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Environmental Influences on Faecal Indicator Organisms in Coastal Waters and Their Accumulation in Bivalve Shellfish

Carlos J. A. Campos · Simon R. Kershaw · Ron J. Lee

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Abstract Shellfish production areas are often located in shallow estuarine and coastal systems impacted by fluxes of faecal indicator organisms (FIOs) that exhibit extreme spatial and temporal variability. FIO abundance and distribution in the marine environment are determined by the combined effects of light intensity, water mixing, sewage content and suspended particulate matter. Favourable conditions for FIO survival are low solar radiation, low temperature, low salinity, low densities of micro-predators and high levels of organic matter. Rainfall is the parameter most commonly associated with peak levels of FIOs. Resuspension of contaminated sediments in the water column dominates FIO distribution in shallow and depositional estuaries during storm conditions. Water/flesh FIO ratios may differ between shellfish growing waters because salinities and water temperatures also influence filter-feeding activity. Data are lacking on the role of biological processes on FIOs uptake and clearance in shellfish, particularly during periods of good water quality. FIO accumulation is usually of higher magnitude in mussels and cockles than in oysters and surf clams. It is proposed that differences in FIO accumulation rates are associated with the biological activity and the position of shellfish in the water column in relation to the location of impacting pollution sources. Accurate information on catchment hydrology, land uses, FIO loads from sewerage-related sources and livestock production areas are required to adequately characterise the microbiological status of shellfisheries.

C. J. A. Campos (✉) · S. R. Kershaw · R. J. Lee
Centre for Environment, Fisheries & Aquaculture Science (Cefas), Aquatic Health and Hygiene Division, Food Safety Group, Weymouth Laboratory, Weymouth, Dorset DT4 8UB, UK
e-mail: carlos.campos@cefas.co.uk

C. J. A. Campos · S. R. Kershaw · R. J. Lee
European Union Reference Laboratory, Weymouth, Dorset, UK

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List of abbreviations

CSO	Combined sewer overflow
ENT	Enterococci
FC	Faecal coliform
FIO	Faecal indicator organism
WwTW	Wastewater treatment works

Introduction

Faecal indicator organisms (FIOs) such as faecal coliforms (FC), *Escherichia coli* and enterococci (ENT) have been used as surrogates for microbial pathogens to assess the microbiological quality of bivalve shellfish (e.g. mussels, oysters, clams, cockles) and their growing waters. Shellfish production areas are often located in transitional and coastal waters which are influenced by many climatic and human-mediated factors interacting in the boundaries of land, freshwater and seawater environments. These influences are considerably more stressful to enteric bacteria than those in the gastro-intestinal tract of humans and other warm-blooded animals where FIOs live (Troussellier et al. 1998). The dynamics of FIO accumulation and clearance from shellfish and therefore the ratio $FIO_{water}/FIO_{shellfish}$ at any given time are the product of environmental interactions and physiological characteristics of each species (Younger et al. 2003).

The environmental influences on FIO contamination of coastal waters have been extensively studied, particularly since the implementation of the statutory requirements of the Water Framework Directive in the European Union (EU) and the Clean Water Act in the United States of America (USA) (Kay et al. 2007). However, very few studies have contextualised this body of evidence with shellfish hygiene