Photodynamics and DNA Modifications of Arsenic Radicals

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Introduction

We have assumed that dimethylarsenic peroxyl radical [(CH₃)₂AsOO·] 15 produced in the metabolic processing of inorganic arsenics, is responsible for lung-specific DNA damage 21 and lung-tumorigenicity 20 in mice. To further elucidate the production of the arsenic peroxyl radical, a laser-photolysis study using diphenylarsenic as model-compounds was carried out and the DNA modifying actions of its radicals were investigated.

Methods

Laser photolysis-studies of diphenylarsinous iodide [(C₆H₅)₂AsI] in aerated or degassed toluene were carried out with the use of a Nd-YAG laser (355 nm). The photoproducts in aerated toluene were analyzed by HPLC. Continuous photolysis of diphenylarsinous iodide [(C₆H₅)₂AsI] and oxybis-diphenylarsine [(C₆H₅)₂As₂] in aerated toluene was performed with a 250-W mercury lamp. The scavenging activity of mannnitol and hypotaurine towards the radicals produced by photolysis of diphenylarsenics was determined by a deoxyribose assay. DNA adducts formed by reaction with DNA, and the radicals produced by photolysis of diphenylarsenics, were determined by the postlabeling method.

Results and Discussion

Transient absorption spectra for aerated and degassed toluene solutions of diphenylarsinous iodide after a 355 nm-laser pulse were measured. The apparent second order decay rate constants, \( k (e) \), of the radical in the aerated and degassed toluene were \( 4.5 \times 10^8 \text{ cm}^2\text{s}^{-1} \) and \( 2.6 \times 10^8 \text{ cm}^2\text{s}^{-1} \) at 410 nm, respectively. Furthermore, the major of photolysis product of diphenylarsinous iodide and oxybis-diphenylarsine in the aerated condition was diphenylarsinic acid [(C₆H₅)₂As(O)OH]. These results suggest that the diphenylarsenic radical [(C₆H₅)₂As·] produced by photolysis of diphenylarsinous iodide and oxybis-diphenylarsine is converted into diphenylarsinic acid [(C₆H₅)₂As(O)OH] via the production of diphenylarsenic peroxyl radical [(C₆H₅)₂AsOO·] in the aerated system.

The formation of thymine propenal was observed by photolysis of diphenylarsinous iodide and oxybis-diphenylarsine in the presence of thymidine. However, the production of thymine propenal was only affected marginally by the addition of hydroxy radical-scavenging agents such as mannitol and hypotaurine. Furthermore, the formation of DNA adducts was observed by photolysis of oxybis-diphenylarsine with calf thymus DNA.

In conclusion, these findings suggest that diphenylarsenic radical [(C₆H₅)₂As·] and diphenylarsenic peroxyl radical [(C₆H₅)₂AsOO·] are produced by the photolysis of diphenylarsinous iodide and oxybis-diphenylarsine, and that these radicals have DNA-modifying actions.

References