Potential environmental enrichment for zebrafish used in regulatory toxicology

Submitted by

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..................................................................................(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 health 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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CHAPTER 1 – GENERAL INTRODUCTION

1.1 ANIMAL WELFARE

1.1.1 Defining welfare
1.1.2 Philosophy and ethics of animal welfare
1.1.3 Why are welfare studies needed?
1.1.4 The history of animal welfare
1.1.5 Which animals should be protected?
1.1.6 How should welfare be measured?

1.2 FISH WELFARE

1.2.1 Scientific basis for its necessity
1.2.2 Sentience in fish
1.2.3 How can fish welfare be compromised?
1.2.4 Current standards in fish welfare

1.3 INDICATORS OF WELFARE IN FISH

1.3.1 Physiological indicators
1.3.2 Behavioural indicators

1.4 ENVIRONMENTAL ENRICHMENT

1.4.1 Introduction to environmental enrichment
1.4.2 Enrichment in the laboratory
1.5 **REGULATORY TOXICOLOGY** 62

1.5.1 Enrichment for fish used in regulatory toxicology 63

1.6 **THE MODEL SPECIES - ZEBRAFISH (Danio rerio)** 66

1.6.1 Background and life history 66
1.6.2 Use of zebrafish in the laboratory 67

1.7 **AIMS OF THE STUDY** 68

### CHAPTER 2 – GENERAL MATERIALS AND METHODS 71

2.1 **SOURCE AND MAINTENANCE OF ZEBRAFISH** 73

2.2 **EXPERIMENTAL STUDIES WITH ZEBRAFISH** 73

2.2.1 Responses of zebrafish to a structured environment 73
2.2.1.1 Behavioural and physiological responses of juvenile zebrafish to a structured environment 74
2.2.1.2 Behavioural responses of adult zebrafish to a structured environment 78
2.2.2 Effects of tank structures on acute and chronic stress responses of zebrafish 78
2.2.3 Behavioural and physiological responses of zebrafish to airstones 80

2.3 **BEHAVIOURAL MEASUREMENTS** 81

2.3.1 Activity level 83
2.3.2 Shoaling density 83
2.3.3 Aggression 84
2.3.4 Percentage time spent in bottom third of the tank 84
2.3.5 Proximity to tank structures/air stones 85

2.4 **PHYSIOLOGICAL MEASUREMENTS** 86

2.4.1 Whole-body cortisol 84
2.4.2 Quantification of gene expression in zebrafish brain and liver relating to stress 85
2.4.2.1 RNA extraction 87
2.4.2.2 cDNA synthesis 88
2.4.2.3 Quantitative PCR 88
CHAPTER 8
Potential environmental enrichment for zebrafish used in regulatory toxicology

2.5 STATISTICAL ANALYSIS 90

CHAPTER 3 – BEHAVIOURAL AND PHYSIOLOGICAL RESPONSES OF ZEBRAFISH TO A STRUCTURED ENVIRONMENT 93

3.1 INTRODUCTION 95

3.2 MATERIALS AND METHODS 101

3.3 RESULTS 103

3.3.1 Behavioural responses to tank structures and observation day 103
3.3.1.1 Juveniles 103
3.3.1.2 Adults 105
3.3.1.3 Comparison of juvenile and adult behavioural results 106
3.3.2 Whole-body cortisol content 107

3.4 DISCUSSION 116

3.5 SUMMARY 129

CHAPTER 4 – EFFECTS OF TANK STRUCTURES ON THE ACUTE AND CHRONIC STRESS RESPONSE OF ADULT ZEBRAFISH 132

4.1 INTRODUCTION 133

4.2 MATERIALS AND METHODS 140

4.3 RESULTS 142

4.3.1 Behavioural responses to tank structures and chasing stress 142
4.3.2 Whole-body cortisol content 145
4.3.3 Glucocorticoid Receptor expression 145

4.4 DISCUSSION 153

4.5 SUMMARY 167
CHAPTER 5 – BEHAVIOURAL AND PHYSIOLOGICAL RESPONSES OF ZEBRAFISH TO AIR STONES

5.1 INTRODUCTION

5.2 MATERIALS AND METHODS

5.3 RESULTS

5.3.1 Behavioural responses to airstones
5.3.2 Glucocorticoid Receptor and PEPCK expression
5.3.3 Mortality
5.3.4 Dissolved oxygen content

5.4 DISCUSSION

5.5 SUMMARY

CHAPTER 6 – GENERAL DISCUSSION

6.1 OVERVIEW OF FINDINGS

6.2 SHORTFALLS AND LIMITATIONS

6.3 KEY ISSUES AND RECOMMENDATIONS FOR FUTURE WORK

CHAPTER 7 – REFERENCES

CHAPTER 8 – APPENDIX