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COMPARISON OF FATTY ACID COMPOSITION OF EGG YOLKS OBTAINED WHITE AND BROWN HENS FED IN THE SAME WAY METHOD

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In this study, fatty acid composition of egg yolk obtained from brown and white chickens fed by the same method was investigated by gas chromatography. Twenty two different fatty acid were determined in the egg. Palmitic acid was defined as the maximum saturated fatty acid. Linoleic acid, linolenic acid and arachidonic acid were with the highest amount as unsaturated fatty acids. In this study the ratio of n-3/n-6 of white eggs was higher than the one of brown egg. Egg yolk of white chickens regarding fatty acids may be valuable in human consumption.

Key words: brown egg; white egg; fatty acid composition; gas chromatography

СПОРЕДБА НА МАСНОКИСЕЛИНСКИОТ СОСТАВ НА ЖОЛТОЦИТЕ НА ЈАЈЦАТА ДОБИЕНИ ОД БЕЛИ И КАФЕАВИ КОКОШКИ ХРАНЕТИ ПО ИСТ МЕТОД

Во оваа студија, со помош на гасната хроматографија, беше истражуван маснокиселинскиот состав на жолтокот на јајцата добиени од бели и кафеави кокошки хранети на ист начин. Беа утврдени дваесет и две различни масни киселини во јајцето. Палмитинската киселина беше дефинирана како најзастапена заситена масна киселина. Линолната, линоленската и арахидонската киселина како незаситени масни киселини беа со најголема количина. Во овој опит, соодносот n-3/n-6 кај белите јајца беше повисок од оној кај кафеавите јајца. Жолтокот на јајцата од бели кокошки во однос на маснокиселинскиот состав има важно место во основната исхрана на човекот.

Клучни зборови: обоено јајце; бело јајце; масно киселински состав; гасна хроматографија

1. INTRODUCTION

Polyunsaturated fatty acids, mainly those of the w-3 family, such as docosahexaenoic (DHA), have a very important role in these diseases prevention, because of its property of decreasing the blood pressure and being a reducer of rates of blood plasma's triglycerides (Park et al., 1997). According to Connor (2000), there was a strong evidence of inverse relation between the quantity of the w-3 fatty acids in diet, blood and tissues, and coronary diseases and their complications. ω-3 fatty acids, therefore, are considered benefic and researches have been trying to increase their quantity in food, especially eicosapentaenoic (EPA), or docosapentaenoic (DPA) and docosahexaenoic (DHA) (Stadelman and Pratt, 1989). Lin et al., (1991) recommended including ω-3 and ω-6 in food for children. They pointed out that when only a-linolenic acid was present in diet, it could be deficient in the reserves of DHA in the brain and the retina. From a nutritional point of view, egg is a good source of proteins, vitamins, minerals and highquality lipids such as polyunsaturated fatty acids (PUFAs) for the human diet (Mazalli et al., 2004).

Many egg brands from specially fed chickens are available supermarkets in Turkey including farm egg, market egg, and ratio eggs. Omega 3 fatty acids enriched eggs currently exported as food, which are sold in other countries.

The fatty acids composition of hen egg yolks can be affected by diet, age of hen, geographical location (Parlat et al., 2010). Egg of poultry as a hase been one of the sources of omega 3 all over the world. The objective of this research was to determine both the fatty acid composition and SFA/PUFA ratio variation of egg yolk of poultry living in natural environment.

The objective of the present study was to compare the nutritionally important fatty acid compositions between eggs from white and brown hens fed by the same method. The levels of ω-3/ω-6 ratios and PUFA, MUFA were compared between the fatty acid composition of egg yolks obtained from brown and white layers fed with the diets.

2. MATERIALS AND METHODS

2.1. Animals and diets

In the periods of 30 days, 60 laying hens at 28 weeks of age were housed in battery cages and were assigned to three different feeding experimental diets. Experimental diets contained for white hens 1) canola oil (3%), 2) normal feeding and 3) eggs of market, for brown hens 1) canola oil (3%) 2) normal feeding and 3) eggs of market, respectively.

