University of Antwerp
Toxicological Centre

POLYTECHNIQUE MONTRÉAL
TECHNOLOGICAL UNIVERSITY

Dermal bioaccessibility of metal(loid)s from polluted soils and permeation through synthetic skin

Prof. Gerald J. ZAGURY, Eng., M. Env., Ph D
Department of Civil, Geological, and Mining Engineering
Polytechnique Montréal, Montreal (QC), CANADA

07 APRIL 2023, 9.30-10.00h, CDE (room R008)

Dermal exposure to soil or dust-bound metal(loid)s has received less attention than oral/inhalation exposure. Nevertheless, dermal exposure might significantly contribute to the total body burden of metal(loids) in humans for some exposure scenarios. The dermal bioaccessible fraction of metal(loid)s is the quantity that is dissolved in synthetic skin film liquids (SSFLs) and is available to penetrate through the skin. Bioaccessibility testing is more ethical, cheaper and less time consuming than *in vivo* bioavailability testing, and thus used as a surrogate of bioavailability. However, an appropriate *in vitro* dermal bioavailability estimation should involve the coupling of bioaccessibility data with skin permeation data to characterize risks more accurately (1, 2).
While physicochemical properties of synthetic sweat can impact the bioaccessibility and permeation of soil-bound metal(loid)s, such As, Cr, Cu, Ni, Pb, and Zn (2-4), it is unclear how the characteristics of synthetic sweat affect the speciation and transdermal permeation of bioaccessible metal(loid) fractions. Here we present an overview on dermal bioaccessibility of metal(loid)s found in reference soils and various field-collected soils. Site-specific diffusion parameters of soluble metal(loid)s obtained using the Franz cell methodology (equipped with a Strat-M membrane) were compared with generic values recommended by the US EPA. Overall, As, Cr, Cu, and Ni were able to diffuse through the Strat-M membrane, while Pb and Zn were not able to permeate the synthetic skin regardless of whether or not sebum was present in SSFLs. More studies are needed to assess metal(loid) speciation (including interaction with organic sebum components) in SSFLs after soil extraction to investigate the formation of more permeable organic species.
Finally, we highlighted the research needs to properly use bioaccessibility and transdermal permeation data. This will improve human health risk studies and allow for better protection of children and workers exposed to dust and soils originating from urban and industrial contaminated sites.

References
1. Stefaniak AB, Duling MG, Geer L, Virji MA (2014). Environ Sci Process Impacts, 16(2): 341-351
2. Marin Villegas CA, Zagury GJ (2021). Environ Sci Technol, 55: 8215−8222.
3. Leal LTC, Güney M, Zagury GJ (2018). Chemosphere, 197:42–49.
4. Marin Villegas CA, Güney M, Zagury GJ (2019). Sci Total Environ, 692: 595–601.

Prof. Zagury holds a degree in Civil Engineering from Polytechnique Montréal (Canada). He earned his MSc in Environmental Sciences and PhD in Environmental Engineering from Sherbrooke University (Canada) in 1997. Since 2002, he has been a professor in the Civil, Geological, and Mining Engineering department at Polytechnique Montréal. Prof. Zagury has also served as an invited professor at Bosphorus University (Istanbul), Ghent University, and the University of Antwerp (Belgium), and he acts as a scientific advisor for Total Energies. His research focuses on human health risk assessment, speciation, and toxicity of metal(loid)s in contaminated soils, as well as passive treatment of mine drainage. He is also involved in developing in-vitro tests to assess oral, inhalation, and dermal bioaccessibility and bioavailability of metals and organic contaminants. Prof. Zagury has supervised more than 50 master's and PhD students, and he is the author of over 90 scientific papers in highly reputable journals. Additionally, he has given approximately 100 oral presentations at international conferences.