Effect of Dietary Fat Sources on the Fatty Acid Composition and Sensory Characteristics of Chicken Meat

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Abstract: The research was carried out in two experiments on Ross 308 male hybrid chickens. Chickens were divided into five groups (five dietary treatments differing in source and concentration of plant oil and fish oil). Feeding chickens with diets of determined composition from 22nd to 42nd day of fattening resulted in altered fatty acid profile in white meat and dark meat, and in significantly lowered n-6/n-3 polyunsaturated fatty acids (PUFA) ratio in white meat. Increase of n-3 PUFA concentration in diets resulted in statistically significant ($P = 0.001$) increase of n-3 PUFA, as well as in decrease ($P = 0.02$) of n-6 PUFA in white and dark chicken meat in the 1st experiment. The 2nd experiment resulted in statistically significant increase of n-3 PUFA concentration in white and dark chicken meat ($P < 0.001$), and n-6 PUFA concentration decreased only in dark chicken meat ($P < 0.001$). The increase of PUFA in both experiments was accompanied with decrease of saturated fatty acids (SFA) concentration in chicken meat. Although all experimental treatments were assessed as having more fishy odour and flavour than the control sample, statistically significant difference between samples was found only for fishy flavour in dark meat ($P < 0.05$). In the 2nd experiment, where the feeding treatment was altered seven days before chickens' slaughtering (fish oil was omitted), the intensity of fishy odour and flavour was assessed with "none" to "slightly noticeable" ($P > 0.05$). In order to produce chicken meat as functional product, it is possible to reach balance between high n-3 PUFA concentration and satisfactory sensory traits characteristics of chicken meat.

Key words: Chicken, meat, FA profile, n-3 PUFA, sensory characteristics, dietary fat.

1. Introduction

Anthropological and epidemiological studies indicate that humans have evolved with respect to nutrition which had n-6 polyunsaturated fatty acids (PUFA)/n-3 PUFA ratio of 1, while today that ratio in so called Western nutrition amounts from 15/1 to 16.7/1 [1, 2]. Similar values (17.1/1) were also obtained in some studies in Croatia [3, 4]. High n-6 PUFA/n-3PUFA ratio is related to occurrence of many diseases cardiovascular, inflammatory and

autoimmune diseases, and cancer [2, 5-7]. This is the reason why animal products, which are mostly consumed and which fatty acid content can be easily modified, tend to be subject to increase of n-3 PUFA portion, especially of long-chain eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) [8, 9].

However, increased portion of these acids in animal feed, and consequently in a product, can cause unwanted changes in sensory characteristics, which are also affecting product acceptability [10, 11] and affect the meat quality [12]. The aim of this study was to determine in what way different combinations and concentrations of plant oils and oil preparations

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enriched with EPA and DHA in diet affected fatty acid profile in chicken meat and its sensory characteristics.

2. Materials and Methods

2.1 Materials

The research into effects of dietary treatments from 21st to 42nd day of fattening on sensory characteristics of meat was carried out on Ross 308 chickens within two experiments. In the 1st and 2nd experiment, diets were balanced at 20% of crude protein and 13.5 MJ ME/kg.

Dietary treatments in the 1st experiment:

K (control): 5% sunflower oil;

A: 2.75% sunflower oil, 2% linseed oil, 0.25% PBE1 oil;

B: 2.75% sunflower oil, 2% linseed oil, 0.25% PBE2 oil;

C: 2.50% sunflower oil, 2% linseed oil, 0.5% PBE1 oil;

D: 2.50% sunflower oil, 2% linseed oil and 0.5% PBE2 oil.

Dietary treatments in the 2nd experiment:

K (control): 3% soybean oil;

A: 3% linseed oil;

B: 2.9% linseed oil and 0.1% PBE1 oil;

C: 2.9% linseed oil and 0.1% PBE2 oil.

