

## **Toxicological effects and behavioural and biochemical responses of *Oreochromis mossambicus* gills and its cholinesterase to copper: a biomarker application**

### **ABSTRACT**

Gills are both morphologically and physiologically complex whereby they perform several functions such as gas exchange, ion and water exchange, acid base balance, nitrogenous waste excretion, and other metabolic transformations. They are one of the first fish organs to be exposed to heavy metals in the aquatic environment. The exposure of *Oreochromis mossambicus* to copper showed deleterious effects to normal fish behaviours and varying degrees of gill damage when visualized under inverted light microscopy (stained with haematoxylin–eosin), scanning electron microscopy, and transmission electron microscopy. Abnormalities of the nucleus shape, swollen cells, lipid droplet deposition, and an increase in vacuolation on the affected gills were observed with the degree of damage associated with CuSO<sub>4</sub> exposure concentration. CuSO<sub>4</sub> exposure in *O. mossambicus* also gave various patterns of inhibitory effects on cholinesterase (ChE) depending on the concentration of exposure and the organs exposed. Copper exposure altered ChE activity extracted from the gills of *O. mossambicus* with 99.9% of inhibition at the highest exposure concentration of CuSO<sub>4</sub> (20 mg/L). Hence, this study suggests the potential of this fish to become a sentinel species that permits the detection of lower copper contamination levels.