RNA Regulation: Identifying and Preventing AMP Depurination in Early Life RNA Polymerization

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Life formed on Earth 4 billion years ago using RNA to store genetic information, but how RNA first synthesized is unknown, due to no enzymes. RNA bases underwent repeated wet-dry cycles in volcanic conditions, causing polymerization. However, adenosine monophosphate (AMP) underwent depurination, where adenine fell off and impaired the molecule. My objective was to use lipid and adenine to identify and prohibit AMP depurination in the prebiotic development of RNA. Volcanic conditions were simulated by evaporating and rehydrating dilute AMP and phosphoric acid (H3PO4) solutions in three 30 minute wet-dry cycles on a hot plate. Experimental groups contained 10 mM adenine or 10 mM lysophosphatidylcholine (LPC). After cycling, samples were separated on TLC plates and illuminated under 254 nm UV light. AMP spots were scraped, hydrated, sonicated, and centrifuged. Nanodrop spectrometer analyzed samples, and the amount of AMP/adenine was found through Beer's Law using the 260 nm absorbance. A protective effect of LPC and adenine was observed. On average, the control AMP solution underwent 33% depurination, while the separated adenine increased 50%. LPC samples contained increased AMP amounts. The adenine experimental samples were protected against depurination and averaged 21% more AMP after cycling. Hypothesis testing using t-tests and p-values showed adenine samples significantly reduced AMP depurination when compared to the controls. Depurination was detected with samples containing AMP and H3PO4 in simulated prebiotic volcanic conditions. Adding LPC and adenine to the samples reduced depurination and increased the AMP present. This suggests that in prebiotic conditions the integrity of AMP was protected in the presence of adenine and lipid, and RNA based life could begin.

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