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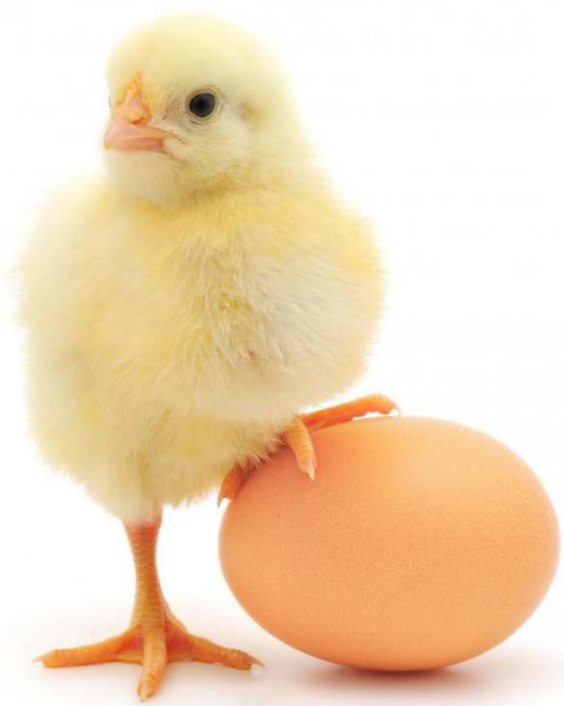

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Influence of Animal and Vegetable Oil in Layer Diets on Performance and Serum Lipid Profile

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Abstract: This experimental was conducted to determine the effects of the dietary animal fat and vegetable oils on performance and lipid metabolism in serum of laying hens. Two hundred Isabrown hens at 67 weeks of age were randomly divided into five groups containing 40 hens each therefore there were five dietary treatments groups, control group (CO) was fed basal diet without fat supplementation. Experimental groups were offered diets having 4 % tallow (TO), 4 % mixture of tallow and flaxseed oil (1:1) (MTFO), 4 % sunflower oil (SO) and 4 % flaxseed oil (FO) respectively. Fat supplementation effected laying performance and serum lipid parameters were significantly ($p<0.05$) different among groups except for egg weight. Fat supplementation improved egg production, feed intake and feed efficiency in experimental groups compared with control group. Whereas egg weight was not affected of fat supplementation. Serum high density lipoprotein cholesterol (HDL-C), was significantly higher in group fed FO diet than others, hovewer, triglyceride (TG), total cholesterol (TCOL), and lipoproteins (low density lipoprotein cholesterol (LDL-C), very low density lipoprotein cholesterol (VLDL-C) levels were found significantly lower than other groups. These results suggest that dietary FO may be valuable ingredient to layers for reducing serum TCOL, LDL-C, VLDL-C, and TG and increasing serum HDL-C levels without any adverse effect.

Key words: Laying hens, serum lipids, dietary fat, and laying performance

Introduction

Fats are frequently included in poultry diets to increase the energy density (Pinchasv and Nir, 1992; Sanz *et al.*,1999) Also, fatts have been to be a practical and economical means by which to increase energy levels in poultry diets (Latour *et al.*, 1994; Peebles *et al.*, 1997a). The addition of 5% poultry fat to broiler breeder diets has been reported to increase egg production and could reduce feed intake (Brake, 1990). Digestibility of dietary fats is affected by the fatty acid (FA) profile. Several studies have shown better utilization of unsaturated fats, leading to higher ME for unsaturated fats than for saturated fats (Craspo and Esteve-Garcia 2001). At same time, dietary fats are known to influence of the body membranes lipid composition, plasma lipoprotein concentrations, liver metabolism or structure and functions of certain tissues, depending on their constitutive unsaturated or saturated fatty acid concents (Donaldson, 1979; Tepperman, 1981; Hansen, 1986; Cristian *et al.*, 1988; Conroy *et al.*, 1986). It is well known that lipoproteins are largely responsible for the transport of lipids in the blood. Dietary fat can alter blood composition and serum lipoproteins levels are subject to change by including added fat in diets (Hermier and Dillon, 1992). Generally, saturated fatty acids increase plasma LDLs which are very atherogenic, partly by reducing receptor-mediated up take, wherease HDLs provide protection againist atherosis by transportion cholesterol from tissue to liver for concersion to bile acids and excretion (Grundy, 1989; Eisenberg 1984). Nevertheless, dietary polyunsaturated fatty acids (PUFAs) depress serum VLDL, LDL lipids and cholesterol, increasing HDLs compared with saturated fatty acids. The PUFAs of vegetables as flxseed, safflower olive, sunflower and soy bean oils, containg mostly unsaturated fatty acids are effective incounter acting the effects of dietary saturated fatty acids, but the n-3 PUFAs may be equally or more hypolipidemic (Kinsella *et al.*, 1990). Recent epidemiological observations, which showed the fatty acids composition of the plasma and platelet lipids reflected the dietary fatty acid with regard to the relative concentrations of n-6 and n-3 PUFAs (Bang *et al.*, 1980).

The aim of this study was to determine to the effects of different dietary fat sources that differ in fatty acid profile, laying performance and serum lipid metabolism of laying hens.

