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Article

Fatty acids profile and quality characteristics of broiler chicken meat fed different dietary oil sources with some additives

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Abstract

The study was carried out to investigate the effect of feeding broiler chicken on different vegetable oils with feed additives on the quality characteristics of chicken meat. A total of 216 one-day-old chicks of Hubbard strain were randomly assigned to six dietary treatments as (2×3) factorial designs where two sources of dietary oil with three levels of commercial multi-enzyme feed additives. Treatments were: soybean oil only (T1), soybean oil+ ZAD (T2), soybean oil + AmPhi-BACT (T3), palm oil only (T4), palm oil + ZAD (T5) and palm oil + AmPhi- BACT (T6). Results showed that feeding broiler chickens on different types of dietary oils had significant effect on the fatty acid profile of broiler chicken meat. UFA/SFA ration of broiler chicken fed palm oil were significantly lower compared with those fed soybean oil. Broiler fed on soybean oil had significantly higher n-6: n-3 ration compared with broiler fed on palm oil. Regardless of the source of dietary oil, significant differences were observed in the most of fatty acid profile in the chicken meat among levels of commercial multi- enzyme feed additives. Meat of T5and T6 had the higher pH value, followed by meat of T1and T3 groups, while the lowest pH value found in meat of T2 and T4. The higher cooking loss was found in meat of T4 while, meat of T5had the lowest value. Data of chilling loss indicated that the differences between dietary treatments were not significantly different except for meat of T6 which had the higher chilling loss. No significant differences were found in color measurements between dietary treatments.

KEYWORDS

Broiler feed, Fat source, Commercial multienzyme, chicken meat, fatty acid, Quality characteristics.

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1 Introduction

Poultry feeding is one of the most important aspects of poultry production. Therefore, for profitable poultry rearing, provision of economical and balanced feed is due. Fats constitute the main energetic source for poultry and they have the highest caloric value among all the nutrients (Anjum et al., 2004). Poultry meat contains high and low total fat content and, more importantly a higher monounsaturated and polyunsaturated fatty acid (MUFA and PUFA) content than other meats (Howe et al., 2006). Currently, consumers are more concerned about their food, especially nutritional aspects. Among the nutritional aspects of food, lipid content and fatty acid profile are the most important factors (Bostami, et al., 2017). Plant oils have commonly been used as energy sources in diets of broiler chicks (Jalali et al., 2015). Advantages of utilizing oils in poultry diet include decrease of feed dust, increase in absorption and hydrolysis of lipoproteins supplying the essential fatty acids, (Nobakht et al., 2011). The fatty acid content of broiler meat depends on the type of diet intake by the birds (Crespo & Esteve-Garcia, 2002).

Enzyme such as microbial phytase has been used as commercial feed additive in broiler feed production to improve nutritive values of plant based diets. Inclusion of exogenous enzyme in animal's diet has been shown to improve broiler's performance (Wang, et al., 2013) but the effect on meat quality has to be determined as certain feed additives have been found to affect Performance and carcass characteristics (Omojola, et al., 2014) .

Therefore, the objective of this study was to determine the effect of palm oil and soybean oil with or without addition of feed additives in finisher diets on the fatty acids profile of chicken meat and to examine the impact of these oils and feed additives on the quality characteristics of meat such as color measurements, pH value, chilling and cooking loss.

2 Material and method

2.1 Experimental Design

The experimental procedures were approved by the Poultry Production Department, Faculty of Agriculture, Ain Shams University and as followed by the Animal Breeding Department, Animal and Poultry Production Division, Desert Research Center.

The current study was conducted at Poultry Experimental Unit, Faculty of Agriculture, Ain Shams University, located in Agricultural Research Station, Shalaqan, Qalyobia Governorate, Egypt. The experiment was a 2 × 3 factorial design with two sources of vegetable oils (soybean oil and palm oil) with three levels of commercial multi-enzyme feed additives included (ZAD which contains bacteria (Ruminococcus flavefaciens) with concentration of (28 x 104). Also it contains a mixture of enzymes (Cellulase - Xylanase - α-Amylase -Protease). AmPhi-BACT, which contains bacteria (Lactobacillus acidophilus) and (Lactobacillus planterum) and (Bifidobacterium bifidum) and extract ferment of both (Bacillus subtilus) and (Aspergillus niger) with concentration of 5 g / kg and also contains a mixture of enzymes that is estimated as 34.5 units / gram, that is equivalent to 2 g / kg (Cellulase - Beta-glucanase - Hemicellulase).

