K^+ vs. Na^+ Driving Force of Prebiotic Peptide Emergence

Michael Dubina
St. Petersburg Academic University RAS, St. Petersburg, Russia

Metal ions in aqueous conditions is one of the triggers of the essence of life. The contradiction between the Na^+ and K^+ compositions of seawater and living cell cytoplasm led Yuri Natochin to the hypothesis that the first protocell could have emerged in KCl solution, but not in NaCl, as commonly believed [1]. We investigated the relative effects and concentration dependence of Na^+ and K^+ in a model peptide synthesis reaction as well as physical theory for an interpretation of the experimental data. Using HPLC-MS/MS analysis, we found that K^+ is more than an order of magnitude more effective in the *L*-glutamic acid oligomerization in aqueous solutions than the same concentration of Na^+, which is fully consistent with the diffusion theory calculations [2, 3]. Using *de novo* sequencing algorithm for abiogenic oligopeptide identifying we found that the most effective potassium ion concentrations for the *L*-Glu peptide yields is 1.0 M [4]. Interestingly, potassium complies with all the physical-chemical requirements of accelerated prebiotic polymerisation of amino acids, which is unique in contrast to other mono- and divalent metallic ions. We propose that K^+ fundamentally predominates Na^+ as a driving force of the prebiotic peptide formation, regardless of the terrestrial or interstellar origin of amino acids as the first building blocks of life on the Earth.

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[2] Dubina MV et al. 2013, OLEB, 43, 109
[3] Dubrovskii VG et al. 2013, J Chem Phys, 138, 244906
[4] Terterov I et al. 2014, Rapid Comm Mass Spectrom, 28, 33