

Ionic liquids are a group of chemical compounds which has gained the interest of scientific communities around the world. The popularity of this group of chemical substances results from the possibility of designing their physicochemical properties and biological activity, which is associated with the ionic structure. The melting points of ionic liquids are an important parameter used for their characterization. By definition, they are organic salts with a melting point that does not exceed 100 °C. During recent years, ionic liquids have been divided into three generations due to their design. The I generation includes salts with specific physical properties, while II generation includes ionic liquids with the desired physical and chemical properties. The last generation is focused on substances with designed physicochemical properties but also desirable biological activity. As such, novel active substances were introduced to the world literature, which allow for combating harmful or undesirable organisms in stored cereals. During recent years, ionic liquids with bactericidal, fungicidal and antifeedant activity have been described.

In the framework of the project, studies will be undertaken to develop and describe the methodology for the synthesis and purification of novel quaternary dicationic salts (ionic liquid precursors) - bis-ammonium, bis-phosphonium and ammonium-phosphonium ester linkers, which will be introduced to world literature for the first time. The synthesis of precursors will consist of two stages - quaternization and O-alkylation. The development of the preparation process will allow to select parameters such as the reaction environment, temperature and reaction time. Then, the inorganic anion will be exchanged for the amino acid anion (L-proline, L-histidine), as a result of the exchange reaction, which will allow to obtain dicationic ionic liquids. After the selection of an appropriate purification technique, the structure of new salts will be confirmed by means of nuclear magnetic resonance (NMR) and molecular calculations will be carried out.

The characterization of basic physicochemical properties (solubility, density, viscosity, refractive index, phase transitions, thermal stability, surfaceactivity) will be an indispensable aspect of the project. The specified parameters will allow to supplement the literature with new data as well as to find a correlation between structures and the appropriate parameter.

The obtained dicationic salts will also be tested in terms of biological activity (bacteriostatic, fungistatic and antifeedant) and will be combined with commercially active substances. The research will be focused on confirming the synthesis of new III ionic liquids as well as determining the impact of structural changes in the cation (type of quaternary atom and the length of the ester linker) and anion. The studied salts will also be tested in terms of environmental impact by investigation of their biodegradability. Considering that the structure of chemical compounds will influence the biological activity and physicochemical properties, all data obtained will be thoroughly analyzed in order to determine the relationship between them.

In summary, the designed dicationic ionic liquids with amino acid anions are potential substances with biological activity and a negligible impact on the natural environment. The development of the methodology for their preparation and the determination of physicochemical properties is therefore of high importance and will allow to increase the knowledge in this field.