A total of 216 one-day-old chicks of Hubbard strain were used for this study, the chicks were randomly assigned to six treatment groups. Each group included six replicates and each replicate was made up of six chicks. The basal diet was formulated to meet the nutrient

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requirements of broiler chicken following the National Research Council (NRC, 1994) as shown in Table (1). Diets were offered in three feeding phases, starter from one-day-old to 11 days (basal diet – without additives - all birds), grower from 12 to 22 days (basal diet - without additives - all birds) and finisher from 23 to 35 days (experimental diets specified per treatment).

Table 1: Feed ingredients and chemical analyses of experimental diets

	Starter (0-11)	Grower (12-22)	Finisher (23-35)					
Ingredients			**T1**	**T2**	**T3**	**T4**	**T5**	**T6**
Corn (grains)	52.05	55.91	56.80	56.80	56.80	56.80	56.80	56.80
Soybean Meal (44%)	31.50	30.00	28.25	28.25	28.25	28.25	28.25	28.25
Corn Gluten Meal (62%)	7.20	4.86	4.40	4.40	4.40	4.40	4.40	4.40
Soybean Oil	3.00	3.65	5.00	5.00	5.00	-	-	-
Palm Oil	-	-	-	-	-	5.00	5.00	5.00
Wheat Bran	2.00	1.50	2.00	2.00	2.00	2.00	2.00	2.00
Di-Calcium Phosphate	1.85	1.60	1.34	1.34	1.34	1.34	1.34	1.34
Calcium Carbonate	1.30	1.50	1.35	1.35	1.35	1.35	1.35	1.35
Premix*	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Salt (NaCl)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
DL-Methionine	0.29	0.28	0.21	0.21	0.21	0.21	0.21	0.21
L-Lysine HCL	0.21	0.10	0.05	0.05	0.05	0.05	0.05	0.05
Total	100	100	100	100	100	100	100	100
Nutrient content (Calculated) **								
Crude Protein %	23.00	21.00	20.00	20.00	20.00	20.00	20.00	20.00
Crude Fat %	5.69	6.39	7.76	7.76	7.76	7.76	7.76	7.76
Crude Fiber %	3.88	3.75	3.70	3.70	3.70	3.70	3.70	3.70
ME Kcal/ Kg diet	3029	3076	3171	3171	3171	3171	3171	3171
Calcium %	1.00	1.01	0.90	0.90	0.90	0.90	0.90	0.90
Available Phosphorus %	0.50	0.45	0.40	0.40	0.40	0.40	0.40	0.40
Lysine %	1.30	1.15	1.06	1.06	1.06	1.06	1.06	1.06
Methionine & Cystein %	0.97	0.93	0.84	0.84	0.84	0.84	0.84	0.84

***** Each 3 Kg of premix contains: Vitamins: A: 12000000 IU; Vit. D3 2000000 IU; E: 10000 mg; K3: 2000 mg; B1:1000 mg; B2: 5000 mg; B6:1500 mg; B12: 10 mg; Biotin: 50 mg; Coline chloride: 250000 mg; Pantothenic acid: 10000 mg; Nicotinic acid: 30000 mg; Folic acid: 1000 mg; Minerals: Mn: 60000 mg; Zn: 50000 mg; Fe: 30000 mg; Cu: 10000 mg; I: 1000 mg; Se: 100 mg and Co: 100 mg.
****** Nutrient content calculated based on chemical analysis data of feedstuffs provided by NRC (1994).

The present trial was designed as testing dietary treatments was focused on only finisher stage and thus experimental diets will be offered for 12 days before marketing, from 23 days and up to 35 days. Chicks were housed in galvanized cages, where nine birds were allotted to a pen cage of 100 cm long, 40 cm width and 40 cm height. The cages were kept in

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environmentally controlled rooms, where the temperature was maintained around 32° C for the first week and was decreased by 3° C weekly afterwards. Lighting program was controlled to provide 23 hours light and one hour dark daily by candescent bulb lighting system.

