RESEARCH ARTICLE

ARAŞTIRMA MAKALESİ

Effects of poppy seed oil supplementation in diets on egg production, egg quality and some blood parameters in laying hens ▸

İsmail BAYRAM#, İbrahim Sadi ÇETİNGÜL, Mehmet YARDIMCI, Emine Hesna ŞAHİN, Abdil Burhaneddin AKKAYA, Cangir UYARLAR

Key Words
Hen
Egg yield
Poppy seed oil
Blood

Anahtar Kelimeler
Tavuk
Yumurta verimi
Haşhaş tohumu yağı
Kan

Department of Animal Nutrition and Zootechny
Faculty of Veterinary Medicine
Afyon Kocatepe University
03200 - Afyonkarahisar
TURKEY

*** Corresponding author**
Tel:+902722281312-168
Fax:+902722281349
Email:ibayram1965@yahoo.com

▸ A part of this study was presented at the 1st Mediterranean Summit of WPSA, Thessaloniki, Greece 2008

S U M M A R Y

Poppy has been one of the most important medicinal plant in humans until now. It and its products can not be manufactured synthetically. This study was conducted to determine the effects of poppy seed oil (PSO) supplementation in diets on egg production, feed intake, feed conversion ratio (FCR), egg quality (shape index, shell tickness, yolk index, albumine index, haugh units and yolk color), egg cholesterol levels and some blood parameters (cholesterol, trigliseride, HDL and LDL cholesterol) in laying hens. The experimental groups were divided as control (no supplementation) and five treatments groups (supplemented with 0.5,1.0,1.5, 2.0 and 2.5 % PSO). A total of 240 laying hens at 35 weeks age were used as the study material. The experiment was performed within 8 weeks. The poppy seed oil addition up to 2.5 % did not cause any detrimental effect of egg production. Feed consumption didn't differ amoung the groups (P>0.05). Egg shell thickness and blood HDL values were affected significantly by PSO supplementation. It was concluded that PSO did not negatively affect egg production and egg quality. Moreover feed conversion ratio values were affected positively by PSO supplementation to the diets. Thus, PSO could be used and up to 2.5 % in the layer hen diets.

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Yumurta Tavuğu Rasyonlarına İlave Edilen Haşhaş Tohumu Yağının Yumurta Verimi, Kalitesi İle Bazı Kan Parametreleri Üzerine Etkisi

Ö Z E T

Haşhaş bitkisi ve ondan elde edilen yan ürünleri, sentetik olarak üretilemediğinden dolayı, insanlık için hala en önemli bitkidir. Bu araştırma, yumurta tavuğu rasyonlarına ilave edilen haşhaş tohumu yağının (HTY) yumurta verimi (YV), yem tüketimi, yemden yararlanma oranı (YYO), yumurta kalitesi parametreleri (şekil indeksi, kabuk kalınlığı, sarı indeksi, ak indeksi, sarı rengi ve haugh birimi), yumurta kolesterol seviyesi ile bazı kan parametreleri (kolesterol, trigliserit, HDL ve LDL) üzerine etkilerini belirlemek amacıyla gerçekleştirilmiştir. Araştırmada HTY ilave edilmeyen bir kontrol ve % 0.5, 1.0, 1.5, 2.0 ve 2.5 oranlarında HTY ilave edilen 5 adet deneme grubu oluşturulmuştur. Araştırma 8 hafta sürdürülmüştür. Rasyonlara HTY katılması ile yumurta verimi olumsuz etkilenmemiştir. HTY yumurta kabuk kalınlığı ve kan HDL değerlerini artırmıştır. Sonuç olarak, YV ve kalitesine negatif etkileri olmaması ve YYO'nı olumlu yönde etkilemesinden dolayı HTY'nın yumurta tavuğu rasyonlarında % 2.5 düzeyine kadar kullanılabileceği kanaatine varılmıştır.

