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INFLUENCE OF FOUR DIETARY OILS ON SELECTED BLOOD CONSTITUENTS IN EGG-TYPE CHICKENS

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Abstract: The enrichment of eggs with polyunsaturated fatty acids (PUFA), particularly with omega-3 fatty acids, has attracted the attention of both researchers and the food industry, because these fatty acids are essential for normal body development and play an important role in the prevention of heart diseases. This experiment was conducted to evaluate the effect of four dietary oils on selected blood metabolites in egg-type chickens. One hundred and five (105) Isa Brown laying hens at 34 weeks of age were used and the study lasted for 6 weeks in a completely randomised design. Hens were randomly allotted to seven dietary treatments namely: basal diet (T_1), basal diet + 1.5% palm oil (T_2), basal diet + 1.5% soybean oil (T_3), basal diet + 1.5% sesame seed oil (T_4), basal diet + 1.5% fish oil (T_5), basal diet + 0.75% soybean oil + 0.75% fish oil (T_6) and basal diet + 0.75% sesame seed oil + 0.75% fish oil (T_7). The treatments had 5 replicates of 3 hens each. Blood samples (5mls) were collected from the jugular vein of a bird per replicate for serum and haematological parameters. There were no significant differences observed in packed cell volume, haemoglobin, red blood cell, white blood cell, lymphocyte, heterophils and basophils of birds on experimental diets but diets had an influence ($P<0.05$) on the monocytes, eosinophils and platelets of birds. Monocytes of birds on the control diet were similar to those of birds on T_3 (basal diet + 1.5% soyabean oil) but significantly ($P<0.05$) higher than monocyte counts for birds on other diets. Eosinophils of birds on the experimental diets were similar except for those on T_4 (basal diet + 1.5% sesame seed oil) with significantly higher eosinophil values compared with others. A similar trend was observed in platelets of birds on the experimental diets. There were no significant differences observed in triglycerides, high density lipoproteins and cholesterol of birds on experimental diets. Low density lipoprotein (LDL) of birds on the control diet was similar to those recorded for birds on different dietary oils supplemented diets except for those on T_6 (basal diet + 0.75% soybean oil + 0.75% fish oil) with significantly ($P<0.05$) reduced LDL. It can be concluded that dietary oils combination of 0.75% soybean oil + 0.75% fish oil could be effective in reducing serum low density lipoprotein in laying birds.

Key words: palm oil, sesame seed oil, soybean oil, fish oil, laying hens, blood profile.

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Introduction

People with hypercholesterolemia have three times higher risk of heart attacks than those who have normal blood lipid profiles. It was reported that hypercholesterolemia contributed to 45% of heart attacks in Western Europe and 35% of heart attacks in Central and Eastern Europe from 1999 to 2003. In human nutrition, animal products such as meat, milk and egg play an important role. Consumers have changed their attitude towards egg consumption because of fear that eggs will raise their blood cholesterol levels. Eggs therefore have been singled out by diet-heart advocates as food to be avoided even though the egg contains the best and least expensive high quality protein of high biological value and balanced distribution of minerals and vitamins except vitamin C (Shrimpton, 1987; Connor, 2000). The many attempts to reduce cholesterol in egg content have had little practical application. An alternative way to reduce the cholesterol effects of eggs is by altering the yolk fatty acid composition. Egg yolk total fat content cannot be altered; however, fatty acid composition can be altered by using PUFA-rich dietary oils in hen's diet (Milinsk et al*.,* 2003). The enrichment of eggs with polyunsaturated fatty acids (PUFA), particularly with omega-3 fatty acids has attracted the attention of both researchers and the food industry, because these fatty acids are essential for normal body development and play an important role in the prevention of heart diseases, diabetes, arthritis, inflammatory and auto-immune conditions, and cancer (Simopoulos, 2000). The use of different dietary oils as energy sources in the diets of laying hens is one of the methods used nutritionally to change the lipid profile of eggs (Baucells et al., 2000; Grobas et al., 2001; Shafey et al., 2003; Cabrera et al., 2005). Some of the oil sources are rich in long chain polyunsaturated fatty acids that can change the proportion of the constituents of egg yolk (Hargis and Van Elswyk, 1993; Eseceli and Kahraman, 2004).

