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Effects of Different Levels of Processed Fat and Vitamin E on Laying Hens Performance and Egg Yolk Cholesterol

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Abstract: An experiment was conducted to evaluate the effects of different levels of Calcium Soap Unsaturated Fatty Acids (CSUFA), with supplemental α-tocopheryl acetate (α-Toc) on laying hen's performance and egg yolk cholesterol. Ninty six Leghorn hens (Hy-Line), from 38-46 weeks of age were used in a 2×3 factorial arrangement with tow levels of vitamin E (0 or 1000 mg kg^{-1} of diets) and three levels of CSUFA (0, 2 and 4% of diets) in a completely randomized design with six treatments and four replicates and four hens per replicate. Feed Intake (FI), Egg Production (EP), Egg Weight (EW), Yolk Weight (YW), Shell Thickness (ST), Haugh Unit (HU), Yolk Cholesterol (YC) and Feed Conversion Ratio (FCR) were measured. The result of this experiment indicated that EW, YW, FI, FCR were significantly ($p<0.05$) affected by fat levels. FI and FCR were decreased with fat levels from 0-4%. Different levels of dietary vitamin E had no significant effect on FI, EP, FCR, EW, YW, ST, HU and YC ($p>0.05$).

Key words: Fat, vitamin E, yolk cholesterol, laying hen, egg production, feed

INTRODUCTION

Fat is a common source of energy in poultry feed. Studies have shown that type of dietary fat of the laying hens has a significant effect on egg composition (Grobas *et al*., 2001).

Consumers limit their intake of eggs because adverse publicity about Saturated Fats (SF) and cholesterol. Genetic, age and pharmacology agents are known to affect egg cholesterol deposition (Hargis, 1988). Consumption of Unsaturated Fatty Acid (UFA) has been reported to reduce the risk of atherosclerosis and stroke (ISO *et al*., 2002; Lada and Rudel, 2003).

A high concentration of USF in the cell membranes (yolk membranes) increases the susceptibility to peroxdative degradation (Mckay and King, 1980) and increases the requirement for vitamin E. In the cellular membranes, α-Toc, the most important membrane-bound lipid-soluble anti oxidant.

In avians, dietary supplementation of Toc has been reported to increase the Toc content of eggs and increase oxidative stability of hen tissues (Cherian *et al*., 1996). The objective of this study were to determine the best of level of CSUFA Effects of CSUFA on the performance of laying hens and effects of supplemental vitamin E on the performance of laying hens.

MATERIALS AND METHODS

Diets, birds and their management: The experiment was conducted at the poultry station of Ramin Agricultural and Natural Resources University in southwest of Iran. Total 96 leghorns (HyLine-W36) layers in 38 weeks of age were used in this study. Diets were isoenergetic and isonitrogenous and formulated to meet NRC (1994) requirements (Table 1). Basal diet containing 0, 2 or 4% Calcium Soap of Unsaturated Fatty Acids (CSUFA) with 0 or 1000 mg of vitamin E per kg of feed. CSUFA is a commercial products that manufactured by Faravarsazan Co. in Iran that contain of 7800 kcal ME kg^{-1} and 5±1% Ca. Feed and water were *ad libitum* and the hens in this experiment were acclimatized a 16 h daily photoperiod.

Experimental design and data collection: The experimental design was Completely Randomized (CRD) using a 2×3 factorial arrangement with tow levels of vitamin E (0 or 1000 mg kg^{-1} of diets) and three levels of CSUFA (0, 2 and 4% of diets). Each treatment had four replicates and each replicate was allotted 4 birds. FI and EP were recorded daily. Eggs were collected and EW, YW, HU and ST as measured three times during the feeding period. Haugh unit was determined using following formula:

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Table 1: Composition and nutritional value of diets (g kg^{-1})

Ingredients	Basal diet (BD) (g kg^{-1})	BD +2% CSUFA (g kg^{-1})	BD +4% CSUFA (g kg^{-1})
Yellow corn	62.8	53	38.5
Soybean meal	18.7	18.3	17.4
Wheat	4	5.2	10.8
Barley	0.6	4.9	10
Wheat barn	0.3	3	6
CSUFA (fat)[1]	0	2	4
Fish meal	3	3	3
Dicalcium phosphate	1	1	0.9
Oyster	8.4	8.4	8.2
Salt	0.17	0.17	0.17
DL-Methionine	0.13	0.13	0.13
Sodium bicarbonate	0.3	0.3	0.3
vitamin D_3	0.1	0.1	0.1
Vitamin and mineral premix[2]	0.5	0.5	0.5
Nutrient content			
Metabolizable energy kcal kg^{-1}	2750	2750	2750
Crude Protein (CP)	16	16	16
Calcium	3.64	3.75	3.75
Available phosphorous	0.39	0.40	0.39
Lino leic acid (%)	1.28	1.8	2.25

