

QUANTITATIVE ANALYSIS OF FLUORIDE CONTENT IN PACKAGED DRINKING WATER BOTTLES AVAILABLE IN KERALA, INDIA.

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Abstract

Objective: To quantitatively analyze the fluoride content in packaged drinking water bottles available in Kerala, India.

Materials and Methods: Twenty different brands of packaged drinking water bottles available in the state of Kerala, India were included in the study. Three samples of each brand procured from different batches were included in the analysis. The fluoride content was determined using fluoride-ion selective electrode method and expressed as mean of three samples. The mean fluoride content in different brands of packaged drinking water was compared using Kruskal Wallis ANOVA. P-value of <0.05 was considered to be statistically significant

Results: Six brands of packaged drinking water bottles had fluoride level less than the detection limit of 0.01 mg/L. The mean fluoride content of the remaining 14 brands of packaged drinking water bottles ranged from 0.09mg/L to 0.32mg/L and there was no statistically significant difference. (H value-2.54, p value-0.68)

Conclusion: The fluoride content in majority of the packaged drinking water bottles available in markets in Kerala were found to be below the optimum desired level as per Bureau of Indian Standards (BIS) for packaged drinking water.

Key words: Fluoride, Packaged drinking water, Fluoride-ion selective electrode, Kerala, India.

The World Health Organization recommends the total daily intake of fluoride at 0.5 – 1.0 mgF/kg body weight for optimal dental health and to avoid the risk of aesthetically objectionable dental fluorosis.¹ Before the advent of topical fluorides, the drinking water was one of the major sources of fluorides for the prevention of dental caries.

Artificial water fluoridation alone was able to reduce the prevalence of dental caries by 50% – 60% and hence was credited as one of the ten most successful public health measure of the 20th century (Centre for disease control and prevention, 2008).²

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However, in recent times, dilution effect has reduced the lone contribution of water fluoridation in caries prevention.

A recent trend witnessed among Indian population is consumption of packaged drinking water on a daily basis. The reasons for this changing lifestyle are manifold. It might be due rising health consciousness, improved purchasing power among public, poor quality of ground water, non-availability of piped drinking water supply in certain areas and easy availability of bottled drinking water.

According to commercial reports (Water portal report for India, 2013), the per capita consumption of bottled water increased in India by 21% in 2011-12, with South India being the biggest consumer in the country accounting for 52% of the total market. Another commercial report released in 2011 substantiated the above data and showed that nearly 50% of the water bottling units are in the South Indian states of Tamil Nadu and Kerala (Pepsi and Co., 2011).⁴

The changing pattern of drinking water consumption has its own health implications. Hence, the Government of India (GoI) classified packaged drinking water under "Food category" and brought it under the purview of "Prevention of Food and Adulteration Act".⁵ Furthermore, certification was issued to brands of packaged drinking water adhering to Bureau of Indian Standards (BIS), IS 13428 and IS 14543. The BIS has laid certain criteria related to colour, odour, microbial counts in packaged drinking water as "mandatory" and certain criteria related to dissolved solids including fluorides in packed drinking water as "desirable". As per BIS guidelines, the desirable fluoride content in packaged drinking water should be 0.6mg/L to 1.2mg/L with the maximum permissible limit not exceeding 1.5mg/L (Bureau of Indian Standards, restructured for packaged water,2005).⁶

In this background, a study was conducted with the aim of quantitatively analyzing the fluoride content in packaged drinking water available in the market in Kerala as it holds a major place in Indian market for packaged drinking water.

Materials and Methods:

The list of all brands of packaged drinking water bottles was obtained from the List of Licentiate for packaged water bottles in India. There were 31 brands of packaged water bottles in Kerala registered with Bureau of Indian Standards (BIS), of which license of 11 brands were deferred. The remaining 20 brands of packaged drinking water bottles were included in the study. Three bottles of each brand with different batch numbers were purchased from various departmental stores/supermarkets across the major cities of India. All the procured samples, had minimum due of three months for its expiry as mentioned in the label.

All the water samples were stored at room temperature in their original sealed plastic containers. The brand label of each bottle was removed and pasted with new label of alphabetic code from A (A₁, A₂,A₃) to T(T₁,T₂,T₃) so that the analyst was blinded to the brand of water. Fluoride levels were determined by a fluoride-ion selective electrode in conjunction with ion analyzer using an acetate buffer system, namely Total Ionic Strength Adjustment Buffer(TISAB).

