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Effect of Different Levels of Palm Olein Oil in Laying Hen's Performance and Yolk Cholesterol

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Abstract: Ninety-six 26-week-old white leghorn layers (w-36) were fed commercial diets containing 0, 1.5, 3, 4.5% Palm Olein Oil (PO) and the diets were iso-caloric and iso-nitrogenous. Hens randomly assigned to 4 treatment diets, with 3 replicates and 8 layers in each replicate. The experiment was conducted over a period of 12 week in order to study the effects of feeding palm olein oil on hen performance (egg production, egg weight, egg mass, feed intake, feed conversion ratio (FCR) and weight gain) and egg quality parameters (Hough unit score, yolk colour index, yolk index, egg shape, shell weight, shell thickness and density). The yolk of eggs extracted and cholesterol content were determined in each period. Blood samples were collected in non-heparin zed tubes from 6 hens in each treatment by puncturing the bronchial vein at end of experiment and serum was collected after 8-10 h as per standard procedures and was stored for subsequent analysis. Hen performance (egg production, egg weight, egg mass, feed intake and FCR) and egg quality parameters (Haugh unit score, yolk colour index, yolk index, egg shape, shell weight, shell thickness and density) were not significantly ($p>0.05$) different among treatments except in body weight. The highest and lowest gain body weight was observed on 10% (170 g) and 0% (90 g) PO treatment, respectively ($p<0.05$). The yolk and blood cholesterol content were increased in 4.5% palm olein oil and the different among palm olein oil levels and control were statistically significant ($p<0.05$).

Key words: Palm olein oil, cholesterol, egg quality, layer, egg production

Introduction

The palm grows well in wet, humid parts of tropical Asia (mainly South-east Asia), Africa and Central and South America Palm oil is a greatest oils the entire world. The palm oil has a greatest saturated fatty acid. Crude palm oil (CPO) is dark orange in coloration due to the presence of various carotenoids and is bleached during the refining process to produce refined, bleached, deodorized palm olein. Palm fatty acid distillate (PFAD) is a by-product from the physical refining of CPO and contains mainly free fatty acids. Vitamin E tends to concentrate in the PFAD fraction during the refining process. The various products of CPO refining had been previously described (Ng *et al*., 2003).

The palm kernel oil has effect on fatty liver kidney syndrome (FLKS) in chicken ($p<0.05$) when 2% was added in diet chicken. They reported a lower amount of biotin (120 mcg kg^{-1} feed) was needed in case of palm kernel oil supplement as compared with the necessary biotin (160 mcg kg^{-1} feed)-in order to prevent FLKS mortality when palm kernel oil was not contained in the rations. The biochemical analysis of the liver and kidney syndrome-coupled with the correlation and regression analysis of the data collected showed that a minimum of 120 mcg kg^{-1} feed was needed by broiler chicks for the prevention of FLKS (Oloyo and Ogunmodede, 1989). Punita and Chaturvedi (2000) reported that when they added the red palm oil with laying hen diets, they observed maximum reduction of egg cholesterol. At recently studies were reported so that using of palm olein in laying hen diets caused reduction the total cholesterol of egg (Hodzic *et al*., 2008). Other researchers was showed that after 3 weeks heat stress when laying hens fed palm oils the total leukocyte count decreased as compared flaxseed and commercial diets but heterophils was increased as compared other groups (El-Sebaie *et al*., 2008).

The main aim of this study was to determine the best level of palm olein oil on production performance (gain body weight, egg production, egg weight, egg mass, FCR and feed intake), egg quality (Haugh unit, yolk index, yolk colour index, shell thickness and specific gravity), egg cholesterol and blood factors of laying hens of Leghorn W36.

Materials and Methods

Animals and diets: Ninety-six White Leghorn "w-36" laying hens at 26 week old were housed in laying cages maintained in an environmentally controlled house at the Behparvar Animal Farm plant. The birds were fed a standard layer diet (16% CP; 2820 kcal ME kg^{-1} diet). The birds were randomly assigned (24 hens per treatment) to 4 experimental diets (0, 1.5, 3 and 4.5 palm olein oil). The ingredient and nutrient composition of the basal and experimental diets (based on AOAC, 1990) is shown in Table 1.

