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EXTENDED ABSTRACT

Effect of copper sulphate in the behavior of Mozambique tilapia under different temperatures

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The future effects of climate change are an important concern for the majority of researchers and politicians, with enormous potential impacts for humans but also for the majority of wildlife all around the world (DellaSala, 2018), affecting also aquatic organisms Marine and riverine ichthyofauna can be affected through the alteration of water physicochemical characteristics, habitat and food web alterations, inducing changes in behaviour, growth, development and reproduction (Bong et al., 2017). There is evidence that metabolic rate increases more rapidly than food ingestion rates due to warming (Manciocco et al., 2014). On the other hand, warming temperature may rise toxicity of xenobiotics, like copper sulphate, which is a versatile chemical extensively used in industry, agriculture and, most importantly, fish farming (Ashish et al., 2013). Its toxicity can be changed by factors such as temperature and low level of dissolved oxygen, being these a major concern, inducing thermal and severe hypoxia stress on fish (Al-Bairuty et al., 2013) leading to stress-on-stress effect.

In this study we pretended to assess the effect and also the interaction of temperature and copper on Mozambique tilapia behaviour. For this end, we randomly distributed 70 fish in 6 aquariums to test copper sulphate, added to concentrations of 1.1 mg/L (C1), 3.6 mg/L (C2)

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and 0 mg/L control (C0), and for each concentration, C0, C1 and C2, we tested two water temperatures, 25°C (T1) and 32°C (T2). The fish were exposed to these conditions for 28 days.

Visual observations were performed always by the same person during 20 minutes twice a day, at the beginning (P0), middle (P1) and end of the experiment (P2). We analyzed four types of behaviors: stationary in the bottom, SB (fish remained motionless at the bottom); feeding inhibition, FI (observing the feeding behavior avoidance of the fish), hoovering in the water column (HC) and gasping at the surface, GS (when fish stood at the top of the water column reaching for atmospheric oxygen).

Fish stationary at the bottom presented statistical significance for T1 on P2. In feeding inhibition, we observed significant differences during all the assay, with higher effect on P2, particularly in T1. We detected significant differences on P2 for fishes hoovering in the water column, only on fish exposed to copper, with similar values for T1 and T2 (±40%). We verified that in T2 there were more fishes hovering in the water column and they were highly affected during P1 (±47%) and P2 (±60%). This may reflect also a lower level of dissolved oxygen in water, intensified by the presence of copper because fish from the control group rarely showed this behaviour.

We can conclude that higher temperature of water related with oxygen level turned fish more lethargic, with a decrease in normal social behaviour and increase in the feeding inhibition, mainly for fish exposed to higher levels of copper, affecting their metabolism and physiology.

These behaviour changes affect normal interaction of fish and can reflect a reduction in their survival under our laboratorial conditions. We can translate these results to the riverine fish (Fonseca et al., 2016) that will be less likely to move, leading them to thermal physiological limits, which, together with pesticides or heavy metals like copper sulphate and others (Davidson et al., 2009), can reduce the geographic distribution of aquatic species and potentiate large-scale changes in fish species which will become vulnerable under climate change and increase hypoxia areas.

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