The nutritional and clinical status of an animal can be determined by myriad of metabolites and other constituents contained in the blood. Hence, World Health Organization recommends the use of blood and biochemical parameters in medical nutritional assessment. Several studies have been conducted to evaluate the effects of different omega-3 fatty acid sources on the cholesterol and fatty acid composition of egg yolk and meat (Caston and Leeson, 1990; Cherian and Sim, 1991; Coetzee and Hoffman, 2002; Komprda et al., 2003). However, its effect on blood constituents of laying birds is scanty. It was therefore, the objective of this study to determine the effect of four dietary oils on some selected blood constituents of egg-type chickens.

Materials and Methods

Experimental site

This experiment was carried out at the Poultry Experimental Unit of the Teaching and Research Farm, University of Ibadan, Oyo State, Nigeria. The University is located at latitude 7^{o} 10^{o} N and longitude 3^{o} 2^{o} E and lies in the south-western part of Nigeria with a prevailing tropical climate with a mean rainfall of about 1037mm per annum. The mean monthly ambient temperature ranges from 28^{o}C in December to 36^{o}C in February with an average yearly humidity of about 82%. The vegetation at the University represents an interphase between the tropical rain forest and the derived savannah. The project complied with the University of Ibadan ethics requirements for animal handling. The study was executed within the University of Ibadan Teaching and Research Farm; the project did not include any activity that contravened animal welfare and humane handling in animal husbandry.

Experimental diets and management of experimental birds

One hundred and five Isa brown laying hens at 34 weeks of age were used for this study. Hens were housed in a battery cage in a semi-controlled environment. The layers were randomly allotted into seven dietary treatments by body weight. Each dietary treatment had 5 replicates of 3 hens per replicate. The basal diet was a corn-soybean meal diet formulated to meet the nutrient requirements (NRC, 1994) for layers (Table 1). Treatment 1 (T_1) was a basal diet (no dietary oil); treatment 2 (T2), basal diet + 1.5% palm oil; treatment 3 (T_3), basal diet + 1.5% soybean oil; treatment 4 (T4), basal diet + 1.5% sesame seed oil; treatment 5 (T_5), basal diet + 1.5% fish oil; treatment 6 (T_6), basal diet + 0.75% soybean oil and 0.75% fish oil and treatment 7 (T7), basal diet + 0.75% sesame seed oil and 0.75% fish oil. Hens had free access to experimental diets and water during the study period that lasted for 6 weeks. Diet composition was analysed and compared with the calculated values (Table 2).

Experimental design

The experimental design was a completely randomised design.

Haematological parameters
Blood collection

At day 42, blood was collected from the jugular vein into two vaccutainer tubes for each hen, one containing Ethylene Diamine Tetra Acetic Acid (EDTA) for haematological study and the other sterile vaccutainer tubes without EDTA.

The second set of tubes was covered and centrifuged, serum separated out, decanted, deep-frozen for serum biochemical analyses.

Table 1. Gross compositions (g/100g DM) of experimental diets.

