Experimental study and simulation of oxygen diffusion in a cultivated meat prototype

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May 06, 2024

Abstract

This study presents the fabrication of a cultivated meat prototype featuring a three-dimensional (3D) structure constructed from myoblast C2C12 cell sheets. The absence of blood vessels in dense structures poses a significant challenge to oxygen supply of the cells. To address this, simulations were conducted using the COMSOL Multiphysics package to estimate the maximum achievable size of the 3D constructs. Key model parameters, including the oxygen uptake rate, effective diffusion coefficient, structure porosity, and volumetric mass transfer coefficient, were experimentally determined to perform the simulation accurately. The simulation results revealed that, for the current construct, the maximum achievable structure diameter considering oxygen availability to the cells is 5 mm. To enhance the reliability of the simulation model, it underwent validation against experimental data. This approach represents a valuable strategy with potential applications in various meat cultivation platforms. Its adaptability allows for better control over the desired cell microenvironment and optimization of culture conditions, offering a promising avenue for advancing the field of cultivated meat production.

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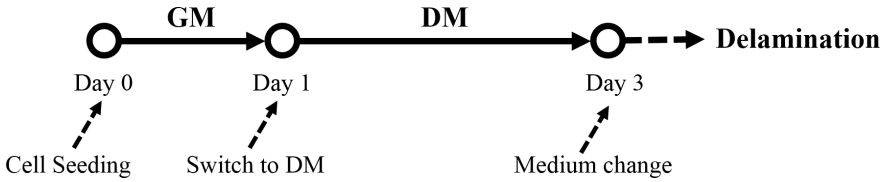