The hens were fed the experimental diets from 26-40 weeks of age for three periods of each 28 days and the

Table 1: Percent ingredients and nutrient compositions of experimental diets

	Composition			
Ingredients (%)	PO 0 (%)	PO 1.5 (%)	PO 3 (%)	PO4.5 (%)
Corn (%)	66.43	51.38	44.37	40.54
Soybean meal (%)	20.10	19.55	19.63	20.43
Wheat %	1	15.67	20	20
Palm Olein (PO) (%)	0	1.5	3	4.5
Limestone	8.5	8.5	8.48	8.49
Fish meal (%)	2	2	2	2
Mineral premix	0.25	0.25	0.25	0.25
Vitamin premix	0.25	0.25	0.25	0.25
DL-Methionine	0.07	0.08	0.08	0.08
Lysine	0.07	0.07	0.09	0.11
Sodium chloride	0.31	0.32	0.34	0.35
Calculated analysis				
Metabolizable Energy, Mcal kg^{-1}		2.820		
Protein (%)		16.10		
Lysine (%)		0.84		
Methionin (%)		0.36		
Met + Cys		0.66		
Nonphytate phosphorous (%)		0.39		
Calcium (%)		3.70		
Sodium (%)		0.17		

*Each Kilogram contains Vit. A (8800000 IU), Vit.B1 (1.477 g), Vit.B2 (4 g), Vit.B3 (7.84 g), Vit.B6 (2.46 g), Vit. B12 (0.01g). Vit.D3(2500000 IU),Vit.E(11000 IU), Vit. K3 (220 g), Folacin (0.25 g) and Biotin (0.15 g). *Each Kilogram contains Manganese Oxide (74.4 g), Ferric Oxide (75 g) Zinc Oxide (64.675), Cupper Sulphate (6 g), Selenium Pre Mix (0.2 g), Calcium Iodate (0.32 g) and Choline Chloride (200 g)

first 2 weeks were for adjustment. Hens were maintained on 16:8 h light: dark cycle and all the diets were iso-caloric and iso-nitrogeneous according to NRC (1994). Feed and Water was supplied ad libitum.

Egg production and egg quality measurements: Performance data were collected during the 12 weeks experimental period. Egg production was recorded daily, while feed consumption, egg weight, egg mass and feed conversion ratio (FCR) were recorded every week and weight gain, antibody titter against Newcastle Disease (ND) and Infectious Bursal Disease (IBD) were recorded at the end of experimental period. Egg quality parameters viz. Haugh unit score, yolk colour index (as measured by Roche yolk colour fan), yolk index, egg shape, shell weight, shell thickness and specific gravity were measured on three eggs from each replicate for 3 consecutive days in every period. The yolk of eggs was extracted and cholesterol content was determined once every 28 days. Blood samples were collected in non-heparinsed tubes from six hens in each treatment by puncturing the brachial vein at the end of experiment and serum was collected after 8-10 h as per standard procedures and stored for subsequent analysis. Individual serum samples were analyzed for antibody responses against IBDV and ND. The IBDV titter were determined by ELISA technique using commercial kits[1] and the plates were read at 405nm on an ELISA reader and ND determined by HI technique.

Statistical analysis: All data were analyzed as a completely randomized design (repeated measurement) by using the general linear models (GLM) procedure of ®SAS software (SAS Institute Inc., 1991). Duncan's multiple Ranges test was employed to compare different means at $p<0.05$ (Duncan, 1955).

$$Y_{ij} = \mu_{ij} + \alpha_i + w_j + \alpha_i w_j + e_{ij}$$

μ_{ij} : The means of each traits,
α_i : Effect of each treatment,
w_j : Effect of period or week,
$\alpha_i w_j$: Effect of interaction period with treatment
e_{ij} : Effect of excremental error.

Results and Discussion

There were not significant differences in overall average on egg production among the 4 dietary treatments for 3 periods (28 days each period) and means of 3 periods (Table 2) ($p>0.05$). The effect of palm olein oil on egg weight and egg mass was not significantly different and the data was represented on Table 3. The 4.5% PO showed the lowest value (50.87) and non significant with other treatments ($p>0.05$). This reduction of egg mass is due to lower egg production and egg weight in 4.5% PO (Table 3).

