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EFFECTS OF POLYLACTIC ACID NANOPLASTICS ON RAT SPERM PARAMETERS

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Plastic pollution is increasingly recognized as a threat to male reproductive health. Recently, attention has been focused on microplastics (MPs, 5 mm-1 µm) and nanoplastics (NPs, <1 µm) that can be intentionally produced or originate from the degradation of larger plastic-waste. MNPs enter the food chain, bypass the biological barriers exerting reprotoxic effects. Considering the growing environmental exposure to plastic-derived materials, the use of biodegradable plastic polymers and strategies aimed at mitigating their possible reproductive impact are urgently needed. In this respect, although polylactic acid (PLA) is widely promoted as a biodegradable and safer alternative to conventional plastics, its potential biological effects on reproduction remain poorly characterized. In additon, Lemna minor (LM), an aquatic plant rich in proteins and antioxidant compounds, may represent a natural dietary intervention to mitigate the biological effects of MPs. In this respect, the present study aims to evaluate the effects of oral PLA exposure and LM dietary supplementation on male reproductive parameters. Male rats were treated from 42 postnatal day (PND) for three weeks and divided into four experimental groups: control (C), PLA (rhodamine B conjugated, administered in drinking water), LM (dietary supplementation), and PLA + LM. At the end of the experimental period, animals were sacrificed. Spermatozoa (SPZ) were collected from the epididymal head and tail and analyzed to evaluate concentration, viability, and motility. Furthermore, immunofluorescence (IF) analyses were performed to assess the internalization of PLA within SPZ in all groups. The expression and localization of prolyl endopeptidase (PREP), a protein involved in sperm function and cytoskeletal organization, were also evaluated, including co-localization analyses with PLA. Results showed that PLA exposure impaired all sperm parameters, including concentration, viability, and motility. Co-treatment with LM partially restored the parameters suggesting a protective effect mediated by its antioxidant properties. IF analyses revealed internalization of PLA within SPZ. Moreover, PREP expression was downregulated in the PLA group, whereas co-treatment with LM restored PREP levels, supporting its role in maintaining sperm function under stress conditions. These findings, although preliminary, indicate that PLA exposure adversely affects sperm quality and PREP localization in male rats, while dietary LM supplementation may exert a protective effect, highlighting its potential as a natural intervention against plastic-induced reproductive toxicity.

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