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Efficacy of a Closed-Water Depuration System in Reducing Bacterial Load in Bivalve Shellfish

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Abstract This study evaluated the effectiveness of a closed water depuration system equipped with a sponge filter for reducing bacterial contamination in black clams (*Villorita cyprinoides*) harvested from the Varapuzha region of the Cochin Estuary, Kerala, India. Initial bacteriological analysis revealed high levels of contamination in the clams, indicating potential food safety risks for consumers. The depuration experiment was conducted in a recirculating tank system fitted with a sponge filter, in which clams were maintained in clean water and sampled at regular time intervals up to 72 hours. Bacterial indicator reduction, including Total Coliforms (TC), Faecal Coliforms (FC), Total Heterotrophic Bacteria (THB), and *Vibrio* species were monitored to evaluate the purification efficiency of the system. Results demonstrated a marked reduction in bacterial load during depuration, with the most pronounced decrease occurring within the first 48 hours. Total coliforms and faecal coliforms were reduced by 98.54% and 98.45%, respectively, reaching substantially lower faecal indicator levels, although compliance with specific regulatory standards requires validation using the prescribed indicator organisms and units. Total heterotrophic bacteria also showed a substantial decline, while *Vibrio* species were reduced to a lesser extent. Nevertheless, a gradual increase in bacterial counts was observed on the inner walls of the depuration tank due to biofilm formation, indicating the possibility of recontamination if the system is not properly cleaned. Overall, the sponge filter-based closed water depuration system proved to be a simple, cost-effective, and water-efficient method for improving the microbiological quality of clams. This approach is suitable for small-scale depuration practices and could help to improve shellfish safety and protect public health. This study may provide practical baseline information for optimising low-cost shellfish depuration systems under tropical estuarine conditions.

Keywords Depuration; Black clam (*Villorita cyprinoides)*; Sponge filter; Bacterial reduction; Biofilm; Closed water depuration system

1 Introduction

Seafood constitutes a vital component of the global diet, particularly in developing countries where it serves as a major source of affordable animal protein. Among the various seafood categories, bivalve molluscs such as clams, mussels, oysters, and scallops are especially important due to their high nutritional value, ecological significance, and economic potential (FAO (Food and Agriculture Organization), 2022). In India, bivalves play a significant role in coastal fisheries, contributing substantially to local livelihoods and the seafood export industry (Laxmilatha, 2018; Anil et al., 2024).

Bivalves are filter-feeding organisms that obtain their nutrition by filtering large volumes of the surrounding water. This feeding mechanism allows them to accumulate suspended particulate matter, including phytoplankton, organic detritus, bacteria, and potentially harmful pathogens (Min et al., 2024; Ochoa-Esteso et al., 2024). While this ecological function contributes to water purification and nutrient cycling, it also makes bivalves susceptible to the bioaccumulation of contaminants, particularly when they inhabit or are harvested from polluted aquatic environments (Martínez-Albores et al., 2020). Consequently, bivalves can act as vectors for foodborne illnesses caused by bacterial, viral, and protozoan pathogens, especially when consumed raw or insufficiently processed (Desdouits et al., 2023).