At the end of experiment, four chickens from each treatment were randomly selected based on similar body weight for slaughtering. Slaughtered birds were scalded in hot water bath, plucked and eviscerated manually. Chicken meat from thigh and abdominal muscles were collected, packed and frozen at -18°C until further analyses.

2.2 Determination of fatty acid profile

The fatty acid profiles of broiler chicken meat were analyzed as describe by AOAC (2012). The fatty acids were methylated with boron tri fluoride in methanol, extracted with heptanes and determined on a gas chromatograph with FID detector (PE Auto System XL) with auto sampler and EZchrom integration system. Carrier gas (He); ca. 25Psi- air 450ml/min- Hydrogen 45ml- split100 ml/min. Oven temperature 200°C injector and detector 250°C. Lipid extraction and direct methylation were performed in accordance with Folsch et al. (1957).

2.3 Physical analysis

2.3.1 pH value

Raw chicken meat pH values were determined as described by Hood (1980). Ten grams of sample was homogenized with 100ml distilled water and measured using a digital pH-meter Jenway 3310 conductivity and pH meter. Values of pH were determined in triplicate for each treatment.

2.3.2 Cooking loss

Chicken meat samples of each treatment were cooked in a water bath at 85°C until the internal temperature reached 78°C (Meek et al., 2000). Cooked meat samples were cooled in running tap water for 1 h and then cooked samples were reweighed. All cooking measurements were done on three replicates per treatment. The cooking loss was determined as follows:

$$Cooking\ loss\ (\%) = \frac{(Uncooked\ sample\ weight)\ -\ (Cooked\ sample\ weight)\ \times 100}{(Uncooked\ sample\ weight)}$$

2.3.3 Chilling loss

Chilling loss of broiler chicken meat was determined as describe by Omojola et al. (2014). Broiler chicken meat samples (200±10 g) were chilled at 4°C for 24 hours, after which the meat was thawed and weighed .Three replicates were done for each treatment. Chilling loss was calculated as follows:

$$Chilling\ loss\ (\%) = \frac{Initial\ weight\ (before\ chilling)\ -\ Final\ weight\ (after\ chilling)\ \times 100}{Initial\ weight\ (before\ chilling)}$$

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2.4 Color measurements

Color of raw chicken meat samples was measured by Chroma meter (Konica Minolta, model CR 410, Japan) calibrated with a white plate and light trap supplied by the manufacturer (CIE, 1976). The color was expressed as L* (lightness), a* (the redness) and b* (the yellowness). The average of three spectral readings at different locations was obtained for each treatment.

2.5 Statistical analysis

Analysis of variance (ANOVA) was used to test the obtained data using the general linear modeling procedure (SAS, 2000). The used design was one way analysis. Duncan's multiple tests (1955) were applied for comparison of means and the significance was defined as $P<0.05$.

3 Results

Data of fatty acid profile of broiler chicken meat fed on different types of oil and commercial multi- enzyme additives are showed in Table (2). It was observed that meat of chicken fed on diets containing palm oil (T3,T4and T6) had higher content of palmitic acid(C16:0) than those fed on soybean oil(T1,T2 andT3). Meat of broiler chicken fed soybean oil had higher content of linoleic acid (C18:2ω6) than that fed on palm oil. Also, it can be found that UFA/SFA ration of broiler chicken fed on palm oil groups (T4, T5adT6) were significantly lower compared with those fed on soybean oil (T1,T2 and T3). The polyunsaturated fatty acids content was significantly higher in broiler chicken meat fed on diets containing soybean oil than that fed on diets containing palm oil. Broiler fed on soybean oil had significantly higher n-6: n-3 ration compared with broiler fed on palm oil. Regardless of the source of dietary oil, significant differences were observed in the most of fatty acid profile in the chicken meat among levels of commercial multi- enzyme feed additives.

Table (3) showed the physical characteristics of broiler chicken meat fed on different types of vegetable oil and feed additives. Broiler chicken fed on palm oil (T5and T6) had the higher pH value, followed by broiler fed on soybean oil (T1and T3). Also; it can be found that addition of commercial multi-enzyme feed additives had a significant effect on pH value of broiler chicken meat fed on soybean oil (T2 and T3), while no significant effect was found on pH value of those fed on palm oil with addition of commercial multi-enzyme feed additives (T5 and T6).