Treatments Ingredients	T_1	T_2	T_3	T_4	T_5	T_6	T_7
Maize	58.05	53.55	53.55	53.55	53.55	53.55	53.55
Soya bean meal	22.00	22.00	22.00	22.00	22.00	22.00	22.00
Wheat offal	9.20	12.20	12.20	12.20	12.20	12.20	12.20
Palm oil	0.00	1.50	0.00	0.00	0.00	0.00	0.00
Soya bean oil	0.00	0.00	1.50	0.00	0.00	0.75	0.00
Sesame oil	0.00	0.00	0.00	1.50	0.00	0.00	0.75
Fish oil	0.00	0.00	0.00	0.00	1.50	0.75	0.75
Limestone	8.50	8.50	8.50	8.50	8.50	8.50	8.50
Di-calcium phosphate	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Vit-min premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30
DL-methionine	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10	0.10	0.10
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Calculated analysis							
Crude protein	17.11	17.16	17.16	17.16	17.16	17.16	17.16
ME, kcal/kg	2699.80	2718.61	2723.75	2723.02	2720.54	2722.15	2721.78
Fat	2.73	2.70	2.70	2.70	2.70	2.70	2.69
Crude fibre	3.22	3.46	3.46	3.46	3.46	3.46	3.46
Calcium	3.60	3.61	3.61	3.61	3.61	3.61	3.61
Total phosphorus	0.49	0.50	0.50	0.50	0.50	0.50	0.50
Methionine	0.38	0.38	0.38	0.38	0.38	0.38	0.38
Lysine	0.98	0.99	0.99	0.99	0.99	0.99	0.99
Sodium	0.22	0.23	0.23	0.23	0.23	0.23	0.23

DM – Dry matter; T_1 = Basal diet; T_2 = Basal diet + 1.5% palm oil; T_3 = Basal diet + 1.5% soya bean oil; T_4 = Basal diet + 1.5% sesame seed oil; T_5 = Basal diet + 1.5% fish oil; T_6 = Basal diet + 0.75% soya bean oil + 0.75% fish oil; T_7 = Basal diet + 0.75% sesame seed oil + 0.75% fish oil.
Vit-Min premix = Vitamin-mineral premix, ME = Metabolisable energy *2.5kg Premix supplied contain Vit. A = 10,000,000 IU; Vit. D_3 = 2,000,000 IU; Vit. E = 23,000mg; Vit. K_3 = 2,000mg; Vit .B_1 = 3000mg; Vit. B_2 = 6,000mg; Nicotinic acid = 50,000mg; Calcium pantothenate = 50,000mg; Vit. B_6 = 5,000mg; Vit. B_{12} = 25mg; Folic acid = 1000mg; Biotin = 50mg; Choline chloride = 400,000mg; Manganese = 120,000mg; Iron = 100,000mg; Zinc = 80,000mg; Copper = 8,500mg; Iodine = 1,500mg; Cobalt = 300mg; Selenium = 120mg and Anti-oxidant = 120,000mg.
Source: Agboola et al. (2016).

Packed cell volume estimation

The blood samples collected in bottles containing EDTA were gently mixed and drawn up in a micro-haematocrit capillary tube to ¾ of its length. One end of the tube was sealed with plasticine. The capillary tube was placed in a micro-

haematocrit centrifuge ensuring that the plasticine end is outward. After closing, these were then centrifuged at 12,000 rpm for 4 minutes. The tubes were then read in the haematocrit reader. The reading expressed the packed red blood cells as a percentage (%) of the total volume of blood (Mitruka and Rawnsley, 1981).

Haemoglobin

Haemoglobin concentration was determined by a cyanmethaemoglobin method using Drabkin's solution as diluents.

Red blood cell (RCB) and platelets counts

The properly mixed blood sample from the bottles containing EDTA was drawn up to 0.5 mark of a red blood cell pipette. The pipette was immersed into normal saline and carefully drawn up to exactly 101 marks after which the dilute blood was mixed by shaking for about half a minute. About a quarter of the content was expelled before filling the haematocytometer counting chamber and was allowed to stand for about a minute to settle after filling. All the red cells were counted using the x 40 objective lens and x 8 eye piece of microscope, with the aid of a counter.

RBC Total count =RBC counts x 10 x dilution factor;
=RCB counts x 10,000.

Platelets were determined by the phase microscopy method of Brecher and Cronkite (1950).

White blood cell (WBC) and differential leukocyte counts

The total leukocyte counts were determined using Neubauer haemocytometer after appropriate dilution, and differential leukocyte counts were performed using the oil immersion objective examination of blood films stained with the modified Romanowsky's Giemsa stain (Wittekind, 1979).

