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Effect of Vegetable Oil Types and Vitamin C on Some Physiological Traits and Immune Status of Broiler Breeder Hens

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Abstract

THE research was conducted on broiler Broiler breeder hens (Ross 308) to determine the effect of flax oil, palm oil, and vitamin C on physiological performance and immune status. The mothers were divided into 5 treatments (20 chickens and 4 roosters/treatment): the first treatment (control), the second treatment (2% flax oil), the third treatment (2% flax oil + vitamin C 300 mg/kg feed), the fourth treatment (2% palm oil), and the fifth treatment (2% palm oil + vitamin C 300 mg/kg feed). Mothers were vaccinated against Newcastle disease at the ages of 46 and 50 weeks, and blood samples were collected during the research. The results showed that the addition of flax oil significantly reduced (P≥0.05) the level of cholesterol, triglycerides, and adding vitamin C significantly increased both the concentration of total protein and globulin and the proportion of globulin:albumin and decreased the level of cholesterol and triglycerides significantly compared to control. The addition of palm oil led to a significant increase in the concentration of both globulin and the proportion of globulin:albumin, HDL – C and ALT significantly, reduce the concentration of triglycerides and the ratio of HDL – C: LDL – C significantly. With the addition of vitamin C, the concentration of glucose and HDL – C: LDL – C decreased significantly, and the concentration of HDL-C and ALT was significantly increased. The antibodies titer against Newcastle disease did not differ significantly for all treatments except for the flax oil treatment, which outperformed the treatments by 52 weeks of age, and the heterophils and heterophil/lymphocyte (H/L) ratio decreased significantly, and the proportion of mononuclear cells to flax oil treatment increased significantly compared to control.

Keywords: Flax Oil, Palm Oil, Vitamin C, Broiler breeder.

Introduction

Poultry products (eggs and meat) are one of the most important food sources for humans, and eggs are of high nutritional value because they contain protein and a good percentage of fats, minerals, and vitamins [1,2]. Adding oils and fats to chicken diets is widespread nowadays, as oils give more energy than twice as much energy as carbohydrates [3-5]. It improves the palatability of the feed material and reduces the speed of passage of food through the gut, allowing for better metabolism [6,7]. However, fats and oils tend to react with oxygen (oxidation) and negatively affect human health, especially when the proportion of polyunsaturated fatty acids (PUFA) in the cell membrane and ribosomes increases, which leads to genetic mutations or cell death due to the formation of lipid peroxides [8,9]. Palm oil contains 50% saturated fatty acids, which are associated with cholesterol by the ester bond. It is a foodstuff rich in energy that can be practically used in poultry diets, as each unit of it is equivalent to two units of carbohydrates in terms of energy production and being a good source of carotene and tocopherol [10]. Recent research has recently turned to flax oil, as it is one of the oils rich in polyunsaturated acids, especially the n-3 type, such as linolenic acid [11], which has the role of reducing the risk of disease development [12]. It is also important for the health and development of the brain and immune system

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[13]. They also help directly or indirectly in fat metabolism, and these acids play a major role in many biochemical activities in the body as they form an important part of cellular membranes [14]. Cellular antioxidants have become common in recent years due to their importance in rebuilding damaged tissues and maintaining optimal growth and production conditions [15]. Vitamin C is one of the most powerful natural water-soluble antioxidants, as it is found in high concentrations in many tissues, especially the brain [16-18]. The study aims to determine the effect of vegetable oil and vitamin C on some physiological and immunological features of broiler mothers (Ross 308).

Material and Methods

The research was carried out in the poultry field of the Department of Livestock / College of Agriculture and Forestry / University of Mosul from 2/3 to 4/27/2013. The study used mothers of broiler chickens (Ross 308) prepared from the Taq Taq hatchery / Erbil at the age of 43 weeks. The chickens were subjected to an experimental period of one week for acclimatization to the place and feeding. They were raised according to standard conditions for 12 weeks, distributed among 5 treatments (20 hens and 4 roosters/treatment) in 4 replicates (5 hens and roosters/replicate). The first treatment (control) was fed with a standard diet. The second treatment was fed a standard diet plus (2% flax oil), the third treatment was fed a standard diet plus (2% flax oil + vitamin C 300 mg/kg feed), the fourth treatment was fed a standard diet plus (2% palm oil). The fifth treatment was fed a standard diet (2% palm oil + vitamin C 300 mg/kg feed). The herd was vaccinated against Newcastle disease at 46 and 50 weeks. Blood samples were collected at 46, 48, and 52 weeks, and the blood serum was isolated by centrifugation. The serum was divided into two parts. The first was used to estimate the volumetric standard for antibodies against Newcastle disease using the ELISA method, and the second was used for biochemical estimates that included estimating the glucose concentration. Total cholesterol, triglycerides, HDL, LDL, total protein, albumin, and the enzymes ALT and AST) using the ready-made analysis kit manufactured by the French company Biolabo, an enzymatic method. Blood samples were taken from six birds per a treatment at 52 weeks, and blood strips were made. They were fixed by immersing them for a few minutes in methanol after drying them then staining them with Giemsa stain to read them under a microscope to study the differential count of white blood cells. The data were analyzed statistically using a completely randomized design (C.R.D) and using the program [19], and to determine the significance of the differences between the means, used the Duncan multiple range test [20].