[1]Calcium Soap Unsaturated Fatty Acids, [2]Vitamin and mineral premix provides per 2.50 kg of product: vit, A, 7,700,000 IU; 15000 mg B_1; 4400 mg B_2; 55000 mg B; 3000 mg B_6; 8.8 mg B_{12}; 3,300,000 IU D_3; 6600 IU E; 550 mg K_3; 110 mg B_5; 22000 mg B_5; 55 mg H_2; 275 mg cholin chloride; 100 mg antioxidant; 66 mg Mn; 33000 mg Fe; 66000 mg Zn; 8800 mg Cu; 300 mg Se and 900 mg I

$$\text{Haugh unit} = 100\log\left[H - \frac{\sqrt{G(30w^{0.37} - 100}}{100} + 1.9\right]$$

Where:

G = 32.2
H = Albumin height (mm)
W = The weight of whole egg (g)

Six eggs were randomly sampled from each replicate, their yolks separated and weight each three yolks, were pooled, homogenized and two samples placed in airtight containers prior to analysis. Cholesterol concentration of the yolk was determined by gas-liquid chromatography (Nugara and Edvards, 1970).

Data analysis: All collected data were subjected to analysis of variance using General Linear Models (GLM) procedure of SAS (ver. 9.1) and Duncan's Multiple Range Test were used to determine treatments difference.

RESULTS AND DISCUSSION

Results from the present study indicate that EW, YW, FI and FCR affected by different levels of CSUFA (Table 2 and 3). There were no significant difference in YC, EP, ST and HU between hens fed with diets have CSUFA ($p>0.05$). Birds fed with diets contain 2% of fat, had higher EW and YW than birds fed with diets contains 0 or 4% of fat. It appears that the high linoleic acid contents of CSUFA were the major of increases of EW. Grobas *et al.* (2001) reported that increases of the EW were depended to high content of linoleic acid and energy intake of laying hens fed USFA in diets. Grobas *et al.* (1999) have shown that by increasing linoleic acid in 1.15-1.65% of diets, YW were increased. The deposition of oleic and linoleic acids in egg yolk were positively related to the range of dietary USF contents, therefore with increases USF in the diet, YW was increased. By increasing of fat in the laying hens diet, FI was decreased therefore, total protein intake and EW were decreased too (Table 2).

Table 2: Effects of CSUFA on EW, EP, FI and FCR of laying hens

Treatments	EW (g)	EP (%)	FI (g/hen/day)	FCR (g feed g^{-1} egg)
CSUFA (0%)	59.8[b]	85.6[a]	112.5[a]	1.87[a]
CSUFA (2%)	61.3[a]	86.8[a]	105.8[b]	1.73[b]
CSUFA (4%)	60.1[b]	86.6[a]	102.0[c]	1.70[b]

[a-c]Means in the same row with the same letter(s) are not significantly different ($p>0.05$)

Table 3: Effects of CSUFA on YC concentration, YW, ST and HU of laying hens

Treatments	YC (mg g^{-1})	YW (g)	ST (μm)	HU
CSUFA (0%)	12.9[a]	17.7[b]	361.8[a]	88.2[a]
CSUFA (2%)	12.6[a]	18.9[a]	364.5[a]	87.2[a]
CSUFA (4%)	12.7[a]	18.3[ab]	361.1[a]	87.6[a]

[a-b]Means in the same row with the same letter(s) are not significantly different ($p>0.05$)

Results of this study agreement with founds of Srichai and Balnave (2004), who observe increases EW by used sunflower oil and rice pollard in diet of laying hens. Different levels of CSUFA had no significant effect on YC (Table 3). However, feeding diets contain of CSUFA was a few decreased in YC than basal diet (12.6 and 12.7 vs. 12.9 mg g^{-1}, respectively). The findings are in agreement with Rowghani *et al.* (2007), who did not observe any increase in YC with 1% CSFA supplementation and similar with Scheideler and Froning (1996) reports. FI and FCR were decreased with fat levels from 0-4%. As expected, CSUFA decreased FI and improved FCR, because these diets were more concentrated and had more energy than the basal diet. These results are agreement with Karanajeewa and Tham (2004) findings who used corn oil in diets of growing and laying pullets and similar with Augustyn *et al.* (2006) findings. The main effect of supplemental vitamin E were no significant ($p>0.05$) difference in yolk cholesterol and performance of lying hens ($p<0.05$) (Table 4 and 5). Puthpongsiriporn *et al.* (2001), have shown that the performance of laying hen were not influenced by supplemental vitamin E in normal conditions.

Table 4: Effects of vitamin E on EW, EP, FI and FCR of laying hens

Treatments	EW (g)	EP (%)	FI (g/hen/day)	FCR (g feed g^{-1} egg)
Without Vit. E	60.5[a]	86.1[a]	106.8[a]	1.77[a]
With Vit. E	60.3[a]	86.7[a]	106.7[a]	1.76[a]

Table 5: Effects of vitamin E on YC concentration, YW, ST and HU of laying hens

Treatments	YC (mg g^{-1})	YW (g)	ST (μm)	HU
Without Vit. E	12.8[a]	18.2[a]	364.1[a]	87.6[a]
With Vit. E	12.6[a]	18.4[a]	360.8[a]	87.8[a]

[a]Means in the same row with the same letter(s) are not significantly different ($p>0.05$)

CONCLUSION

Increasing 2% fat positively affected laying hens' performance and egg weight.

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