Natural volatile substances of native herbal plants in the biological protection of crops - from a comprehensive analysis of their composition and activity to modeling process parameters

The main scientific goal of the project is to provide a comprehensive explanation of the role of natural essential oils in the process of *Fusarium* fungal growth inhibition and binding and/or degradation of *Fusarium* mycotoxins through detailed characteristics of their qualitative and quantitative composition and assessment of biological activity in the *in vitro* and *in vivo* tests taking into account a number of factors on the effectiveness of this process.

Fusarium species - the most common fungal pathogens - infect many crop plants in all stages of development, ultimately causing a decrease in their quality (germination capacity, baking parameters) and yield (losses of 7-70%). In addition, most fungi of the genus *Fusarium* show the ability to biosynthesise toxic secondary metabolites - mycotoxins, among which the most significant - from the point of view of food and feed safety - are deoxynivalenol, zearalenone and fumonisins.

In view of the increasing numbers of scientific reports indicating the common resistance of *Fusarium* pathogens to applied fungicides and their negative impact on the environment attempts are being made to develop alternative, effective methods of crop protection. The activities carried out in this field are multidirectional; on the one hand, preparations are sought for with a limited content of chemicals, effective already at low doses, while on the other hand, more and more emphasis is placed on the biological protection of plants using biopreparations.

One of the solutions may be to use a wide spectrum of valuable biological properties of natural essential oils, in particular, antifungal, antibacterial or insecticidal. Herbal plants, of which Poland is one of the leading producers, may be valuable and easily available sources of these natural volatile substances, and the use of modern extraction techniques will provide high-quality material with desirable antimicrobial properties.

Insufficient knowledge in this area has prompted us to undertake the research planned in this project, the aim of which will be to conduct a multifaceted analysis of the interaction between bioactive compounds present in the essential oils and *Fusarium* fungi, along with their influence on the secondary metabolism, e.g. mycotoxin biosynthesis. To our knowledge, there is also no information on proteomic analyses that could help explain this process more precisely. It is worth emphasizing that this new approach may provide interesting data on the processes occurring at the fungal cell level. What is more, there is also a lack of information on the mechanism of interaction between essential oils and mycotoxins. So far, it has not been clarified whether mycotoxins are degraded, transformed or bound by bioactive compounds contained in oils.

To our knowledge it will be the first such widely planned research, using a range of modern analytical and diagnostic methods facilitating the search for valuable bioactive plant components that can find widespread use, among others in the biological protection of cereals and be an alternative to the commonly used fungicides.