Seven days prior to slaughtering chickens were fed diets without PBE1 and PBE2 oil. PBE1 is oil of sea organisms containing 15.36% EPA and 9.99% DHA, and PBE2 is also oil of sea organisms with 10.55% EPA and 22.10% DHA.

2.2 Methods

Chickens were slaughtered after 42 days of fattening. Samples of white meat (breasts) and dark meat (drumsticks with thighs) were taken for chemical analysis. Fat content was determined by the Stoldt method (Hungarian Standard No. 6830-66). Fatty acid profile in meat samples was determined by the Chrompack CP 9000 chromatograph equipped with flame ionization detector. From the homogenised

sample, dependent on fatty acid composition, 2-4 g was measured for fatty acid composition in glass equipment and 5 cm³ n-heptane and in order to eliminate water content of the sample 2-4 g dry sodium-sulphate was added to it. From the heptane solution containing fat that is free from water, 0.5 cm³ were pipetted to a test tube, and 0.5 cm³ sodium-metilate was added to it, the mixture was heated at 60 °C for 60 min, and during this time the mixture was shaken up intensively every 10 min. After this 1 cm³ n-heptane and 1 cm³ distilled water was added to the mixture, it was homogenised, the heptane phase was separated from the water phase, (the excess of the reagent was removed), the heptane phase was dried by dry sodium-sulphate, and dependent on fat content of the sample, 0.5-2.0 µL was injected into the column of the gas chromatograph (300 × 25 mm, quartz capillary). The humid phase (active phase) was Cp-Sil-88. The temperature of the injector and the flame ionisation detector was 220 °C, the temperature of the column at the start was 100 °C, the speed of the warm up of the column was 6 °C/min until 210 °C, and this temperature was used at the end of the analysis. For quantitative evaluation, the weight percentage proportions of the methyl esters were regarded as equal to the proportions of the corresponding peaks in the chromatogram. The fatty acid composition for unknown samples was calculated as a function of the comparative mass percentage of fatty acid methyl-esters [13]. Cooled, boneless and frozen meat was stored for 30 days at -20 °C until sensory analysis. Thawing was carried out in refrigerator for 16 h. Preparation/roasting and sensory analysis of white and dark meat were done separately. Meat samples of each treatment were separately wrapped in aluminium foil and roasted in the oven at a temperature of 175 °C, 60 min for white meat and 50 min for dark meat. Based on previous research, these conditions were proved as optimal. Before serving, the samples were cut into pieces and heated in glass containers with lids in a water bath at temperature of 55-60 °C. Samples

(20 g) were served in covered plastic containers labelled with three-digit number. Panel of seven selected assessors evaluated the intensity of following sample characteristics: chicken odour and flavour, fishy odour and flavour and rancid odour and flavour, using scale from 0 (imperceptible) to 9 (extremely perceptible), while the overall impression was assessed by scale from 1 (poor) to 5 (typical). All samples were served simultaneously. Assessment was carried out in four replications with different coding, from 2 to 4 pm. During training that lasted for several days panelists were presented samples of chicken meat from different dietary treatments, and different types of oil (fish, linseed, sunflower and rancid oils), for the purpose of developing common terminology and scale usage [14].

2.3 Data Analysis

Average values and standard deviations were calculated for each parameter ($\bar{x} \pm SD$). Sensory analysis data were tested by Friedman's test, while the fatty acids content was tested by ANOVA, both using Statistica 7.0 software.

3. Results and Discussion

Table 1 gives an overview of fatty acids concentrations in finisher diets within the 1st experiment. Control diet K contained 56.94% n-6 PUFA, and only 3.02% α -LNA, so that ratio n-6/n-3 PUFA was very wide, being 14.53:1. Diets A, B and C had reduced portions of n-6 PUFA, but increased concentration of n-3 PUFA, especially of EPA (groups A = 0.68% and C = 1.51%) and DHA (groups B = 0.63% and D = 1.21%).

