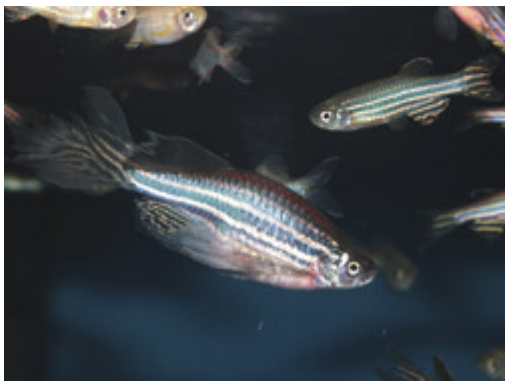
The zebrafish as a new vertebrate model for molecular and cellular mechanisms of learning and memory, including synaptic dysfunction in Alzheimer's disease

Results in Brief

Learning and memory in zebrafish

A European study used zebrafish as a model organism to study the key processes of learning and memory. Apart from providing invaluable knowledge on the pathophysiology of Alzheimer's disease (AD) this model could be further exploited for drug design.

CLIMATE CHANGE AND ENVIRONMENT



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A considerable number of neurological disorders including AD, multiple sclerosis and Parkinson's disease manifest with learning disabilities and memory loss. However, we do not fully comprehend the molecular and cellular mechanisms of memory and learning.

Scientists on the EU-funded LEARNING AND MEMORY project proposed that for such investigations we need a suitable model organism. In this context, they used zebrafish (Danio rerio), a powerful model organism which combines genetic manipulations and behavioural memory testing. Using this model, they performed molecular and cellular analysis of the processes underlying learning and memory.

They focused on the learning of the startle response and localised the synaptic changes in the network underlying this particular behaviour. In parallel, they investigated memory deficiencies induced by AD-associated proteins, such as amyloid beta. To this end, they injected amyloid beta into the larval zebrafish and were able to show that learning is indeed blocked by amyloid beta. Similar results were obtained with the amyloid precursor protein (APP), which was seen to regulate zebrafish axonal outgrowth, synaptic formation and the startle response. Treatment with the commonly used AD medications showed an overall protection against memory impairments.

From a clinical perspective, the LEARNING AND MEMORY study used patient samples to identify gene variants and their association with disease development. Single nucleotide polymorphism analysis of the ARC gene in AD patients' unravelled one gene variant which reduced the risk of AD development.Project members demonstrated the potential of using zebrafish as a model organism to study basic learning and memory processes in both health and disease. This also opened up new avenues for utilising zebrafish as a future drug discovery tool.

Keywords

Zebrafish | learning | memory | Alzheimer's disease | amyloid beta | single nucleotide polymorphism | ARC gene | drug discovery

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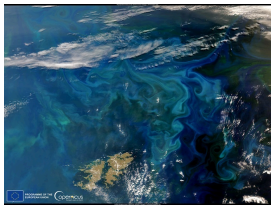

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