The prebiotic origin of the RNA nucleosides and translation

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Abstract: The widely accepted RNA world hypothesis suggests that life emerged from RNA, which was able to (self)-replicate and evolve.[1] Replication of the information in RNA requires the formation of the complementary pyrimidine-purine Watson-Crick base pairs (A:U and G:C) for which we need to find prebiotically plausible synthesis scenarios.[2,3] I am going to report about new chemistry that allows the formation of these four canonical nucleosides[4,5] plus a set of non-canonical RNA bases[6] that are found until today in the transfer-RNA of organisms on earth [7]. The synthesis is achieved under plausible prebiotic conditions. The new prebiotic access to these molecules is based on the FaPy-pathway towards the purine nucleosides,[3] and an isoxazole pathway that generates the pyrimidines.[4] The chemistry is driven exclusively by fluctuations of physicochemical parameters such as pH, temperature and concentration. Importantly, the described chemistries are compatible with each other so that all four RNA building blocks can be formed in the same geochemical environment.[4]

Next to the formation of nucleosides, the emergence of life also required amino acids and the process of translation. We were able to show that certain RNAs have the property to self-decorate with amino acids and that these amino acids can react directly attached to RNA to peptides. This so far unknown property of RNA allows to extend the RNA world theory[1] to an RNA-peptide world concept for the beginning of life.[8]

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