INTRODUCTION

Poppy is a culture plant cultivated for centuries. The origin of the poppy cultivation is not clearly known. It is thought that Turks had concerned with poppy seed cultivation in the Middle East, their former homeland and disseminated this culture to other land by the migrations. The utilized parts of the plant are; poppy which is obtained from the scratched raw fruits, dried raw fruits, leaves, seeds, oil which is obtained from the seed and pulp obtained after the extraction of the oil.[1] In the capsule of poppy, there are over than 20 alkaloids such as morphine, codeine, naskapin, papaverin and tebain which change according to harvesting time.[2] As a result of poppy (which includes morphine and codeine) consumption, these alkaloids can be seen in blood.[3] Poppy seed involve 4.3-5.2% moisture, 22.3-24.4% crude protein, 46.5-49.1% ether extract, 11.7-14.3% nitrogen free extract, 4.8-5.8% crude cellulose, 1.03-1.45% calcium, 0.79-0.89% phosphorous, 8.5-11.1 mg/100 g iron, 740-1.181 μg/100 g thiamin, 765-1.203 μg/100 riboflavin and 800-1.280 μg/100 nicotinic acid.[4] In addition, it consists 6 μg/kg iodine, 29 mg/kg manganese, 22.9 mg/kg copper, 15.6 g/kg magnesium, 0.3 g/kg sodium, 5.25 g/kg potassium, 130 mg/kg zinc as micro mineral.[5] Moreover, there exists 2.80% lecithin, 1.62% oxalic acid, 3-3.6% pentose and narcotine, amorphous alkaloid, enzyme diastase, emulsyn and lipase, nuclease.[1] In a study aiming to determine the oil content and fatty acid composition of poppy seeds having different colors,[6] the oil content percentage was found to be between 48.48-53.37% and fatty acid values were determined as 70.94-73.15% linoleic acid, 13.56-14.61% oleic acid, 10.68-12.15% palmitic acid, % 1.13-1.97 stearic acid and 0.29-0.70% α-linolenic acid. Bayram and Akıncı[7] supplemented poppy seed meal (PSM) to the diets of layer quails up to 25% and found that egg yield, FCR and internal egg quality properties weren't affected negatively. In addition, no change was determined in glucose, urea, cholesterol, Aspartat amino transferase (AST), Alanin amino transferase (ALT), Lactat dehydrogenase (LDH) values in blood serum, therefore they concluded that PSM could be used up to 25% in laying quail diets. Bayram *et al.*[8] stated that supplementation of PSM up to 25% to layer hen diet caused decrease in egg yield, egg quality and negatively affected liver. On the other hand, supplementation up to 20% could be used confidently due to no adverse effect.

The objective of this study was to determine the effects of supplementation of 2.5% poppy seed oil in layer hen diet on egg yield, FCR, egg internal quality traits, egg cholesterol level and some blood parameters.

MATERIALS and METHODS

A total of 240 layer hens (Hy-Line/ Brown) of 35 week age were used in this study. The experiment was carried out on 6 groups (5 treatment and 1 control group) of each consisting 40 hens. Diet composition is shown in Table 1. The birds were allocated in cages of each consisting 5 hens in a poultry house. In addition, 4 repetition sub-groups of each group were constituted. The experiment was conducted under hot season from may to june without using any cooling systems. Feed was provided ad libitum in the feeders. Light was supplied for 16 hours/day throughout the experiment.

Table 1. Experimental diets kg/ton (in natural form)
Çizelge 1. Deneme rasyonları kg/ton (Doğal halde)

