VIBRIOS INCREASE AS INDICATOR OF MUSSEL - FARM IMPACT IN COASTAL MARINE ENVIRONMENT

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Abstract.

Counts of cultivable bacteria were made in order to determine the impact of a mussel farm on the quality of the water and sediment, in a coastal area of the Tyrrhenian Sea. Bacterial parameters were examined from March, 1997 to February, 1998 at mussel and control stations. A significant correlation between temperature and *Vibrio parahaemolyticus* was reported at the control and mussel stations. Vibrio distribution in the water column is not related to the biodeposition of the mussel farm. Mussel farms determined an increase in density of vibrios in sediments, suggesting that these bacteria are good indicators of organic enrichment.

Key-words: bacteria, Mediterranean Sea, aquaculture

Introduction

Aquaculture activities (particularly mussel farms) are undergoing a rapid expansion in many parts of the world, resulting in an increasing interest and concern for their potential impact on coastal marine environments (1). Mussel cultivation produces large biodeposits of pseudo-faeces and faeces (2), which affect the quality and quantity of particulate organic matter available for benthic organisms (3) and stimulate microbial biomass and productivity (4). Bacteriological monitoring (i.e. vibrios) is of great importance especially in aquaculture, in fact areas suitable for productive purposes must possess optimal quality levels (5, 6, 7). In order to assess the effects of mussel farming on the coastal marine environment of a temperate area of the western Mediterranean, cultivable vibrios were studied in both water column and sediments beneath a mussel farm and compared with a control site.

Materials and methods

This study was conducted from March 1997 to February 1998 in the Gulf of Gaeta (Tyrrhenian Sea, NW-Mediterranean Sea). Sediment and water samples (at a depth of 0 and 10 m) were collected, respectively, by SCUBA divers and by using 9-liter Niskin bottles on a monthly basis at two stations: the Mussel station located inside the mussel farm and the Control station (about 1 km away from the mussel farm) in a southern area not occupied by the aquaculture plants. All stations were located at a depth of 10 m.

The temperature (T, °C) was measured by a portable multiparametric probe (Hydrolab, Inc. Austin, USA). To evaluate the density of halophilic vibrios research was carried out by filtering various amounts of each sample (1, 10 and 100 ml) through Millipore membrane (0.45 μm) and placed on TCBS agar (Difco). Incubation was carried out at 20 and at 37 °C for 24 h in order to enumerate respectively the total presumptive vibrios (PV), usually present in the marine environment, and PVP (presumptive *Vibrio parahaemolyticus*), a group of potentially pathogenic species able to grow at 37 °C.

Results and discussion

The average values (± se) relative to vibrio-like organisms are reported in Table 1. In water column, presumptive vibrio abundance was not significantly higher than in the Control (t-test, $p = 0.46$ and $p = 0.31$ for surface and bottom water, respectively), even though it was constantly high, (in surface and bottom layer) during the warmest months (June – September), when the water temperature ranged from 16.5 to 25.7 °C. In farm sediments, the density of total vibrios (on average, $6.3 \pm 5.9 \times 10^4$ CFU g^{-1}) was higher than in the Control (on average $4.0 \pm 3.2 \times 10^4$ CFU g^{-1}) even though this difference was not significant (t-test, $p = 0.22$). PVP density in the Mussel station showed a course similar to the Control and was significantly correlated to temperature (r ranging from 0.76 to 0.91; $p<0.01$ at surface and bottom layer, respectively) for all stations, indicating that temperature exerts a major control on this bacterium. Moreover *V. parahaemolyticus* was distributed homogeneously with no variation between the control and the mussel station influenced by the biodeposition of the mussel farm (8).

The density of total vibrios in mussel farm sediments was higher than at the Control, whereas no clear differences were observed for water column probably due to the higher hydrodynamic regime and dilution (9). These results indicate that these bacteria are good indicators of organic enrichment and suggest that mussels concentrate vibrios, which are then released, through faeces and pseudo-faeces to surface sediments. Larger sinking particles such as faecal aggregates (10) and marine snow (11) may constitute substrate for bacteria colonization. In fact the results confirm that vibrios and particularly *V. parahaemolyticus* are frequently found in surface sediments when the surrounding water column conditions are unfavorable (i.e. low temperature, 12) or on suspended substrata (13). The microorganisms present in the sediment of the Gulf of Gaeta, a highly retentive system (i.e., accumulation system), is increased by organic loads resulting from mussel biodeposition.

Table 1. Average values of presumptive vibrios (PV) and presumptive Vibrio parahaemolyticus (PVP) in the water and sediment samples of the Gaeta Gulf.

	PV		PVP	
	Control	Mussel	Control	Mussel
samples	x ± se	x ± se	x ± se	x ± se
Surface water[a]	$3.5\pm2.9 \times 10^3$	$3.6\pm2.5 \times 10^3$	$4.6\pm3.5 \times 10^2$	$5.0\pm4.7 \times 10^2$
Bottom water[a]	$1.4\pm1.0 \times 10^4$	$4.2\pm2.4 \times 10^3$	$2.6\pm1.6 \times 10^2$	$9.2\pm1.7 \times 10^2$
Sediment	$4.0\pm3.2 \times 10^4$	$6.3\pm5.9 \times 10^4$	$6.0\pm1.0 \times 10^3$	$4.5\pm3.5 \times 10^3$

a The number of vibrios is referred to CFU 100 ml-1 for bottom and surface water.
b The number of vibrios is referred to CFU g-1 for sediment samples.

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