Ecotoxicology and toxicology: problems and decisions

Muriel Bost¹ · Wilfried Sanchez²

Received: 5 December 2017 / Accepted: 12 December 2017 / Published online: 8 January 2018
© Springer-Verlag GmbH Germany, part of Springer Nature 2018

During the last decade, advances in analytical methods, an avalanche of information available over the Internet and a creation of international collaborations, have greatly increased our understanding of the role of trace elements in humans. Today, morbidity and mortality related to trace element deficiencies or toxicities affect more than half of the world's population. Research on both essential and toxic trace elements runs the gamut, from studies of dietary intake, requirements, and standards to optimal homeostasis and threshold values to genetic, molecular, and biochemical investigations of mechanisms of action. Specifically, trace elements are known to be involved in receptor, hormone, and enzyme functions, as well as genetics and derangements in disease.

Disorders of trace element metabolism represent an important class of human diseases. The best known of these reflect abnormalities in iron, copper, or zinc metabolism. These diseases can lead to a deficiency of the metal in the tissues (e.g., matriptase-2 deficiency for iron, Menkes disease for copper, acrodermatitis enteropathica for zinc) or an excess (e.g., hemochromatosis for iron, Wilson's disease for copper). The adverse health effects resulting from trace element malnutrition have been almost completely solved in affluent countries with the exception of marginalized population groups, but deficiencies of trace element are still quite prevalent in less developed countries. Similarly, acute and chronic toxicity due

to overexposure/pollution is a much more extensive problem in less developed countries than those that are affluent. Subclinical conditions of toxicity may be associated with a chronic low level occupational, environmental toxic exposure, or food toxicology and lead to insidious biological effects that indirectly affect health and disease risk.

The propensity of a metal to be accumulated by living organisms depends on the affinity of the element for biological surfaces and its ability to cross external cell membranes, which, in turn, depends on its speciation. Once incorporated inside cells, the fate of the metal and its effects will depend on the ability of the organism to detoxify, and ultimately, eliminate the metal. Metals inappropriately bound to sensitive sub-cellular components, such as mitochondria or metabolic enzymes, can lead to oxidative stress and substantial metabolic costs. Each species within a food web possesses its own capacity for metal accumulation, storage, detoxification, and elimination. This species-specific response, combined with behavioral and ecological considerations of predator-prey interactions, greatly affects the capacity of metals to efficiently transfer along food webs and to induce toxicity.

The present issue of ESPR contains selected articles contributed by speakers at the International Seminar "Ecotoxicology and toxicology: problems and decisions."

The meeting was held in Rovaltain, Alixan, France, on 26 November 2015 and was organized by Trace Element-Institute for UNESCO (TEU) and Foundation Rovaltain, in collaboration with IBSP UNESCO and supported by Region Rhône-Alpes administration.

The main objective of TEU (<http://www.trace-element.org>) is to develop, to promote, and to coordinate inter-region, national, and international actions in all areas related to trace elements and toxic metals, from basic knowledge to high-level research and its practical applications, in accordance with UNESCO recommendations.

The purpose of the Rovaltain Foundation (<http://www.fcsrovaltain.org>) is to increase and to circulate scientific knowledge in such areas as environmental health,

Responsible editor: Philippe Garrigues

✉ Muriel Bost
muriel.bost@trace-element.org

¹ Trace Element – Institute for UNESCO, Laboratory of Trace Element and Toxic Metal Analysis, PharmacoTox Unit, CBAPS; Laboratories of Neurogenetic and Hereditary Diseases of Metabolism, CBPE; National Reference Centre for Wilson Disease – HFME, 7 rue Guillaume Paradin, 69008 Lyon, France

² Rovaltain Scientific Foundation, BP16110, 26958 Valence cedex 9, France

toxicology, and ecotoxicology by setting up requests for research proposals, scientific conferences, and thematic days.

The goal of this partnership is to improve the knowledge on how toxic metals impact the connections between health and environment. It also aims to develop training and information in this particular area. A better understanding of the potential long-term effects of trace chemical substances on man is both a stake and a challenge for the scientific and medical communities.

