

When looking at flowers or buying fruit and vegetables, we do not realize how complicated and amazing their internal structure is. Plant organs (e.g. leaf, root, etc.) are made of tissues and those – of cells. The cell wall is a protective barrier of the cell interior. It provides the cell shape and appropriate rigidity. Moreover, it participates in the exchange of components with the external environment and in many other biological and physiological processes. The functions and properties of the cell wall depend on its structure. The basic components of the cell wall are polysaccharides: cellulose, hemicellulose and pectins. Molecules of polysaccharide are able to bind together in a liquid and form a three-dimensional network. A well-networked structure that fills the entire volume of the sample characterizes the gel. The ability of polysaccharides to self-organize, form complex structures and gel is one of the basic functional properties of these natural polymers. The process of a three-dimensional network formation depends on many factors, such as the chemical structure, spatial structure and size of polysaccharide molecules, electric charge on their surface, pH of the solution, the presence of mono- and polyvalent positively charged ions (cations) as well as negatively charged ions (anions) in the solution, the diameter of these ions and interactions with water molecules. The explanation of the mechanisms of this process is of the interest to scientists.

Onion is an often grown vegetable in our home gardens. Adjacent to other plants, it can positively (e.g. beets) or badly (e.g. beans) affect their growth and development, which is called allelopathy. Cell wall polysaccharides of onion have antioxidant, antibacterial and antifungal properties. Under the right conditions, they can form gels. Their gelling properties were mainly investigated in terms of the potential use of these biopolymers in the food, pharmaceutical and cosmetic industries. The results of some studies indicated that polysaccharides of the onion cell wall present in the soil stimulated the plant growth. The plant nutrients, such as nitrogen, phosphorus, potassium and sulfur, are also present in the soil solution. Their ionic forms are available to the plant roots. An influence of these ions on the behavior of polysaccharides extracted from the onion cell wall has not been characterized so far.

An effect of the structure and valence of ions (cations and anions) containing plant nutrients on the self-organization and gelation of the polysaccharide fractions extracted from onions will be studied in the Project. Moreover, the properties of these polysaccharides in the soil – plant system will be characterized.

Investigations will be performed for the suspensions of polysaccharides in salt solutions at the constant ionic strength without the pH adjustment. Moreover, for the three selected concentrations of polysaccharides, the effect of the acidic, neutral and alkaline environment, respectively, will be checked. The polysaccharides will be characterized in terms of particle size, mobility in the electric field, the surface electrical charge, and optical properties. The structure of polysaccharides will also be described on the basis of the analysis of images obtained with the atomic force microscope. Quantitative analyzes are also planned to evaluate the nutrient binding by these biopolymers. Research on the influence of polysaccharides and plant nutrients on the soil properties (including specific surface area, surface electric charge, macronutrient content, etc.) will be the next stage of Project. It will be based on the examination of the properties of two soils that differ in their granulometric composition and organic matter content. In an experiment planned at the end of the Project, the properties of onion cell wall polysaccharides in the soil-plant system will be studied using the red beet (*Beta vulgaris* L.) and common bean (*Phaseolus vulgaris* L.) plants in a pot experiment.

The research will allow to characterize the influence of nutrients important for plant growth and development on the physicochemical properties, the self-assembly and gelation of the onion polysaccharides. The results could help discover new functional properties of these polysaccharides, e.g. as soil nutrient carriers for plants or matrices for retaining such nutrients.