Selenium nanoparticles and their utilization in scaffolds

Applications of **selenium nanoparticles** or generally antimicrobial nanoparticles can be different. They can be used to ensure sterility of environment or materials. Nanoparticles can cover washable surfaces in health care facilities, while at the same time provide various coatings and dressings to reduce the risk of post-operative infections. Another use of nanoparticles in human medicine is in the treatment of bacterial infections, e.g., post-traumatic or postoperative infections. Recently, there is a demand for products for the treatment of bacterial infections of the leg ulcers, where the treatment of infections is significantly complicated and prolonged. Resistant strains of bacteria that resist the action of conventional antibiotic drugs significantly contribute to the complicated treatment of bacterial infections.

Selenium nanoparticles (SeNPs) were tested on commercial bacterial strains (*Staphylococcus aureus*, *Escherichia coli*, methicillin-resistant *Staphylococcus aureus*) and on bacterial isolates, which are the more valuable matrix for the use of the products in practice. All the tested bacterial isolates were isolated from wound swabs from infectious patients (n = 300) from the Trauma Hospital in Brno and identified by using matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF MS). These strains were consequently exposed to SeNPs. Almost all of the bacterial strains (n = 63) exhibited inhibition zones larger than 5 mm (limit for sensitivity to antibiotics) after the application of the SeNPs (300 µM). Furthermore, in some tested strains (n = 8 for gram positive (G^+); n = 4 for gram negative (G^-)) even the inhibition zones larger than 12 mm (limit value for very sensitive bacteria to antibiotics) were observed. The effects of the composite were generally higher for the G^+ bacteria in comparison with G^- bacteria, which are generally more resistant to antimicrobial agents due to their cell wall structure.

Since 2014, product **Selenbact** has been marketed in veterinary medicine, primarily for the treatment of surface bacterial infections. This product has been primarily targeted at treatment of infections in small animals such as dogs and cats. Selenbact was prepared in several forms, in the form of gel, spray and ointment. The product was manufactured in cooperation with the pharmaceutical company MedicProgress.

For the use of **selenium nanoparticles in scaffolds,** we have been working with nanomaterials by coating techniques on the coating materials for chronic wound prevalence. Film samples were prepared without and with selenium nanoparticles, polymeric material and bacteria. In several strains have been found to inhibit growth not only in the contact area, but also to inhibit the spread of bacteria to surrounding tissues across the spectrum of all strains. The selenium concentrations used in our samples were even much lower than in the product Selenbact.