The samples and fluoride standard solutions (0.2, 0.4, 0.6, 0.8 and 1ppm) were diluted with TISAB. The test solutions which contained 25ml of the sample and 25ml of TISAB solution were mixed with a magnetic stirrer for 3 minutes. The electrode potentials of sample solution were directly compared with those of fluoride standard solutions. Fluoride ion concentration was determined using a fluoride-ion selective electrode (Metrohm, 605 ion-selective Metro-sensor Electrodes, 6.0502. 150, FL, USA) combined to a digital readout meter (Metrohm, pH/ion-meter, Model 781, FL, USA). After the fluoride analysis was completed, the water bottles were decoded of its alphabetic codes. Both coding and decoding was done by an independent person, who was not involved in the research. The data obtained was tabulated and expressed in terms of mean of three samples. The mean fluoride content in different brands of packaged drinking water was compared using Kruskal Wallis ANOVA.

Results:

Table 1 shows out of 20 brands analyzed, six brands had fluoride content less than the detection limit of 0.01mg/L and no substantial difference in the fluoride content of the remaining 14 brands The mean fluoride content in packaged drinking water samples included in this study ranged from 0.01mg/L to 0.32mg/L. None of the brands had displayed the fluoride concentration on the packing labels.

Discussion:

This was the first study conducted in Kerala to analyze the fluoride content in all the available packaged drinking water bottles. This study was contemplated, because Kerala state in South India has nearly 30% NRI population, mostly living or working in the Gulf countries and are characterized by their changing lifestyle hence expected to have higher consumption of packaged drinking water. Further, the ground water level is fast declining, with available sources having poor quality water.⁶ When compared to all previous studies, the highest number of brands of packaged drinking water (n = 20) were included in the study.

The fluoride content in packaged drinking water bottles available in different regions tends to show variation. In the present study, the highest fluoride

TABLE 1-Fluoride content (mg/L or ppm) in different samples of packaged drinking water bottles.

Serial No	Product Code	Mean Fluoride Content mg/L	H value	P value
1	A	0.19	2.54	0.68
2	B	0.25		
3	C	0.11		
4	D	0.15		
5	E	0.12		
6	F	0.13		
7	G	BDL/<0.01		
8	H	0.09		
9	I	0.14		
10	J	BDL/<0.01		
11	K	0.11		
12	L	BDL/<0.01		
13	M	0.26		
14	N	BDL/<0.01		
15	O	0.17		
16	P	0.32		
17	Q	BDL/<0.01		
18	R	0.11		
19	S	0.15		
20	T	BDL/<0.01		

level recorded in packaged drinking water was 0.32mgF/L which was similar to the study conducted by Mythri et al., and Thippeswamy et al., 201. However a study conducted by Puneet and Kumar, in Agra had fluoride content upto 0.86mg/L. This difference is perhaps due to the fact that major parts of North India including Agra are endemically fluorosed zones.

In the present study, the concentration of fluoride in majority of packaged drinking water bottles available in Kerala were less than the optimum desired level as per Bureau of Indian Standards. While none of the other studies conducted earlier have shown fluoride level in packaged drinking water to be below the detectable limit of 0.01mg/L, in this study 6 brands had less than the detectable amount.^{11,12,13,14,15}

Bureau of Indian Standards requires that the water drawn from its source be purified using such as reverse osmosis and distillation generally remove 90% or more of fluoride. So, this might be the reason for six brands of drinking water to have less than the detection limit.

The main limitation of this study is that the fluoride content of packaged drinking water dispensed in 20 litre PET jars were not assessed. Although 76

manufacturing units in South India have registered with the BIS, it is possible that the same manufacturer may market drinking water packed in 20 litre PET jar with more than one brand name.

Furthermore, the Indian market is flooded with many unregistered brands of drinking water packed in 20 L pet jars. So, obtaining a proper sample frame was difficult and hence, fluoride content of drinking water packed in 20 litre PET jars could not be assessed in the present study. However, this study is of significance as it is the first study in which fluoride content of all commercially available packed drinking water bottles complying with BIS in Kerala was assessed.

This study was not done with the intent to question the credibility of BIS, rather, rather to just assess the fluoride content in bottled drinking water as it is given under desirable criteria and not mandatory criteria to obtain BIS endorsement. From this study, we can infer that the exposure to fluoride among subjects who drink bottled drinking water is very limited. Furthermore, this study highlights the importance for strict monitoring and surveillance of fluoride levels in packaged drinking water in Kerala market.

The label of packaged drinking water bottles should contain the information on its fluoride content so that the public can make informed decision. Further studies are strongly recommended to assess the fluoride content in drinking water packed in 20 litre PET jars as it used in majority of the households.

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Conflict of Interest: None Declared