Data of cooking loss of broiler chicken meat fed on different types of oils showed that no significant differences were found between broiler fed on soybean oil T1 and T2; slight difference was found in cooking loss of T3 group, while significant differences were found in cooking loss of broiler fed on palm oil. Addition of commercial multi- enzyme feed additives had significant effect on cooking loss. Broiler chicken fed on palm oil supplemented with commercial multi- enzyme feed additives had lower cooking loss 21.59 and 26.40 %but slight difference was found in cooking loss of broiler chicken fed on soybean oil with commercial multi- enzyme feed additives.

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Table 2: fatty acid composition (% of total fatty acids) of broiler chicken meat

Fatty acids		T1	T2	T3	T4	T5	T6	SEM
Caproic acid	C6:0	1.18	-	-	-	-	-	
Caprlyic acid	C8:0	-	-	-	-	-	0.33	
Capric acid	C10:0	-	-	-	-	-	0.73	
Lauric acid	C12:0			0.13	0.16	0.16	1.80	
Myristic acid	C14:0	0.67^{e}	2.00^{b}	0.79^{ed}	1.31^{c}	0.88^{d}	3.62^{a}	0.06
Pentadecanoic acid	C15:0	-	0.43	0.25	0.15	0.18	1.0	
Palmitic acid	C16:0	24.70^{b}	21.39^{e}	23.34^{cd}	33.60^{a}	22.66^{d}	23.99^{cb}	0.37
Heptadecanoic acid	C17:0	0.20^{d}	0.34^{c}	0.48^{b}	0.40^{c}	0.40^{c}	1.13^{a}	0.01
Stearic acid	C18:0	5.50^{d}	5.96^{cd}	6.31^{bc}	6.42^{bc}	6.89^{b}	10.19^{a}	0.24
Arachidic acid	C20:0	-	0.25	0.14	0.71	0.20	0.33	
Behenic acid	C22:0	-	-	-	0.50	-	-	
∑SFA		32.25^{b}	30.54^{c}	31.44^{bc}	43.25^{a}	31.38^{bc}	43.14^{a}	0.49
Tetradecenoic acid	C14:1ω5	-	-	-	0.15	-	-	
	C15:1ω6	-	-	-	-	-	0.38	
Palmiticoleic acid	C16:1ω9	4.56	0.27	0.16	-	0.13	0.20	
	C16:1ω7		3.55	3.89	1.57	3.53	2.80	
	C16:1ω5		0.36	-	-	-	-	
Oleic acid	C18:1ω9	37.30^{a}	29.46^{d}	36.94^{a}	32.39^{c}	33.49^{b}	31.81^{c}	0.35
Vaccinic acid	C18:1ω7	2.39^{c}	3.91^{a}	2.89^{b}	2.39^{c}	3.00^{b}	0.48^{d}	0.06
Gadolic acid	C20:1ω9	0.23	0.96	-	0.40	0.30	0.66	
Eicosaenoic acid	C20:1ω11	-	-	0.27	-	-	-	
	C20:1ω7	-	-	-	-	-	0.40	
Eicosaenoic acid	C20:1ω5	-	-	-	-	-	0.25	
Docosenoic acid	C22:1ω11	0.20	0.10	0.26	-	-	-	
	C22:1ω9	-	-	-	0.24	-	-	
∑MUFA		44.68^{a}	38.60^{c}	44.41^{a}	37.15^{d}	40.44^{b}	36.96^{d}	0.36
	C16:2ω4	-	0.36	-	0.16	-	-	
	C18:2ω5	-	0.21	-	0.36	-	0.22	
Linoleic acid	C18:2ω6	22.00^{b}	24.98^{a}	22.62^{b}	14.39^{d}	25.19^{a}	16.62^{c}	0.32
	C18:2ω4	0.20	-	-	-	-	0.21	
	C20:2ω6	0.17	0.67	0.18	-	0.12	0.55	
Decatrienoic acid	C16:3ω4	-	0.21	0.11	0.64	0.15	0.21	
γ linolenic acid	C18:3ω6	-	0.71	0.11	0.13	0.17	0.37	
Linolenic acid	C18:3ω3	0.73^{d}	1.57^{a}	0.72^{d}	1.20^{b}	1.16^{b}	0.89^{c}	0.03
α octadectetraenoic	C18:4ω3	-	-	-	0.27	-	0.30	
Eicosatrienoic acid	C20:3ω6	-	0.51	-	-	0.13	0.36	
Arachidonic acid	C20:4ω6	-	1.10	0.40	0.36	0.42	0.52	
Eicosapentaenoic	C20:5ω3	-	0.16	-	1.06	0.17	-	
∑PUFA		23.30^{c}	30.45^{a}	24.14^{c}	18.29^{e}	27.51^{b}	20.27^{d}	0.39
∑UFA		67.84^{a}	69.05^{a}	68.55^{a}	55.44^{b}	67.96^{a}	57.16^{b}	0.63
UFA/SFA		2.10^{b}	2.25^{a}	2.17^{ab}	1.27^{c}	2.16^{b}	1.32^{c}	0.02
MUFA/ SFA		1.38^{a}	1.25^{b}	1.40^{a}	0.85^{c}	1.28^{b}	0.85^{c}	0.02
PUFA/ SFA		0.72^{d}	0.99^{a}	0.76^{c}	0.42^{f}	0.87^{b}	0.46^{e}	0.01
∑ω6		22.17^{d}	27.91^{a}	23.31^{c}	14.89^{f}	26.03^{b}	18.80^{e}	0.34
∑ω3		0.73^{d}	1.74^{b}	0.72^{d}	2.23^{a}	1.33^{bc}	1.20^{c}	0.13
n-6:n-3		30.55^{a}	16.25^{bc}	32.47^{a}	6.88^{d}	19.60^{b}	15.68^{c}	1.15
Non identified		0	0.52	0.01	1.20	0.04	0	

