THE FLUORIDE CONCENTRATION OF THE PUBLIC WATER SUPPLY IN THE URBAN ZONE AND INDIGENOUS VILLAGES OF BAÍA DA TRAIÇÃO, PARAÍBA, BRAZIL

Natanael Victor Furtunato **Bezerra**[1], Karla Lorene de França **Leite**[2], Mariana Marinho Davino de **Medeiros**[3], Mariana Leonel **Martins**[2], Wilton Wilney Nascimento **Padilha**[1] , Yuri Wanderley **Cavalcanti**[1*]

[1]Department of Clinical and Social Dentistry, Federal University of Paraiba, João Pessoa, PB, Brazil;
[2]Department of Pediatric Dentistry and Orthodontics, Dental School, Federal University of Rio de Janeiro, RJ, Brazil.
[3]Department of Prosthodontics and Periodontology, Piracicaba Dental School - FOP/UNICAMP, Piracicaba, SP, Brazil.

Palavras-chave: População Indígena. Fluoretos. Vigilância em Saúde Pública. Controle da Qualidade da Água.

RESUMO

Introdução: É sabido que o município de Baía da Traição possuía sistema de fluoretação de águas de abastecimento. **Objetivo**: Avaliar a concentração de fluoreto (F^-) na água de abastecimento público do município de Baía da Traição-PB. **Métodos**: Amostras de água de abastecimento público foram coletadas em 13 locais, sendo um na zona urbana (Centro) e 12 distribuídas na zona rural (aldeias indígenas). Para cada local, três pontos de coleta distintos foram selecionados por conveniência entre novembro de 2015 e janeiro de 2016. A análise foi realizada em duplicata, utilizando-se um eletrodo íon-específico para fluoreto acoplado a um potenciômetro, previamente calibrados. As amostras (750 µL) foram adicionadas a 750 µL de solução TISAB II, consideradas a uma curva de calibração com concentrações de 0,2 a 1 mg/L. **Resultados**: Em novembro, dezembro e janeiro, respectivamente, as concentrações de F^- no Centro foram 0,32, 0,11 e 0,09 mg/L, e a média das aldeias indígenas, 0,08 (±0,02), 0,08 (±0,03) e 0,07 (±0,02) mg/L. Todas as amostras apresentaram concentrações abaixo do recomendado (<0,60 mg/L) pelo Ministério da Saúde para o benefício anticárie. **Conclusão**: Portanto, as águas de abastecimento público de Baía da Traição apresentaram concentrações de F^- insuficientes para prevenir a cárie dentária em nível populacional.

Keywords: Indigenous Population. Fluorides. Public Health Surveillance. Water Quality Control.

ABSTRACT

Introduction: It is known that the municipality of Baía da Traição, Brazil, has a system for fluoridation of the water supply. **Objective**: To evaluate the fluoride concentration (F^-) of the public water supply in the city of Baía da Traição-PB. **Methods**: Public water samples were collected in 13 sites, being one in the urban zone (downtown) and 12 in the rural zone (indigenous villages). In each site, three distinct collection points were selected for convenience between November 2015 and January 2016. The analysis was performed in duplicate using a fluoride ion-specific electrode coupled to a potentiometer, previously calibrated. The samples (750 µL) were added to 750 µL of TISAB II solution, considered on a calibration curve with concentrations of 0.2 to 1 mg/L. **Results**: In November, December and January, respectively, concentrations of F^- in the downtown area were 0.32, 0.11 and 0.09 mg/L, while the average concentrations in the indigenous villages were 0.08 (± 0.02), 0.08 (± 0.03) and 0.07 (± 0.02) mg/L. All samples had concentrations below the recommended levels (<0.60 mg/L) by the Ministry of Health for the anticaries benefit. **Conclusion**: The public water supply of Baía da Traição presented concentrations of F^- insufficient to prevent dental caries at the population level.

