

# ANTIOXIDANT ENZYMES ACTIVITIES IN *MYTILUS GALLOPROVINCIALIS* EXPOSED TO 17 $\alpha$ -ETHINYLESTRADIOL (EE2): POTENTIAL IMPLICATIONS FOR HUMAN HEALTH

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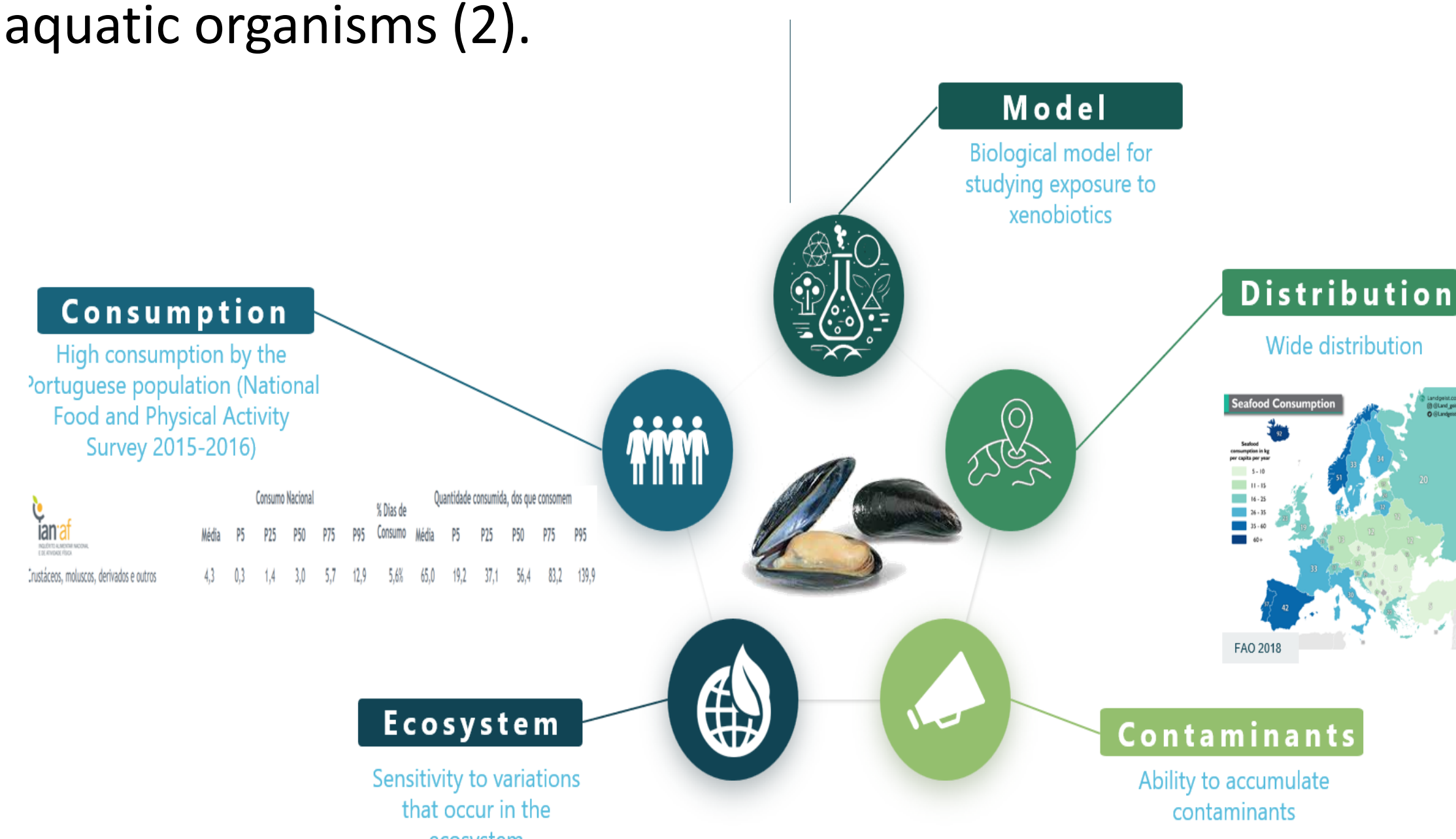
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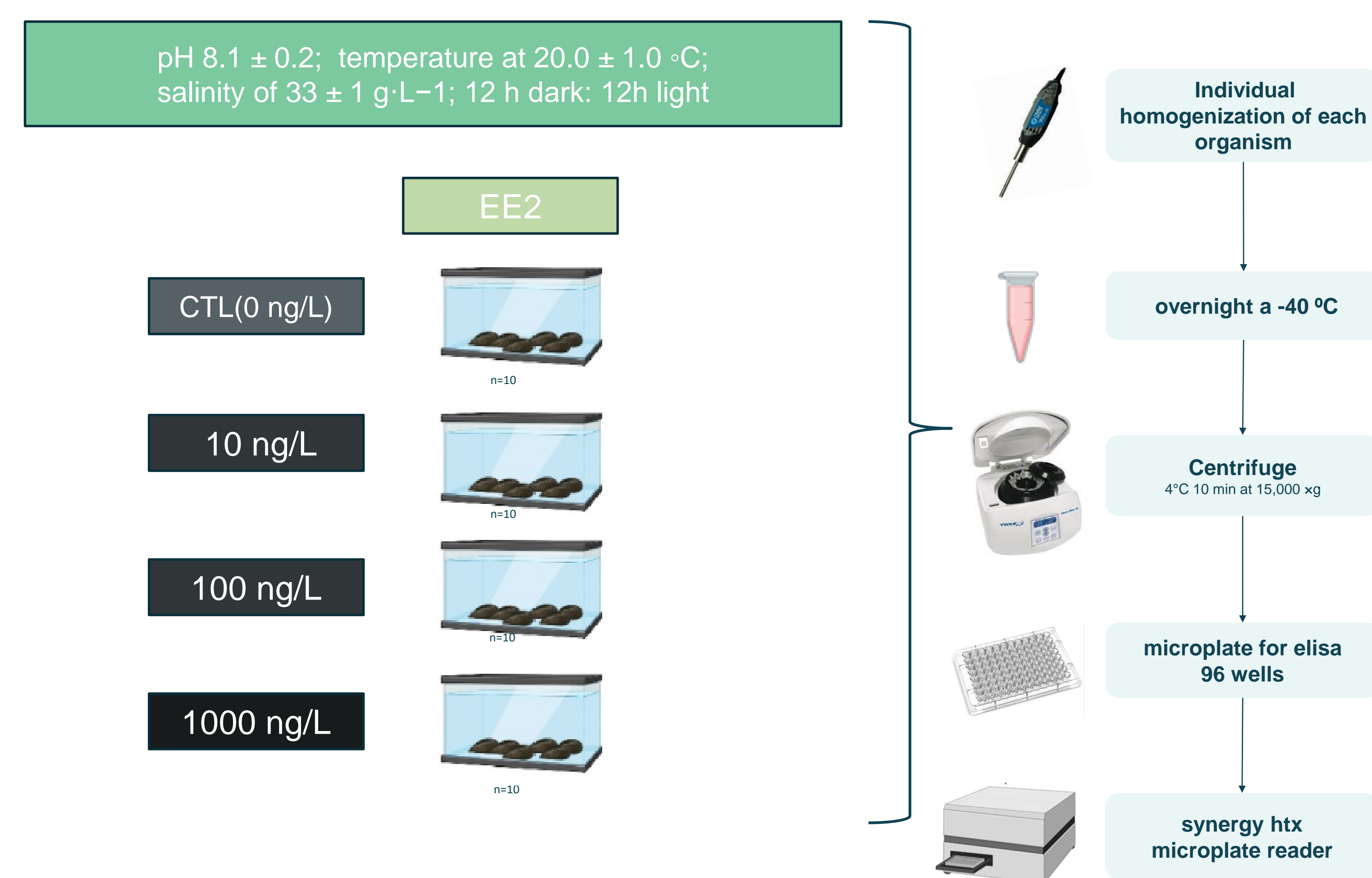
## INTRODUCTION