a-e means within the same column with different superscripts letters are different ($p<0.05$). T1, T2 and T3: Treatments for soybean oil/ soybean oil with ZAD 0.5kg/ton and soybean oil with AmPhi-BACT 0.5kg/ton. T4, T5andT6: Treatments for palm oil/ palm oil with ZAD 0.5kg/ton and palm oil with AmPhi-BACT 0.5kg/ton. Means ± standard deviation. SEM: standard error of means.

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Table 3: physical properties of broiler chicken meat

Treatments	Parameters		
	pH	Cooking loss (%)	Chilling loss (%)
T1	6.11±0.02^{b}	33.21±4.67^{ab}	3.64±0.42^{b}
T2	5.96±0.06^{c}	31.77±1.14^{ab}	3.25±0.23^{bc}
T3	6.08±0.01^{b}	30.14±0.94^{b}	3.13±0.05^{c}
T4	5.99±0.01^{c}	33.89±1.90^{a}	3.37±0.11^{bc}
T5	6.19±0.01^{a}	21.59±0.45^{d}	3.64±0.51^{b}
T6	6.18±0.03^{a}	26.40±2.76^{c}	4.20±0.18^{a}
SEM	0.01	1.03	0.14

a-d means within the same column with different superscripts letters are different (p<0.05). T1, T2 and T3: Treatments for soybean oil/ soybean oil with ZAD 0.5kg/ton and soybean oil with AmPhi-BACT 0.5kg/ton. T4, T5andT6: Treatments for palm oil/ palm oil with ZAD 0.5kg/ton and palm oil with AmPhi-BACT 0.5kg/ton. Means ± standard deviation. SEM: standard error of means

Results of chilling loss of broiler chicken fed on different types of vegetable oil showed that the differences between broiler chicken fed on soybean oil were not significantly different. No significant differences were found between broiler chicken fed on palm oil except for T6 which had the higher chilling loss.

Addition of commercial multi-enzyme had no significant effect on chilling loss of broiler chicken meat except for broiler chicken fed on palm oil with multi- enzyme feed additives (T6)which had the higher chilling loss.

Color measurements of broiler chicken meat fed on different dietary oils and commercial multi- enzyme feed additives shown in Table (4). No significant differences were found in *L** value between dietary treatments.

Table 4: color measurements of broiler chicken meat

Treatments	Parameters		
	L	a	b
T1	51.82±4.37	11.80±2.02	20.05±3.24
T2	54.02±2.09	12.18±0.48	16.56±7.38
T3	53.74±2.70	12.89±2.36	19.53±1.26
T4	53.60±5.30	11.58±1.72	18.65±1.08
T5	52.41±1.25	13.55±0.33	21.06±2.96
T6	53.71±3.48	11.51±2.53	22.17±4.35
SEM	2.00	1.03	2.30

Means within the same column with different superscripts letters are different (p<0.05). T1, T2 and T3: Treatments for soybean oil/ soybean oil with ZAD 0.5kg/ton and soybean oil with AmPhi-BACT 0.5kg/ton. T4, T5andT6: Treatments for palm oil/ palm oil with ZAD 0.5kg/ton and palm oil with AmPhi-BACT 0.5kg/ton. Means ± standard deviation. SEM: standard error of means.

