2011

Challenges and opportunities for toxicology in Mexico

Rodrigo Franco
University of Nebraska-Lincoln, rfrancocruz2@unl.edu

Balam Muñoz
Centro de Investigación y de Estudios Avanzados del IPN, Mexico

Published in *Toxicology Mechanisms and Methods* 21:9 (2011), pp. 635–636; doi: 10.3109/15376516.2011.615978

Challenges and opportunities for toxicology in Mexico

Rodrigo Franco
Redox Biology Center and School of Veterinary Medicine and Biomedical Sciences, University of Nebraska– Lincoln, Lincoln, USA

Balam Muñoz
Department of Toxicology, Centro de Investigación y de Estudios Avanzados del IPN, Mexico

Corresponding author – Rodrigo Franco, Redox Biology Center and School of Veterinary Medicine and Biomedical Sciences, 114 VBS 0905, University of Nebraska-Lincoln, Lincoln, NE 68583, USA; tel 402 472-8547, fax 402 472-9690, email rfrancocruz2@unl.edu

Exposure to environmental toxicants such as pollutants, chemicals, allergens and natural toxins has detrimental effects on health and is considered to contribute substantially to the etiology of human diseases of major public health significance. Industrialization, increase in population and growth of chemical-related industries have generated a variety of environmental problems of major relevance to developing countries that must be addressed by toxicological research. Industrial development has resulted in an increased release of chemicals and other agents into the environment, resulting in damage to the environment as well as increasing the risk of adverse effects on human health (McMichael 2000). Mexico, as a developing country, faces many common problems to other developing countries. Researchers in developing countries, including Mexico, battle obstacles with education collaboration and determination, despite progress in recent years more work is needed.

Toxicology is an important multidisciplinary area of biomedical research. Nowadays, toxicology has achieved an enormous importance worldwide (Rojas 2005). New materials, global warming, nanosciences, bioproducts, pollution, among other issues have induced a way of rethinking the risks and consequences of progress. Scientists and governments are working together to design new politics, methodologies and studies to understand and minimize the impact of toxicants in population and environment. Mexico is still facing many troubles in the toxicological field. Chemicals such as polycyclic aromatic hydrocarbons, lead, mercury, arsenic, pesticides, among others, are common sources of exposure for some populations in Mexico. This country also possesses important ecosystems that are endangered, in part, for the use of chemicals. Concentrations of ozone, nitrogen dioxide and particulate matter in urban areas frequently exceed international safety thresholds. Chemical and biological contamination of major sources of drinking water have been reported to increase by 40% over the past 10 years. In addition, the number of diseases associated with some kind of toxic exposure is increasing in recent years (McMichael 2000; Rojas 2005).

We have developed this Special Issue titled "Challenges and Opportunities for Toxicology in Mexico" with the aim to highlight not only the challenges toxicology research faces in Mexico, but also the efforts and drive towards cutting edge research to address them. Altogether, this special issue should be a valuable source of information for all readers with an interest in toxicology and human health.

Mexico is an important economy worldwide and is a major exporter of several supplies and commodities. Because of this, its industry is a source of occupational exposure to several chemical derivatives (Nieusma 2011). The situation of occupational toxicology in Latin America, and particularly in Mexico is reviewed in this issue by Dr. Muñoz and Dr. Albores. In the frame of the 30th Congress of the International Commission of Occupational Health to be held in Cancun, the authors present current data, statistics and studies about this topic in Mexico. In addition, they propose the use of molecular studies to increase accuracy in diagnosis of occupational associated diseases, improve techniques of biomonitoring in the work environment and develop current databases for occupational exposure limits.

Inorganic arsenic is a well-known environmental toxicant that is associated with a variety of adverse health effects such as increased risk of cancer and of non-cancerous diseases including diabetes (Kapaj et al. 2006). In Mexico, there are several geographic areas with high ar-

senic levels (Coronado-Gonzalez et al. 2007, Cebrian et al. 1983). Because the action of arsenic as a toxin and carcinogen is affected by its metabolism, understanding the relationship between the phenotype of arsenic metabolites in urine is especially relevant to its risk assessment. Dr. Luz M. Del Razo contributes to this special issue with a study aimed to determine the phenotype of inorganic arsenic in urine.

Lead and mercury are two of the most hazardous chemicals to human health, and particularly dangerous to children (Wild and Kleinjans 2003). Several toxic effects include damage to lungs, kidney and brain. Human activities, such as mining, contribute significantly to increase environmental concentrations of these elements. In this issue, Dr. Emma Calderón analyzes current data regarding the role of lead and mercury exposure in the development of central nervous system diseases in Mexican children. Furthermore, the differences in toxicokinetics, mechanisms and exposure sources for both chemicals are also discussed.

