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RESEARCH ARTICLE

Effects of Lovastatin Suplemented Diet on Laying Performance, Egg Quality, Yolk Lipid Profile and Some Serum Parameters in Laying Hens

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ABSTRACT

This study was carried out to determine the effects of lovastatin supplementation on laying performance, egg quality, yolk lipid profile and some serum parameters in Lohmann LS white commercial laying hens reared in poultry houses of Food and Livestock Application and Research Center of Ataturk University. In this experiment, Lohmann layers (n=48, 46 wks of age) were randomly divided into two groups such as control (C) fed with basal diet and treatment (L) group fed with diet including 0,0059 % of lovastatin. After one week of the adaptation period, experiment lasted for five weeks. During the experimental period, hens were fed as ad-libitum and water through nipples was available for all the times. Lovastatin supplementation increased feed consumption (FC) and feed conversion ratio (FCR). Except for yolk color, other egg quality traits were not affected by diet including 0,0059 % of lovastatin. Hens fed with treatment diet had greater triglyceride and phosphatidyl serine values than hens fed with basal diet. Differences between the groups in terms of the levels of egg yolk and serum cholesterol were not significant in present study. These differences could be attributed to short experimental period and low lovastatin added to basal diet of hens. In conclusion, further studies should be conducted to clarify the effects of lovastatin supplementation on laying performance, egg quality, yolk lipid profile and some serum parameters in laying hens fed with diets including lovastatin at different levels during long feeding period.

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Introduction

Egg is one of the most important foods with its high protein value, rich in vitamins and minerals and low in calorie. Scientific and technological developments in poultry have enabled the egg to be produced in abundant and economical ways in recent years, but egg consumption has not been reached of the desired level because of cholesterol content. Egg contain about 200 mg of cholesterol and is considered a major source of dietary cholesterol (Çakır and Yalçın 2004; Elkin et al., 1999; Mori et al., 2000; Kim et al., 2004).

Egg cholesterol level is influenced by genetic, age and nutritional factors. Nutritional factors, such as type of fat, dietary fiber, the amount of vitamin C, can affect egg cholesterol level (Naber, 1976; Çakır and Yalçın 2004). There

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are many studies dealt with the effect of genetic selection and various dietary factors on egg cholesterol levels. However, it is extremely difficult to reduce egg cholesterol levels by dietary manipulations. Genetic selection programs have resulted in only modest changes in egg cholesterol levels (Elkin and Rogler 1990; Mori et al., 2000).

Therefore, much attention has been focused on the use of several pharmacological agents to reduce the cholesterol content of eggs. Lovastatin, simvastatin, and atorvastatin have been shown to reduce egg cholesterol content as well as liver and plasma cholesterol concentration (Luhman et al. 1990; Elkin et al., 1999; Mori et al., 1999; Kim et al., 2004).

Lovastatin is a statin drug, used for lowering cholesterol in those with hypercholesterolemia to reduce risk of cardiovascular diseases. It acts as competitive inhibitor of 3-hydroxy-3-methylglutaryl-coenzyme A reductase (HMG-CoA reductase) and it inhibits cholesterol synthesis by making an inhibitory effect (Elkin and Rogler 1990; Mori et al., 1999; Kim et al., 2004) .

This study was carried out to determine the effects of lovastatin supplementation on laying performance, egg quality, yolk lipid profile and some serum parameters in Lohmann LS white commercial laying hens.

Materials and Methods

This research was carried out at Atatürk University Food and Livestock Application and Research Center in accordance with permit of Local Ethic Committee on Animal Experiment considering the project (BAP 2002/12) supported by Ataturk University in Erzurum, Turkey (39°55'N, 41°16'W).

In this experiment, Lohmann layers (n=48, 46 wks of age) were randomly divided into two groups such as control and treatment, and placed into cages (50x46x46 cm, widthxdepthxheight). Each group was replicated in 6 cages, 4 hens per cage. The control (C) and treatment (L) were fed with basal diet in mash form and diet including 0,0059 % of powdery lovastatin, respectively. Firstly, a premixture including basal feed and lovastatin at recommended proportion on prospectus was prepared in a mixer and then this homogenized premixture was added into basal feed in feed unit. After one week of the adaptation period, experiment lasted for five weeks. During the experimental period, hens were fed as ad-libitum and water through nipples was available for all the times. Hen house was lit for 17h. The experimental diet in mash form (16.4% CP, 2670 Kcal ME/kg) was obtained from a commercial feed mill in Erzurum.

