

Estimation of fluoride release in commercial toothpaste

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ABSTRACT

The aim of study is to ensure that the fluoridated toothpaste remain (active) in terms of bioavailability of fluoride in toothpaste.

Seventeenth different brands of toothpastes were collected from the market to determine the concentration of fluoride in the toothpaste. The result indicated that the concentration of fluoride in these products range from 10 p.p.m. to 1000 p.p.m. fluoride. Also, the result revealed that many of these products did not mention the type of abrasive system used to be compatible with the type of fluoride used & to maintain high amount of active fluoride to be benefit by the consumers

Key words: Fluoride dentifrice, Fluoride toothpaste, Abrasive system, marketing

الخلاصة

الهدف من الدراسة هو معرفة تركيز ايون الفلورايد الموجود في معاجين الأسنان المفلورة لبيقى الفلور فعال في التقليل من تسوس الأسنان.
تم جمع سبعة عشر نوعا من معاجين الأسنان من الأسواق المحلية لقياس تركيز الفلورايد فيها. دلت النتائج ان تركيز الفلور في هذه المنتجات كان يتراوح بين 10 - 1000 جزء من المليون فلورايد، كذلك دلت النتائج بأن الكثير من هذه المنتجات لم يذكر نوع المادة المبيضة (أو الساحلة) المستعملة فيها لتكون متلائمة مع نوع الفلورايد المستخدم كي يمكن الحفاظ على أعلى كمية من الفلور حتى يستفيد المستهلك من استخدام هذه المعاجين.

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INTRODUCTION

Dentifrice's are made in three structural forms namely tooth pastes, gels and powders. They provide three important functions. Their abrasive and detergent actions provide efficient removal of debris, plaque, and stained pellicle compared with a toothbrush alone. They polish teeth to provide increased light reflectance and superior aesthetic. Finally, dentifrices act as vehicles for delivery of therapeutic agents like fluoride that provides specific benefits.

Fluoride toothpastes have been proven to be practical and effective way to reduce dental caries⁽¹⁻⁴⁾. Toothpastes containing fluoride of different types was first introducing over 50 years ago. Clinical trails have demonstrated their effectiveness in reducing caries⁽⁵⁻⁸⁾ and because they have been so widely used in many countries, especially in western countries. Fluoride toothpaste has come to play a major part in dental health. The fluoride toothpastes sold in Iraq since late 1970s, and they are only three types of fluoridated toothpastes produced by Iraqi manufacture, Amber and Close up for the adult and Lolo for children use. Other fluoridated toothpastes are also in use, mainly imported from different countries of the world.

The purpose of the study is to ensure that the fluoridated toothpaste remains (active) in terms of bioavailability of fluoride in toothpaste after importing, marketing and during individual usage.

MATERIALS AND METHODS

Seventeenth different brand of toothpastes were collected from the market to determine the concentration of fluoride in the toothpaste. The fluoride concentration in toothpastes was determined using a fluoride ion selective electrode, coupled with a calomel reference electrode. Both were joined to digital pH meter capable of measuring millivoltage of a minimum reproducibility of ± 0.2 mv. Prior to fluoride determination, the samples were mixed with 10% by volume of TISAB (Total Ionic Strength Adjustment Buffer) prepared by dissolving 57 ml of glacial acetic acid, 58 grams of sodium chloride and 0.3 grams of sodium citrate in 500 ml of deionised water. The solution was buffered to pH 5-5.5 using 5N Sodium hydroxide solution. The solution was cooled and diluted to make 1000 ml.

Two calibration curves were constructed, to cover fluoride ion concentration (100-1000) ppm and (1-100) ppm. Standard solutions were prepared by serial dilution of 100 ppm prepared by dissolving (55.25) mg of dried sodium fluoride powder in 250 ml of deionized water.

The millileters of a standard solution was added to 10 milliliters of TISAB. The solution was stirred and the electrode potential in mv was determined.

