The Effects of Dehydration Temperature and Monomer Chirality on Primitive Polyester Synthesis and Microdroplet Assembly

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Synthesis of polyester gels via dehydration of α-hydroxy acids (αHAs) is a plausible route to form primitive functional polymers. αHApolyester gels assemble into membraneless droplets upon rehydration in aqueous media that can segregate and compartmentalize early biomolecules. However, conditions for polyester synthesis and microdroplet assembly have yet to be broadly explored. Thus, the effects of heat and monomer chirality on dehydration synthesis and assembly of homopolyester microdroplets are investigated using microscopy and mass spectrometry. Lower dehydration temperatures (≤80 °C) are observed to result in shorter polyesters than higher temperatures (up to 150 °C). After rehydration of polyester products, droplet assembly propensity correlates with longer polymer length. Low temperature (40 °C) dehydration yields only short polyesters and nearly no droplet formation. Finally, polyesters derived from dehydration/rehydration synthesis of homochiral lactic acid and phenyllactic acid monomers are of equal length and with a similar propensity for droplet assembly as those derived from racemic starting materials. These results suggest that polyesters and microdroplets derived from them can form under a wide variety of temperatures and from different monomer chiralities, enabling many possibilities for such systems to have played a role in systemic self-organization during the origins of life.