

FLUORIDE CONCENTRATIONS IN BOTTLED DRINKING WATER AVAILABLE IN NAJAF AND KARBALA, IRAQ

Reza Fouladi Fard,^a Amir Hossein Mahvi,^b Sara Sadat Hosseini,^a Mohammad Khazaei^c
Tehran, Iran

SUMMARY: The fluoride (F) concentration in 14 brands of bottled drinking water that were proffered or sold during the Arba'een holy trek in Iraq, from Najaf to Karbala, were analysed and compared with the F levels on the labels. The mean F level of the bottled drinking water was 0.28 mg/L with a range of 0.13 to 0.50 mg/L. Significant differences were present between the measured F concentrations and the F values on the labels ($p<0.001$).

Keywords: Bottled water; Fluoride concentration in bottled water; Iraq; Label.

INTRODUCTION

Waters differ in their fluoride (F) levels because of variations in the presence in the earth's crust of F-containing mineral sources, such as fluorapatite, fluor spar, and cryolite, and may reach levels of 10 mg F/L.¹ F levels in drinking water above 1 mg /L may cause fluorosis^{2–4} and several studies have examined the F content of bottled water and the accuracy of the F values on the labels.^{5–13} Bottled drinking water consumption has increased recently, particularly with travellers and in some urban communities.¹⁴ Every year, huge crowds of pilgrims travel to the city of Karbala in pilgrimage to the Imam Hossein holy shrine in Karbala on Arba'een Day, with the main route starting 80 km away in Najaf (Figure). During these holy trek days, different brands of bottled waters are proffered or sold at numerous locations. This study aimed to measure the F concentration in these bottled drinking waters and to check the accuracy of the F values on the labels.

MATERIALS AND METHODS

The F concentration of 14 brands of bottled drinking water that were proffered or sold to Arba'een's Imam Hossein pilgrims during 19–24 December 2013 were analyzed. The sampling locations were around Najaf, Karbala, and the main route between these cities (Figure). All samples were stored in 100 mL polyethylene vessels and preserved in a dark place before delivery to the laboratory for analysis. The F analysis was made by the standard SPADNS method using a Spectrophotometer DR/5000s (HACH Company, USA).

RESULTS AND DISCUSSION

The measured F concentrations in the bottled waters had a range of 0.13 to 0.5 mg/L, with a mean of 0.28 mg/L, and differed significantly from the values shown on the labels ($p<0.001$) (Table). Matloob, in a study during the 2010–2011 pilgrimage, in Babil, Iraq, found that the average bottled water F-concentration was 0.073 ± 0.066 mg/L and 63.5% of the bottled waters did not state the F concentration on the label.¹⁵

^aSchool of Public Health, Tehran University of Medical Sciences, Tehran, Iran; E-mail: rezafd@yahoo.com; ^bFor correspondence: School of Public Health and Center for Solid Waste Research, Institute for Environmental Research, Tehran University of Medical Sciences, Tehran, Iran; E-mail: ahmahvi@yahoo.com; ^cResearch Center for Environmental Pollutants, Qom University of Medical Sciences, Qom, Iran; E-mail: khazaei57@gmail.com.

