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# Sub-Acute Toxicity of $Al_2O_3$ Nanoparticles in the Marine Gastropod Stramonita Haemastoma: Oxidative Stress and Neurotoxicity.

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## ABSTRACT

This study evaluated the toxicity of aluminum oxide nanoparticles ($Al_2O_3$ NPs) using the marine gastropod *Stramonita haemastoma* as a model organism. As nanotechnology has advanced, metallic nanoparticles (NPs) such as $Al_2O_3$ have become widely used in industries like chemicals and medicine due to their beneficial nanoscale properties. However, greater NP application has also raised environmental concerns since aquatic ecosystems experience indirect NP discharges. Marine invertebrates are relevant for assessing NP ecotoxicity given their ecological importance. In this research, snails were exposed to 1, 2.5, and 5 mg/L of $Al_2O_3$ NPs over seven days. Biomarkers were then measured to indicate stress responses. Results showed $Al_2O_3$ NPs significantly inhibited Acetylcholinesterase (AchE) activity, suggesting neurotoxic effects. They also trigged Glutathione (GSH) levels and decreased superoxide dismutase (SOD) activity in the digestive gland, indicating induced oxidative stress. This study demonstrates the ability of $Al_2O_3$ NPs to harm marine gastropods through neurotoxic and oxidative mechanisms and highlights the need for further investigation into nanoparticle impacts on aquatic life.

**Keywords:** Biomarkers, nanoparticles, *Stramonita haemastoma*, ecotoxicity.

## 1 Introduction

The increasing use of metallic nanoparticles in various fields, such as the chemical, medical, biomedical and food industries has raised concerns about their potential impact on the environment and living organisms [1]. Among these nanoparticles, aluminum oxide ($Al_2O_3$) nanoparticles are widely used because of their unique physicochemical properties. However, it is essential to understand the effects of these nanoparticles on aquatic organisms, as aquatic ecosystems are often the final destination for nanoparticle discharges [2], aquatic environments are considered the ultimate sink for NPs, consequently aquatic organisms are likely to be exposed to NPs such as the marine mollusk Stramonita haemastoma, several studies have reported toxicity and accumulation of NPs in marine organisms [3], suggesting that assessing the ecotoxicity of their potential effects is a critical point. The aim of this study is to evaluate the subacute toxicity of $Al_2O_3$ NPs in *Stramonita haemastoma* by measuring GSH, SOD and AchE activity in the digestive gland of this *Muricidae*

## 2 Experimental

After exposure to NPs, the snails were sacrificed and immediately dissected in order to obtain the digestive glands for biochemical assays of GSH, SOD and AchE.



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## 3 Results and Discussion

Diminution of GSH levels with a significant depletion at the level of the digestive gland of individuals exposed to 2.5 and 5 mg/l compared to their control, a significant strong inhibition of AChE activity is observed with also a slight increase in SOD in all groups. This suggests the nanoparticles caused depletion of an important antioxidant in this tissue. The results suggest the nanoparticles may cause oxidative stress and toxicity when ingested by these snails

## 4 Conclusions

Our results have demonstrated the ability of NPs to cause a response of biomarkers surely due to the involvement of oxidative stress. These observations raise concerns about the potential effects of $Al_2O_3$ on the bioavailability of nanoparticles and the health of marine organisms. It is therefore essential to continue research to better understand the implications of these results on the marine ecosystem and environmental health.

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