Research project objectives

The main goal of undertaken researches will be a study of a new methodical approach, which is going to assure a possibility to estimate an influence of a kind of packaging, its production conditions and storage on size of compound migrations streams with an endocrine feature from an internal layer of a food packaging. Actions undertaken within proposed project will be oriented on an identification of an unfavorable biological effects triggered by a mixture of xenobiotics.

Basic research carried out under the project. Reasons for undertaking this particular subject.

In the scientific literature, which publishes the latest research findings related to the monitoring of xenobiotics, as well as the one which addresses different toxicological aspects, one can find increasingly more information on the sources and the volume of emissions released by everyday objects. One of the priority issues in this area of research is, without a doubt, the one of migration of low molecular weight compounds from the packaging to the food stored inside. The multiannual research carried out in numerous research centres enabled, first and foremost, the identification of main groups of compounds leaching from the inner layer of the package as well as the conditions affecting the intensification of this process. Among the most common analytes, both in simulants and in food samples stored in cans or in the polymeric materials, the following types can be distinguished: Bisphenol A (BPA), Bisphenol A diglycidyl ether (BADGE), its derivatives and the compounds of phthalates. The main source of contamination are the special coatings used to protect the inner layer of the packaging from corroding and also to protect food from direct contact with the material used in producing the container. By analyzing the recent literature we may conclude that a significant proportion of world production of BPA (~10%) can be found in the protective layers of these types. Given the fact that BPA is one of the most widely produced chemical compounds, with average global annual production exceeding 4 million tons, it is not difficult to imagine the scope of the exposure to this ecotoxin as a result of the consumption of canned foods. The widespread use of Bisphenol A in the packaging industry is closely linked with the shift in consumption patterns that has taken place recently. The constant lack of time among the citizens of highly developed countries means that a significant share of their daily diets consists of products with a long shelf life, which are sold in metal or polymeric packaging.
The main criterion for approving packaging materials for contact with food are the toxic properties of the substances used to produce a given material and the degree of migration and specific migration determined on the basis of normative values of tolerable daily intake (TDI). Unfortunately, however, the standard guidelines for assessing the impact of packaging on food quality only take into account the numerical values of the parameter "global migration" and "specific migration" fixed for a small group of compounds. Such approach raises many objections, given that the results of a recent study showed that apart from the monitored compounds leaching from the surface of the package, there are also other contaminants and their derivatives formed by interaction with food components and as a result of technological procedures applied. The inability to accurately identify and quantify all the substances released into the food which then enter the body orally and the lack of adequate toxicological knowledge make it impossible to assess the real danger faced by consumers and predict the possible consequences associated with a long-term exposure. What makes the situation even worse is that among a large group of synthetic compounds used during the production of protective layers that can potentially enter the food, the vast majority exhibits properties similar to contaminants from the EDC group (Endocrine Disrupting Compounds). The presence of compounds affecting the proper functioning of the endocrine system in the environment poses many problems for researchers. For many years, many research centres have been conducting research to explain the processes and mechanisms by which these compounds modify the functioning of the living organism. Unfortunately, the knowledge about the complex mechanisms of toxic activity of these compounds is still very limited. What makes the situation even more serious is the fact that, according to numerous experimental data carried out both in vitro and in vivio, the dose-response for these compounds is not monotonic and hence the usage of data obtained by exposing animal organisms to high doses of xenoestrogens in order to assess the risk of toxic effects in humans exposed to low doses over a longer period of time can be seriously flawed. Hence, the application of traditional principles and assumptions on which the assessment of the health risks for other contaminants is based cannot be used to evaluate the hormonally active compounds. Moreover, during the toxicological assessment of hormone derivative compounds it is also necessary to take into account the interaction that can occur between these contaminants. According to numerous studies, the presence of several xenoestrogens of low or even very low levels of concentration may result in a toxic effect. The combined action of biologically active compounds may reduce (antagonism) or reinforce (synergism) the observed toxic effect. In view of such knowledge it is obvious that based on the composition of the sample alone it is not possible to estimate the risk posed by the presence of a mixture of xenobiotics occurring at different levels of content. Determining the total contamination of the sample is only possible when one applies methods that utilize living organisms as active elements during the test.
Although the scientists have for a long time been working on improving methodologies for assessing the suitability of the materials intended for contact with food, the interdisciplinary teams of scientists are currently focusing on detecting, identifying and quantifying the previously unidentified contaminants and developing new, more sophisticated tools enabling quantitative determination of trace elements. So far the literature gives no information on the use of an integrated approach based on both instrumental techniques and an appropriate selection of bioassays. Under the proposed project we plan to use a set of biological tests based on organisms of different trophic levels in order to assess the toxicity, endocrinology and cytotoxicity of model liquid samples and food samples stored in containers whose inner surface is covered with a protective layer. At a later stage, the samples exhibiting toxicity will be the subject of instrumental analysis. The results obtained within the proposed project will give information about both the quantitative and qualitative composition of the samples as well as about their toxicity and endocrinology, which will undoubtedly significantly contribute to the development of knowledge about the size of migration flows of compounds released into food products. Chemometric tests for the development of multi-parameter measurement data sets will provide additional information. It will be possible to determine whether a correlation between different parameters occurs and, if so, how strong it is. The obtained data will help to broaden the knowledge on the occurrence and the levels of EDC compounds and thus revise the health risk assessment. In addition, the results of toxicological analyses will provide impetus to update and extend not only the requirements for new materials in direct contact with food which will be made commercially

available, but also safety and consumer health protection legislation. Moreover, determining the actual impact of packaging on toxicity and endocrinology of food will certainly increase public awareness of the threat posed by canned foods and items stored in plastic packaging. This knowledge can lead to a more informed choice of food products as well as to help to introduce remedial practices aimed at minimizing the degree of exposure to ecotoxins.