2.2. Sample collection

For the determination of the total lipid and fatty acids composition, four eggs from each dietary treatment were randomly selected and analyzed at the end of the 30st day of the experimental feeding. The yolk from each egg was separated mechanically and held in polyethylene packing (in N_2 atmosphere) at –18 °C. Before each analysis, the samples were allowed to achieve room temperature and be homogenized.

2.3. Oil analysis

The contents of crude oil were determined according to AOAC official methods (1995).

2.4. Fatty acid analysis

Total lipids were extracted from the egg yolk samples by the method of Folch et al. (1957). Four-grams samples of egg yolk were homogenized with 80 ml of a 2:1 (v/v) mixture of chloroform-methanol, after which 4 ml 0.88% NaCl was added; the liquid was mixed and left to stand for 2 hours to allow phase separation. The chloroform-methanol extract was evaporated to dryness in a water bath at 50°C under N_2 flow. The lipid extracts were then converted to fatty acid methyl esters by using boron-trifluoride-methylation solution (catalogue no. 3-3021). The Fatty acid methyl esters (FAMEs) were separated and analyzed by the Shimadzu 15-A gas chromatograph (GC), equipped with a dual flame ionisation detector and a 1.8 m × 3 mm internal diameter packed glass column containing 100/120 Chromosorb WAW coated with 10% SP 2330. The injector and detector temperatures were 225 and 245 °C, respectively. Column temperature program was 190 °C for 35 min then increasing at 30 °C/min up to 220 °C where it was maintained for 5 min. Nitrogen at a flow rate of 20 ml/min was used as the carrier gas.

The fatty acid compositions were identified by the comparison of retention times with known as external standard mixtures, quantified by a Shimadzu Class-VP software system. The results were expressed as percentage distribution of fatty acid methyl esters. All the chemicals used for the gas chromatography analysis procedure were obtained from Supelco Inc. (Bellefonte, PA, U.S.A.).

2.5. Statistical analysis

The results were subjected to variance analysis (ANOVA), at 5% significance level, by the Statistica Software (StatSoft, USA, 1996) version 5.0. The mean values were compared by the Tukey test.

3. RESULTS

The results of fatty acid analyses were shown in Table 1 and twenty five fatty acids were identified in the egg yolk from white and brown hens fed by the same method. The lipid content ranged from 30.23% to 32,51% in egg yolks from brown and white hens. There were significant differences between the groups of brown and white egg yolks regardine fat contents. Fat content isn't influenced by different oil sources. Similarly, Parlat et al., (2010) found that the lipid content of egg yolk was at a level of 30.0 %. The fatty acid profiles of egg yolks of the brown and white hens were different.

T a b l e 1

Fatty acid composition of egg yolks from white and brown hens (n = 5)

