Abstract

The meat from pigs fed standard (commercially available) diet does not meet the nutritional recommendations of the World Health Organization (WHO, WHO/FAO, 2003) due to the low omega-3 (n-3) polyunsaturated fatty acids (PUFA) content and the excessive content of omega-6 (n-6) PUFA. Therefore, some attempts are made to determine the optimal quantity and source of fat used as feed additives, which allow to produce pork with health-promoting properties.

Presented doctoral thesis verifies the hypothesis that it is possible to use for about 6-7 weeks before slaughtering the properly selected fat mixtures (as a source of n-3 PUFA) which modify the fatty acid content in the pigs body tissues in order to receive the product with fatty acid composition recommended by WHO.

In order to verify the hypothesis three experiments on growing gilts were performed.

- The aim of the **first experiment** was to investigate the effect of feeding pigs an isoenergetic and isolysonic diets in which 10% of metabolizable energy was replaced by the energy from fat mixtures introducing a similar amounts of saturated fatty acids (SFA, approximately 8.99 g/kg feed), monounsaturated fatty acids (approximately 17.52 g/kg feed), and linoleic acid (C18:2 n-6, LA, approximately 19.15 g/kg feed), but different amounts of α-linolenic acid (C18:3 n-3, ALA, from 2.07 to 8.75 g/kg feed), eicosapentaenoic (C20:5 n-3, EPA) and docosahexaenoic (C22:6 n-3, DHA) acids (together from 0.05 to 1.60 g/kg feed) on the performance, carcass quality and fatty acid content in the pigs body tissues. The research scheme allowed to estimate the net deposition efficiency of ALA and total EPA + DHA in the whole pigs body. On the basis of the obtained results, there was composed a fat mixture allowing to produce pork with such fatty acid composition that meets WHO (WHO/FAO, 2003) and European Union (No. 116/2010) recommendations.
- The aim of the **second experiment** was to investigate the effect of breed/genotype on the nutritional value and health-promoting properties of pork by comparing the fatty acid content in the *Longissimus dorsi* muscle and backfat of pigs fed diet with

modified fatty acid composition estimated in the first experiment. In this diet approximately 9% of metabolizable energy was replaced by the energy from fat

mixture (linseed, rapeseed, and fish oils) introducing the optimal amount of n-3 PUFA determining the favourable PUFA/SFA, LA/ALA and n-6/n-3 PUFA ratios in tissues.

- The aim of the **third experiment** was to investigate the influence of breed/genotype and feeding level (the diet with modified fatty acid composition used in the second experiment) on the fatty acid content (expressed as g per 100 g of tissue) and expression of genes encoding enzymes involved in the fat metabolism in the muscle characterised by either glicolitic (*Longissimus dorsi*) or oxidative (*Biceps femoris*) type of metabolism.

Based on the obtained results, it was found that:

1) replacing a part of metabolizable energy by fat mixture rich in n-3 PUFA allows to produce pork with health-promoting properties recommended by WHO;
2) the health-promoting properties of pork are easier to obtain in pigs with a greater intramuscular fat content regardless of general body fatness;
3) there is a positive relationship between the fatty acid content (expressed as g per 100 g of tissue) and fat content in the examined tissues;
4) the muscles from the loin (*Longissimus dorsi*) and ham (*Biceps femoris*) containing a small amount of intramuscular fat do not meet European Union recommendations for the product recognized as a source of n-3 PUFA or containing high content of n-3 PUFA;
5) pork (muscles with inter- and intramuscular fat) containing more than 10% of fat meets the European Union recommendations for the product recognized as a source of n-3 PUFA;
6) increased intake of ALA, EPA and DHA results in their elevated deposition in the pigs body. The efficiency of ALA and EPA + DHA conversion from the feed to the pigs body amounted on average 56 and 49%, respectively. The obtained data allow to predict the deposition of these fatty acids in pigs tissues and simultaneously foresee the functional properties of pork;
7) general body fatness and intramuscular fat content, which are affected by breed/genotype, influence the qualitative and quantitative composition of fatty acids deposited in pigs tissues to a greater extent than the feeding level;
8) feeding level (at 95 or 85% of assumed *ad libitum* intake) influences mainly the general body fatness and does not change the intramuscular fat content;

9) expression of genes (stearoyl-CoA desaturase – *SCD*, fatty acid-binding protein 4 – *FABP4*, and peroxisome proliferator-activated receptor gamma – *PPARG*), encoding enzymes involved in the fat metabolism, depend to a greater extent on the type of the muscle and genetic factors that influence fat content in the body (breed/genotype) than on the nutritional factors. Muscles characterized by the oxidative metabolism (*Biceps femoris*) are more sensitive to the dietary and genetic factors than those characterized by the glycolytic metabolism (*Longissimus dorsi*) regardless of the experimental factors. For that reason in studying the expression of *SCD*, *FABP4*, and *PPARG* genes, at first the metabolic type of examined muscle and genetic factors should be taken into account, and than the nutritional factors.

Modification of fatty acid content in tissues of pigs body by feeding the animals diet enriched in a mixture of linseed, rapeseed and fish oils (as the sources of n-3 PUFA) for about 6-7 weeks before slaughtering allows to produce pork with health-promoting properties in accordance to WHO recommendations. This effect is easier to obtain in pigs with a greater intramuscular fat content regardless of general body fatness. The expression of *SCD*, *FABP4*, and *PPARG* genes encoding enzymes involved in the fat metabolism in a higher degree depends on the type of the muscle and genetic factors than on the nutritional factors.