MECHANICAL CHARACTERIZATION OF REGENERATING HYDRA TISSUE SPHERES

LABORATORY : Institut Lumière Matière

LEVEL : M1
TEAM(S) : BIOPHYSIQUE

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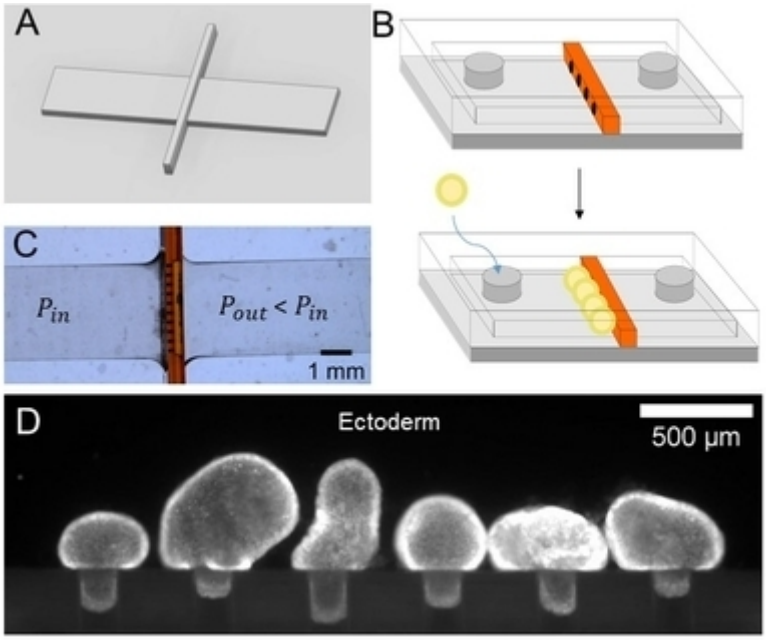
KEYWORD(S) :

SCIENTIFIC CONTEXT :

Hydra vulgaris is a freshwater polyp capable of whole body regeneration, *i.e.* any piece cut from the animal can reform an entire functional organism. In this process, the tissue folds back into a spherical shape and has to spontaneously break its symmetry to define a new head-to-tail axis. Recent experiments show that patterning in *Hydra* requires proper mechanical forces and a coupling between tissue scale mechanics and molecular signals (Ferenc, 2021). To aid in the study of such couplings, we have recently performed a quantitative characterization of the rheology of Hydra tissue spheres (Perros, 2023).



Figure

Figure. A: Schematics of the microfluidic channel. B: The insert in orange is crossed by multiple cylindrical tunnels. The tissue spheres, in yellow get aspirated within. C: Snapshot of the microfluidic channel barred by the insert before loading of the samples. D: Imaging of six samples aspirated within the tunnels.

We observed non-linear elastic effects at low deformations which are currently unexplained. **The subject of this internship will be to properly measure these non-linear effects and question their biological origin.** To do so, we will use an existing micro-aspiration setup (Fig) and focus on the low deformation regime which will require both high resolution microscopy and fine control over the applied stresses. After gathering data on this regime, we will quantify its properties and test potential biological explanations for this surprising behavior.

MISSIONS :

Hydra care: the student will learn how to maintain, grow and use *Hydra* populations for experiments.

Microfluidics: the student will use micro-milling and microfabrication techniques to fabricate the parallel micro-aspiration setup (in collaboration with the team of P. Joseph at LAAS, Toulouse). Pressure controllers will be used to finely control the amount of stress applied on the samples.

Microscopy: fluorescence, brightfield and spinning disk microscopy will be used to image the reaction of the sample to the applied stresses. Hydra lines fluorescently labelled for the different tissues as well as filamentous actin will be used.

Data analysis: the student will be in charge of analyzing the obtained images to measure precisely the deformations induced by the applied stresses. Quantitative data will be gathered and fitted to existing models and the final results presented.

Rheological models: possibility for the student to get involved in the theoretical aspects of the project studying existing literature and models for non-linear elastic behavior in living systems.

OUTLOOKS :

NA

BIBLIOGRAPHY :

Ferenc, J., P. Papasaikas, J. Ferralli, Y. Nakamura, S. Smallwood, and C.D. Tsiairis. 2021. *Mechanical oscillations orchestrate axial patterning through Wnt activation in Hydra*. Sci. Adv. 7:6897.

Perros, T., A. Biquet-Bisquert, Z. Ben Meriem, M. Delarue, P. Joseph, P. Marcq, and O. Cochet-Escartin. 2023. *Mechanical characterization of regenerating Hydra tissue spheres*. bioRxiv. 2023.10.16.562504.

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