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Dietary supplementation with *Lemna minor* mitigates the metabolic alterations induced by ingestion of PLA nanoplastic in a rat model

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Poly(lactic acid) (PLA) has gained considerable industrial relevance, often considered an environmentally preferable material, but it can actually undergo fragmentation, generating micro- and nano-plastics (MPs/NPs), whose biological consequences are still insufficiently characterized. In the present study, we used an untargeted metabolomics approach to investigate the *in vivo* metabolic alterations associated with chronic oral exposure to PLA-NPs and to determine whether supplementation with *Lemna minor* (LM) could modulate the metabolic response to PLA-NPs. Wistar rats were randomly allocated to four experimental groups: untreated controls (CTR), oral PLA-NPs exposure (0.05 mg/ml in drinking water), dietary LM supplementation (20g/day), and combined PLA-NP and LM treatment. Fecal samples were collected at baseline (T0) and after 14 (T1) and 21 days (T2) of treatment and analyzed by liquid chromatography–mass spectrometry (LC–MS) using a high-resolution Orbitrap mass spectrometer. PLA-NPs exposure induced a broad metabolic rearrangement, mainly involving pathways related to bile acid homeostasis, energy regulation and microbial metabolism. Co-supplementation with LM partially counteracted the metabolic alterations induced by PLA-NPs. At T1, LM shifted bile acids, branched-chain fatty acids, and acylcarnitines toward CTR levels, suggesting modulation of bile acid homeostasis, microbial fermentation, and lipid utilization. At T2, partial normalization extended to metabolites involved in carbohydrate, lipid, and nucleotide metabolism. Although residual differences from untreated CTR persisted, these data support a partial rescue of the PLA-NP-associated metabolic phenotype. Collectively, our findings demonstrate that PLA-NPs can induce profound disturbances in metabolic homeostasis and provide a strong rationale for further investigating LM as a potential nutritional countermeasure.

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References

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