Serum Metabolites

Total serum cholesterol, triglycerides, and high density lipoprotein (HDL) were assayed by the method of Roschlan et al. (1974) while low density lipoproteins (LDL) were estimated using the Friedewald equation [LDL= Total cholesterol – (HDL-Tryglycerides/5)].

Chemical and statistical analyses

The proximate composition of diets was determined by the methods of Association of Official Analytical Chemists, AOAC (2000). Data were analysed

using descriptive statistics and analysis of variance, ANOVA ($P<0.05$) SAS (2008). Means differences were separated using Duncan's multiple range test (Duncan, 1955).

Results and Discussion

The result of the proximate composition of experimental layers' diets is as shown in Table 2. The crude protein ranged from 13.95 to 18.18%, crude fibre ranged from 3.20 to 3.40% while ether extract of the diets ranged from 7.23 to 10.10%. A high level of ether extract recorded across the dietary treatments could be due to dietary oil supplementation.

Table 2. Proximate composition (%) of experimental diets.

Parameter	T_1	T_2	T_3	T_4	T_5	T_6	T_7
Dry matter	92.83	92.60	92.79	92.81	93.14	92.91	92.86
Crude protein	13.95	13.86	18.18	16.89	16.56	14.09	14.77
Crude fibre	3.20	3.00	3.22	3.30	3.40	3.30	3.30
Ether extract	7.48	10.10	7.39	7.23	7.30	7.40	7.30
Ash	17.00	15.07	13.00	13.00	13.00	17.00	13.00
Nitrogen free extract	58.37	57.97	58.21	59.58	59.74	58.21	61.63

T_1 = Basal diet; T_2 = Basal diet + 1.5% palm oil; T_3 = Basal diet + 1.5% soya bean oil; T_4- = Basal diet + 1.5% sesame seed oil; T_5- = Basal diet + 1.5% fish oil; T_6 = Basal diet + 0.75% soya bean oil + 0.75% fish oil; T_7 = Basal diet + 0.75% sesame seed oil + 0.75% fish oil.

The result of haematological indices of egg-type chickens on experimental diets is as shown in Table 3. There were no significant differences observed in packed cell volume, haemoglobin, red blood cell, white blood cell, lymphocyte, heterophils and basophils of birds on experimental diets, but diets had an influence ($P<0.05$) on the monocytes, eosinophils and platelets of birds. Monocytes of birds on the control diet were similar to those of birds on T3 (basal diet + 1.5% soya bean oil), but significantly ($P<0.05$) higher than the monocyte count for birds on other diets. Eosinophils of birds on the experimental diets were similar except for those on T4 (basal diet + 1.5% sesame seed oil) with significantly higher eosinophil values compared with others. A similar trend was observed in the platelets of birds on the experimental diets. The blood contains a myriad of metabolites and other constituents, which provide a valuable medium for the clinical investigation and nutritional status of the animals. Dietary components have measurable effects on blood components; hence, blood constituents are widely used in nutritional evaluation and survey of animals (Olorode et al., 1995).

Table 3. Haematological indices of experimental laying birds.

Parameters	T1	T2	T3	T4	T5	T6	T7	SEM
PCV (%)	19.86	23.00	24.40	24.00	22.60	24.60	24.40	2.54
Hb (g/100mL)	7.84	7.40	7.84	7.94	6.90	8.02	7.62	0.65
RBC ($x10^6/\mu L$)	2.17	2.26	2.38	2.69	2.66	2.32	2.32	0.33
WBC ($x10^3/\mu L$)	24.02	24.22	23.94	25.27	24.64	22.27	22.49	1.86
Lymphocytes ($x10^3\mu L$)	57.40	63.00	55.20	55.60	64.20	55.00	53.60	3.45
Heterophils ($x10^3\mu L$)	35.40	29.40	38.40	36.80	30.40	39.20	40.20	3.34
Monocytes ($x10^3\mu L$)	4.00^a	1.60^b	4.20^a	2.60^b	2.60^b	2.80^b	3.00^b	0.63
Eosinophils ($x10^3\mu L$)	3.20^b	3.80^b	2.60^b	5.20^a	2.40^b	2.80^b	3.20^b	0.82
Basophils ($x10^3\mu L$)	0.20	0.20	0.00	0.20	0.20	0.20	0.00	0.17
Platelets ($x10^9/\mu L$)	244.70^b	282.20^{ab}	281.00^b	314.00^a	248.00^b	218.40^b	216.00^b	27.24