Coastal and marine ecosystems are increasingly exposed to contaminants such as endocrine-disrupting compounds (EDCs), which are prevalent in domestic, industrial, and agricultural effluents (1). Among these, 17 $\alpha$ -ethinylestradiol (EE2) a synthetic estrogen used in contraceptives is particularly persistent and bioaccumulative due to its hydrophobic nature and resistance to degradation. EE2 disrupts endocrine and cellular functions, leading to oxidative stress, reproductive impairments, and altered gene expression in aquatic organisms (2).



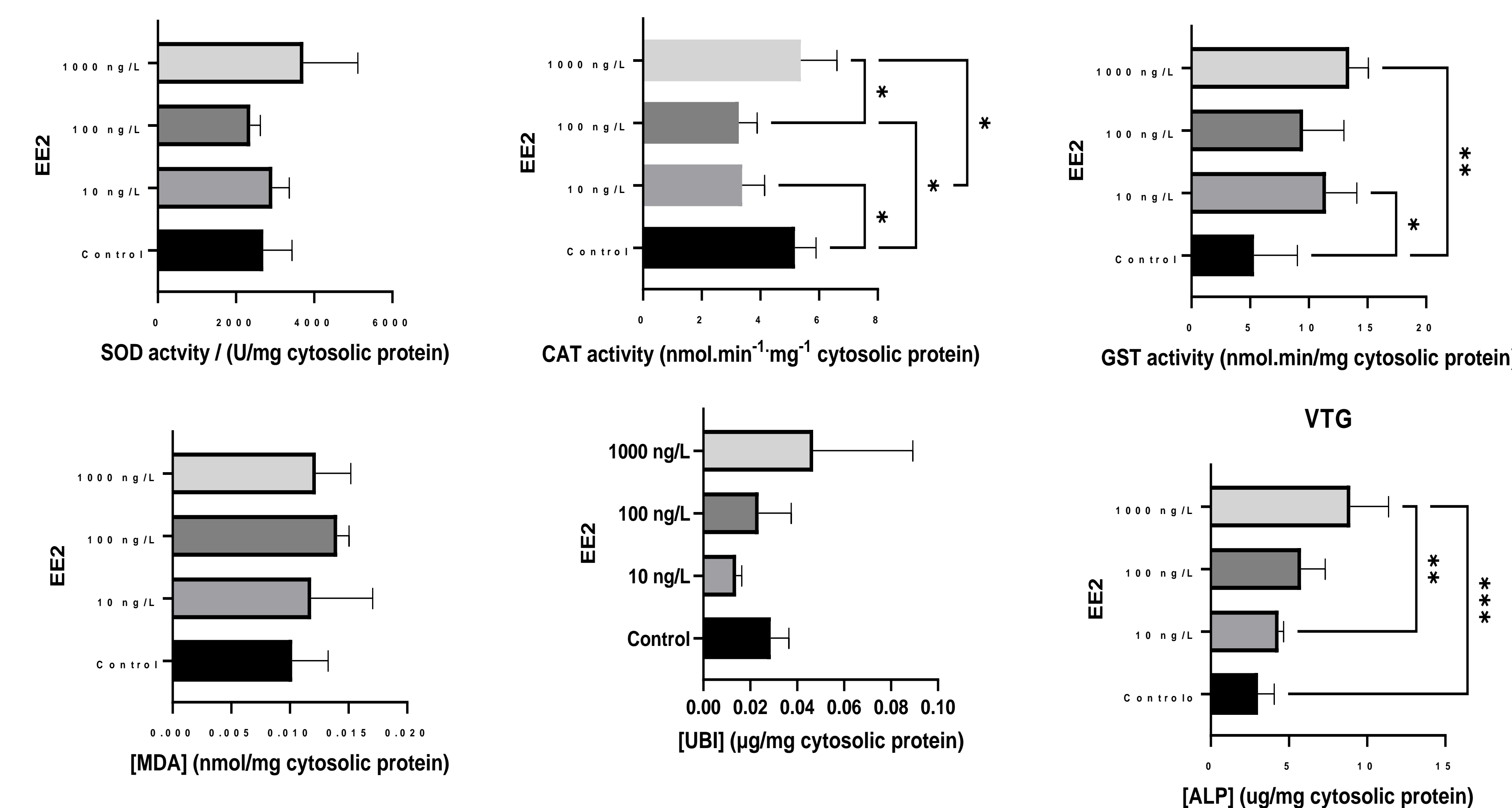
## METHODOLOGY

Mussels with an average length of 2.9  $\pm$  0.3 cm, were collected from Guincho Beach (Portugal), acclimated in laboratory aquaria, and exposed to environmentally relevant concentrations of EE2 (0, 10, 100, and 1000 ng/L) for 28 days. tissue samples were then analysed for antioxidant enzyme activity (CAT, SOD, GST), oxidative damage (MDA, UBI), and endocrine disruption (VTG-like proteins), following protocols adapted from Copeto *et al* (3).



## RESULTS

Exposure of *M. galloprovincialis* to EE2 for 28 days elicited distinct biomarker responses. An increase in SOD activity was observed, reflecting elevated oxidative stress. Glutathione S-transferase (GST) activity was significantly higher at both 10 ng/L and 1000 ng/L ( $p < 0.05$ ), indicating activation of phase II detoxification mechanisms. Catalase (CAT) activity decreased progressively with increasing EE2 concentrations, with a significant reduction at 1000 ng/L ( $p < 0.05$ ), suggesting impaired hydrogen peroxide breakdown capacity. Although malondialdehyde (MDA) and ubiquitin (UBI) levels increased slightly at higher concentrations, these changes were not statistically significant, indicating that oxidative damage was mitigated. Vitellogenin-like protein (VTG) levels increased in a dose-dependent manner, with a significant induction at 1000 ng/L ( $p < 0.01$ ), confirming endocrine disruption.