Table 2 presents content of fatty acids in chicken diets fed from 22nd to 42nd day. The control group K was fed diets which contained soybean oil, and other chicken groups were given diets which contained linseed oil and sunflower oil, as well as PBE1 and PBE2 oils, which were omitted from diets seven days before slaughtering in order to avoid occurrence of so-called fishy odour.

Table 1 Content of fatty acids in chicken diets from 22nd-42nd day (1st experiment).

Fatty acid*	Dietary treatments-groups				
	K	A	B	C	D
Σ SFA	16.30	14.94	14.60	14.80	14.96
Σ MUFA	20.73	21.16	21.01	20.43	20.42
Σ PUFA n-6	56.94	44.96	47.58	47.29	47.03
Σ PUFA n-3	3.92	17.43	15.39	15.84	15.99
α LNA	3.02	16.55	14.15	13.53	13.81
EPA	-	0.68	0.48	1.51	0.82
DHA	-	0.20	0.63	0.65	1.21
Ratio**	14.53	2.57	3.09	2.98	2.95

K (control): 5% sunflower oil; A: 2.75% sunflower oil, 2% linseed oil, 0.25% PBE1 oil; B: 2.75% sunflower oil, 2% linseed oil, 0.25% PBE2 oil; C: 2.50% sunflower oil, 2% linseed oil, 0.5% PBE1 oil; D: 2.50% sunflower oil, 2% linseed oil and 0.5% PBE2 oil; *percent of total fatty acids; ** Σ PUFA n-6/ Σ PUFA n-3.

Table 2 Content of fatty acids in chicken diets from 22nd-42nd day (2nd experiment).

Fatty acid*	Dietary treatments-groups			
	K	A	B	C
Σ SFA	17.47	16.21	16.26	16.03
Σ MUFA	22.17	21.93	22.08	22.73
Σ PUFA n-6	52.44	48.98	47.35	46.55
Σ PUFA n-3	6.80	12.05	13.58	13.78
α LNA	6.61	11.94	13.23	13.10
EPA	0.05	0.03	0.19	0.38
DHA	0.09	0.04	0.10	0.23
Ratio**	7.71	4.06	3.49	3.38

K (control): 3% soybean oil; A: 3% linseed oil; B: 2.9% linseed oil and 0.1% PBE1 oil; C: 2.9% linseed oil and 0.1% PBE2 oil; *percent of total fatty acids; ** Σ PUFA n-6/ Σ PUFA n-3.

Analysis of fatty acid profile in chicken meat lipids (Table 3) from the 1st experiment shows that both meat types changed as a consequence of n-3 PUFA and n-6 PUFA ratio in dietary treatments. White and dark meat of the control (K) contained 3.35% and 3.54% of n-3 PUFA, respectively, while portions of EPA (0.09% and 0.12%, respectively) and DHA (0.91% and 0.65%, respectively) were insignificant. White meat enriched with n-3 PUFA contained 0.62%-0.85% EPA ($P = 0.005$) and 1.74%-4.62% DHA ($P = 0.002$) in total content of fatty acids. Dark meat also exhibited identical changes in the fatty acid profile. It contained 0.49%-0.80% EPA and 1.34%-2.61% DHA ($P = 0.01$) in total content of fatty acids, as depending on the dietary treatment. White and dark meat of the control

Table 3 Fatty acids content in chicken meat (1st experiment).

