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Effect of adding pumpkin and flax oil to diets on the meats physical and chemical traits of broilers

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Abstract

This study was conducted in the fields of Animal Production Department/ Faculty of Agriculture/ Tikrit University during the period from 9th April, 2019 to 14th May, 2019 to know effect of adding pumpkin and flax oil to the diets on physical and chemical traits of the broiler meat. 480 day old chicks (Ross-308) were randomly distributed to eight treatments, each group was divided to three replicates (20 birds/replicate). T1 was a standard feed without supplementation, T2 was standard feed with 50 mg/kg feed of Neomycin antibiotic (positive control), while T3, T4 and T5 diets which sunflower Oil in the control diets replaced with pumpkin seed oil at concentrations 0.5, 1 and 1.5 %, respectively, otherwise T6, T7 and T8 diets replaced with flaxseed oil at concentrations 0.5, 1 and 1.5 %, respectively. The results showed significant decrease ($P \leq 0.05$) in T1, T3, T5, T6 and T8 compared to T2 in the drip loss but the treatments did not differ significantly in the thawing loss, all treatments decreased significantly in the loss during cooking and water holding capacity compared with T2. All treatments increased significantly ($P \leq 0.05$) in the myoglobin concentration compared with T1 except T4 and T7. The cholesterol concentration of meat decreased in all treatments compared to T1. T5 and T8 increased significantly compared with other treatments in pH of meat. All treatments decreased significantly ($P \leq 0.05$) except T4 and T5 compared to T2 in the percent of meat moisture. T6 increased significantly in protein percent compared with T2. All treatments decreased significantly compared with T2 in the fat percent. Ash percent in meat did not differ significantly among treatments. All oxidation indicators such as Thiobarbituric acid (TBA), Peroxide Value (PV) and Free Fatty Acids (FFA) increased significantly ($P \leq 0.05$) compared to T1 for meat stored in the freeze for one and half month. The percentage of all fatty acids increased significantly ($P \leq 0.05$) compared to T1 and T2.

Keywords: broilers, pumpkin oil, flax oil, meat traits, oxidation index.

1. Introduction

Poultry meat mainly the broilers meat one of the main food sources used to raise the rate of people's consumption of animal protein quickly, as it contributes significantly to human food due to its high nutritional value, it is rich in protein, which is characterized by high biological value, fats, minerals especially calcium and phosphorus as well as Vitamins, poultry meat is delicious, palatable, easy to digest, soft and soft, and is also characterized by low fat and cholesterol in poultry meat, making it suitable for human health compared with ruminants meat [1]. Due to increasing global demand for healthy poultry meat, the researchers have paid attention in recent decades to enhancing the health properties of poultry meat especially its fat content and the types and content of fatty acids through many mechanisms such as adding oils that are rich in fatty acids, especially linoleic and linolenic to produce poultry meat rich in these fatty acids [2,3]. The researchers directed to add oils to poultry diets to increase appetite, improve digestion and stimulate natural growth in live birds, as well as have antimicrobial effects [4]. These oils are pumpkin and flax oil, which are rich in unsaturated fatty acids, especially Omega-3 and Omega-6, which are considered the most important essential fatty acids that the body cannot produce it also it considered very important for heart health, reducing high blood pressure, eye and skin safety [5,6]. The researchers [7] found high significant ($P \leq 0.01$) in pH and water holding capacity of broilers meat which were fed on diet that containing flax oil but did not find significant differences ($P \leq 0.05$) among treatments in the dripping loss, thawing loss, cooking loss as well as the percent of moisture, protein, fat and ashes in the broilers meat (breast and thigh). The researchers [8] did not find significant differences ($P \leq 0.05$) among treatments in the percent of moisture, protein and fat in broiler meat that fed pumpkin oil. The researchers [9] found significant increase ($P \leq 0.05$) in the percentage of linoleic and linoleic and oleic fatty acids but found significant decrease in palmitic and stearic in Guinea fowl meat which are fed on pumpkin and flax seeds. In a study conducted by [10] there was a significant increase ($P \leq 0.05$) in the value of peroxide PV and TBA at 5 weeks of age and they did not find significant differences in the percentage of free fatty acids in the quail's meat.



