

# The impacts of neutralized acid mine drainage contaminated water on the expression of selected endocrine-linked genes in juvenile Mozambique tilapia *Oreochromis mossambicus* exposed in vivo

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## Abstract

Acid mine drainage (AMD) is a global environmental concern due to detrimental impacts on river ecosystems. Little is however known regarding the biological impacts of neutralized AMD on aquatic vertebrates despite excessive discharge into watercourses. The aim of this investigation was to evaluate the endocrine modulatory potential of neutralized AMD, using molecular biomarkers in the teleost fish *Oreochromis mossambicus* in exposure studies. Surface water was collected from six locations downstream of a high density sludge (HDS) AMD treatment plant and a reference site unimpacted by AMD. The concentrations of 28 elements, including 22 metals, were quantified in the exposure water in order to identify potential links to altered gene expression. Relatively high concentrations of manganese (~ 10 mg/l), nickel (~ 0.1 mg/l) and cobalt (~ 0.03 mg/l) were detected downstream of the HDS plant. The expression of thyroid receptor- $\alpha$  ( $tr\alpha$ ),  $tr\beta$ , androgen receptor-1 ( $ar1$ ),  $ar2$ , glucocorticoid receptor-1 ( $gr1$ ),  $gr2$ , mineralocorticoid receptor ( $mr$ ) and aromatase ( $cyp19a1b$ ) was quantified in juvenile fish after 48 h exposure. Slight but significant changes were observed in the expression of  $gr1$  and  $mr$  in fish exposed to water collected directly downstream of the HDS plant, consisting of approximately 95 percent neutralized AMD. The most pronounced alterations in gene expression (i.e.  $tr\alpha$ ,  $tr\beta$ ,  $gr1$ ,  $gr2$ ,  $ar1$  and  $mr$ ) was associated with water collected further downstream at a location with no other apparent contamination vectors apart from the neutralized AMD. The altered gene expression associated with the “downstream” locality coincided with higher concentrations of certain metals relative to the locality adjacent to the HDS plant which may indicate a causative link. The current study provides evidence of endocrine disruptive activity associated with neutralized AMD contamination in regard to alterations in the expression of key genes linked to the thyroid, interrenal and gonadal endocrine axes of a teleost fish species.