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SHORT COMMUNICATION

Fluoride in Bottled Waters Consumed in Northeastern Brazil

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ABSTRACT

Objective: To assess the fluoride concentration of bottled waters from municipalities in northeastern Brazil. **Material and Methods:** Bottled mineral waters were purchased in two periods at different commercial places of four large municipalities (João Pessoa, Campina Grande, Patos, and Cajazeiras) in the Paraíba state. The municipalities selected to present the following annual average temperature: João Pessoa 26.5 °C, Campina Grande 23.3 °C, Patos and Cajazeiras 27.5 °C. Fluoride concentration was determined using a combined ion-specific electrode. Readings (in mV) were conducted in triplicates for each standard solution and converted into fluoride concentration (mg F/L) using the Excel® software. **Results:** A total of 72 samples from six brands of bottled water were analyzed. The fluoride concentrations of all samples were low (0.11-0.21mg/L) but higher than those reported on the label and varied among different batches of the same brand. **Conclusion:** The fluoride levels in bottled water vary among brands, and these actual values are not stated in the labels.

Keywords: Fluorides; Water; Oral Health.

Introduction

Environmental fluoride is a natural process [1], and water and beverages are responsible for approximately 75% of the dietary fluoride intake [2]. The population consumes more bottled water than public water due to industrialization, accessibility, and concerns about water quality, safety, and practicability, even though there is a higher cost when compared to public water [3]. Also, the global consumption of bottled water increased from 178 billion to more than 231 billion liters; this increase in Brazil was above the world average (from 12.5 billion to more than 17 billion liters) [4].

The use of bottled water as a primary drinking water source may affect consumers' oral health. Studies showed that several brands contain different fluoride concentrations than reported on the label or higher than recommended, possibly influencing the incidence of dental fluorosis [5,6]. The literature also highlights the importance of determining the fluoride concentration of bottled waters, verifying the acceptable levels to prevent dental fluorosis, and providing reliable data on fluoride exposure [7]. Thus, this study aimed to assess the fluoride concentration of bottled waters from municipalities in northeastern Brazil.

Material and Methods

The Paraíba state has 4.018.127 inhabitants divided into 223 municipalities. This study included a convenience sampling of four large municipalities of Paraíba (João Pessoa, Campina Grande, Patos, and Cajazeiras), corresponding to macroregions of the coast, borborema, and outback. According to the Collaborating Center of the Ministry of Health for Oral Health Surveillance (CECOL), the variation of fluoride concentration in drinking water is established according to the maximum temperatures of the place. The municipalities selected to present the following annual average temperature: João Pessoa 26.5 °C, Campina Grande 23.3 °C, Patos and Cajazeiras 27.5 °C. The CECOL establishes that in places with temperatures below 26.3 °C the variation of the ideal fluoride concentration for the maximum benefit for preventing dental caries with the minimum risk for dental fluorosis is 0.65 to 0.94 mg F/L, and for temperatures between 26.3 to 32.5 C the ideal interval is 0.55 to 0.84 mg F/L.

Data Collection

During two different periods, we purchased three bottled mineral waters of different brands and batches from commercial places across four municipalities in March and December 2021.

Fluoride Analysis

A combined ion-specific electrode for fluoride (ORION 9409BN) and a reference electrode (ORION 900200) were calibrated and connected to an ion analyzer (ORION 710A). Standard solutions ranged from 0.02 to 6.4 mg F/L. Readings (in mV) were conducted in triplicates for each standard solution and converted into fluoride concentration (mg F/L) using the Excel® software.

Data Analysis

Fluoride concentration was obtained using the mean of three readings from each bottled water; a descriptive analysis was performed.

Results

A total of 72 samples of six brands of bottled water were analyzed. Fluoride concentrations in all samples were higher than reported on the label (range from 0.11 to 0.22 mg F/L) and varied among different batches of the same brand (Table 1).

Table 1. Average fluoride concentration (mg L/F) of the first and second data collection.

Municipality	Bottled Water	Number of Samples	First Data Collection		Second Data Collection		Fluoride Concentration in the Label
			Average	+ SD	Average	+ SD	
João Pessoa	Minalba	6	0.18	0.008	0.15	0.004	0.05
	Indáia	6	0.15	0.004	0.16	0.004	0.02
	Crystal	6	0.12	0.012	0.21	0.004	0.04
	Schin	6	0.13	0.015	0.13	0.014	0.05
Campina Grande	Ster Bom	6	0.13	0.024	0.21	0.008	0.02
	Crystal	6	0.21	0.008	0.17	0.008	0.04
	Indáia	6	0.17	0.016	0.14	0.016	0.02
Patos	Crystal	6	0.17	0.016	0.16	0.021	0.02
	Indáia	6	0.12	0.012	0.16	0.020	0.02
Cajazeiras	Crystal	6	0.15	0.008	0.17	0.0012	0.02
	Indáia	6	0.11	0.009	0.17	0.0004	0.02

SD: Standard Deviation.

Discussion

The difference in fluoride levels between brands of bottled water and batches of the same brand can be attributed to fluctuations in the natural fluoride of the water sources. These fluctuations of fluoride content in the water are expected and related to the seasonal variations and volume of rainfalls that can interfere with the geochemistry of groundwater sources [6,8,9]. The fluoride content analysis of different batches of the same brand of bottled water showed variation among brands of bottled water, a fact expected since the same results are found in the literature [8,9]. Seasonal variability in the volume of rainfall could result in fluctuations in the content of fluoride in bottled waters [6].

