Genotoxicity assessment in environmental toxicology - somewhere between the "cult of the imperfect" and the "perfect solution"

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Genotoxicity is one of the first events occurring in organisms exposed to pollutants and stands for the most adverse impact on wildlife. Therefore, the evaluation of the risk to genomic integrity is an unavoidable but also challenging task in the framework of environment health assessment. The difficulty of this pursuit results from three levels of complexity viz. the pollution scenarios, biological and ecological organization, and the net of sub-cellular processes involved in the pro- and anti-genotoxic pathways.

Environmental genotoxicology has accompanied the evolution of other subareas of environmental toxicology and, besides the pollutants traditionally evaluated, showed to be aware to emergent genotoxicants such as pharmaceutical substances, nanomaterials, biotoxins, or radionuclides. A set of diagnostic tools has been applied in a wide diversity of approaches, involving *in vitro*, *ex vivo*, *in vivo* and *in situ* exposures, as well as surveying of wild native specimens. The genotoxicity endpoints commonly used include the detection of DNA adducts, comet assay, induction of chromosomal aberrations (CA) and sister chromatid exchanges (SCE), micronuclei (MN) and erythrocytic nuclear abnormalities (ENA) tests. The comet and ENA/MN are the most adopted assays and their combined use has been recommended since they reflect different levels of genetic impairment. The wide variety of species addressed, tissues sampled and experimental approaches adopted have led to a profusion of adaptations on the protocols. A standardization of procedures for environmental studies is strongly recommended.

The knowledge of tissue- and species-specific temporal patterns of genotoxic responses (e.g. the progression of DNA damage in long-term exposures as well as after removal of genotoxic pressure) is still scarce, which can represent an obstacle on results interpretation.

Some authors state that the ultimate goal of ecogenotoxicoloy should be linking genetic damage at individual level to deleterious effects on higher organizational levels, mainly at population level (e.g. abundance and reproduction impairments). This is a hardly achievable goal for the majority of studies.

Though the “cult of the imperfect” should be avoided and a continuous effort should be carried out by environmental genotoxicologists towards more reliable genotoxicity indicators and the definition of suitable strategies, the “perfect solution” was not yet found, probably because it does not exist.

“If you never miss a plane, you're spending too much time at the airport".

“The best is the enemy of the good”.

"Democracy is the worst form of government, except for all those other forms that have been tried from time to time" (from a House of Commons speech on Nov. 11, 1947).

The perfect solution fallacy is an informal fallacy that occurs when an argument assumes that a perfect solution exists and/or that a solution should be rejected because some part of the problem would still exist after it were implemented.

Notas - Notes