Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 2 (12) November 2013: 160-163

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD

ORIGINAL ARTICLE

The Replacement of Canola Oil and Poultry Fat with Source of Energy Diet and their effect on Blood and Tissue Biochemical Factors of Broiler Chickens

A. Rezaei*, H. Aghdam Shahryar
Department of Animal Science, Shabestar Branch, Islamic Azad University Shabestar, Iran

ABSTRACT

The aim of this research was to investigate the effect of different levels of dietary fat sources (canola oil and poultry fat) on blood and tissue biochemical factors of broiler chickens. A total of 108 day-old broiler chicks (Ross 308 strain) were randomly divided to3treatments(groups of 12 in each) with 3 replicates per treatment in a completely randomized design (CRD) and were fed with experimental diet for the period of 3 weeks (21-42 days of age). The experimental treatments included: 0%supplemented fat (basal diet), the basal diet with added (CO1.5%and PF1.5%) and the basal diet with added (CO3% and PF3%).The following parameters were measured: the levels of cholesterol, triglyceride, HDL and LDL in blood, also levels of cholesterol and triglyceride in tissue (breast and thigh). There was significant effect (P<0.05) of the fat source on the total serum cholesterol. The lowest cholesterol level was absorbed for birds fed basal diet with (CO3% and PF3%) compared with other groups. Total serum triglyceride was not significantly affected by dietary fat sources. The highest HDL was significantly absorbed (P<0.05) for birds fed basal diet with (CO3%and PF3%).Total serum low density lipoprotein (LDL) was significantly affected by dietary fat sources(P<0.05). The lowest content of LDL was found in birds fed basal diet with (Canola oil and poultry fat) compared with control group. Breast cholesterol content of birds was not shown a significant interaction between fat sources. Breast triglyceride content was significantly higher in birds fed basal diet when compared to that of birds fed basal diet with canola oil and poultry fat (P<0.05). There was a significant effect (P<0.05) of the fat source on the thigh cholesterol and triglyceride contents of birds. Birds fed basal diet with (CO3%+ PF3%) had higher levels of cholesterol and triglyceride in thigh tissue. These results suggest that canola oil and poultry fat supplementation induced significant effects in blood and tissue biochemical factors as a best replacement for energy diet.

***Key words**: Cholesterol, triglyceride, low density lipoprotein (LDL), high density lipoprotein (HDL), tissue and dietary fat*

Received 12/10/2013 Accepted 06/11/2013

INTRODUCTION

The term "fat" (animal or vegetal) is used as a synonym for lipid in the human food as well as in the ingredients for animal nutrition. The addition of fat to diets, besides supplying energy, improves the absorption of fat-soluble vitamins, diminishes the pulverulence, increases the palatability of the rations, and increases the efficiency of the consumed energy (lower caloric increment). Furthermore, it reduces the passage rate of the digest in the gastrointestinal tract, which allows a better absorption of all nutrients present in the diet. The main factor that affects the metabolizable energy value of oils and fats is their digestibility, which is dependent on the following factors: the length of the carbonic chain, the number of double bonds, the presence or absence of ester bonds (triglyceride or free fatty acid), the specific arrangement of the saturated and unsaturated fatty acids on the glycerol backbone, the composition of the free fatty acid, the composition of the diet, the type and quantity of triglycerides supplemented in the diet, the intestinal flora, the sex and age of the birds [1-3]. The term "vegetable oil" is actually a generic umbrella term for many types of oils such as corn oil, peanut oil and canola oil. Canola oil is a type of vegetable oil extracted from the seeds of the canola or rape plant. Canola oil is low in saturated fat and contains both omega-6 and omega-3 fatty acids and also containing appreciable amounts of phytosterols and rich in fat-soluble vitamins especially vitamin E as a natural antioxidant. It can reduces low-density lipoprotein and overall cholesterol levels, and as a significant source of the essential omega-3 fatty acid, is associated with reduced all-cause and cardiovascular mortality. It has been observed that there are lots of controversies in poultry nutrition regarding the use of feed ingredients from animal sources. Many poultry experts are against to use animal sources such as Meat cum bone meal and animal fat in poultry

feed. Poultry fat is known as viscera oil and is obtained after the extraction of fat by autoclaving or in a percolator tank and expeller. Importing of poultry fat in diet increases body stores of Oleic Acid that would has the same function (rapid control the amount of LDL and raise the blood levels of HDL). According to Edwards et al. [4], the inclusion of poultry fat in broiler diets resulted in an increase in the deposition of oleic acid and a reduction in the levels of the linoleic acid in the adipose tissue of the birds.Saturated fatty acids increase the amount of high density lipoprotein (HDL) cholesterol more than polyunsaturated fatty acids (The lipids of foods and particularly foods that contain polyunsaturated fatty acids are easily oxidized (chain reaction)) because saturated fatty acids don't oxidized easily and their effects are stable [5-7]. Despite the different sources of animal and vegetable fats, both animal and vegetable fat intake had better results in poultry nutrition.

