

Title of the project: Development of the optimum pectin extraction strategy for 3D printing

Supervisor: Prof. dr hab. Justyna Cybulska

Description of the position

Currently, many methods for pectin extraction have been developed that base on physical and chemical treatments before or during the process. Due to complexity of pectin family in plant cell walls and versatile linkage mechanisms with other components, the extraction method affects pectin molecular structure and properties. Carrot will be applied as a source of pectin because it is one of the most important vegetable in human diet and is widely used for juice production resulting in waste pomace.

3D printing is the state-of-the-art manufacturing technique underpinning a remarkably infinite prospect of customizability, flexibility, and sustainability in the production of tailored geometries additively by depositing materials layer-by-layer. Different feedstocks for 3D printing have been already used, but successful substitution of plastics with a more sustainable and environmentally friendly components, including polysaccharides, have been recently demonstrated. Pectin is a relatively a new component compatible with extrusion 3D printing technology. Printability from the ink based on pectin depends on the molecular structure and presence of functional groups.

Therefore, in this research it is hypothesized that various extraction methods of pectin will result in various printability. The aim of the doctoral research is to develop an optimum extraction method of pectin from carrot for making the ink for 3D printing. Such supporting extraction techniques like: microwaves, high pressure homogenization and ultrasounds, and various extractants will be tested to obtain high yield pectin from carrot. 3D printed objects (models: lines and meshes, and cylinders) will be evaluated according to fidelity, structure and mechanical properties. In results, a new and comprehensive knowledge, and know-how on tuning strategy of the bio ink composition for printing 3D biomaterials will be obtained.

Requirements:

- Completed Master's degree in chemistry, biotechnology, chemical engineering, materials engineering, physics, food technology, etc. (master's degree obtained before the start date of the project, i.e. October 1, 2025);
- Basic knowledge of cell wall structure;
- High laboratory skills are required;
- Good knowledge of English, both written and spoken;
- Availability, good work organization, ability to work in a team and cope with stress;