

OSMO-IONIC RESPONSES OF THE FRESHWATER SHRIMP *MACROBRACHIUM AMAZONICUM* IN RESPONSE TO POLYETHYLENE MICRO- AND NANOPLASTIC EXPOSURE.

Marco Aurelio Miranda Soares¹; Caroline Martins de Souza¹; Brian Pichardo-Casales²; Cléo Alcantara Costa Leite¹; Marisa Narciso Fernandes¹; Michelly Pereira Soares¹; Anieli Cristina Maraschi¹.

¹Laboratory of Zoophysiology and Comparative Biochemistry, Department of Physiological Sciences, Federal University of São Carlos. Washington Luís Highway, Km 235 – Monjolinho, São Carlos – SP, 13565-905, Brazil., ²Estación El Carmen, Instituto de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México, Carretera Carmen-Puerto Real km 9.5, 24157 Ciudad del Carmen, Mexico

INTRODUCTION: Driven by the discharge of urban and industrial effluents and the improper disposal of solid waste, the contamination of aquatic environments has been progressively increasing, with microplastics (MPs) and nanoplastics (NPs) emerging as significant pollutants of concern. MPs and NPs have been shown to cause morphological damage to gill tissues, potentially impairing respiratory and osmoregulatory functions.

OBJECTIVE: The objective of this study was to evaluate the MPs and NPs impact on osmoregulation of freshwater shrimps.

MATERIALS AND METHODS: Total hemolymph osmolality, ion concentrations, and Na⁺/K⁺-ATPase (NKA) immunoreactive area in the gills and antennal gland of *Macrobrachium amazonicum* was analyzed following 120-hour exposure to an environmental relevant concentration of polyethylene phosphorescent microspheres (55–63 µm) and polyethylene nanospheres (200–9900 nm), 1 mg. L⁻¹.

RESULTS AND DISCUSSION: Na⁺, K⁺, and total osmolality remained unaltered after the treatments. While Cl⁻ was elevated in MP group (25,14%; p < 0.05), Ca²⁺ was reduced in the NP group (47,07%; p < 0.05). The total NKA-immunoreactive area remained unchanged in gills but had a significant reduction in antennal gland in both MP and NP groups (MP = 61,06%, NP = 59,83%; p < 0.05). MPs and NPs can compromise cellular membranes and cause cytotoxic effects, potentially disrupting ion transport and changing the molting frequency. In freshwater decapods, Ca²⁺ is involved in cuticular calcification and is stored in the hemolymph; therefore, the reduction in Ca²⁺ levels may be associated with mobilization toward cuticular calcification during molting. Furthermore, the reduction in NKA activity in the antennal gland may be attributed to the physicochemical properties of MPs and NPs, such as their small size and large surface area, which may facilitate tissue penetration and cellular damage, thereby impairing

ATPase function. **CONCLUSION:** Overall, exposure to MPs and NPs induced osmoregulatory disturbances in *M. amazonicum*, potentially leading to ion imbalance, disruption of electrochemical gradients, and reduced ion uptake. After evidencing short-term exposing triggers relevant functional alterations, longer-term investigations are necessary to diagnose the impact of MPs and NPs on ionoregulation in freshwater crustaceans.

Keywords: Osmoregulation; Ionoregulation; Polyethylene Microplastics.

Funding: This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 88887.948263/2024-00