The aims of study to know the effect of adding pumpkin and flax oil to dietary on the physical and chemical traits of broiler meat (Ross-308).

2. Materials and methods

The experiment was conducted in the broilers house field of Animal Production Department / College of Agriculture / Tikrit University during the period from 9th April to 14th May in 2019 to knowing effect of adding pumpkin oil and flax in dietary on the physical and chemical characteristics of the broilers meat. 480 day old broiler chick (308 Ross) with average weight about 43 grams were distributed to eight treatments; each treatment was divided to three replicates (20 birds/ repeats). The birds were rearing in pens were dimensions (2×2)m. The lighting was continuous for 24 hours / day. Feed and water were provided ad libitum throughout the study period (35days). The birds were fed on three diets table (1). T1 were given a standard feed (control) without supplementation, T2 a standard feed added 50 mg / kg feed from the Neomycin antibiotic (positive control), otherwise T3, T4 and T5 diets which sunflower Oil in the control diets replaced with pumpkin seed oil at concentrations 0.5, 1 and 1.5 %, respectively, otherwise T6, T7 and T8 diets replaced with flaxseed oil at concentrations 0.5, 1 and 1.5 %, respectively.

The birds were slaughtered at the age of 35 days, then the carcasses were weighed and placed them in polyethylene bags, the physical characteristics of the meat were calculated after carcasses chilling(4 °C) for one day according to[12]. The thawing loss was calculated after the frozen carcasses (-18 °C) for 3 days, according to[13]. The percentage of weight loss during cooking (barbecue) was calculated according to[14]. The water holding capacity was calculated by pressed the meat according[15]. The chemical properties of meat, such as the myoglobin concentration in meat were measuring by spectrophotometer according to the method[16]. The cholesterol concentration of meat was estimated using standard solutions prepared by the French company (Biolab), according to[17]. PH was estimated by placing the PH Meter directly in the meat piece and reading the pH number. The chemical analysis of meat such as percentage of moisture, protein, fat and ash according to[18]. The fatty acids concentrations in the meat were estimated of the Gas Chromatography according to what he indicated[19]. The oxidation indicators in the meat that stored in the freeze for one and half month, such as the value of peroxide and free fatty acids was estimated according to the method[20]and the estimation of Thiobarbituric acid according to the method of[21].

Table 1. Primary feed materials that used in starting, growth, and final rations for broiler with the chemical composition calculated of feed.

Ingredients	Starter ration%	Grower ration%	Final ration%
Yellow corn	56.22	59.40	63.87
Soybean meal(48%)	34	30.30	25.20
Animal protein*	5	5	5
oil	2	2.93	3.76
Di Phosphate Calcium	0.43	0.21	0.05
Limestone	1.66	1.59	1.55
lysine	0.19	0.13	0.13
Methionine + cysteine	0.25	0.19	0.16
Normal salt	0.25	0.25	0.28
Total	100%	100%	100%
**chemical composition			
Metabolic energy(kilocalorie/kg feed)	3000	3100	3200
Crude protein%	23.09	21.5	19.5
Crude fibers%	3.77	3.5	3.32
Lysine%	1.44	1.29	1.16
Methionine%	0.496	0.479	0.456
Methionine + cysteine%	1.09	0.998	0.91
Calcium%	0.962	0.874	0.80
Phosphor%	0.483	0.436	0.397

* Use the Brocon-5 Special W protein concentrate produced by the Dutch company WAFI, which contains 40% crude protein, 5% crude fat, 3.04% calcium, 5.39% phosphor available, lysine 3.85%, methionine 3.70%, methionine + cysteine 4.13%, Representative energy 2157 kcal / kg, crude fiber 3.20%, sodium 2.40%, chloride 4.16%, 200,000 IU / kg vitamin A, 80,000 IU / kg vitamin D3, 600 mg / kg vitamin E, 60 mg / kg vitamin B1 , 140 mg / kg vitamin B2, 80 mg / kg vitamin B6, 700 mg / kg vitamin B12, 2 mg / kg vitamin H (biotin), 800 mg / kg niacin, 20 mg / kg folic acid, 50 mg / kg vitamin K.