Fatty acids (%)	Dietary treatments-groups ($\bar{X} \pm SD$)*				
	K	A	B	C	D
White meat					
Σ SFA ($P = 0.11$)	34.49 $\pm$ 4.66	30.53 $\pm$ 3.68	30.25 $\pm$ 5.04	32.26 $\pm$ 3.51	27.07 $\pm$ 3.46
Σ MUFA ($P = 0.09$)	19.12 $\pm$ 4.04	22.34 $\pm$ 1.90	19.06 $\pm$ 2.55	19.57 $\pm$ 2.20	19.67 $\pm$ 2.53
Σ PUFA n-6 ($P = 0.02$)	36.24 $\pm$ 3.72	32.42 $\pm$ 1.97	33.73 $\pm$ 4.33	32.92 $\pm$ 1.80	37.47 $\pm$ 2.28
Σ PUFA n-3 ($P = 0.001$)	3.35 $\pm$ 0.25	11.34 $\pm$ 0.63	11.08 $\pm$ 1.56	11.08 $\pm$ 0.79	14.08 $\pm$ 0.80
α LNA ($P = 0.52$)	1.49 $\pm$ 0.48	6.67 $\pm$ 1.43	5.59 $\pm$ 1.50	5.60 $\pm$ 1.45	6.58 $\pm$ 2.11
EPA ($P = 0.005$)	0.09 $\pm$ 0.03	0.63 $\pm$ 0.10	0.62 $\pm$ 0.13	0.67 $\pm$ 0.28	0.85 $\pm$ 0.13
DHA ($P = 0.002$)	0.91 $\pm$ 0.26	1.74 $\pm$ 0.61	2.86 $\pm$ 0.88	2.63 $\pm$ 0.63	4.62 $\pm$ 1.61
Σ n-6 P/ Σ n-3 ($P = 0.005$)	10.85 $\pm$ 1.25	2.86 $\pm$ 0.15	3.05 $\pm$ 0.13	2.99 $\pm$ 0.12	2.67 $\pm$ 0.25
Dark meat					
Σ SFA ($P = 0.89$)	27.26 $\pm$ 1.59	25.80 $\pm$ 1.96	26.33 $\pm$ 2.07	25.47 $\pm$ 1.77	26.65 $\pm$ 4.78
Σ MUFA ($P = 0.06$)	22.91 $\pm$ 1.62	23.49 $\pm$ 2.36	20.92 $\pm$ 1.38	21.38 $\pm$ 0.98	21.13 $\pm$ 1.88
Σ PUFA n-6 ($P = 0.41$)	42.92 $\pm$ 2.06	37.69 $\pm$ 1.16	39.59 $\pm$ 1.56	39.21 $\pm$ 1.54	37.94 $\pm$ 3.84
Σ PUFA n-3 ($P = 0.54$)	3.54 $\pm$ 0.18	11.47 $\pm$ 0.45	11.34 $\pm$ 0.56	11.81 $\pm$ 0.63	11.58 $\pm$ 0.61
α LNA ($P = 0.39$)	2.18 $\pm$ 0.25	7.93 $\pm$ 1.22	6.65 $\pm$ 1.33	7.37 $\pm$ 0.75	7.21 $\pm$ 1.60
EPA ($P = 0.01$)	0.12 $\pm$ 0.02	0.49 $\pm$ 0.08	0.56 $\pm$ 0.09	0.80 $\pm$ 0.09	0.59 $\pm$ 0.06
DHA ($P = 0.01$)	0.65 $\pm$ 0.13	1.34 $\pm$ 0.46	2.49 $\pm$ 0.70	2.12 $\pm$ 0.41	2.61 $\pm$ 0.76
Σ n-6/ Σ n-3 ($P = 0.14$)	12.14 $\pm$ 0.55	3.29 $\pm$ 0.08	3.50 $\pm$ 0.23	3.33 $\pm$ 0.17	3.27 $\pm$ 0.21

K (control): 5% sunflower oil; A: 2.75% sunflower oil, 2% linseed oil, 0.25% PBE1 oil; B: 2.75% sunflower oil, 2% linseed oil, 0.25% PBE2 oil; C: 2.50% sunflower oil, 2% linseed oil, 0.5% PBE1 oil; D: 2.50% sunflower oil, 2% linseed oil and 0.5% PBE2 oil; * mean and standard deviation of 10 replications.

