University of Basel
Department of
Biomedical Engineering

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Master of Science – Biomedical Engineering
Thesis Proposal

Dynamic hydrogels for intestinal organoid culture

Despite strong interest in the regeneration of intestinal tissue and gaining a clearer insight into the fundamental role of peristalsis, matrices used for the culture of intestinal organoids (IOs) and tissues are static. This limits their quality and viability and reduces the accuracy of IO models. Hydrogel matrices that exhibit the peristaltic motion required by intestinal tissues, specifically motion that is responsive to environmental cues, do not currently exist. Catch bond (CB) forming proteins, a subset of mechanoactive protein complexes alter their mechanical properties in response to mechanical and chemical stimulation when bound to a specific substrate. Thus, they are particularly interesting for the design of **environmentally controlled peristaltic materials**.

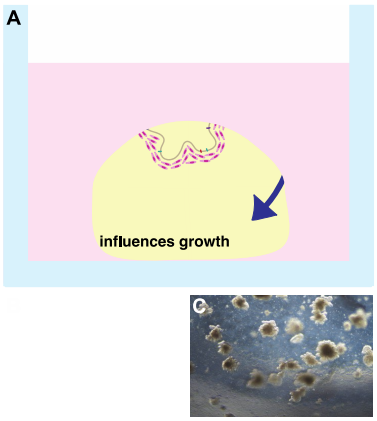

Figure 1: Graphical representation of dynamic hydrogels (A), optical microscope image of IOs cultured in static matrigel (B) and in a dynamic hydrogel (C)

The objective of the proposed research is to **incorporate CB forming proteins** and their substrates (CB complexes (CBCs)) **into a hydrogel matrix**, **quantify their ability to alter the viscoelasticity** of the hydrogel as a function of environmental stimuli and **assess the impact of dynamic behaviour** on cultured IOs. The **specific aims** are to **(1)** investigate how CBCs can be activated or respond to mechanical and chemical stimuli when embedded in a matrix, **(2)** seed the CBC-containing matrices with IOs and determine if mechanical/chemical cues from growing IOs are sufficient to alter the viscoelasticity of the matrix, and **(3)** characterise the morphology and function of dynamically vs statically cultured IOs to assess if dynamic culture improves IO structure/function.

Nature of the Thesis
Experimental: 80%
Documentation: 20%

Specific Requirements
Experience with materials characterisation techniques (e.g. rheology) would be useful but not required.

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