

Identification and Analysis of the Fluoride Concentration in Toothpastes Intended for Children

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Abstract

Objective: To identify the commercially available toothpastes intended for children and their total soluble fluoride concentrations (TSF). **Material and Methods:** Twelve brands of toothpastes intended for children marketed in supermarkets and pharmacies were found and analyzed: Bitufo®; Colgate Smile®; Lilica Ripilica®; Even Baby®; Turma da Mônica Baby®; Loney Tunes®; Loney Tunes Baby®; Malvatrikds Baby®; Oral B Stages®; Sanifil Kids®; Tandy®; Tra-lá-lá Baby®. Duplicate samples of each toothpaste were weighed (+/- 90 to 110 mg) and diluted in 10 mL of distilled water under stirring. To evaluate soluble fluoride, duplicate aliquots of supernatant suspensions were evaluated on specific ion fluoride electrode calibrated with fluoride standard solutions and results expressed in ppm F according to established protocol. **Results:** According to information provided by manufacturers, 5 non-fluoridated toothpastes, 3 toothpastes with less than 1000 ppm F and 4 toothpastes with conventional fluoride concentration (1100 ppm F) were identified. After analysis of soluble fluoride of fluoridated toothpastes, only 02 presented TSF concentration equal to or greater than 1000 ppm F. The TSF concentration (mean $\pm$ SD) for all samples ranged from 8.2 ± 0.1 to 1065.9 ± 24.7 ppm F. **Conclusion:** Few toothpastes intended for children presented soluble fluoride concentrations capable of preventing dental caries. Additionally, regulatory measures need to be implemented for the marketing of toothpastes intended for children with at least 1000 ppm of soluble fluoride, especially in locations without other sources of fluoride (fluoridated water) for the population.

Keywords: Fluorides; Dentifrices; Toothpastes; Dental Caries.

Introduction

Dental caries disease is still considered a public health problem in the Brazilian population, especially in children with low socioeconomic and cultural levels, who present high carbohydrate consumption and inadequate oral hygiene habits [1]. Preventive measures such as the consumption of fluoridated water, topical use of fluoride (toothpaste, gel and varnish) and periodic visits to the dentist to advise parents and patients on eating habits and oral hygiene can have a decisive influence on the development of this disease [2-4].

Currently, oral hygiene with fluoridated toothpaste is considered one of the strategies with good results to reduce the prevalence of dental caries [2-4]. Therefore, discussions about the use of fluoride toothpastes by children, especially regarding their effectiveness in the prevention of dental caries, without increasing the risk of developing fluorosis, have been conducted (concentration of available fluoride, amount of toothpaste in the toothbrush, level of intake of these toothpastes and other sources of fluoride) [4,5]. However, scientific evidence has shown that there is no recommendation for low-fluoride toothpastes for children, since toothpastes must contain soluble fluoride (SF) concentrations equal to or greater than 1000 ppm F [6,7] to be effective in reducing the prevalence and incidence of dental caries disease.

In Brazil, in 1989, soluble fluoride concentrations of 1000 and 1500 ppm in toothpastes were established as minimum and maximum limits, representing the available fluoride concentrations in its soluble ionic form, which could interfere in the demineralization / remineralization process. However, in 1996, a new ordinance excluded the terms "minimum" and "soluble", allowing the marketing of products with lower F concentrations and with insoluble form of fluoride [8]. Therefore, the soluble fluoride concentration in Brazilian toothpastes has been analyzed in different studies [9-11] and the results demonstrated that most toothpastes contain sufficient amounts of soluble fluoride (≥ 1000 ppm F) to effectively prevent dental caries disease and that average amounts of fluoride between 1000 and 1500 ppm have beneficial effects superior to the risk of the development of moderate or severe fluorosis in the permanent dentition [12,13].

However, it is known that toothpastes intended for children without fluoride or with less than 1000 ppm F are marketed for the population, preventing them from receiving the anticaries benefits of fluoride. Additionally, an aggravating factor can be observed, the fluoridated water supply, considered one of the ten most important achievements of public health in the twentieth century in the prevention of dental caries, is extremely unequal, especially in the Northern and Northeastern regions [14]. Thus, it is possible to affirm that in municipalities that do not present fluoridated water supply and where toothpastes are marketed without considering the minimum ideal amount of fluoride for anticaries effect, the population is devoid of methods to prevent dental caries.