Materials and Methods

Two hundred sixty Isabrown laying hens at the 67 weeks of age were randomly assigned to five groups equally (n=40) and housed in cage system. Each treatment was replicated four times. There were five dietary treatments, a basal diet without added fat (CO), the raw material composition and nutritive values of diets are shown in Table 1. Other four experimental diets were arranged with four sources of added in basal diet as follows 4 % level with either tallow (TO), a mixture of tallow and

Table 1: Chemical composition and calculated analysis experimental diets

Ingredients (%) and analysis	I (TO)	II (MTFO)	III (SO)	IV (FO)
Corn	41.5	41.5	41.5	41.5
Wheat	20	20	20	20
Wheat Bran	5	5	5	5
Meat-bone meal	2.5	2.5	2.5	2.5
Soybeanmeal	17	17	17	17
Sunflowermeal	5	5	5	5
Iodized salt	0.25	0.25	0.25	0.25
Lime stone	2.5	2.5	2.5	2.5
Vitamin premix*	0.25	0.25	0.25	0.25
Narblemeal	7	7	7	7
Tallow (TO)	4			
Mixture**		4		
Sunflower oil (SO)			4	
Flaxseed oil (FO)				4
ME (kcal/kg)	2875	2880	2878	2879
Crude protein(%)	16	16.0	16.0	16.0
Crude fiber	4.3	4.30	4.30	4.30
Crude fat	6.6	6.6	6.6	6.6
Crude ash	11.04	11.04	11.04	11.04
Methionine	0.44	0.44	0.44	0.44
Methionine+Cystine	0.72	0.72	0.72	0.72
Calcium	3.7	3.7	3.7	3.7
Total phosphorus	0.55	0.55	0.55	0.55

*Provided per 2,5 kg of Mixture: vitamin A, 8,000,000 IU; Vit-D_3 2,000,000 IU; vit-E, 20,000 IU; vit-K_3, 3000 mg; B_1, 1500 mg; B_2, 4000 mg; nikotinamid 18,000 mg: D-pantothenic acid 6000 mg; B_6, 2500 mg; B_{12} 2500 mg; folik asit 500 mg; chloride 200 0000 mg; D- biotin 1000 mg; Ca 750,000 mg. **Mixture of tallow-flax oil (1:1).

Table 2: Fatty Acid Composition of Dietary Fats

Fatty Acids	Tallow	Sunflower	Flaxseed Oil
$C_{14:0}$	0.68	0.34	0.49
$C_{14:1}$	0.11	-	-
$C_{15:0}$	0.87	0.22	-
$C_{16:0}$	26	11.20	7.70
$C_{16:1}$	1.68	-	0.16
$C_{17:0}$	0.49	0.36	0.28
$C_{17:1}$	0.45	0.23	0.17
$C_{18:0}$	16.79	4.15	4.20
$C_{18:1}$	38.95	23.36	24.28
$C_{18:2}$	12.38	58.89	13.19
$C_{18:3}$	0.33	0.10	49.32
$C_{20:0}$	0.92	0.96	-
$C_{20:1}$	0.34	0.19	0.22
∑SFA	46.76	17.23	12.69
∑MUFA	41.53	23.78	24.83
∑PUFA	12.71	58.99	62.51
∑n-6 PUFA	12.38	58.89	13.9
∑n-3PUFA	0.33	0.10	49.82

flaxseed oil (1:1) (MTFO), sunflower oil (SO) and flaxseed oil (FO), respectively.The faty acids propile of fats were used in experimental diets are shown Table 2. Hens received 16 h light/d throughout the experiment. Feed and water were supplied ad libitum and the experiment was lasted 8 weeks. Eggs were collected daily, egg production and feed consuption were calculated on a weekly basis, egg weight was determined using all egg produced during two consecutive day per week. At the end of the eight weeks experimental period, blood samples were obtained from each subject of V. Cuteneaeulnaris. The analysis of serum , total cholesterol (TCOL), triglyceride (TG) and high density lipoprotein cholesterol (HDL-C) were measured on autoanalyzer by using commercially available kits., very low density lipoprotein cholesterol (VLDL-C) and low density lipoprotein cholesterol (LDL-C), levels was estimated by the method of the Friedewald Equation (Friedewald *et al*.,1972).

Statistical analysis were performed by the statistical package SPSS for Windows, version 6.0. Multiple comparison of the other data was done by using the duncan test after one-way analysis of varience (ANOVA). I these test $p<0.05$ considered as statistically significant.

