Coacervate

A coacervate is a tiny spherical droplet of assorted organic molecules (specifically, lipid molecules) which is held together by hydrophobic forces from a surrounding liquid.

Coacervates were famously proposed by Alexander Oparin as crucial in his early theory of abiogenesis (origin of life). This theory proposes that metabolism predated information replication. The debate as to whether metabolism or molecules capable of Template replication came first in the origins of life remains open[1] and for decades Oparin's theory was the leading approach to the origin of life question.

Coacervates measure 1 to 100 micrometers across, possess osmotic properties and form spontaneously from certain dilute organic solutions. Their name derives from the Latin coacervare, meaning "to assemble together or cluster". Though they were once suggested to have played a significant role in the evolution of cells and, therefore, of life itself, nowadays this approach is mostly abandoned.

Formation

In water, organic chemicals do not necessarily remain uniformly dispersed but may separate out into layers or droplets. If the droplets which form contain a colloid, rich in organic compounds and are surrounded by a tight skin of water molecules, then they are known as coacervates. These structures were first investigated by the Dutch chemist H.G. Bungenberg de Jong, in 1932. A wide variety of solutions can give rise to them; for example, coacervates form spontaneously when a protein, such as gelatin, reacts with gum arabic. They are interesting not only in that they provide a locally segregated environment but also in that their boundaries allow the selective absorption of simple organic molecules from the surrounding medium. In Oparin's view this amounts to an elementary form of metabolism. Bernal commented that they are "the nearest we can come to cells without introducing any biological — or, at any rate, any living biological — substance." However, the lack of any mechanism by which coacervates can reproduce leaves them far short of being living systems.[2]

Complex coacervation

Complex coacervation refers to the phase separation of a liquid precipitate, or phase, when solutions of two hydrophilic colloids are mixed under suitable conditions. The general outline of the processes consists of three steps carried under continuous agitation [3]:

Step 1: Formation of three immiscible chemical phases

The immiscible chemical phases are (i) a liquid manufacturing vehicle phase (ii) a core material phase and (iii) a coating material phase. To form the three phases, the core material is dispersed in a solution of the coating polymer, the solvent for the polymer being the liquid manufacturing vehicle phase. The coating material phase, an immiscible polymer in a liquid state, is formed by utilizing one of the methods of phase separation coacervation, that is,

- By changing the temperature of the polymer solution
- By adding a salt
- By adding a non-solvent
- By adding incompatible polymer to the polymer solution
- By inducing a polymer-polymer interaction.
Step 2: Depositing the liquid polymer coating upon the core material

This is accomplished by controlled, physical mixing of the coating material (while liquid) and the core material in the manufacturing vehicle. Deposition of the liquid polymer coating around the core material occurs if the polymer is adsorbed at the interface formed between the core material and the liquid vehicle phase, and this adsorption phenomenon is a prerequisite to effective coating. The continued deposition of the coating material is promoted by a reduction in the total free interfacial energy of the system, brought about by the decrease of the coating material surface area during coalescence of the liquid polymer droplets.

Step 3: Rigidizing the coating

This is usually done by thermal, cross linking or desolvation techniques, to form a self sustaining microcapsule.

References


External links

• illustration of continuous coacervation (http://www.microporetech.com/coacervate.html)
• Coacervation for Flavor Encapsulation (http://www.rtdodge.com/coacer.html)
Article Sources and Contributors

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