Original Article

Received: Aug. 2011

Accepted: Nov. 2011

Accuracy of Fluoride Levels in the Bottled Drinking Water Products Sold in Hamadan, Iran

Massum, T.* Mojarrad, F. Khodakarami, K.*****

* Pedodontist, Private Practice, Tehran, Iran

**Associate Professor, Department of Pediatric Dentistry , Faculty of Dentistry, Hamadan University of Medical Sciences, Hamadan, Iran

***Dentist

ABSTRACT

Statement of the Problem: Generally, the main source of fluoride intake is drinking water. Excessive consumption of bottled water as a substitute or in addition to the tap water supply may have implications for safe fluoride supplementation. In this study, fluoride contents in six commercial brands of bottled water were measured.

Materials and Methods: Six different brands of bottled drinking water available in Hamadan, Iran, were selected. The fluoride concentration was determined in the laboratory by using a HACH spectrophotometer. The standard SPANDS method was used to determine fluoride ion concentration.

Results: The range of fluoride content of various bottled water products was 0.09–0.7 mg/L. In all the samples the fluoride contents on the labels were different from the measurements in the laboratory.

Conclusion: The manufacturers' labeling of fluoride concentrations in Iran may be inaccurate. When prescribing fluoride supplements, dentists should be aware of the fluoride content of bottled water products used by pediatric patients.

Keywords: Drinking Water , Fluorides, Spectrophotometer.

INTRODUCTION

Water, used directly as a drink or indirectly as an additive to beverages and some foods, is an essential source of fluoride intake.[1] One of the most common trends among consumers in recent years in various countries, including Iran, is the replacement of their daily water intake with bottled water.[2]

Corresponding author: F. Mojarrad, Department of Pedodontics, Faculty of Dentistry, Hamadan University of Medical Sciences, Hamedan, Iran. Tel: +98 912 607 25 22 Email: FarzadMojarad@yahoo.com

The replacement of tap water by bottled water happens mainly for these reasons: easy access and low price of bottled water, the questions about the public water source and the strong chlorine taste, resulting from generalized water chlorination in most areas.[2]

Traditionally, tap water has made an important contribution to total water intake with 40–50% of daily water intake coming from this source when the ambient temperature is lower than 21°C.[3] However, more recently, there has been a trend to use

more natural beverages,[4] a developing passion for fitness, greater travel and access to refreshments, as well as moves towards consumption of more food outside the home. These changes, as well as the concern about the taste and quality of public water supplies and the potential for pollution of water, have prompted many people to turn to bottled water.[1]

The supervision of the contents of mineral water is not strict and the concentration printed on the labels may not be accurate. One study in Pakistan showed that about 52% of bottled water was not suitable for drinking.[6] Therefore, there was a need to conduct such kind of research to determine the accuracy of the concentration of fluoride mentioned on the labels of the bottled drinking water.[5]

For effective preventive measures, it is important to know precisely the concentration of different elements in water the people are drinking. For example, in the case of fluoride (F) level, it is well documented in literature that drinking fluoridated water reduces the incidence of dental caries. However, a significantly higher concentration of fluoride may lead to an objectionable fluorosis problem.[6]

The aim of this study was to determine the concentration of fluoride in commercially available bottled water products distributed in different parts of Hamadan, Iran and to report the accuracy of the labeling of fluoride concentration on the bottle.[7]

MATERIALS AND METHODS

Six different brands of non-carbonated bottled drinking water products, including Damavand, Vata, Bisheh, Nestle, Alvand and Koohrang, were collected from the supermarkets of Hamadan, Iran in 2007. From each brand five bottles with different dates of bottling (production date) were bought during a period of 4–6 weeks. The bottles were made of polyethylene terephthalate (PET).

The samples were analyzed for fluoride concentration in the laboratory of Health Faculty, Hamadan University of Medical Sciences.

The bottled water was kept sealed in original plastic containers at room temperature until analyzed for the fluoride level.

Before the analysis of the samples, the HACH spectrophotometer (Model DR5000)[8] was calibrated by testing 25 mL of distilled water with 5 mL of buffered solution.

The standard SPANDS method[9] was used to determine fluoride ion concentration. The SPANDS method for fluoride determination involves the reaction of fluoride with a red zirconium dye solution.

The spectrophotometer was adjusted for wavelength at 580 nm throughout the procedure. Data were analyzed using SPSS 15.

ANOVA was applied after logarithmic conversion where necessary to detect significant differences between means. One-sample Kolmogorov-Smirnov test was

used to verify the normal distribution of the observations. A probability level of $P<0.05$ was considered statistically significant.