Submitted: February 02, 2018
Modification: April 03, 2018
Accepted: April 05, 2018

*** Correspondence to:**
Yuri Wanderley Cavalcanti
Department of Clinical and Social Dentistry, Federal University of Paraiba (UFPB), Campus I, Cidade Universitária, João Pessoa, PB, 58051-900, Brazil.
yuri@ccs.ufpb.br

INTRODUCTION

The indigenous population is subject to a process of transculturation that leads to a higher incidence of dental caries due to increased cariogenic feeding.[1,2] In addition, the history of social exclusion, coupled with neglect of oral health services, contributes to a framework of epidemiological invisibility that hampers the elaboration of strategies for prevention and health promotion in these populations.[2,3]

As compared to the Brazilian population in general,[4] the indigenous population living in the Potiguara Indigenous Reservation of Paraíba (Rio Tinto, Baía da Traição and Marcação) presented a higher mean of decayed,

missing and filled teeth of deciduous (dmft) and permanent dentition (DMFT) at the ages of 5 (dmft = 5.8), 12 (DMFT=3.6), and 15 to 19 (DMFT=7.1).[5] Thus, comprehensive health measures, such as fluoridation of the public water supply, could contribute to the reduction of dental caries rates among the indigenous population that are considered to be vulnerable.[6,7] A cohort study of Brazilian adults[6] demonstrated that access to fluoridated water for over 75% of the lifetime was associated with a lower prevalence of caries. In addition, a systematic review[7] demonstrated that discontinuation of the fluoridation process contributed to increased prevalence of dental caries.

Fluoridation of the public water supply is a cost-effective public health measure as it has a low per capita cost[8] to prevent caries regardless of age and socioeconomic or cultural level, thereby reducing the disease prevalence with a population-wide coverage.[6-8] If recommended fluoride levels are provided, this process becomes an efficient, simple and safe measure to promote the anticaries benefit.[6,7,9]

The World Health Organization[10] and the National Oral Health Policy[11] encourage the implementation of actions that favor the fluoridation of the public water supply. Federal Law nº 6.050 as of May 24, 1974, regulated by the Decree nº 76,872 as of December 22, 1975, establishes the mandatory fluoridation in the treatment of the public water supply in Brazil, in the Water Treatment Stations (WTS).[12] The Ordinance nº 2914, dated from December 12, 2011, provides for the procedures for controlling and monitoring the quality of water for human consumption and its drinking water standard. In the case of fluoride addition, the recommended values must comply with the Ordinance nº 635, dated from January 30, 1976, with maximum permitted values of up to 1.5 mg/L of the fluoride ion.[13,14]

Baía da Traição presents two entities responsible for supply management and distribution of the public water supply, namely: the Autonomous Water and Sewage Service (SAAE) under the city management, responsible for the central area of the municipality, and the Department of Sanitation of the Special Secretariat of Indigenous Health (SESAI), responsible for controlling the water supplied to the indigenous villages. In addition, the National Program for Surveillance of Water Quality for Human Consumption plays an important role in Health Surveillance. However, there is no surveillance of the water quality in the municipality under the terms recommended by current legislation.[13,14]

Fluoridation monitoring is the part of the health surveillance that assesses the fluoride concentration in the public water supply in a given region through public and private institutions unrelated to the corresponding WTS.[15] In order to promote the maintenance of fluoride at optimal concentrations for human consumption, monitoring of fluoride levels is offered as a regular measure to verify the quality of the public water supply.[15-17] Baía da Traição does not have an entity unrelated to the municipality that inspects the levels of fluoride in the public water supply, with the purpose of notifying those responsible for managing the irregularities identified.

Considering the history of fluoridation of the public water supply in Baía da Traição, it is necessary to monitor the levels of fluoride in the water supply, so that to guide the sanitary organs in regard to the adequate enrichment of the waters. Verification of the fluoride concentration is relevant to determining the natural concentration of fluoride in drinking water and the amount needed to achieve the optimal concentration for the anticaries benefit of fluoridation. In addition, the possible inequality of access to fluoridated water for a population under vulnerable situations motivates the development of our study. In order to contribute to this matter, the present study aimed to evaluate the concentration of fluoride (F^-) in the public water supply in the city of Baía da Traição, PB, Brazil.