** The chemical composition of diets was calculated according to [11].

The study data analyzed by using [22] and using the complete random design (CRD) to study the effect of the treatment on the different characteristics and compare the means by using the Duncan multi-range test to find the significant differences between them [23].

3. Results and discussion

Table (2) shows the effect of pumpkin and flax oil on the physical characteristics of the broilers meat, a significant decrease ($P \leq 0.05$) was observed in the drip loss of carcasses in T3, T5, T6 and T8 compared with T2 and did not differ compared with T1. The treatments did not significant differ ($P \leq 0.05$) in thawing loss of carcasses, although the value of T4 and T6 decreased compared to T1 and the value of T7 decreased compared to T1 and T2. A significant decrease ($P \leq 0.05$) were found in cooking loss in all treatments compared with T2 which showed the highest value (33.20%) and did not differ compared with T1 except T8. The water holding capacity all treatments except T7 showed a significant decrease ($P \leq 0.05$) compared with T2 which showed the highest values (30.16%) then T7 was (26.33%) but the treatments did not differ significantly with T1.

Table 2. Effect of adding pumpkin and flax oil to dietary on the loss of exudate liquid and the loss during dissolution (%) of broiler meat carcasses (Mean \pm standard error).

Treatments	Drip loss%	Thawing loss%	Cooking loss%	WHC%
T1	0.54 \pm 0.10 c	1.73 \pm 0.11	25.03 \pm 0.84 bc	24.16 \pm 1.45 bc
T2	1.07 \pm 0.19 ab	1.99 \pm 0.35	33.20 \pm 1.38 a	30.16 \pm 1.16 a
T3	0.42 \pm 0.22 c	2.08 \pm 0.14	21.03 \pm 1.81 cd	19.66 \pm 0.60 c
T4	0.67 \pm 0.05 bc	1.94 \pm 0.41	24.83 \pm 1.53 bc	22.83 \pm 1.30 bc
T5	0.53 \pm 0.07 c	2.35 \pm 0.15	21.90 \pm 0.49 bcd	24.33 \pm 0.16 bc
T6	0.55 \pm 0.10 c	1.88 \pm 0.21	25.73 \pm 0.76 b	21.16 \pm 2.02 c
T7	1.17 \pm 0.18 a	1.60 \pm 0.10	24.83 \pm 0.27 bc	26.33 \pm 3.03 ab
T8	0.56 \pm 0.08 c	2.07 \pm 0.40	19.20 \pm 1.87 d	22.33 \pm 0.44 bc
Significant level	*	NS	*	*

T1- standard feed, T2 standard feed added 50 mg / kg feed, neomycin antibiotic, T3, T4, T5 feed diets with pumpkin oil at 0.5, 1, 1.5%, respectively. T6, T7, T8 diets with added flax oil 0.5, 1, 1.5%, respectively.

- Different characters in the same column indicate significant differences between means of treatments ($P \leq 0.05$).

This result differed with [24, 25, 26], while this finding was consistent with [7]. The decrease in the drip loss, the thawing loss and cooking loss due to the increase in the weights of the bird carcasses that were fed on pumpkin and flax oil and these oils are contain phenolic compounds that act as antioxidants that contribute to the protection and stability of the cellular composition of meat and fats as well as act to protecting of sarcoplasm and fluid components in the cellular membranes surrounding the muscle fibers from the oxidative damage resulting from the formation of free radicals that cause the damage of these membranes, which increases the ability of muscles to hold water and less fluid loss [27]. The significant decrease in water holding capacity in some treatments, due decreases the percentage of muscle protein, which reduces the amount of water retained and linked to protein and the lack of free water [28].