A calibration curves were constructed on a standard semilogarithmic paper by plotting the millivolt readings (linear axis) against concentration (log axis) measurement. The same 1=1 mixing procedure was used with other standards and with unknown.

RESULTS

The type of toothpaste, concentration of fluoride (ppm), nationality of the products and some notes about the products (if there is any mentioned about presence, concentration of fluoride, presence and type of abrasive material, expired date...) is shown in table (1).

Two products used in this study were from Iraqi manufactures (Close up and Amber) other products are from Jordan (3), Syria (1), Turkey (3), China (5), Thailand (1), and other two products of unknown nationality. The result revealed that the concentration of fluoride in these products range from 10 ppm in Sign toothpaste to 1000 ppm in Sanino smokers toothpaste.

Table (1): The type of toothpastes, concentration of fluoride (ppm), nationality and notes of the products.

No	Type	Fluoride conc. ppm	Nationality	Notes
1	Clos up	620	Iraqi	MFP 0.8%
2	Amber	760	Iraqi	MFP 0.8%
3	Diamond Glow	620	Jordan	MFP 1.14%
4	Trifresh Glow	530	Jordan	Fluoride
5	Kolynos	350	Syria	
6	Sanino	700	Turky	MFP 0.76+ 0.1% NaF
7	Sanino/Smokers	>1000	Turkey	Si+NaF
8	Denicotin	140	Turkey	MFP 0.76% + 0.1% NaF
9	Signal/2	720	Turkey	NaF 1000 ppm
10	Sign/Child	680	China	Ca+Fluorid, ex.
11	Sinan	680	China	MFP 0.76%+ NaF 0.1%+Ca, ex.
12	Sign	10	China	Fluoride
13	Deluxe	780	China	CaCO ₃ , ex
14	Guchiling	100	China	CaCO ₃
15	Colgate	200	Thailand	
16	Flash	20	-----	
17	SnowWhite	90	-----	CaCO ₃

MFP = Sodium Mono fluorophosphate
Si = Silica
Ca = Calcium

NaF = Sodium Fluoride
ex = expired date
CaCO₃ = Calcium carbonate

DISCUSSION

In addition to other topical fluoride therapy, fluoride toothpastes are the most widely used forms of fluoride therapy in the developed countries. While in the third world countries, the fluoride contained in the toothpastes consider as a practical approach to the problem of delivery topically applied fluoride to a large number of population specially for Iraqi population that rarely use of other fluoride supplements. The vast majority of fluoride toothpastes in the world have involved pastes yielding approximately 1000 ppm (either as 0.76% sodium mono fluorophosphate, 0.24% NaF or 0.4% stannous fluoride).

The other ingredients of toothpaste are abrasive, binding agent, humectants, detergents agent in addition to preservative, coloring and sweating agents. Abrasives (cleaning and polishing agents) are the largest ingredient of the toothpaste formula. The most common abrasive system use are calcium carbonate, dicalcium phosphate dihydrate, insoluble sodium metaphosphate, silica, calcium pyrophosphate, sodium bicarbonate and sodium and aluminum silicate. Consideration of the abrasives in fluoride toothpaste formulation is essential because they have the potential to inactivate fluoride, evident by experiments^(9,10) and clinical studies^(3,11).

Many studies evaluated the rate of loss of fluoride in relation to type of fluoride contain and abrasive system used. As in studies use NaF with abrasive contain calcium, reported reduction of the amount of fluoride availability because of the binding of fluoride by calcium^(12,13). While other suggest that to improve the anticaries action of NaF by use a more compatible abrasive system^(14,15). Many studies use NaF with silica abrasive reported yielding more than 95% of the total fluoride content and had a better clinical anticaries^(16,17).

From the finding of the study many of the products only mentioned that contain fluoride (Trifresh, Sign and Deluxe) without specification of fluoride type. While others mentioned the type of abrasive system use only as (Snow white, Guchiling), Sanino for smoker reported contain NaF with titanium dioxide and Signal 2 reported contain NaF. So from these products, it is uncertain that the type of fluoride and abrasive system is compatible to maintain the amount of fluoride availability high for improving the anticaries action.

