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Orientation: Integral Management of the Sea

Specialization Area: Environmental Analysis and Evaluation

Research Area: 3.6. Pollution and environmental impacts

PhD project: **Interaction between microplastics and copper: toxicity assessment in zebrafish (*Danio rerio*) and blackspot seabream (*Pagellus bogaraveo*)**

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Summary: Microplastics (MPs) have been recognized as ubiquitous in ecosystems worldwide and potentially toxic to aquatic organisms. MPs can easily adsorb and accumulate other waterborne pollutants, such as copper (Cu), which is a heavy metal of great concern. Thus, this THESIS aimed to assess the toxicological effects of MPs and Cu, alone or combined, in two fish species, the zebrafish (*Danio rerio*) and the blackspot seabream (*Pagellus bogaraveo*). Overall, the results demonstrated that MPs and Cu, alone or combined, decrease survival of early life stages, induce oxidative stress, cell damage, neurotoxicity and, consequently, disrupt the locomotor, avoidance and social behaviors in fish. However, these effects were dependent on several factors, including the development stage, the uptake route, the exposure duration, and species. In the acute exposure (96 h), these effects were mostly noticed in Cu and mixture (Cu+MPs) exposed groups, with MPs alone not producing significant effects. When exposed subchronically (14 days) or chronically (30 days), it was observed that MPs alone and Cu+MPs had a higher toxic effect on fish, highlighting that the toxicity of the plastic particles may arise after longer exposures. Besides, concerning the potential interaction between MPs and Cu, the overall outcome of this THESIS was that MPs modulated Cu toxicity. Taking into account the main results, it can be suggested that the excessive generation of ROS, followed by the induction of oxidative stress and/or the activation of apoptosis pathways, may potentially precede molecular and major signaling pathway changes, which in turn could lead to disruption of critical neurocircuits and changes in fish behavior. In general, the results have enhanced our knowledge regarding the effects of MPs and Cu in fish early life and adult stages, particularly at the neurological and behavioral levels.

