THE PROFILE OF FATTY ACIDS IN INTRAMUSCULAR FAT OF CHICKENS

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Background

Chicken meat is a very desirable product in the nutritive habits of population so that its consumption is steadily growing in many countries, as well as in Croatia. Although the chicken meat contains only 1.5 % to 6% fat (depending on the part of carcass), scientists are trying to change the profile of fatty acids in the muscular lipids. Meat tastiness is the main criterion of the market quality and is related to the lipid content. Demands for increase of α-linolenic acid (αLA), eicosapentaenoic (EPA) and docosahexaenoic (DHA) fatty acids are set as an additional criterion. From health and nutritive point of view chicken meat enriched with PUFA n-3 ingredients is preferred by consumers. Nowadays, the exploration of possibilities of chicken meat designing is of great importance (Kralik et al., 1996; Komprda et al., 1999; Okuyama and Ikemoto, 1999; Škrtić, 1999).

Objectives

The aim of the research was to determine the profile of the fatty acids in the lipids of breast muscles and in the lipids of thighs with drumsticks muscles. Data about deposition of SFA, MUFA, PUFA n-6 and PUFA n-3 enable new insights about nutritive qualities of white and red chicken meat.

Methods

The research was carried out on male Ross broilers. They were fed *ad libitum* from 1st to 28th day with mixture, which contained 22.67% crude proteins and 14.19 MJ ME; from 29th to 42nd day they were fed with finisher mixture, which contained 20.43% crude proteins and 14.18 MJ ME. Besides other forage ingredients, both mixtures contained 5% animal fat and 1% fish oil. The fattening period lasted 35 days. After cutting carcasses into the main parts, the breast - white meat and thighs with drumsticks - red meat (n=10), without skin and visible fatty tissue, were used for analysis. Muscles were minced and analysis was conducted on homogenized samples. The content of fatty acids in the lipids of white and red meat was determined with Chrompack CP-9000 chromatograph with flame ionisation detector. The temperature of injector and flame of ionisation detector was 220°C. The starting temperature was 100°C; inflamation speed of the column was 6°C /min to 210°C and that temperature was being used during the analysis procedures. For quantitative evaluation we used the percentage methylester relation, which was taken as an equivalent of proportions of particular chromatogram peaks (Csapo et al., 1986). The content of the following fatty acids was proven: lauric (C12:0), myristic (C14:0), pentadecaenoic (C15:0) palmitic (C16:0), heptadecanoic (C17:0), stearic (C18:0), arachidic (C20:0), behenic (C22:0), lignoceric (C24:0), palmitoleic (C16:1), oleic (C18:1), eicosenoic (C20:1), nervonic (C24:1), linoleic (C18:2n-6), eicosadienoic (C20:2n-6), arachidonic (C20:4n-6), α-linolenic (C18:3n-3), eicosapentaenoic (C20:5n-3), docosapentaenoic (C22:5n-3) and docosahexaenoic (C22:6n-3).
The results were processed by the statistics computer program SAS, version 6.12. T-test established the statistically relevant differences for evaluated parameters of white and red meat.