The chemical tests of meat in table (3) shows the effect of pumpkin and flax oil on the concentration of myoglobin, pH and cholesterol concentration of broilers meat. Significant increased ($P \leq 0.05$) was observed in T4, T5, T7 and T8 compared with T1 in myoglobin, pH and cholesterol concentration of broilers meat but the other treatments did not differ significantly with T2. T5 and T8 showed a significant increase ($P \leq 0.05$) compared with T1 and T2 and other treatments in PH of meat. This result differed with [29, 30]. However, the concentration of cholesterol in meat decreased significantly in all treatments ($P \leq 0.05$) compared with T1 which recorded the highest values. This result was consistent with [31, 32]. The reason for the high level of myoglobin concentration of meat in most treatments that fed pumpkin and flax oil due to these oils are contain phenolic compounds that act to stabilize the color of the meat and maintain the myoglobin pigment despite its presence in poultry meat in small amounts by stopping the formation of free radicals that producing from the oxidation process of fats that helping of pigment oxidation and the transformation the brown colour of meat as a result of the metmyoglobin formation that containing Fe⁺ [33]. The significant increase in the pH of the meat due to the difference in the way stress treated before slaughter to some birds which are reduces the amount of muscle glycogen that keeps the muscle pH high [34]. The reason for

low concentration of cholesterol in the thigh meat of the treatments of birds that were fed on pumpkin and flax oil are due to these oils contain high concentrations of linolenic acid enhance trace it in meat and act to fat oxidizes well as increase metabolic processes and decrease the percentage of fat in the tissues and thus decrease cholesterol concentration in the Meat[35,36].

Table 3. Effect of adding pumpkin and flax oil to dietary on concentration of mycyclopin (mg/gm), cholesterol (mg/10g) and pH of the thigh carcass (average \pm stand error).

Treatments	Meat myoglobin	Meat PH	Meat Cholesterol
T1	1.31 \pm 0.12 d	5.63 \pm 0.08 c	21.25 \pm 0.38 a
T2	5.09 \pm 0.08 a	5.66 \pm 0.03 c	2.18 \pm 0.25 c
T3	1.66 \pm 0.31 cd	5.76 \pm 0.03 c	8.73 \pm 0.25 b
T4	4.92 \pm 0.36 ab	5.63 \pm 0.03 c	3.78 \pm 0.14 c
T5	2.38 \pm 0.47 c	5.93 \pm 0.03 ab	4.51 \pm 0.14 c
T6	2.07 \pm 0.05 cd	5.70 \pm 0.05 c	9.60 \pm 2.01 b
T7	4.39 \pm 0.36 ab	5.80 \pm 0.05 bc	4.65 \pm 0.77 c
T8	4.18 \pm 0.10 b	6.03 \pm 0.03 a	10.91 \pm 0.25 b
Significant levels	*	*	*

T1- standard feed, T2 standard feed added 50 mg / kg feed, neomycin antibiotic, T3, T4, T5 feed diets with pumpkin oil at 0.5,1,1.5%, respectively. T6, T7, T8 diets with added flax oil 0.5,1,1.5%, respectively.

- Different characters in the same column indicate significant differences between means of treatments ($P \leq 0.05$).

Table (4) shows the effect of pumpkin and flax oil on the chemical composition of thigh of broiler. There were significant decrease ($P \leq 0.05$) between the treatments of the moisture percent of thigh in T3, T6, T7 and T8 compared with T2 and did not different these treatments with T1. The protein percent of meat the treatments did not differ compare with T1 and T2, except significant increase ($P \leq 0.05$) in T6 compared with T2. The fat percentage, all treatments showed a significant decrease ($P \leq 0.05$) compared to T2 which reached the highest values(9.66%) but did not differ compared with T1.

Table 4. Effect of adding pumpkin and flax oil to dietary on the chemical composition (%) of the femoral segment of broiler carcasses (mean \pm standard error).