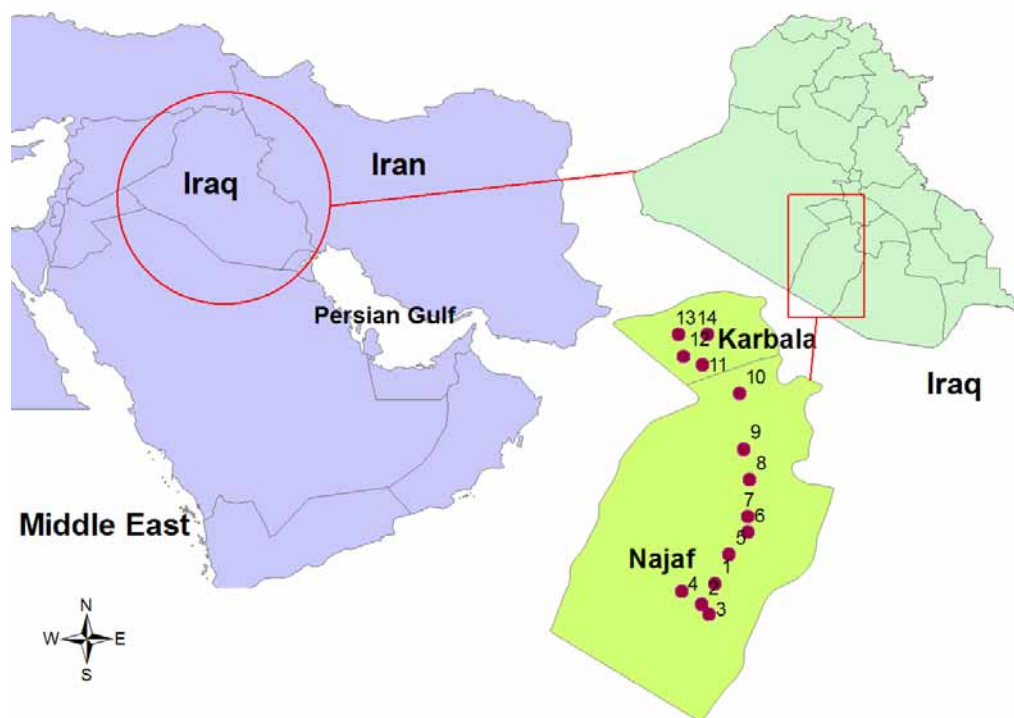


Figure. Locations in Iraq where the bottled drinking water samples were collected. Names of the brands of bottled water proffered or sold: 1: Hayat, 2: Al waha, 3: Al ghaith, 4: Lava, 5: Mina, 6: Al ameer, 7: Jod, 8: Hana, 9: Al bayan, 10: Rovian, 11: Al khazyr, 12: Al safa, 13: Al zain, 14: Arafah.

Table. Labelled and measured fluoride (F) concentrations of 14 brands of bottled water proffered or sold in Najaf and Karbala, Iraq

No	Brand	Labelled F concentration* (mg/L)	Measured F concentration (mean±SD mg/L)	Difference between labelled and measured concentrations [†] (%)
1	Hayat	0.90	0.28±0.02 [‡]	-69
2	Al waha	NL	0.30±0.02	-
3	Al ghaith	0.90	0.28±0.02 [‡]	-69
4	Lava	0.03	0.21±0.02 [‡]	+600
5	Mina	0.70	0.35±0.02 [‡]	-50
6	Al ameer	0.03	0.30±0.02 [‡]	+900
7	Jod	NL	0.50±0.02	-
8	Hana	0.90	0.15±0.02 [‡]	-83
9	Al bayan	NL	0.44±0.02	-
10	Rovian	<0.11	0.29±0.02 [‡]	+163
11	Al khazyr	NL	0.23±0.02	-
12	Al safa	NL	0.13±0.02	-
13	Al zain	0.50	0.16±0.02 [‡]	-68
14	Arafah	NL	0.24±0.02	-

*NL= F concentration not labelled. [†]Positive sign (+) indicates the measured F concentration is higher than the labelled concentration. Negative sign (-) indicates the measured F concentration is lower than the labelled concentration. [‡]Compared to the labelled F concentration, p<0.001.

In another study in Riyadh, Saudi Arabia, Aldrees and Al-Manea found the mean F concentration in 15 brands of bottled water was 0.79 mg/L and that in two brands a significant difference was present between the measured and labeled F concentrations.¹³ In Australia, Mills et al. found that 90% of bottled water samples had F concentrations of less than 1.2 mg/L.⁷ In Iran, mean bottled water F concentrations have been found of 0.3 mg/L (Tehran, 2008),⁸ 0.29 mg/L (Tehran, 2009),¹⁴ 0.157 mg/L (Sanandaj),¹⁰ and 0.18 mg/L (Bushehr)⁵ with the measured and labelled F concentrations differing in approximately half of the brands.

Black tea consumption is very common in this region, and as tea leaves have a high F content,¹⁶ in areas where the drinking water F-concentration is above 1 mg/L, it is recommended that this beverage is prepared with low-F water, such as low-F bottled water or with water that has been treated to lower its F content, with, for example, a selected hybrid resin.¹⁷

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