MODIFICATION OF VERY LONG CHAIN n-3 PUFA IN CHICKEN MEAT

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Background

The content of PUFA n-3 in chicken meat is of great importance for human nutrition. The ratio of n-6/n-3 PUFA in meat should be as narrower as possible (Okuyama and Ikemoto, 1999). This recommendation is based upon the fact that PUFA n-6 and PUFA n-3 affect differently the immunological functions and inflammatory processes in humans and animals (Caldor, 2001). PUFA n-6 acts pro-inflammatory, while PUFA n-3 has anti-inflammatory effects. Within n-3 PUFA group, EPA and DHA are more important than precursors of α-linolenic acid (Ollis et al., 1999). Recommended amounts of specific fatty acids for adults are the following: LA 4.4-20 g/day, LNA 1.35-2.2 g/day) and LC n-3 PUFA 0.16-1.6 g/day (Meyer et al., 2003). According to Ollis et al. (1999), only 15% of LNA is converted to VLC n-3 PUFA. Chicken meat is a valuable source of n-3 PUFA because of the possibility to change the profile of fatty acids (Kralik et al., 2003). The content of fatty acids and cholesterol level in chicken meat can be influenced by using the fats, which differ in their contents of fatty acids (Kralik et al., 1997). The content of EPA and DHA in chicken meat can be increased by addition of fish oil and fish flour to the diets (Chanmugam et al., 1992, Lopez-Ferrer et al., 1999). The content of linoleic and linolenic acids is increased by addition of soybean oil and rapeseed oil to the diets (Scaife et al., 1994).

Objectives

The aim of this research was to determine the effect of addition of PBE oil in different amounts to finishers and the content of n-3 PUFA, i.e. very long-chain fatty acid equivalent (VLCE) in white and dark meat.

Materials and methods

Chickens were divided into five groups. From the 1st to 21st day, they were fed with starter mixture (A), which contained 22.67% of crude proteins and 14.19 MJ/kg ME. From 22nd to 42nd day chickens were fed with finishers (B_1, B_2, B_3, B_4, and B_5), which were balanced at the level of 20.43% of crude proteins. The first control group was given B_1 mixture, while the 2nd, 3rd, 4th and 5th group were fed with B_2, B_3, B_4 and B_5 mixtures, which had the animal fat partially replaced by the Pronova Biocare Epax 3000 T6 preparation (PBE oil), in the amounts of 0.5%, 1%, 1.5% and 2%, respectively. This oil contains, besides other fatty acids, 15,36% eicosapentanoic acid (EPH) and 9.99% docosahexanoic acid (DHA). The content of fatty acids in the lipids of white and dark chicken meat was determined on 9 samples of each group by the Chrompack CP-9000 chromatograph with flame ionization detector. Each fatty acid was shown in % of the total fatty acids (Csapo et al., 1986). On the basis of the content of α-linolenic acid**,** eicosapentanoic and docosahexanoic acids in lipids, the content of stated fatty acids was calculated in white and dark meat. Veri long chain fatty acid equivalent was shown according to Komprda et al. (2003) as follows: VLCE = 0.15 LNA + (EPA + DHA).

Results and discussion

Table 1 shows the data, which refer to the content of fats and n-3 PUFA in white and dark chicken meat. Portions of fats in white meat fluctuated from 1.08 to 1.45%. Highly significant difference is found between 2nd and 3rd group, 2nd and 4th group, as well as between 3rd and 5th group. Chemical analysis of dark meat showed the portion of fats of 4.22-5.02%, but no statistically significant differences were found out between groups. Results that are similar to ours are stated also by Komprda et al. (1999), Škrtić (1999) and Crespo and Esteve-Garcia (2001). The contents of EPA and DHA in lipids of white meat are significantly higher in all experimental groups in comparison to the control groups. In comparison with the 1st group, the 5th group, which was fed with 2% of PBE preparation, contained 291.93% more EPA and 92.54% more DHA in the lipids of breast muscles. The results obtained in this research are similar to those of Hulan et al. (1988), but higher than those stated by Komprda et al. (1999a) and Zelenka et al. (2001). The feeding of chickens with

