Can environmental enrichment improve the welfare of laboratory zebrafish?

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Fish welfare

Fish welfare is an area of increasing public and regulatory concern. In the UK, researchers share a legal and moral obligation to consider the welfare of laboratory fish. The University of Exeter promotes the principles of the "3Rs"—the refinement, reduction and replacement of animals in research—and is committed to achieving the highest possible standards of animal care and welfare.

The zebrafish

The zebrafish (*Danio rerio*) is a popular model organism for scientific research in a variety of fields.

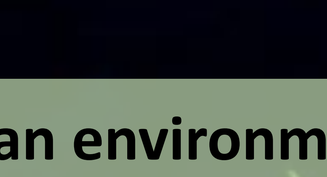

Figure 1. The zebrafish, *Danio rerio*.

Zebrafish are native to the Indian subcontinent where they are typically found in vegetated areas of static or slow moving waters. In contrast, laboratory fish are usually kept in bare aquaria in order to reduce variability between experimental groups. Although the zebrafish is a well-studied species, little is known about the effects of laboratory housing on its wellbeing. This study will investigate whether environmental enrichment can improve the welfare of laboratory-maintained zebrafish.

Aims

1. Evaluate the use of environmental enrichment to improve the welfare of laboratory zebrafish.
2. Investigate the environmental preference of zebrafish.

Research questions

1. Can environmental enrichment improve zebrafish health?
2. Will environmental enrichment give fish something that they want?

Proposed methods

Colonies of zebrafish are being raised in plain tanks and in tanks 'enriched' with gravel and plants. Standard tank sizes and stocking densities are being used to reflect the reality of the laboratory environment. Measurements of health, physiology and behaviour will be compared between treatments.

Survival rate

The percentage of fish surviving in each treatment will be determined at 30-, 60- and 90-days post fertilisation (dpf).

Body length, weight, condition and growth rate

Fish will be measured and weighed. Body condition (length as a percentage of mass) and growth rate will be calculated.

Sex ratio

When the fish reach sexual maturity at around 90 dpf, the ratio of females to males in each treatment will be determined as the sexual phenotype can be affected by environmental factors as well as genetic factors.

Brain size

The telencephalon and optic tectum brain regions will be measured. (These areas of the brain are of interest because of their environment-relevant functions—the telencephalon is involved in spatial memory and the optic tectum in visual processing.)

Response to stress

To compare the responsiveness of the fish to stress, ventilation rate and behaviour in a novel environment will be assessed.

Environmental preference

Fish will be given a simple choice test. Time spent in enriched versus barren areas of a divided tank will be compared.

Figure 2. A tank divided into two compartments for assessment of environmental preference.

Preliminary results

In the study to date we have shown a difference in survival rate between the larvae raised in enriched tanks (83% survived to 30 dpf) and larvae raised in plain tanks (54% survived to 30 dpf) (p = <0.001, Fisher's exact test, n = 300 per treatment).

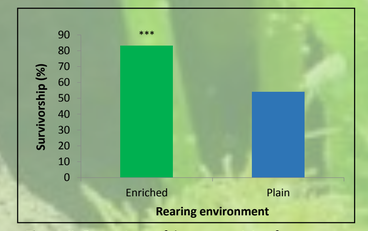

Figure 3. Percentage of larvae surviving from age 0–30 dpf in enriched and plain tanks.

Discussion

This study is ongoing, and most endpoints have yet to be measured. Initial findings, however, suggest that environmental enrichment could improve the welfare of laboratory zebrafish by increasing survivorship of larval fish. We expect these data to help advance understanding on what environmental conditions improve housing conditions for fish in laboratories and reduce stress. Reducing stress in laboratory fish is likely to improve the validity and repeatability of research data and so reduce the number of fish required in any one experiment.

Implications for human wellbeing

Building our knowledge of this model fish species is likely to have repercussions for other animals, including humans. Evidence that the environment in which an individual lives affects wellbeing could support the evaluation of enrichment for preventing human behavioural disorders and may assist our understanding of such problems.

Further information

For a pdf of this poster and citations from the literature, contact Carole Lee at cjl219@exeter.ac.uk.

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