	EXPERIMENTAL GROUPS					
	Control	1	2	3	4	5
Feedstuffs						
Corn	555.86	560.99	566.15	570.74	575.69	562.79
Soybean meal	141.78	139.75	162.43	184.41	207.22	186.06
Full fat soya	115.06	109.10	76.42	44.61	12.37	2.43
Sunflower meal	75.04	73.76	72.48	72.53	71.82	110.93
Poppy seed oil	-	5.00	10.00	15.00	20.00	25.00
Limestone	88.26	88.32	88.38	88.44	88.50	88.74
DCP*	13.82	13.89	13.95	14.00	14.06	13.43
Salt	2.56	2.54	2.52	2.51	2.49	2.51
Vitamin**	2.50	2.50	2.50	2.50	2.50	2.50
Mineral***	1.00	1.00	1.00	1.00	1.00	1.00
DL-Methionine	1.12	1.15	1.17	1.19	1.21	1.10
$NaHCO_3$	2.00	2.00	2.00	2.00	2.00	2.00
Toxin binding	1.00	1.00	1.00	1.00	1.00	1.00
Calculated Analyses						
Crude protein, %	17.50	17.50	17.50	17.50	17.50	17.50
Metabolisable energy, kcal/kg	2825	2825	2825	2825	2825	2825
Calcium,%	3.75	3.75	3.75	3.75	3.75	3.75
Phosphorus,%	0.653	0.656	0.647	0.645	0.642	0.653

*: DCP, Dicalcium Phosphate

**Provided by per kg of diet: Vitamin A, 10 000 IU; vitamin D3, 1 000 IU; vitamin E, 25 mg; vitamin K3, 3 mg; vitamin B1, 2 mg; vitamin B2, 6 mg; niacin 20 mg; vitamin B6, 4 mg; vitamin B12, 15 mg, folic acid, 0.8 mg; choline chloride,

***Provided by per kg of diet: 300 mg; Mn, 80 mg; Fe, 60 mg; Zn, 60 mg; Cu, 5 mg, I, 1 mg; Co, 0.2 mg; Se.

Determination of egg yield and quality

Egg production was recorded each day at the same time. The eggs were weighed once a week with an electronic scale with a sensitivity of ±0.01 gr and recorded. Egg quality traits were measured by taking 24 eggs from each group at 4th weeks and 8th weeks of experiment. Egg shape index was measured by an instrument designed by Rausch.[9] Albumen height (HA) was measured by a tripod micrometer (Mitutoyo, 0.01 mm, Japan), albumen length (L) and width (WA) by a compass (Swordfish, 0.02 mm, China) and then the albumen index was calculated with the following formula;

[Albumen index = HA / {(L+ WA)}x100].

Yolk height (HY) was measured by tripod micrometer (Mitutoyo, 0.01 mm, Japan) and yolk diameter (D) by a compass (Swordfish, 0.02 mm, China), then the yolk index was calculated by the formula;

[Yolk index=(HY /D)x100].

Haugh unit was calculated with following formula;

$[Haugh\ unit = 100.logHA+7.57-1.7\ WE^{0.37}]$

where the HA is albumen height and WE is egg weight.[10] The values of egg yolk colour were measured by a colour scala.[11] A micrometer was used to determine shell thickness. Shell lining was removed from samples obtained from the tapered, thick and middle parts of a broken egg; they were measured and an average obtained.[10] Regarding the blood parameters, 24 samples from each group were taken at the middle and end of the study and the serum was obtained.

The serum parameters such as cholesterol, triglyceride, high density lipoprotein (HDL) and low density lipoprotein (LDL) were determined using commercial kits (Sigma) by ELISA device. Egg cholesterol level was determined according to the method notified by Uyanık *et al.*[12] Variance analysis among the groups was used for statistical purposes, Duncan test was applied to determine priorities.[13]

RESULTS

There were statistical difference among the groups in terms of egg production, a decrease was seen in the experimental groups 1 and 2 related to 0.5 % and 1.0 % poppy seed oil consumption ($P<0.01$) (Table 2). Oil supplementation to diets at 2.0% and 2.5% levels caused a decrease in FCR, compared to other groups ($P < 0.05$). Moreover, there were statistical differences in terms of egg shell thickness and HDL values (Tables 3 and 4).