The calcium-containing abrasives were markedly more compatible with sodium MFP than with NaF⁽¹³⁾, and Depaola suggested that a formulation with the proper molar ratio of calcium and sodium MFP may have superior cariostatic effect to the currently available formulation⁽¹⁸⁾.

This study revealed that many toothpaste contain NaMFP alone as (Close up, Diamond Glow and Amber), all of these did not mentioned the type of abrasive used, the concentration of fluoride reported in the product was 0.8% for Close up and Amber, while Diamond glow reported 1.14%.

Many studies reported usage of mixed fluoride system (0.76% MFP and 0.1% NaF) and they compare with MFP toothpaste, the results showed that the mixed fluoride systems showed significant reduction in mean caries increments compared with MFP toothpaste^(19,20), while other studies reported no differences in efficacy between them^(21,22).

From the finding of this study many of the products contain a mixed fluoride system as (Sanino, Sinan, and Denicotin). The result of the study revealed that there was considerable variation in amount of fluoride in toothpastes ranging from 10-1000 ppm. The highest fluoride level was found in Sanino/smoker (>1000 ppm), Deluxe, Amber, Signal 2 and Sanino (>700 ppm) Sinan, Sign for children, Close up, Diamond

glow (>600 ppm), Trifresh (530 pm), while other products reported less than 200 ppm. It appear that the Iraqi product (Amber and Close up) contain high amount of fluoride in the toothpaste.

It can be indicated from this finding that there are many fluoridated toothpaste in the market did contain the amount of fluoride that have an effect in reduce dental caries. Also many of these products did not mentioned the type of abrasive system use to be compatible with type of fluoride use and finally to maintain high amount of active fluoride to be benefit by the consumers.

So to enhance the effectiveness of fluoride to reduce the dental carries is by increasing the availability of fluoride ions from specific formulation through improved compatibility of the fluoride active with certain dentifrice components (especially abrasive system).

The prime consideration of the FDA in establishing bioequivalence tests were the potential for fluoride agent abrasive interaction and the maintenance of fluoride activity (availability) over the shelf-life of the product⁽¹⁶⁾. From all the products only three of them (Sinan, Delux and Sign for children) mentioned the expired date of toothpaste. It is important to mention the expired date of any product to make sure that the product is new and fluoride is available in reactive form. In spite of there are some publications proposed rules concerning the long-term availability of fluoride in toothpaste^(23,24).

The use of fluoridated toothpaste is very important to decrease the dental caries as they reported in many developed countries^(25,26) and as mentioned by Bratthall et al. they revealed the response of 52 experts for the main reasons explaining the caries decline in many western countries over the past 3 decade, they reported that the most effective method was the use of fluoride toothpaste⁽²⁷⁾.

So any attempt to increase the use of fluoridated toothpaste require the education of the population through the different mass media and involvement and commitment from manufactures, government as well as from those involved in managing and implementing health promotion.

REFERENCES

1. Murray JJ, Rugg-Gunn AJ: Fluorides in caries prevention, 2nd edn. Guildford wright 1982.
2. Mellberg J, Ripa LW: Fluoride in preventive dentistry. Theory and clinical Applications. Chicago. Quintessence 1983.
3. Stooky CK: Are all fluoride dentifrices the same in: Wei S.H. (Ed) Clinical uses of fluorides. Philadelphia, Lea and Febiger 1985.
4. Holt RD: The pattern of caries in a group of five years old children and in the same Cohort at 9 year of age. *Community Dental Health* 1995; 12: 93-99.
5. Luck H, Ruhlman CD, Chung KL, Shurzenberger OP, Lehnhoff RW: A three year clinical comparison of a sodium monofluophosphate dentifrice with sodium fluoride dentifrices on dental caries in children. *J Dent Child* 1987; 54: 241-244.
6. De Paola P, Soparker P, Triol C, et al: The relative anticaries effectiveness of sodium fluoride as contained in currently available dentifrice formulation. *Am J Dent* 1933; (Spec.Iss): 507-512.

