ELSEVIER

Water Research 39 (2005) 469–477

WATER RESEARCH

www.elsevier.com/locate/watres

Mytilus galloprovincialis filter feeding on the bacterial community in a Mediterranean coastal area (Northern Ionian Sea, Italy)

Loredana Stabili*, Maria Immacolata Acquaviva, Rosa Anna Cavallo

Istituto per l'Ambiente Marino Costiero—Sezione di Taranto—CNR, via Roma 3, Taranto 74100, Italy

Received 17 May 2004; received in revised form 5 October 2004; accepted 11 October 2004

Abstract

This study was carried out seasonally, throughout a year, to evaluate the filtering activity on bacteria of *Mytilus galloprovincialis*. Six microbiological parameters were researched in the water and mussels samples collected along the coastal area of the Northern Ionian Sea in three stations, S. Vito, Lido Gandoli and Lido Silvana. We detected the densities of culturable heterotrophic bacteria by spread plate on Marine Agar, total culturable bacteria at 37 °C on Plate Count Agar and vibrios abundance on thiosulphate-citrate-bile-sucrose-salt (TCBS) agar. Total and fecal coliforms as well as fecal streptococci were determined by the Most Probable Number. Bacterial concentrations at 20 and 37 °C as well as vibrios concentrations were higher in the mussel samples compared to the corresponding seawater throughout the year. The results obtained could contribute to improve the information relatively either to the natural processes existing between bacteria and mussels or to the risk of human infections related to the consumption of mussels.

Keywords: Culturable heterotrophic bacteria; Vibrios; Total and fecal coliforms; Fecal streptococci; Filter-feeding activity; Mussels; Northern Ionian Sea

1. Introduction

''Filter feeders'' refers to organisms that gather food through filtering of the water column. In coastal marine areas macro filter feeders such as ascidians, polychaetes, bivalves, and sponges are a large component both in terms of biomass and numbers. Due to their large filtration capacity, these taxa may potentially process major parts of the water column on a daily basis (Doering and Oviatt, 1986; Loo and Rosenberg, 1989; Peterson and Riisgard, 1992; Cloern, 1996). Many attempts have been made to determine the filtration rates of bivalves, but the results are often difficult to interpret and compare. The conflicting data on filtration rates seem partly to be due to incorrect use of methods, and partly to be caused by differences in experimental conditions (Riisgard, 2001). Clearance rates of mussels have mainly been obtained with *Mytilus edulis*, in laboratory experiments or in situ in intertidial coastal zones of oceans. Cole et al. (1992) demonstrated that mussels filter, on an average, 7.5 L of seawater per hour. Widdows et al. (1995) measured on *M. edulis* collected along the North Sea coastline of the UK filtration rates of about $6.5\,L\,g^{-1}\,h^{-1}$ in Shetland mussels and a filtration rate of $6.07\pm0.40\,L\,g^{-1}\,h^{-1}$ in mussels from Whitsand, Cornwall. In the Mediterranean sea, the main

*Corresponding author. Tel.: +39 832298897; fax: +39 832298626.

E-mail address: loredana.stabili@iamc.cnr.it (L. Stabili).

0043-1354/$ - see front matter © 2004 Elsevier Ltd. All rights reserved.
doi:10.1016/j.watres.2004.10.010

species cultivated is *Mytilus galloprovincialis*, on which few data on metabolic rates are available (Ceccherelli and Barboni, 1983; Matsuyama et al., 1997; Navarro et al., 1991).

Further understanding of filter-feeding behavior in bivalves is required to establish the role of bivalve shellfish in ecosystem processes (Bayne and Hawkins, 1992; Dame, 1993; Herman, 1993). Because of their large filtration capacity, mussels may potentially affect the levels of the planktonic microorganisms. The relationship between microorganisms and benthic filter feeders may be functionally important to aquatic ecosystems (Kautsky, 1981; Prins et al., 1998). Once mussels filter and consume planktonic microorganisms, they release inorganic nutrients into the water column and deposit feces and pseudofeces onto the sediment. These nutrients on the sediment surface can then either be remineralized or stirred back into the water column (Widdows et al., 1998). Concerning the mussels' filter-feeding activity, laboratory experiments have shown that the filter feeding may exert a control on microbial community in terms of abundance and biodiversity (Mohlenberg and Riisgard, 1978; Kiorboe et al., 1981; Jorgensen et al., 1984).

