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Analytical chemistry is used in a lot of fields of science, such as in physicochemical researches, environmental or biological and medical fields. Metabolomics is used in connection with the exploration of new technologies to authenticate food. Metabolomics is based on analytical chemistry, biochemistry and biology.

Researches which use metabolomics tools have been widely applied in medical diagnostic or food examinations for more than a decade. Analytical methods such as nuclear magnetic resonance spectroscopy or mass spectrometry in connection with metabolomics have been recently used more frequently in Poland too.

In the past few years we have observed increasingly common situations, in which food was falsified or we have such as “wholesome” products have been of lower quality. For this reason it is very important to search for methods, which allow a fast, cheap and uncomplicated examination of food and agricultural products.

This doctoral dissertation presents researches which use nuclear magnetic resonance spectroscopy, which relate to metabolomics analyses of food and agricultural products such as poppy seeds, hen eggs and cereals. The biggest advantages of this examination are simplicity and velocity of researches and the fact that in a single measurement we can mark both the quality and quantity of all chemical compounds without preliminary distribution of the individual groups of compounds.

This doctoral dissertation shows an innovative approach to study rancidity and brewing processes in poppy seeds and also the optimization of poppy mass production. We created a rancidity profile based on changes in the level of small weight molecular compounds which are in poppy seeds. Moreover, we defined biochemical basis of changes, which occur in poppy seeds during rancidity process.

In the following study we are also focused on comparing of metabolic profiles of yolk and white, derived from hens, which are fed different kinds of feeds. One of them was fed a conventional feed and others were fed with the feed *Kalanchoe daigremontiana* and *Medicago sativa* containing herbs known for antitumor properties. Received results didn't show any significant differences between the composition of eggs derived from hens which are fed different feed.

Other examinations of eggs were focused on the by differentiation between metabolomics profiles of eggs depending on different types of hen farming. The comparison of ecological farming, which is considered to be healthier, with other types (free range, bedding and caged) presents that only two metabolites are different in groups in yolk (glutamine and sarcosine) and white (formic acid and choline).

In the following dissertation the examination of five different kinds of cereals (wheat, rye, triticale, oats, barley), allows creating a metabolic profile for each of them. The above study confirmed earlier research oats are characterized by the biggest content of free fatty acids and also that the protein, which is in cereals, is defective, although we can find in wheat many exogenous amino acids. Additionally, we have succeed in using metabolomics tool, which confirmed that triticale is a genetic mixture of wheat and rye. It has been also demonstrated that the accumulation of various content of heavy metal ions impacts in different ways on the metabolic profile of each examined cereal. We have also created correlation maps heavy metal ions contained in soli and those contained in crops. Moreover, we created correlations maps between plant metabolites and heavy metal ions content in plants and in soil. The last step in metabolic research of cereals was creating a chart using MetPa application, which confirmed that the accumulation of heavy metal ions has the biggest impact on the citric acid cycle, alanine, glutamine and aspartic acid metabolism and also brain chain amino acids metabolism.

The above dissertation confirmed, that metabolomics examination with multivariate chemometric and statistical analysis can successfully be used in food and agricultural products studies.