Results and discussion

The analysis of fatty acids content (Table 1) shows in most cases significant ($P<0.05$) and very significant differences ($P<0.01$) between white and red meat. The statistical significance has not been confirmed only in the difference of the content of pentadecaenoic (C15:0) and heptadecanoic (C17:0) acids in these two kinds of meat. In the group of saturated acids of the both kinds of meat the major portion have palmitic acid (C16:0) and stearic acid (C18:0), which make 23.43% and 13.88% in the white meat, and 2.77% and 9.90% in the red chicken meat. Oleic acid (C18:1) is better represented in the red meat than in the white meat (31.98% and 26.02%). Polyunsaturated linoleic acid (C18:2n-6) is also higher in the red meat than in the white meat (17.23% and 13.38%).
Taking into consideration that the eicosapentaenoic (C20:5n-3) and docosahexaenoic acids (C22:6n-3) are especially important for human health as well as for prevention of cardiovascular diseases, scientists recommend the decreasing of their portion in the meat (Okuyama and Ikemoto, 1999).
Our results show that the saturated fatty acids (C12:0, C14:0, C15:0, C16:0, C17:0, C18:0, C20:0, C22:0, C24:0) are stored in higher amount in the white meat in comparison to the red meat (39.46% and 33.81%). Polyunsaturated fatty acids (C18:3n-3, C20:5n-3, C22:5n-3 and C22:6n-3) are also contained in higher amounts in the white meat than in the red meat (5.50% and 3.23%). In the case of monounsaturated fatty acids (C16:1, C18:1, C20:1, C24:1) we found just the opposite, because these fatty acids are contained in the red meat in higher amounts than in the white meat (32.50% and 29.62%)
Research results of Leskanich and Noble (1997), as well as of Komprda et al. (1999) differ from ours in the content of SFA and MUFA. Not only from our results, but also from the results of cited authors can be concluded that PUFA n-6 (C18:2n-6, C20:2n-6, C24:4n-6) is accumulated more in the red than in the white meat (19.85% and 17.69%). The opposite happens with PUFA n-3 (C18:3n-3, C20:5n-3, C22:5n-3, C22:6n-3) because these acids are settled in the white meat more than in the red meat (5.5% and 3.23%). The relation between PUFA n-6 / PUFA n-3 is considerably better in the white meat (3.22) than in the red meat (6.14). The relation PUFA n-6 / PUFA n-3 in the research of Komprda et al. (1999) was 4.5 to 19.2 in the red meat, and 3.1 to 13.6 in the white meat, depending on the source of fat in the food. Hulan et al. (1989) found that the breast muscles contain less lipids and three-glycerides, but more omega-3 fatty acids, especially EPA and DHA, as well as more fatty acids in general than the muscles of drumsticks. Žlender et al. (2000) also found that not only EPA and DHA, but also arachidonic acid accumulate in greater amounts in the white meat than in the red chicken meat. The same authors point out that the way of chicken rearing (indoor or outdoor) affects the profile of fatty acids in the lipids of muscles.
The chicken meat (red and white) can be very valuable source of essential fatty acids. Profile of fatty acids in the lipids of breast muscles, as well as of the thighs with drumsticks can be also one of the criteria of nutritive value of these meat kinds. In the lipids of the white meat there are more SFA and PUFA n-3, and the lipids of red meat are richer in MUFA and PUFA n-6. Relation of PUFA n-6 /PUFA n-3 is more favourable in the white meat than in the red chicken meat.

Pertinent literature

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Table 1. Fatty acids content in intramuscular fat of chicken meat (%)

Fatty acid		Breast muscles (white meat) $\bar{x} \pm s_{\bar{x}}$	Thighs with drumsticks muscles (red meat) $\bar{x} \pm s_{\bar{x}}$	Significance of differences
Lauric	C12:0	0.47±0.06	0.31±0.07	**
Myristic	C14:0	0.82±0.08	1.05±0.09	**
Pentadecaenoic	C15:0	0.14±0.05	0.13±0.05	n.s.
Palmitic	C16:0	23.43±0.71	21.77±0.10	**
Heptadecanoic	C17:0	0.30±0.10	0.30±0.02	n.s.
Stearic	C18:0	13.88±0.35	9.90±1.01	**
Arachidic	C20:0	0.14±0.01	0.16±0.02	*
Behenic	C22:0	0.18±0.02	0.10±0.01	**
Lignoceric	C24:0	0.12±0.02	0.09±0.01	**
∑ SFA		39.46	33.81	
Palmitoleic	C16:1	1.52±0.03	3.44±0.10	**
Oleic	C18:1	26.02±0.15	31.98±0.25	**
Eicosenoic	C20:1	0.34±0.03	0.47±0.06	**
Nervonic	C24:1	1.73±0.15	0.46±0.05	**
∑ MUFA		29.62	35.20	
Linoleic	C18:2n-6	13.38±0.75	17.23±3.25	**
Eicosadienoic	C20:2n-6	0.67±0.02	0.52±0.08	**
Arachidonic	C24:4n-6	3.65±0.52	2.10±0.53	**
∑ PUFA n-6		17.69	19.85	
α-linolenic	C18:3n-3	0.52±0.03	0.82±0.08	**
Eicosapentaenoic	C20:5n-3	0.62±0.02	0.48±0.05	**
Docosapentaenoic	C22:5n-3	1.91±0.08	0.96±0.04	**
Docosahexaenoic	C22:6n-3	2.95±0.09	1.45±0.25	**
∑ PUFA n-3		5.50	3.23	
SFA / MUFA		1.33	0.96	
SFA / PUFA		1.70	1.46	
PUFA n-6 / PUFA n-3		3.22	6.14	

n.s. non significant $P>0.05$; *$P<0.05$; ** $P<0.01$