Treatments	Moisture %	Protein %	Fat %	Ash %
T1	71.16 \pm 0.32 cd	17.18 \pm 2.01 ab	8.37 \pm 0.32 b	1.61 \pm 0.27
T2	72.76 \pm 0.56 ab	15.23 \pm 1.79 b	9.66 \pm 0.45 a	1.54 \pm 0.31
T3	71.30 \pm 0.25 cd	20.23 \pm 2.37 ab	7.04 \pm 0.49 cd	1.61 \pm 0.19
T4	72.13 \pm 0.18 bc	15.23 \pm 1.79 b	7.18 \pm 0.21 cd	1.34 \pm 0.20
T5	73.50 \pm 0.26 a	17.18 \pm 2.01 ab	6.37 \pm 0.27 d	1.23 \pm 0.18
T6	70.83 \pm 0.46 d	23.53 \pm 2.79 a	8.65 \pm 0.20 b	1.05 \pm 0.05
T7	56.04 \pm 0.75 cd	19.13 \pm 2.24 ab	8.61 \pm 0.04 b	1.25 \pm 0.02
T8	71.63 \pm 0.31 cd	14.98 \pm 1.74 b	7.98 \pm 0.27 bc	1.32 \pm 0.11
Significant level	*	*	*	NS

T1- standard feed, T2 standard feed added 50 mg / kg feed, neomycin antibiotic, T3, T4, T5 feed diets with pumpkin oil at 0.5,1,1.5%, respectively. T6, T7, T8 diets with added flax oil 0.5,1,1.5%, respectively.

- Different characters in the same column indicate significant differences between means of treatments ($P \leq 0.05$).

The results did not significant differences ($P \leq 0.05$) between treatments in the ash percentage of the thigh meat. This result differed with[8,29]. The low moisture content in thigh meat of most treatments that were fed on pumpkin and flax oil due to the high protein content in them due to an inverse relationship between the percentage of moisture and the percentage of protein in the meat[34]. The high protein content due to contain these oils a high percentage of Omega3, which is linked to with phospholipids in the cell membrane of muscle, this linked improves the effectiveness of the insulin hormone, which increases the efficiency of food utilization and increases protein building by act to reduce the pathways of protein breakdown[37]. The significant decrease of thigh fat percentage due to increase the percentage of fatty acid linolenic in the meat that act to fat oxidize and increase metabolic processes thus the lower fat percentage in the tissues[38].

Table (5) shows the effect of pumpkin and flax oil on the fatty acids percentage of broiler meat there was a significant increase ($P \leq 0.05$) in the percent of linoleic and palmitic fatty acids in T5, T6 and T8 compared with T1, T2 and other

treatments. Significant increase ($P \leq 0.05$) also in the percentage of oleic fatty acid in all treatments compared with T1 and T2 except T6, which did not differ significantly compared with them. T6 and T8 increased significantly ($P \leq 0.05$) compared to T1 and T2 in stearic and linolenic acid percentage and other treatments did not differ compared with T1 and T2.

Table 5. Effect of adding pumpkin and flax oil to dietary on the percentage of fatty acids% in thigh meat of broilers (mean \pm standard error).

Treatments	Lenolic %	Olic %	Stearic %	Palmetic%	Lenolinic %
T1	0.032 \pm 0.005 d	0.437 d \pm 0.06 d	0.014 \pm 0.0005 c	1.105 \pm 0.05 d	0.0013 \pm 0.0006 c
T2	0.030 \pm 0.009 d	0.440 \pm 0.051 d	0.015 \pm 0.005 c	1.139 \pm 0.03 d	0.0015 \pm 0.0002 c
T3	0.041 \pm 0.006 d	3.661 \pm 0.236 a	0.068 \pm 0.016 c	1.638 \pm 0.19 d	0.0025 \pm 0.0002 bc
T4	0.061 \pm 0.016 cd	2.674 \pm 0.591 ab	0.041 \pm 0.0006 c	1.223 \pm 0.12 d	0.0023 \pm 0.0001 bc
T5	0.126 \pm 0.009 bc	1.609 \pm 0.132 c	0.132 \pm 0.012 bc	3.250 \pm 0.12 bc	0.0037 \pm 0.001 bc
T6	0.150 \pm 0.023 b	1.224 \pm 0.125 cd	0.211 \pm 0.115 b	4.862 \pm 0.51 a	0.0045 \pm 0.0006 bc
T7	0.021 \pm 0.011 d	3.661 \pm 0.236 a	0.047 \pm 0.001 c	2.107 \pm 0.05 cd	0.0022 \pm 0.0006 bc
T8	0.326 \pm 0.055 a	2.140 \pm 0.588 bc	0.561 \pm 0.013 a	4.015 \pm 1.16 ab	0.0134 \pm 0.001 bc
Significant level	*	*	*	*	*

T1- standard feed, T2 standard feed added 50 mg / kg feed, neomycin antibiotic, T3, T4, T5 feed diets with pumpkin oil at 0.5, 1, 1.5%, respectively. T6, T7, T8 diets with added flax oil 0.5, 1, 1.5%, respectively.