The feed intake were not affected with treatments because all diets have the same energy and protein ($p>0.05$, Table 4). FCR is very important parameters for showing the efficiency of production; the highest of this parameter was observed in 4.5 % PO (Table 4) and it is not good because increasing this parameter caused increased the cost of production. This effect may be due

Table 2: Effect of dietary Palm olein oil on egg production (%)

PO levels (%)	PO 0 (%)	PO 1.5 (%)	PO 3 (%)	PO 4.5 (%)	SEM
First period	91.52	92.71	92.27	90.92	1.885
Second period	92.11	91.97	91.85	91.22	2.05
Third period	89.69	89.58	90.03	88.89	1.95
Mean of period	91.11	91.42	91.38	90.34	1.86

Means in row with common superscript do not do not differ significantly ($p<0.05$)

Table 3: Effect of dietary Palm olein oil on egg mass and egg weight (g)

PO	Egg Weight				Egg Mass			
levels (%)	First period	Second period	Third period	Mean period	First period	Second period	Third period	Mean period
0	54.84	58.11	60.23	57.73	50.24	52.77	53.40	51.81
1.5	54.85	58.07	58.45	57.70	50.31	52.85	52.90	52.02
3	53.81	56.48	59.13	56.19	49.65	51.78	51.27	50.91
4.5	53.76	56.22	58.41	55.91	48.82	51.32	52.59	50.87
SEM	0.51	0.59	0.57	0.67	1.02	0.98	1.04	0.87

Means in column with common superscript do not do not differ significantly ($p<0.05$)

Table 4: Effect of dietary Palm olein oil on feed intake and FCR

PO	Feed Intake				FCR			
levels (%)	First period	Second period	Third period	Mean period	First period	Second period	Third period	Mean period
0	86.58	92.81	98.05	93.51	1.72	1.73	1.83	1.75
1.5	87.42	95.34	99.45	93.67	1.79	1.81	1.88	1.82
3	90.60	94.89	100.13	94.79	1.79	1.87	1.89	1.86
4.5	92.32	94.50	99.41	94.91	1.86	1.91	1.93	1.90
SEM	2.61	2.59	2.11	2.32	0.063	0.056	0.066	0.062

Means in column with common superscript do not do not differ significantly ($p<0.05$)

to higher oil in PO diet and caused increased the FLKS in laying hens and resulted reduction of releasing eggs. The gain body weight in laying hens is bad effect but these parameters were increasing with increased levels of PO and the highest of gain body weight was observed in 4.5% PO (170 g) and this increase was statistically significant ($p<0.05$). When body weight increased, the egg production was reduced due to this gain body weight is bad.

The data on egg quality parameters in 3 periods are shown in Table 5-7. Egg quality parameters (egg shape, yolk colour index, yolk index, shell thickness and the percent of yolk weight per egg) were not affected significantly by PO levels in all periods except yolk colour index that increasing with corresponding increased PO in diets ($p<0.05$). The PO has much carotenoids and due to increasing the yellow of yolk and these finding was agreement with Ng *et al*. (2003) that reported the palm oil has much carotenoid and has effect on yolk colour. The colour of egg is an important trait for selecting eggs for some country such as Iran and U.S.A. and at this country is important for economical and increasing sell of eggs. The specific gravity of eggs is a main trait that showed the quality of shell, when the thickness of shell is weak, the specific gravity was low but with increasing the shell quality, the specific gravity was increased (Table 5-7). It is not vary in treatments ($p>0.05$). As the higher oil in PO due to increased saponification with minerals such as calcium, phosphorous, magnesium and potassium and decreased absorption of Ca and P in intestine. The Ca and P has a main role in forming shell egg and bone, therefore; the reduction of minerals caused reduce shell thickness of egg and reducing specific gravity.

The percent of yolk weight per egg were not affected with different levels of PO in three periods. But Wang 1996 reported that increasing the percent of albumen weight per egg with used 8% safflower oil (Table 5-7) but we did not research about using of PO in diet and changed of percentage of yolk per egg weight.

