Environmental Toxicity Assessment: state of the art and future directions in a world of arising threats

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The present editorial introduces to a Special Issue in Environmental Science and Pollution Research journal, highlighting selected papers presented at the 19th International Symposium on Toxicity Assessment (ISTA19) that was held in Thessaloniki, Greece, in August 2019. For more than 30 years, the biennial ISTA congresses serve as a catalyst for fruitful exchanges between researchers, managers, and legislators involved in all fields of environmental science, safety, and health. ISTA provides a forum for discussions on current advances in toxicity and risk assessment, on fundamental or innovative concepts in ecotoxicology, as well as on research on environmental protection and conservation. Nowadays, investigation of environmental toxicity is more necessary than ever; the general public is continuously bombarded with various environmental agents—some of them less than innocuous, permissible exposure limits for workers are commonly reevaluated and new scientific data enable us to ban, limit, restrict, or re-register pesticides and other chemicals. At the same time, novel testing technologies and tools continue to emerge. These techniques utilize fewer live organisms and they are in vitro and in silico oriented. Thus, there is a need for developing a long-range vision and strategy for toxicity testing that encompasses more humane methods without compromising validity and reliability. Only this approach will be able to give answers to current and imminent environmental problems.

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The following 12 manuscripts are just a glimpse of these concerns that were talked about in ISTA19. At the same time, these selected manuscripts demonstrate the breadth of toxicity assessments being conducted globally.

It would be a great disservice to ISTA's ideology if we forgot where we originated from; as such, the special issue opens with the participation of Professor Paule Vasseur and her team (Vasseur et al. 2020) on how it all started with "Ecotoxicology, revisiting its pioneers."

Right after diving into the past, we emerge in the present with the presentation of an ultrarapid screening test developed by Snell and Persoone (2020). The test uses a desiccated rotifer which, when rehydrated, can easily classify water-based samples into four toxic categories.

From novel bioassays to well-established ones, we continue with the research of Courtois et al. (2020) on how the model organism *Eisenia foetida* accumulates and biotransforms Ag, which is increasingly used in agriculture, especially in nanoparticle form.

Staying in the crop field, we then investigated the *hrpZ_{P_{sph}}*-transgenic *Nicotiana benthamiana* response under Cd stress (Mitsopoulou et al. 2020) and how it differs from its wild-type homologue.

The realistic threat of Cd soil contamination as well as Cr contamination was the focus of research of Antoniadis and Golia (2020) on agricultural soils in Central Greece. It was shown that the pollution arises from fertilizers, but it also has a lithogenic component.

Contamination of soil by toxic metals was also the research focus of the review of Charvalas et al. (2021). Case studies of Chalikidiki and Kozani in Greece were chosen in order to showcase the potential of phytoremediation, in relation to the local flora characteristics.

Intensive agriculture and clashing land uses further facilitate soil metal contamination in Greece; as such, our own research here (Giannakis et al. 2020) examined how land

spreading of municipal sludge may affect this burden in the long run, at soils which have received this treated waste twice in the course of 2 years.

Moving on from land to water, newly synthesized rubber-based sorbents were tested as passive samplers for polycyclic aromatic hydrocarbons (Tureyen et al. 2020). It was shown that at least the sampler prepared in benzene performed very well and it could be used for both short- and long-term monitoring in the aquatic environment.

Passive samples were also subject of the research from Sofield et al. (2021); in their paper, the authors investigated how water quality parameters affect metal accumulation kinetics in freshwater so that these modifying factors are also considered.

Besides chemical pollution, aquatic ecosystems may also suffer from toxic blooms. The vulnerable Mediterranean basin has been chosen as a case study for the review of Marampouti et al. (2020), who have also considered the origin and the impact of 20 contributing invasive species.

Regarding aquatic pollution and wastewater treatment, the research group of Médice et al. (2020) has focused on norfloxacin, a common antibiotic, which after wastewater chlorination produces various by-products of documented ecotoxicity.

On the same plane, another durable pollutant, the fungicide fludioxonil, was treated on upflow immobilized cell bioreactor so that it could be successfully metabolized, in the study of Mavriou et al. (2020).

As already stated, these manuscripts mirror the broad and multidisciplinary research presented and promoted in ISTA19. This joint effort was fruitful because of the dedication and the punctuality of the authors, the professionalism and the commitment of the ESPR journal, and the perseverance and the enthusiasm of the ISTA organizing team. We are looking forward to the next ISTA congresses, to an expanding international audience, and to the continuous participation of scientists, assessors, policy makers, and sensitized public.

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