

Fluoride Content of Bottled Drinking Water Available in North West of Iran

Reza Fouladi Fard^{a,c}, Nezam Mirzaei^{b,c*}, Ahmad Reza Yari^a, Hiva Daraei^b, Esmail Ghahramani^b, Hossein Kamani^d, Mohammad Ahmadpour^e

^aResearch Center for Environmental Pollutant, Qom University of Medical Sciences, Qom, Iran.

^bEnvironmental Health Research Center, Kurdistan University of Medical Sciences, Sanandaj, Iran.

^cDepartment of Environmental Health Engineering, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran.

^dHealth Promotion Research Center, Zahedan University of Medical Sciences, Zahedan, Iran.

^eDepartment of Public Health, Maragheh University of Medical Sciences, Maragheh, Iran.

*Correspondence should be addressed to Dr. Nezam Mirzaei; Email: nezammirzaei@yahoo.com

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Background: Consumption of bottled waters has received popularity and more acceptances. Fluoride is necessary for human life. But high levels of fluoride can cause some problems for human health such as Fluorosis and teeth and bones problems. The aim of this study is measure the fluoride content in bottled waters consumed in North West of Iran and comparison with the amount listed on their labels and with the drinking water standards.

Methods: In this study, 10 brands of bottled water were sampled from markets over the two seasons randomly. Samples were analyzed for fluoride using Ion Chromatography (IC) method.

Results: Results showed that fluoride concentration in different brands had a significant difference ($P < 0.05$). The concentration of fluoride in samples ranged between 0.04 and 0.32 mg/L. Among analyzed selected brands four brands were observed significant differences with the measured values.

Conclusion: Totally the measured values didn't match with the values declared on the labels (Reliability coefficient < 0). It was revealed that fluoride concentration in all brands was less than the lower range of Iranian national standard (0.7-1.2 mg/lit).

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Background

Consumption of bottled waters has increased and received popularity and more acceptances, particularly with travelers and in some urban communities. Bottled water consumption has doubled in the years between 1997 and 2007 (1-4). The tendency of bottled waters consumption may be due to lack of clean water access with good quality, haven't inappropriate taste and odor, and these believes that bottled waters has more therapeutic characteristic, natural and healthier than tap water (5-7). There are more than 100 companies of bottled water in Iran.

Bottled waters consumption has increased in recent years, especially in urban communities and travelers (8).

Fluoride in drinking water is usually the main source of fluoride intake (9). High levels of fluoride intake can cause some problems for human health such as Fluorosis and teeth and bones problems. However, a recommended value of this element can be beneficial to dental health (3,8,10-11). American Dental Association (ADA) has recommended a range of 0.7-1.2 mg/L in drinking water. This value has been accepted as fluorides standard value in drinking bottled water. The guideline of World

Health Organization (WHO) for fluoride in drinking water is 1.5 mg/L (1,8,12). Some studies have been done to investigate of fluoride concentration in bottled waters in the world, including in Iran (8,13).

That is both high and low concentration of it are harmful

Aims of the study: This study aimed to measure the fluoride concentration of bottled waters in North West of Iran (Sanandaj city) and comparison with the labeled values and present standards.

Materials & Methods

In this cross-sectional study, 10 most common brands of bottled drinking waters were purchased from supermarkets in Sanandaj (North West of Iran) during summer 2011 to winter 2012. These brands assigned with a number as a code (1-10) so that those undertaking the analysis would be blind to the source. Three samples (1.5-liter bottles) were taken from each brand. The ion chromatograph (IC) with auto-suppression (Metrohm, Compact IC plus 882) was used to measure the fluoride content. The mobile phase was consisting of Sodium Hydrogen Carbonate (1.7 mM/L) and Sodium Carbonate (1.8 mM/L) in solvent of Merck ultra pure water. A standard curve was drawn based on fluoride standard solutions (Fluka Company at concentrations of 1, 5, 25 and 50 mg/L). Ultra-pure water was used as blank, and all samples were analyzed in a stable condition and the amount of fluoride in the samples measured based on standard curve. Experiments carried out at the laboratory of Kurdistan University of Medical Sciences. Data analysis was performed by SPSS software (Version 20).

Results

Table 1 shows concentration and standard deviation of fluoride in various brands, as shown in table 1 the concentration of fluoride in

samples ranged between 0.04 and 0.32 mg/L and the average of measured fluoride in all samples was 0.16 ± 0.09 mg/L. ANOVA and POST HOC with Tukey method showed that there was a significant difference between fluoride concentration in bottled water ($P < 0.05$). In this table, the negative numbers represents a lower measured concentration as compared to the label concentration and positive number represents higher measured concentration as compared to the label. The value of fluoride was presented in eight brands, and there was a considerable difference between measured and labeled concentration in 4 brands (Table 1). It was revealed that the average of overall concentrations measured is significantly lower than mean value that declared on the labels of different brands. Pearson test showed that there is no homology between the measured values and the values declared on the labels (Reliability coefficient < 0). According to Iran's bottled water standards and American Dental Association (ADA) guideline (0.7-1.2 mg/L) it can be noted that (Fig. 1) in all brands the fluoride concentration was not in the standard range, (i.e. they were less than 0.7 mg/L).