MATERIALS AND METHODS

Characterization of collection sites

The municipality of Baía da Traição is located on the northern coast of the state of Paraíba (PB), Northeast Brazil (Latitude: 06º 41 '18 "S; Longitude: 34º 56' 09" W). According to the Brazilian Institute of Geography and Statistics (IBGE),[18] Baía da Traição has a territorial area of 102,242 square kilometers; an estimated population in 2016 of 8,951 inhabitants; Human Development Index (HDI) of 0.581; Gini index 0.38; and average household income per capita of R$ 170 (compared to R$ 510 in João Pessoa, capital of the state).

The municipality of Baía da Traição has a population of 5,591 natives, with 23.61% (n=1320) of them distributed in the urban zone (downtown) and 76.39% (n=4271) in the rural zone (indigenous villages: Akajutibiró, Benfica, Bento, Cumaru, Forte, Galego, Lagoa do Mato, Laranjeira, Santa Rita, São Francisco, Silva, Tracoeira and São Miguel).[19]

Collection of water samples

In each site of interest (downtown and indigenous villages), three distinct and non-consecutive residences were selected for convenience, which served as representative points of collection sites (Figure 1). Water samples were collected from the following indigenous villages: Akajutibiró, Bento, Cumaru, Forte, Galego, Lagoa do Mato, Laranjeira, Santa Rita, São Francisco, Silva, Tracoeira and São Miguel. Samples (n=39) were collected between November 2015 and January 2016, once a month, on weekdays, identified with the location and date of the collection. The time interval



Figure 1: *Distribution of sample collection sites in Baía da Traição-PB: Downtown (n=1) and Indigenous villages (n=12), 2016. PhotoScape software was used for construction of the figure. The image taken on Google Maps (https://www.google.com/maps/).*

between the first and last collection of the respective points did not exceed 24 hours. After collection, the water samples were sent for laboratorial analysis.

Analysis of fluoride concentration

The analyses were performed using a fluoride ion-specific electrode (Orion Star Series, Thermo Scientific, Singapore) coupled to a potentiometer (Orion Star Series, Thermo Scientific, Singapore).[20] The calibration of the equipment was done in duplicate, in order to reduce the margin of error, taking into account the expected values for samples with standard solutions ranging from 0.2 to 1 mg/L. For this, standard solutions were obtained by serial dilutions from a standard solution of 100 mg/L. For the standard curve, a "blank" reference value obtained from a sample of distilled and deionized ultrapure water was considered, which is the first point of the curve to be analyzed. The reading range of the calibration curve was 0.2 mg/mL. The reading of the points of the calibration curve were obtained in triplicate from 750 µL of each of these points plus 750 µL of Total Ionic Strength Adjustor Buffer (TISAB II); a pH adjusting buffer, ionic strength and decomplexing. The mean values of the electrical conductivity (mV) were transferred to a spreadsheet in Excel software (Microsoft®) and the relationship between electrical conductivity (mV) and the fluoride concentration [log F^-] (r^2=0.999; Slope=-57.9) was determined by linear regression. There was no difference greater than 5% between the expected and the calculated, for each point of the curve.

Data analysis

The values obtained in duplicate, including the TISAB II-added groups (1:1 ratio), were transferred to a spreadsheet in Excel (Microsoft®) software, transformed from millivolts (mV) to mg/L, and analyzed descriptively.

A comparative analysis of the data obtained in the present study was carried out with the recommended limits for fluoride concentration as a function of the average daily maximum temperature recommended by the Ministry of Health, through Administrative Rule 635 / Bsb, as of December 26, 1975[14] (Chart 1). The mean maximum daily temperature of Baía da Traição was 28.83ºC,[21] with minimum, maximum and optimal fluoride concentrations of 0.6; 0.8; and 0.6 mg/L, respectively.

