ORIGINAL ARTICLE

Fluoride concentration in toothpastes of the Mexican market

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Abstract

Introduction. The most widely used method for applying fluoride (F^-) topically is the fluoridated toothpaste. Its early use in large quantities is a risk factor for dental fluorosis. Objective: to determine the actual concentration of F^- in toothpastes sold in the Mexican market.

Material and methods. Sixty-five different commercial toothpastes were analysed using the F^- ion-specific electrode technique.

Results. The range of the F^- content was from 0 to 2 053 ppm. Of them, 16.92% were toothpastes for infant use (range= 0-1153 ppmF). Mexican toothpastes had a mean of 879 ± 599.2 ppmF^- and imported toothpastes have a mean of 619.7 ppmF^-; 54.5% of the infantile toothpastes presented F^- concentrations above 730 ppm and in 40% of the analyzed products, annotation on F^- content was found.

Conclusions. Our results showed a wide variation in F^- concentration and suggest the need to implement policies to regulate the F^- concentration in these products. It is important that all the manufactured dentifrices show in the label and package the total F^- content of the product and the recommended doses will be printed, in order to prevent dental fluorosis.

Key words. Toothpaste; dental fluorosis; fluoride ion; dentifrice; ion-specific electrode.

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Introduction

Toothpastes containing fluoride (F^-) were introduced first over 30 years ago without any questioning. The most widely used method for applying F^- topically is by means of a dentifrice, since in countries where dentifrices are used; almost all products in the market contain a F^- compound.[1,2] The effect of F^- containing dentifrices on caries reduction and remineralization of initial caries lesions has also been demonstrated.[3-7] Recent evidence suggests that prevalence of F^- related enamel opacities has increased in areas where the domestic water contains optimal or low F^- levels.[8-11] This phenomenon has been referred as the "halo effect".[12] According with numerous studies in Mexico, it is possible to consider that this effect can be related to water fluoridation, F^- supplements, soft drinks, food processing and diet, this condition occurs in numerous Mexican communities. Many of the above mentioned products contain variable functional concentrations of F^-, because they are prepared with fluoridated water. It has been assumed that the early use of F^- toothpaste may be associated with an increased risk of dental fluorosis in both water fluoridated and non-water fluoridated communities.[13]

Dental fluorosis is a disorder in the mineralization of the teeth related to the exposure to an excessive amount of F^- during tooth development. Rock summarised the effect of F^- on general health and concluded that tooth development is the most vulnerable process.[14] Crown mineralization of the permanent incisors begins at three months postnatal age and it is achieved during the fourth year of life, so that the risk is highest during this period. Fluoridated toothpaste may represent a problem since it is known that during tooth brushing, young children swallow a considerable proportion of the paste dispensed on the brush.[15,16]

The objective of this study was to determine the F^- ion concentration in different commercial dentifrices sold in the Mexican market.

Material and methods

Different brands of toothpastes used by the local population of Mexico City were analysed. The F^- content was determined by triplicate in the 65 most widely used toothpastes of different trademarks. Samples of each product were purchased from supermarkets and groceries in different areas of Mexico City. Name of the product, lot number, size and material container were recorded.

Dentifrice treatments

The F^- containing dentifrices were divided into two groups; one for children use and another for general purpose and their F^- concentration compared. Dentifrice supernatants were prepared by thoroughly mixing 1 g of dentifrice with 2.5 mL of deionised water. The suspensions were centrifuged at 5 000 rpm for 30 minutes and the supernatant recovered.

Fluoride ion concentration analysis

The analysis of the F^- content in the toothpaste was made using an Orion Research Ionalyzer (Fluoride Ion Specific Electrode, Model 96-09, Cambridge, MA; USA) and an Orion 720 A potentiometer.

