

THE IMPACT OF GLYPHOSATE AND HIGH TEMPERATURE: AN INTEGRATED AND MULTIBIOMARKER APPROACH TO EVALUATE REDOX STATUS AND BEHAVIOR IN ADULT ZEBRAFISH (*Danio rerio*)

Jaíne Ames¹, Edivania G. de Batista¹, Tamiris R. Storck¹, Jossiele W. Leitemperger¹, Silvana I. Schneider¹, Julia Canzian¹, João V. Borba¹, Alice E. Visentini¹, Kassia S. Crivellaro¹, Mayck S. de Oliveira¹, Estivan D. Fernandes¹, Denis B. Rosemberg¹, Vania L. Loro¹

¹Universidade Federal de Santa Maria, Santa Maria, RS, Brasil.

INTRODUCTION: Animals in the aquatic environment, such as fish, are often subject to physical and chemical stress. As a chemical factor, pesticides stand out due to their widespread presence and diversity in this habitat. Among the most widely used pesticides worldwide, glyphosate leads the ranking in use. Due to this wide range of use, glyphosate is constantly found in aquatic environments, due to its applications in agricultural areas and its diversity of products, showing its persistence in this environment. The physical factor that can directly affect ectothermic animals is temperature. We know that the increase in water temperature, linked to factors such as climate change, constitutes a significant threat. **AIM:** Therefore, in this study, we examined the effects of exposure to environmentally relevant concentrations of glyphosate, active ingredient glyphosate (GAI), and glyphosate-based herbicide (GBH) in combination with high temperature (34 °C) in adult zebrafish (*Danio rerio*). **MATERIALS AND METHODS:** Adult zebrafish were acclimated to 28 or 34 °C for 96 h. After, the fish were exposed to 225 and 450 µg L⁻¹ (GBH or GAI) for 7 days at 28 or 34 °C. We analyzed behavioral endpoints (anxiety-like response, sociability, and aggressivity) and biochemical biomarkers of the brain and muscle (oxidative stress). After obtaining the results, we calculated the IBR (Integrated Biomarker Response) to characterize the effects of glyphosate and temperature. **RESULTS:** Anxiety-like responses and decreased sociability were disrupted by the combination of glyphosate and high temperature. Furthermore, there is a decrease in Acetylcholinesterase activity in the brain, and an increase in Lipid Peroxidation, Protein Carbonylation, Acetylcholinesterase activity, and Glutathione S-Transferase activity in the muscle. These results demonstrated oxidative stress, anxiety-like behavior, and decreased sociability caused by glyphosate and high temperature. The results of IBR demonstrate that GAI associated with a temperature of 34 °C is more toxic than GBH associated with the same temperature. **CONCLUSION:** We concluded that glyphosate and high temperature combined affected redox homeostasis and behavioral disorders in zebrafish.

Keywords: Fish. Herbicide. Oxidative Stress.

This work was supported by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES – PROEX, process number 88887.660849/2022-00).