Potential environmental enrichment for zebrafish used in regulatory toxicology

Submitted by

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I certify that all material in this thesis which is not my own work has been identified and that no material has previously been submitted and approved for the award of a degree by this or any other University.

.....(Luanne Wilkes)

ABSTRACT

The aim of environmental enrichment is to alter the environment of a captive animal in a way that results in improved mental and physical welfare. The technique has been utilised effectively for many years for captive mammals in a variety of settings. However, until now it has never been considered as a way of improving the welfare of aquatic animals such as fish.

Fish that are used in regulatory toxicology studies are at present maintained solely in barren tank environments. Little is known about how these types of environments affect the well-being of the animals residing there and whether they impact either physiological heath or behavioural repertoire. This thesis aims to address this gap in the knowledge regarding the potential for environmental enrichment to improve the welfare of fish used in regulatory toxicology. More specifically it looks at two types of enrichment and the effects of these on the commonly used model species, the zebrafish (*Danio rerio*).

The first type of enrichment studied was glass rod structures of varying heights provided to increase tank complexity and provide refuge. The glass structures did not produce any quantifiable benefits in unstressed fish and appeared to delay the formation of stable social hierarchies. When fish were stressed by a period of chasing, the presence of the glass rods appeared to reduce the magnitude of the cortisol response. Whilst this could be viewed as a potential benefit, it was felt that it would not outweigh the costs of this type of enrichment.

The second type of enrichment studied was provision of airstones. Again, no clear evidence was found that fish in tanks with airstones experienced an improvement in welfare. The main observation was the vast increase in mortality in tanks containing these airstones, in particular, those of a smaller size. Regardless of the physiological cause underlying this result, this can only be viewed as a negative consequence and one that appears to rule out airstones as an effective form of enrichment for this species and strain of fish.

It was also observed that both stress and the presence of enrichment influenced the absolute deviation from the mean in several endpoints. Since changes in endpoint variation will have effects both on the number of animals required to statistically measure environmentally relevant effects this is a factor that should be considered when researching methods of environmental enrichment.

Finally, results from these studies suggest the possibility that laboratory zebrafish do not require the addition of environmental enrichment to tanks in order to promote maximum welfare. Furthermore, as considerable costs would be involved in implementing many types of enrichment (relating to manufacture, cleaning, incompatibility of results with previous studies etc.) it is likely that observed benefits would have to be both substantial and well established in order for changes in regulatory guidelines to take place. For a species such as zebrafish that are extremely easy to breed and maintain in the laboratory with minimal amounts of disease, social problems or mortalities, it may be that current conditions are satisfactory.

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