Fatty acids	1.	2.	3.	4.	5.	6.
C 12:0	0.00 ± 0.00a	0.00 ± 0.01a	0.00 ± 0.01a	0.01 ± 0.01a	0.04 ± 0.07a	0.00 ± 0.00a
C 13:0	0.07 ± 0.03a	0.09 ± 0.03a	0.05 ± 0.10a	0.02 ± 0.02a	0.09 ± 0.18a	0.02 ± 0.01a
C 14:0	0.35 ± 0.02a	0.29 ± 0.09a	0.26 ± 0.02a	0.32 ± 0.05a	0.40 ± 0.25a	0.26 ± 0.03a
C 15:0	0.01 ± 0.00a	0.01 ± 0.00a	0.03 ± 0.07a	0.00 ± 0.01a	0.02 ± 0.01a	0.00 ± 0.00a
C 16:0	24.52 ± 1.19b	24.28 ± 1.22b	23.75 ± 0.59b	23.98 ± 0.43b	26.89 ± 1.73a	24.82 ± 0.45b
C 17:0	0.00 ± 0.01a	0.00 ± 0.00a	0.01 ± 0.01a	0.00 ± 0.00a	0.00 ± 0.00a	0.01 ± 0.01a
C 18:0	7.05 ± 0.54a	6.86 ± 0.71a	7.09 ± 1.26a	6.66 ± 0.79a	6.89 ± 1.04a	7.96 ± 0.34a
C 20:0	0.16 ± 0.12a	0.14 ± 0.07ab	0.04 ± 0.01b	0.08 ± 0.10ab	0.09 ± 0.04ab	0.03 ± 0.01b
C 21:0	0.17 ± 0.19a	0.08 ± 0.10ab	0.00 ± 0.00b	0.16 ± 0.11a	0.09 ± 0.01ab	0.21 ± 0.03a
C 22:0	0.41 ± 0.54bc	0.82 ± 0.87abc	0.00 ± 0.00c	0.77 ± 0.81abc	1.18 ± 0.48ab	1.60 ± 0.37a
C 24:0	0.00 ± 0.00b	0.00 ± 0.00b	0.46 ± 0.53a	0.25 ± 0.25ab	0.00 ± 0.00b	0.09 ± 0.04ab
∑ SFA	32.78 ± 1.97bc	32.61 ± 0.87bc	31.68 ± 1.87c	32.26 ± 1.85c	36.07 ± 1.71a	35.02 ± 0.57ab
C 14:1	0.02 ± 0.01b	0.05 ± 0.05b	0.17 ± 0.06a	0.04 ± 0.05b	0.03 ± 0.02b	0.12 ± 0.02a
C 16:1	2.27 ± 0.34b	2.89 ± 0.54ab	2.58 ± 0.12b	2.61 ± 0.23b	3.61 ± 1.04a	2.65 ± 0.33b
C 17:1	0.06 ± 0.01b	0.04 ± 0.04b	0.00 ± 0.00b	0.03 ± 0.03b	0.37 ± 0.19a	0.04 ± 0.01b
C 18:1	42.11 ± 2.31b	43.24 ± 3.83ab	37.38 ± 0.46c	40.39 ± 3.42bc	46.31 ± 1.23a	40.66 ± 1.42bc
C 20:1	0.25 ± 0.04bc	0.11 ± 0.13c	1.46 ± 0.31a	0.40 ± 0.61bc	0.23 ± 0.17bc	0.70 ± 0.20b
C 22:1	0.88 ± 0.30a	0.73 ± 0.53ab	0.00 ± 0.00c	0.26 ± 0.51bc	0.15 ± 0.08c	0.00 ± 0.00c
∑ MUFA	45.52 ± 2.75bc	47.01 ± 3.96ab	41.58 ± 0.65c	43.70 ± 3.64bc	50.32 ± 0.53a	44.12 ± 1.52bc
C 18:2	20.45 ± 1.20ab	18.97 ± 3.64b	22.63 ± 1.44a	21.62 ± 1.83ab	11.99 ± 1.16c	19.25 ± 0.89b
C 18:3	0.14 ± 0.10b	0.17 ± 0.09b	0.39 ± 0.02ab	0.56 ± 0.40a	0.24 ± 0.19b	0.11 ± 0.04b
C 20:4	0.19 ± 0.08b	0.20 ± 0.15b	1.41 ± 0.09a	0.48 ± 0.76b	0.33 ± 0.50b	0.14 ± 0.03b
C 20:5	0.02 ± 0.01a	0.11 ± 0.11a	0.00 ± 0.00a	0.01 ± 0.01a	0.04 ± 0.03ab	0.00 ± 0.00a
C 22:3	0.00 ± 0.00b	0.00 ± 0.00b	0.14 ± 0.11a	0.10 ± 0.11ab	0.00 ± 0.00b	0.00 ± 0.00b
C 22:4	0.28 ± 0.40ab	0.48 ± 0.43a	0.07 ± 0.09ab	0.03 ± 0.06b	0.20 ± 0.26ab	0.15 ± 0.01ab
C 22:5	0.28 ± 0.40a	0.22 ± 0.13a	0.31 ± 0.23a	0.25 ± 0.05a	0.36 ± 0.11a	0.32 ± 0.09a
C 22:6	0.32 ± 0.10b	0.20 ± 0.22b	0.56 ± 0.33ab	0.76 ± 0.35a	0.31 ± 0.28b	0.58 ± 0.09ab
∑ PUFA	21.70 ± 1.13b	20.38 ± 3.71b	25.53 ± 1.70a	23.90 ± 2.99ab	13.56 ± 1.47c	20.55 ± 0.95b
∑ ω 3	0.76 ± 0.40c	0.69 ± 0.19c	1.39 ± 0.26ab	1.68 ± 0.69a	0.95 ± 0.12bc	1.00 ± 0.10bc
∑ ω 6	20.91 ± 1.11b	19.65 ± 3.51b	24.14 ± 1.50a	22.13 ± 2.47ab	12.52 ± 1.40c	19.53 ± 0.87b
∑ ω 3/6	0.04 ± 0.02b	0.04 ± 0.01b	0.06 ± 0.01ab	0.08 ± 0.03a	0.08 ± 0.01a	0.05 ± 0.01ab
∑ ω 6/3	34.05 ± 17.81a	29.17 ± 3.84ab	17.68 ± 2.26bc	16.07 ± 9.23bc	13.27 ± 0.46c	19.61 ± 1.25bc
∑ SFA/PUFA	1.52 ± 0.08bc	1.65 ± 0.34b	1.25 ± 0.15c	1.37 ± 0.18bc	2.69 ± 0.38a	1.71 ± 0.09b