Results and Discussion

Table 1 shows the effect of treatments on some biochemical characteristics of broiler broilers at the age of 46 weeks. The glucose concentration increased significantly ($P \geq 0.05$) in both the flax oil and vitamin C treatment and the palm oil and vitamin C treatment compared to the control treatments. And flax oil. Total protein concentration increased significantly in the flax oil treatment compared to the control, flax oil, and vitamin C treatments. It did not differ significantly from the palm oil and palm oil and vitamin C treatments. Albumin concentration increased significantly in the flax and vitamin C treatments compared to the control, flax, and palm oil treatments. The concentration of globulin and the globulin: albumin ratio increased significantly in the flax and palm oil treatments compared to the rest. As can be seen from Table (1), the concentration of the ALT enzyme significantly increased in the palm oil and palm oil and vitamin C treatments compared to the control and flax oil treatments, and the concentration decreased significantly. Total cholesterol in the palm oil and palm oil and vitamin C treatments compared to the rest of the treatments. The concentration of triglycerides in the palm oil and palm oil and vitamin C treatments compared to the rest of the treatments, and the decrease was significantly greater in the palm oil treatment compared to Treatment of palm oil and vitamin C, and the concentration of LDL-C increased significantly ($P \geq 0.05$) in the two treatments of flax oil and flax oil and vitamin C compared with the two treatments of control, palm oil and vitamin C. In contrast, the ratio of HDL-C: LDL-C increased significantly ($P \geq 0.05$) in the flax oil and vitamin C treatment compared to the control, palm oil, and vitamin C treatments. All treatments did not significantly affect the concentration of AST and high-density lipoproteins (HDL-C). The significant increase in the level of glucose in the breeder hens blood serum can be attributed to the flax oil treatment. Vitamin C, to the fact that polyunsaturated fatty acids have worked to reduce glucose receptors in cell membranes, or perhaps to the effect of vitamin C, which activates somatic cells, especially (alpha cells) in the pancreatic gland, which is responsible for secreting the hormone gluconeogenesis, which stimulates the liver to manufacture glucose from non-carbohydrate sources (Gluconeogenesis). These are fatty acids. As for the significant increase in the level of glucose in blood serum treated with palm oil, this may be because palm oil contains vitamins A and E, which play an important role in fat metabolism in the body by activating the gluconeogenesis process and stimulating the liver to produce glucose from saturated fatty acids, which led to an increase in the level of glucose in the blood serum of palm oil. The level of glucose and the reduction of the level of cholesterol and triglycerides in blood serum at the same time.

TABLE 1. The effect of treatment with flax oil, palm oil, and vitamin C on some biochemical characteristics of broiler breeder hens (Ross-308) at 46 weeks of age.