Therefore, the aim of this present study was to identify toothpastes intended for children marketed in the municipality of Maceió, Brazil, which does not present fluoridated water supply, and to analyze the total fluoride and total soluble fluoride concentrations in these toothpastes.

Material and Methods

This study identified toothpastes intended for children marketed in different supermarket and pharmacy networks randomly selected in Maceió, Brazil. Supermarket networks evaluated were Extra, Hiper Bompreço, Unicompra, Makro and Atacadão and pharmacy networks were Pague Menos, Permanente and Farmácia do Trabalhador. These establishments were chosen because they are the largest in the municipality of Maceió, have greater population access and are present in different neighborhoods. Information on the toothpastes identified is shown in Table 1. Subsequently, the analysis of the total fluoride and total soluble fluoride concentrations in these toothpastes was carried out.

Table 1. Information (trademark, fluoridated agent and fluoride concentration) of toothpastes.

Trade Name	Brand	Code	Fluoridated Agent
Luney Tunes	Laboratório Boniquet do Brasil, São Bernardo do Campo, SP, Brazil	1	NaF 1100 ppm
Tandy	Colgate-Palmolive Company, São Paulo, SP, Brazil	2	NaF 1100 ppm
Lilica Ripilica	Condor Ind. Com., São Bento do Sul, SC, Brazil	3	NaF 500 ppm
Bem 10	Bitufo Montagem e Comércio de Escovas Ltda, Itupeva, SP, Brazil	4	NaF 750 ppm
Turma da Mônica Baby	Even – Ind. Reunidas Raymundo da Fonte S/A, Paulista, PE, Brazil	5	No fluoride
Colgate Smiles Barbie	Colgate-Palmolive Company, São Paulo, SP, Brazil	6	NaF 1100 ppm
Sanifill Kids	Sanifill Ind. e Com. Ltda, Curitiba, Brazil	7	NaF 1100 ppm
Tra-lá-lá Baby	Phisalia, Osasco, SP, Brazil	8	No fluoride
Oral B Stages	Oral B, Naucalpan de Juarez, Mexico	9	NaF 500 ppm
Malvatrikids Baby	Laboratório Daudt, Rio de Janeiro, RJ, Brazil	10	No fluoride
Baby Luney Tunes	Laboratório Boniquet do Brasil, São Bernardo do Campo, SP, Brazil	11	No fluoride
Even Baby	Even – Ind. Reunidas Raymundo da Fonte S/A, Paulista, PE, Brazil	12	No fluoride

Analysis of Fluoride Concentrations in Toothpastes

Analyses of the concentrations of Total Fluoride and Total Soluble Fluoride were performed according to recommended methodology [8]. For this, duplicate samples of each toothpaste were weighed (+/- 90 to 110 mg) and diluted in 10 mL of distilled water under constant stirring (Thermix Stirrer Model 120 - Fisher Scientific, Pittsburg, PA, USA) until total dilution of the toothpaste.

Subsequently, duplicate aliquots (0.25 ml) of the suspension of each toothpaste were transferred into test tubes containing 0.25 ml of 2.0 M HCl, kept in incubation for 1 hour at 45°C. Then, 0.5 mL of 1M NaOH and 1 mL of TISAB II (Total ionic strength adjustment buffer II-1.0 M acetate buffer, pH 5.0, containing 1.0 M NaCl and 0.4% CDTA) were added to each sample for quantification of Total Fluoride concentration. For Total Soluble Fluoride analysis, the suspension obtained from the dilution of the toothpaste was centrifuged at 3000 g for 10 min at room temperature and duplicate aliquots (0.25 ml) of the supernatant were added of 0.25 ml of 2M HCl and incubated for 1 hour at 45°C. Then 0.5 mL of 1M NaOH and 1.0 mL of TISAB II were added. For analyses, a specific ion fluoride electrode (Ion Plus Fluoride, Orion 9609 BN, USA) coupled to a 720 A potentiometer (Procyon do Brasil Ltda., São Paulo, SP, Brazil), previously calibrated with standard

fluoride solutions, was used with the following concentrations: 0.0; 4.0; 8.0; 16.0; 32.0; 64.0 ppm F for the construction of a standard curve.