- Different characters in the same column indicate significant differences between means of treatments ($P \leq 0.05$).

These results were agree with [9,29]. The reason for the high fatty acids in the thigh for most treatments that were fed on pumpkin and flax seed oil is that it contains a high percentage of unsaturated fatty acids, especially the linoleic and linoleic fatty acids, which leads to an increase in the deposition of the polyunsaturated fatty acids in meat [36,39].

Table (6) shows the effect of pumpkin and flax oil in estimating the oxidative indicators in broiler meat that stored in the freeze for a one and half month. All treatments showed a significant increase ($P \leq 0.05$) in the Peroxide Value (PV) compared with T1, which showed the lowest values on the other hand there was a significant decrease in all treatments ($P \leq 0.05$) except for T3 and T5 compared with T2. The results showed a significant increase in all treatments ($P \leq 0.05$) compared with T1 in the concentration of Thiobarbituric acid (TBA) and did not differ compared with T2 except for the significant increase ($P \leq 0.05$) in T6, T7 and T8 compared to T2. The percentage of free fatty acids (FFA) all treatments showed significant increase ($P \leq 0.05$) compared with T1 and did not differ compared with T2 except T8.

Table 6. Effect of adding pumpkin and flax oil to dietary on oxidation indicators for thigh meat of broilers (mean \pm standard error).

Treatments	PV Milliequivalent/kg	TBA mg Malondialdehyde /kg	FFA %
T1	0.22 \pm 0.01 e	2.02 \pm 0.02 g	1.01 \pm 0.005 d
T2	0.31 \pm 0.008 c	3.48 \pm 0.04 b	2.17 \pm 0.003 bc
T3	0.30 \pm 0.003 c	3.62 \pm 0.01 a	2.14 \pm 0.003 c
T4	0.26 \pm 0.006 d	3.28 \pm 0.01 c	2.15 \pm 0.01 bc
T5	0.31 \pm 0.008 c	3.56 \pm 0.008 a	2.16 \pm 0.005 bc
T6	0.35 \pm 0.006 b	2.92 \pm 0.03 e	2.18 \pm 0.003 b
T7	0.37 a \pm 0.003	2.76 \pm 0.008 f	3.05 a \pm 0.02
T8	0.39 a \pm 0.006	3.02 \pm 0.006 d	2.17 bc \pm 0.003
Significant level	*	*	*

T1- standard feed, T2 standard feed added 50 mg / kg feed, neomycin antibiotic, T3, T4, T5 feed diets with pumpkin oil at 0.5,1,1.5%, respectively. T6, T7, T8 diets with added flax oil 0.5,1,1.5%, respectively.

- Different characters in the same column indicate significant differences between means of treatments ($P \leq 0.05$).

This finding was agree with [3,10]. From the results appear the treatments of pumpkin and flax oil to increase in oxidative values and this causing increase in rancidity in broiler meat due to increase the unsaturated fatty acids of meat such as linoleic acid and linolenic which is rapidly rancid compared with other saturated fatty acids [40]. The high peroxide values in meat also it may due to resulting from the increase in polyunsaturated fatty acids in the meat because of the process of fat oxidation by the lipolysis enzymes such as the enzyme Phospholipase and Lipase which act to release the FFA that causing the off odor in the meat that may be rejected by the consumer when increasing storage period [41].

We conclude the pumpkin and flaxseed oil improve most physical and chemical traits of broiler meat and increase unsaturated fatty acids and increased also all peroxidase indicates except peroxide value in broilers meat.

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