Periods	Treatment				
	Control	Flax oil 2%	Flax oil 2% and vitamin C 300 mg/kg feed	Palm oil 2%	Palm oil 2% and vitamin C 300 mg/kg feed
Glucose mg/100 ml	138.00±2.71^{b}	130.89± 4.81^{b}	171.42 7.02^{a}	198.21 13.87^{a}	189.12 13.49^{a}
Total protein g/100 ml	4.06± 0.23^{b}	5.25± 0.29^{a}	4.11± 0.16 ^{b}	4.61± 0.32 ^{ab}	4.55± 0.27 ^{ab}
Albumin g/100 ml	2.58± 0.17^{b}	2.17± 0.19 ^{c}	3.15±0.11^{a}	1.91± 0.02^{c}	2.81± 0.10 ^{ab}
Globulin gm/100 ml	1.48± 0.35^{bc}	3.08±0.16^{a}	0.96±0.09^{c}	2.70±0.32 ^{a}	1.74± 0.18^{b}
Globulin:albumin ratio	0.62± 0.18^{b}	1.46±0.13 ^{a}	0.30±0.03^{b}	1.41±0.17 ^{a}	0.61± 0.04 ^{b}
ALT enzyme(IU/L)	8.33± 1.56^{bc}	7.16± 0.47 ^{c}	11.00±1.00^{ab}	13.00±1.50 ^{a}	13.16± 1.07 ^{a}
AST enzyme(IU/L)	32.00±1.15^{a}	29.33± 2.18 ^{a}	28.50± 3.07^{a}	36.83± 3.16 ^{a}	35.50±3.31 ^{a}
Total cholesterol mg/100 ml	162.89± 10.60^{b}	200.52± 3.84 ^{a}	179.55± 5.15^{b}	128.60± 8.97 ^{c}	136.12± 2.91^{c}
Triglycerides mg/100 ml	552.66± 41.02^{a}	613.17± 26.38 ^{a}	566.40± 36.95^{a}	341.01± 43.83 ^{c}	444.05± 10.85^{b}
HDL - C mg/100 ml	25.80± 2.58^{a}	31.54± 2.21 ^{a}	26.51± 2.29^{a}	26.44± 2.90 ^{a}	25.54± 1.53 ^{a}
LDL - C mg/100 ml	26.56± 3.23^{bc}	40.94± 3.85 ^{a}	39.76± 2.89^{a}	33.95± 1.19 ^{ab}	21.77± 0.25 ^{c}
LDL-C:HDL-C ratio	1.07± 0.15^{bc}	1.29± 0.08 ^{abc}	1.56±0.20^{a}	1.38± 0.18 ^{ab}	0.87± 0.06 ^{c}

*Horizontally different letters mean there is a significant difference at the probability level ($P \geq 0.05$).

As for the reason for the significant increase in the level of glucose in the treatment of palm oil and vitamin C, it may be due to the decrease in glucose receptors in cell membranes or perhaps due to the effect of vitamin C, which activates somatic cells, especially alpha cells in the pancreatic gland, which are responsible for secreting the glucocorticoid hormone, which stimulates the liver to manufacture glucose from non-carbohydrate sources (gluconeogenesis, which is fatty acids), which leads to raising the level of glucose and lowering the level of cholesterol and triglycerides in the blood. Blood serum and the increase in the level of total protein, total cholesterol, and triglycerides are attributed to treatment with flax oil. Perhaps the polyunsaturated fatty acids present in flax oil have stimulated the pancreatic beta cells to secrete the hormone insulin, which works to increase the entry of glucose into the body's cells, and this leads to a reduction in the level of glucose which increase the level of total protein, total cholesterol, and triglycerides in the blood serum by stimulating it to build proteins and fats. As for the high level of albumin in the blood serum of the flax oil and vitamin C group, perhaps because vitamin C reduces the secretion of the hormone corticosterone and thus maintain protein levels. Including albumin [21]. The significant increase in the globulin: albumin ratio for the flax oil and palm oil treatments was a reflection of the significant decrease in the albumin level in both treatments. The significant increase in the level of the ALT enzyme in the blood serum of the palm oil and palm oil and vitamin C groups was perhaps because palm oil contains saturated fatty acids, which caused liver stress, which was reflected in an increase in the concentration of the enzyme in the blood. The increase in the level of LDL-C in the blood serum of the flax oil, and vitamin C treatments may be attributed to a decrease in the number of LDL-C receptors in the body's cells, thus increasing its secretion from the liver and increasing its level in the blood. The increase came. The ratio of HDL-C, LDL-C for flax oil and vitamin C treatment was significant due to the increase in LDL-C.

It is clear from Table 2 that the concentration of total protein and the AST enzyme was not significantly affected ($P \geq 0.05$) in all treatments. The glucose concentration increased significantly in the palm oil and vitamin C treatments compared to the control and flax oil treatments. It also increased significantly ($P \geq 0.05$) the albumin concentration in the flax and palm oils, and vitamin C treatments compared to the rest of the treatments, which did not differ significantly from each other. The globulin concentration in the palm oil treatment increased significantly compared to the flax oil, palm oil, and vitamin C treatments. It did not differ significantly with the control and vitamin C treatments. Flax and vitamin C. The results show a significant decrease ($P \geq 0.05$) in the globulin: albumin ratio in the flax oil, palm oil, and vitamin C treatments compared to the control and palm oil treatments, which did not differ significantly from each other, and it increased significantly ($P \geq 0.05$). The concentration of the ALT enzyme in the palm oil and palm oil and vitamin C treatments compared with the control and flax oil treatments. In contrast, the flax oil and vitamin C treatment did not differ significantly compared to the palm oil and vitamin C treatment. In contrast, the treatments' total cholesterol concentration decreased significantly ($P \geq 0.05$). Flax oil, vitamin C, palm oil, palm oil, and vitamin C compared with the flax oil treatment. At the same time, the largest significant decrease was recorded in the flax oil and vitamin C

