Multi-component Chemistry and minerals open new ways for the origin of life

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Abstract

Multi-Component Chemistry is a potent tool for the synthesis of highly functionalized hetero-cyclic and hetero-acyclic compounds by only one-pot processes, often endowed of biological relevance in the context of the Origin of life [1]. Depending on the specific set of experimental conditions, these processes can be selective or unselective, affording a limited or, in alternative, a large variety of reaction products, respectively. Multi-Component chemistry is the pillar of both Chemomimesis [2] and Molecular Darwinism [3]. On the *conservation* side, Chemomimesis acts by selective and reproducible prebiotic processes which are expected to perform as template for biological systems [4]. From the *variation* side, Molecular Darwinism results in the adaptation of the system to changing conditions. It has no a priori aim and in the frame of a prebiotic process it is favored by the largest variety of reaction products. Thus, Chemiomimesis and Molecular Darwinism are principles acting in balanced cooperation in the frame of Systems Chemistry. Is it possible to identify some of the geochemical and geophysical principles guiding their evolution towards Life? The *hidden* ingredient in the Urey-Miller experiment [5], and the main role played by meteorites and different energy sources in the prebiotic synthesis of PNA's building blocks [6, 7] are telling examples of the balance between these two principles, possibly opening up the clarification of some relevant mechanisms and interactions operative at the borderline between prebiotic Chemistry and rudimental pre-Biology.

References

[1] Botta, L., Cesarini, S., Zippilli, C., B. M. Bizzarri, Fanelli, A., Saladino, R. Multicomponent Reactions in the Synthesis of Antiviral Compounds Current Medicinal Chemistry 2022, 29(12), 2013.
[2] Eschenmoser, A.; Loewenthal, E. Chemistry of potentially prebiological natural products. Chem. Soc. Rev.1992, 21, 1–16.
[3] Wicken, J.S. An organismic critique of molecular Darwinism. J. Theor. Biol. 1985, 117, 545–561.
[4] Saladino, R., Šponer, J.E., Šponer, J., , Pino, S., Mauro, E.D. Chemomimesis and molecular darwinism in action: From abiotic generation of nucleobases to nucleosides and RNA Life 2018, 8(2),24.
[5] Criado-Reyes, J., Bizzarri, B.M., García-Ruiz, J.M., Saladino, R., Di Mauro, E. Scientific Reports 2021, 11(1),21009
[6] Bizzarri, B.M., Fanelli, A., Cesarini, S., Saladino, R. A Three-Way Regioselective Synthesis of Amino Acid Decorated Imidazole, Purine and Pyrimidine Derivatives by Multicomponent Chemistry Starting from Prebiotic Diaminomaleonitrile Eur. J. Org. Chem. 2022,(25), e202200598.
[7] Bizzarri, B.M., Fanelli, A., Botta, L., Nencioni, L., Saladino, R. Aminomalononitrile inspired prebiotic chemistry as a novel multicomponent tool for the synthesis of imidazole and purine derivatives with anti-influenza A virus activity RSC Advances 2021, 11(48), 30020-30029.