this preparation resulted in the increase of EPA and DHA in the thigh lipids. The highest content of unsaturated omega-3 fatty acids is found out in the lipids of dark meat in the 5th group, which was fed with mixture containing 2% of PBE preparation. Moreover, the content of EPA and DHA in the lipids of thigh muscles is increased from 0.48% and 1.45% (1st group) to 1.18% and 1,83% (2nd group); 1.30% and 2.83% (3rd group), 2.24% and 3.76% (4th group) and 2.76% and 4.91% (5th group). Statistical analysis showed highly significant differences ($P<0.01$) in the content of EPA and DHA between 1st and 2nd, 1st and 4th, then between 2nd and 5th, and 3rd and 4th, as well as between 3rd and 5th group. Table 2 presents the data of the n-3 PUFA content in g/100 g in white and dark meat. Graph 3 presents VLC n-3 PUFA equivalent in white and dark chicken meat. Komprda et. al. (2003) succeeded to increase the VLC n-3 PUFA equivalent in turkey meat by addition of linseed and fish oil to the diets. The addition of PBE preparation in the diets resulted in the increase of VLC n-3 PUFA equivalent from 48 mg/100 g and 93 mg/100 g to 59 and 143, 60 and 183, 73 and 258, and 119 and 390 mg/100 g, respectively, in white and dark chicken meat.
Comparison of the EPA and DHA contents in the lipids of white and dark chicken meat shows higher deposition of stated fatty acids in the lipids of white meat. Considering the fact that dark meat contains more fats than white meat, the contents of EPA and DHA in dark meat is thus considerably higher than in white chicken meat. Addition of the PBE preparation to diets resulted in the higher deposition of stated fatty acids in both white and dark meat (Table 2).

Conclusions

Based on the obtained results, it can be concluded that the addition of PBE preparation to the diets in the amounts of 0.0%, 0.5%, 1.0%, 1.5% and 2.0% resulted in the statistically significant increase of EPA and DHA in white and dark chicken meat. Very long-chain fatty acid equivalent (VLCE) was also increased in both meat kinds. Related to the increase of concentration of PBE oil in the diets, VLC equivalents were also increased from 48 to 119 in white meat, and from 93 to 90 mg/100 g in dark meat.

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Table 1. Content of fats and PUFA n-3 in lipids of white and dark chicken meat

	Groups					F-value
	1st	2nd	3rd	4th	5th	
			White meat			
Fat, %	1.32	1.38	1.13	1.08	1.45	**
α-Linolenic acid[1]	0.52	0.82	0.61	0.75	0.66	*
EPH[1]	0.62	1.11	1.49	2.21	2.43	*
DHA[1]	2.95	3.03	3.79	4.47	5.68	**
			Dark meat			
Fat, %	4,51	4.51	4.42	4.22	5.02	n.s.
α-Linolenic acid[1]	0.82	0.98	0.91	0.74	0.70	*
EPH[1]	0.48	1.18	1.30	2.24	2.76	**
DHA[1]	1.45	1.83	1.82	3.76	4.91	**

[1]g in 100 g of total fatty acids; n.s. = non significant; * P<0.05; **P<0.01

Table 2. Content of PUFA n-3 (g/100 g) in white and dark chicken meat

	Groups					F-value
	1st	2nd	3rd	4th	5th	
			White meat			
α-Linolenic acid*	0.007	0.011	0.007	0.008	0.010	*
EPH*	0.008	0.015	0.017	0.024	0.035	**
DHA*	0.039	0.042	0.042	0.048	0.082	**
			Dark meat			
α-Linolenic acid*	0.037	0.044	0.040	0.031	0.035	n.s.
EPH*	0.021	0.053	0.058	0,095	0.138	**
DHA*	0.066	0.083	0.125	0.159	0.246	**