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Also, data showed no significant differences were found between *a** and *b** values of broiler chicken meat. Addition of commercial multi- enzyme feed additives had no significant effect on color measurements.

4 Discussion

Feeding broiler chicken on different types of dietary oils had significant effect on the fatty acid profile of broiler chicken meat. The higher content of palmitic acid (C16:0) in chicken groups fed on palm oil than that groups fed on soybean oil may be due to the high content of palmitic acid in palm oil. These results are in agreement with that obtained by Abdulla *et al.* (2015) they found that the proportion of palmitic acid (C16:0) increased in meat from broiler fed palm oil (PO) in comparison with those fed diets supplemented with soybean oil (SO)and linseed oil(LO). The increase in the proportion of palmitic acid in chicken fed the palm oil diet could be owing the high palmitic acid content of palm oil (Abdulla *et al.,* 2015).This result is similar to the findings of Hitn (2006) and Smink *et al.* (2010) they reported that the levels of palmitic acid increased significantly in broiler breast muscle supplemented with palm oil compared with groups supplemented with soybean oil, coconut oil and sunflower oil. Higher content of linoleic acid (C18:2ω6) was found in meat of broiler chicken fed soybean oil than that fed on palm oil. These results are agree with that found by Abdulla *et al.* (2015) who reported that birds fed LO and SO diets had significantly higher linoleic acid compared with those fed PO. Also, Ayed *et al.* (2015) found that soybean oil caused large increase in the level of linoleic acid in broiler chicken meat compared with palm oil. The increasing level of linoleic acid is more pronounced because this acid is readily absorbed and deposited within the chicken's fat depot (Ayed *et al.,* 2015). UFA/SFA ration of broiler chicken fed palm oil were significantly lower compared with broiler chicken fed soybean oil. These results are close to that obtained by Abdulla *et al.* (2015) they reported that the proportion of total saturated of meat samples increased, while total UFA content decreased when palm oil (PO) was incorporated in the diet, resulting in a significantly lower UFA: SFA ratio of the broiler breast muscle compared with those fed soybean oil (SO) and linseed oil (LO) diets. The polyunsaturated fatty acids content was significantly higher in broiler chicken meat fed on diets containing soybean oil than that fed on diets containing palm oil. These results are agrees with Ayed *et al.* (2015) they found that the polyunsaturated fatty acids content was significantly ($p<0.05$) higher in the group fed by ration containing soybean oil.

The n-6: n-3 ratio significantly differs among sources of oil. These results are close to that obtained by Bostami *et al.* (2017) they found that the higher n-6: n-3 ratio was found in broilers fed on soybean oil. Significant differences were observed in the most of fatty acid profile in the chicken meat among levels of commercial multi- enzyme feed additives. Responses to enzymes vary widely and are difficult to predict since enzyme action may be affected by many factors, including environment, amount of enzyme in the reaction, and interactions between enzyme and other substances, which are still not fully understood (Zakaria *et al.,* 2010).

Effect of feeding broiler chicken on different types of oils showed significant differences in pH values of chicken meat. These results are disagrees with that obtained by Pekel *et al.* (2012) they found that the pH of breast meat did not differ between broilers fed on diets supplemented with soybean oil and the neutralized sunflower soapstock oil.

Addition of commercial multi-enzyme feed additives had no significant effect on pH value of broiler chicken meat fed on palm oil. These results are close to that obtained by Zakaria *et*

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al. (2010) they found that enzymes addition had no effect on pH value of broiler chicken meat. However, the effect of dietary enzyme on pH value of chicken meat was difficult to understand. These may be due to that enzymes are difficult to predict since enzyme action may be affected by many factors, including environment, amount of enzyme in the reaction, and interactions between enzyme and other substances, which are still not fully understood.