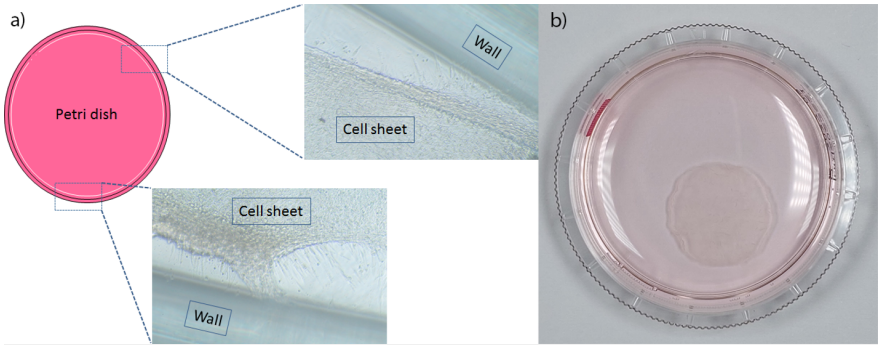

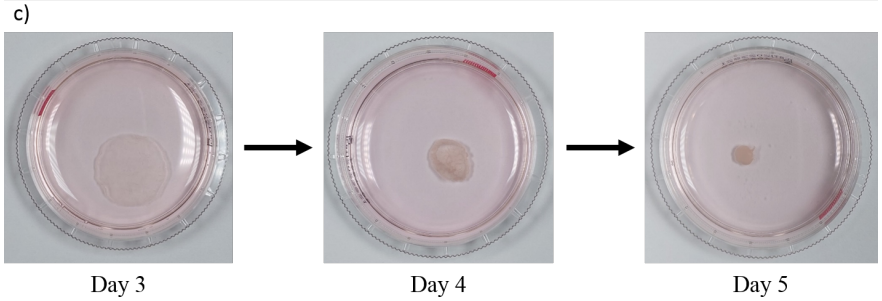

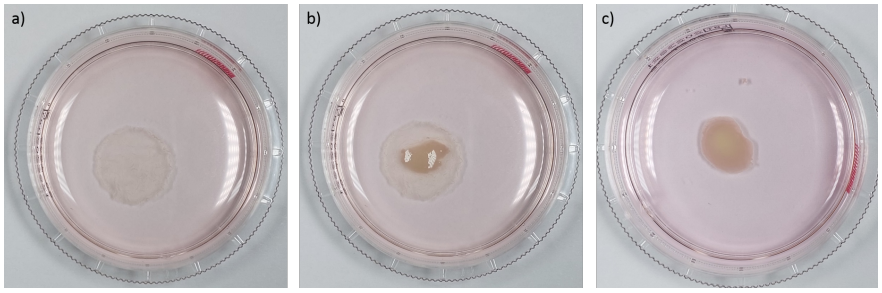

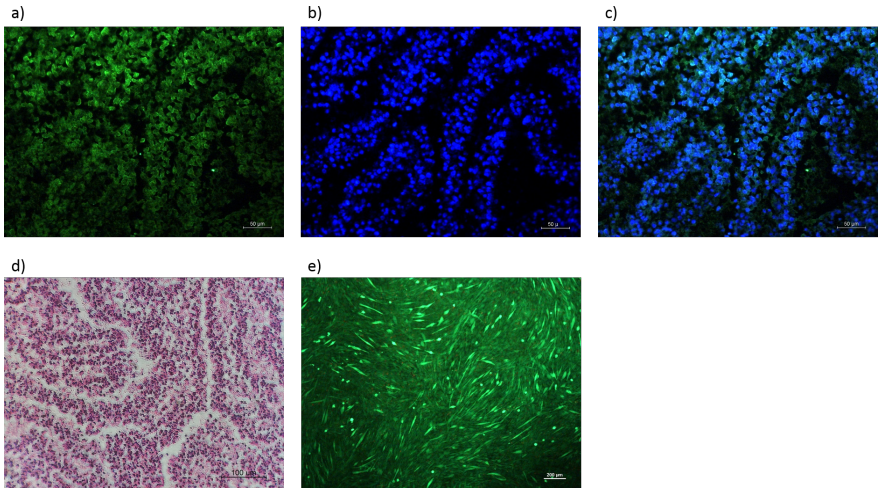

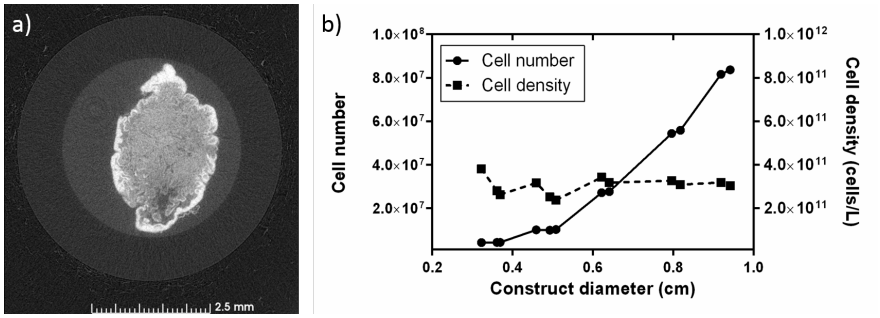

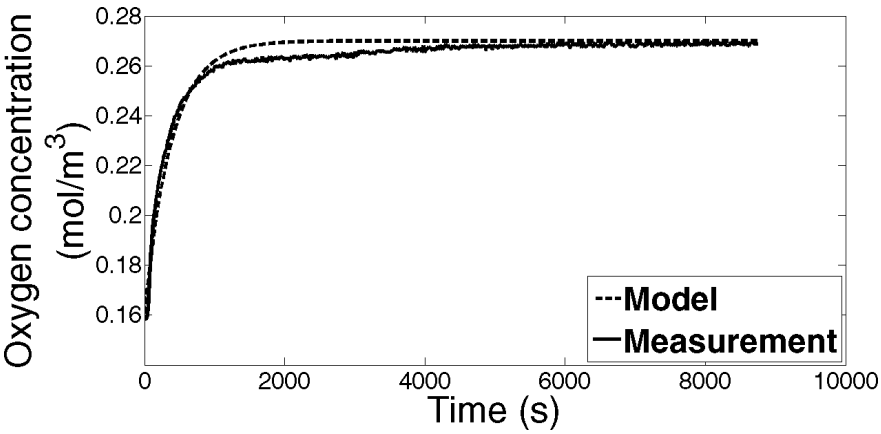