Concentration of the F^- ion was determined by comparing the ionalyzer readings with a standard curve made with standard solutions from 0.01 ppmF^- to 10 ppmF^-. From the equation of calibration curve, the percentage of free fluoride concentration was measured according to the following formula:

$$\%F = [(ppmF^-)\ (\text{sample wt} + \text{buffer solution wt}) \times 100]\ (\text{wt of sample} \times 10^6)$$

Results

According to the guidelines of the Norma Oficial Mexicana PROY-NOM-219-SSA1-2002,[17] 58 toothpastes (87.7%) were within the rule (no more than 500 ppm F^- for children use and less than 1 500 ppm F^- for other dentifrices). F^- concentrations are

Table 1. Fluoride content in the analized toothpastes

Sample	IFC% *	IFC ppm **	ppm found	% found
1	Not indicated	1 100	1 000	0.1
2	Not indicated	1 100	1 000	0.1
3	Not indicated	1 100	800	0.08
4	Not indicated	1 450	2 000	0.2
5	Not indicated	1 450	2 000	0.2
6	Not indicated	1 450	1 333	0.1333
7	0.32	1 450	1 000	0.1
17	0.243	1 100	1 140	0.114
18	0.243	1 100	1 180	0.118
19	1.0	1 500	0.0	0.0
20	1.0	1 500	0.0	0.0
21	Not indicated	1 200	81	0.0081
22	Does not contain	Does not contain	28	0.0028
23	0.225	1 000	1 183	0.1183
24	Does not contain	Does not contain	8	0.0008
25	Not indicated	1 500	59	0.0059
26	Not indicated	1 500	376	0.0376
27	Not indicated	1 500	316	0.0316
28	0.32	Not indicated	1 660	0.166
37	Not indicated	1 000	0.0	0.0
38	0.45	1 100	1 504	0.1504
39	Not indicated	800	121	0.0121
40	Not indicated	232	1 010	0.101
41	Does not contain	Does not contain	0	0.0
42	Not indicated	243	1 015	0.1015
43	1.0	1 500	434	0.0434
45	0.243	Not indicated	1 153	0.1153
46	0.15	Not indicated	1 197	0.1197
47	Not indicated	1 200	207	0.0207
48	Not indicated	1 200	182	0.0182
49	Not indicated	500	523	0.0523
50	Not indicated	500	437	0.0437
52	Not indicated	310	1 390	0.139
54	Not indicated	1 200	305	0.0305
55	Not indicated	1 450	29	0.0029
56	Does not contain	Does not contain	109	0.0109
58	Not indicated	0.7	64	0.0064
60	Not indicated	1 450	1 573	0.1573
61	Not indicated	500	376	0.0376
62	Not indicated	1 100	886	0.0886
63	Not indicated	500	730	0.073
64	Not indicated	1 100	803	0.0803
65	Not indicated	1 450	1 610	0.161

22 toothpastes did not indicate the fluoride content

* Indicated fluoride content (percentage)

** Indicated fluoride content (in ppm)

shown in table 1.

Of the 65 analysed toothpastes, a mean F^- concentration of 751.3 ± 550.8 ppmF^- was obtained (range =0 to 2 053 ppmF^-). Dentifrices indicated for children use comprised 16.92% (n =11) of the analysed sample. For them, the mean F^- concentration was 563.4 ± 349.81 ppmF^- with a range between 0 and 1 153 ppmF^-.

Twenty-nine (44.62%) of the commercially available toothpastes analysed in this study were of Mexican manufacture, they had a mean of 879 ± 599.2 ppmF^- (range =0 to 2 053 ppmF^-). Meanwhile 55.38% (n =36) of the analysed toothpastes were manufactured in other countries, they had a mean of 619.7 ± 461.7 ppmF (range =0 to 1 610 ppmF^-). Since there is no actual normativity regulating the F^- content in toothpastes manufactured and/or sold in the Mexican market, we used the normativity project Norma Oficial Mexicana PROY-NOM-219-SSA1-2002.[17]

Of the 11 toothpastes indicated for children use and manufactured in Mexico, we found 54.5% with fluoride concentrations less than 523 ppm and 45.5% showed F^- concentrations over to this limit (730 ppm to 1 153 ppm). Finally, 12.3% of the analysed sample (n =7) showed F^- concentrations over 1 500 ppm. Of them, four were from national origin (range =1 760 ppmF^- to 2 053 ppmF^-) and three were manufactured in other countries (range =1 504 ppmF^- to 1 610 ppmF). It was noted that in 40% of the analysed products (n =26), annotation on their F^- content was found.

The F^- concentration found in the different analysed toothpastes did not match with the concentration specified in the envelopments or packages.