Discussion

In similar studies that carried out in Iran, difference between the labeled concentration and the measured concentration was revealed. The previous studies in Iran, the average of 0.35 mg/L and 0.29 mg/L have been reported in bottled water by Ghaderpoori and Dobaradaran (8, 13). Nabipour found that the mean fluoride concentration of bottled water was 0.18 mg/L with a range of 0.00 to 0.37 mg/L in Bushehr, Iran (14). Shams et al. reported that the average concentration of fluoride in five most available brands of bottled drinking water in Gonabad, Iran was 0.23 mg/L (15). The result of Gupta and Kumar study showed that the concentration of fluoride in the fifteen

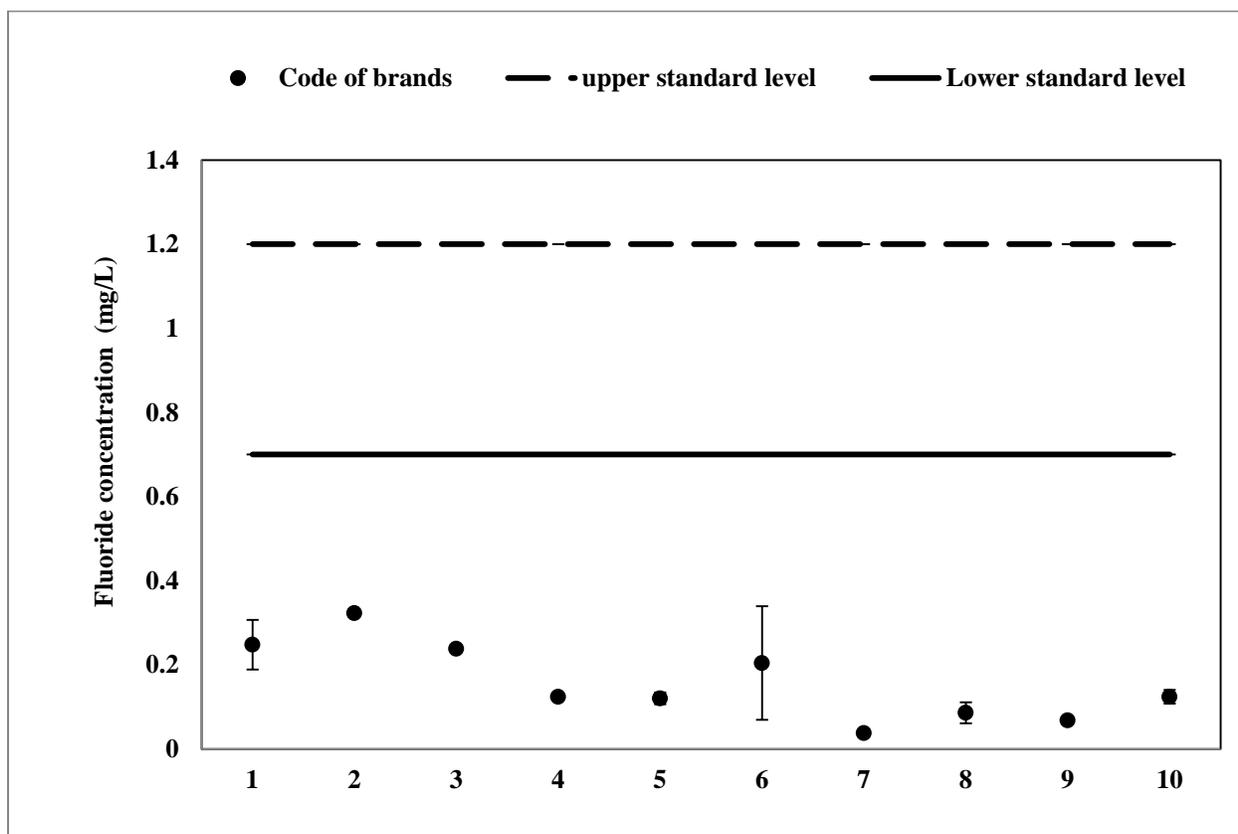


Figure 1) Fluoride concentration in different bottled water brands in comparison with standard

Table 1) Labeled and measured fluoride concentrations in different bottled water brands

Brand cods	Fluoride concentration specified on the label (mg/L)	Mean ± SD fluoride concentration (mg/L)	Difference between labeled and measured concentration (%)
1	0.27	0.25±0.06	-8
2	0.4	0.32±0.00	-20
3	0.23	0.24±0.005	+3
4	0.2	0.12±0.001	-38
5	0.54	0.12±0.01	-78
6	-	0.21±0.14	-
7	0.1	0.04±0.002	-62
8	-	0.09±0.02	-
9	0.8	0.07±0.006	-92
10	0.11	0.12±0,02	+13
Total mean	0.33	0.16±0.096	-52

brands of bottled drinking waters purchased in Agra (India) ranged between 0.45 and 0.86 mg/L (16).

A study has been carried out on bottled water in Australia showed that the fluoride concentration of 9% of the brands was in the range of Australia standard. (1.2-1.7 mg/L), one percent more than the standard ranges and the majority of samples were below the standard range (17). Another study on bottled water brands in Ohio showed only 3 of 57 have also been measured in the standard range of EPA (0.8-1.3 mg/L) and other were less than this range (18). The results of study which conducted on 15 brands of bottled water in Saudi Arabia showed that only two brands the measured concentrations of fluoride had significant difference with labeled concentrations. The mean of fluoride concentrations was 0.79 mg/L (1). Ahiropoulos reported that the fluoride concentration of 50 percent of brands in Egypt had significant difference with labeled concentrations (19).

Conclusions

The result of this study showed that measured fluoride concentrations in all brands were less than the lower range of Iranian standards (0.7-1.2 mg/L). Although this range of concentrations have not bad effect on human health, but based on the guidelines of Iranian physicochemical standard and American Dental Association guideline since the optimum concentration of fluoride is healthful and necessary to human, we recommend to keep fluoride concentration in the range of 0.7-1.2 mg/L in bottled water. Differences between the measured and labeled concentrations indicate the lack of precision or uncertainty in the declared values. So the regulations on health supervision and quality control of these products are strongly recommended.

Footnotes

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Conflict of Interest:

The authors declare no conflict of interest.

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