contained only 0.09% and 0.12% EPA, respectively, and 0.91% and 0.65% DHA, respectively. The n-6/n-3 PUFA ratio in white meat of the control was 10.85:1 and in dark meat it was 12.14:1. Application of described dietary treatments has lowered the mentioned ratio to 2.67-3.05:1 in white meat, and to 3.27-3.50:1 in dark meat. Increasing of dietary PUFA resulted in a decrease of SFA and MUFA concentration in chicken organism [15]. In described experiment, increase of PUFA concentration in diets was also accompanied with increased deposition of PUFA, along with reduces in concentration of SFA and MUFA.

Sensory assessment of meat samples (Table 4) shows that differences between samples for the characteristic of chicken odour and flavour and rancid odour and flavour were not statistically significant ($P > 0.05$) for either white meat or dark meat.

All dark meat samples were assessed as having more fishy odour and flavour than the control, but statistically significant difference was only for flavour ($P < 0.05$).

White meat samples were also noticed to have more

intensive fishy odour and flavour than the control samples, however, the differences were not statistically significant ($P > 0.05$).

This could be explained by the fact that chicken dark meat contains more fat than white meat, so the characteristic of fishy flavour was more expressed in this type of meat.

According to overall sensory assessment, control sample was better assessed than other samples of both white and dark meat, although differences were not statistically significant ($P > 0.05$).

Supplementation of linseed oil has no negative effects on sensory characteristics of meat [9, 16]. Consumers accept meat of chickens that were fed 1.25% fish oil or linseed oil five days prior to slaughter [17].

Analysis of fatty acid profile in chicken meat of the 2nd experiment (Table 5) proves that applied dietary treatments had effect on the deposition of some fatty acids in chicken muscle tissue. Increase of n-3 PUFA in chicken diets (treatments A, B and C) resulted in increase of those fatty acids in white and dark meat.

Table 4 Effect of dietary treatments on the sensory characteristics of chicken meat (1st experiment).

Characteristic	Dietary treatments-groups ($\bar{x} \pm \text{SD}$)*				
	K	A	B	C	D
White meat					
Chicken odour ($P = 0.69$)	5.9 $\pm$ 2.1	5.5 $\pm$ 2.0	5.8 $\pm$ 1.6	5.5 $\pm$ 2.3	5.3 $\pm$ 2.0
Fishy odour ($P = 0.30$)	0.5 $\pm$ 0.8	1.5 $\pm$ 0.6	0.8 $\pm$ 0.7	1.7 $\pm$ 0.9	1.5 $\pm$ 1.0
Rancid odour ($P = 0.35$)	0.8 $\pm$ 0.7	0.7 $\pm$ 0.6	0.8 $\pm$ 0.7	0.4 $\pm$ 0.4	0.4 $\pm$ 0.5
Chicken flavour ($P = 0.72$)	5.7 $\pm$ 2.2	5.2 $\pm$ 2.3	5.5 $\pm$ 2.1	5.0 $\pm$ 2.5	5.1 $\pm$ 2.3
Fishy flavour ($P = 0.09$)	0.2 $\pm$ 0.3	0.6 $\pm$ 0.7	0.5 $\pm$ 0.6	1.4 $\pm$ 1.4	1.0 $\pm$ 1.0
Rancid flavour ($P = 0.77$)	0.6 $\pm$ 0.7	1.0 $\pm$ 1.1	0.7 $\pm$ 0.8	0.7 $\pm$ 0.8	0.8 $\pm$ 0.9
Overall impression ($P = 0.61$)	3.8 $\pm$ 0.8	3.1 $\pm$ 0.9	3.5 $\pm$ 0.7	3.0 $\pm$ 1.2	3.0 $\pm$ 1.0
Dark meat					
Chicken odour ($P = 0.34$)	6.1 $\pm$ 2.2	5.0 $\pm$ 2.6	5.4 $\pm$ 1.8	5.5 $\pm$ 2.4	5.8 $\pm$ 1.9
Fishy odour ($P = 0.61$)	0.8 $\pm$ 0.9	1.7 $\pm$ 1.1	1.4 $\pm$ 0.7	1.5 $\pm$ 1.1	1.3 $\pm$ 0.7
Rancid odour ($P = 0.93$)	1.0 $\pm$ 1.0	0.8 $\pm$ 0.4	1.1 $\pm$ 0.7	1.0 $\pm$ 0.9	1.0 $\pm$ 0.6
Chicken flavour ($P = 0.22$)	6.2 $\pm$ 2.3	5.0 $\pm$ 2.4	5.5 $\pm$ 1.9	5.4 $\pm$ 2.1	5.4 $\pm$ 1.7
Fishy flavour ($P = 0.04$)	0.3 $\pm$ 0.6	1.8 $\pm$ 1.2	1.2 $\pm$ 0.8	1.4 $\pm$ 0.9	1.3 $\pm$ 0.8
Rancid flavour ($P = 0.46$)	1.2 $\pm$ 0.8	0.8 $\pm$ 0.5	0.8 $\pm$ 0.7	1.0 $\pm$ 0.6	0.8 $\pm$ 0.8
Overall impression ($P = 0.31$)	3.8 $\pm$ 0.7	2.9 $\pm$ 1.0	3.1 $\pm$ 0.8	3.0 $\pm$ 1.0	3.1 $\pm$ 0.8