treatment compared with the control and flax oil treatments, and the concentration of triglycerides in the palm oil treatments compared with the control and flax oil treatments decreased significantly. In contrast, The concentration decreased significantly in the flax oil, vitamin C, and palm oil and vitamin C treatments compared to the flax oil treatment. In contrast, the concentration of high-density lipoproteins (HDL-C) increased significantly ($P \geq 0.05$) in the palm oil treatment compared to the rest of the treatments, while the lowest concentration was recorded. It was significantly higher in the treatment with instead of flax oil and vitamin C. The results of the analysis of low-density lipoproteins (LDL-C) showed its highest concentration in the treatment of flax oil compared to the rest of the treatments, and the ratio of HDL-C, LDL-C decreased significantly ($P \geq 0.05$) In the palm oil and palm oil and vitamin C treatments compared to the rest of the treatments, the higher glucose level in the palm oil treatment and the palm oil and vitamin C treatment may be because palm oil contains vitamins A and E, which play an important role in the metabolism of fats in the body by activating the gluconeogenesis process and stimulating the liver. The production of glucose from saturated fatty acids, led to an increase in the level of glucose and a decrease in the level of total cholesterol and triglycerides in blood serum at the same time. As for the decrease in the level of cholesterol and triglycerides in the treatment of flax oil and vitamin C, it may be that vitamin C has inhibited the secretion of the hormone corticosterone from the cortex of the adrenal gland, which is reflected in increased thyroid activity and thus reduces the level of cholesterol and triglycerides [22]. The considerable rise in albumin levels in the flax oil, palm oil, and vitamin C treatments may be due to the liver producing albumin from unsaturated or saturated fatty acids. As for the increase in the level of globulin in the blood serum of birds treated with palm oil, it is a result of its maturation and cleavage. The vaccine increased lymphocyte proliferation, which increased antibody (immune globulin) formation, and the globulin: albumin ratio increased, while the flax oil, palm oil, and vitamin C treatments decreased this ratio due to their higher albumin levels. The significant increase in the ALT enzyme is attributed to the palm oil and palm oil with vitamin C treatments, perhaps due to the stress on the liver that resulted from giving the vaccine to the mothers, which led to an increase in the enzyme concentration in the blood serum. The level of total cholesterol and triglycerides in the blood serum of birds treated with flax oil may be due to a significant increase in the ALT enzyme. It may be that the polyunsaturated fatty acids found in flax oil stimulated the pancreatic beta cells to secrete the hormone insulin, which reduced the level of glucose and increased the level of total cholesterol and triglycerides in the blood serum by stimulating it to build fat in the body. The significant decrease in the level of LDL is attributed to vitamin C in the blood serum of birds treated with palm oil and vitamin C, perhaps because palm oil contains vitamins A and E, which are cellular antioxidants, and both of them enhance the role of vitamin C in hepatic fat metabolism and mitigate the effect of saturated fatty acids. As for the high level of LDL-C in the blood serum of birds treated with flax oil, perhaps it is due to a decrease in the number of LDL-C receptors in the tissues and, thus an increase in the ratio of HDL-C: LDL-C. The ratio also increased in the treatment of flax oil and vitamin C, perhaps due to the significant decrease in the level of HDL-C. As for the decrease in the ratio between the palm oil and palm oil with vitamin C treatments, it was due to low LDL-C levels and high HDL-C levels for both treatments.

TABLE 2. The effect of treatment with flax oil, palm oil, and vitamin C on some biochemical characteristics of broiler breeder hens (Ross-308)at 48 weeks of age.