Table 2. Mean performance data of the experimental groups
Çizelge 2. Deneme gruplarının ortalama performans değerleri

	EXPERIMENTAL GROUPS							
	Control	1 (0.5 % PSO)	2 (1.0% PSO)	3 (1.5 % PSO)	4 (2.0 % PSO)	5 (2.5 % PSO)	SEM	P
Egg production, (%)	90.1[a]	87.1[b]	87.4[b]	89.5[a]	91.2[a]	90.6[a]	0.68	**
Egg weights, (g)	65.5	65.4	65.5	66.5	65.2	65.7	0.40	NS
FC, (g/day)	105.7	101.4	107.0	107.1	104.1	104.6	2.24	NS
FCR, (kg feed/kg egg)	1.79[a]	1.80[a]	1.81[a]	1.80[a]	1.75[b]	1.75[b]	0.01	*

Means within a row sharing a common supercript are significantly different, * : P<0.05, ** : P<0.01

FC: Feed Consumption, FCR: Feed Convertion Ratio, NS: Non significant,

Table 3. Mean Egg quality values of the experimental groups
Çizelge 3. Deneme gruplarının ortalama yumurta kalite değerleri

	EXPERIMENTAL GROUPS							
	Control	1 (0.5 % PSO)	2 (1.0% PSO)	3 (1.5 % PSO)	4 (2.0 % PSO)	5 (2.5 % PSO)	SEM	P
Yolk index	43.42	44.01	43.77	43.94	42.48	42.48	0.27	NS
Albumen index	8.42	8.53	7.78	8.56	9.12	9.18	0.18	NS
Shape index	77.21	76.63	76.74	77.73	76.92	77.18	0.24	NS
Haugh units	82.81	83.57	80.52	83.99	85.94	87.07	0.77	NS
Yolk color	8.78	8.66	8.50	8.71	8.15	8.56	0.20	NS
ST#Mmx10^{-2}	35.79[b]	35.41[b]	36.64[ab]	36.58[ab]	35.93[bc]	37.33[a]	0.16	**

Means within a row sharing a common supercript are significantly different,
**: P<0.01, #: ST, Shell thickness, NS: Non significant

Table 4. Some blood parameters and egg cholesterol levels of the experimental groups
Çizelge 4.Deneme gruplarının bazı kan parametre ve yumurta kolesterol değerleri

	EXPERIMENTAL GROUPS							
	Control	1 (0.5 % PSO)	2 (1.0% PSO)	3 (1.5 % PSO)	4 (2.0 % PSO)	5 (2.5 % PSO)	SEM	P
Blood Kolesterol (mg/dl)	88.02	80.42	83.59	85.90	83.85	75.42	5.91	NS
Trigliseride (mg/dl)	605.42	498.67	547.06	536.40	558.88	562.96	19.17	NS
HDL (mg/dl)	8.36b	9.57ab	10.95ab	12.21a	12.66a	14.70a	0.75	*
LDL (mg/dl)	67.81	62.56	62.77	63.68	70.99	70.95	2.47	NS
Egg cholesterol (mg/g)	305.37	244.35	246.14	297.02	242.15	274.37	28.53	NS

Means within a row sharing a common supercript are significantly different, *: P<0.05, NS: Non significant

DISCUSSION

Supplementation of PSO up to 2.5% in the laying hen diets didn't any detrimental effect (except 0.5 % and 1 % levels) in terms of egg production. The results on Mexican poppy seed supplementation to chicken diet stated by Norton and O'Rourke[14] confirmed the results of the study conducted by Pahwa and Catterje[15] on rats. On the other hand, the PSO results, confirmed the results obtained by Midilli *et al.*[16] in which they supplemented PSO at 3% level to the diet of layer quails and determined no adverse effect on egg yield.

