Poster # 11

Automated electro-mechanical bioreactor for enhancing the maturation of engineered muscle tissues in vitro – A promising avenue for cultivated meat?

Beatrice Masante

1. Department of Mechanical and Aerospace Engineering and PolitoBIOMed Lab, Politecnico di Torino, Italy
2. Interuniversity Center for the Promotion of the 3Rs Principles in Teaching and Research, Turin, Italy

Physical forces are known to be one of the crucial components regulating stem cells in their niche [1] and, at a higher scale, physical stimuli play a key role in the structural and functional maturation of tissues. A tissue that is particularly exposed to physical stimulation is the cardiac muscle, which undergoes continuous pulsed electrical excitation followed by cyclic contraction. Recently, we demonstrated that providing in vitro controlled mechanical [2] or electrical [3] stimulation to engineered cardiac tissues can result in enhanced maturation and contractility. In order to provide more biomimetic conditions, an automated bioreactor for delivering combinable electrical and mechanical stimuli to engineered cardiac or skeletal muscle tissues has been developed. The bioreactor, designed for fitting to a standard 12-well plate, allows the stimulation of up to 12 hydrogel-based constructs. Each construct embeds two micro-posts and can be exposed to: 1) stretch (strain = 2 - 100%; frequency = 0.5 – 3 Hz), with micro-posts coupled to a controlled stepper motor; 2) electrical stimulation (amplitude = 0.3 – 12.0 V; frequency = 0.5 – 10.0 Hz; pulse duration = 1 – 10 ms), thanks to electrodes connected to a purpose-built electrical stimulator. Based on a customized closed-loop control, the bioreactor enables operator-independent culture and provides a robust platform for culturing and investigating engineered cardiac or skeletal muscle tissues in a controlled and reproducible way. Moreover, due to its scalable and modular design, the proposed bioreactor has the potential to be applied in the future for the production of cultivated meat.

References:
1. Manokawinchoke J et al., Arch Oral Biol. 2021
2. Massai D et al., Front Bioeng Biotechnol. 2020
3. Gabetti S. et al., Front Bioeng Biotechnol. 2023