Periods	Treatment				
	Control	Flax oil 2%	Flax oil 2% and vitamin C 300 mg/kg feed	Palm oil 2%	Palm oil 2% and vitamin C 300 mg/kg feed
Glucose mg/100 ml	125.94 6.76^{c}	181.44 7.24^{b}	192.27 7.12^{ab}	190.08 16.50^{ab}	220.65 10.26^{a}
Total protein g/100 ml	4.56± 0.31^{a}	4.94±0.16^{a}	4.38±0.37^{a}	4.84±0.27^{a}	4.46 0.08^{a}
Albumin g/100 ml	2.51±0.15^{b}	3.35±0.15^{a}	2.67± 0.27^{b}	2.53± 0.20^{b}	3.36±0.07^{a}
Globulin gm/100 ml	2.05± 0.19^{ab}	1.58 0.03^{bc}	1.70± 0.23 ^{abc}	2.31±0.38^{a}	1.09±0.11^{c}
Globulin:albumin ratio	0.82±0.06^{a}	0.47± 0.02^{bc}	0.67± 0.11^{ab}	0.97±0.18^{a}	0.32± 0.03^{c}
ALT enzyme(IU/L)	13.00±1.31^{c}	13.50± 1.64^{c}	15.16± 1.35^{bc}	22.33± 3.24^{a}	21.00± 2.06^{ab}
AST enzyme(IU/L)	39.16±1.90^{a}	36.00±2.56^{a}	34.33±2.40^{a}	42.66± 4.03^{a}	41.66± 2.65^{a}
Total cholesterol (mg/100 ml)	171.96±13.06^{ab}	192.04± 5.57^{a}	145.01± 5.96^{c}	160.38± 10.59^{bc}	155.17± 3.73^{bc}
Triglycerides (mg/100 ml)	530.0± 47.70^{ab}	596.07±11.26^{a}	437.04± 37.56^{bc}	362.49± 48.59^{c}	453.99± 26.33^{bc}
HDL - C (mg/100 ml)	40.37± 4.21^{bc}	37.28± 3.09 ^{bc}	33.15± 3.42 ^{c}	59.92± 4.88 ^{a}	45.47± 1.77 ^{b}
LDL - C mg/100 ml	25.58± 2.96 ^{bc}	35.54± 3.48 ^{a}	24.44± 2.03 ^{bc}	27.96± 0.26 ^{b}	18.90± 0.30 ^{c}
LDL-C:HDL-C ratio	0.71±0.08 ^{a}	0.95± 0.05 ^{a}	0.80± 0.13 ^{a}	0.48± 0.04 ^{b}	0.41± 0.01 ^{b}

*Horizontally different letters mean there is a significant difference at the probability level ($P \geq 0.05$).

Table 3 shows the effect of flax oil, linseed oil, vitamin C, palm oil, palm oil with vitamin C on some biochemical characteristics of broiler mothers at 52 weeks of age, as the glucose concentration decreased significantly (P≥0.05) in the palm oil and vitamin C treatment compared to In all treatments, the concentration of total protein increased significantly in the flax oil and vitamin C treatments compared to the control group. As for the albumin concentration, it was not significantly affected (P≥0.05) in all treatments, and the concentration of globulin and the ratio of globulin albumin increased significantly (P≥0.05). In the flax oil, vitamin C, and palm oil treatments compared to the control group, the ALT enzyme concentration also increased significantly in the palm oil treatment compared to all treatments. As can be seen from Table 3, the a significant increase in the AST enzyme concentration in the palm oil treatment compared to the flax oil and palm oil treatments. Flax, vitamin C, palm oil, and vitamin C did not differ significantly from the control treatment. As for the concentration of total cholesterol decreased significantly (P≥0.05) in the flax oil and flax oil with vitamin C treatments compared to all treatments, and the concentration of triglycerides decreased significantly in the flax oil treatments. Flax oil, vitamin C, and palm oil compared to the control group, palm oil, and vitamin C. The concentration of HDL-C also increased significantly (P≥0.05) in the palm oil and palm oil and vitamin C treatments compared to the rest of the treatments. As for the concentration of LDL-C increased significantly in the flax oil treatment compared to the flax oil, vitamin C, palm oil, and vitamin C treatments, which did not differ significantly from the control and palm oil treatments. Regarding the ratio of HDL-C: LDL-C in the blood serum, adding vitamin C was unnecessary. The palm oil treatment had a significant effect when it was not added to it, and both decreased significantly from the rest of the treatments and control, which were not significantly different from each other. Palm oil and vitamin C therapy lowers blood glucose levels by inhibiting adrenal cortex corticosterone release and gluconeogenesis in mothers. Or the decrease is due to the ability of vitamin E present in palm oil to enhance the role of Vitamin C, which acts as an antioxidant in the cell and reduces the effect of oxidative stress, which leads to the activation of the work of body cells, including pancreatic beta cells, and thus activates the secretion of the hormone insulin, which reduces the level of blood glucose[23]. Inhibiting the gluconeogenesis process was reflected in an increase in the level of total cholesterol and an increase in blood glucose levels. The level of triglycerides in the blood serum during this treatment. As for the increase in the level of total protein and globulin in the blood serum when treated with flax oil and vitamin C, the reason may be due to the role of vitamin C in inhibiting the secretion of the hormone corticosterone, which was reflected in an increase in the division, proliferation, and maturation of lymphocytes [24] which led to an increase in the formation of antibodies (immune globulins) as a result of giving the vaccine to mothers, and this was reflected in the significant increase in the globulin: albumin ratio for that treatment. As for the increase in the globulin level and the globulin: albumin ratio for the palm oil treatment, perhaps because the oil contains fortified vitamin A. To produce antibodies and vitamin E, which increases the immune response. In addition, the vaccine given to birds may have stimulated the production of immune globulins from lymphocytes, which led to an increase in the level of globulin, which was reflected in an increase in the globulin: albumin ratio. The reason for the decrease in the level of total cholesterol and triglycerides in the treatment of flax oil, flax oil with vitamin C indicates that the polyunsaturated fatty acids contained in flax oil work to hinder the formation of cholesterol and triglycerides [25]. As for the decrease in the level of triglycerides in the treatment of palm oil, this may be because the oil contains vitamins A and E, which play an important role in fat metabolism in the body. The increase in the enzymes ALT and AST in the treatment of palm oil may be due to the stress caused to the liver by the vaccine, in addition to the saturated fatty acids. Which works to increase the effectiveness of metabolism in the liver and increases its activity. The high level of HDL-C in the palm oil and palm oil with vitamin C treatments is because palm oil contains vitamins A and E, which act as antioxidants in the cell and have enhanced the role of vitamin C in fat metabolism and raised the level of HDL-C and reducing the effect of saturated fatty acids, which led to a significant decrease in the ratio of LDL-C: HDL-C for those treatments. This indicates an improvement in the appearance of fat in the bird's body. The high level of LDL-C in the blood serum of the flax oil treatment is perhaps due to a decrease in the number of LDL-C receptors in tissues, which leads to an increase in its level in the blood. The above results agreed with the results [26], who found no significant difference in the glucose level in the blood serum of broilers (Ross) fed a diet containing 2.5% flax oil compared to birds fed a control diet.

