NON-ENZYMATIC POLYMERIZATION OF RNA INSIDE COMPLEX COACERVATES.

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Introduction: Compartmentalization of cells via lipid bilayer is common across different domains of life on Earth. However, there are also non-membranous compartments within the cells that have diverse functions. For example the nucleolus, which is the site of ribosome assembly, contains densely packed RNAs and ribosomal proteins. Complex coacervates provide analogous membraneless compartments where the condensed phase is highly concentrated with polymers. We have explored complex coacervates as possible routes to membraneless compartments during the primordial world, where chemistries relevant to origins of life may have take place.

We used (poly)allylamine hydrochloride (PAH) and nucleotide triphosphates to generate complex coacervates that selectively concentrate nucleic acid molecules in the polymer-rich condensed phase. Previous studies have found that both NTPs and Mg^{2+} ions can reach high concentrations (>1M) inside coacervates, even with <5 mM in bulk solution[1]. We show that RNAs that bind to fluorophore and activate fluorescence maintain their structure and remain functional inside coacervates, thus supporting the idea that these coacervates may provide suitable environment for ribozyme catalysis and other RNA molecules to remain functional. We also found that PAH/ATP coacervates support non-enzymatic polymerization of RNA from imidazole-activated nucleotide monomers. Interestingly, our preliminary data suggest that non-enzymatic polymerization is enhanced inside at sub-optimal conditions, such as conditions lacking of Mg^{2+}. We are currently studying the effects of several key parameters such as ionic conditions and interactions of coacervates with other additives to sustain and possibly enhance non-enzymatic polymerization of RNA. We are further exploring in vitro evolution of functional RNAs within the crowded environment of coacervates.

[1] Frankel E. A., Keating C.D, and Bevilacqua P. C. (2016) *Langmuir*, *32*, 2041–2049.