Establishing efficacy of honey as an urban biomonitor for heavy metal distribution

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Rapid urbanization, exploding human population, and climate change create urgent scientific and societal challenges that highlight the need for ongoing and adaptive environmental monitoring. Honey from *Apis mellifera* (Western honeybee) can serve as a biomonitor by elucidating small-scale pollutant distribution within a city[1] or regionally[2]. A pilot study in Metro Vancouver (BC, Canada) concluded that trace element concentrations and lead (Pb) isotopic compositions of honey reflect nearby land use and anthropogenic activities such as shipping ports and heavy traffic. Honey sampled from downtown hives, near the Port of Vancouver, shows elevated trace element concentrations compared with suburban and rural honey, and distinctly higher $^{208}Pb/^{206}Pb$ (i.e., less radiogenic) compared with local environmental proxies (e.g., oysters, Fraser River sediment and volcanic rocks), indicating possible input from Asian anthropogenic sources[1].

To strengthen the case for honey as a biomonitor of heavy metal distribution in urban settings, and to provide additional context, ongoing work now involves analysing other environmental proxies at various sampling scales. Locally, i.e. from Metro Vancouver, we are assessing pollen (as bee bread) topsoil, and PM_{10} air particulates while regionally we are sampling shellfish, BC herring, and Pacific salmon. Trace element concentrations and Pb isotopic compositions of these proxies will provide context and guide interpretation of honey results. Furthermore, we will assess the practicality of using Pb isotopic compositions of honey as input for city-scale Pb mixing and receptor models. We contend that biomonitors like honey may become essential tools in the very near future as the field of urban geochemistry expands to accommodate its ever-changing scientific requirements. Developing a framework for use of honey in this context is essential for applying the technique to other metropolitan centres.

[1] Smith et al. (2019) *Nat. Sustain* **2** 223-232
[2] Zhou et al. (2018) *Env. Sci. & Tech.* **52** 991-1001.