TABLE 3. The effect of treatment with flax oil, palm oil, and vitamin C on some biochemical characteristics of broiler breeder hens (Ross-308) at 52 weeks of age.

Periods	Treatment				
	Control	Flax oil 2%	Flax oil 2% and vitamin C 300 mg/kg feed	Palm oil 2%	Palm oil 2% and vitamin C 300 mg/kg feed
Glucose mg/100 ml	200.97± 12.54[a]	196.35± 13.26[a]	230.31± 16.47[a]	193.23± 22.33[a]	144.69± 13.62[b]
Total protein g/100 ml	4.11± 0.19[b]	4.90±0.52[ab]	5.80± 0.47[a]	5.47± 0.79 [ab]	4.72± 0.36 [ab]
Albumin g/100 ml	3.55±0.15 [a]	3.12±0.26 [a]	2.94±0.28 [a]	3.07±0.29 [a]	3.55± 0.29 [a]
Globulin gm/100 ml	0.55± 0.19 [c]	1.78± 0.44 [abc]	2.86±0.52 [a]	2.40±0.63 [ab]	1.17± 0.32 [bc]
Globulin:albumin ratio	0.16± 0.06 [c]	0.59± 0.14 [abc]	1.04±0.21 [a]	0.78± 0.18 [ab]	0.35± 0.10 [bc]
ALT enzyme(IU/L)	20.00±1.94 [c]	18.66± 2.17 [c]	21.83± 1.30 [bc]	31.50±4.29 [a]	28.66± 3.05 [ab]
AST enzyme(IU/L)	48.16± 2.84 [ab]	43.66± 2.97 [b]	44.16± 2.85 [b]	58.50±7.66 [a]	56.66± 3.07 [ab]
Total cholesterol mg/100 ml	181.22± 5.19 [a]	159.86± 9.03 [b]	129.24± 9.77 [c]	197.11± 5.51 [a]	194.35± 2.57 [a]
Triglycerides mg/100 ml	534.82± 20.73 [a]	402.40± 60.94 [bc]	325.95± 46.21 [c]	404.59± 21.82 [bc]	487.76± 16.90 [ab]
HDL - C mg/100 ml	50.37± 4.23 [c]	48.82± 1.12 [c]	43.60± 1.66 [c]	91.84± 2.42 [a]	79.85± 5.33 [b]
LDL - C mg/100 ml	23.88± 3.03 [ab]	30.55± 4.48 [a]	20.45± 2.46 [b]	24.35± 0.25 [ab]	16.94± 0.11 [b]
LDL-C:HDL-C ratio	0.48±0.06 [a]	0.63± 0.10 [a]	0.46± 0.04 [a]	0.26± 0.01 [b]	0.21± 0.01 [b]

*Horizontally different letters mean there is a significant difference at the probability level (P ≥ 0.05).