Means in the same row with different superscripts are significantly ($P<0.05$) different, SEM = Standard error of mean. Means in the same row with no superscripts do not differ significantly ($P>0.05$); PCV = Packed cell volume, RBC = Red blood cell, WBC = White blood cell, Hb = Haemoglobin; T_1 = Basal diet; T_2 = Basal diet + 1.5% palm oil; T_3 = Basal diet + 1.5% soya bean oil; T_4 = Basal diet + 1.5% sesame seed oil; T_5 = Basal diet + 1.5% fish oil; T_6 = Basal diet + 0.75% soya bean oil + 0.75% fish oil; T_7 = Basal diet + 0.75% sesame seed oil + 0.75% fish oil

The result of the present study agrees with the findings of Odunsi et al. (2007) who stated that packed cell volume, haemoglobin, white blood cell, mean cell volume, mean cell haemoglobin and mean cell haemoglobin concentration values were not affected by 15 g kg^{-1} oil supplementation in broiler diets. This suggests a normal physiological functioning and better circulatory gaseous exchange since haematocrit and Hb measure the concentration of red blood cells and transportation of oxygen and carbon dioxide respectively. Eosinophils are mobilised at the site of antigens-antibody reactions, and this mobilisation is accompanied by an increase in the number of eosinophils in the blood stream (Deldar, 1994). A very low value of eosinophils recorded for birds on experimental diets could mean that the immune response of birds on this diet was enhanced. Circulatory monocytes are tissue macrophages, known as the mononuclear phagocyte system (MPS), playing an important role in phagocytising and destroying intra cellular organisms (fungi, protozoa and viruses) and transformed cells (Deldar, 1994) while eosinophils play a primary

role of detoxification (Coles, 1986). In this study, the monocyte and eosinophil counts recorded were within the normal physiological range reported by Nirmalan and Robinson (1971), who suggest that there is no presence of an intracellular organism to elicit the activities of MPS which could abnormally increase the monocyte count and parasitic infestation to raise eosinophil counts than normal. However, the high monocyte values observed in birds on the control and 1.5% soya bean oil supplemented diets probably suggest the presence of the condition known as monocytosis.

Serum metabolites of laying birds fed experimental diets

The results of serum metabolites of laying birds on experimental diets are shown in Table 4. There were no significant differences observed in triglycerides, high density lipoproteins and cholesterol of birds on experimental diets. Low density lipoprotein (LDL) of birds on the control diet was similar to those recorded for birds on different dietary oil supplemented diets except for those on T_6 (basal diet + 0.75% soyabean oil + 0.75% fish oil) with significantly ($P<0.05$) reduced LDL. Dietary lipids can alter the blood composition and serum lipoprotein level (Hermier and Dillon, 1992).

Table 4. Serum metabolites of laying birds on experimental diets.

Parameter (mg/dL)	T1	T2	T3	T4	T5	T6	T7	SEM
Triglycerides	361.50	469.50	344.00	560.00	414.20	332.80	437.20	77.67
HDL	11.33	10.31	11.93	10.51	12.40	10.57	10.72	1.10
LDL	33.72^{ab}	41.52^{a}	23.23^{ab}	44.78^{a}	40.67^{a}	14.45^{c}	44.58^{a}	7.53
Cholesterol	69.37	73.26	63.95	77.66	64.26	62.69	69.07	7.99

Means in the same row with different superscripts are significantly ($P<0.05$) different, SEM = Standard error of mean, Means in the same row with no superscripts do not differ significantly ($P>0.05$); HDL = High density lipoprotein, LDL = Low density lipoprotein T_1 = Basal diet; T_2 = Basal diet + 1.5% palm oil; T_3 = Basal diet + 1.5% soya bean oil; T_4 = Basal diet + 1.5% sesame seed oil; T_5 = Basal diet + 1.5% fish oil; T_6 = Basal diet + 0.75% soya bean oil + 0.75% fish oil; T_7 = Basal diet + 0.75% sesame seed oil + 0.75% fish oil.

