Dissertation abstract
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“Use of infrared spectroscopy for Escherichia coli uropathogenic strains differentiation”

The research hypothesis of the submitted doctoral dissertation assumes that the IR spectrum of bacteria contained information about their phenotypic characteristics. The measurement of the infrared spectra in the range of live and intact bacterial cells will identify the phenotypic traits (antibiotic sensitivity, production of enzymes).

As a research model we chosen collection of uropathogenic Escherichia coli strains and bacteria isolated from a entomopathogenic nematodes.

The theoretical part of the Thesis describe usage of IR spectroscopy in microbiological diagnostics, a statistical methods used in the analysis of spectroscopic data and information on the resistance of uropathogenic Escherichia coli strains to antibiotics. Also presented information on the role of bacteria in the life cycle of the entomopathogenic nematodes. The results of this Thesis are divided into nine subsections. The first subsection - it concerns the resistance of UPEC to 22 antibiotics. Based on the data 7 antibiotics were selected for further study. In the second and third subsections describe the impact of the loss of water in the shape of the IR spectrum of bacteria and verified the correctness of the adopted methodology of measurements and preliminary analysis of spectroscopic data. In the fourth section provides an example of the IR spectrum UPEC strain. The fifth section evaluates the various IR spectra of UPEC strains on the basis of the index D. In the sixth section demonstrated a correlation between the IR spectrum of strains resistant to antibiotics and the presence of proteins on the bacterial surface. In the seventh and eighth section presents the analysis of chemometric obtained spectroscopic data using artificial neural network, K nearest neighbors algorithm and decision trees. The sensitivity and specificity of the proposed mathematical models in most cases over 90%. In the ninth chapter presents the isolation of bacteria from inside the bodies of entomopathogenic nematodes, marking ureolytic properties of these bacteria, as well as the creation of a mathematical model for detecting this feature. Taxonomic affiliation of microorganisms was determined by two independent methods: sequencing of the 16S rRNA gene fragments spectrometry and MALDI-TOF. What is new is the isolation of the two species of bacteria (Delftia acidovorans, Pseudochrobactrum sp.), which has not yet been reported as associated with entomopathogenic nematodes. Based on the wavenumbers 935 cm$^{-1}$ and 1158 cm$^{-1}$ was constructed model discriminating ureolytic and non-ureolytic strains.