RESULTS

Six commercial brands of bottled drinking water were tested for determination of fluoride level in bottled drinking water products marketed in Hamadan. The fluoride ion concentrations in bottled drinking water products sold in Hamadan are shown in (Table 1). Regarding the quality of the labeling of bottled water, none of them had mentioned the accurate fluoride concentration on the labels. The mean fluoride concentrations of samples of Damavand, Vata, Koohrang, Nestle, Bishe and Alvand bottled water products were 0.7, 0.6, 0.3, 0.03, 0.05 and 0.09 mg/L, respectively. The highest mean concentration was found in bottled water from Damavand, which had a measured mean fluoride concentrations of 0.71 (± 0.12) mg/L. In two samples (Damavand and Vata) the displayed fluoride concentration on the label was below the level measured in this study; it was labeled 0.20 and 0.11 mg/L compared with a measured fluoride content of 0.71 and 0.62 mg/L, respectively. For one sample (Alvand) the displayed fluoride concentration on the label was far above the level measured in this study; it was labeled 0.6 mg compared with a measured fluoride content of 0.09 mg (Table 1). None of the six brands displayed precise values for fluoride content. Based on the results of ANOVA, the association between bottled water brands and labels was not statistically significant at $P<0.05$.

Table 1: Label and laboratory values of fluoride levels of bottled drinking water

Brands	Fluoride concentration on the label (mg/L)	Fluoride concentration in the sample (mg/L)
Damavand	0.2	0.7
Vata	0.11	0.6
Koohrang	0.23	0.3
Nestle	0.07	0.03
Bishe	0.07	0.05
Alvand	0.6	0.09

Table 2: the concentration of labeled and measured fluoride in bottled waters in this study and two previous studies in Iran

Brands	Fluoride concentration on the label (mg/L)	Fluoride concentration in sample (mg/L)		
		present study	Previous study	
			Ghaderpoori (7)	Amanlou (16)
Damavand	0.2	0.7	0.31	0.12
Vata	0.11	0.6	0.11	0.1
Koohrang	0.23	0.3	0.07	0.20
Nestle	0.07	0.03	0.41	-
Alvand	0.6	0.09	-	-
Bishe	0.07	0.05	-	0.27

Table 3: Accuracy of the printed concentrations of fluoride in bottled waters in various studies

Researcher	Country	N	Accurate label	References
Weinberger	Canada	17	1	3
Ahiropoulos	Greece	4	2	2
Toumba	England	7	3	11
Macfaden	England	26	6	12
Zohouri	England	8	2	1
Dobaradaran	Iran	17	6	13
Ghaderpoori	Iran	13	3	7
Present study	Iran	6	0	

DISCUSSION

Increased consumption of mineral water as a substitute or in addition to the public water supply may have implications for safe fluoride supplementation.[10]

The results of this investigation were compared with those of other studies in Iran in relation to fluoride levels in mineral (bottled) water products. Large variations in fluoride concentration (0.09 to 0.7 mg/L) were found for all the samples analyzed, consistent with the results of previous studies in Iran (Table 2). Variations like these were also observed in the results of a study by Ramires et al, in which variations between 0.07 and 1.51 mg/L of fluoride were found for the same brand.[10]

The fluoride levels in all the brands evaluated in this study revealed significant differences between the measured fluoride concentration and that labeled on the bottle.[2,7] Table 3 also shows discrepancies in other studies.

For effective preventive measures, it is important to know precisely the concentration of different elements in water that the people are drinking.

For example, in the case of fluoride (F) level, it is well documented in literature that fluoridated drinking water reduces the incidence of dental caries. However, a significantly higher concentration of fluoride may lead to an objectionable fluorosis condition.[5,6]

The American Academy of Pediatrics (1986) recommended that for optimal dental health the total daily intake should be 0.05–0.07 mg fluoride per kilogram of body weight, and to avoid the risk of dental fluorosis the fluoride intake should not exceed a daily level of 0.10 mg of fluoride per kilogram of body weight.[14]

In this study, 2 bottled water samples (Damavand and Vata), out of 6, showed fluoride levels near the recommended maximum value of 0.7 ppm, although some had lower doses. There were signification differences between mean fluoride levels determined in the laboratory and the value on the labels of Nestle, Alvand and Bishe. These high levels of concentration could develop the objectionable fluorosis problem but it will not be serious. Dentists should be careful in making decisions about fluoride recommendations because the values mentioned on the label of the bottle may not be accurate.

Even in many other countries,[1,2,4,11,15] some bottled water companies do not state the fluoride concentration on the label. For example in Ahiropoulos from Greece only 4 of the 22 brands of bottled water products state the fluoride concentration on the labels.[2]

It is also important that the consumers have accurate information about the fluoride content of the bottled water they drink. With this in mind it may be advisable for mineral water products to be assayed at least twice per year in relation to their fluoride content by an independent organization. There is no strict regulation on the labeling of fluoride content of bottled drinking water products in Iran; thus appropriate regulation seems absolutely necessary.[16]

CONCLUSION

This study showed that bottled drinking water in Iran may contain various concentrations of fluoride and accuracy of the printed concentrations might be doubtful. Dentists should be aware of the fluoride concentration of the drinking water of their child patients when prescribing fluoride supplements. This is of particular importance as there is a potential risk of dental fluorosis as a result of high levels of fluoride.

ACKNOWLEDGMENTS

This work was supported by a grant from Hamadan University of Medical Sciences (No. 88819118522).

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