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Liquid Crystal Phases of RNA Mononucleoside Triphosphates in Aqueous Solution

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Introduction: Nucleic acid (NA) oligomers as short as 4 base pairs can carry out the self-assembly steps of duplexing, end-to-end aggregation of duplexes, and condensation of aggregates to form columnar liquid crystal phases. In such phases the molecules, self-selected because of their complementarity, create a fluid structural and chemical environment in which oligomer ligation into longer polymers can be strongly promoted [1]. This ligation represents an autocatalytic step in a positive feedback loop in which the liquid crystal structure selects, organizes and polymerizes molecules, thereby enhancing its own stability. Recently it has been shown that Deoxynucleotide Triphosphates (dNTPs) in aqueous solution form duplex base pair stacks that order into columnar liquid crystal phases [2]. Here we investigate the self-assembly behavior of Ribonucleosidal Triphosphates (rNTPs), exploring aqueous mixtures of rATP and rUTP, and of rATP and dTTP, for liquid crystal ordering. The liquid crystal behavior of these mixtures was assayed by polarized light microscopy. These observations showed that mixtures with equimolar concentrations of rATP and dTTP exhibited liquid crystal behavior [Figure 1]. Liquid crystal odering in the rATP and rUTP mixtures has yet to be observed under similar conditions. The observation of columnar phase in the rATP and dTTP mixtures, indicates that they are potential candidates for exploring the effect of liquid crystal ordering on ligation based on pyrophosphate elimination.

References: [1] Fraccia TP et al (2015), *Nature Communications* 6:6424.[2] Smith GP et al (2017), *Origins XVIII* abstract #4185.

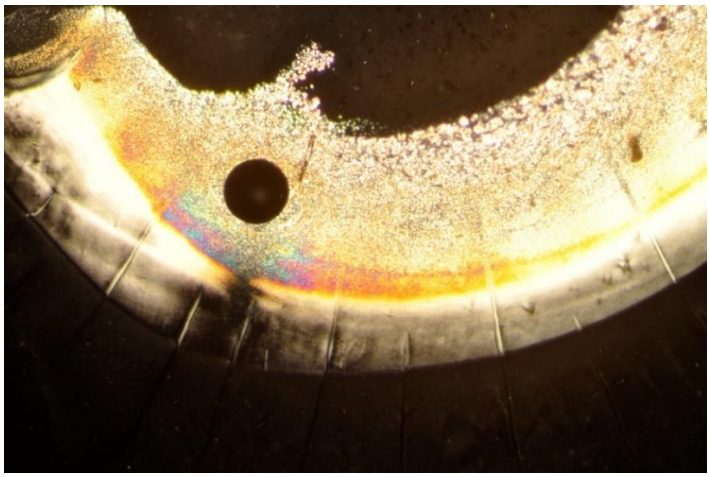

Figure 1 – Polarized Light Microscopy image of RNA Adenosine Trisphosphate (ATP) and Deoxythymidine Triphosphate (dTTP) liquid crystal phases.

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