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Stability of Amino Acids and Their Precursors (Hydantoins) against UV Light and Its Relevance to Origins of Life
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It is suggested that life on Earth could have been seeded by the delivery of organics from outer space during the intense bombardment period of primitive Earth. A large number of amino acids and their precursors have been detected in the extracts of carbonaceous chondrites, but their origins and original structure in the chondrites still remain controversial. Numerous simulation experiments have also suggested that these bioorganic compounds were formed from possible interstellar media by irradiation with high-energy particles or ultraviolet (UV) light. Furthermore, organics including amino acids and their precursors in inner part of comet and meteorites are safe from UV light, but organics in interplanetary dust particles (IDPs) are fully irradiated with strong solar UV as well as high-energy particles near Earth orbit. Thus, it is of interest to investigate how these organic compounds alter or survive against UV radiation. In this study, we examined the stability and photolysis products of hydantoin (Hyd) and its 5-substituted molecules, such as 5-methylhydantoin (M-Hyd), 5,5-dimethylhydantoin (DM-Hyd), 5-ethylhydantoin (E-Hyd), 5-ethyl-5-methylhydantoin (EM-Hyd). When 5-substituted hydantoins (EM-Hyd, E-Hyd, DM-Hyd and M-Hyd) were irradiated with UV light, Hyd (a precursor of glycine) was formed as major photolysis products. Therefore, it is assumed that 5-substituted hydantoins in extraterrestrial bodies were possible glycine precursors. Considering the photostability factor, EM-Hyd (precursor of isovaline) was less stable than isovaline aginst UV, though EM-Hyd is generally more stable than isovaline aginst radiation.It is due to the fact that isovaline has larger abosorption coefficient in UV region than EM-Hyd. The present experimental results may point out the potential importance of the photochemistry of isovaline, glycine and their precursor molecules (i.e., hydantoin and 5-substituted hydantoins) in Solar System bodies.

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