

FLUORIDE AND CHLORIDE LEVELS IN THE BUSHEHR COASTAL SEAWATER OF THE PERSIAN GULF

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SUMMARY: The aim of this study was to establish base-line data for concentrations of fluoride (F) and chloride ion (Cl⁻) in seawater along the Bushehr coastal area of the Persian Gulf. Six samples were collected from 8 sampling points. The concentration of F ranged from 2.28 to 2.92 mg/L (mean 2.64 mg/L) and that of Cl⁻ from 21.71 to 34.54 g/L (mean 27.59 g/L). The F to Cl⁻ ratio in different stations in Bushehr coastal area ranged from 7.22×10^{-5} to 12.77×10^{-5} (mean 9.73×10^{-5}).

Keywords: Bushehr coast; Fluoride to chlorinity ratio; Persian Gulf seawater.

INTRODUCTION

Fluoride (F) is widely distributed in the environment and is therefore of special concern. Because it can cause a wide range of adverse health effects,¹⁻⁴ excessive consumption of F in Iran has been well studied, but there appear to be no data on F concentration levels in the water of the Persian Gulf. As F is a major component in seawater and the peculiar geochemistry of F compared to other halogens has been of interest in research, the aim of this study was to establish base-line data for concentration of F and the F to Cl⁻ ratio in seawater along the Persian Gulf in the Bushehr coastal area.

MATERIALS AND METHODS

Seawater samples from 8 stations (6 samples from each station) were collected along the Persian Gulf in the Bushehr port coastal area during May-July 2013 (see Figure).

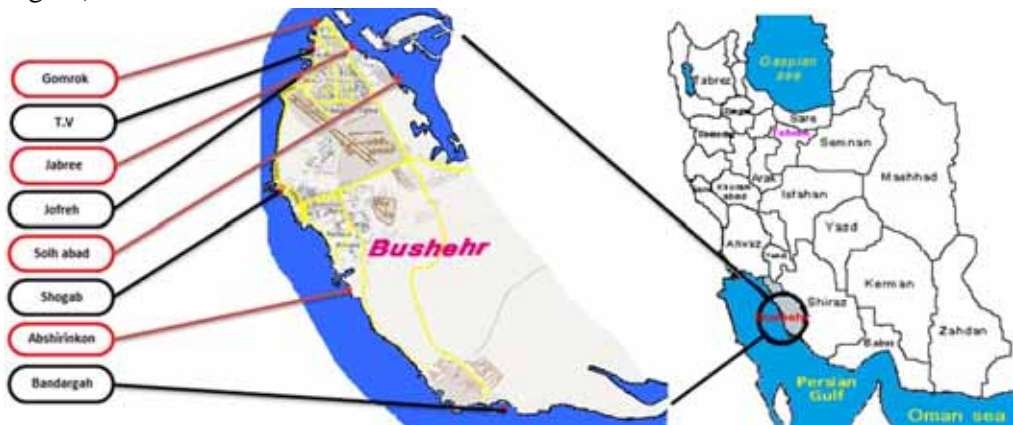


Figure. Location of the sampling points along the Persian Gulf in the Bushehr coastal area.

Water temperature was measured with a mercury thermometer. Air temperature records during sampling days were extracted from the meteorological office in

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Bushehr. The Cl^- concentration was determined by standard methods,⁵ and pH was determined using a pH meter (Metrohm, Switzerland). For the F analyses, the standard SPADNS method was used with a UV-VIS spectrophotometer (model CAM spec M 501). Although chlorinity is not equivalent to Cl^- levels, the factor for converting a chloride concentration in seawater to include bromide, for example, is only 1.0045. Therefore, for practical purposes and here also, the Cl^- concentration (in g/kg of solution) is considered nearly equal to chlorinity in seawater.

RESULTS AND DISCUSSION

The results of seawater samples including water temperatures, pH, F/ Cl^- ratios, F and Cl^- concentrations along the Persian Gulf in the Bushehr coastal area are shown in the Table 1. Note that the F/ Cl^- ratios, like F and Cl^- concentrations, are calculated from the 6 samples collected at each site, not the unweighted means listed in Table 1.

