

Deltamethrin impairs fish immunity through the brain-thyroid-immune axis

GA, UNITED STATES, October 21, 2026 /EINPresswire.com/ -- [Deltamethrin](#) disrupts gut bacteria and brain clock signaling, impairing antibacterial immunity in Nile tilapia through the brain–thyroid–immune axis. Dietary sodium butyrate alleviates this immune damage.

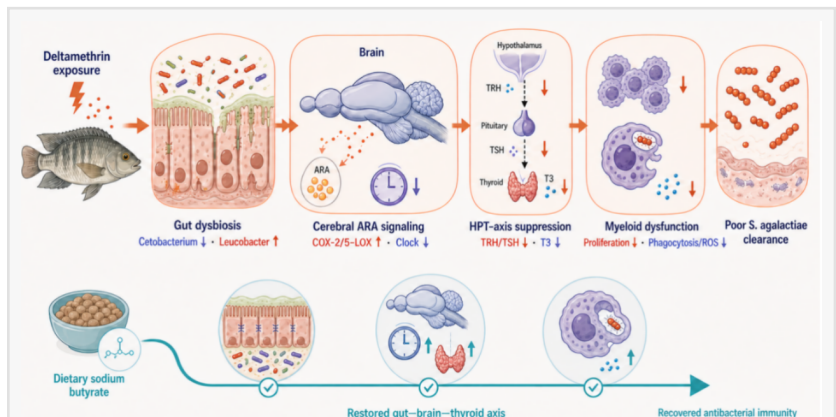
Deltamethrin is used in agriculture and public health and can enter waterways through runoff. Its effects on fish are often assessed through tissue damage or death. A new study(doi:

<https://doi.org/10.1016/j.enceco.2026.09.004>) in Environmental Chemistry and

Ecotoxicology examined another concern: whether prolonged exposure undermines the immune cells that help fish fight infection. Fish receiving dietary sodium butyrate showed improved immune-cell proliferation and bacterial engulfment, reduced intestinal inflammation and lower liver bacterial loads. Thyroid-related gene expression also partially recovered. The results provide an experimental basis for exploring nutritional approaches to reduce pesticide-related immune damage.

The team first exposed Nile tilapia to deltamethrin and tested their response to the bacterial pathogen *Streptococcus agalactiae*. After 28 days of exposure at 1 microgram per liter, myeloid cells, frontline defenders that engulf bacteria, responded less effectively to infection. The fish also carried higher bacterial loads in their livers.

“Exposure changed the gut bacterial community, reducing *Cetobacterium* and increasing *Leucobacter*,” says corresponding author Ye Chen, from. Zhejiang University. “To test whether these changes contributed to immune damage, we transferred gut bacteria from exposed donors into recipient fish. The recipients developed similar defects in immune-cell function and bacterial clearance.”



HOW DELTAMETHRIN DISRUPTS THE GUT–BRAIN–THYROID AXIS AND WEAKENS FISH IMMUNITY, AND HOW DIETARY SODIUM BUTYRATE ALLEVIATES THESE EFFECTS.

Further, brain analyses revealed reduced expression of clocka, a core biological-clock gene. "Blocking Clock function with the compound CLK8 also weakened antibacterial defenses and reduced thyroid-related hormone signals," says Chen. "These experiments support a connection between gut microbial imbalance, brain clock signaling and immune function."

"Our findings suggest that pesticide-related immune damage involves communication between organs, extending beyond injury to individual tissues," says first author Yi Cao. "This offers a new perspective on how prolonged exposure can affect resistance to infection."

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Lucy Wang

BioDesign Research

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