

Detection of pathogens, including bacteria, viruses, fungi, and yeast, is integral to food control, clinical diagnostics, and environmental research. Among these pathogens, bacterial infections are of particular concern, causing severe health problems after entering the body through the gastric route. In addition, the detection of specific bacterial strains is also required in the process and quality control of food products because their shelf-life is limited mainly due to microbiological safety. For example, lactic acid bacteria significantly impact food products' quality and shelf-life due to their fermentation and spoilage capability. However, although they are responsible for food taste and texture improvement, they can also contribute to spoilage. Unfortunately, currently available and most widely used methods are laborious and time-consuming, leading to the search for fast, reliable, inexpensive, novel tools.

Since bacterial cells contain many endogenous fluorophores, which can vary between bacterial strains, monitoring their content and ratio may serve as a basis for their identification. To acquire this information, multispectral fluorescence can be used, which consists in recording a series of emission spectra at several excitation wavelengths. Then, appropriate machine learning algorithms must be used to allow the extraction of useful spectral information and the identification of bacterial strains. The undoubted advantage of this approach is the possibility of performing non-invasive and label-free analysis of bacteria in real time.

The scientific goal of the project is to test the research hypothesis regarding the possibility of bacteria classification by taxonomical units using multispectral fluorescence combined with machine learning algorithms. Consequently, the proposed research project aims to develop a novel method based on multispectral fluorescence that would allow rapid, label-free, and non-invasive alternative for food-related bacteria identification, namely lactic acid bacteria. In addition, we would like to thoroughly identify the spectral features in excitation-emission matrices (EEMs) of bacteria, focusing on the potential of their differentiation at family, genus, species, or serotype levels. The critical evaluation and comparison of machine learning algorithms for EEM data modeling will be carried out to develop a hierarchical tool to identify bacterial strains. The proposed project aims to broaden the knowledge regarding the capabilities of multispectral fluorescence in the taxonomical classification of bacteria. In addition, the proposed approach has potential as quick, simple and versatile fluorescence test that can be helpful in bacterial strains identification in food control.