K (control): 5% sunflower oil; A: 2.75% sunflower oil, 2% linseed oil, 0.25% PBE1 oil; B: 2.75% sunflower oil, 2% linseed oil, 0.25% PBE2 oil; C: 2.50% sunflower oil, 2% linseed oil, 0.5% PBE1 oil; D: 2.50% sunflower oil, 2% linseed oil and 0.5% PBE2 oil; * mean and standard deviation of four replications.

The increase was mostly related to content of α LNA, as during the last 7 days of fattening chickens had diets with reduced content of EPA and DHA due to exclusion of PBE1 and PBE2 oils. That procedure aimed at improvement of organoleptic characteristics of chicken meat in order to avoid unwanted occurrence of fishy flavour in dark meat, which was the case in the 1st experiment.

The authors' previous research proved that feeding of chickens with commercial diets could result in deposition of EPA and DHA in chicken meat if diets were enriched with α LNA, due to biosynthesis and elongation of that acid, which is possible in monogastric animals [18]. It was determined [19] that more narrow ratio of n-6/n-3 PUFA (white meat 0.77: 1, dark meat 0.93:1) could be reached if chicken diets contain 3.6% α LNA. With α LNA concentration in the diets of only 0.2%, the meat exhibited significantly wider ratio (white meat 13.63:1, dark meat: 17.22:1).

All white and dark meat samples were assessed having strong chicken odour and flavour (Table 6), and slightly noticeable rancid odour and flavour, but the differences between samples were not statistically significant ($P > 0.05$), neither for chicken or rancid odour and flavour.

Intensity of fishy odour and flavour was assessed as none to slightly noticeable, and slightly higher values were obtained in dark meat. Differences between samples were not statistically significant ($P > 0.05$).

Supplementation of 8.2% fish oil to chicken diets resulted in meat of very poor sensory parameters [8]. However, if fish oil was replaced with linseed oil two weeks prior to slaughtering, consumers evaluated such meat as acceptable. Supplementation of 1% fish oil to chicken diets prior to slaughtering results in produced meat of satisfactory sensory characteristics. Panel of assessors did not determine differences in sensory characteristics of such meat and the meat of chickens fed with 8% of fat [11]. Better quality of meat (lower concentration of cholesterol) exhibited broilers that were fed diets rich in n-3 PUFA, and better grade for sensory characteristics of meat was given to broilers fed with diets rich in n-6 PUFA [20].

