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Prediction of the environmental impact of coastal population on the quality of the sea

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ABSTRACT

The increase of coastal population -especially by tourists- is something considered as flourishing of the socio-economic conditions of the district. Too little -if any- attention is given to the effects caused by this situation. In the present study taking into consideration the quality of the seawater as the main parameter affecting the population of tourists, an attempt has been made in order to predict the variation of the quality of seawater with population. To achieve that, the beaches were classified according to their use -and consequently the amount of wastewater discharged into the sea -into four groups: I)coasts that are used only for swimming and recreational purposes, II) coasts used simultaneously for dwelling, swimming and recreational purposes, III) coasts along which only dwellings exist, and IV) natural and man-made harbours.

Bodrum -one of the most popular touristic resorts of Turkey -was selected as the experimental site where six beaches; one from group I, one from group II, one from group III, two from group IV and one transitional group I-II, were selected as the survey areas. Three stations close to each other in approximately 10-20 meters from the shore were chosen for sampling. Samples collected at all three stations at each survey beach were mixed to obtain a typical composite sample. Samples were collected three times a day - early in the morning before people started coming to the beach; at noon when the beach was most crowded; and late in the afternoon when people started to leave the beach. During the survey 40320 observations were made from December 1985 to February 1988. Parameters such as atmospheric pressure, air temperature, cloudiness, sunny period, prevailing wind direction and its speed, precipitation, light intensity, turbidity, seawater temperature, pH, colour, salinity and coliform concentration were determined. Assuming the concentration of the total coliform as the most important microbial pollution indicator for beaches an attempt has been made for the determination of the variation of coliform concentration as a function of the remaining parameters. To achieve this a multilinear regression program was used in which the number of total coliform was treated as the dependent variable while the others were accepted as independent variables. As a result of this analysis, the following relation was obtained:

$$N = \frac{(C_1 \sqrt{P} + C_2)}{10^{A-3}}$$

$$A = \frac{\ln(I^{0.29}\ T_u^{-0.072}) + 1.22}{0.95^{\theta-20}}$$

where

A is a parameter affecting the die-off of bacteria due to environmental conditions,
N is the number of total coliforms per 100 milliliters,
I is the intensity of light (lux),
Tu is the turbidity (FTU),
θ is the temperature of seawater (°C),
P is the population density (number of people/100m^2),
C_1 is the population density coefficient and
C_2 is the coastal characteristic coefficient.

The coefficients C_1 and C_2 of this equation have been found to have the values given below:

Coast Group	C_1	C_2
I	15.7	0.020
I-II	78.4	0.223
II	220.5	0.682
III	281.7	0.293
IV	1310.5	2173.0

Parameters such as BOD, total nitrogen, total phosphorus etc. proved that they didn't contribute significantly to the total coliform concentration. The correlation obtained between actual determined values and the values estimated by the derived equation is above 86 percent.

The results obtained by this study is a significant contribution for the prediction of the environmental impact of tourist population to seawater quality and consequently for the prevention of the deterioration of the environment and protection of public health.

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M-II2

Comparative survival of fecal indicators in seawater

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Introduction

The high inactivation rates in the marine environment of total and fecal coliforms are an important shortcoming for the use of these microorganisms as indicator of remote and viral pollution (1). Other microorganisms such as fecal streptococci and several groups of bacteriophages (Coliphages, F-specific phages and *Bacteroides fragilis* phages) have been proposed as alternative fecal indicators because of their higher survival capacity in sea water.

The objective of this study was to evaluate the effect of marine water upon the stability of several indicators microorganisms under laboratory conditions.

Material and Methods

To study the comparative survival of bacteria and bacteriophages an Erlenmeyer flask with 900 ml of unpolluted seawater was inoculated with 100 ml of sewage. The mixture was incubated in the dark at 18°C for up to 15 days. Bacterial and bacteriophages survivors were enumerated at time 0 and subsequents days (3, 7, 10 and 15 days) using the following growth media and assay techniques.

Bacterial counts:
Total coliforms (**TC**), fecal coliforms (**FC**) and fecal streptococci (**FS**) were enumerated by spread technique using m-Endo agar (Difco Lab. Detroit Mich.), m-FC agar (DIFCO) and m-Enterococcus agar (Difco) plates. When there was a low concentration of bacteria, membrane filtration procedure (2) was used for the analysis.

Phages count:
Specific phages of the strains *Escherichia coli* C (**CP**) (ATCC 13706) and *E.coli* K12 Hfr (**K12P**) (PC0008) were enumerated by the double agar layer method (3). Selective counts of F-specific bacteriophages (**FSP**) were obtained using *Salmonella typhimurium* WG49 as bacterial host (4). To evaluate the possible interference by somatic *Salmonella* phages (**SSP**) parallel counts were also made using F$^-$ strain (*S. typhimurium* WG45). Phages actives against *Bacteroides fragilis* HSP 40 (**BFP**) were enumerated by the soft agar overlay method (5) using the samples decontaminated by membrane filtration (0.45 µm filters previously treated with 3% beef extract at pH 9.5).

Results and Discussion

Figure 1 (A and B) shows the effect of the marine water on the survival of the microorganisms. Fecal and total coliforms showed the highest rate of inactivation in seawater whilst the die-away rate of fecal streptococci was more closely paralleled that of bacteriophages, excepting coliphages that did not present a significant inactivation after the sampled period.

F-specific and *B. fragilis* bacteriophages were the groups of phages that showed the least stability in seawater. Low survival of some members of F-specific phages as f2 have been described by others authors (6).

Because of the lower persistence of coliform bacteria in marine water these microorganisms can be useful indicator of enteric bacterial pathogens but not of virology pollution. Somatic coliphages can be more appropriated indicator microorganisms.

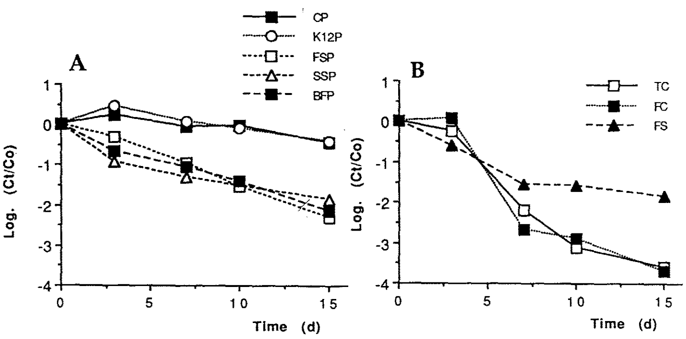

Figure 1 (A and B) : Microbial inactivation in seawater.

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