POPULAR-SCIENTIFIC SUMMARY OF PROJECT

Annually, a few thousand tons of antibiotics and their transformed compounds (TPs) are introduced to the environment from wastewater treatment plants (WWTPs), livestocks or as a result of human and animal excretion, or dispose of expired or unused medications. The presence of these compounds in the environment is of a great interest due to their potential to cause negative effects – accumulation and spread of antibiotic resistance and the increased toxicity of the mixture of drugs and their TPs. Beta-lactam antibiotics, including the sub-groups of penicillins, cephalosporins and carbapenems comprise the largest share of antibiotics for human use in most countries. The second one are tetracyclines, which are the most popular antibiotics for animal use. This accounts for approximately 95% of total antibiotic use in the world. The metabolism of those active compounds in humans and animals varies widely. Some of compounds are metabolized by 90% or more, while others are metabolized by only 10% or even less and they are excreted as the parent compound or as metabolites in urine and faeces into wastewater in case of human medicines and in case of veterinary into manure from animal farms. Animal manure used as a fertilizer can be a main source of antibiotics in agriculture soils. Furthermore, antibiotics can reach groundwater, which is often source of drinking water. Antibiotics and their TPs entering the environment can affect the evolution of the bacterial community structure which play a significant role in the ecosystem. In the environment, the presence of antibiotics even in sub-inhibitory concentrations can be associated with chronic toxicity.

The main concern for the release of antibiotics into the environment is related to the development of antibiotic resistance genes (ARGs) and bacteria (ARB), which reduce the therapeutic potential against human and animal pathogens. A number of reservoir and habitats may be sites for emergence and maintenance of resistant microorganisms. These include hospitals, WWTPs, farms, aquaculture and habitats to which faces and urine from humans and animals are excreted. Among the ecological compartments which may be considered as important for the transfer of antibiotic resistance we chose to study two different groups of environmental samples: (I) the environment, where antibiotics originated from human treatment: hospital and municipal wastewater before and after treatment, surface water bodies which are receivers of WWTPs' effluents, WWTPs' workers, (II) the environment where antibiotics originated from animals treatment: manure from the poultry, dairy and swine farms, soil from fields fertilized with tested manure, groundwater and crops from the same fields, farms' workers.

The project covers a wide range of research from different areas of chemistry, agronomy, microbiology and bioinformatics, what represents its interdisciplinary profile. To date, scientists have not well recognized the risk of a long exposure to low concentrations of antibiotics on native bacteria. Above all, however, there is lack of simultaneous studies on the effects of antibiotics and their transformation products on environmental microorganisms. Therefore, it is very important to determine the occurrence and fate of micropollutants. Analysis of a broad spectrum of drugs (beta-lactams, tetracyclines and their transformation products) will allow to understand their synergistic and/or antagonistic effects on populations of environmental bacteria. Determination of the environmental pollution by drugs, ARGs and ARB is extremely important, because this knowledge may be used to improve the effectiveness of measures to prevent the ARGs and ARB spread. Including into research also workers od WWTPs and animal's farms, will allow to determine the possibility of ARB and ARGs transmission from the environment to the human respiratory system. This type of research is usually carried out sporadically and accidentally. The actions taken in this project are part of the WHO global action plan for drug resistance prevention, which underlines the need to implement the One Health program involving coordination between many sectors and entities, including human medicine and veterinary medicine, agriculture, the environment, food and the consumer.