***Table 1**: Mean and standard deviation (SD) of drinking water fluoride concentrations during the respective months and quarter in the downtown area and indigenous*

Regions \ Month	Nov./2015		Dec./2015		Jan./2016		Average of the quarter	
	[F-] (mg/L)		[F-] (mg/L)		[F-] (mg/L)		[F-] (mg/L)	
	Average	SD	Average	SD	Average	SD	Average	SD
Downtown	0.32	0.02	0.11	0.00	0.09	0.01	0.17	0.13
Indigenous Villages	0.08	0.02	0.08	0.03	0.07	0.02	0.07	0.02
Akajutibiró Village	0.07	0.00	0.08	0.00	0.07	0.00	0.07	0.01
Bento Village	0.07	0.00	0.07	0.00	0.07	0.00	0.07	0.00
Cumaru Village	0.08	0.00	0.07	0.00	0.07	0.00	0.07	0.01
Forte Village	0.06	0.00	0.07	0.00	0.07	0.00	0.07	0.01
Galego Village	0.12	0.01	0.10	0.01	0.09	0.02	0.10	0.02
Lagoa do Mato Village	0.08	0.00	0.08	0.00	0.07	0.00	0.08	0.01
Laranjeira Village	0.05	0.00	0.05	0.00	0.05	0.00	0.05	0.00
Santa Rita Village	0.12	0.00	0.15	0.00	0.14	0.00	0.14	0.02
São Francisco Village	0.07	0.00	0.06	0.00	0.07	0.00	0.07	0.01
São Miguel Village	0.09	0.01	0.09	0.01	0.09	0.00	0.09	0.00
Silva Village	0.08	0.01	0.09	0.00	0.08	0.00	0.08	0.01
Tracoeira Village	0.04	0.01	0.05	0.00	0.06	0.00	0.05	0.01

Average daily maximum air temperatures (º C)	Recommended limits for fluoride ion concentration in mg/L		
	Minimum	Maximum	Optimum
10.0 - 12.1	0.9	1.7	1.2
12.2 - 14.6	0.8	1.5	1.1
14.7 - 17.7	0.8	1.3	1.0
17.8 - 21.4	0.7	1.2	0.9
21.5 - 26.3	0.7	1.0	0.8
26.4 - 32.5	0.6	0.8	0.6

***Chart1:** Fluoride concentration limits according to the average of the maximum daily temperatures.* Source: *Ordinance nº 635 / Bsb, of December 26, 1975.*[16]

RESULTS

In the months of November/2015, December/2015 and January/2016, the F- concentrations in the downtown area were 0.32, 0.11 and 0.09 mg/L, respectively, against 0.08 (±0.02), 0.08 (±0.03), and 0.07 (±0.02) mg/L in the indigenous villages (Table 1). It was observed that 100% of the samples (n=39) had concentrations below the limit recommended by the Ministry of Health to promote the anticaries benefit (<0.60 mg/L) (Chart 1). As seen in Table1 , the highest concentrations of fluoride were found in a region in downtown Baía da Traição, while the lowest concentrations were found in the Laranjeira and Tracoeira villages.

DISCUSSION

The city of Baía da Traição (PB) is one of the few municipalities in Paraíba state which has a water fluoridation system[5]. Initially, the present study aimed to identify the fluoride levels in the water supplies of the city, focused on a technical monitoring and also on the inequality of access to fluoridated water in urban and rural areas (indigenous villages). However, the study findings reveal that only residual levels of fluoride were detected in the water, which was incompatible to what had been disclosed about the city of Baía da Traição having access to fluoridated water.

After samples were collected, discontinuation of fluoridation took place in the downtown area in December 2015.[22] In addition, the Orientation Plan for Water Treatment of the Indigenous Villages does not advocate the fluoridation of the public water supply as a measure that should be used[23]. In this sense, it is necessary to reestablish the fluoridation of

the water in the downtown area of the city and implement it in the indigenous villages, calling the SAAE and the Sanitation Department of SESAI to their respective competencies.

Only after direct contact with the SAAE of the municipality did the authors have access to the information that fluoridation had been interrupted in December 2015.[22] However, the collections occurred between the months of Nov/2015, Dec/2015 and Jan/2016. Therefore, it is verified that the fluoridation system was not being conducted accordingly, with Nov/2015 values similar to those of Dec/2015 and Jan/2016. This aspect reinforces the need for external control and systematic evaluation of water quality. In addition, it points to the need to resume fluoridation, since the residual levels are insufficient to produce the anticaries benefit.

