

GADOLINIUM AND REPRODUCTIVE HEALTH IN NON-TARGET ORGANISMS: EVIDENCE FROM *MYTILUS GALLOPROVINCIALIS* SPECIES

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Gadolinium (Gd), a lanthanoid and rare earth element, due to its paramagnetic properties, is a versatile element, especially for medical applications like magnetic resonance imaging. Its high performances, combined with overexploitation, and limited removal efficiency of wastewater treatment plants (WWTPs) have led to increasing above geogenic background concentration, mainly in marine-coastal ecosystems, more directly in contact with human activities and WWTP effluents, with potential risks for resident non-target biota. The aim of this study was to assess the potential impact of GdCl₃ and Gd₂O₃ on the reproductive health of the Mediterranean mussel *Mytilus galloprovincialis*, following a 28-day chronic exposure. The temporal profile (T0, T7, T15, T28) of biological responses to 1 and 10 µg/L of both Gd forms was investigated in male and female gonads by a multi-biomarker approach. Histological analysis revealed a pronounced distribution of hemocytes throughout connective tissues, along with early spawning events in both sexes. An impair-

ment in energy reserve management, reflected by glycogen, essential for gametogenesis, was demonstrated by both dPAS/PAS histochemical and metabolomic analyses based on 1H NMR spectroscopy, and statistically confirmed by PCA and PLS-DA. The findings suggested a sex-specific modulation of metabolism, mainly affecting energy (lactate and mytilitol) and defense (histidine) pathways. Consistent with these results, qPCR analysis showed altered relative expression levels of the Vtg and VERL genes at T7 and T15, particularly in male gonads. Overall, the collected data strengthen the hypothesis of Gd interference with male and female mussels reproductive functions and, consequently, its impact on the survival of non-target species.

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