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Research Article

Estimation of Bottled Drinking Water Fluoride Extracted From Different Natural Springs of Iran

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ABSTRACT

Background: Bottled water consumption has been doubled in Iran in recent years.The aim of this study is to evaluate the fluoride content of bottled drinking waters commercially available in Iran extracted from different springs over the country and comparison with the drinking water standardsin the world.

Methods and materials:17commercially available brands of bottled water were obtained from supermarkets having labels for ion contents such as fluoride. Spectrophotometry was used to analyze and determine the fluoride concentration in the samples.

Results: The concentration of fluoride in samples ranged between 0.11 (ppm) to 0.53 (ppm) in which was nearly the same as the values mentioned on the labels.The differences between the upper and lower values may be regarded significant

Conclusion: the fluoride content of mineral bottled waters customary used in Iran is in generallower than the optimal level of world national standards (0.7-1.2 mg/lit)and there is a need to elevate the fluoride levels in bottled waters.

Keywords: Bottled water, Fluoride Concentration, Label,

INTRODUCTION

Groundwater is the main source of drinking water for the area residents in all of the world. Fluorine is the most electronegative naturally and reactiveion of allelements in drinking water . Waters differ in their fluoride (F) levels because of variations in the presence of the earth's crust of F-containing mineral sources, such as fluorapatite, fluorspar, and cryolite, and may reach levels of 10 mg F/L.[17]It occurs as F- in soils and natural waters due to chemical weathering of some F--containing minerals .[25]Fluoride in small amounts is anessential component for normal mineralization of bonesand formation of dental enamel .[2] When present in optimal quantities it is known to prevent caries by various mechanisms but more predominantly by deposition of calcium fluoride crystals which is more resistant to demineralizationprocess[4, 23].F levels of course in drinking water above1 mg /L may cause fluorosis[10]in enamel tissue according to World Health Organization, the standard rate of fluoride in drinking water is 0.5–1 ppm.[19]

Community water fluoridation began in 1945 and is considered as an effective way of preventing caries in children as well as adults . The World Health Organisation has identified dental caries as a worldwide epidemic and also

recommended to add fluoride to drinking water in naturally occurring water whit less than optimal fluoride levels.[23]

Fluoride concentrations in drinking water differ between countries as well as within the same country itself, dependent on natural circumstances leading to water fluoridation. The knowledge of the fluoride levels in drinking water is an important issue to all health care professionals especially dentists to regulate the optimum fluoride level needed.[21]

Iran has different weather and temperature varyingfrom +50°C to −20°C in various regions . Groundwater is a major source of drinking water and so intake of fluoride.[3, 18]However,in recent years there has been a replacement of drinking purified tap water with bottled water.The tendency of bottled waters consumptionmay be due to the lack of clean water access withgood quality, without inappropriate taste and odor in different regions and it is believed that bottled waters have more therapeutic characteristic,are more natural andhealthier than tap water.[1, 24]. Some studies have been done to investigate the fluoride concentration in bottled waters in the world, as well as in IranGhaderpooriet al. and Dobaradaran et al. have been reported an average of 0.35 mg/L and 0.29 mg/L fluoride ion in bottled water of Tehran, Iran [5, 22]. Nabipour et al. 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.[8]A study carried out on bottled water in Australia showed that the fluoride concentration of only 9% of the brands of bottled waters was in the range of Australia standards,(1.2-1.7 mg/L).[14] Another study on bottled water brands in Ohio showed only 3 of 57 samples have also been measured to be in the standard range.[12]The present study aims to evaluate the fluoride content of different bottled waters from different spring sources available in Iran.

METHODS AND MATERIALS

Bottles of 17 commercially available brands of mineral water prepared in the present year were obtained from supermarkets around shiraz, iran. The labels of the bottles were studied to check for labelling of fluoride concentrations. All bottles were stored in a dark place and in their original closed plastic containers at room temperatures until the fluoride analysis was done. The samples were analyzed in a Water TreatmentLaboratory, in shiraz. Spectrophotometry was used to analyze the fluoride concentration in the samples. This method involved measuring the intensity of a Zirconia coluor in the sample solutions and relating it to the concentration of their fluoride content . The control solution (10 millilitres of distilled water) was tested for fluoride concentration as well . Then, the standard solutions of known fluoride concentrations were tested to check for the reliability of the technique. After shaking the bottles of water, a 10-millilitre sample was pipetted from each and mixed with 2 millilitres of *Spands reagent*. This reagent helps to detect the color that shows the wavelength of fluoride; which is detected at 580 nanometres. The pH of the water samples was also measured using a pH-meter (Model 240, Corning). 10 samples were randomly selected and re-analyzed to assess the reliability of the method. All samples were number coded so that the investigators were blind to the type of water contained in the bottles.All the data were entered and analyzed using SPSS (Statistical Package for Social Sciences) and Microsoft Excel.