According to the SAAE reports, fluoridation of the public water supply in downtown Baía da Traição was in force in November/2015.[22] Thus, as expected, the highest observed concentration of residual fluoride (0.32 mg/L) was found in this collection period. During the other periods, in the months of December/2015 and January/2016, the public water supply in the downtown area presented decreasing residual fluoride concentrations (0.11 and 0.09 mg/L, respectively). The decrease in fluoride concentrations represents the period of interruption of fluoridation of the public water supply by the SAAE.[22] This finding reinforces the need to provide anticaries benefits to the population of Baía da Traição, since fluoride concentration was not maintained at ideal levels (0.6-0.8 mg/L).[7,9,16]

Similar conditions of low fluoride concentrations in the public water supply were observed in studies carried out in small, medium and large-size municipalities in the state of Piauí[23,24] and large-size cities in the State of São Paulo.[16] Such inadequate concentrations (<0.60 mg/L) can be regularized upon compliance to water quality surveillance techniques for human consumption.[15-17]

On the other hand, fluoride concentrations corresponding to the public water supply of the indigenous villages of Baía da Traição did not exceed 0.15 mg/L during the year's quarter. Hence, residual fluoride concentrations can be explained by the absence of fluoridation of the public water supply by the Sanitation Department of SESAI. In addition, the document Guidelines for Monitoring the Quality of Water for Human Consumption in Indigenous Villages (DMAQI) presents the protocol for the treatment of the public water supply of indigenous villages, but there is no indication to fluoridation as a necessary measure. [23]

The interruption or absence of fluoridation of the public water supply of Baía da Traição compromises the protection of the oral health of the people residing in this municipality.[6-8] In addition, interruption of water fluoridation has a negative effect on collective oral health, reflecting the increased prevalence and experience of dental caries, according to the results of a recent systematic review.[7]

The results of this study point to the need for epidemiological monitoring of the population involved, as well as to warning government agencies as to strategies to increase access to preventive measures against dental caries, in order to overcome political, financial and technical constraints due to collective benefit provided by this measure.[25] Therefore, the results should be monitored, disseminated and government measures should be taken accordingly to ensure that the framework in question is reversed and that fluoridation is resumed in the downtown area and implemented in the indigenous villages.[7,9]

According to current legislation in Brazil,[14] public water supply in the municipality of Baía da Traição (downtown and indigenous villages) presented fluoride concentrations below the recommended level to promote the anticaries benefit to the population (<0.60 mg/L) in the checkpoints analyzed. After verification of the fluoride concentration, the investigators of the present study made contact with the SAAE and the Department of Sanitation of SESAI, communicating the results and emphasizing the preventive importance of fluoridation. Thus, these public organs can check the current fluoride concentration and adjust the concentration accordingly to promote the anticaries benefit at a population-wide level.

The authors identified that the water quality is adequate for human consumption and allows for the implementation of the fluoridation system by accessing surveillance reports on water quality for human consumption *in loco*. However, this latter measure depends only on political desirability and government articulation on more than one level (municipal and federal, at least). It is known that the 'Brasil Sorridente' (Smiling Brazil) Program finances the installation and maintenance of public water supply fluoridation systems. Thus, the interruption process must be combated in view of the collective benefit generated from this action.

The population must be warned about the negative impacts of interrupting water fluoridation. Besides that, a wider governmental campaign should stimulate the installation and maintenance of public water supply fluoridation systems. Although there is a financial source that covers the system, there is not any movement pushing up municipalities to implement fluoridation systems. Periodic external control, which is very important to assess quality, should be performed by research centers like Universities. The most important measure, to our knowledge, would be education directed to population, in order to provoke

permanent changes in the way health public measures would impact the daily live of individuals.

