Pain and welfare in rainbow trout

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Introduction

The welfare of fish has been the focus of less research than that of higher vertebrates such as birds and mammals (Braithwaite & Huntingford, 2004). Aquaculture supplies fish for human consumption and use in scientific research. Without appropriate guidelines, the welfare of fish in this expanding industry could be overlooked at various stages including handling, transport and slaughter. This essay will discuss three recently published studies conducted on rainbow trout (Oncorhynchus mykiss): two in relation to pain perception, the third concerning the reduction of handling stress.

Discussion

The first study had two aims: (1) to determine the presence of nociceptors in the trigeminal system of the head of rainbow trout and (2) to examine the behavioural responses of rainbow trout to the application of potentially noxious stimuli (Sneddon et al., 2003). Each aim was investigated independently. The first experiment involved recording neural activity from single cell bodies in the trigeminal ganglion following the application of various stimuli. Three potentially damaging or noxious stimuli were applied, namely mechanical pressure, heat, and acetic acid. From the electrophysiological recordings, the authors located 22 nociceptors in the head of the rainbow trout. Eighteen of these responded to mechanical, thermal and chemical stimuli and thus were classed as polymodal nociceptors; the other four responded to mechanical and thermal stimulation and were classed as mechanothermal receptors. The authors concluded that rainbow trout possess the neural apparatus to detect noxious stimuli and that they are therefore capable of nociception.

The second experiment reported (Sneddon et al., 2003) involved the injection of various substances into the lips of trout, where the nociceptors were detected. Rainbow trout (n=20) were trained to respond to a light cue by swimming to a feeding ring to receive food. This training was utilised after treatment and allowed recording of the time taken to resume feeding for each treatment group. The trout were assigned to one of four treatment groups: (1) saline injection, (2) bee venom injection, (3) acetic acid injection and (4) handling only. The trout were anaesthetised and then injected with the appropriate substance or simply handled. Upon recovery from anaesthesia, behaviour and opercular (gill) beat rate were recorded. The light cue was switched on and food delivered to the tank; the cue was presented several times until all trout resumed feeding. Venom-injected trout and acid-injected trout had significantly higher opercular rates and took significantly longer to resume feeding compared to the saline and control groups. They were also observed rocking on their pectoral fins on the gravel floor for 1.5 hours after treatment. The acid-injected trout were also observed rubbing their lips on the gravel and tank walls.

A separate paper (Sneddon, 2003) extended the second experiment described above, with identical procedures but different treatment groups. The groups are: (1) saline injection, (2) acetic acid injection, (3) acetic acid-plus-morphine injection, (4) morphine injection, and (5) handling only (n=5). Acid-injected trout had a significantly greater increase in opercular rate and took significantly longer to resume feeding than all other groups. Both acid-injected trout and acid-plus-morphine-injected trout rubbed their lips against the gravel and tank walls and showed the rocking behaviour previously described. However, the acid-plus-morphine-injected trout performed both these behaviours significantly less frequently than the acid-injected trout. Assuming that the rocking and lip-rubbing behaviours are signs of pain, Sneddon (2003) concludes that morphine could be used as an analgesic in rainbow trout. The results of these studies indicate that rainbow trout have the neuroanatomy to detect potentially noxious stimuli and that the application of such stimuli appears to elicit a behavioural response. The increased time to resume feeding and the rocking and lip-rubbing behaviours described in both papers were interpreted as potential indicators of pain. The authors propose that such behaviours are complex and therefore may not be a simple reflex to the stimuli (Sneddon et al., 2003; Sneddon, 2003).

The third study aimed to compare the physiological effects of the two anaesthetics clove oil and tricaine methanesulphonate (MS-222) in stressed adult rainbow trout (Wagner et al., 2003). The initial stressor was a caudal puncture to sample blood. Trout were then placed in an anaesthetic bath containing either clove oil or MS-222 until full anaesthesia was reached; at this point the trout exhibited a partial loss of muscle tone and were responsive only to strong tactile or vibrational stimuli (Keene et al, 1998). After anaesthesia, the trout were transferred to a bath containing oxygenated water until full recovery. In addition to the initial caudal puncture, which served as the baseline sample, blood samples from each group were taken at full anaesthesia, full recovery, and at 1, 4, 24, and 48 hours post-anaesthetic exposure. Blood was analysed for glucose, lactate, haematocrit and plasma cortisol and, overall, returned similar results for clove oil and MS-222. Wagner et al. (2003) suggest that clove oil be used as an alternative to MS-222 to reduce short-term handling stress in trout. This is based on the result that 1 hour after exposure to MS-222, the cortisol levels in the trout were significantly elevated from the baseline reading, while the increase was not significant in trout exposed to clove oil. Trout exposed to clove oil took significantly less time to reach full-anaesthesia and significantly more time to recover than trout exposed to MS-222. Due to the longer recovery time, it is possible that clove oil may not be a practical alternative for use in research under time constraints (Keene et al., 1998).

Conclusion

The three reviewed papers studied rainbow trout and therefore the application of the results to fish in general is difficult. Future research should be conducted with a wider range of fish species. Different parts of the fish's body could also be tested for nociception using a variety of noxious stimuli. The responses of juvenile trout to clove oil and MS-222 should be considered in future research. The research reviewed does not demonstrate that fish have a conscious awareness of pain.

Research suggesting that fish are capable of feeling pain highlights the potential for the welfare of these animals to be undermined in husbandry situations and questions the appropriateness of present guidelines regarding the humane treatment of fish. In light of such evidence the Canadian Council on Animal Care are currently revising their guidelines for the care and use of fish in research facilities (Griffin & Gauthier, 2004).

References

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