

THE ENZYMATIC DESTRUCTION OF FULLERENE C₆₀

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The drug without the knowledge of its fate in the organism is nothing. Although fullerene C₆₀ is of particular interest among other carbon nanostructure's, data on its transformations in mammals are virtually absent. Attempting to find the possibility of degradation of fullerene C₆₀ by mammalian enzymes, we have selected myeloperoxidase (MPO), which is one of the key components of the innate immune system of mammals and ensures neutrophil activity against foreign agents. Fullerene (Neotec Product, Russia, 99%) was used as nanoC₆₀ prepared by the solvent-exchange method (a light yellow solution with a particle size from 130 to 390 nm and a zeta potential of -30 mV). MPO was isolated from the extract of frozen HL-60 cells and purified by affinity chromatography's. The nanoC₆₀ solution was incubated at 37°C in the presence of 100 nM MPO in 150 mM NaCl, adding hydrogen peroxide daily to a final concentration of 50 μM. The selected time and concentration mode of adding hydrogen peroxide does not inactivate the enzyme, i.e., provided a stable formation of HOCl. The monitoring of changes of the reaction mixture showed that, during the first two days of incubation in the presence of MPO the yellow solution became colorless. In the UV spectra of the reaction mixture, the intensity of the peak at 333–335 nm decreases over time until the complete disappearance. The IR spectroscopy data showed that the signals characteristic of the unsubstituted fullerene core C₆₀ disappeared 3 days after the addition of hydrogen peroxide. The mass-spectra of the reaction mixture on the 5-6 days contained no fragments with the molecular weights of 720 and above, which, in turn, indicates the degradation of core [1]. In the methyl *tert*-butyl ether extract of reaction mixture of the 5th day by chromato-mass-spectrometry were detected the present, among others, of the following compounds, namely 4-methylheptan-2-on, 3-methylbenzaldehyde, 4-ethyl-1,3-benzenediol, 4-hydroxy-4-methylpen-tan-2-on and 2,2,4,4-tetramethyltetrahydrofuran. Thus, we for the first time demonstrated the principal possibility of biodegradation of fullerene C₆₀ molecule using the human neutrophil enzyme MPO. This process, unlike other examples of the biological modification of fullerenes, leads to a complete loss of the fullerene molecule topology.

Reference

1. Litasova E.V., Iljin V.V., Sokolov A.V., Vasilyev V.B., Dumpis M.A., Piotrovskiy L.B. Doklady Biochem. Biophys. 2016, Vol. 471, pp. 417–420.