

THE RADIOLYSIS OF KETO ACIDS

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Abstract: The aim of this work is to study the radiation-induced reactions of keto acids of biological importance in aqueous solution. The results obtained show that dimerization reaction is the main pathway for decomposition.

I. INTRODUCTION

The search for the origin of life on Earth is based on the assumption that life is the consequence of some physical and chemical-specific conditions, if these conditions are fulfilled, life emerged [1]. Chemical evolution is the possible step for the formation of biologically relevant compounds started from simple inorganic molecules and promoted by an energy source. Among the energy sources is radioactivity. This work is done in this framework, particularity concerning with the stability of some keto acids in an aqueous medium and the presence of high radiation fields. The radiation chemistry behavior of keto acids of biological importance is scarce, and a systematic study is needed because the presence of the keto group (C=O) makes these type of compounds very reactive in a radiation environment.

I.A. Experimental Procedures

The acids considered are pyruvic acid (CH₂COCO₂H), oxalacetic (HO₂CH₂COCO₂H) acid, and 2, ketoglutaric (HO₂CH₂CH₂COCO₂H) all of them in aqueous solution oxygen free. The solutions (0.05 M, pH acid) were irradiated at different doses from 0 to 150 kGy, in a cobalt-60 gamma source. The dose was calculated by Frick-Copper sulfate dosimeter [2]. The irradiated samples were analyzed immediately after irradiation. The analysis of the samples was performed by gas chromatography, using the methyl ester of the corresponding acids for its identification and estimation [3, 4]. A gas chromatograph coupled to a mass detector was used for the determination of radiolytic products. A molecular simulation carried out by HyperChem.

I.B. Results

In all the systems abstraction and dimerization reactions were the more important. For pyruvic acid, the main product was tartaric acid (dimer), in the radiolysis of oxalacetic acid the main product was malic acid and the dimer. For the case of 2-ketoglutaric acid, the products were succinic acid and the dimeric acid. Table I present some of the results for the 2-ketoglutaric acid. Other nonvolatile products also were detected (malonic, oxalic, pyruvic acid, but they are in minor proportion

Table I. Decomposition of 2-ketoglutaric acid in aqueous solution, oxygen-free

Doses, kGy	Succinic	Dimer	Decomposition
10	4.5	9	18
20	7.7	17	26
280	61	-	91

II. CONCLUSIONS

Several products were detected, and the formation can be explained via the attack of the radiolytic products of water. In all the systems abstraction and dimerization reactions were the more important. The decomposition increased with the dose given rise to biologically important compounds.

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REFERENCES

1. , S.L.MILLER and L. ORGEL. *The Origins of Life on Earth*, Prentice-Hall, Inc. New Jersey. (1974).
2. J. W. T SPINKS,. AND R. J. WOODS. *An introduction to radiation chemistry*. A Wiley Interscience Publication. New York. pp. 71-126. (1990).
3. Z.D. DRAGANIC, S.I. VUJOSEVIC, A. NEGRÓN-MENDOZA, J.A. AZAMAR, I.G. DRAGANIC. "Radiation chemistry of a multicomponent aqueous system relevant to chemistry of cometary nuclei", *J. Mol. Evol* **22**, 175-187 (1985).
4. A. NEGRÓN-MENDOZA, Z. DRAGANIC, R. NAVARRO, I.G. DRAGANIC, "Aldehydes, ketones and carboxylic acids formed radiolitically in aqueous solutions of cyanides and nitriles" *Radiation Research*, **95**, 248-261 (1983).