Data Analysis

A descriptive analysis of the total fluoride and total soluble fluoride concentrations was performed through the mean and standard deviation. Data were tabulated and linear regression analysis was performed between F and mV concentration standards, and F concentration was expressed in ppm F (mg F / Kg) through the Excel 2007 Software (Microsoft® Office System, 2007, Redmond, Washington, USA).

Results

According to information provided by manufacturers on products' labels (Table 1), it could be observed that: 5 toothpastes had no fluoride, 3 toothpastes had fluoride concentration less than 1000 ppm F and 4 toothpastes had conventional fluoride concentration (1100 ppm F). After analysis of total fluoride and total soluble fluoride, it was verified that only 2 fluoridated toothpastes presented fluoride concentration equal to or greater than 1000 ppm F. The TSF concentration for all the samples ranged from 8.2 ± 0.1 to 1065.9 ± 24.7 ppm F (Figure 1).

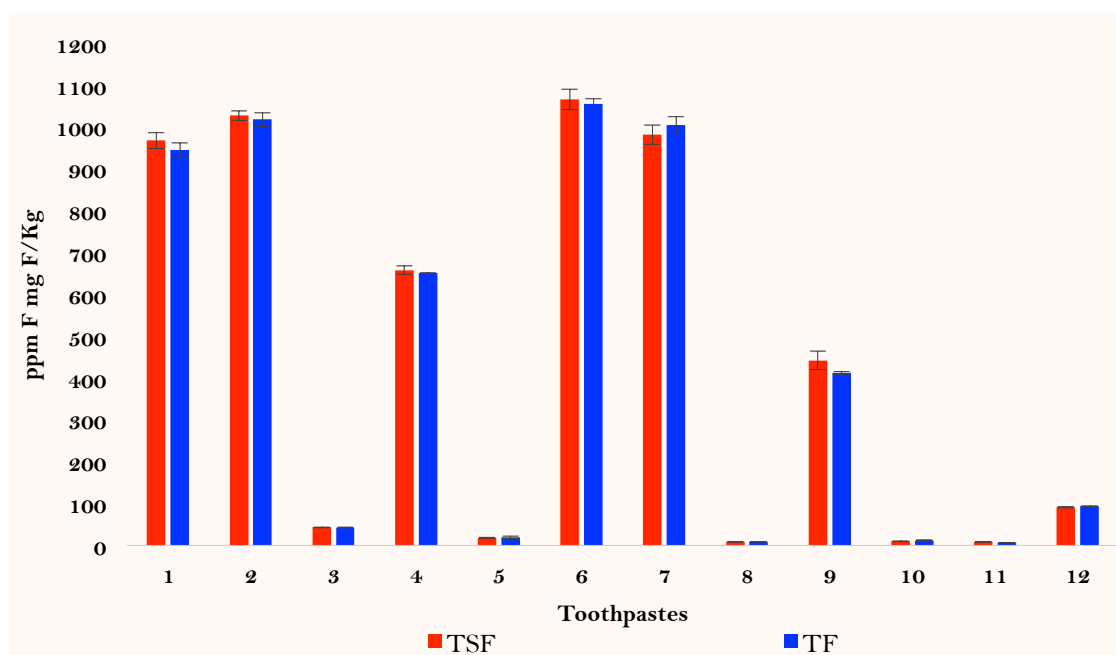


Figure 1. Total fluoride (TF) and total soluble fluoride (TSF) concentrations (ppm F) found in evaluated toothpastes (mean $\pm$ SD).

Discussion

Toothpastes can be defined as creams or gels consisting of different chemical substances that facilitate the removal or disorganization of the dental biofilm and allow the supply of fluoride to act in the demineralization and remineralization of the dental substrate [15,16]. For this, the minimum

fluoride concentration required to present anticaries effect is at least 1000 ppm of soluble fluoride [9-12].

According to results of the present study, this condition does not fit the toothpastes identified in the capital of Alagoas, since most toothpastes found for marketing have absence or low fluoride concentration, according to manufacturers' data. This fact exposes children to the risk of developing dental caries, since these concentrations are not effective in reducing dental caries prevalence.

In relation to total soluble fluoride concentrations of toothpastes evaluated, the results suggest that only two brands had concentrations equal to or greater than 1000 ppm F and that the other two did not present the amount of 1100 ppm F reported on their labels. However, it is noteworthy that the fluoride concentrations found for these samples were 966.99 and 981.05 ppm F and that in this situation, concentration difference between 100 and 200 ppm F is considered minimal when the anticaries effect is evaluated [17]. Regarding the other toothpastes, the results showed absence or low fluoride concentration.

