PERSPECTIVE

Storage and detoxification of marine pollutants by the cephalopod digestive gland

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ABSTRACT

The importance of cephalopods for fisheries and even aquaculture is prompting questions about how these mollusks are affected by environmental stressors like pollution and climate change. However, compared to other molluscs, particularly bivalves, which serve as frontline models in aquatic toxicology, these animals' responses to environmental toxins, are significantly less well studied. Cephalopods have a similar fundamental body structure, but because they are active predators with rapid growth and metabolic rates, they have diverse adaptations, sometimes unique. The majority of research on the digestive gland, which is similar to the liver in vertebrates, concentrated on metal bioaccumulation and its relationship to environmental concentrations, with evidence that certain cellular structures (such spherulae) and proteins were involved. Although there is debate regarding how phase I and phase II detoxification enzymes work in molluscs, There is proof of CYP-mediated bio-activation, albeit at a lesser level than in vertebrates, but further research is still needed on this topic. The discovery of genes and proteins that are important for toxicology, such as metallothioneins, heat shock proteins, and phase II conjugation enzymes, underscores the necessity of increased genomic annotation as a prerequisite to comprehend toxicant-specific pathways. Although some evidence from biomarker techniques, notably those related to oxidative stress, suggests that these molluscs' digestive glands are certainly susceptible to chemical aggressiveness, little is known about how organic toxicants are stored, metabolised, and removed. Additionally, it is difficult to determine the causes of pollution and its toxicopathic effects, which makes it difficult to use these organisms for bio-monitoring or, at the very least, to understand how they are impacted by anthropogenically induced climate change.

Keywords: Toxicopathic; Molluscs; Cephalopods; Anthropogenically; Proteomics

INTRODUCTION

Due to convergent evolution, one particular group of invertebrates known as cephalopods shares many crucial traits with high-order animals, with a focus on nervous system function. However, given that cephalopods share the basic molluscan body plan with chordates, these traits are comparable to those of chordates. However, molluscs are a cunningly diverse group of creatures that include everything from huge predatory squids like Architeuthis to sedentary filter feeders like bivalves. Because they consume a variety of live prey and have rapid growth and metabolic rates, cephalopods are particularly interesting in terms of how human activity affects food webs. This raises crucial considerations about bioaccumulation and stressor tolerance. The physiological and molecular mechanisms behind toxicopathological consequences and detoxification procedures in humans are not well understood, nevertheless By emphasising the comparative microanatomy, physiology, and molecular processes among different groups of molluscs, the current review aims to summaries the state-of-the-art on the role of the digestive gland in the detoxification of organic and inorganic contaminants in cephalopods. These findings, however, suggest that toxicological pathways in cephalopods may be more diverse and complex than anticipated.

DESCRIPTION

In terms of specialized endosomes, the digestive gland epithelia of ephalopods are more complicated than those of other molluscs. In reality, what appear to be mutually exclusive entities include "boules" (vacuoles engaged in digestion and enzyme release) and "brown

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bodies" (excretion of crystalline salts and amorphous components). is hampered by the lack of thorough studies integrating digestive gland histology and cytology with molecular pathways as well as by the absence of comparative studies between molluscan taxa.

Since cephalopods are known to bio-accumulate considerable levels of hazardous elements like Cd, even while others, like Hg, seem to be less significant, the vast majority of research on toxicants in cephalopods focuses on metals, which indicates metal- and organ-specific mechanisms. In comparison to other organs, such as the mantle and arms, the digestive gland has been shown to contain the highest concentrations of both essential (such as Cu and Zn) and non-essential (such as Ag, Cd, and Pb) metals in several cephalopods, with emphasis on Sepia and Octopus. The latter organ raises particular concerns regarding human consumption.

Overall, the cephalopod digestive gland does detoxify organic toxicants, albeit it may be better suited to get rid of poisons and undesired byproducts from feed and basal metabolism. Additionally, endpoints that are typical biomarkers in vertebrates might not be the best ones in molluscs, especially for phase I. Currently, oxidative stress and phase II responses, along with ECOD activity, seem to be Understanding how molluscs evolved to handle dangerous substances more reliable biomarkers of exposure to bioactive organic toxicants. Phase III of detoxification is still up for debate because it has only really been reported for vertebrates, such fish. For the removal of xenobiotics, the function of certain transporters, such as ATP binding cassette (ABC) transporters, found in digestive tract cells, is discussed. metabolites. ABC transporters have been studied in other molluscs, albeit they haven't been examined in cephalopods yet, and it has already been shown that they act in gills during metal-induced challenge.

CONCLUSION

It would be important to try and link phase III activity to the shape and function of excretory vacuoles in digestive gland cells. With the development of cutting-edge proteomics, metabolomics, (epi) genomics, and transcriptomics tools (next-generation sequencing of genomic DNAs and RNAs), as well as bioinformatics, more mechanistic information could be retrieved regarding detoxification pathways in cephalopods and other molluscs while assisting in the discovery of potentially novel mechanisms of detoxification through phases I to III in cephalopods.