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Effects of several rare earth elements on the growth, photosynthetic pigments, ascorbate content, and lipid peroxidation level of *Lemna minor* L.

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Rare Earth elements (REE) have become essential in strategic sectors such as high- and green technologies. Their increasing use worldwide over the last decade has led to anthropogenic REE releases detectable in the environment, generating a global concern as they may pose a risk to soil and human health. Indeed, the greater availability of REEs for potential uptake by plants and consequent introduction into the food chain could influence the intake and metabolism of living organisms. Although some data reported that REEs might affect the germination, root and shoot development, as well as the function and nutritional quality of plants, little is known about the environmental behaviors of REEs. Therefore, further studies are needed to comprehend the REE's toxicological effects on both ecosystems and organisms. In this study, morphological and biochemical effects of seven REEs, such as cerium (Ce), neodymium (Nd), gadolinium (Gd), dysprosium (Dy), holmium (Ho), ytterbium (Yb), and lutetium (Lu) on *Lemna minor* L., commonly known as duckweed, have been investigated. This species, widely used as a model system of aquatic plants and ecotoxicological bioassays, was grown under standard procedures according to ISO 20079 (2004) and exposed to two different concentrations for each REE individually (0,1 and 1 mM). After 3, 7, and 12 days of treatment, the possible toxicological effects based on the growth rate and changes in morphology and in photosynthetic pigments, ascorbate and lipid peroxidation level were measured. The results showed that Ho, Lu, and Nd exerted the most toxic effect on the growth rate and morphology parameters, while Ce and Yb, at a lower concentration, did not show significant adverse effects. At low concentrations, REEs had no or slight effect on the chlorophyll and carotenoid contents, while at 1 mM, they caused a significant decrease in the pigments content generally at longer exposure times. Changes in ascorbate and lipid peroxidation also occurred. Because *L. minor* can absorb and accumulate heavy metals and other pollutants like REEs through the lower surface of the fronds and the roots, it is important to have further studies on its importance in the bioremediation of aquatic ecosystems.