, c and d: means in the same row having different letters are significantly different at (P≤ 0.05)

Table 4. Fertility, hatchability and body weight at hatch of quails fed diets containing different lipid sources. ($\bar{X}$ ± SE).

Parameters	Treatment			
	control	**Corn oil**	**Sun flower oil**	**Reused oil**
Fertility (%)	94.336±1.76	86.769±3.548	89.16±4.25	87.089±3.24
Hatchability (%)	88.557±3.77	87.548±4.57	86.77±4.306	97.03±1.187
Body weight at	8.72±0.08c	8.769±0.08c	9.479±0.077a	9.125±0.106b

1 NS not significant, * Significant at (P≤ 0.05), ** Significant at (P≤ 0.01)
2 a, b, c and d: means in the same row having different letters are significantly different at (P≤ 0.05)

Table 5. Body weight of quails fed diets containing different lipid sources. ($\bar{X}$ ± SE).

Parameters	Treatment			
	control	**Corn oil**	**Sun flower oil**	**Reused oil**
Initial BW(g)	240.48±1.534	236.035±3.077	237.535±3.0019	238.91±2.001
Final BW (g)	279.24±2.7409	284.017±3.716	283.369±7.94	279.00±8.97
Body weight gain (g)	38.746±4.4268	47.98±2.449	45.83±5.211	40.089±10.341
Change BW %	16.14±1.986	20.34±1.1038	19.23±1.989	16.86±4.452

1 NS not significant, * Significant at (P≤ 0.05), ** Significant at (P≤ 0.01)
2 a, b, c and d: means in the same row having different letters are significantly different at (P≤ 0.05)

Table 6. input / output analysis and economical efficiency of Japanese quail fed the experimental diets.

Parameters	Treatment			
	control	Corn oil	Sun flower oil	Reused oil
Total feed intake/(hen+0.4 male)	3.16	3.00	2.98	2.99
Price /kg feed (LE)	6.47	6.65	6.57	6.15
Total feed cost / hen (LE)	20.45	19.97	19.56	18.38
Total chick production (chicks/hen)	47.34	40.57	44.81	44.68
Total price of chicks production	71.01	60.86	67.21	67.02
Net revenue/ hen (LE)	50.56	40.89	47.64	48.64
Economic efficiency EEF	2.47	2.048	2.44	2.65
Relative ee (100)	100	82.91	98.79	107.29

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تاثير اضافه انواع مختلفه من الزيوت النباتيه ومخلفات زيوت القلي علي الاداء الانتاجي والتناسلي للسمان الياباني

أجريت هذه الدراسة لتقييم تأثير إضافة أنواع مختلفة من الزيوت النباتية في تحسين أداء الإنتاجي والتناسلي للسمان الياباني. تم استخدام 112 طائر سمان ياباني عمر 6 أسابيع ووزعت بشكل عشوائي على أربعة معاملات كل معاملة 4 مكررات 7 طيور لكل مكررة (ذكرين و 5 إناث). قسمت الطير الي المعاملات التالية: المعاملة الأولي (مجموعة الكنترول 2.5 ٪ من الزيت التجاري (مزيج من زيت فول الصويا وزيت عباد الشمس وزيت بذرة القطن)) ، والثانية (2.5 ٪ زيت ذرة) ، والثالثة (2.5 ٪ زيت عباد الشمس) ، والرابعة (2.5 ٪ من مخلفات زيت القلي – قلي الأسماك – (الزيت التجاري)). تم قياس وزن الجسم و الزيادة في وزن الجسم و استهلاك العلف والكفاءة الغذائية و إنتاج البيض و وزن البيضة و كتلة البيض ونسبة الخصوبة ونسبة التفريخ و وزن الكتاكيت عند الفقس وجودة البيض وتقدير الكفاءة الاقتصادية لكامل الفترة التجريبية (10 أسابيع). ومن النتائج وجد انة لم يكن هناك تأثير كبير على عدد البيض و كتلة البيض و معدل وضع البيض و الغذاء المستهلك والكفاءة الغذائية ، باستثناء وزن البيض الذي كان أعلى بالنسبة للطيور التي غذيت على زيت عباد الشمس ومخلفات زيت القلي بالمقارنة بالمجموعة الثانية (زيت الذرة). لم يكن هناك تاثير معنوي (p> 0.05) لمصادر الدهون التي تم تقييمها بالنسبة لوزن الصفار اونسبة الصفار البيض اونسبة البياض اونسبة القشر او دليل شكل البيضة او دليل الصفار او وحدة هوف اوسمك القشرة ، و SWUSA بين المعاملات. ومع ذلك ، كان هناك زيادة معنوية في وزن البياض ووزن القشرة والمحور العرضي للبيضة نتيجة لإضافة زيت عباد الشمس بالمقارنة بإضافة زيت الذرة ، ويزيد بشكل كبير (p> 0.05) قوة القشرة و ESA مقارنة بمجموعة زيت الذرة أو مجموعة التحكم . كانت هناك فروق ذات دلالة إحصائية في معدل الخصوبة ونسبة الفقس بين المعالجات التجريبية. ومع ذلك ، فإن وزن جسم الكتاكيت عند الفتحة يزداد بشكل كبير (p> 0.05)) بسبب إضافة زيت عباد الشمس الذي يقارن بين المعالجات الأخرى ويزيد بشكل كبير نتيجة لزيت النفايات بمقارنة علاج التحكم وزيت الذرة علاج. وقد لوحظ أن معالجة طيور السمان بأنواع مختلفة من الزيوت النباتية ليس لها تأثير كبير على وزن هذه الطيور أثناء التجربة. أدى استبدال الزيت التجاري بزيت النفايات إلى زيادة الكفاءة الاقتصادية. ومع ذلك ، أدت إضافة زيت الذرة إلى انخفاض الكفاءة الاقتصادية.