Results and Discussion

Performance parameters: Performance parameters are shown in Table 3. In this study, dietary fat supplementation affected the feed intake, egg production and feed efficiency ($p<0.05$). But not significat effects on egg weigh. Average feed intake of groups ranged from 102.4 to 115.1 g/d. Fat supplementation decreased feed intake in treatments groups due to increasing dietary ME. The highest feed intake was obtained from CO (115.1 g/d). Therefore CO is containing lower ME than experimental diets (2600 vs 2880 kcal/kg ME). Egg production and feed efficiency significantly ($p<0.05$) affected from fat supplementation between CO and other groups. The low feed efficiency was in CO (2.74 kg feed/kg egg). The highest egg production was obtained from SO (62.68 %) containing high level of linoleic acid. Egg weight was not influenced by dietary treatments in current study however, the high egg for hens fed MTFO (64.17 g) than for hens fed the other diets. The supplementation of diet with 4 % maize oil providing 22.4 g linoleic acid kg/diet increased the egg weight in the experiment of Whitehead *et al*. (1993). The investigators suggested that positive effect of dietary linoleic acid on plasma estradiol metabolism, which may enhance the lipid and protein synthesis for egg formation. Our results are similar to previous studies (Shafey *et al*, 1992; Meluzzi *et al*, 2000; Lang and Jean, 1991; Chamruspollert and Sell, 1999; Pal *et al*., 2002). That using different dietary fats containing different PUFAs had any effect on performance parameters. These different results could be due to the use of different strains, age, dietary fat type, and duration of the experiment.

Serum lipoprotein parameters: The means of serum TCOL, LDL-C, VLDL-C, HDL-C and TG levels were shown in the Table 4 in this study. Dietary fat supplementation affect serum lipid composition. There were statistically significant ($p<0.05$) differences among

Table 3: Performance parameters of laying hens

Parameters	I	II	III	IV	V	SEM	P
Feed Consumption, gr/d	115.10^a	106.92	106.18	104.4	103.4	0.95	*
Hen-day Egg Production %	53.51^c	62.10	60.70	62.68	59.21	1.53	*
Egg Weigh, g	62.20	63.68	63.8	64.17	63.60	0.97	NS
Feed Efficiency kg feed/kg egg	2.74^a	2.47	2.74	2.62	2.73	0.75	**

p<0.05

Table 4 : Lipoprotein concentrations in Serum of laying Hens

Paramters (mg/dl)	Control	Added different Fats (% 4)					
	I	II	III	IV	V	SEM	P
TCOL	119.17^b	138.66^a	136.67^a	86.50^b	82.67^b	2.35	*
TG	107.00^c	162.83^a	153.5^b	86.50^c	82.67^c	2.23	*
HDL-C	59.00^b	41.17^d	47.17^c	65.13^b	75.00^a	1.91	*
VLDL-C	21.40^c	32.56^a	30.70^a	16.90^b	16.52^b	0.48	*
LDL-C	48.60^b	65.23^a	56.80^b	20.48^c	15.30^c	3.27^c	*

$^{a, b, c, d}$: Means in a row with different superscripts are significantly different (P<0.05).

treatments. The low levels of serum TCOL, LDL-C, VLDL-C, and TG were obtained from group which was fed FO containing high proportion n-3 PUFA. Therefore, the reponsible for reduction of serum LDL-C, VLDL-C, TCOL, and TG levels in serum and increase HDL-C (Kinsella *et al.*, 1990). Teh high levels of serum LDL-C, VLDL-C, TCOL and TG were in second group taken diet that is containing TO.The third group serum parameters were found between TO and Fo The serum parameters of SO were found similar to FO.

The digestion, metabolism, and transport of dietary lipids and the effects of different dietary FAs on lipoprotein metabolism have been extensively reviewed. Generally, saturated FAs increase plasma LDL (Grundy, 1989). Dietary n-3 PUFAs can reduce TG synthesis and chylomicron secretion from intestinal cell (Harris, 1989) and suppress hepatic FA synthesis on TG production, thereby limiting VLDL secretion. Diet rich in linoleic acid and oleicacid also suppress VLDL and LDL concentration,but n-3 PUFAs appear to be more effective, (Nestel *et al.*, 1984). In a study reported that fish oil ingestion increased hepatic HDL receptor activity 71% in rats (Roach *et al.*, 1987). Dietary PUFAs may promote lipoprotein metabolizm by altering the activity of certain lipolytic and transfer enzymes function in the plasma. Aviram *et al.* (1986) suggested that especially, n-3 PUFAs facilitate the transfer of FAs from VLDLs to LDLs. The effects of dietary n-3 PUFAs on lipoprotein lipase,which catalyzes the degradation of VLDLs and chylomicrons in extrahepatic tissues, is unclear. Haug and Hostmark (1987) reported that fish oil decreased lipoprotein lipase activity by 50% in male rats. Dietary PUFAs of vegetable oils, containing mostly linoleic acid, are effective in counter-acting the effects of dietary saturated FAs (Grundy, 1989). Thus n-3 PUFAs may reduce plasma lipids, alter the composition of cell and tissue PUFAs, improve vascular tone, and modify cell-to-cell interactions by altering eicosanoid balance (Kinsella *et al.*, 1990). Our results are similar to previous studies(Kinsella et al.1990; Hermier and Dillon, 1992; Iwata *et al*, 1992; Peebles *et al.*, 1997b; Celebi and Utlu, 2004 and Iwata *et al.*, 1992).

In spite of the fact that the metabolism of lipids and lipoproteins might be somewhat different from those in humans,these findings can be regarder as a quide for humans therefore, it could be suggested that the poulty productions from such birds fed on lipid source with higher proportion of PUFA would more benefical the people who are healt concious.

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