The data of egg and yolk cholesterol were increased with corresponding increased of PO in diet ($p<0.05$) (Table 8). The PO has much saturated fatty acid and palm olein has much oleic acid. The palm olein oil has much monounsaturated fatty acid and this resulted reducing excreted of cholesterol, more cholesterologeneze and absorption of cholesterol in intestine, due to increasing of reserving cholesterol in blood and egg (Weis and Scott, 1979; Bartove *et al.*, 1971). Some scientists believed the egg and yolk cholesterol has a bad effect on heart and CHD (Harris, 1997). Some methods for reducing the egg and blood cholesterol are involved the omega-3 fatty acids, fiber, chemicals drug and other additive such as garlic and Cu

Table 5: Effect of dietary Palm olein oil on egg quality (period 1; 28-32)

PO levels (%)	Haugh unit (%)	Egg shape (%)	Yolk index (%)	Yolk colour Index	Specific Gravity (g cm^{-3})	Shell thickness (mm)	% of yolk per egg
0	62.60	77.35	39.15	5.87^{b}	1.0850	35.11	25.59
1.5	61.98	77.03	40.05	6.02^{ab}	1.0843	35.23	25.45
3	61.74	76.62	40.83	6.33^{a}	1.0841	34.25	24.86
4.5	61.71	76.21	41.28	6.41^{a}	1.0840	34.01	24.65
SEM	0.74	0.71	1.33	0.35	0.0009	0.86	0.57

Means in column with common superscript do not do not differ significantly ($p<0.05$)

Table 6: Effect of dietary Palm olein oil on egg quality (period 2; 32-36)

PO levels (%)	Haugh unit (%)	Egg shape (%)	Yolk index (%)	Yolk colour Index	Specific Gravity (g cm^{-3})	Shell thickness (mm)	% of yolk per egg
0	60.64	77.15	39.95	6.01^{b}	1.0853	35.12	27.38
1.5	60.86	76.89	40.45	6.27^{ab}	1.0847	35.00	27.15
3	61.86	76.77	41.13	6.53^{a}	1.0842	34.62	26.86
4.5	61.95	75.65	41.88	6.78^{a}	1.0837	33.51	26.62
SEM	0.61	0.69	0.92	0.32	0.00081	0.82	0.59

Means in column with common superscript do not do not differ significantly ($p<0.05$)

Table 7: Effect of dietary Palm olein oil on egg quality (period 3; 36-40)

PO levels (%)	Haugh unit (%)	Egg shape (%)	Yolk index (%)	Yolk colour Index	Specific Gravity (g cm^{-3})	Shell thickness (mm)	% of yolk per egg
0	60.58	73.87	40.05	5.04^{b}	1.082	35.73	26.62
1.5	60.52	72.34	41.45	5.17^{b}	1.0816	35.81	26.41
3	61.95	71.89	43.13	5.67^{ab}	1.0802	34.46	25.41
4.5	62.54	71.50	44.76	5.92^{a}	1.0783	33.16	24.21
SEM	0.55	0.77	2.77	0.26	0.0013	0.87	0.62

Means in column with common superscript do not do not differ significantly ($p<0.05$)

Table 8: Effect of dietary Palm olein oil on egg quality(period 2; 32-36)

PO levels (%)	Egg cholesterol (mg egg^{-1})	Yolk cholesterol (mg g^{-1})	Blood cholesterol (mg dL^{-1})	ND titter	IBD titter	Gain body weight (g)
0	200.81^{b}	12.55^{b}	143.00^{b}	8.67	6812	90.00^{c}
1.5	216.86^{ab}	13.55^{ab}	157.67^{ab}	8.33	6075	98.00^{bc}
3	219.26^{a}	13.65^{a}	161.00^{a}	8.33	5590	118.00^{b}
4.5	222.11^{a}	13.87^{a}	162.33^{a}	8.67	5520	170.00^{a}
SEM	6.61	0.785	9.96	0.67	742.78	19.56

Means in column with common superscript do not do not differ significantly ($p<0.05$)

in diet but the saturated fatty acids was resulted high cholesterol in egg and blood, these results were agreement with my findings(Cherian *et al*., 1996; Weis and Scost, 1979). Hodzic *et al*. (2008) was reported adding of palm olein oil to diet decreased the egg and yolk cholesterol that this result was disagreement with our findings.

The blood cholesterol did not significantly different within control and different levels of PO, but the minimum and maximum numerically blood cholesterol observed in control and 4.5% PO treatments, respectively and the different among treatments were statistically significant ($p<0.05$).

Effect of dietary antibody against ND, IBD and are represented in Table 8. There was not significant differences in case of ND titter and IBD titter with feeding all levels palm olein oil (PO).

Conclusion: The using of different levels of palm olein oil did not effect on performance and production parameters and

egg quality except yolk colour index and gain body weight. The ND and IBD titter; egg and yolk cholesterol and blood cholesterol did not vary. The yolk and blood cholesterol was increased significantly ($p<0.05$)

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[1]-kits