

SEASONAL DISTRIBUTION OF INDICATOR BACTERIA IN SEAWATER FROM BOSPHORUS

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Abstract

In this study, enumeration of fecal coliforms in seawater from Bosphorus was performed since 1991 with two samplings per month. Beside this study, sulphite reducing *Clostridium perfringens*, fecal streptococci and total aerobic bacteria were detected in 1996. The results showed that there is direct relationship in the presence of all indicator bacteria at the same time. Total and fecal coliform numbers in the seawater samples were high ($10^3 - 10^4 / 100 \text{ ml}$) as compared to the standard value. It seems that there is seasonal variation in indicator bacteria numbers. Especially, total coliform numbers in seawater were found very high in summer time. The number of total aerobic bacteria was found as 10^5 and $10^4 - 10^6$ per ml-1 at 22°C and 37°C incubation temperatures, respectively.

Key-words : bacteria, sewage pollution, Bosphorus

Introduction

Microbiological pollution in seawater is a very common problem on almost all the coast of developing countries. Rumelikavagi region of Bosphorus (Fig. 1) is the main area where is mussels harvesting and heavily used for recreation, fishing during the all seasons. This place is also a coastal area with high average population density. Time to time, sewage is discharged directly or indirectly into the sea at various points along the coast. So, seawater in this area may become gradually contaminated with human pathogenic microorganisms (1, 2, 3, 4).

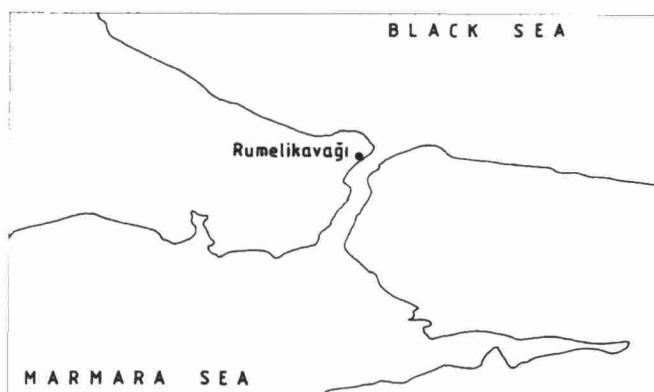


Fig. 1. Location of sampling site in Bosphorus.

Seawater must be examined to ensure that contaminating microorganisms are not present. It is known that there are great difficulties for detection and enumeration of pathogenic microorganism of seawater. For these reasons indicator organism have been used to evaluate water quality and potential health hazards associated with the consumption of contaminated mussels. A few microbiological studies have been carried out in seawater from Bosphorus (1, 5). In these studies, generally fecal coliform, *Escherichia coli* have been determined as indicator bacteria for fecal pollution for water quality surveys.

In this study, seawater samples were analyzed for the presence of total and fecal coliforms, fecal streptococci, sulphite reducing clostridia and total aerobic bacteria count to verify the extension of pollution in Rumelikavagi region of Bosphorus. Another purpose of this study was to find possible relationship among the indicator microorganisms of fecal pollution.

Materials and methods

Seawater samples were collected from Rumelikavagi region of Bosphorus where is the main area for mussel harvesting. Water collection was carried out in monthly samplings in accordance with the standard methods (6). During the samplings, the temperature of the seawater was regularly measured. Seawater samples were taken withing 15 m distance far from the shore and 2 m bottom of sea surface and analysed within 6 h after collection. Total aerobic bacteria were determined in triplicate according to standard procedures using Plate Count Agar (Difco) at 22°C for $72 \pm 3 \text{ h}$ and 37°C for $48 \pm 3 \text{ h}$ in aerobic condition (7).

Total coliform, fecal coliform, fecal streptococci and *Clostridium perfringens* numbers were quantified over 1 year period from January 1996 to January 1997 seasonally. Fecal coliform and total coliform concentration was determined by the Membrane Filtration Technique using Membrane Lauryl Sulphate Broth at 44.5°C for $48 \pm 3 \text{ h}$ and

Endo -NKS (Sartorius) at 37°C for fecal coliform and total coliform, respectively (7, 8).

The analysis of fecal streptococci and *Clostridium perfringens* was carried out using Most Probable Number Techniques (7, 9). For quantitative analysis of fecal streptococci, Azide Dextrose Broth and Bile Aesculin Agar were used as isolation media. Differential Reinforced Clostridia Medium and Litmus Milk were used for determination of *Clostridium perfringens*. Seawater samples were heated at 75°C for 10min., so that only the *Clostridium* spores counted (7, 9).

Results and discussion

Seasonal variation of temperature in seawater of Bosphorus in 1991 and 1996 were given in Table 1. As can be seen the temperature of the seawater varies seasonally from 5°C to 22°C.

Results indicated that the mean fecal coliform counts, in spring and summer of 1991 and summer and autumn of 1996 were usually higher ($10^3 - 10^4$ per 100 ml) than standards established for seawater (Fig. 2).

Table 1. Seasonal variation of seawater temperatures in 1991 and 1996.

Seasons	Temperature 1991	°C ± SE 1996
Winter ^a	5 ± 1.5	7.3 ± 2.3
Spring ^b	8.1 ± 2.0	10.3 ± 3.5
Summer ^c	20.1 ± 2.0	22 ± 2.0
Autumn ^d	15.1 ± 2.4	15.6 ± 1.4

^a : December - January - February, ^b : March - April - May, ^c : June - July - August, ^d : September - October - November. Each number is the mean of three values.

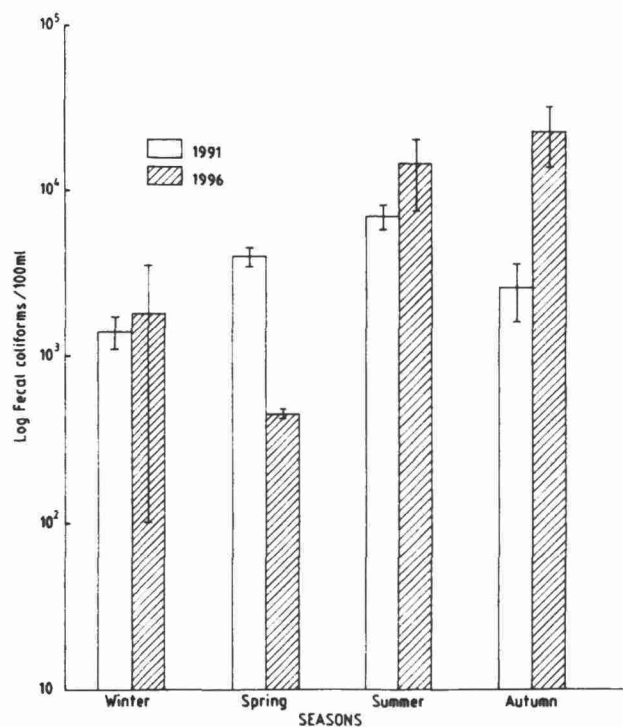


Fig. 2. Seasonal variation in fecal coliform counts in 1991 and 1996.