MATERIALS AND METHODS

In this experiment 108 day-old broiler chicks (Ross 308 strain) were weighted and distributed randomly to 3 treatments with 3 replicates (12 chicks in each replicate/pen). The experimental groups included: 0%supplemented fat (basal diet), the basal diet with added (CO1.5% and PF1.5%) and the basal diet with added (CO3% and PF3%). Diets were formulated to meet the requirements of broiler as established by the NRC (81994). Ingredients and nutrients composition of experimental diet were shown in Table 1. Birds were fed with experimental diet for the period of 3 weeks (21-42 days of age). The experiment was carried out in a Completely Randomized Design (CRD).

At the end of experiment (at 42 days of age) 2 chicks from each pen randomly selected and blood samples were obtained from each subject of V.Cuteneaeulnaris. The analysis of serum, total cholesterol (TCOL), triglyceride (TG), high density lipoprotein Cholesterol (HDL) were measured on auto analyzer (ALYSON 300) with using commercially available kits. Very low density lipoprotein cholesterol (VLDL-C) and low density lipoprotein cholesterol (LDL-C) levels were estimated by the method of the Friedewald Equation [9].

Also at the end of experiment, 2 chicks randomly selected from each pen and slaughtered. Tissue samples (breast and thigh) were obtained for analysis cholesterol (TCOL) and triglyceride (TG) content.

Statistical Analysis: Data collected subjected to analysis of variance and significant differences observed in means subjected to Duncan's multiple range test. All data were analyzed by ANOVA using the General Linear Model (GLM) procedures of the SAS Institute [10].

RESULTS AND DISCUSSION

Blood Biochemical Factors: Table 2 shows the effect of fat source on blood biochemical factors (TCOL, TG, HDL-C and LDL-C). There was significant effect ($P<0.05$) of the fat source on the total serum cholesterol. The lowest cholesterol level was absorbed for birds fed basal diet with (CO3% and PF3%) compared with other groups. Canola oil is high in monounsaturated fatty acids, low in saturated fatty acids and containing appreciable amounts of phytosterols and rich in fat-soluble vitamins especially vitamin E as a natural antioxidant can decrease the amount of cholesterol and LDL-cholesterols levels in the blood (11Mattson and Grund, 1985; 5Mensink and Kata, 1987), also saturated fatty acids in poultry fat can increase the amount of high density lipoprotein (HDL) more than monounsaturated fatty acids [7] because their effects are so stable and oxidation of saturated fatty acids aren't easier than monounsaturated fatty acids, so transmission of cholesterol (especially LDL) to out of the serum and liver increases.

Total serum triglyceride was not significantly affected by dietary fat sources. In spite of this result, the highest level of triglyceride was absorbed for birds fed basal diet with (CO3% and PF3%) compared with other groups. Canola oil would increase absorption and digestion capability because of unsaturated fatty acids that exists in it, also unsaturated fatty acids with the production of mixed micelles (with the help of bile salts) play a role in digestion of saturated fatty acids, so increases free fatty acids concentration in plasma because of increasing biosynthesis of triglyceride in liver [12].

The highest HDL was significantly absorbed ($P<0.05$) for birds fed basal diet with (CO3% and PF3%). Canola oil as a source of monounsaturated fatty acids (such as oleic acid) and polyunsaturated fatty acids and rich in fat-soluble vitamins especially vitamin E as a natural antioxidant (unsaturated fatty acids can increase the absorption of the vitamin from other food stuffs) would rapidly control the amount of LDL and so increase the amount of HDL, also importing of poultry fat in diet increases body stores of oleic acid that would has the same function (rapid control the amount of LDL and raise the blood levels of HDL). Saturated fatty acids increase the amount of high density lipoprotein (HDL) cholesterol more than polyunsaturated fatty acids because saturated fatty acids don't oxidized easily compared with unsaturated fatty acids and also their effects are stable [5,6,7].