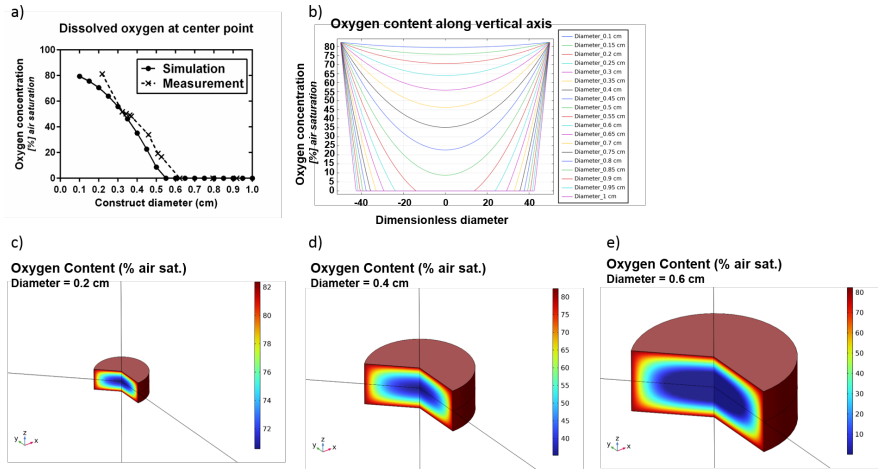

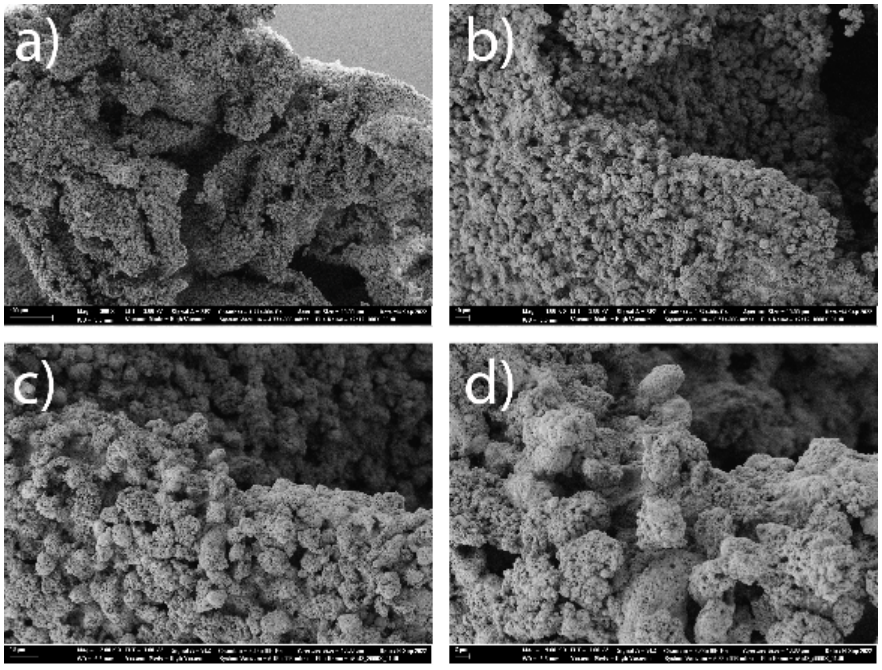

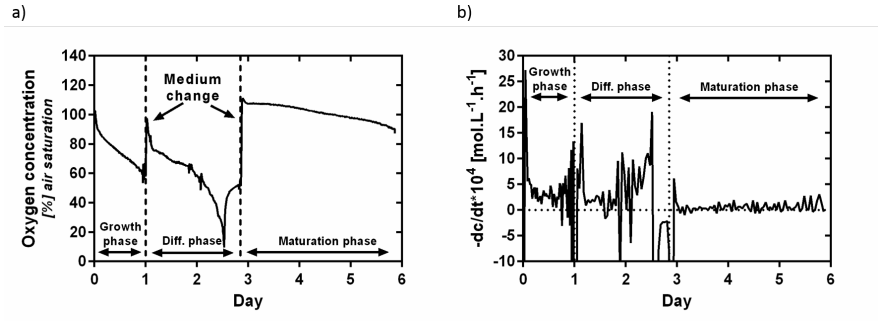

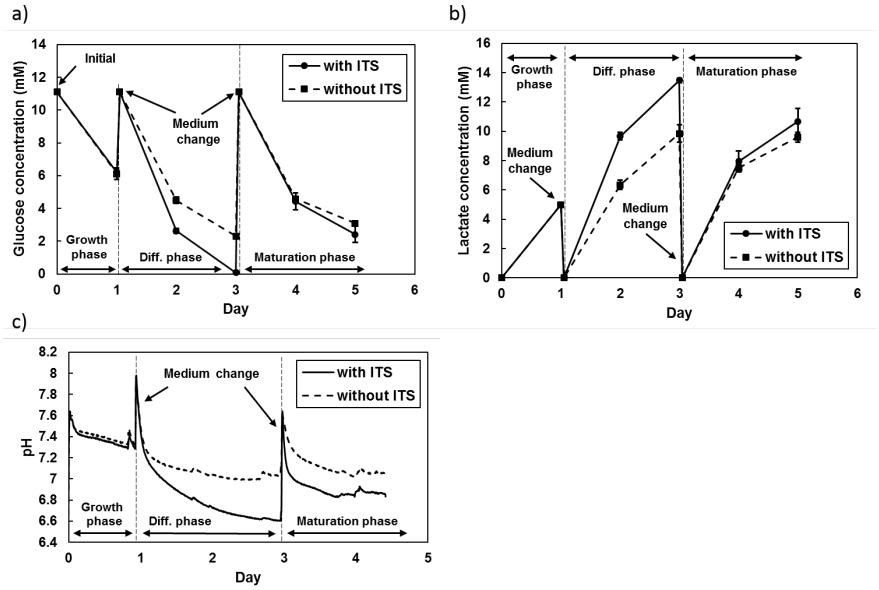

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