According to Federal Decree nº 5440 of May 4, 2005,[26] the organs and entities responsible for public supply systems should frequently make available information on the characteristics of the water distributed through the use of understandable and easily accessible measures to consumers.[27] This reality, however, was not verified in the municipality of Baía da Traição, and may also be the reality of other Brazilian municipalities. The importance of fluoridation of the public water supply, as well as the adversities resulting from the deficiency of fluoride maintenance at ideal concentrations, should be disseminated to the population of Baía da Traição[6]. Thus, this knowledge will not only be restricted to dentists, health professionals and government, as the population may claim their rights to protection against dental caries arising from a continuous and regular process of fluoridation.[27]

CONCLUSION

In the period evaluated, the public water supply in the municipality of Baía da Traição presented fluoride concentrations below the levels capable of promoting the anticaries benefit. The fluoride concentrations observed in this study may assist in determining the remaining concentration for adequacy of the public water supply of the downtown area and indigenous villages.

Disruption of the fluoridation system may impact the caries prevalence of the population involved, and further protection measures are required. In this sense, effective fluoridation must overcome political, financial and technical constraints due to the collective benefit provided by this measure.

ACKNOWLEDGE

Thanks to Prof. Dr. Jaime Aparecido Cury and Technician Waldomiro Vieira for the concession of the combined fluoride electrode and technical training conducted at Piracicaba Dental School, University of Campinas, Brazil.

REFERENCES

1-Moura PG, Batista LRV, Moreira EAM. Indigenous peoples: reflection about the influence of urban civilization on nutritional status and oral health *Rev. Nutr.* 2010 23(3):459-65. doi: 10.1590/S1415-52732010000300013.

2-Aamodt K, Reyna-Blanco O, Sosa R, Hsieh R, De la Garza Ramos M, Garcia Martinez M, *et al*. Prevalence of caries and malocclusion in an indigenous population in Chiapas, Mexico. *Int Dent J.* 2015 65(5):249-55. doi: 10.1111/idj.12177.

3-Alves filho P, Santos RV, Vettore MV. Factors associated with dental caries and periodontal diseases in Latin American indigenous peoples: a systematic review. *Rev. Panam. Salud Públ.* 2014 35(1):67-77, PMID: 24626450.

4-Brazil, Ministry of Health. Secretariat of Health Care. Department of Primary Care. SB Brazil Project 2010: oral health conditions of the Brazilian population 2010: main results. Ministry of Health, Department of Health Care, Department of Basic Attention. - Brasília: Ministry of Health, 2011.

5-Sampaio FC, Freitas CHSM, Cabral MBF, Machado ATB. Dental caries and treatment needs among indigenous people of the Potiguara Indian reservation in Brazil. *Rev. Panam. Salud Públ.* 2010 27(4):246–51. PMID: 20512226.

6-Peres MA, Peres KG, Barbato PR, Höfelmann DA. Access to Fluoridated Water and Adult Dental Caries: A Natural Experiment. *J Dent Res.* 2016 95(8):868-74. doi: 10.1177/0022034516643064.

7-McLaren L, Singhal S. Does cessation of community water fluoridation lead to an increase in tooth decay? A systematic review of published studies. *J Epidemiol Community Health*. 2016 0:1–7. doi: 10.1136/jech-2015-206502.

8-Martinez EHS, Frias AC, Mendes HJ, Olympio KP. Per capita cost of fluoridating the public water supply in a large municipality. *RGO - Rev Gaúcha Odontol*. 2013 61(4):549-56. Available from: http://www.revistargo.com.br/viewarticle.php?id=3100

9-Frazão P, Peres MA, Cury JA. Drinking water quality and fluoride concentration. *Rev. Saúde Públ.* 2011 45(5):964-973. doi: 10.1590/S0034-89102011005000046.

10-World Health Organization - WHO. Fluoride in Drinking-water. Edited by K. Bailey, J. Chilton, E. Dahi, M. Lennon, P. Jackson and J. Fawell. Geneva, 2006.

11-Brazil, Ministry of Health. Secretariat of Health Care. Department of Basic Attention. Notebooks of Basic Attention, n. 17. Brasília, 2006.