The potential of plants as medicines for human use is widely been accepted. About 65% of the world population relies upon traditional remedies for their health needs and scientific validation of the medicinal properties of botanicals is now beginning to support their use (Farnsworth et al. 1985). Plants of the genus Ardisia are commonly used since ancestral times and some plants of this genus have been well-documented in traditional medicine in Mexico (Kobayashi and de Mejia 2005). However, only limited information exists regarding their toxic and medicinal properties. Dr. Elvira Gonzalez de Mejia reviews the available scientific literature related to the bioactivity, potential health benefits and probable toxicity of plants of the genus Ardisia with the aim to highlight the need for a more comprehensive characterization of extracts to confirm the health-promoting properties claimed for these species.

DDT [1,1-bis(p-chlorophenyl)-2,2,2-trichloroethane] was one of the most widely used organochlorine pesticide in the world and is considered to be a pollutant of high persistence in the environment (Turusov et al. 2002). Until the year 2000 in Mexico, dichlorodiphenyltrichloroethane (DDT) was used for both the control of malaria and for agricultural purposes. Recent studies have found DDT and its metabolites in the environment and in human tissues in Mexico (Yanez et al. 2002). Dr. Fernando Diaz-Barriga has previously demonstrated the ability of this toxin to induce the activation of cell death pathways in peripheral blood cells and in this special issue, his research group studies the occurrence of programmed cell death in Mexican indigenous children exposed to DDT.

Organophosphorous (OP) insecticides have been extensively used in Mexico becoming a major public health concern (Sanchez-Pena et al. 2004; Gamlin et al. 2007). Dr. Betzabeth Quintanilla-Vega reviews the current data of OP use and their related toxicity from epidemiological and experimental studies conducted in Mexico. This work illustrates that OP exposure represents a risk for reproductive, developmental and neurological disorders in Mexican populations, particularly for those communities dedicated to agriculture/farming activities.

We would like to thank all authors for submitting their exciting contributions for this issue, the referees for their critical but constructive comments, Dr. Rakesh Dixit (Editor in Chief), Luis G Valerio (Deputy Editor in Chief) and the Editorial Board of "Toxicology Mechanisms and Methods" for their outstanding cooperation. Finally, this work would not have been possible without the help from Joris Roulleau at Informa.

Declaration of interest — This work was supported by National Institutes of Health Grant P20RR17675 Centers of Biomedical Research Excellence (COBRE) (Franco R) and Consejo Nacional de Ciencia y Tecnología Grant 104316 (B Muñoz).

References

Cebrián ME, Albores A, Aguilar M, Blakely E. 1983. Chronic arsenic poisoning in the north of Mexico. *Hum Toxicol* 2:121–133.

Coronado-González JA, Del Razo LM, García-Vargas G, Sanmiguel-Salazar F, Escobedo-de la Peña J. 2007. Inorganic arsenic exposure and type 2 diabetes mellitus in Mexico. *Environ Res* 104:383–389.

Farnsworth NR, Akerele O, Bingel AS, Soejarto DD, Guo Z. 1985. Medicinal plants in therapy. *Bull World Health Organ* 63:965–981.

Gamlin J, Diaz Romo P, Hesketh T. 2007. Exposure of young children working on Mexican tobacco plantations to organophosphorous and carbamic pesticides, indicated by cholinesterase depression. *Child Care Health Dev* 33:246–248.

Kapaj S, Peterson H, Liber K, Bhattacharya P. 2006. Human health effects from chronic arsenic poisoning—A review. *J Environ Sci Health A Tox Hazard Subst Environ Eng* 41:2399–2428.

Kobayashi H, de Mejía E. 2005. The genus Ardisia: A novel source of health-promoting compounds and phytopharmaceuticals. *J Ethnopharmacol* 96:347–354.

McMichael AJ. 2000. The urban environment and health in a world of increasing globalization: Issues for developing countries. *Bull World Health Organ* 78:1117–1126.

Nieusma J. 2011. Employee safety as a goal creates communication, cooperation, and using the best data available. *Toxicol Mech Methods* 21:75.

Rojas M. 2005. Latin America's present and future challenges in toxicology education. *Toxicol Appl Pharmacol* 207:722–727.

Sánchez-Peña LC, Reyes BE, López-Carrillo L, Recio R, Morán-Martínez J, Cebrián ME, Quintanilla-Vega B. 2004. Organophosphorous pesticide exposure alters sperm chromatin structure in Mexican agricultural workers. *Toxicol Appl Pharmacol* 196:108–113.

Turusov V, Rakitsky V, Tomatis L. 2002. Dichlorodiphenyltrichloroethane (DDT): Ubiquity, persistence, and risks. *Environ Health Perspect* 110:125–128.

Wild CP, Kleinjans J. 2003. Children and increased susceptibility to environmental carcinogens: Evidence or empathy? *Cancer Epidemiol Biomarkers Prev* 12:1389–1394.

Yáñez L, Ortiz-Pérez D, Batres LE, Borja-Aburto VH, Díaz-Barriga F. 2002. Levels of dichlorodiphenyltrichloroethane and deltamethrin in humans and environmental samples in malarious areas of Mexico. *Environ Res* 88:174–181.