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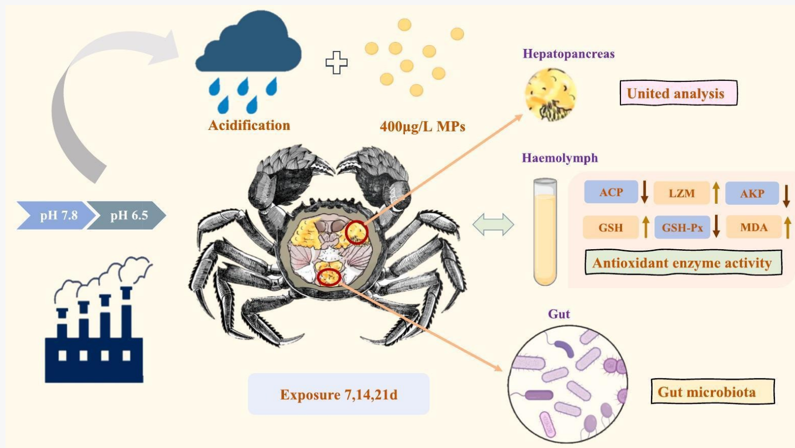
# Low pH aggravates toxicity of polystyrene microplastics in crab Eriocheir sinensis

GA, UNITED STATES, June 12, 2025 /EINPresswire.com/ -- Microplastics (MPs) and freshwater acidification jointly threaten aquatic ecosystems. This 21-day study on Eriocheir sinensis revealed synergistic toxicity: combined low pH (6.5) and MPs exacerbated oxidative stress and immune suppression, disrupted the TCA cycle and arginine biosynthesis, and altered gut microbiota function. While MPs alone affected pyrimidine metabolism, acidification amplified MPs' toxicity via immune-metabolic crosstalk. The findings underscore the need to evaluate multiple stressors under climate change, providing critical insights for aquatic risk assessment.



Physiological Responses Of E. Sinensis To Acidification-Microplastics Co-Exposure.

The concurrent intensification of global warming, population growth, economic development, and urbanization has led to rising plastic waste generation and worsening ocean acidification. Under these compounded environmental pressures, plastics undergo accelerated degradation through multiple mechanisms including seawater erosion, UV radiation, and microbial activity, generating vast quantities of microplastics (MPs) <5 mm in size. Simultaneously, rising atmospheric carbon dioxide ($CO_2$) concentrations enhance seawater dissolution, driving persistent pH decline.

“The global surface seawater pH has already decreased by 0.1 units since pre-industrial times, representing a 30% increase in acidity,” shares Zhigang Yang, lead author of a new study published in Environmental Chemistry and Ecotoxicology. “These dual stressors present unprecedented threats to aquatic ecosystems.”

Using Chinese mitten crab (Eriocheir sinensis) as a model organism, the research team employed a 21-day exposure experiment integrating enzyme activity assays, gut microbiota profiling, and hepatopancreas metabolomics to investigate individual and combined effects of low pH and polystyrene MPs.

The key findings include: (1) Combined low pH (6.5) and MPs exposure synergistically exacerbated oxidative damage and immune suppression; (2) While MPs alone primarily disrupted pyrimidine metabolism, co-exposure significantly impaired the TCA cycle and arginine biosynthesis while activating serotonin metabolism; (3) Gut microbiota maintained α-diversity but showed substantial COG functional alterations.

“Our results demonstrate how freshwater acidification amplifies MPs toxicity in crustaceans through immune-metabolic crosstalk,” says Yang. “They provide novel mechanistic perspectives for ecological risk assessment of multiple environmental stressors under climate change scenarios.”

The researchers encourage future research to incorporate more environmentally relevant MPs such as rubber and fibers to further enhance ecological relevance.

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