According to the latest epidemiological survey, the children population of Maceió, Brazil, has dental caries prevalence of 2.7, classified as moderate [18], so these results would make the situation even more worrying due to the fact that the capital of Alagoas, as well as other Brazilian cities, does not have public fluoridated water supply, which is a safe and effective method for the prevention of dental caries [14].

According to an evaluation conducted in Brazilian capitals, the caries index showed a decline in capitals with fluoridated water supply compared to those without this service, which showed an increase [19], and the caries index may become smaller when the use of fluorinated water and fluorinated toothpaste is associated [20]. However, depending on the quality of life of the population, the comprehensive use of fluoridated toothpaste can make fluoridated water a dispensable method [21]. Thus, according to results obtained, the population of the municipality of Maceió is restricted in obtaining the benefits of fluoride in its two main forms of use, fluoridated toothpaste and water, for the prevention of dental caries. Although only few establishments (supermarkets and pharmacies) in the capital of Alagoas have been visited and 12 types of toothpastes available for marketing have been identified, it was observed that the majority of the population can afford for these products, since these are the main commercial establishments of the state capital.

The identification of the marketing of these toothpastes shows that the use of products with intermediate fluoride concentrations can still be seen as a risk factor for the development of dental fluorosis, but according to scientific evidence, toothpastes with fluoride concentrations between 1000 and 1500 ppm have beneficial effects greater than the risk of developing moderate or severe fluorosis in the permanent dentition [12,13]. In addition, their use should be stimulated considering some precautions to prevent fluorosis, such as: supervised brushing in children, use of a small amount of toothpaste on the toothbrush, do not leave toothpaste within the reach of children and stimulate expectoration after tooth brushing [5,13,16,21-24].

Therefore, the results of the present study suggest the need to adjust fluoride concentration, at least 1000 ppm of soluble fluoride, in toothpastes in order to reduce the prevalence of dental caries detected in the last national epidemiological survey.

Conclusion

Few toothpastes intended for children presented soluble fluoride concentration capable of preventing dental caries. In addition, regulatory measures need to be implemented for the marketing of toothpastes intended for children with at least 1000 ppm of soluble fluoride, especially in municipalities without other sources of fluoride for the population, such as Maceió, Brazil.

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Conflict of Interest: The authors declare no conflicts of interest.

References

- [1] Ribeiro AG, Oliveira AF, Rosenblatt A. Early childhood caries: Prevalence and risk factors in 4-year-old preschoolers in João Pessoa, Paraíba, Brazil. *Cad Saúde Pública* 2005; 21(6):1695-1700. <https://doi.org/10.1590/S0102-311X2005000600016>
- [2] Losso EM, Tavares MCR, Silva JYB, Urban CA. Severe early childhood caries: An integral approach. *J Pediatr* 2009; 85(4):295-300. <https://doi.org/10.1590/S0021-75572009000400005>
- [3] Frazão P. Cost-effectiveness of conventional and modified supervised toothbrushing in preventing caries in permanent molars among 5-year-old children. *Cad Saúde Pública* 2012; 28(2):281-90. <https://doi.org/10.1590/S0102-311X2012000200007>
- [4] Marinho VC, Higgins JP, Sheiham A, Logan S. Fluoride toothpastes for preventing dental caries in children and adolescents. *Cochrane Database Syst Rev* 2003; (1):CD002278. <https://doi.org/10.1002/14651858>
- [5] Bennadi D, Kshetrimayum N, Sibyl S, Reddy CV. Utilization profiles among preschool children. *J Clin Diagn Res* 2014; 8(3):212-5. <https://doi.org/10.7860/JCDR/2014/7309.4165>
- [6] Walsh T, Worthington HV, Glenny AM, Appelbe P, Marinho VC, Shi X. Fluoride toothpastes of different concentrations for preventing dental caries in children and adolescents. *Cochrane Database Syst Rev* 2010; 20(1):CD007868. <https://doi.org/10.1002/14651858>
- [7] Ortiz AC, Tenuta LM, Tabchoury CP, Cury JA. Anticaries potential of low fluoride dentifrices found in the Brazilian market. *Braz Dent J* 2016; 27(3):298-302. <https://doi.org/10.1590/0103-6440201600729>
- [8] Brasil. Ministério da Saúde. Guia de Recomendações para o Uso de Fluoretos no Brasil. Brasília: Ministério da Saúde, 2009. [In Portuguese]
- [9] 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. <https://doi.org/10.1590/S0103-64402010000500003>
- [10] Ricomini Filho AP, Tenuta LM, Fernandes FS, Calvo AF, Kusano SC, Cury JA. Fluoride concentration in the top-selling Brazilian toothpastes purchased at different regions. *Braz Dent* 2012; 23(1):45-8. <https://doi.org/10.1590/S0103-64402012000100008>
- [11] Cury JA, Dantas EDV, Tenuta LMA, Romão DA, Tabchoury CPM, Nobrega DF, Velo MMAC, Pereira CM. Fluoride concentration in most sold MFP/CaCO₃ - based Brazilian toothpastes at the expiration time. *Rev Assoc Paul Cir Dent* 2015; 69(3):248-51.
- [12] Santos APP, Oliveira BH, Nadanovsky P. Effects of low and standard fluoride toothpastes on caries and fluorosis: Systematic review and meta-analysis. *Caries Res* 2013; 47(5):382-90. <https://doi.org/10.1159/000348492>