4. Conclusions

There were two experiments carried out to assess effect of dietary treatments on the content of fatty acids and on sensory characteristics of chicken meat. Results of the 1st experiment indicated that increase of n-3

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Table 5 Fatty acids content in chicken meat (2nd experiment).

Fatty acids (%)	Dietary treatments-groups ($\bar{X} \pm SD$)*			
	K	A	B	C
White meat				
Σ SFA ($P = 0.04$)	32.54 $\pm$ 3.42	29.94 $\pm$ 1.86	29.94 $\pm$ 1.59	28.09 $\pm$ 2.38
Σ MUFA ($P < 0.001$)	18.11 $\pm$ 1.28	21.46 $\pm$ 1.34	22.40 $\pm$ 1.38	24.03 $\pm$ 2.04
Σ PUFA n-6 ($P = 0.12$)	38.84 $\pm$ 3.49	37.39 $\pm$ 1.76	35.73 $\pm$ 0.82	36.30 $\pm$ 2.18
Σ PUFA n-3 ($P < 0.001$)	6.21 $\pm$ 0.27	7.65 $\pm$ 0.45	7.67 $\pm$ 0.22	8.14 $\pm$ 0.84
α LNA ($P < 0.001$)	2.85 $\pm$ 0.58	4.69 $\pm$ 0.22	5.11 $\pm$ 0.29	5.80 $\pm$ 0.79
EPA ($P = 0.34$)	0.46 $\pm$ 0.05	0.23 $\pm$ 0.10	0.21 $\pm$ 0.03	0.21 $\pm$ 0.04
DHA ($P = 0.04$)	1.62 $\pm$ 0.30	1.51 $\pm$ 0.24	1.25 $\pm$ 0.12	1.14 $\pm$ 0.17
Σ n-6/ Σ n-3 ($P < 0.001$)	6.28 $\pm$ 0.77	4.89 $\pm$ 0.22	4.66 $\pm$ 0.11	4.48 $\pm$ 0.21
Dark meat				
Σ SFA ($P = 0.31$)	22.12 $\pm$ 1.34	21.25 $\pm$ 0.78	21.45 $\pm$ 0.75	20.92 $\pm$ 1.38
Σ MUFA ($P = 0.005$)	24.55 $\pm$ 0.78	27.10 $\pm$ 1.97	26.17 $\pm$ 1.61	28.35 $\pm$ 1.88
Σ PUFA n-6 ($P < 0.001$)	46.34 $\pm$ 1.37	42.13 $\pm$ 1.44	42.62 $\pm$ 1.62	41.02 $\pm$ 2.29
Σ PUFA n-3 ($P < 0.001$)	6.30 $\pm$ 0.56	8.27 $\pm$ 0.43	8.96 $\pm$ 0.24	8.99 $\pm$ 0.43
α LNA ($P < 0.001$)	5.22 $\pm$ 0.24	7.28 $\pm$ 0.37	7.96 $\pm$ 0.35	8.02 $\pm$ 0.65
EPA ($P = 0.03$)	0.42 $\pm$ 0.03	0.11 $\pm$ 0.02	0.15 $\pm$ 0.02	0.16 $\pm$ 0.02
DHA ($P = 0.15$)	0.36 $\pm$ 0.03	0.50 $\pm$ 0.12	0.44 $\pm$ 0.15	0.43 $\pm$ 0.05
Σ n-6/ Σ n-3 ($P < 0.001$)	7.38 $\pm$ 0.44	5.10 $\pm$ 0.14	4.76 $\pm$ 0.09	4.57 $\pm$ 0.13

K (control): 3% soybean oil; A: 3% linseed oil; B: 2.9% linseed oil and 0.1% PBE1 oil; C: 2.9% linseed oil and 0.1% PBE2 oil; * mean and standard deviation of 10 replications.

