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3D alginate hydrogels: Impact of substrate stiffness on cellular response

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Background & Aim: Currently, the design of extracellular matrices is directed towards mimicking the cellular microenvironment. Additionally, these matrices allow the study of cell behavior in response to varying physicochemical and mechanical properties. For instance, mechanical properties such as stiffness have been reported to alter cell differentiation, adhesion, and viability. Thus far, the cellular response studies have been conducted on two-dimensional (2D) substrates, nonetheless, three-dimensional (3D) microenvironments appear most suitable to approach to native cellular behavior. Alginate hydrogels provide an appealing 3D microenvironment; however, a full characterization of mechanical property-function relationships is still elusive. This study is therefore dedicated to determine if changes in the stiffness of alginate hydrogels might lead to significant cytoskeletal changes in cells upon encapsulation.

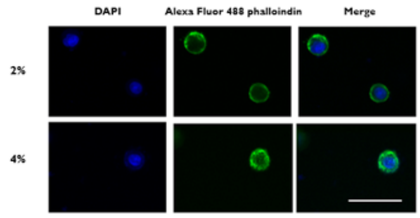

Figure 1. Confocal imaging of Vero cells cultured on alginate hydrogels prepared at two different concentrations (1% and 2% w/v). Cells were stained with DAPI

Method: Hydrogels with alginate contents of 2% and 4% (w/v) were prepared by the diffusion method. Subsequently, hydrogels stiffness was determined via Atomic Force Microscopy (AFM). Finally, vero cells were encapsulated in the hydrogels where actin filaments were stained and imaged using confocal microscopy.

Results & Conclusion: Stiffness values of the 2% and the 4% hydrogels were significantly different (p-value <0.0001) and approached 30.5 kPa and 300.3 kPa, respectively. Additionally, a simple inspection revealed that actin filament was most abundant for the 4% hydrogel. Accordingly, it is possible to suggest that, as for the 2D systems, a more rigid 3D microenvironment can lead to an increase of actin filaments. Furthermore, the observed cell geometries suggest that not only focal adhesions with the extracellular matrix but local changes in mechanical properties are responsible for important structural changes in cells.

Biography

Alejandra Suarez-Arnedo has completed her BS degrees in Chemical Engineering and Microbiology at Universidad de los Andes. She is pursuing her Master's degree in Biological Sciences with an emphasis in microbiology and biomedical engineering. She conducts research on cellular differentiation and design of extracellular matrices using alginate hydrogels at the Laboratory of Human Genetics.

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