## OBJECTIVE

To evaluate the effects of EE2 at environmentally relevant concentrations (10–1000 ng/L) over 28 days in *M. galloprovincialis*. Several biomarkers were analyzed, including superoxide dismutase, catalase, and glutathione S-transferase activity (oxidative stress), malondialdehyde and ubiquitin content (cellular damage), and vitellogenin-like protein levels (endocrine disruption), to assess sub-lethal toxicological responses and the organism's compensatory antioxidant mechanisms.

## CONCLUSION

This study demonstrates that exposure to environmentally relevant concentrations of 17 $\alpha$ -ethinylestradiol (EE2) triggers oxidative stress responses and endocrine disruption in *M. galloprovincialis*. The induction of antioxidant enzymes (SOD, GST) and vitellogenin-like proteins, alongside the suppression of catalase activity, highlights EE2's capacity to interfere with cellular homeostasis. Despite the absence of significant oxidative damage (MDA, UBI), the observed biomarker responses suggest early physiological alterations that may compromise mussel health under prolonged exposure. These findings reinforce the utility of *M. galloprovincialis* as a sentinel species for monitoring estrogenic contaminants and support the need for stricter environmental regulation to protect both ecosystem integrity and food safety. In a country with one of the highest seafood consumption rates in Europe, the implementation of effective environmental policies and regulatory frameworks to monitor and control contaminants like EE2 in marine ecosystems is essential to safeguard both environmental and public health.

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