12-Brazil, Decree n. 76,872 of December 22, 1975. Regulates Law no. 6,050, of May 24, 1974. Official Diary, Brasília, section 1, p. 16997, 1975.

13-Brazil, Ministry of Health. 2,914, dated December 12, 2011. Provides on the procedures for controlling and monitoring the quality of water for human consumption and its drinking water standard. Official Diary, Dec. 14 2011.

14-Brazil, Ministry of Health. Ordinance nº 635 / Bsb, of December 26, 1975. Approves the Norms and Standards on the Fluoridation of Water from Public Systems of Supply, Destined for Human Consumption. Official Journal, Jan. 30 1976.

15-Panizzi M, Peres MA. Ten years of external control over water fluoridation in Chapecó, Santa Catarina State, Brazil. *Cad. Saúde Pública.* 2008 24(9):2021-31. doi: 10.1590/S0102-311X2008000900008.

16-Santos CCM, Rodrigues JCS, Lopes MRV, Povinelli RF, Terreri ALM. Fluoride concentration in the public water supply: the retrospective study and the external control. *Rev Inst Adolfo Lutz.* 2012 71(3):507-13. Available from: http://periodicos.ses.sp.bvs.br/pdf/rial/v71n3/v71n3a11.pdf

17-Kuhnen M, Gamba B, Narvai PC, Toassi RFC. Quality of treated water: evaluation of fluoride levels in 10 years of heterocontrol in a city of the State of Santa Catarina. *Vigil. sanit. Debate.* 2017 5(1):91-6. doi: 10.3395/2317-269X.00833.

18-Brazil, Brazilian Institute of Geography and Statistics - IBGE. CensusDemographic 2010: Cities. [cited 11 Ago, 2017]. Available from: http://www.cidades.ibge.gov.br/xtras/perfil.php?lang=&codmun=250140&search=paraiba|baia-da-traicao.

19-Brazil, Information System for Indigenous Health Care - SIASI.[cited 29 Abr, 2016]. Available from: http://portalms.saude.gov.br/index.php/oministerio/principal/secretarias/secretaria-sesai/mais-sobre-sesai/9518-%20estaques.

20-Cury JA, Oliveira MJL, Martins CC, Tenuta LMA, Paiva SM. Available

fluoride in toothpastes used by Brazilian children. *Braz Dent J.* 2010 21(5):396-400. doi: 10.1590/S0103-64402010000500003.
21-Silva JS, Val CM, Costa JN, Moura MS, Silva TAE, Sampaio FC. Monitoring water fluoridation in three cities in Piauí State, Brazil. *Cad. Saúde Pública.* 2007 23(5):1083-8. doi: 10.1590/S0102-311X2007000500010.
22-Brazil, Baía da Traição City Hall, Paraíba. Autonomous Water and Sewage Service (SAAE). Result of daily physical and chemical examination. Bay of Treason, 2015-2016.
23-Brazil, Ministry of Health. Special Secretariat of Indigenous Health (SESAI). Guidelines for Monitoring the Quality of Water for Human Consumption in Indigenous Villages (DMAQI). Brasília - DF, 2014.
24-Silva JS, Moreno WG, Forte FDS, Sampaio FC. Natural fluoride levels from public water supplies in Piauí State, Brazil. *Ciênc. saúde coletiva.* 2009 14(6):2215-20. doi: 10.1590/S1413-81232009000600030.
25-Brazil, Decree No. 5.440, of May 5, 2005. Establishes definitions on the water quality control of supply systems and establishes mechanisms and instruments for the dissemination of information to the consumer about the quality of water for human consumption. Official Gazette, May 6, 2005.
26-Mork N, Griffin S. Perceived safety and benefit of community water fluoridation: 2009 HealthStyles survey. *J Public Health Dent.* 2015 75(4):327-36. doi:10.1111/jphd.12104.
27-Brazil, Ministry of Agriculture, Livestock and Supply. National Institute of Meteorology (Internet); [cited 2016 Jan]. Available from: http://www.inmet.gov.br/portal/.