n.s. = non significant; * P<0.05; **P<0.01

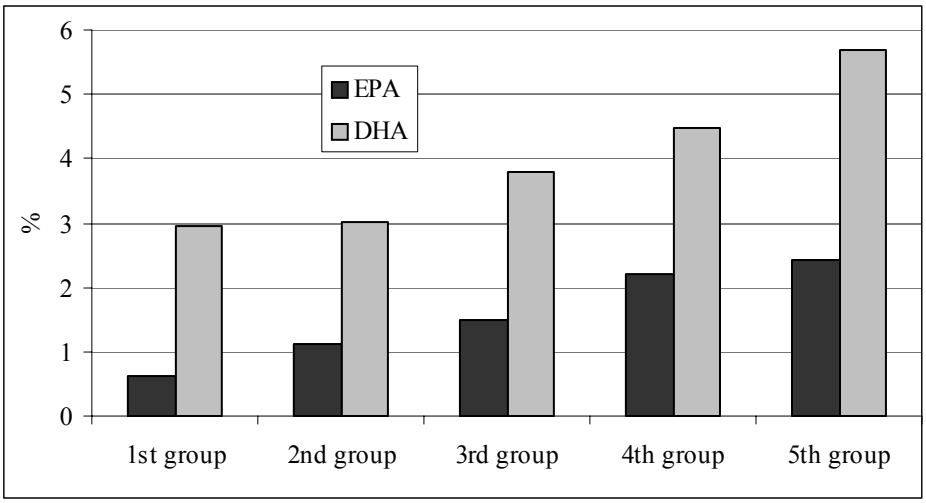

Figure 1. Content of EPA and DHA (%) in total fatty acids of white meat

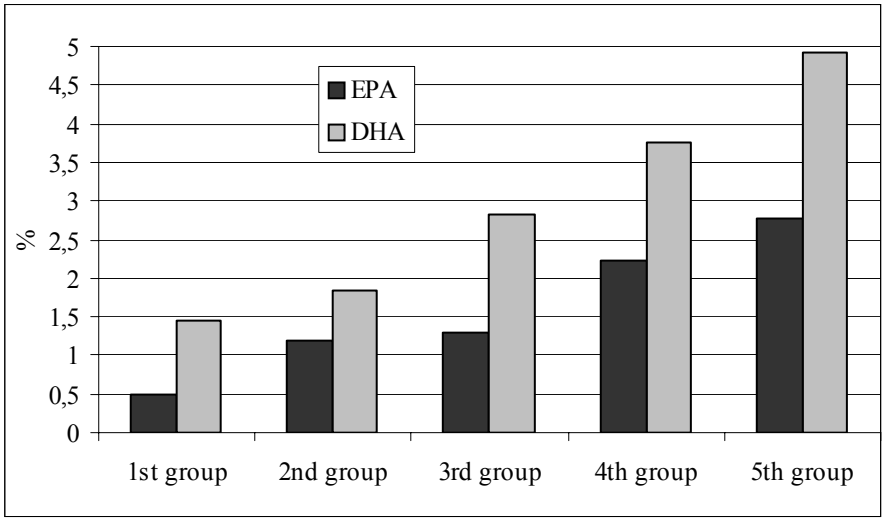

Figure 2. Content of EPA and DHA (%) in total fatty acids of dark meat

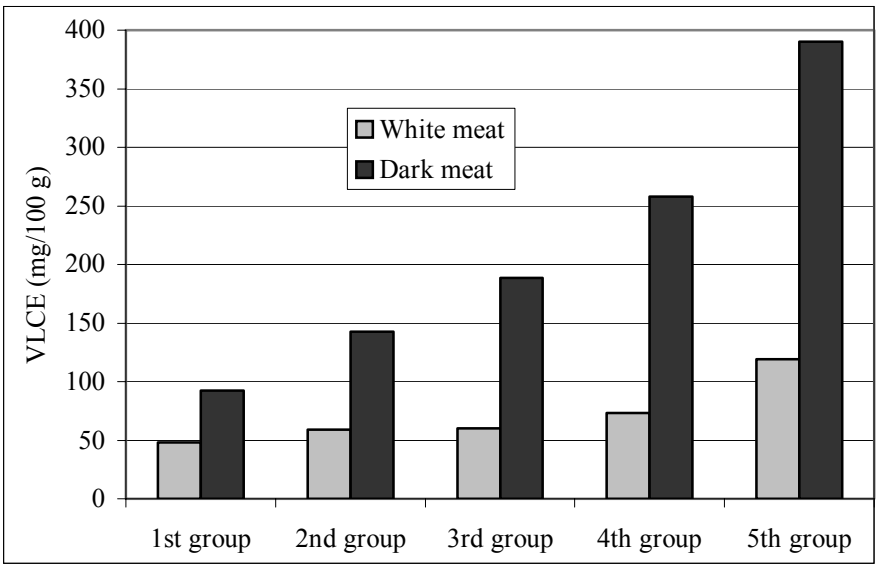

Figure 3. Equivalent of very long chain n-3 polyunsaturated fatty acids (VLCE) in white and dark meat