This stake is equally shared by TEU and the Rovaltain Platform, whose development driving force lies in the very understanding of long-term effects of chemical, biological, or physical substances on man and his environment. Trace elements and especially metallic trace elements (MTE) are involved in many biological mechanisms and may be associated with the emergence of certain diseases, along with other chemical substances. MTE and the approaches allowing for the study of their potential effects on man are specific points of synergy between TEU and the Rovaltain Platform.

Both structures can efficiently co-develop various fields of expertise and deal with the needs in terms of scientific monitoring and communication to the scientific community and the general public.

To increase, to reinforce, and to speed up the regional, national, and international spread of such knowledge, the partnership relies on the creation and exploitation of joint synergies in four fields of action: training, information, expert assessment, and scientific monitoring.

The objective of this seminar was to bring together scientists to present their findings and discuss future trends and directions concerning toxic metals effects on environment and human health; the invited experts are coming from academia, university, or research center and are able to demonstrate new skills, to report new achievements, and to share relevant experiences and knowledge.

Nearly 50 participants came from France, Italy, Hungary, Tunisia, Morocco, Russia, Canada, and Brazil.

The collection included in this special issue covers topics on toxic metals effects due to different etiologies of toxicity as (i) human metabolic toxicosis with hemochromatosis, (ii) effect of occupational exposure on trace element status in children (iii) environmental monitoring on bird, and (iv) food toxicity and its control.

Acknowledgements Muriel Bost and Wilfried Sanchez would like to thank (i) TEU satellite centers and authors for providing articles, (ii) Region Rhône-Alpes administration and ADN association for financial support, and (iii) Catherine Billard for her assistance. They also wish to thank ESPR for the opportunity to present the results of this collaborative research and for the invitation to this special issue.

Muriel Bost has a degree in Pharmaceutical and Biological Sciences, PhD in Pharmaceutical Sciences specializing in molecular biology. Muriel BOST is a biologist-pharmacist in Civil Hospitals of Lyon (France). She is responsible for the Laboratory of Trace Analysis and Toxic metals in the pharmacotoxicology unit of the South Biology and Anatomic-Pathology Center in Lyon and she also works in the Laboratory of Neurogenetics and Laboratory of

Hereditary Metabolic Diseases, East Biology and Pathology Center in Lyon. Her scientific work mainly focuses on the study of Wilson's disease, which started with her PhD thesis prepared in France and the USA. She took part in the creation of the the French Wilson Reference Center for Rare Diseases in 2005 and participated in EuroWilson, a European project. She is author and co-author of 61 papers mainly on the genetics of Wilson's disease and the relationship between trace element deficiency or metal toxicity and health. She is the President of Trace Element-Institute for UNESCO (Lyon, France), President of SFEMW (*Francophone Society for Wilson Disease Study*) and a member of SFERETE (*Francophone Society for Study and Research of Essential and Toxic Elements*; President from 2002 to 2005), FESTEM (*Federation of European Societies on Trace Elements and Minerals*, Treasurer since 2016), ISTERH (*International Society For Trace Element Research in Humans*; secretary in 2003–2004), and SFTA (*Société Française de Toxicologie Analytique*).

Wilfried Sanchez is the Chief Executive Officer of the Rovaltain Scientific Foundation. He holds to a doctorate from the National Museum of Natural History in ecotoxicology. Wilfried SANCHEZ worked for 10 years at the French Institute for Industrial Environment and Risks (INERIS). This work, combining research and expertise, focused on the development of innovative tools for monitoring the quality of aquatic environments and the study of the effects of

emerging contaminants (pharmaceuticals, microplastics, ionic liquids). He is an author of more than 50 scientific publications; Wilfried SANCHEZ participated in the work of the health agency (ANSES) and the European Commission on endocrine disruptors. He was also a member of various working groups at the national and European level on improving the monitoring of aquatic environments.