Total serum low density lipoprotein (LDL) was significantly affected by dietary fat source (P<0.05). The lowest content of LDL was found in birds fed basal diet with (CO1.5% and PF1.5%) and with (CO3% and PF3%) compared with control group. Due to high amount of monounsaturated fatty acids and moderate amounts of polyunsaturated fatty acids and also appreciable amounts of phytosterols in canola oil and also rich in fat-soluble vitamins especially vitamin E as a natural antioxidant, the blood level of total LDL-cholesterol decrease [11,5,7]. Poultry fat as a source of saturated fatty acids in diet would increase the oleic acid contents in body so results in rapidly control of the blood LDL-cholesterol and raise the blood high density lipoprotein (HDL).

Table 1: Ingredients and nutrients Composition of experimental diets (%)

Item	Control	CO 1.5% + PF1.5%	CO 3% + PF 3%
Ingredient			
Corn	62.09	62.34	56.26
SBM (44%)	30.27	30.82	32.67
Starch	4.14	-	-
Canola oil	-	1.5	3
Poultry fat	-	1.5	3
Oyster	1.47	1.46	1.44
DCP	1.22	1.25	1.27
Lysine	0.049	0.077	0.075
Methionine	0.081	0.090	0.090
Vitamin premix	0.25	0.25	0.25
Mineral premix	0.25	0.25	0.25
Salt	0.20	0.20	0.21
Coccidiostat	0.05	0.05	0.05
Sand	-	0.213	1.433
ME (kcal/kg)	3000	3018	3020
Crude protein	18.76	18.85	18.87
Ca%	0.90	0.91	0.90
AP%	0.35	0.37	0.36
ME/CP	159.91	160.1	160
SBM = Soybean meal; DCP = Dicalcium phosphate; ME = Metabolizable Energy			
CP = Crude protein; AP= Availability Phosphorus			

Table 2: Lipoprotein concentration in serum of broiler chicks

Treatment	TCOL	TG	HDL-C	LDL-C
Control	160.3 [a]	44.2	19.7 [b]	131.8[a]
CO 1.5% + PF 1.5%	147 [ab]	40.5	29.3 [ab]	109.6[b]
CO 3% + PF3%	131.2[b]	52.0	33.7[a]	99.8[b]
P value	0.0312	0.1211	0.0254	0.0342
SEM	5.21	6.14	3.029	4.261

Table 3: Cholesterol and triglyceride concentration in tissue (breast and thigh) of broiler chicks

Treatment	Control	CO1.5% + PF1.5%	CO3% + PF3%	P value	SEM
Breast					
TCOL	37.3	43.3	47	0.0842	4.022
TG	10.7[a]	7.3[b]	8[b]	0.0219	0.061
Thigh					
TCOL	156.3[b]	192.7[ab]	206.7[a]	0.0445	12.131
TG	23.7[b]	42.7[ab]	48.7[a]	0.0472	3.710

[a, b]: Means in a row with different superscripts are significantly different

Tissue Biochemical Factors

Breast cholesterol and triglyceride:

Breast cholesterol content of birds was not shown a significant interaction between fat sources. Breast triglyceride content was significantly higher in birds fed basal diet when compared to that of birds fed basal diet with canola oil and poultry fat(P<0.05). Result regarding cholesterol and triglyceride content in breast tissue are shown in Table 3. Unsaturated fatty acids and monounsaturated fatty acids and polyunsaturated fatty acids and also appreciable amounts of phytosterols and rich in fat-soluble vitamins especially vitamin E as a natural antioxidant in canola oil have been shown to lower LDL-cholesterol in the blood [11,5].Addition of poultry fat to diet as a fat source can increase the amount of oleic acid in body, so results in rapidly control of the blood LDL-cholesterol and raise the blood high density lipoprotein (HDL). Due to the role of LDL as a main source of VLDL and also the role of VLDL in

triglyceride transferring from liver to tissue (such as muscle), each factor that can reduce the amount of VLDL and conversion of VLDL to LDL, results in lower amount of triglyceride in the blood so biosynthesis of triglyceride in liver reduce by fat sources (canola oil and poultry fat) also trans fatty acids that exists in poultry fat can reduce biosynthesis of triglyceride in liver because trans fatty acids act like saturated fatty acids (saturated fatty acids don't oxidized easily compared with unsaturated fatty acids and their effects are stable) so raises the blood levels of HDL [5-7].