- [13] O'Mullane DM, Baez RJ, Jones S, Lennon MA, Petersen PE, Rugg-Gunn AJ, et al. Fluoride and oral health. *Community Dent Health* 2016; 33(2):69-99.
- [14] Antunes JLF, Narvai PC. Dental health policies in Brazil and their impact on health inequalities. *Rev Saúde Pública* 2010; 44(2):360-5. <https://doi.org/10.1590/S0034-89102010005000002>
- [15] Buzalaf MAR, Magalhães AC. Dentifrícios: Como e quando prescrever. In: Lubiana NF, Moyses SJ, Groisman S (Editors). *Programa de Atualização em Odontologia Preventiva e Saúde Coletiva (Pro-Odonto Prevenção)*. Ciclo 2, Módulo 1. Porto Alegre: Artmed, 2008. p. 63-124. [In Portuguese]
- [16] Martinez-Mier EA, Tenuta LMA, Carey CM, Cury JA, van Loveren C, Ekstrand KR, et al. European organization for caries research workshop: Methodology for determination of potentially available fluoride in toothpastes. *Caries Res* 2018; 24; 53(2):119-36. <https://doi.org/10.1159/000490196>
- [17] Cury JA. Dentifrícios: Como escolher e como indicar. In: APCD (Org.). *Odontologia*. São Paulo: Artes Médicas, 2002. p. 281-295. [In Portuguese]
- [18] Brasil. Ministério da Saúde. Projeto SB Brasil 2010: Pesquisa Nacional de Saúde Bucal SB Brasil 2010. Resultados Principais. Brasília: Ministério da Saúde, 2011. [In Portuguese]
- [19] Narvai PC, Frias AC, Frattucci MVB, Antunes JLF, Carnut L, Frazão P. Water fluoridation in Brazilian capitals in the beginning of the XXI century: The effectiveness in question. *Saúde Debate* 2014; 38(102):562-71. <https://doi.org/10.5935/0103-1104.20140052>
- [20] Cruz MGBD, Narvai PC. Caries and fluoridated water in two Brazilian municipalities with low prevalence of the disease. *Rev Saude Publica* 2018; 52:28. <https://doi.org/10.11606/S1518-8787.2018052016330>
- [21] Cury JA. Uso do Flúor e Controle da Cárie Como Doença. In: Baratieri LN, Monteiro Júnior S. *Odontologia Restauradora: Fundamentos e Possibilidades*. São Paulo: Santos, 2001. p. 31-68. [In Portuguese]
- [22] Magalhães AC, Moron BM, Comar LP, Buzalaf MAF. Rational use of dentifrices. *RGO* 2011; 59(4):615-25.
- [23] Cury JA, Tenuta LMA. Evidence-based recommendation on toothpaste use. *Braz Oral Res* 2014; 28(Spec Issue 1):1-7. <https://doi.org/10.1590/S1806-83242014.50000001>
- [24] Celeste RK, Luz PB. Independent and additive effects of different sources of fluoride and dental fluorosis. *Pediatr Dent* 2016; 38(3):233-8.