

Research objective and aim of the study

For recent decades, the amount of produced plastic has increased dramatically. More than 8.3 billion tons of different types of plastics have been produced since the 1950s, with only a small recycled proportion. Different plastics have become an important element contributing to environmental pollution; due to its use in products that have a contact with foods, it is very important to assess polystyrene impact on the human body.

Numerous studies have confirmed the toxicity of various types of plastic micro- and nanoparticles for living organisms (in aquatic environment, in particular), as well as the ability of these substances to accumulate in mammalian organisms. However, the mechanisms of the impact of plastics nanoparticles on the human body and their consequences for health are still only partly recognised. The respiratory and digestive systems are the main routes of the body entering by nanoplastics, and the circulatory system transports them to various tissues and organs. The circulatory system may not only be an important element of the distribution of plastic nanoparticles within the body, but also one of the first targets for their harmful actions.

The aim of the project is to comprehensively assess the impact of plastic nanoparticle (NPs) on blood physiology and vascular walls in the context of assessment of their cytotoxicity, pro-inflammatory and pro-thrombotic effect risks.

The study concept and methodology

The concept of the proposal is based on examination of the effects of NPs on the main pillars of the haemostatic balance in the circulatory system, including:

1. Determination of the influence of the tested NPs on the whole blood coagulation ability and activity of platelets (with particular emphasis on the assessment of the risk of increasing their reactivity by nanoplastic particles).
2. Assessment of effects of the presence of plastic nanoparticles on blood plasma haemostatic properties - both in terms of the activity of the blood coagulation cascade proteins and components of the fibrinolytic system.
3. Assessment of the plastic NPs influence on the functions of the endothelium.
4. Determination of functional consequences of exposure to NPs for erythrocytes - in the context of their physiological functions and participation in the processes related to haemostasis.
5. Determination the plastic NPs effects on the activation of inflammasome and pro-coagulant state of human monocytes and macrophages.

The planned studies will include the effects of NPs (~50 nm), originating from various types of plastics: polystyrene (PS), polypropylene (PP), polyethylene (PE) and polyethylene terephthalate (PET), and the research methodology will be based on biochemical analyses, the use of molecular biology methods, modern diagnostic tools and transmission electron microscopy. The proposal will be accomplished at three research units of the Faculty of Biology and Environmental Protection of the University of Lodz, i.e. at the Department of General Biochemistry, the Department of Biophysics of Environmental Pollution and the Department of Oncobiology and Epigenetics as well as the Department of Translational Immunology and Experimental Intensive Care, Centre of Postgraduate Medical Education, Warsaw.

The expected results

This is the first project aiming to investigate the effects of different plastic nanoparticles on functions of key elements of the haemostatic system and to assess the functional consequences of their presence for cellular and plasma components of blood, as well as for endothelial cells. The planned studies will provide new data, extending the current state of knowledge and contributing to a better understanding of the consequences and potential health risks associated with so extensive use of plastic in everyday life.