

Heavy metal pollution, as a consequence of intensive industrial activity, poses a serious threat to living organisms, including plants. In response to heavy metals, plants activate various protective mechanisms at the molecular and physiological levels. Many studies have shown that metal-resistant endophytic bacteria, which inhabit plants, significantly support the growth and development of their hosts under adverse conditions. It should be noted that the interaction between bacteria and plants is a very complex process. Recently, it was discovered that microvesicles produced by bacteria also play a role in these interactions. Bacterial microvesicles, especially those produced by gram-negative bacteria, are increasingly attracting the attention of researchers. Despite being much smaller than bacteria, microvesicles play a vital role in numerous biological processes due to their unique composition. They can contain products of bacterial metabolism, antigens, virulence factors, and genetic material (DNA, RNA). The content of these structures depends on the environmental conditions and the presence of toxic substances. The latest research has demonstrated that treating plants with bacterial vesicles protects them from infections caused by pathogens. Therefore, microvesicles hold great potential as biological vaccines for plants. However, it remains unclear whether microvesicles produced by endophytic bacteria are involved in supporting the growth and development of plants exposed to adverse environmental factors, such as heavy metals.

The main objective of this project is to investigate what role microvesicles produced by heavy-metal-resistant endophytic bacteria play in plants exposed to these toxic compounds. We aim to find out what defense mechanisms against heavy-metal-induced stress in plants are triggered by EVs of metal-resistant bacteria. Using advanced molecular techniques, we will analyze if the presence of bacterial EVs in plants intensifies the activity of genes associated with the response to heavy-metal-induced stress. Additionally, we will assess whether microvesicles from metal-resistant bacteria induce physiological changes in plants, which will improve their fitness under adverse conditions.

We expect that the results obtained from this research will provide a better understanding of the role of EVs as mediators in bacteria-plant interactions under heavy-metal-induced stress. Furthermore, these findings may contribute to plant growth-supporting and sustainable crop protection strategies in challenging environments.