Advancing drug discovery with 3D cell culture models

Photos: Supplied

By André Damons

An interdisciplinary research project by researchers from the University of the Free State (UFS), the Central University of Technology (CUT), and FARMOVS – a clinical research company associated with the UFS – aims to create more accurate and ethical models for drug testing and improving the development of new treatments.

The researchers are developing innovative 3D cell culture models using 3D-printed mini-bioreactors to create more accurate and human-like models to advance drug discovery and disease research.Dr Angélique Lewies, a Y-rated scientist and Senior Lecturer from the Robert WM Frater Cardiovascular Research Centre (Frater Centre) within the UFS Department of Cardiothoracic Surgery, is leading the research project. The project, she explains, was initiated to address the challenges associated with current 3D cell culture techniques, which are often expensive and complex. Recognising the need for a more cost-effective and user-friendly solution, the researchers embarked on this collaboration to develop a novel 3D cell culture system.

"This innovative approach not only promises to cut costs, but also promotes ethical research practices in the scientific community," says Dr Lewies.

Improving reliability of drug testing

Zurika Murray, a behavioural geneticist, and her colleague from the Department of Genetics, Dr Marieka Gryzenhout, a C-rated scientist and Senior Lecturer – are the other UFS researchers who are part of the project. Dr Jaco Wentzel from FARMOVS is

also involved in the project and serves as the pharmaceutical industry partner and consultant for the project. With experience in cellular biology and pharmaceuticals, he ensures that the new 3D cell culture models meet industry standards and can be used effectively in drug development. Dr Wentzel's role is crucial in bridging the gap between academic research and practical application in the pharmaceutical industry.

Dr Lewies says the project focuses on creating 3D cell cultures, known as spheroids and organoids, which mimic human tissue more accurately. These 3D models can improve the reliability of drug testing and reduce the need for animal experiments, aligning with the 3R principles: Reduction, Replacement, and Refinement.

Traditional drug discovery and disease studies often rely on flat (2D) cell cultures and animal models. While animal models are essential for understanding disease and testing drug safety, they do not always predict how humans will respond, and their use raises ethical concerns.

"We aim to develop affordable and efficient 3D-printed mini-bioreactors for growing these advanced cell cultures. These bioreactors will be designed to fit into existing cell culture labs, making them accessible to researchers. By leveraging the cutting-edge 3D printing technology at CUT's Centre for Rapid Prototyping and Manufacturing (CRPM), the team hopes to create a versatile platform for various research applications," says Dr Lewies.

Revolutionising medicines developed

By combining expertise from engineering, biology, and mycology, the team is set to revolutionise how diseases are studied and medicines developed. Funded by the CUT and UFS Joint Research Programme, this initiative promises to foster innovation and lead to new research collaborations.

"By developing 3D cancer spheroids and cardiac organoids (mini heart models), my team aims to find ways to prevent cardiac cell damage that can lead to serious cardiovascular disease, while enhancing the effectiveness of chemotherapy drugs. A collaborative project with the Department of Genetics aims to develop neural organoids (mini brain models) to evaluate potential treatment options for mental health conditions such as depression and anxiety," says Dr Lewies.

The project's long-term focus is to potentially discover new drugs to prevent and treat heart and brain diseases, as well as to develop therapies for cardio-oncology and neurological applications.

The team – which includes Dr Angélique Lewies from the Robert WM Frater Cardiovascular Research Centre, Zurika Murray from the Department of Genetics, Dr Jaco Wentzel, a pharmaceutical consultant at FARMOVS, and Dr Marieka Gryzenhout, a C-rated scientist and Senior Lecturer in Genetics – is blending engineering, biology, and mycology expertise. Their work aims to transform disease research and medicine development.

Photos: Anja Aucamp and Sonia Small