It is evident from Table 4 that there is no significant difference in the size of antibodies against Newcastle disease in the blood serum of mothers of broiler chickens at the age of 46 weeks (before vaccination) at the probability level (P≥0.05), while at the age of 48 weeks (after the first vaccination). The flax oil treatment was significantly superior to the palm oil treatment and the palm oil and vitamin C treatment, and at the age of 52 weeks (after the second vaccination), the flax oil treatment was significantly superior to both the flax oil and vitamin C treatment and the palm oil treatment and the palm oil and vitamin C treatment at the probability level (P≥0.05). The high volumetric standard of antibodies is due to the fatty acids found in flax oil, especially linoleic and linolenic, which work to change the tissue structure of the cells producing antibodies and stimulate the formation of lymphocytes, which leads to stimulating them to produce antibodies when vaccinated against the disease [27]. The decrease in the volumetric standard of antibodies in palm oil treatment may be due to the palm oil containing saturated fatty acids that reduce the production of antibodies against Newcastle disease by reducing the immune response [28]. The results agreed with [29], who used palm oil, soybean oil, and flax oil in the diets of cobb broilers, which led to a significant decrease in the measurement of antibodies against Newcastle disease in the blood of chickens ingested with palm oil compared to the measurement of antibodies in the blood of chickens ingested flax oil. The findings coincided with the researcher [30], who employed vitamin C at (0, 10, 50, 100, 200) mg/kg feed and found no significant change in Newcastle disease antibodies in grill chicken blood serum by percentage.

TABLE 4. The effect of treatment with flax oil, palm oil, and vitamin C on the size of antibodies against Newcastle disease in the blood serum of broiler breeder hens (Ross 308).

Periods	Treatment				
	Control	Flax oil 2%	Flax oil 2% and vitamin C 300 mg/kg feed	Palm oil 2%	Palm oil 2% and vitamin C 300 mg/kg feed
At 46 weeks	11320±1284.89[a]	13101± 71.80[a]	12828± 728.83[a]	12489± 785.43[a]	10727± 391.5 [a]
At 48 weeks	14998± 507.29[ab]	16715.3±758.31[a]	14723± 699.29[ab]	13520± 764.91[b]	13363± 759.39[b]
At 52 weeks	13568± 591.42[ab]	15697± 517.21 [a]	12756± 1485.08[b]	12332± 407.37 [b]	11247± 520.40 [b]

*Horizontally different letters mean there is a significant difference at the probability level (P ≥ 0.05).

It is clear from Table 5 that the treatments of flax oil and palm oil with or without the addition of vitamin C improved the differential ratio of heterophils, as it decreased significantly in these treatments compared to the control treatment at the probability level (P≥0.05), as well. These treatments increased the differentiation rate of monocytes and reached a significant level in the flax oil treatment compared to the control treatment. As for the stress factor (heterophil: lymphocyte (H/L) ratio), the four treatments improved this characteristic, as it decreased significantly in the flax oil treatment. Vitamin C and palm oil treatment and palm oil with vitamin C treatment compared with the control

treatment at the probability level (P≥0.05). The improvement in the stress coefficient, especially in the treatments to which vitamin C was added, is due to the role that vitamin C plays in reducing the secretion of the hormone corticosterone, which leads to an increase in the resistance of internal organs such as the liver and kidneys, which leads to a reduction in the percentage of H/L ratio [31]. While the treatments did not have any significant effect on the differential ratio characteristics of eosinophils, basophils, and lymphocytes at the probability level (P≥0.05) compared to the control treatment, it may be that the polyunsaturated fatty acids present in flax oil, such as linoleic acid, have led to the stimulation of the organs. Lymph nodes such as the Fabricia gland and the spleen produce lymphocytes[28]. Although it was a mathematical increase, it contributed to reducing the stress factor. As for the decrease in the stress factor in the treatment of palm oil, perhaps because palm oil contains vitamins A and E, which have a positive effect on the lymphatic organs. The above results agreed with the results [29], Who used palm oil, soybean oil, and flax oil in the cobb broiler diet, and did not find a significant difference in the percentage of (H/L) ratio) (stress factor) between the palm oil and flax oil diets.

TABLE 5. The effect of treatment with flax oil, palm oil, and vitamin C on the differential percentage of white blood cells and the stress factor heterophil:lymphocyte ratio (H/L ratio) of broiler breeder hens (Ross-308).