Furthermore, as a consequence of the filter-feeding activity, mussels accumulate and concentrate many pollutants in seawater, particularly those which are particulate or are associated with particles. They also accumulate other pollutants such as fecal bacteria (American Public Health Association (APHA), 1992). This ability to accumulate materials facilitates the detection and measurement of pollutants that may be in the water column at very low concentrations. The fact that mussels can accumulate bacteria and viruses and the fact that mussels are harvested for human consumption has led to their use in routine determination of the quality of mussel flesh and water in terms of hygiene and public health. Field studies concerning the filtration activity of mollusks on bacterioplankton regard prevalently microbial pollution indicators and vibrios. Oysters, clams, mussels have been described as reservoirs of vibrios (Høi et al., 1998). Among the Mollusca, the most studied species are *Crassostrea gigas* (Pacific oyster) and *C. virginica* in which vibrios have been found among the Gram-negative microorganisms associated with their tissues (Kaysner et al., 1989; Kaspar and Tamplin, 1993). Although Mar Piccolo of Taranto (Ionian Sea, Italy) is one of the most important *M. galloprovincialis* farming areas in Italy, apart from the study relative to the presence of vibrios in *M. galloprovincialis* and seawater (Cavallo and Stabili, 2002) there is little known on feeding activity on bacteria of mussels in this coastal area.

The present study represents a contribution to the knowledge of *M. galloprovincialis* feeding on bacteria in the Northern Ionian Sea. The study was carried out, seasonally, throughout a year, to research six microbiological parameters both in the water and mussels samples collected along the coastal area of the Northern Ionian Sea in three stations, S. Vito, Lido Gandoli and Lido Silvana.

2. Materials and methods

2.1. Sampling methods

Seawater samples were collected, seasonally, over an annual cycle (late December 2001, April, August and early November 2002) in three sites located in the Northern Ionian Sea, S. Vito, Lido Gandoli and Lido Silvana (Fig. 1). Water samples were obtained aseptically in presterilized 1000 mL glass bottles with hermetic stoppers submerged to a depth of 50 cm. The samples were transported on ice and processed for enumeration and isolation of bacteria.

2.2. Abiotic parameters

Temperature, salinity, and dissolved oxygen were measured in situ using a multiparametric sounding-line "Ocean Seven 401" (Jolzonant, Italy). An oxygen saturation of 100% was considered the oxygen concentration in the air (Lorenti and De Falco, 2004).

2.3. Mussel samples

Mussel samples of *M. galloprovincialis* were collected seasonally in the Gulf of Taranto (Italy) using SCUBA equipment (depth range = 5–15 m). Animals were washed in clean tap water and placed in a 60 L aquarium in a temperature-controlled room. The salinity of the water was 37‰ and the temperature was maintained at 22 °C. Tank water was filtered through 0.2 μm pore size membranes (Millipore) and aerated. Animals were acclimated to these conditions for 2 or 3 days before the field studies were undertaken. After acclimation, the animals were randomly divided into 9 groups consisting of at least 30 individuals each, suspended in mesh cages in the three sampling sites of the Northern Ionian Sea, and collected after about 2 weeks of permanence. For each sampling site three groups of mussels were employed. Mussels were collected with the associated seawater samples, transferred to the laboratory, and prepared for bacteriological analysis.

2.4. Bacteriological methods

The mussels were washed, scrubbed free of dirt, and shucked with a sterile knife. Meat and liquor (ca.100 g) were diluted and homogenized in a sterile Waring blender. The homogenates were then processed as seawater samples.