7. Stephen K, Chestnutt I, Jacobson A, *et al* : The effect of NaF and SMFP toothpaste on 3-years caries increments in adolescents. *Int Dent J* 1994; 44: 278-295.
8. Marks RG, Cont A, Morehead J, *et al*: Results from three years caries clinical trial comparing NaF and SMFP fluoride formulation. *Int Dent J* 1994; 44: 275-285.
9. Ingram GS: Reaction of monofluoro phosphate with appetite. *Caries Res* 1972; 6: 1-15.
10. Pader M, Cancro LP, Gnillo B: The evaluation of fluoride dentifrices. *J Soc Cosmet Chem* 1977; 28: 681-694.
11. Volpe AR: Dentifrices and mouth rinses. In: Caldwell R.C. and stallard RE (Eds) A textbook of preventive Dentistry. Philadelphia WB Saunders 1977, pp.173-213.
12. Reed MW: Clinical evaluation of three concentration of sodium fluoride in dentifrices. *J Am Dent Ass* 1973; 80:1401-1403.
13. Hattab F: The state of fluoride in toothpastes. *J Dent* 1989; 17:47-54.
14. Forman B: Studies on the effect of dentifrices with low fluoride content. *Comm Dent Oral Eidemiol* 1974; 2:166-175.
15. Edland D, Koch G: Effect on caries of daily supervised tooth brushing with sodium monofluorophosphate and sodium fluoride dentifrices after 3 years. *Scand J Dent Res* 1977; 85:41-45.
16. Zacherl WA: Clinical evaluation natural sodium fluoride, stannous fluoride, sodium monofluorophosphate and acidulated fluoride phosphate dentifrices. *J Can Dent Assoc* 1972; 38: 35-38.
17. Beiswanger B, Gish C, Mallatt S: A three year study of the effect of sodium fluoride-Silica abrasive dentifrice on dental caries. *Pharmacol Ther Dent* 1981; 6: 9-16.
18. De Poala PF: Clinical studies of monofluorophosphate dentifrices. *Caries Res* 1983; 17: 119-135.
19. Hodge HC, Holloway P, Davies T, Worthington H: Caries prevention by dentifrices containing a combination of sodium monofluorophosphate and sodium fluoride. *Br Dent J* 1980; 149:201-206.
20. Mainwaring P, Naylor M: A four year clinical study to determine the caries inhibiting effect of calcium glycerophosphate and sodium fluoride in calcium carbonate base dentifrices containing sodium monofluoro phosphate. *Caries Res* 1983; 17: 267-276.
21. Juliano G, Yraola B, Cano-Arenalo M, Triol C, Volpe A: Clinical study comparing the anticaries effect of two fluoride dentifrices. *IADR AADR* 1985; (Abs), 131.
22. Ripa LW, Leske G, Spoto A, Varma A: Clinical comparison of the caries inhibition of two mixed NaF-Na₂PO₃F dentifrices containing 1000 and 2500 ppm F compared to a conventional Na₂PO₃F dentifrices 1000 ppm F results after two years. *Caries Res* 1987; 21:149-157.
23. Us Food and Drug Administration: Establishment of a monograph on Anticaries drug products for over the counter human use; proposed Rulemaking (part IV) Department of Health, Education and Welfare 1980.
24. Standards Association of Australia: Draft Australian standard for toothpastes 1982.
25. Truin G, Konig K, Kalsbeck H: Trends in dental caries in the Netherlands. *Adv Dent Res* 1993; 7(1): 15-18.
26. Kalsbeck H, Truin G, Van Rossum G, Van Rijkom H, Poorterman J, Verrips G: Trend in caries prevalence in Dutch adults between 1983-1995. *Carries Res* 1998; 32: 160-165.
27. Bratthall D, Hansel P, Sundberg H: Reasons for the caries decline what do the experts believe? *Eur J Oral Sci* 1996; 104: 416-422.