Studied attributes	Treatment				
	Control	Flax oil 2%	Flax oil 2% and vitamin C 300 mg/kg feed	Palm oil 2%	Palm oil 2% and vitamin C 300 mg/kg feed
Heterophil %	40.16± 0.30 [a]	35.50± 2.07 [b]	35.50± 0.92 [b]	35.16± 1.13 [b]	34.66± 1.28 [b]
Eosinophil %	4.83± 0.30 [a]	4.83± 0.60 [a]	4.83± 0.47 [a]	5.50± 0.22 [a]	5.83± 0.30 [a]
Basophil %	0.83± 0.16 [a]	1.00± 0.00 [a]	1.00±0.00 [a]	1.00±0.00 [a]	1.00± 0.00 [a]
Lymphocyte %	52.16± 0.60 [a]	54.16± 2.18 [a]	56.00± 1.09 [a]	55.33± 0.61 [a]	54.33± 1.05 [a]
Monocyte %	2.00± 0.68 [b]	4.50± 0.56 [a]	3.50± 0.80 [ab]	3.16± 0.79 [ab]	4.16± 0.60 [ab]
Stress factor (H:L ratio) (Heterophil: lymphocyte ratio).	0.76± 0.004 [a]	0.67± 0.06 [ab]	0.63± 0.01 [b]	0.63± 0.02 [b]	0.64± 0.03 [b]

*Horizontally different letters mean there is a significant difference at the probability level (P ≥ 0.05).

Conclusions

The addition of flax oil to the diets of broiler mothers led to a decrease in the concentration of enzymes ALT and AST mathematically. The level of cholesterol and triglycerides significantly, and adding vitamin C significantly increased both the concentration of total protein and globulin and the proportion of globulin: albumin, but adding palm oil has increased significantly the concentration of both globulin and the proportion of globulin: albumin, HDL-C and ALT, and decreased significantly the concentration of triglycerides and the proportion of HDL-C: LDL-C and by adding vitamin C, the concentration of glucose and the proportion of HDL-C: LDL-C decreased and the concentration of HDL-C and ALT increased significantly. The volumetric standard of antibodies against Newcastle disease did not differ significantly for all treatments except for the flax oil treatment, which outperformed all treatments by 52 weeks of age. Broiler mothers' diets with vegetable oils reduce the differential ratio of white blood cells, specifically heterozygous cells and heterocytes/lymphocytes. In contrast, flax oil greatly enhanced mononuclear cell percentage.

Conflicts of interest

There is no conflict of interest.

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تأثير نوع الزيت النباتي وفيتامين C في بعض الصفات الفسيولوجية والحالة المناعية لإمهات فروج اللحم

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اجري البحث على أمهات فروج اللحم نوع (Ross 308) لمعرفة تأثير زيت الكتان وزيت النخيل وفيتامين C في الأداء الفسلجي والحالة المناعية. قُسِّمَت الأمهات إلى 5 معاملات (20دجاجة و4 ديكة/معاملة)، المعاملة الأولى (سيطرة)، المعاملة الثانية (2% زيت الكتان)، المعاملة الثالثة (2% زيت الكتان + فيتامين C 300ملغم/كغم علف)، المعاملة الرابعة (2% زيت النخيل)، المعاملة الخامسة (2% زيت النخيل + فيتامين C 300ملجم/كجم علف). تم تلقيح الأمهات ضد مرض النيوكاسل بعمر46 و50 أسبوع، وتم جمع نماذج الدم خلال البحث، بينت النتائج أن إضافة زيت الكتان خفض معنوياً (أ≥0,05) مستوى الكولسترول والكليسريدات الثلاثية وبإضافة فيتامين C ارتفع معنوياً كل من تركيز البروتين الكلي والكلوبيولين ونسبة الكلوبيولين: الألبومين وانخفض معنوياً مستوى الكولسترول والكليسريدات الثلاثية مقارنةً مع السيطرة، إن إضافة زيت النخيل أدى إلى ارتفاع معنوي بتركيز كل من الكلوبيولين ونسبة الكلوبيولين: الألبومين وHDL – C وALT معنوياً، وخفض تركيز الكليسريدات الثلاثية ونسبة HDL – C : LDL – C معنوياً. وبإضافة فيتامين C انخفض معنوياً تركيز الكلوكوز و HDL – C : LDL – C وارتفع معنوياً تركيز HDL – C وALT. ولم يختلف المعيار الحجمي للأجسام المضادة ضد مرض النيوكاسل معنوياً لجميع المعاملات ماعدا معاملة زيت الكتان التي تفوقت على المعاملات بعمر52 أسبوع، وانخفضت معنوياً نسبة الخلايا المتغايرة ونسبة الخلايا المتغايرة/ الخلايا اللمفاوية وارتفعت معنوياً نسبة الخلايا وحيدة النواة لمعاملة زيت الكتان مقارنةً مع السيطرة.

الكلمات المفتاحية : زيت الكتان، زيت النخيل، فيتامين C ، أمهات فروج اللحم.