ABSTRACT

ASSESSMENT OF TRICLOPYR EFFECTS ON ENERGY METABOLISM AND BEHAVIOR IN ZEBRAFISH (*DANIO RERIO*)

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BACKGROUND: Triclopyr is an auxin-like herbicide commonly used in agriculture and forestry to manage broadleaf weeds. It has been detected in various aquatic environments at concentrations ranging from 0.000004–5.13 mg/L. Owing to its presence in these ecosystems and the limited understanding of its toxicity mechanisms in non-target organisms, triclopyr is classified as an emerging contaminant, raising significant environmental concerns. OBJECTIVE: This study aimed to evaluate the acute toxicity of triclopyr on energy metabolism and behavior using embryonic and larval stages of zebrafish (*Danio rerio*) as a new approach methodology (NAM). MATERIAL AND METHODS: Zebrafish embryos at ≤ 3 hours post-fertilization were exposed to 0.12, 0.47, 1.76, 6.64, and 25 mg/L of triclopyr up to 120 hours. To evaluate the cellular energy metabolism of the zebrafish larvae, samples were collected for biochemical analyses. The focused on measuring available energy reserves (EA), including carbohydrates, proteins, and lipids, as well as quantifying energy consumption (EC), the rate of cellular energy allocation (CEA), and lactate dehydrogenase (LDH) activity. Additionally, larvae were subjected to a 10-minute dark phase followed by a 10-minute light phase, allowing for the evaluation of changes in activity patterns and stress responses under varying light conditions. RESULTS AND CONCLUSION: Zebrafish larvae showed reduced available energy at 0.47, 6.64, and 25 mg/L of triclopyr, alongside elevated total energy consumption at 0.12, 1.76, 6.64, and 25 mg/L of triclopyr. CEA levels declined significantly at 0.12–25 mg/L of triclopyr, while LDH activity rose at 0.12 and 1.76 mg/L, indicating a shift to anaerobic metabolism under triclopyr-induced energy demand. Behavioral disruptions included reduced dark-phase swimming (1.76 and 6.64 mg/L), decreased velocity (1.76 mg/L), and increased inactivity (0.12–6.64 mg/L). Energetic and behavioral data suggest triclopyr acts as a mitochondrial uncoupler, disrupting energy allocation during early development. Detoxification via excretion and/or ROS production may further impair energy metabolism in larvae.

KEYWORDS: Metabolism; Aquatic toxicology; New Approach Methodologies; Auxin-like herbicide
FUNDING SOURCE: CAPES-PrInt process 88887.716831/2022-00