Phosphorylation of Biomolecules in a Deep Eutectic Solvent

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Introduction:

Phosphorus (P) as we know is central to life. It is ubiquitous in biochemistry, most commonly as biological phosphate esters to contribute significantly to life in the form of structure (phospholipids), metabolism and energy (ATP, sugar phosphates, etc.,) and genetic information (DNA, RNA). But how P got incorporated into the biological world is still unclear [1]. The terrestrial P minerals such as apatite, monetite and whitlockite are unreactive in aqueous environments. Although, mineral struvite fairly reacts with biomolecules under higher temperature conditions but its evolution on hadean Earth is still questionable [2, 3]. Here, we show that significant yields of organophosphates are obtained by heating different P sources with organic molecule in a new type of deep eutectic solvent (Urea: ammonium formate: water, called as DES hereafter). This solvent shows good yields of organophosphates such as guanosine monophosphates, uridine monophosphates, adenosine monophosphates, glycerol monophosphate, choline phosphate and ethanolamine phosphate with yields ranging from 10-60% under mild heating. We also show that heating glycerol in this DES system in the presence of kaolinite clay significantly improves the yields. Different P sources such as P minerals (monetite, schreibersite and struvite, condensed P compounds (trimetaphosphates) and simple P salts such as Na2HPO4 or NaH2PO4 show facile phosphorylations of the nucleosides and alcohols under mild heating in the DES. Our reactions show that efficient phosphorylations of even challenging biomolecules (such as guanosine) are possible under mild conditions in our DES.

References: 1. M. Gull. Prebiotic Phosphorylation Reactions on the Early Earth, *Challenges* 2014, *5*(2), 193-212.

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