Egg production and feed consumption were measured daily, egg weight was measured biweekly and body weight was measured at the beginning and the end of the experiment. Eighteen eggs from each group were taken and stored for 24 h at room temperature at the beginning and end of the experiment to determine egg quality parameters such as shape index, shell strength, shell thickness, yolk index, albumen index and Haugh unit. Yolk color was estimated according to the CIE standard colorimetric system (Yolk Colour Fan, the CIE standard colorimetric system, F. Hoffman-La Roche Ltd., Basel, Switzerland). After 4wk of lovastatin administration, the blood samples were taken from the wing vena (10 hens) using heparinized tubes for blood parameters. In addition, ten eggs from each group were collected at the end of the experimental period to determine yolk lipid profiles by the HPTLC methods (Hara and Radin 1978; Macala et al. 1983). The yolk lipids were seperated into following classes: cholesteryl ester (CE), triglyceride (TG), free fat acid (FFA), cholesterol (COL), phosphatidylserine (PS) ve phosphatidylcholine (PC).

Performance and egg quality characteristics were tested with One-way ANOVA. t-test was used for egg lipid profile and blood parameters. All statistical analyses have been made with the SPSS 10.01 (SPSS 1996) package software.

Results and Discussion

The effects of lovastatin on laying performance are presented in Table 1. As seen in Table 1, the highest feed consumption and FCR were observed in the lovastatin group. Differences between the groups were significant ($p<0.05$). Although the effect of time on feed consumption was found significant ($p<0.01$), the effect of the group x time interaction was insignificant. However, Elkin and Rogler (1990) and Kim et al (2004) did not observe significant change in feed consumption and FCR among groups.

Table 1. The effect of lovastatin on laying performance

	C	L				
	Mean	Mean	SEM	Group	Time	CxL
Feed consumption (g/d)	95.16	103.12	2.76	*	**	ns
Egg production (%)	72.37	69.43	2.74	ns	**	ns
Egg weight (g)	66.01	64.61	0.84	ns	ns	ns
FCR (kg feed/kg egg)	1.86	2.25	0.20	*	ns	*
Cracked egg yield (%)	4.41	10.80	1.96	ns	ns	ns

*(P<0.05), **(P<0.01), ns: non significant

The differences in egg production, egg weight and cracked egg yield between groups were insignificant. The lowest egg production was observed in the lovastatin group compared to the control group. Elkin and Rogler (1990) reported that lovastatin had no effect on egg production, egg weight and cracked egg yield. The findings of Luhman et al (1990) and Kim et al (2004) also supported the findings obtained from present study.

Shape index, shell strength, shell thickness, shell weight, yolk color, yolk index, albumin index and haugh unit were determined as egg quality traits of laying hens (Table 2).

It was determined that except for yolk color there was no effect on the shape index, shell strength, shell thickness, shell weight, yolk index, albumin index and Haugh unit. The laying hens fed with diet including lovastatin produced eggs with yolk color significantly higher than the control. The effect of time on yolk color was significant ($p<0.05$). Results related to yolk color were similar with the findings of Mori et al (2000), they reported that drug addition did not affect the shell weight, shell thickness, albumin and shell quality.

Table 2. The effect of lovastatin on egg quality traits of laying hens

	C	L				
	Mean	Mean	SEM	Group	Time	CxL
Shape index (%)	73.72	74.73	1.07	ns	ns	ns
Shell strenght (kg/cm^2)	0.57	0.474	0.096	ns	ns	ns
Shell thickness (mm×10^{-2})	0.34	0.337	0.014	ns	*	ns
Shell weight (g)	6.97	7.28	0.25	ns	ns	ns
Yolk color	7.21	8.05	0.18	**	*	ns
Yolk index (%)	38.90	39.79	0.88	ns	ns	ns
Albumen index (%)	7.45	8.77	0.64	ns	ns	ns
Haugh unit	77.70	83.03	2.64	ns	ns	ns

*(P<0.05), **(P<0.01), ns: non significant

The egg yolk lipid profile of the eggs collected at the end of the experiment are given in Table 3. There was no difference among groups except for TG and PS. The differences between the groups in terms of TG and PS were significant ($p<0.05$). Elkin and Rogler (1990) reported that by adding lovastatin in the amount of 0.059-0.0265%, egg cholesterol could be reduced by 15.5%. Luhman et al (1990) observed that relatively low doses of lovastatin or colestipol did not reduce the egg yolk cholesterol. Kim et al (2004) found that oral intake of 0.06% provastatin reduced egg cholesterol by 20% when compared to control group. Mori et al (2000) reported that lovastatin had no significant effect on egg yolk cholesterol. The lack of significant differences in present study may be due to the low proportion of lovastatin.

