Physicists devise method for building artificial tissue

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New York University physicists have developed a method that models biological cell-to-cell adhesion that could also have industrial applications.

This system, created in the laboratory of Jasna Brujić, an assistant professor in NYU's Department of Physics and part of its Center for Soft Matter Research, is an oil-in-water solution whose surface properties reproduce those found on biological cells. Specifically, adhesion between compressed oil droplets mimics the mechanical properties of tissues and opens the path to numerous practical applications, ranging from biocompatible cosmetics to artificial tissue engineering.

Their method is described in the journal the *Proceedings of the National Academy of Sciences*.

Previously, Brujić's laboratory has determined how spheres pack and devised methods for manipulating the packing process. In this PNAS study, Brujić and her research team sought to create a method that would address the role of packing in tissues from the point of view of how mechanical forces affect protein-protein adhesion between cells.

In biology, cell-to-cell adhesion is crucial to the integrity of tissue structure—cells must come together and stick in order to ensure tissue cohesion. However, the daunting complexity of biological systems has long prevented their description using general theoretical concepts taken

from the physical sciences. For this reason, the research team designed an original biomimetic solution, or emulsion, that reproduces the main features of cell-to-cell adhesion in tissues.

Emulsions form the basis for a range of consumer products, including butter, ice cream, and milk. In addition, the emulsion in the PNAS study is tuned to match the attractive and repulsive interactions that govern adhesion between cells. The experimental conditions reveal the circumstances under which pushing forces are necessary to create adhesion.

By varying the amount of force by which the droplets of oil were compressed by centrifugation and the amount of salt added to this solution, the NYU team was able to isolate the optimal conditions for cell-to-cell adhesion. Screening electrostatic charges by the addition of salt and compressing the droplets by force enhances protein-protein interactions on the droplet surfaces. This leads to adhesion between contacting droplets covering all the interfaces, just as in the case of biological tissues.

Their results, which matched the researchers' theoretical modeling of the process, offer a method for manipulating force and pressure in order to bind emulsions. This serves as a starting point for enriching a range of consumer products, by reconfiguring their molecular make-up to enhance consistency and function, and for improving pharmaceuticals, by bolstering the delivery of therapeutic molecules to the blood stream.

More information: For more on the Brujić Laboratory, go to www.physics.nyu.edu/~jb2929/index.html

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