Enzymatic Inactivation of the Veterinary Antibiotic Florfenicol

Muller, Marik (School: Hermann-von-Helmholtz Gymnasium Potsdam)

Antibiotics are an important milestone in medicine; however, their increased use has resulted in an alarming rise of antimicrobial resistances. The antibiotic florfenicol is used in large quantities in animal farming and aquaculture, where it enters the environment through waste products, faeces, or milk of treated cows, promoting antimicrobial resistance, and ultimately leading to untreatable multidrug-resistant pathogens threatening also human health. Florfenicol-resistant bacteria often activate export mechanisms that result in resistance to various structurally unrelated antibiotics. I devised a novel strategy for enzymatic inactivation of florfenicol in different media such as saltwater or milk. Using a combinatorial approach and metabolic selection, I optimized a hydrolase enzyme (EstDL136) for florfenicol cleavage. Reaction kinetics were followed by time-resolved nuclear magnetic resonance spectroscopy. Importantly, the hydrolase remained active in different media such as saltwater or cow milk. I developed different environmentally friendly application strategies for florfenicol inactivation using the optimized hydrolase. As potential filter device for cost-effective treatment of waste milk or aquacultural wastewater, the hydrolase was immobilized on Ni-NTA agarose or silica as carrier materials. In two further application examples, the hydrolase was used as cell extract or encapsulated with a semi-permeable membrane. This facilitated, for example, florfenicol inactivation in whole milk, which can help to treat waste milk from medicated cows, to be fed to calves without the risk of inducing antibiotic resistances. Such enzymatic inactivation of antibiotics in general enables therapeutic intervention without promoting antibiotic resistances.

Awards Won:
Fourth Award of $500