**Molecular and physiological response of foodborne pathogens to selected natural bioactive compounds and development of novel biodegradable polymers with antibacterial activity**

Catastrophic consequences of antibiotic resistance and strict food quality and safety standards made natural bioactive molecules (NBMs) became very important topic in science. NBMs are now getting more interest in the food industry to prevent the multiplication of food-contaminating bacteria or to prevent the spreading of foodborne diseases. Recently, hundreds of new bioactive compounds have been identified, many of which could not previously be isolated, purified and examined for their biological effects. Up to date, the precise and accurate mechanism of bactericidal effect of the most of NBMs has not been fully established. Mostly, studies are focused on physico-chemical methods aimed at detecting cell membrane disruption, cytoplasmic leakage, coagulation of cytoplasmic proteins, morphological deformities, changes in protein composition and blockage of some enzymatic reactions. These are simple chemical interactions, i.e. **only description of the effects,** and not the mechanisms. It can be also pointed out that the mechanisms of antimicrobial action of NBMs recognized so far are in fact mostly unknown, unclear or insufficiently tested. **So, the main goal of this project is to accurately reveal the molecular and physiological mechanisms of reactions of foodborne pathogenic bacteria exposed to selected natural bioactive molecules (NBMs) that can be used for food preservation in bactericidal concentrations.** For this project we will create a multidisciplinary team consisting of microbiologist, food and plant scientists, molecular biologists, bioinformatic and technology scientists. The project will have the most comprehensive approach to study antimicrobial mechanisms of natural molecules which will include genomic and transcriptomic approach, bioinformatic analysis, physiological/biochemical analyses, technological processes and clinical microbiology.

To study the mechanisms of antibacterial action in the presence of NBCs the following species will be used: ***S. aureus*** is the only zoonotic agent from genus, producing an important enterotoxin causing foodborne poisoning with diarrhea and vomiting. ***Listeria monocytogenes*** is zoonotic causative agent of listeriosis manifested as encephalitis, miscarriages or septicemias. It can be present in vegetables, meat, milk and cheese, it can survive and grow under refrigeration conditions, low pH and high salt concentrations. ***B. cereus*** is the causative agent of so called "selflimited" benignant infections in humans followed by diarrhoea. ***C. perfringens*** is an anaerobic, spore-forming organism commonly found in fresh meat and poultry products. Spores of the organism can survive many food processing procedures. Shiga toxin-producing ***E. coli*** (STEC) are important enteric pathogens worldwide, causing diarrhea with or without blood visibly present and hemolytic uremic syndrome. ***Salmonella spp.*** are causative agents of salmoneloses -zoonosis still present on all continents. ***Campylobacter*** is a part of normal intestinal flora of pigs and poultry thus being one of the most frequent causative agents of campylobacteriosis in humans which is transmitted through insufficiently cooked meat.

NBMs that were selected for this project are a) Usnic acid (UA) commonly found in the lichen (mostly *Usnea barbata*) has shown a variety of biological activities, including antimicrobial activity against Gram positive bacteria. Although strong candidate for novel antimicrobial, UA has never been included in official medicine, mostly because little or nothing is known about its mechanism of action. b) Xanthohumol (XA) occurs only in the hop (*Humulus lupulus*). Its strong anticarcinogenic activity is the focus of attention, but there are anxiolytic, anti-inflammatory, anti-obesity and antibacterial effects Nothing is known about the mechanism of its antibacterial activity c) Carnosoic acid (CA), originates from sage (*Salvia* spp.) and rosemary (*Rosmarinus officinalis*), is very important compound due to its proven strong antioxidant activity. It has been reported in the literature to have antibacterial activity but its mechanisms of action are completely unknown. In this project NBMs will be also impregnated into new materials that could potentially be used for food packaging or medical devices. The functionality of NBMs on the materials will be examined, that is, whether they retain their activity. While this is entirely fundamental research, the end results of this project can be of great future benefit in the applied food industry as well as in medicine.