

Supplementary Materials for

Islet-on-Chip: Promotion of Islet Health and Function via Encapsulation within a
Polymerizable Fibrillar Collagen Scaffold

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Table S1. Summary of Computational Modeling Parameters

| Geometry | Dimension | | | Ref. |
|---|-----------------------|-----------------------|-----------------------|-------------|
| Channel Height (mm) | 0.5 | | | |
| Channel Length (mm) | 35-37 | | | |
| Chamfer Angle (degrees) | 45° | | | |
| Islet Diameter (μm) | 150 | | | [1] |
| Transport Parameter | Medium | Collagen | Islet | Ref. |
| Porosity | – | 0.845 | 0.1 | [2,3] |
| Permeability (m^2) | – | 7.5×10^{-13} | 1×10^{-15} | [3,4] |
| Diffusion Coefficient of Oxygen (m^2/s) | 3.0×10^{-9} | 2.5×10^{-9} | 2.0×10^{-9} | [1] |
| Diffusion Coefficient of Glucose (m^2/s) | 0.9×10^{-9} | 0.6×10^{-9} | 0.3×10^{-9} | [1] |
| Diffusion Coefficient of Insulin (m^2/s) | 0.15×10^{-9} | 0.11×10^{-9} | 0.05×10^{-9} | [1,4] |
| Maximum Oxygen Consumption Rate ($\text{mol}/\text{m}^3 \text{ s}$) | – | – | -0.034 | [1] |
| Maximum Glucose Consumption Rate ($\text{mol}/\text{m}^3 \text{ s}$) | – | – | -0.028 | [1] |
| Maximum Insulin Secretion Rate, 1 st Phase ($\text{mol}/\text{m}^3 \text{ s}$) | – | – | 21×10^{-5} | [1] |
| Maximum Insulin Secretion Rate, 2 nd Phase ($\text{mol}/\text{m}^3 \text{ s}$) | – | – | 3×10^{-5} | [1] |
| Oxygen Concentration (mM) | 0.2 | – | – | [1] |
| Low Glucose Concentration (mM) | 2.5 | – | – | |
| High Glucose Concentration (mM) | 15 | – | – | |
| Outlet Pressure (Pa) | 0 | – | – | [1] |

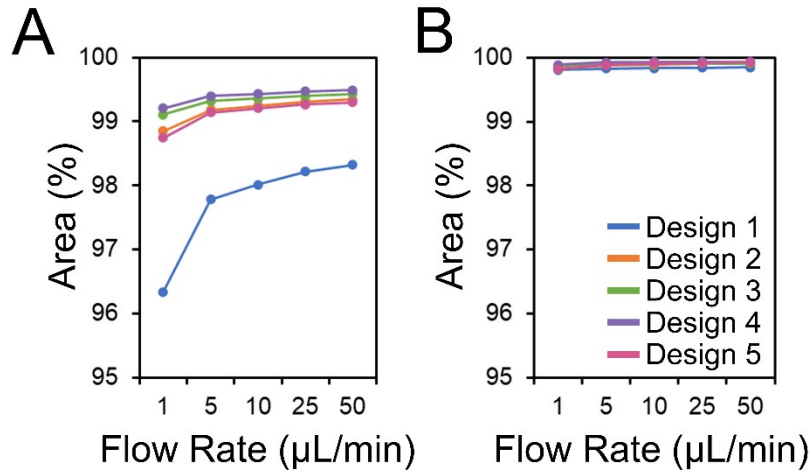


Figure S1. Quantification of oxygen concentration within simulated islet-collagen compartments. Percentage of the islet-collagen compartment A) above threshold for *in-vivo* oxygen levels (0.02 mM)⁵ and B) above threshold for hypoxia-induced dysfunction (5.1 μM).⁵

