Brominated flame retardants (BFRs) are the most effective compounds in reducing the combustion of synthetic materials. For this reason, these substances are widely used in the production of electrical and electronic devices, textiles, furniture and other everyday products. BFRs account for 25% of all flame retardants used in the industry. The content of BFRs in the finished product is 5-30%. The most commonly used BFRs is tetrabromobisphenol A (TBBPA), which accounts for 60% of the global market for these substances. TBBPA production takes place mainly in the United States, China, Japan and Israel; however, it is used all over the world as a component of prefabricates such as epoxy-resins and polycarbonates and various products including, furniture, textiles and electronic devices. Other compounds from this group are 2,4,6-tribromophenol (2,4,6-TBP), pentabromophenol (PBP) and tetrabromobisphenol S (TBBPS). It has been shown that both general human population and workers (employed in the production, packaging and transport of BFRs) are exposed to bromophenolic flame retardants.

In 2012, the European Food Safety Authority concluded that it was not possible to assess human health risk posed by bromophenolic flame retardants due to insufficient data on the presence of these compounds in food and food chain as well as negligible number of toxicological studies.

The results that have been obtained so far by the Applicant have shown that TBBPA, TBBPS, 2,4,6-TBP and PBP exhibit adverse effects on human peripheral blood mononuclear cells (PBMCs). It has been observed that the tested compounds decreased cell viability, changed cell morphology, depleted ATP level, increased reactive oxygen species (ROS) level and induced lipid and protein peroxidation (work in preparation). The current studies also showed genotoxic potential of these substances in PBMCs as they were capable of inducing DNA single and double-strand breaks formation. Moreover, preliminary studies have shown apoptotic potential of BFRs discussed.

In this study, I have decided to compare apoptotic potential of TBBPA, TBBPS, 2,4,6-TBP and PBP on human PBMCs and evaluate the underlying mechanism of action of these substances. The project includes six experiments concerning the evaluation of changes in cell membrane permeability characteristic for apoptosis as well as changes in transmembrane mitochondrial potential and cytosolic calcium ion level. Moreover, caspase-8 -9 -3 activities, poly(ADP-ribose) polymerase-1 (PARP-1) cleavage and chromatin condensation will be assessed.

PBMCs are very useful research model in the study of the effect of various xenobiotics on nucleated cells. These cells play a crucial role in the immune response protecting human body against viruses, bacteria and cancer cells. Disorders in the functioning of PBMCs may affect the development of so-called “immunological paralysis” that makes human organism susceptible to pathogens, and thus maybe responsible for infections including sepsis. In addition, enhanced apoptosis of lymphocytes (main population of PBMCs) plays a key role in various diseases development including cancer and autoimmune disorders (asthma, allergy). There are also studies, which have shown the effect of some BFRs like TBBPA on the development of type 2 diabetes and cancer. Bromophenolic flame retardants bioaccumulate in living organisms, which in turn leads to their biomagnification in the food chain. These compounds have been shown to exhibit adverse effects on the endocrine system by disrupting the metabolism of some hormones.

It must be noted that insufficient toxicological data describing the effect of bromophenolic flame retardants on living organisms including humans makes necessity to conduct studies in this area. The intention of this work is to pay attention to the problem arising from the widespread use of BFRs in everyday products and common exposure of humans to their action. The obtained results may allow to establish cooperation with other research units in the world. Moreover, the popularization of the problem may contribute to reduction (if BFRs studied occurs to be toxic) of the use of bromophenolic flame retardants in the industry and/or replacing them with less harmful analogs. The results of the study are expected to be published in renowned open access journal from JCR list and presented at conferences.