p25

FORMATION OF AMINO ACIDS BY UV-IRRADIATION OF AMINE SOLUTIONS

Shimoyama, A., Yokoyama, H. and Mita, H.
Department of Chemistry, University of Tsukuba, Tsukuba 305, Japan

Simple amines (methyl-, ethyl-, and propylamine) are plausible compounds which existed in the very early stage of chemical evolution. We, therefore, carried out experiments of uv-irradiation to aqueous solutions of these compounds in order to examine the formation of amino acids. During these experiments, we found 1-aminoethanol, to a certain amount, among the products. Therefore, 1-aminoethanol solution was also uv-irradiated to test the amino acid formation.

In the experiments, 10 mmol dm^{-3} solution of methylamine, ethylamine, or propylamine, and 1 mmol dm^{-3} solution of 1-aminoethanol were irradiated by uv (99% 254 nm and 1% 185 nm, 3 x 10^{18} photons/s) at 293 K for max. 21 h. Products were examine for amino acids by an amino acid analyzer and a gas chromatograph connected to a mass spectrometer.

By the 21 h uv-irradiation, methylamine was reduced to 20% of the original amount . The most abundantly formed amino acid was glycine which showed its maximum yield of ca. 0.08% on the basis of carbon atom at 15 h irradiation. Other amino acids identified were D,L-alanine, β-alanine, D,L-β-aminoisobutyric acid, D,L-β-aminobutyric acid, γ-aminobutyric acid, D,L-valine, 5-aminovareric acid, D,L-aspartic acid, and D,L-glutamic acid. The identified D,L-amino acids were found as nearly racemic. A characteristic feature of these amino acids was the predominance of non-α-amino acids, i.e., β-alanine was 20 times more abundant than alanine, and α-aminobutyric acid was not found. In addition to amino acids, 1-aminoethanol was found with its maximum yield of ca. 5% on the basis of carbon atom at 15 h irradiation.

The uv-irradiations of ethylamine and propylamine solutions gave roughly similar result as that of methylamine.

The uv-irradiation of 1-aminoethanol showed formation of similar kinds but more abundant amino acids as being compared to those of amines.

The uv-irradiation dissociates water molecules producing OH radials which promotes oxidation in the amine solutions. This interpretation was supported by the fact that ethylamine and 1-aminoethanol solutions at pH 2 produced amino acids about 10 times more abundantly than at pH 10.

Present irradiation experiment was carried out at room temperature, which may be applicable only to the primitive oceans of earth. Further experiments on solid states at lower temperatures is underway and will provide useful information on chemical evolution elsewhere.