



Toxins in the Food Chain: Understanding Bioaccumulation of Carcinogens in Marine Life and Human Health Risks

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Abstract

Marine ecosystem is facing threats of pollution from heavy metals and pesticides that have the propensity to bioaccumulate and biomagnify through food chains, putting biodiversity and human health at risk. This chapter focuses on bioaccumulation and trophic transfer of heavy metals and carcinogenic effects that have their pathway in marine organisms to humans via seafood consumption. Objectives include examining the mechanisms of bioaccumulation, evaluating ecological disruptions, assessing cancer risks from prolonged exposure, and analysing the shortcomings of current legal frameworks. The chapter underscores the persistence of heavy metals in aquatic ecosystems, their toxic impacts on marine species, and the severe health risks, including cancer, linked to contaminated seafood. The study urges strong discharge controls, improved water quality standards, and integrated monitoring systems to lower heavy metal contamination, preserve biodiversity, and protect human health from carcinogenic risks. It also calls for international cooperation, public awareness, and strong regulations.

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Chapter 19

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ABSTRACT

Marine ecosystem is facing threats of pollution from heavy metals and pesticides that have the propensity to bioaccumulate and biomagnify through food chains, putting biodiversity and human health at risk. This chapter focuses on bioaccumulation and trophic transfer of heavy metals and carcinogenic effects that have their pathway in marine organisms to humans via seafood consumption. Objectives include examining the mechanisms of bioaccumulation, evaluating ecological disruptions, assessing cancer risks from prolonged exposure, and analysing the shortcomings of current legal frameworks. The chapter underscores the persistence of heavy metals in aquatic ecosystems, their toxic impacts on marine species, and the severe health risks, including cancer, linked to contaminated seafood. The study urges strong discharge controls, improved water quality standards, and integrated monitoring systems to lower heavy metal contamination, preserve biodiversity, and protect

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human health from carcinogenic risks. It also calls for international cooperation, public awareness, and strong regulations.

1. INTRODUCTION

The word “bioaccumulation” is very commonly associated when discussing environmental pollution and its impact on ecosystems and human health. It describes gradual accumulation of some substances, particularly harmful chemicals in living things to quantities far higher than those found in the surrounding environment. This phenomenon has the potential to disrupt entire food chains and ecosystems, in addition to the individual organisms affected. Numerous exposure pathways may affect the process of the result such as having direct contact with polluted air, water, or soil or ingestion of contaminated food.

Bioaccumulation is commonly quantified using bioaccumulation factors (BAF), which characterize the rise of pollutants from water to biota while taking into account all exposure pathways (Proc et al, 2021). The material is considered bioaccumulation when these parameters value above predetermined criteria, commonly 5000 on a wet weight basis. The bioaccumulation process includes uptake from the environment, diffusion within the body, metabolism to possibly less or more harmful substances, storage in tissues such as bones or fat, and final elimination. The rate and amount of bioaccumulation depends on the habitat, the organism's biological characteristics, and the material's chemical composition. This phenomenon occurs when the substance's rate at which material builds up within an organism surpasses the rate at which it is broken down (metabolization) or eliminated, resulting in a progressive rise in the substance's presence within the organism. Both the properties of the material and the biological qualities of the organism have significant influence over this process. Substances that are stable, fat-soluble, and resistant to metabolic breakdown are more likely to be bioaccumulated. These materials frequently contain persistent organic contaminants and heavy metals like mercury that can enter the food chain and linger in the environment (Md. Nizam Uddin et al, 2021).

However, thinking from the organism perspective, factors such as environment, food habits, and metabolism rate are quite crucial. Organisms with slower metabolisms or those higher up the food chain are more likely to experience bioaccumulation. For instance, predatory animals have higher levels of accumulated toxins than species lower in the food chain due to a similar process called biomagnification, which raises the concentration of toxins at each trophic level.

Bioaccumulation is a major concern because of the persistence of heavy metals, hydrophobic compounds, food chain expansion, and persistent organic pollutants (POPs). People and wildlife may be exposed to persistent pollutants (POPs) includ-

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