Cholesterol is widely distributed in the body and plays an important role in the synthesis of steroid hormones, bile salts and vitamin D. Generally, saturated fatty acids increase plasma low density lipoproteins (LDL), which are very atherogenic, partly by reducing receptor-mediated up-take of cholesterol, whereas unsaturated fatty acids promote the production of plasma high density lipoproteins (HDL) which provide protection against atherosclerosis by transportation of cholesterol from tissue to liver for conversion to bile acids and

excretion (Grundy, 1989). Polyunsaturated fatty acid (PUFA) of dietary oils can decrease the plasma cholesterol concentrations in laying hens (Mori et al., 1999). The result of the present study showed that dietary oils did not influence the cholesterol, triglycerides and high density lipoprotein of the experimental diets. This is probably a normocholesterolemic condition which could be attributed to the n-3 and n-6 effect of the dietary oils and their ability to bind cholesterol in the small intestines. This agrees with the findings of Mighelenj et al. (2004), who reported no significant change in serum cholesterol levels of laying hens receiving canola seed and linseed at 2.5, 5 and 7.5% of the ration. Also, Ansari et al. (2006) reported that plasma cholesterol levels in laying hens receiving varying levels of linseed (0, 5, 10 and 15% of diet) were not significantly different across the diets. However, diets had an influence on the low density lipoprotein of birds in the present study and this is in consonance with the findings of Fébel et al. (2008), who reported that plasma total cholesterol and LDL-cholesterol decreased when birds' diets were fortified with 3% linseed oil, with no significant change in HDL-cholesterol. Similarly, Crespo and Esteve-Garcia (2002a) reported lower plasma very low density lipoprotein (VLDL) and total cholesterol levels in broilers fed diets supplemented with linseed oil. The authors averred that the decrease in cholesterol concentration may be explained by the suppression of hepatic cholesterol production. Celebi and Utlu (2006) were able to find a significant decrease in total cholesterol and VLDL-cholesterol in the blood serum of hens fed rations containing 4% linseed oil with an increase in serum HDL-cholesterol of hens. Similarly, Švedova et al. (2008) observed a decrease in serum total cholesterol and an increase in HDL cholesterol in laying hens fed 3% linseed oil in the ration. Many studies showed a decrease in serum triglyceride (TG) levels in the birds receiving diets rich in n-3 PUFA. An et al. (1997) found that n-6 and n-3 PUFA differ in their effect on TG concentration in the birds. According to the authors, n-3 PUFA reduced the serum TG level but n-6 PUFA did not. Celebi and Utlu (2006) observed a decrease in serum TG level of the laying hens receiving diets fortified with 4% linseed oil and added that dietary n-3 PUFA can decrease TG synthesis and secretion from intestinal cells and can suppress hepatic fatty acid synthesis as TG is produced. Schumann et al. (2000) reported a decrease of almost 25% in plasma TG of laying hens fed 4% linseed oil in their diet. According to Crespo and Esteve-Garcia (2002b), broilers fed n-3 PUFA rich diets showed lower concentrations of TG in blood serum. In contrast, Svedova´ et al. (2008) reported an increase in plasma TG level in the hens fed 3% linseed oil when compared to the control. In another study carried out by Fébel et al. (2008), n-3 PUFA supplementation (3% linseed oil in the diet) to the birds did not alter the plasma TG levels. It has been further reported that HDL-cholesterol concentrations were not affected by any of oil sources such as fish, canola and soya bean oils in laying hens (Murata et al., 2003).