Differences between the fluoride concentration analyzed in bottled waters and reported on the label were already observed in the literature [5,7-9]. Our study reinforces the need for periodic analysis of fluoride concentration to confirm compliance with the legislation and provide reliable and safe water for consumers. Studies have also reported high fluoride concentrations in bottled waters, above what is written on the label. In this sense, total fluoride intake (i.e., all fluoride sources) may be the most critical risk factor for dental fluorosis, justifying studies regarding common sources of fluoride [5,10,11].

Nutritional labeling is an information tool for consumers to choose and develop their food plans [10]. Although fluoride is not considered essential for human life, it is important to prevent dental caries; thus, information on fluoride concentration must be reliable [10].

In the present study, bottled waters from four municipalities of the Paraíba state presented fluoride concentrations below adequate to prevent dental caries, corroborating studies from other regions [6,12]. The fluoride values found in bottled waters in this region do not pose a potential risk for dental fluorosis nor have a beneficial effect for preventing dental caries. However, the fluctuations of fluoride in the water indicate that some variations in the fluoride content are expected. This is not considered among suppliers since the actual values are not presented on the labels of the products.

The use of fluoride in terms of risk/benefit should be controlled by analyzing all its possible intake sources. Commercialized mineral waters, considered a source of fluoride intake, associated with other studies [13,14] will enable the establishing of an oral health care plan for the public in question.

The present study had limitations, such as the number of municipalities and brands included. However, we aimed to cover a large population and commercial area to represent the coast, Borborema, and outback of Paraíba. Future studies must obtain information about water sources from other regions of Paraíba and Brazil and monitor the concentration of components and values on labels to offer reliable and safe information to consumers.

Conclusion

Fluoride concentration of bottled waters was higher than the values reported on the label and varied among different batches of the same brand. These concentrations showed no potential risk for the development of dental fluorosis. These results reinforce the importance of fluoride control and analysis for properly disclosing data on labels of bottled waters.

Authors' Contributions

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All authors declare that they contributed to a critical review of intellectual content and approval of the final version to be published.

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Conflict of Interest

The authors declare no conflicts of interest.

Data Availability

The data used to support the findings of this study can be made available upon request to the corresponding author.

References

[1] Edmunds WM, Smedley PL. Fluoride in natural waters: Essentials of medical geology. Springer: Berlin; 2013. 311-336.

[2] Nowak B, Sicilio L, Kizior C, Tedder G, Zimmerman N, Bobo N. Advocating for oral health through fluoridation. NASN Sch Nurse 2019; 34(5):288-294. https://doi.org/10.1177/1942602X19831655

[3] Grizzo LT, Magalhães AC, Fraiz FC, Sampaio FC, Volpato LER, Honório HM, et al. Fluoride concentrations in bottled water from five regions of Brazil. Dent Res J 2010; 89(1):3161-3161.

[4] Rodwan-Junior JG. Bottled water 2011: the recovery continues. New York: International Bottled Water Association; 2012. Available from: http://www.bottledwater.org/files/2011BWstats.pdf [Accessed on May 13, 2021].

[5] Grec RH, de Moura PG, Pessan JP, Ramires I, Costa B, Buzalaf MA. Fluoride concentration in bottled water on the market in the municipality of São Paulo. Rev Saude Publica 2008; 42(1):154-157. https://doi.org/10.1590/s0034-89102008000100022 [In Portuguese].

[6] Souza CFM, Paredes SO, Forte FDS, Sampaio FC. Fluoride content of bottled water commercialized in two cities of northeastern Brazil. Braz J Oral Sci 2009; 8(9):206-209.

[7] Venturini CQ, Frazão P. Fluoride concentration in bottled water: A systematic review. Cad Saúde Colet 2015; 23(4):460-467.

[8] Rezvani GM, Kalteh S, Asgari TF, Zeraatkar A, Mahvi AH. Health risk assessment of nitrate and fluoride in bottled water: a case study of Iran. Environ Sci Pollut Res Int 2021; 28(35):48955-48966. https://doi.org/10.1007/s11356-021-14027

[9] Ani FE, Akaji EA, Uguru NP, Ndiokwelu EM. Fluoride content of commercial drinking water and carbonated soft drinks available in Southeastern Nigeria: dental and public health implications. Niger J Clin Pract 2020; 23(1):65-70. https://doi.org/10.4103/njcp.njcp_248_19

[10] Zohoori FV, Maguire A. Are there good reasons for fluoride labelling of food and drink? Br Dent J 2018; 224(4):215-217. https://doi.org/10.1038/sj.bdj.2018.123

[11] Steinmetz JE, Martinez-Mier EA, Jones JE, Sanders BJ, Weddell JA, Soto-Rojas AE, et al. Fluoride content of water used to reconstitute infant formula. Clin Pediatr 2011; 50(2):100-105. https://doi.org/10.1177/0009922810379908

[12] Maraver FV, Isidro AS, Jose AF. Fluoruro en aguas minerales naturales envasadas en España y prevención de la caries dental. Aten Primaria 2015; 47(1):15-24. https://doi.org/10.1016/j.aprim.2014.04.003 [In Spanish].

[13] Fernandes IC, Forte FDS, Sampaio FC. Molar-incisor hypomineralization (MIH), dental fluorosis, and caries in rural areas with different fluoride levels in the drinking water. Int J Paediatr Dent 2021; 31(4):475-482. https://doi.org/10.1111/ipd.12728

[14] de Sousa ET, Alves VF, Maia FBM, Uchoa MNS, Forte FDS, Sampaio FC. Influence of fluoridated groundwater and 1,100 ppm fluoride dentifrice on biomarkers of exposure to fluoride. Braz Dent J 2018; 29(5):475-482. https://doi.org/10.1590/0103-6440201801959