RE: Evaluating additive versus interactive effects of copper and cadmium on life history

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Sadeq and Beckerman (2020) conducted a risk assessment on the combined toxicity of copper (Cu) and cadmium (Cd) on *Daphnia pulex*. Both metals reduced ingestion rates, reduced reproduction, delayed maturation, reduced body size at maturity, and lowered somatic growth rate. Caution should be paid that there is an interaction between the metals, and the metal effects varied by *D. pulex* food levels and genotypes. As non-additive effect was observed by interactions, it is difficult to predict outcomes accurately. The authors used *Daphnia pulex* as an indicator of toxic effect. As there is another way to detect biological effect of the combined toxicity of Cu and Cd on plant, I present the information with special reference to non-additive effect of two metals on carrot.

An et al. (2020) examined the effects of mixtures of Cu and Cd on physiological measures and expression of growth-related genes in carrot under greenhouse cultivation. According to the mixtures of Cd and Cu at higher concentration, the malondialdehyde content increased significantly and the proline content did not change. Under the combined pollution of Cd and Cu, the level of damage in carrot via genetic and phenotypic changes increased non-linearly as Cd and Cu concentrations increased.

I previously reported the content of Cd and Cu in carrots (Lee et al. 1999; Kawada et al. 2002), and the content of copper in the soil did not correlate with the content of copper in the carrots. Regarding soil-plant discrepancy in copper, I speculated the reason as the low solubility of copper in the soil and the low intake into plant roots from the soil. Combination

of Cd and Cu absorption in carrot from soil and combined toxic effect on carrot were not considered in our research. An et al. (2020) presented information that Cd and Cu absorption into carrots was closely related to genetic and phenotypic changes in carrot. Although human health effect was observed after the accumulation of toxic metals into critical organs, the process of two metal accumulations into plants and foods was complex. When conducting risk assessment of combined metals on human health, metal flows from inorganic to organic substances should be paid attention to understand the profound knowledge of ecosystem.

Declarations

Ethical approval This article does not contain any studies with human participants or animals performed by the author.

Informed consent There is no need of informed consent in this study.

Conflict of interest The author declares no competing interests.

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