Conclusion

Haematological parameters (PCV, Hb, RBC, WBC, platelets and white blood cell differential counts) observed in this study showed that addition of dietary oils to layers' diets did not have any adverse effects on blood profile. The serum biochemical indices (triglycerides, HDL and cholesterol) examined also showed that dietary oils had no effect on serum metabolites except low density lipoprotein (LDL) which was significantly reduced in birds on 0.75% soya bean oil + 0.75% fish oil supplemented diet compared to birds on other dietary treatments. It can therefore be recommended that dietary oils could be added to diets of laying birds especially the combination of 0.75% soya bean oil + 0.75% fish oil with an expected reduction in low density lipoprotein.

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UTICAJ ČETIRI DIJETETSKA ULJA NA ODABRANE SASTOJKE KRVI KOD KOKOŠI ZA PROIZVODNJU KONZUMNIH JAJA

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R e z i m e

Obogaćivanje jaja polinezasićenim masnim kiselinama (engl. *polyunsaturated fatty acids* – PUFA), posebno omega-3 masnim kiselinama, privlači pažnju kako istraživača tako i prehrambene industrije, zato što su ove masne kiseline neophodne za normalan razvoj tela i imaju važnu ulogu u prevenciji bolesti srca. Eksperiment je sproveden kako bi se procenio uticaj četiri dijetetska ulja na odabrane metabolite u krvi kod kokoši za prozvodnju jaja. Korišćeno je stotinu i pet (105) *Isa Brown* kokoši nosilja starosti 34 nedelje, a istraživanje je trajalo 6 nedelja u potpuno slučajnom dizajnu ogleda. Kokoši su nasumično raspoređene u sedam hranidbenih tretmana, odnosno: osnovni obrok (T_1), osnovni obrok + 1,5% palminog ulja (T_2), osnovni obrok + 1,5% sojinog ulja (T_3), osnovni obrok + 1,5% susamovog ulja (T_4), osnovni obrok + 1,5% ribljeg ulja (T_5), i osnovni obrok + 0,75% sojinog ulja + 0,75% ribljeg ulja (T_6) i osnovni obrok + 0,75% susamovog ulja + 0,75% ribljeg ulja (T_7). Tretmani su imali pet ponavljaja svaki sa po 3 kokoši. Uzorci krvi (5 ml) su uzimani iz jugularne vene svake ptice radi određivanja serumskih i hematoloških parametara. Nije bilo značajnih razlika u pogledu vrednosti hemokrita, hemoglobina, crvenih krvnih ćelija, belih krvnih ćelija, limfocita, heterofia i bazofia ptica na eksperimentalnoj ishrani, ali je sastav obroka imao uticaj ($P<0,05$) na monocite, eozinofile i trombocite ptica. Broj monocita ptica na kontrolnoj ishrani bio je sličan kao kod ptica na tretmanu T_3 (osnovni obrok + 1,5% sojinog ulja), ali značajno ($P<0,05$) viši nego broj monocita kod ptica koje su dobijale druge obroke. Eozinofili ptica na eksperimentalnim obrocima bili su slični osim kod ptica na tretmanu T_4 (osnovni obrok + 1,5% susamovog ulja) sa značajno većim vrednostima eozinofila nego kod ostalih tretmana. Sličan trend je zabeležen kod trombocita ptica u eksperimentalnim grupama. Nije bilo značajnih razlika u vrednostima triglicerida, lipoproteinima visoke gustine i holesterolu ptica u eksperimentalnim grupama. Lipoprotein niske gustine (engl. *low density lipoprotein* – LDL) ptica na kontrolnoj ishrani bio je sličan onima zabeleženim kod ptica hranjenih obrocima sa dodatkom različitih dijetetskih ulja osim za one na tretmanu T_6 (osnovni obrok + 0,75% sojinog ulja + 0,75% ribljeg ulja) sa značajno ($P<0,05$) sniženim LDL. Može se zaključiti da bi kombinacija 0,75% sojinog ulja + 0,75% ribljeg ulja u obroku mogla biti efikasna u smanjivanju količine lipoproteina niske gustine u serumu kod kokoši nosilja.

Ključne reči: palmino ulje, susamovo ulje, sojino ulje, riblje ulje, kokoši nosilje, profil krvi.

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