Table 6 Effect of dietary treatments on the sensory characteristics of chicken meat (2nd experiment).

Characteristic	Dietary treatments-groups ($\bar{X} \pm SD$)*			
	K	A	B	C
White meat				
Chicken odour ($P = 0.16$)	7.2 $\pm$ 0.7	7.1 $\pm$ 0.7	6.9 $\pm$ 0.6	7.0 $\pm$ 0.7
Fishy odour ($P = 0.14$)	0.4 $\pm$ 0.4	0.5 $\pm$ 0.7	0.6 $\pm$ 0.6	0.4 $\pm$ 0.5
Rancid odour ($P = 0.59$)	0.7 $\pm$ 0.8	0.5 $\pm$ 0.6	0.6 $\pm$ 0.6	0.9 $\pm$ 0.8
Chicken flavour ($P = 0.27$)	7.2 $\pm$ 0.7	6.9 $\pm$ 0.7	6.8 $\pm$ 0.8	6.7 $\pm$ 0.7
Fishy flavour ($P = 0.11$)	0.2 $\pm$ 0.3	0.5 $\pm$ 0.6	0.6 $\pm$ 0.7	0.3 $\pm$ 0.4
Rancid flavour ($P = 0.46$)	0.5 $\pm$ 0.6	0.5 $\pm$ 0.6	0.6 $\pm$ 0.7	0.6 $\pm$ 0.7
Overall impression ($P = 0.17$)	4.0 $\pm$ 0.4	4.0 $\pm$ 0.6	3.7 $\pm$ 0.6	3.7 $\pm$ 0.5
Dark meat				
Chicken odour ($P = 0.09$)	6.9 $\pm$ 1.0	6.9 $\pm$ 0.5	7.4 $\pm$ 0.6	6.9 $\pm$ 0.7
Fishy odour ($P = 0.08$)	1.0 $\pm$ 1.0	1.1 $\pm$ 0.6	0.3 $\pm$ 0.2	0.6 $\pm$ 0.3
Rancid odour ($P = 0.12$)	0.8 $\pm$ 0.8	0.6 $\pm$ 0.6	0.3 $\pm$ 0.2	0.6 $\pm$ 0.5
Chicken flavour ($P = 0.28$)	6.8 $\pm$ 1.1	6.7 $\pm$ 0.6	7.3 $\pm$ 0.8	6.8 $\pm$ 0.7
Fishy flavour ($P = 0.27$)	0.9 $\pm$ 1.1	1.0 $\pm$ 0.7	0.3 $\pm$ 0.2	0.5 $\pm$ 0.6
Rancid flavour ($P = 0.20$)	0.5 $\pm$ 0.6	0.7 $\pm$ 0.7	0.3 $\pm$ 0.4	0.4 $\pm$ 0.4
Overall impression ($P = 0.23$)	3.6 $\pm$ 1.0	3.4 $\pm$ 0.7	4.1 $\pm$ 0.4	3.7 $\pm$ 0.5

K (control): 3% soybean oil; A: 3% linseed oil; B: 2.9% linseed oil and 0.1% PBE1 oil; C: 2.9% linseed oil and 0.1% PBE2 oil; * mean and standard deviation of four replications.

PUFA in diets significantly increased their deposition in white and dark chicken meat. Reduce of n-6/n-3 ratio in diets resulted in more favourable ratio in white and dark chicken meat. Panel of sensory assessors identified occurrence of weak, but still noticeable odour and taste of fish in dark chicken meat ($P < 0.05$). Supplementation of PBE1 and PBE2 oils to dietary

treatments in the amount 0.25% and 1.51% affected increase of deposited EPA and DHA in chicken meat, but it was the reason for poorer grade of sensory characteristics of meat. Results of the 2nd experiment proved that omitting PBE1 and PBE2 oils from diets seven days prior to slaughtering led to production of meat enriched with n-3 PUFA with satisfactory sensory

characteristics.

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