

Osteoarthritis is a disease mainly affecting the elderly, whose clinical symptoms include joint pain and restricted movement. Osteoarthritis affects millions of people worldwide causing suffering to patients and severely affecting their independence and quality of life.

Currently, treatment for osteoarthritis usually involves anti-inflammatory drugs, which are known for their systemic side effects and inability to regenerate joint cartilage. For patients at an advanced stage of the disease, the only viable option is surgery, such as joint replacement, which carries significant risks and involves a long recovery. In healthy articular cartilage, the strong interaction between biopolymers and water molecules creates a hydration layer at the friction boundary, characterised by high resistance to normal loads and elasticity against shear forces. This results in an extremely low coefficient of friction during joint movement. Osteoarthritis promotes degradation and damage to the articular cartilage, leading to uneven wear, fractures, reducing its elasticity and consequently its ability to carry loads. To prevent the joint from destroying, a hyaluronic acid solution is injected. However, the clinical effectiveness of delivery hyaluronic acid preparations is limited in patients with moderate to severe osteoarthritis. One reason for the limited efficacy of hyaluronic acid is its rapid degradation in the joint cavity, which requires frequent injections resulting in inflammation. Therefore, there is an urgent need to develop new formulations for delivery injections that will increase lubrication in the joint by replacing depleted joint fluid.

The aim of the project is to use aqueous solutions of novel polypeptides, which hyperbranched structure and appropriately selected functionalization will provide a formulation with a viscosity that ensures its injection into the joint as well as its retention in the joint. The research will aim to develop an optimal delivery formulation that provides excellent lubrication of the joint, and easy application and drug delivery capability. To this end, a library of polypeptides with different structures and molecular weights containing different groups in the structure, i.e. hydrophobic and ionic groups, etc., will be synthesized.

The knowledge gained in this project will show the relationship between the structural features of the synthesised polypeptides, rheological properties, drug release profiles and lubrication properties of joint surfaces, as well as therapeutic efficacy in the treatment of osteoarthritis. Research will include the synthesis, characterization of polymers and biological studies of the resulting formulations, including in vivo studies. Fundamental research carried out under this project will overcome the limitations of current osteoarthritis treatments, providing a breakthrough in the treatment of osteoarthritis.

The project will be a Polish-Chinese joint venture under the Sheng programme.