1. White eggs addition to 3% Canola oil in ratio
2. White eggs from hens with natural feeding
3. White eggs sold in grocery store
4. Brown eggs addition to 3% Canola oil in ratio
5. Brown eggs from hens with natural feeding
6. Brown eggs sold in grocery store

4. DISCUSSION

The poultry egg yolks contained a beneficial n-3/n-6 ratio contributing to cardiovascular risk reduction. The major effects of these fat or oil sources were observed for C18:1n9, C16:0, C18:2n6, C18:0, and C16:1n6, respectively. Parlat et al. (2010) reported that the egg yolks from brown hens showed production of eggs with high ω-3/ω-6 and SFA/PUFA ratios. Similar results were identified in this study for all egg yolks. Palmitic acid was the primary saturated fatty acid of 23.75–26.89 % for egg yolk in different feeding diets.

Oleic acid was predominant fatty acid in egg yolks. Oleic acid was identified as a primary MUFA in the egg yolks for all diets (37.38–46.38 %). In the experiment of Sehu et al. (2012), oleic acid was the major fatty acid of egg yolks. Palmitoleic acid was the second most abundant MUFA (2.27–3.61 %) in the present study.

In this work, the SFA contents were generally much higer than PUFA in all groups such as white eggs addition to 3% Canola oil in ratio, white eggs from hens with natural feeding, white eggs sold in grocery store, brown eggs addition to 3% Canola oil in ratio, brown eggs from hens with natural feeding, brown eggs sold in grocery store group, 21.70, 20.38, 25.53, 23.90, 13.56, and 20.55%, respectively. Monounsaturated fatty acid contents of egg yolks were higher than SFA in all groups, 45.52, 47.01, 41.58, 43.70, 50.32, and 44.12%, respectively. In general, MUFA is higher than SFA and PUFA (Jia et al., 2005). Similar results were identified in this study for MUFA in all groups (41.58–50.32 %).

The high ω-3 content (1.68 %) in egg yolks from brown and white hens of addition to 3% Canola oil in ratio group may be attributed to these researchers' report. In regard to the importance of PUFA in the formation of ω-3 and ω-6 metabolites, a 10:1 ratio of dietary ω-3/ω-6 fatty acids the egg yolks from brown and white hens, ω-3 amounts in eggs were found to be as 0.76, 0.69, 1.39, 1.68, 0.95 and 1.00%, respectively.

The long chain of ω-3 and ω-6 fatty acids and ω-6/ω-3 is important for human health. In the present study, the ω-6/ω-3 ratios were 34.05, 29.17, 17.68, 16.07, 13.27, 19.61 % in white eggs addition to 3% Canola oil in ratio, white eggs from hens with natural feeding, white eggs sold in grocery store, brown eggs addition to 3% Canola oil in ratio, brown eggs from hens with natural feeding, brown eggs sold in grocery store, respectively. Dyerberg, (1986) ratio of ω-3/ω-6 PUFAs are beneficial for human health, ω-6 content was higher than ω-3 content in all egg yolks.

5. CONCLUSIONS

The results of this work, showed that feeding played an important role on fatty acid composition of egg yolks. The amount of all fatty acids of egg yolks from white and brown eggs is different, that is, it is possible to say that change fatty acid composition of the egg yolk.

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