Healthy eating strategy with increased consumption of plant-based foods plays important role in the prevention of many chronic diseases, such as heart disease, cancer, stroke, diabetes, Alzheimer's disease, cataracts, and age-related function decline. The changes in dietary patterns and lifestyle, such as increasing the consumption of fruits and vegetables and more balanced intakes of meat and plant foods, are a practical and effective strategy for reducing the incidence of aforementioned diseases. Silicon (Si) is not considered as a nutrient for plant growth and development, however, it was noticed that Si supplementation improves the the state of plant growth and development in both normal and stressful conditions.

Our objective of this study is to investigate and explain the mechanism of positive effects of Si on plant cells as well as to identify and prepare biologically active Si compounds from plants or plant extracts that show valuable effects on the plant cells. Thus, the planned research will enter the area of metabolomics and bioanalytics - analysis of the Si cycle and its known and unknown organic forms in the network: ecosystem - plant - food - living organisms and finally humans nutrition (diet). We believe that the beneficial effect of Si on stressed plants may explain the mechanism of Si action at the cellular level. As a stress factor we will use cadmium (Cd), which is not involved in any known biological process and at the same time is considered to be one of the most dangerous heavy metals toxic to organisms, including plants, at very low concentrations. We hypothesize that the analysis of the cell and tissue recovery responses may provide novel insight and dissect the order of involved processes induced by Si in the cells and tissues of plants treated with Cd. In our studies, we will first confirm the positive effect of Si on the control and Cd-treated plants. For this purpose, we will use three species of plants important from the point of view of diet and human health: pea (*Pisum sativum* L.), alfalfa (*Medicago sativa* L.) and common wheat (*Triticum aestivum* L.). We will analyze the accumulation of Si and Cd in the plants tissues and its effect on plant physiology, development and ultrastructure of single cells. During the research step we will use both Si and Cd speciation analysis using high performance liquid chromatography (HPLC) with inductively coupled plasma mass spectrometry (ICP-MS), biochemical and enzymatic assays as well as various microscopic techniques (e.g. optical, fluorescent, transmission electron microscopy - TEM). In addition, we will examine changes in plant metabolism using high-resolution mass spectrometry techniques, such as HPLC - Orbitrap - MS and matrix-assisted laser desorption ionization time-of-flight mass spectrometry (MALDI-TOF/MS), as well as capillary electrophoresis coupled with mass spectrometry (CE-MS). The non-targeted analysis using m/z clouds, multivariate statistical analyzes and bioinformatic tools will be used to interpret and evaluate the results. These studies will provide important insights into Si mechanism of action ultimately leading to the identification of novel biologically active Si compounds. Subsequently, we will select the conditions and methods for preparing plant extracts enriched with various silicon compounds (maceration, accelerated solvent extraction - ASE, supercritical fluid extraction - SFE) and assess their antimicrobial activity, cytotoxicity and phytotoxicity using, e.g. cell lines cultures, flow cytometry, classical bacterial culture techniques as well as microscopic and electrophoretic techniques (CE).

We believe that the proposed study will benefits the knowledge regarding Si influence on plant growth and development of Cd-treated plants but more important it will provide the opportunity to find new biologically active compounds. These Si based compounds could be used to improve human health in the future as a dietary supplement.