Drinking Water Contaminants: Toxicity of halogenated polycyclic aromatic hydrocarbons

S.S. José¹*, M. Pinto², A.M.M Antunes³, H. Louro³, L.Jordao¹ M.J. Silva², A.S. Cardoso¹

¹ Departamento de Saúde Ambiental, Instituto Nacional de Saúde Doutor Ricardo Jorge (INSA), Lisboa, Portugal; ² Departamento de Genética Humana, INSA, Lisboa, Portugal; ³ Centro de Química Estrutural, Instituto Superior Técnico, Universidade de Lisboa, Lisboa, Portugal. * Departmento de Saúde Ambiental (DSA), Instituto Nacional de Saúde Doutor Ricardo Jorge (INSA), Avenida Padre Cruz 1649-016 Lisboa, Portugal; †silvia.jose@insa.min-saude.pt; (+351) 217519298

Introduction

Food may be contaminated with polycyclic aromatic hydrocarbons (PAHs) in the process of smoking or heating. These contaminants or their derivatives can also be present in drinking water when raw water contains with discharges of untreated industrial/waste water effluents, forest fires or by solubilisation of organic material from contaminated soils. A few studies have shown that water disinfection can lead to halogenated derivatives of PAHs (HPAHs) as chlorinated and brominated derivatives, and there are evidences that these compounds may have greater mutagenicity than the parent PAHs.

Aims:

Human hazard assessment of chlorinated/brominated derivatives of pyrene (Pyr) and benzo[a]anthracene (BaA), 1-CIPyr, 1-BrPyr and 7-CIBaA - through characterization of the cytotoxic and genotoxic effects in HepG2 cells

Results and Discussion

Formation of Halogenated Pyren (1-CIPyr, 1-BrPyr) and Benzo(a)anthracene (7-CIBaA) derivatives under aqueous disinfection conditions in waters contaminated with PAHs

Evaluation of cytotoxic and genotoxic effects of chlorinated and brominated derivatives in HepG2 cells

Results of the neutral red assay 24h exposure to Pyr, 1-CIPyr, 1-BrPyr for concentrations (10 to 200 µM); BaA and 7-CIBaA for concentrations (1 to 200 µM); (* p<0.05; ** p<0.001; ***p<0.0001)

- Cell viability > 60% for Pyr and derivatives (1-CIPyr and 1-BrPyr)
- Cell viability < 50% for BaA and derivative 7-CIBaA)
(BaA: IC50 =3.37 µM ; 7-CIBaA: IC50= 12.63 µM)

Conclusions

- The observation that 7-CIBaA can be formed under water disinfection conditions and that it displays a stronger genotoxic potential than BaA, a genotoxic and probable carcinogenic chemical, raises some concern as to the hazard associated to this and other HPAHs that might remain to be identified.
- While it is undeniable that disinfection of drinking-water is essential for public health protection, the identification of new possibly hazardous water chlorination by-product emphasizes the need of using raw water with a reduced content of organic carbon and the development of safer water disinfection methods.