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

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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...
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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

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