RESULTS

The F concentration in the 17 brands of bottled drinking water and tap water sources are shown in Table 1. For each water sample the concentration is shown in (ppm)fluoride .The mean fluoride content of the 17 bottled watersamples was 0.30(ppm) with a range from 0.11 to 0.53(ppm). The highest and lowest fluoride concentration was found in bottled water from Sepidan and Koohrang,which had a measured fluoride concentrations of 0.53 and 0.11 PPM respectively. Differences between the measured and label values were not statistically significant in3brands (Shemiran, Kanibel, Margoon) in which the fluoride concentration was not stated on their label. Most of the labeled fluoride concentration of the bottled

water samples was almost in agreement with our measurements. However, two samples(Prim, Dasani) had a lower fluoride level than the value stated on the label with a difference of approximately 0.3 ppm. Two of the samples (Polur and Vata) had higher fluoride level than the value stated on their label with a difference of approximately 0.3 mg/L and 0.2 mg/L respectively .

Table.1 Labeled and measured fluoride concentrations of 17 commercial bottled waters and tap water sources in Shiraz, available in Iran (mg F/L)

Bottled water brand	Labeled F concentration (NL=not labeled)	Measured F concentration (mg/L,ppm)
Dasani	0.6-1.1	0.35
Prime	0.4	0.17
Koohrang	0.23	0.11
Sovana	0.2	0.20
Shesh peer	0.17	0.23
Vata	0.11	0.49
Damavand	0.2	0.29
Polur	0.07	0.41
Sepidan	0.5	0.53
Baba barfi	0.3	0.38
Pars	0.3	0.25
Sutrap	0.23	0.39
Shemiran	NL	0.34
Kanibel	NL	0.23
Damash	0.2	0.24
Margoon	NL	0.3
Mabda	0.44	0.29

DISCUSSION

Fluoridated water is generally regarded as a safe and practical way to prevent dental caries among all groups of the society.[6]In view of the fact that the fluoride content of tap water in Iran is reported inconsistently and more or less variable throughout the country and there is an over-growing shift toward the consumption of bottled mineral water, it is indispensableand important to know and control the concentration of different elements including fluoride in these products.[20]

The fluoride concentration of bottled mineral water samples in the present study varied widely according to their different geographic sources ; consistent with the results of previous studiesin Iran and othercountries.In our study, the fluoride concentration of the samples were ranged between 0.11 to 0.53 ppm with a mean concentration of 0.30 ppm.Ramires et al, showed variations between 0.07 and 1.51 mg/L of fluorid in Brazil.[16]Massum et al, also found even Larger variations in fluoride concentration (0.09 to 0.7 mg/L) of six brands of bottled drinking water sold in hamedan, Iran.[13]

Jimenez at al, showed that the mean fluoride concentration of commercially available bottled water inMexico City was in a more higher range (0.05 to 4.8 ppm).[9] The range of fluoride for the present studywas in range of 0.11 to 0.53 ppm.The result of Gupta and Kumar study showed that the concentration of fluoride in the fifteen brands of bottled drinking waters purchased in Agra (India) ranged between 0.45 and 0.86 mg/L as well.[7]

Moslemi et al, reported that the measured fluoride concentrations of bottled water were significantly lower than those printed on the labels and the mean fluoride level of both bottled and tap water samples evaluated is considerably lower than accepted standards in Tehran, Iran .[20]

Generally,mean scoresof fluoride obtained from the studies conducted in Iran (0.43 ± 0.17 ppm) is less than standard values of 0.7 ppm for tropical and 1.2 ppm for cold regions recommended by World Health Organization.[18] There are different concentrations of water fluoride in Iran due to variable ecological conditions of the country. Therefore, proper plans and policies should be designed and executed to standardize fluoride concentration of different bottled waters.[18]for example ;It is important that manufacturers recognize and

monitor fluoride concentrations in their products and if necessary, fluoride levels should be modified in the final product.The wide ranges of fluoride concentrations in bottled water make the real fluoride intakeestimation by the populations very difficult to assess. Wide variations in dietary patterns add further to the complexity. Knowing All of the fluoride intake sources of a patient is important, and the total fluoride intake from all sources must be evaluated to prevent the development of fluorosis .[11]So dentists should review the total fluoride intake from the drinking water and other sources of their patients with respect to their age,gender, seasonal changes of temperature and then prescribe additive fluoride if needed.[15]

CONCLUSION

The results in this study indicate that the fluoride content of mineral bottled waters extracted from different natural springs in Iran is lower than the optimal level suggested by WHO.The highest and lowest fluoride concentrations were found in water samples from Sepidan and Koohrang respectively (0.53 and 0.11ppm)with an almost significant range width of 0.42 .Most of the labled fluoride concentrations of the bottled water samples were almost in agreement with our measurements but more accurate control is needed for fluoride estimation of bottled water samples in Iran .

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