The Laboratory of Applied Biotechnology (LAB) at AMU NanoBioMedical Centre

focuses on cutting-edge interdisciplinary research at the intersection of biology, chemistry, and materials science. The LAB's activities are driven by a commitment to innovation and practical applications in medicine and biotechnology. Its primary focus areas are meniscus regeneration, 3D bioprinting, and the use of nanoparticles in diagnostics.

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3D Bioprinting

The laboratory specializes in developing advanced 3D bioprinting techniques, particularly for creating tissue models and scaffolds for regenerative medicine based on methacrylated extracellular matrices isolated from native tissues aiming to design scaffolds that mimic the structural and mechanical properties of the tissue. Creating bioinks for skin regeneration and designing 3D-printed scaffolds for meniscus regeneration are two noteworthy research areas. By providing patients with customized and biocompatible solutions, these initiatives seek to transform medical care.

Meniscus Regeneration

In the context of meniscal repair, the LAB investigates innovative approaches that combine 3D bioprinting with cellular biology. As of right now, two research grants for applied research have been carried out: LIDER “MeniScaff 3D - bioprinted, 3D scaffolds reinforced with carbon nanotubes, stimulating chondrogenesis of mesenchymal stem cells for meniscus regeneration” and TECHMATSTRATEG "Development of bioinks for 3D bioprinting based on chemically modified porcines dECM, enriched with recombinant hybrid proteins, nanomaterials and synthetic polymers" which has resulted in several publication and three patent applications: “Bioink based on the extracellular matrix (ECM) isolated from the porcine meniscus, the method of its preparation and the use of the meniscus model for 3D bioprinting; “Method of obtaining decellularized extracellular matrix isolated from mammalian tissues and application in regenerative medicine” and “Bioink, method of manufacture and use for meniscus bioprinting”. Additionally, the LAB seamlessly collaborates with Professor Tomasz Piontek and RehasportClinic to facilitate the integration of research findings into clinical practice.

Single-Cell RNA Sequencing

The laboratory is also engaged in advanced single-cell RNA sequencing studies to unravel the complexity of cellular behavior in biological systems. This cutting-edge technique is used to analyze gene expression patterns at the single-cell level, providing insights into cell heterogeneity and development, crucial for understanding disease mechanisms, tissue regeneration, and the development of 3D bioprinted scaffolds. Two NCN grants were recently awarded to the LAB: OPUS “Porcine menisci transcriptome multi-approach NGS study: investigations on zonal cell composition, human resemblance, and potential applications in xenotransplantation” and SONATA “Is metformin having a cardioprotective role in mouse model of autoimmune myocarditis. Evaluation of the mechanism of action using multiomics approach.”

Nanoparticles for Diagnostics

The LAB focuses also on designing and functionalizing nanoparticles for use in the detection and monitoring of diseases. A key area of interest is the application of superparamagnetic iron oxide nanoparticles (SPIONs) in diagnostics by integration of SPIONs with advanced molecular techniques to detect miRNAs and antibodies with high specificity and sensitivity. LAB is applying for two patents: P.441196 - A method of detecting anti-SARS-CoV-2 antibodies using hybrid binding nanoparticles and the use of hybrid binding nanoparticles for the detection of anti-SARS-CoV-2 antibodies and P.437380- Antibodies binding hybrid nanoparticles, production and utility for binding of specific antibody anti-SARS-CoV-2.