Table 1. Mean values of water temperature, pH, F concentration and Cl^- levels in different stations along the Persian Gulf in the Bushehr coastal area (number for each parameter = 6)

| Station | Water temperature (°C) | pH | F mg/L±SD | Cl^- (g/L±SD) | F/ Cl^- *10 ⁵ ±SD |
|-------------|---------------------------|------|----------------|---------------------------|--|
| Gomrok | 31.2 | 8.2 | 2.73 ± 0.13 | 29.28 ± 2.55 | 9.42 ±1.11 |
| Solhabad | 31.2 | 8.16 | 2.68 ± 0.08 | 24.67 ± 0.76 | 10.88 ±0.46 |
| Shogab | 31.4 | 8.2 | 2.67 ±0.11 | 33.06 ± 1.77 | 8.09 ±0.36 |
| Jofreh | 31.2 | 8.2 | 2.65 ± 0.10 | 25.49 ± 2.92 | 10.51 ±1.08 |
| Jabree | 31.2 | 8.18 | 2.64 ± 0.03 | 25.03 ± 2.27 | 10.64 ±0.94 |
| Bandargah | 31.6 | 8.2 | 2.64 ± 0.05 | 28.21 ±2.73 | 9.44 ±0.84 |
| T.V | 31.2 | 8.18 | 2.62 ± 0.17 | 24.18 ± 1.65 | 10.9 ±1.29 |
| Abshirinkon | 31.6 | 8.2 | 2.43 ±0.12. | 30.76 ± 1.99 | 7.94 ±0.50 |
| Mean | | | 2.64 | 27.59 | 9.73 |

Air temperature during sampling days ranged from 29.5 to 35°C, and the mean water temperature ranged from 31.2 to 31.6°C. The concentration of F in the Bushehr coast water ranged from 2.28 to 2.92 mg/L, and the Cl^- concentration ranged from 21.71 to 34.54 g/L with mean concentrations of 2.64 mg F/L and 27.59 g Cl^- /L, respectively (Table 1). The F to Cl^- weight concentration ratio in different stations ranged from 7.22×10^{-5} to 12.77×10^{-5} with a mean of 9.73×10^{-5} .

Table 2 shows some previous reports^{6–10} on F and F/Cl⁻ ratio levels in different seas. In agreement with our report, a study¹⁰ of Mediterranean Seawater (Oliva on the east coast of Spain), a high F concentration (2.50 mg/L) has also been reported.

Table 2. F and F/Cl⁻ ratio levels in some previous studies

| Sampling points | F concentration | F/Cl ⁻ | Ref |
|-------------------------------------|-----------------|----------------------------|-----|
| Tokyo Bay | 0.63–1.27 mg/kg | 6.71–8.76x10 ⁻⁵ | 6 |
| Karachi coastal area | 1.04–1.52 mg/L | - | 7 |
| Coastal & estuarine area of Georgia | - | 6.9x10 ⁻⁵ | 8 |
| West coast of India | 1.33 mg/kg | 6.83x10 ⁻⁵ | 9 |
| Cantabrian (Sangenjo) | 1.70 mg/L | - | 10 |
| Mediterranean sea (Barcelona) | 1.45 mg/L | - | 10 |
| Mediterranean sea (Oliva) | 2.50 mg/L | - | 10 |

In a recent study,¹¹ we reported the F content of the skin and muscle tissues of the commercially important species of fish, the Indo Pacific-King mackerel (*Scomberomorus guttatus*) and tiger tooth croaker (*Otolithes ruber*) that are harvested off the Bushehr shores of the Persian Gulf. It is likely, therefore, that the higher F concentration of the Bushehr coastal water of the Persian Gulf compared to the average F content of seawater (1.2–1.4 mg/L)¹² contributes to the high F content of the skin and muscle of these fish.¹¹ Therefore, in view of the relatively high consumption of fish in Bushehr Province, together with the high concentration of F in drinking water in certain parts of the province,³ the use of low F bottled drinking water^{13,14} and more research on the F content of sea foods harvested from the Persian Gulf are recommended.

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