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Nature of the Problem

The importance of the health of coastal and estuarine waters becomes clear when we realize that 53% of the United States population lives in the coastal region. This coastal population, of about 155 million, inhabits 17% of the land area of the contiguous United States. The coastal population currently increases by 3600 people per day, with a projected increase of 27 million people by 2015. As the most developed region of the United States, pollutants are an increasing concern to the health of these coastal systems. Pollutants from agriculture, industry, urban areas, and the burning of fossil fuels, entering through wind, rain and river run-off, increase as the population increases in these areas (1).

In marine and freshwater environments, colloidal organic matter (COM) makes up a large portion (i.e. 20-70%) of the bulk dissolved organic matter (DOM) (2). These colloids have high complexation capacities and can strongly bind with potentially toxic heavy metals, introduced through pollutants to the system. Marine organisms, such as estuarine bivalves, take up heavy metals bound to COM through solution phases or filter feeding (3). Estuarine bivalves, particularly oysters and mussels, are frequently used in environmental assessment and monitoring programs due to their ability to concentrate metals from the surrounding water. As a valuable fisheries resource, it is imperative to understand the mechanisms of this uptake to improve our ability to assess these sensitive areas.

Research Objectives

The proposed research investigates the importance of the types and concentrations of DOM to metal binding, as well as the mechanisms of COM uptake by bivalves. Focus areas are: 1) To determine if metals are taken up because DOM is used as a food source, 2) To evaluate metal uptake as a function of size and kind of DOM, e.g., if metal-complexing acid polysaccharides (APS) are modifying DOM and metal uptake. It is possible that metals bound to polysaccharides, especially APS, are taken up more efficiently due to their fibrillar and surface-active nature (4).

For these experiments, American oysters (Crassostrea virginica) are collected from the field and purged before time series experiments are begin. Natural colloidal organic matter collected from ultrafiltered Galveston Bay water, as well as commercially available Alginic Acid and Carrageenan compounds, are used for these experiments. Radiolabeling of colloidal matter with metals, or by C14 (5,6), enables me to study the bioavailability of colloids to bivalves and investigate the pathways and mechanisms of ingestion. Gamma Spectroscopy and Liquid Scintillation spectrometry are used to analyze the samples.

The goal for this research is to achieve the following objectives: 1) Demonstrate that oysters can remove colloidal matter from the water through filter feeding and utilize it as a food source, 2) Test the hypothesis that the bioavailability of metals to oysters is enhanced by complexation with colloidal matter, 3) Test the hypothesis that the type of colloidal matter affects the uptake of metals, with greater uptake occurring in the presence of APS compounds. This can be expected due to the ability of APS to form aggregates that increase the particle size being filtered, and the formation of a fibrous "mesh" that can allow the oyster to filter out and ingest smaller particles.

Understanding the mechanisms and pathways that control the bioavailability of heavy metals when bound to colloidal particles will allow bivalves to be used more effectively in monitoring coastal and estuarine ecosystems. Increasing this knowledge will benefit both the health of the coastal environment and the people living there.

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