The results regarding feed consumption are shown in Table 2. Considering average feed consumption values of the whole study, no significant difference was seen among the groups. This study is confirmed by Midilli *et al.*[16] who declared that PSO didn't make any change in feed consumption in laying quail. Bayram *et al.*[8] reported that feed consumption increased parallel to the increase in the concentration of PSM in layer hen diets and they explained this situation by the high crude cellulose content of PSM. Balevi and Coskun[17] stated that no significant difference occurred in feed consumption of layer hens after supplementing different oils into the diet. In our study, feed convertion ratio (FCR) values were different among the groups. Considering the average values of the data of the whole study, the best results were obtained in 2% and 2.5% poppy oil supplemented groups (group 4 and 5) while the worst results were obtained in other groups. Utilization of PSO at 0.5 and 1.0 % levels in diets not only caused a decrease in egg yield but also result in an increase in feed consumption. These results were different from the findings on layer quails stated by Bayram and Akıncı.[7] This could be due to the utilization of PSM.

The egg weights did not differ among the groups during the whole study (Table 2). This result also confirmed the findings of Bayram and Akıncı[7] and Midilli *et al.*[16] in which they observed no change in egg weights of the layer quail fed by PSM and PSO. In another study, Bayram *et al.*[8] supplemented PSM into the diet of layer hens and found differences in egg weights. They concluded that the group having higher live weights also produced heavier eggs.

The differences between groups weren't significant in terms of egg quality parameters such as shape index, yolk index, albumin index, haugh unit and yolk color (Table 3). Egg shell values were seen thinner in control and trial groups ($P < 0.01$). Contrary to this, group 5 (2.5% poppy oil supplemented group) showed the highest value. This could be due to the improvement in egg shell quality by supplementing PSO into diet where the birds were kept inside a house without having a cooling fan under hot conditions. Thus, Akıncı and Bayram[18] determined that egg shell got thinner after PSM supplementation to diets in layer hens. The researchers thought that the phytat content of poppy seed meal deteriorated the absorbtion calcium and phosphorous and therefore the shell quality got worst. Also, Eklund and Sjöblom[19] demonstrated that PSM contains 3.9 g/100g phytat. There was no difference in haugh unit values among the groups. Al Bustany[20] reported that lysine level of diet was effective on haugh unit value. That is, higher haugh unit value occurred in case of lower lysine content of diet. This could be due to the balanced levels of diets in terms of lysine content. It could also be said that PSO supplementation didn't make any change on this situation. In another study

conducted by Bayram *et al.*,[8] some decrease was observed in haugh unit value by the increase of PSM in diet. They concluded that the increase of PSM level in diet affected lysine levels negatively and caused decrease in haugh unit. Eklund and Sjöblom[19] reported that lysine content of PSM was lower than that of soybean meal. Although statistical difference was determined among the groups in terms of blood cholesterol, triglyceride, and LDL values related to PSO supplementation to diets (Table 4), a decrease was seen in the serum triglyceride and cholesterol levels. These results confirmed the findings of Bayram *et al.*[8] in which they stated that blood cholesterol level decreased by supplementation of PSM into diets. Utilization of PSM which has 20% oil content decreased the blood cholesterol level. In a study on the diabetic patients who didn't need insulin, blood triglyceride, cholesterol and insulin levels decreased at the end of 10 days in the groups those consumed high oil content diets enriched by linoleic acid. Moreover, it was emphasized that PSO contained high levels of linoleic acid. Similarly Çetingül[21] supplemented hazelnut oil which was rich from oleic acid up to 3% into layer hen diets and determined that egg cholesterol level decreased while oleic acid level increased. HDL levels of the experimental groups were significantly higher than that of the control group. High levels linoleic acid in PSO lead to higher HDL levels in the hen blood sera. Anderson[22] stated that the consumed feed with high linoleic acid content caused higher HDL levels in blood sera.

In conclusion, egg yield was considered as the most important indicator in the commercial laying hen production. Since no adverse effect on egg yield and quality was seen, poppy oil could be supplemented in layer hen diets up to 2.5% due to its positive effects on egg shell thickness.

ACKNOWLEDGEMENTS

The authors thank Osman İşlek for his support in providing the study material as well as allowing us to use the poultry houses of the company. The project was supported by the Scientific Research Committee (Project No: AKU 051.VF.01) of Afyon Kocatepe University, TURKEY.

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