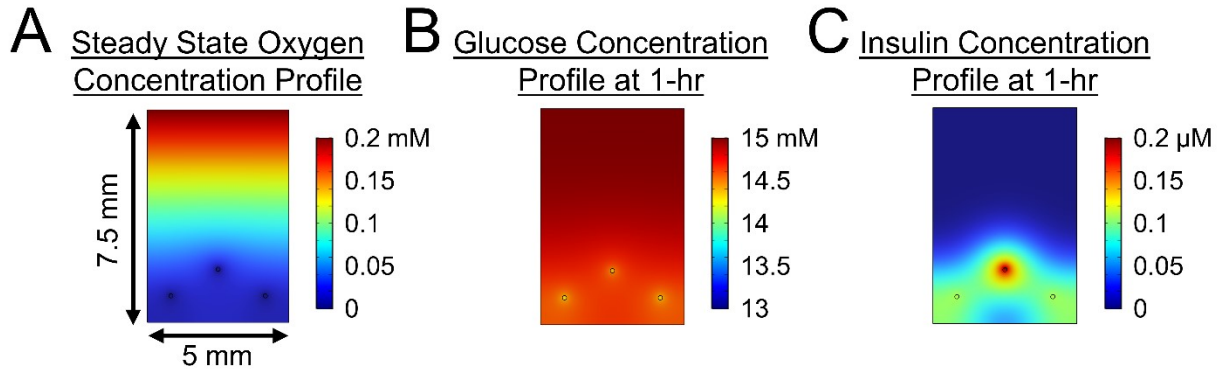


Figure S2. Simulation of conventional static suspension culture. Results for simulated suspension culture in 96-well plate, including (A) oxygen concentration profile at steady state; (B) glucose concentration profile at 1-hour time point following initiation of 15 mM glucose incubation; and (C) insulin concentration profile at 1-hour time point following initiation of 15 mM glucose incubation.

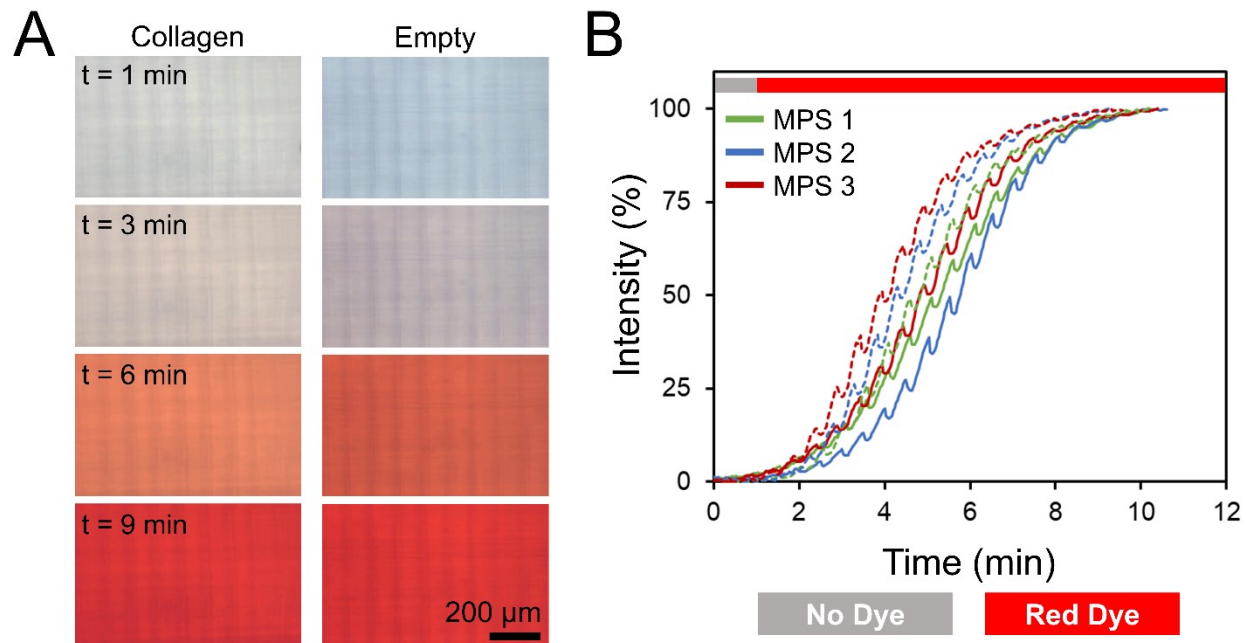


Figure S3. Characterization of transport properties within the MPS islet-collagen compartment in the absence and presence of a collagen scaffold. A) Representative brightfield images of the region of interest at 1, 3, 6, and 9 minutes showing the transport of dye over time in the absence or presence of the collagen scaffold. B) Plots show mean intensity of the region of interest over time, with the transition between solution containing no dye and dye occurring at 1 minute. Solutions were perfused at a flow rate of 25 $\mu\text{L}/\text{min}$ and the islet-collagen compartment of the MPS contained 50 μL collagen (solid line) or was left unfilled (dashed line).

References

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