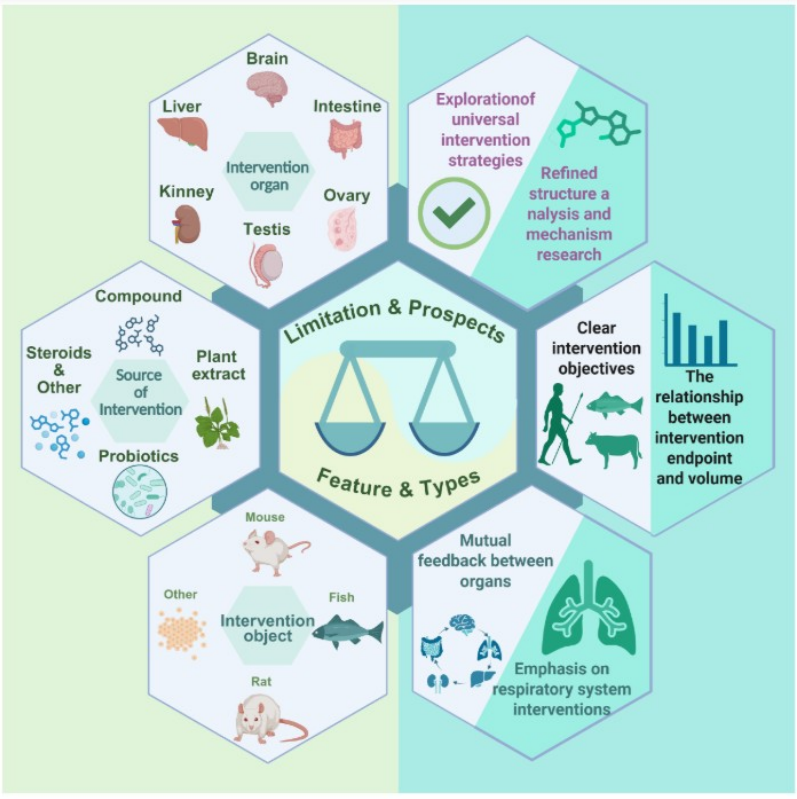
Can biology fight back? Emerging strategies to protect animals from microplastic damage

GA, UNITED STATES, March 2, 2026 /EINPresswire.com/ -- Microplastics and nanoplastics are increasingly recognized as pervasive environmental contaminants that accumulate in animals through food chains, posing risks to multiple organs. While growing evidence has documented their toxic effects, far less attention has been paid to how this damage might be mitigated. This systematic review synthesizes current research on biological and chemical interventions designed to alleviate organ injury caused by micro- and nanoplastic exposure in animals. By examining a wide range of experimental models, the study evaluates emerging strategies—including natural compounds, probiotics, and pharmaceutical agents—that target inflammation, oxidative stress, metabolic disruption, and cell death. The findings highlight both promising protective effects and critical gaps that must be addressed before effective interventions can be translated into broader health and environmental solutions.



Intervention Strategies and Research Gaps in Micro- and Nanoplastic-Induced Organ Injury.

The rapid expansion of plastic production, combined with inadequate waste management, has resulted in the widespread presence of microplastics and nanoplastics in terrestrial, freshwater, and marine ecosystems. These particles can enter animal bodies through ingestion, inhalation, or contact and subsequently accumulate in organs such as the liver, intestine, brain, and reproductive tissues. Previous studies have linked such accumulation to inflammation, oxidative stress, immune dysfunction, and metabolic disorders. However, most research has focused on detecting exposure and describing toxicity, rather than exploring ways to reduce harm once exposure has occurred. Based on these challenges, it is necessary to conduct in-depth research

on effective interventions that can mitigate micro- and nanoplastic-induced organ damage.

In a review published (DOI 10.1007/s11783-026-2102-3) online on January 5, 2026, in Engineering Environment, researchers from Guizhou Normal University and collaborating institutions systematically assessed current intervention strategies aimed at reducing organ injury caused by micro- and nanoplastic exposure. By analyzing experimental studies from the past five years, the team categorized intervention approaches according to target organs, biological mechanisms, and treatment types. Their work provides a comprehensive overview of how antioxidants, probiotics, natural products, and pharmaceuticals may counteract plastic-induced toxicity, while also identifying major knowledge gaps that hinder the development of effective and universal protective strategies.

The review evaluated 48 experimental studies involving animals such as fish, rodents, and cellular models, focusing on organ-specific damage caused by micro- and nanoplastics. The liver and intestine emerged as the most frequently studied targets, reflecting their central roles in metabolism and exposure pathways. Across these organs, plastic particles were shown to disrupt biochemical indicators, damage tissue structure, and activate inflammatory and oxidative stress pathways.

Several intervention strategies demonstrated protective effects. Natural compounds—including flavonoids, polyphenols, and plant-derived extracts—were repeatedly found to reduce oxidative stress by activating antioxidant defense systems and suppressing inflammatory signaling. Probiotics showed promise in restoring gut barrier integrity and rebalancing intestinal microbiota, thereby limiting downstream organ damage through the gut–liver axis. Certain pharmaceuticals and micronutrients were also reported to modulate lipid metabolism, reduce cell death, and attenuate immune responses triggered by plastic exposure.

Despite these advances, the review highlights clear limitations. Most interventions remain at an early experimental stage, with inconsistent dosing strategies and limited mechanistic understanding. Research on respiratory and female reproductive systems is notably scarce, and few studies examine interactions between multiple organs. These findings underscore the need for more integrated and mechanism-driven approaches to intervention research.

“Current research shows that microplastics do not cause isolated damage but trigger complex, multi-organ responses,” the authors note. “Intervention strategies that target oxidative stress, inflammation, and metabolic imbalance offer encouraging results, yet they remain fragmented.” They emphasize that future work should move beyond single-organ models and explore how interventions influence systemic interactions, dosage safety, and long-term outcomes. According to the researchers, establishing standardized evaluation frameworks will be essential for transforming experimental interventions into practical tools for protecting animal health in polluted environments.

The findings have important implications for environmental health, food safety, and ecological

risk management. By identifying candidate interventions that can reduce organ damage in exposed animals, the review provides a foundation for developing protective strategies in aquaculture, livestock production, and wildlife conservation. Such approaches could help limit the transfer of plastic-associated toxicity through food chains, ultimately reducing risks to human health. More broadly, the study shifts the research focus from merely documenting microplastic harm to actively exploring mitigation solutions. As plastic pollution continues to intensify worldwide, intervention-oriented research may become a critical component of integrated strategies to manage its long-term biological and ecological impacts.

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