Data of cooking loss indicated that addition of commercial multi- enzyme feed additives had significant effect on cooking loss of broiler chicken meat. Broiler chicken fed on diets supplemented with commercial multi- enzyme feed additives had lower cooking loss than those fed on diets without feed additives. These results are disagrees with that obtained by Omojola *et al.* (2014) they found that chicken fed diets containing sesame and soybean diet supplemented with enzymes had higher cooking loss than those on sesame and soybean diet without enzymes. While, Zakaria *et al.* (2010) found that dietary enzyme had no effect on cooking loss of broiler chicken meat. However, the lower cooking loss in meat of T5and T6may be attributed to their pH values. Low pH of meat is known to negatively affect the water-holding capacity of the meat and cooking loss is a function of the WHC (Warris and Brown, 1987). The higher pH improved the WHC and reduced the cooking loss.

Data of chilling loss indicated that the differences between dietary treatments were not significantly different except for broiler chicken fed on palm oil with commercial multi- enzyme (T6) which had the higher chilling loss. These results are close to that obtained by Teye *et al.* (2015) they found that palm kernel oil residue inclusion up to 17.5% in broiler rations has no significant effects on chilling loss of broiler chicken meat. Also, the results of the present study are consonance with that obtained by Omojola *et al.* (2014) they reported that there was no significant effect on chilling loss of broiler chicken meat fed on diets (soybean and sesame) supplemented with or without microbial phytase.

Data of color measurements indicated that color characteristics of broiler chicken meat were not affected by the dietary oil types and feed additives. These results are close to that obtained by Pekel *et al.* (2012) they found that breast meat color (*L**, *a**, *b** values) were not affected by the dietary fat source on any of the measurement days (storage at 4°C for 0, 1, 2, and 5 days). Also, Dalólio *et al.* (2015) found that enzyme supplementation in diets based on corn and soybean meal did not influence the color parameters of chicken meat. L* was reduced when the dietary levels of fat increased. Zakaria *et al.* (2010) they reported that dietary enzyme had no effect on the broiler chicken meat color. Also, they reported that enzyme addition did not affect the different meat quality parameters which are related to each other, such as the pH value and color. Woelfel *et al.* (2002) reported that there was a relationship between L* value and muscle pH in which L* value increased as the muscle pH decreased in broiler chicken meat. Results of L* and pH values showed the same trend.

5 Conclusion

The results of the current study confirmed that using soybean oil and palm oil in broiler chicken diets would subsequently affect the composition of fatty acids in chicken meat. Broiler fed on palm oil had higher total n-3 and lower n-6:n3 compared with broiler fed on soybean oil.

However, palm oil can be used in broiler chicken feeding with positive effects on meat quality and human health.

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References

Abdulla, N. R., Loh, T.C., Akit, H., Sazili, A.Q., Foo, H.L., Mohamad, R., Abdul Rahim, R., Ebrahimi, M., Sabow, A.B., 2015. Fatty acid profile, cholesterol and oxidative status in broiler chicken breast muscle fed different dietary oil sources and calcium levels. South African Journal of Animal Science. 45(2), 153-163.

Anjum, M. I., Mirza, I. H., Khan, A. G., Azim, A., 2004. Effect of fresh versus oxidized soybean oil on growth performance, organs weights and meat quality of broiler chicks. Pakistan Veterinary journal, 24(4), 173-178.

AOAC. Official method of analysis. 19th ed. Gaithersburg Maryland: Association of Official Analytical Chemists; 2012.

Ayed, H. B., Attia, H., Ennouri, M., 2015. Effect of oil supplemented diet on growth performance and meat quality of broiler chickens. Advanced Techniques in Biology & Medicine. 4, 1- 4.

Bostami, A.B.M.R., Mun, H.S., Yang, C.J., 2017. Breast and thigh meat chemical composition and fatty acid profile in broilers fed diet with dietary fat sources. Journal of Food Processing & Technology.8, 672.

CIE. Commission International de L´ Eclairage (1976) Official recommendations on uniform colour spaces. Colour difference equations and metric colour terms, Suppl. No. 2. CIE Publication No. 15 Colourimetry. Paris.

Crespo, N., Esteve-Garcia, E., 2002. Nutrient and fatty acid deposition in broilers fed different dietary fatty acid profiles. Poultry Science. 81, 1533-1542.

