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Anti-inflammatory benefits from gut bacteria found in fish and humans

Researchers at the Centenary Institute have found that sensitivity of the immune system to ‘good’ gut bacteria is present in zebrafish, proving that the ability of an animal to benefit from good gut bugs is evolutionarily conserved whether you walk or swim.

The study, published in the science journal ‘Gut Microbes’, was an international effort led by Centenary Institute researchers with collaborators from the Duke University School of Medicine, USA and Macquarie University, Sydney.

Using transparent zebrafish embryos, the researchers found that zebrafish inflammatory immune cells are calmed by the addition of butyrate. Butyrate is an important ‘short chain fatty acid’ molecule that is produced when good bacteria ferment dietary fibre in the gut—it’s widely touted as a treatment for a range of inflammatory diseases in humans.

“We found that butyrate treatment on zebrafish reduced inflammatory markers on important immune cells called macrophages (a type of white blood cell) that are the generals of the immune system and that help fight inflammatory diseases,” said Dr Pradeep Cholan, lead author of the study and research officer in the Immune-Vascular Interactions Laboratory in the Centenary Institute’s Tuberculosis Research Program.

“From an evolutionary perspective, the fact that zebrafish neutrophils (another type of white blood cell) use the same receptor as human neutrophils to ‘sense’ butyrate and activate anti-inflammatory benefits, is yet another example of co-evolution between animals and their gut bacteria for mutual benefit,” said senior author of the study Dr Stefan Oehlers, Head of the Centenary Institute Immune-Vascular Interactions Laboratory and also affiliated with the Discipline of Immunology and Infectious Diseases at the University of Sydney.

This study underpins a wider body of research at the Centenary Institute using transparent zebrafish embryos to analyse the interactions between animals and their gut bacteria during inflammatory disease states.

“We have been excellent at using zebrafish to find ‘bad’ bacteria that cause or worsen diseases in people, but here we show that these tiny fish could contribute to the finding of ‘good’ bugs or prebiotics that act like a natural ibuprofen,” said Dr Oehlers.

The research was funded by the NHMRC, the NSW Health Early-Mid Career Fellowships Scheme and the University of Sydney.

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Publication:

Conserved anti-inflammatory effects and sensing of butyrate in zebrafish.

<https://doi.org/10.1080/19490976.2020.1824563>

Images:

Live imaging of green inflammatory macrophages and red anti-inflammatory macrophages responding to a wound.

https://drive.google.com/file/d/18br6W94HNRiQXccGiyZ_WBPPa9dXxp50/view?usp=sharing

Video:

Red neutrophils responding to a skin wound in a zebrafish embryo.

https://drive.google.com/file/d/1e38Ngr8LEU6D_Qj6Rk8xEc-tPLoFtQD1/view?usp=sharing

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About the Centenary Institute

The Centenary Institute is a world-leading independent medical research institute, closely affiliated to the University of Sydney and the Royal Prince Alfred Hospital. Our research focuses on three key areas: cancer, inflammation and cardiovascular disease. Our strength lies in uncovering disease mechanisms and applying this knowledge to improve diagnostics and treatments for patients.

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