Discussion

F^- supplements have been widely used by people all over the world and in the past the F^- uptake from F^- dentifrices has been evaluated.[1] F^- dentifrice effect on caries reduction and remineralization of the initial caries lesion has also been analysed and demonstrated.[18] This argument was used by numerous companies to develop diverse toothpastes, which have been distributed and sold in the Mexican market. The World Health Organization (WHO) establishes that for dental decay prevention, F^- concentration in dentifrices should not exceed 1 500 ppm and in fluoridated toothpastes indicated for children use, the maximum concentration should not be higher to 550 ppmF^-.[19] Recently, several authors demonstrated that the use of F^- supplements (including toothpastes) are risk factors for development of dental fluorosis lesions.[20]

Taking in mind the WHO recommendations, the new Mexican normativity PROY-NOM-219-SSA1-2002[17] is being revised by the Mexican health authorities and they included all the WHO parameters for determining the upper and lower permissible F^- concentrations in toothpastes sold in the Mexican market. Our results showed that F^- concentration in toothpastes sold in the Mexican market varied widely. Likewise, it is important to note that the highest F^- concentrations found in our analysed sample were found in dentifrices manufactured in Mexico.

In the Mexican market, several brands of dentifrices indicated for children use are sold, and there is not enough information to the general population about the F^- needs for dental health in children. Taking in mind this lack of information, it is possible that when the parents select the toothpaste for children use, they never bear in mind that the daily F^- ingestion is quite different for children than that recommended for adults.[14] Results of this study show that more than 40% of toothpastes indicated for children use contain F^- concentrations over the WHO regulations.

Several studies indicate that inadvertently (or intentionally for the flavour) young children swallow up proportions of the toothpastes they use for toothbrushing.[16,17,20] Toddlers tend to swallow greater proportions of the toothpaste they place on their toothbrushes than doodler preschool-aged children.[21]

With the aim to help tooth decay prevention, since 1993 a salt fluoridation program has been

implemented in Mexico.[22] Results from recent studies showed that there are several sources of F^- as bottled beverages, juices, nectars and bottled drinks for the Mexican population.[12]

Recent epidemiological studies in Mexico have shown that the prevalence of dental fluorosis has increased. The increase in dental fluorosis is primarily in milder forms, though there has also been some increase in the moderate category.[8-11]

The Mexican normativity NOM-OF-013-SSA1-1993 establishes that consumption of fluoridated salt, F^- supplements and fluoridated toothpastes should be avoided in those zones were the mean F^- concentration in water for human consumption is greater or equal to 0.7 ppm.[19]

In considering the current status in Mexico and the future role of F^- on dental caries prevention, we suggest than Mexican health authorities should be alert in controlling and monitoring the F^- concentration in all national and imported products, and in the surveillance on the information contained in the envelope and package. Also, the container of all fluoridated toothpastes should have a legend preventing its use in water or salt fluoridated areas.

This information should include the actual F^- concentration in the product and the pertinent recommendations, which permit the customers to select the adequate toothpaste according to their dental needs. We consider that with the above mentioned proposals, new cases of dental fluorosis will be prevented and the dental fluorosis incidence will be reduced in the Mexican population.

CONCENTRACIÓN DE FLUOR EN LAS PASTAS DENTALES QUE SE VENDEN EN MÉXICO

Introducción. El método más usado para la aplicación tópica de flúor (F^-) es la pasta dental fluorada. Su uso temprano en grandes cantidades es un factor de riesgo de fluorosis dental. Objetivo: conocer la concentración de F^- en las pastas dentales que se venden en México.

Material y métodos. Se analizaron 65 pastas dentales usando la técnica del electrodo específico para fluoruros.

Resultados. El contenido de fluoruro en la muestra analizada varió de 0-2053 ppm. De ellas, 16.92% fueron pastas para uso infantil (límite =0 -1153 ppmF^-). Las pastas fabricadas en México tuvieron un promedio de 879 ± 599.2 ppmF^-. Las pastas de origen extranjero tenían un promedio de 619.7 ppmF^-; 54.5% de las pastas para niños presentaron valores de F^- superiores a 730 ppmF^-. Solamente 40% de los productos analizados tenían impresa la concentración de F^- en las envolturas.

Conclusiones. Nuestros resultados mostraron una amplia variación en la concentración de F^-. Esto sugiere que es necesario implementar medidas que regulen su concentración en dichos productos. Es importante que, para prevenir lesiones de fluorosis dental, los fabricantes de pastas dentales impriman en la etiqueta el contenido total de fluoruro y las dosis recomendadas.

Palabras clave. Pastas dentales; fluorosis dental; fluoruro; dentífrico; electrodo ion-específico.

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