Dalólio, F. S., Vaz, D. P., Moreira, J., Albino, L. F. T., Valadares, L. R., 2015. Carcass characteristics of broilers fed enzyme complex. Biotechnology in Animal Husbandry. 31 (2), 153-162.

Duncan, D. B., 1955. Multiple range and multiple Ftests. Biometrics. 11, 1- 42.

Folsch, J., Lee, M., Sloane-Stanely, G.H., 1957. A simple method for the isolation and purification of total lipids from animal tissue. Journal of biological Chemistry. 226, 497-509.

Hood, D. E., 1980. Factors affecting the rate of metmyoglobin accumulation in prepackaged beef. Meat Science. 4 (4), 47–50.

Howe, P., Meyer, B., Record S., Baghurst, K., 2006. Dietary intake of long-chain ω-3 polyunsaturated fatty acids: contribution of meat sources. Nutrition. 22, 47-53.

Htin, N.N., 2006. Effects of dietary fatty acid saturation on broiler chickens subjected to high ambient temperatures. Ph.D. Thesis research. Universiti Putra Malaysia. Accessed January 2006.

Jalali, S. M. A., Rabiei, R., Kheiri, F., 2015. Effects of dietary soybean and sunflower oils with and without L-carnitine supplementation on growth performance and blood biochemical parameters of broiler chicks. Archives Animal Breeding. 58, 387–394.

Meek, K. I., Claus, J. R., Duncan, S. E. , Marriott, N. G. , Solomon, M. B., Kathman, S. J. , Marini, M. E., 2000. Quality and sensory characteristics of selected post rigor, early deboned broiler breast meat tenderized using hydrodynamic shock waves. Poultry sci. 79,126 -136.

  ISSN: 2283-3927

Nobakht, A., Tabatbaei, S., and Khodaei, S. 2011. Effects of different sources and levels of vegetable oils on performance, carcass traits and accumulation of vitamine in breast meat of broilers. Current Research Journal of Biological Sciences.3(6), 601–605.

NRC, 1994. National Research Council. Nutrient Requirements of Poultry 9th Ed. Composition of poultry feedstuffs. National Academy Press, Washington, DC, USA.

Omojola, A. B., Otunla, T. A., Olusola, O. O., Adebiyi, O. A., Ologhobo, A. D., 2014. Performance and carcass characteristics of broiler chicken fed soybean and sesame/soybean based diets supplemented with or without microbial phytase. American Journal of Experimental Agriculture. 4 (12), 1637-1648.

Pekel, A. Y., Demirel, G., Midilli, M., Yalcintan, H., Ekiz, B., Alp, M., 2012. Comparison of broiler meat quality when fed diets supplemented with neutralized sunflower soapstock or soybean oil. Poultry Science. 91, 2361–2369.

SAS, 2000. User's Guide Statistics. SAS Institute, Inc., Cary, N.C., USA.

Smink, W., Gerrits, W., Hovenier, R., Geelen, M., Verstegen, M., Beynen, A., 2010. Effect of dietary fat sources on fatty acid deposition and lipid metabolism in broiler chickens. Poultry Science. 89, 2432-2440.

Teye, M., Apori, S.O., Ayeida, A.A., 2015. Carcass parameters and sensory characteristics of broiler chicken fed diets containing palm (Elaeis guineensis) kernel oil residue. International Journal of current microbiology and Applied Science. 4(6), 1030-1038.

Wang, W., Wang, Z., Yang, H., Cao, Y., Zhu, X., Zhao, Y., 2013. Effects of phytase supplementation on growth performance, slaughter performance, growth of internal organs and small intestine and seum biochemical parameters of broilers. Open Journal of Animal. Science. 3(3), 236-241.

Warriss, P. D., S. N. Brown., 1987. The relationship between initial pH, reflectance and exudation in pig muscle. Meat Science. 20, 65–74.

Woelfel, R. L., C. M. Owens, E. M. Hirschler, R. Martinez-Dawson, and A. R. Sams. 2002. The characterization and incidence of pale, soft and exudative broiler meat in a commercial processing plant. Poultry Science. 81, 579–584.

Zakaria, H. A. H., Mohammad, A. R. J., Abu Ishmais, M. A., 2010. The Influence of Supplemental Multi-enzyme Feed Additive on the Performance, Carcass Characteristics and Meat Quality Traits of Broiler Chickens International. Journal of Poultry Science. 9 (2), 126-133.

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