

Abstract

The submitted thesis is concerned with the use of gas chromatography (GC) to determine fatty acids (FA) in clinical samples and study of the effect of FA on the occurrence and prevention of selected diseases. The work is focused on FA metabolism in relation to essential FA and highly beneficial polyunsaturated fatty acids (PUFA) of the omega-3 group, such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), which are insufficiently represented in the nutrition of western populations. The experimental part is concerned with the development of GC methods for determining FA as their methyl esters and their use for analysis of samples in intervention clinical studies of OMEGA and VEGGIE-2. The study of OMEGA concentrates on the incorporation of beneficial omega-3 PUFA into the food chain through microalgae synthesizing EPA and linseed containing mainly α -linolenic acid. These sources were employed to prepare a mixture for feeding poultry and the obtained eggs and chicken meat enhanced in omega-3 FA were used as ingredients for preparing food. Following 8-week dietary intervention performed on healthy volunteers, a statistically significant increase was found in the content of DHA in erythrocytes, equal to 4.4 % before and 5.1 % after the dietary intervention in the test group. The determined omega-3 index also exhibited an increase from 5.1 % to 5.8 % in the tested group and from 5.3 % to 5.8 % in the control group. In the second study VEGGIE-2, the overall FA profile was monitored in vegans as a model group for studying dietary factors affecting insulin resistance, such as intervention by amino acids with branched side chains. The study demonstrated that the plasmatic levels of omega-3 FA with longer chains are reduced in vegans because of elimination of their main source from the diet and slow endogenic synthesis. Simultaneously, a detailed analysis of FA *cis/trans* isomers in fat tissue was performed amongst vegans using the newly developed GC separation on two connected hundred-metre columns. The analyses demonstrated that vegans have a comparable level of elaidic acid of 1 mg/g compared to 1.2 mg/g amongst omnivores and a 3-fold lower level of *trans*-vaccenic acid of 0.4 mg/g compared to 1.5 mg/g. The total sum of all the *trans* fatty acid isomers (TFA) is 4.6 mg/g amongst vegans compared to 7.7 mg/g amongst omnivores. Vegans also have substantially higher levels of Σ PUFA, with 92% content of linoleic acid, and their concentration is twice as high as for omnivores. In conclusion, the developed method was employed for determining TFA in breast milk with a determined level of total TFA of $0.9 \pm 0.27\%$, which is 3-4 times lower than the value determined at our workplace in a similar study in 2007.