Thigh cholesterol and triglyceride:

There was a significant effect ($P<0.05$) of the fat source on the thigh cholesterol and triglyceride contents of birds. Birds fed basal diet with (CO3%+PF3%) had higher levels of cholesterol and triglyceride in thigh tissue so the lowest cholesterol and triglyceride in thigh was observed for birds fed basal diet compared with fat source in diet. Results regarding cholesterol and triglyceride contents in thigh tissue are shown in Table 3. Due to high amount of unsaturated fatty acids and omega-3 fatty acids, the highest amount of metabolizable energy in canola oil and also their effect on digestion, metabolism and transferring of dietary lipid and the effect of dietary canola oil on lipoprotein metabolism [13] and digestibility of saturated fatty acids (by the formation of mixed micelles) and also due to triglyceride, free fatty acids composition and essential fatty acids (Arachidonicacids) that exists in poultry fat, excessive energy can deposit due to high amount of metabolizable energy in basal diet with (CO3%+ PF3%) because of increasing fatty acids concentration [14, 14,15]. Due to muscular work of thigh compared with breast, the blood supply to this tissue increasing and reception of this muscle is higher than it is used so muscle requires and also transfers of fatty acids and glucose to that tissue increases. Extra amount of fatty acids deposit in thigh and extra amount of glucose can convert to fatty acids and deposit. Production of triglyceride can be done by the glucose and excessive caloric intake.

The breast muscular has lower fat than thigh muscular because of their function and muscle work.

ACKNOWLEDGEMENT

Financial support for this study (Islamic Azad University, ShabestarBranch) was provided. The authors are also grateful to them valuable support and to A.M. Vatankhah for his skilled technical assistance throughout the experimental analyses.

REFERENCE

1. Renner R, Hill FW, (1961). Utilization of fatty acids by the chicken. J. Nutr., 74:259-264.
2. Nascif CCC, Gomes PC, Albino LFT, Rostagno HS, (2004). Determination of valoresenergéticos of algunsóleos and gorduraspara male broilers chicks and fêmeasaos 21 days old. Revista Brasileira of Animal Science. 33(2):375-385.
3. Leeson S, Summers JD, (2001). Nutrition of the chicken. 4th ed. Ontario University Books., 413p.
4. Edwards HM, Denmamn F, Abou-Ashour A, Nugara D. (1973). Influences of age, sex and type of dietary fat supplementation on total carcass and fatty acid composition. Poultry Science, 52:934-948.
5. Mensink, R. P. and M. B. Katan, (1987).Effect of monounsaturated fatty acids versus complex carbohydrates on high density lipoprotein in healthy men and women.Lancet., 1:129-50.
6. Judd, S.T., cleridence, B. A. Cleridence, R. A. Muesing, 1994. Dietary transfatty acids: Effect on plasma lipids and lipoprotein of healthy men and women. Am. J clin.Nutr., 59: 861-80.
7. Ascherio, A. and W. C. Willett, (1997). Health affects of trans fatty acids. Am. J. Clin. Nutr., 66: 1006 –1010.
8. National Research Council: Nutrient requirement of poultry. 8th Revised ed., National academy press, Washington, D. C. 1994.
9. *Friedewald, W.T.*, R. I. Levy, D.S.Fredrickson. (1972). Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. *ClinChem*;*18*:*499*-502
10. SAS Institute, 2000. SAS/STAT user's guide. SAS institute Inc.Cary.NC.
11. Mattson, F. H. and S.M. Grundy, (1985). Comparison of effect of diets saturated fatty acids, monounsaturated fatty acids and polyunsaturated fatty acids on plasma lipids and lipoproteins in man. J. Lipid. Res., 26: 194-202.
12. Lambert, B., and C. Jacquemin, (1979). Inhibition of epinephrine induced lipolysis in isolated white adipocytes of aging rabbits by increased alpha-adrenergic responsiveness. J. Lipid Res., 20: 208–216.
13. Kinsella. J. E, B. Lokesh, S.Broughton and J.Whelan, (1990). Dietary Polyunsaturated fatty acids and eicosanoids: Potential effects on the modulation of inflammatory and immune cells: An overview. Nutr., 6:24-44.
14. Katan, M.B., (1995). Commentary on the supplement trans fatty acids and coronary heart disease risk. Am. J. clin.Nutr., 62:518-519.
15. Talebali, H. and A. Farzinpour, (2005).Effect of different levels of full fat canola seed as a replacement for soybean meal on the performance of broiler chickens.Int. J. Poult. sci., 3: 982-98.

How to cite this article

A. Rezaei, H. Aghdam Shahryar. The Replacement of Canola Oil and Poultry Fat with Source of Energy Diet and their effect on Blood and Tissue Biochemical Factors of Broiler Chickens. Bull. Env.Pharmacol. Life Sci., Vol 2 (12) November 2013: 160-163