How do aquatic plants respond to combined effects of cadmium and low carbon dioxide?

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Ottelia alismoides. Credit: J.M.Garg / Wikimedia / GNU Free Documentation License

Cadmium (Cd), classified as a human carcinogen, is dispersed into aquatic ecosystems mainly through industrial processes or via the application of phosphate fertilizers. The high solubility of Cd in water facilitates its wide distribution in aquatic systems, and it can be readily taken up by aquatic plants and cause phytotoxicity.

For aquatic plants, carbon-shortage is another common problem. Nevertheless, the aquatic plants have evolved carbon dioxide -concentrating mechanisms (CCMs) to counter the problem of inorganic carbon limitation. Very few reports are available on the combined effects of Cd and low inorganic carbon stress in aquatic plants.

Ottelia alismoides is the only known species to perform three CO_2-concentrating mechanisms (CCMs): facultative Crassulacean acid metabolism (CAM), constitutive bicarbonate (HCO_3^-) use and C_4 photosynthesis.

The Aquatic Plant Biology Research Group led by Prof. Li Wei from the Wuhan Botanical Garden studied the combined effects of Cd and low inorganic carbon stress on CCMs in O. alismoides, and they discovered that O. alismoides exhibited an elevated Cd accumulation along with the increasing Cd concentration.

Cd treatment induced appreciable phytotoxicities in O. alismoides, including the damaged leave anatomy and chloroplast ultrastructure, as well as the reduced pigment biosynthesis and chlorophyll fluorescence.

The pH-drift technique showed that both Cd-treated O. alismoides plants could not uptake HCO_3^-. The diurnal change of acidity was absent, as well as the significant decrease in photosynthetic enzyme activity, indicating the disturbance within C_4 and CAM cycle.

The alterations in the functionality of CCMs in O. alismoides induced by Cd might be related with the inhibition of the enzymes involved in inorganic carbon fixation, and the destruction of chloroplasts, as well as the re-allocation of energy and nutrients involved in CCMs and Cd detoxification.

The results have been published in a paper in *Ecotoxicology and*

Environmental Safety, titled "Responses of CO_2-concentrating mechanisms and photosynthetic characteristics in aquatic plant Ottelia alismoides following cadmium stress under low CO_2."

More information: Wenmin Huang et al. Responses of CO_2-concentrating mechanisms and photosynthetic characteristics in aquatic plant Ottelia alismoides following cadmium stress under low CO_2, *Ecotoxicology and Environmental Safety* (2020). DOI: 10.1016/j.ecoenv.2020.110955

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