Evaluation of Glyceraldehyde Under Simulated Prebiotic Conditions

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Introduction: Prebiotic origin of sugars, like ribose (a central subunit of RNA) remains unknown [1]. So, a probable mechanism that leads to their synthesis from simpler molecules in space or primitive Earth like conditions still requires to be elucidated. The study of possible precursors, like glyceraldehyde (the simplest triosa), subjected to different sets of simulated prebiotic conditions is then useful to try to understand the pathways that might had originated this kind of building blocks of life. Considering that information about the radiation chemistry of ketones and aldehydes, whether in aqueous solution or in solid state, is scarce, the aim of the present work was to observe the behavior of DL-glyceraldehyde in solid state when irradiated with ionizing radiation (from a gamma ray source) at different doses and temperatures, and in absence of oxygen, compared to what was previously observed in aqueous solutions. By using Electronic Paramagnetic Resonance (EPR), polarography, and High Performance Liquid Chromatography (HPLC) coupled to Mas Spectroscopy (MS), it was determined that solid DL-glyceraldehyde produces stable free-radical species even at low doses. Low and room temperature showed the same spectral composite EPR patterns, with different concentration of species due to the stability of polyalcohols' primary radicals, that are usually very unstable and are observed in higher concentration at low temperatures. As observed in aqueous solutions, the decomposition of glyceraldehyde is a function of irradiation dose. As in aqueous solution, malonaldehyde was detected in small amounts by HPLC-MS. In aqueous solution were identified products of radiolysis like ethylene glycol and glycolaldehyde, which are considered intermediates for sugars and sugar like molecules [1], and have been identified in comets and solar-type protostars [2].

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References:

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