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PREBIOTIC CHEMISTRY

The Use of Ascorbate as an Oxidation Inhibitor in Prebiotic Amino Acid Synthesis: A Cautionary Note

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Abstract It is generally thought that the terrestrial atmosphere at the time of the origin of life was CO_2-rich and that organic compounds such as amino acids would not have been efficiently formed abiotically under such conditions. It has been pointed out, however, that the previously reported low yields of amino acids may have been partially due to oxidation by nitrite/nitrate during acid hydrolysis. Specifically, the yield of amino acids was found to have increased significantly (by a factor of several hundred) after acid hydrolysis with ascorbic acid as an oxidation inhibitor. However, it has not been shown that CO_2 was the carbon source for the formation of the amino acids detected after acid hydrolysis with ascorbic acid. We therefore reinvestigated the prebiotic synthesis of amino acids in a CO_2-rich atmosphere using an isotope labeling experiment. Herein, we report that ascorbic acid does not behave as an appropriate oxidation inhibitor, because it contributes amino acid contaminants as a consequence of its reactions with the nitrogen containing species and formic acid produced during the spark discharge experiment. Thus, amino acids are not efficiently formed from a CO_2-rich atmosphere under the conditions studied.

Keywords Amino acid · Prebiotic synthesis · CO_2-rich atmosphere · Spark discharge

Introduction

It is now generally thought that life emerged via chemical evolution on the Earth (e.g., Oparin 1952). According to this model, the building blocks of life such as amino acids would have been available from abiotic sources. Since the Miller–Urey experiment (Miller 1953), various types of prebiotic amino acid syntheses have been studied (e.g., Schlesinger

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