Table 3. The effect of lovastatin on egg yolk lipid profiles of laying hens

	C	L	P
	Mean±SEM	Mean±SEM	
CE (%)	4.87±0.80	4.32±0.60	ns
TG (%)	56.22±0.62	60.38±1.58	*
FFA (%)	0.39±0.11	0.32±0.03	ns
COL (%)	20.41±0.51	20.23±0.41	ns
PS (%)	0.28±0.01	0.56±0.08	*
PC (%)	6.34±0.36	5.31±0.46	ns

CE, cholesteryl ester; TG, Triglyceride; FFA, Free fat acid; COL, cholesterol; PS, Phosphatidylserine; PC, Phosphatidylcholine
*(P<0.05), **(P<0.01), ns: non significant

Table 4. The effect of lovastatin on serum parameters of laying hens

	C	L	P
	Mean±SEM	Mean±SEM	
Uric acit (µmol/L)	7.43±0.48	4.40±0.37	**
Total protein (g/L)	4.71±0.29	4.95±0.21	ns
Albumin (g/L)	1.40±0.08	1.56±0.10	ns
Globulin (g/L)	3.31±0.24	3.39±0.12	ns
Alkalin phosphatase (U/L)	11164.00±749.83	6114.00±1589.62	*
Triglycerides (mg/L)	874.00±148.94	1230.50±236.86	ns
Cholesterol (mmol/L)	97.00±13.069	124.00±10.78	ns
HDL (g/L)	16.50±3.26	17.50±2.84	ns
VLDL (g/L)	174.83±29.79	246.00±47.40	ns
LDL (g/L)	89.00±28.55	46.50±3.85	ns

*(P<0.05), **(P<0.01), ns: non significant

There were no statistically differences total protein, albumin, globulin, triglycerides, cholesterol, HDL, VLDL and LDL values between the groups ($p>0.05$) (Table 4). The mean values of uric acid and alkalin phosphatase in lovastatin group were lower than in the control group ($p<0.05$ and $p<0.01$, respectively). Uric acid, a nitrogenous end-product of amino acid and purine catabolism. In brief, it is the main end-product of N metabolism in birds. Alkalin phosphatase (ALP) is an enzyme found in intestinal contents and tissues such as liver, bone, and kidney which are sources of plasma alkalin phosphatase, and helps to breakdown of proteins in animal body. The low ALP value in the blood serum is not a disease or a case. Lovastatin from statins group used to decrease the levels of cholesterol induces a decline in the serum uric acide and ALP values (Alberts, 1998). But, the mechanism by which lovastatin effects on low uric acid and ALP values in the blood serum of laying hens is not completely known. Elkin et al. (1999) reported that VLDL did not affect cholesterol levels in

lovastatin or simvastatin, these researchers' findings were similar with results obtained from present study. Although Mori et al. (2000) found that lovastatin with 0.005% tended to decrease the mean of triglyceride (14.9%) and total cholesterol (10.1%), Mori (2000) observed that 0.001% lovastatin caused a significant reduction of triglyceride (38.5%) and cholesterol (36.5%) levels. Kim et al. (2004) reported that 0.08% of lovastatin decreased the plasma total cholesterol concentration by 28% compared to the control group. Similar to the present study, Elkin and Rogler (1990) and Hugget et al (1993) found that plasma cholesterol and triglyceride concentrations were not affected of lovastatin.

In this study, laying performance, egg quality traits, egg yolk lipid profile and some blood parameters were examined. It has been determined that the results related to egg yolk and serum cholesterol parameters, performance and egg quality traits from present study are different when compared to the findings of other studies. Lovastatin did not affect egg quality traits except for yolk color. Feeding with relatively low doses of lovastatin did not affect serum and egg yolk cholesterol parameters.

Conclusion

In conclusion, further studies should be conducted to clarify the effects of lovastatin supplementation on laying performance, egg quality, yolk lipid profile and some serum parameters in laying hens fed with diets including lovastatin at different levels during long feeding period.

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