



Original Article

Current status of fluoride concentration and information labeling of oral hygiene products on the Korean market

Chi-Un Oh¹ · Kyung-Hee Kim²

¹Department of Preventive and Public Health Dentistry, School of Dentistry, Chonnam National University

²Department of Dental Hygiene, Hanyeong University

Corresponding Author: Kyung-Hee Kim, Department of Dental Hygiene, Hanyeong University, 18-43 Janggunsan-gil, Yeosu-si, 59720, Korea.
Tel: +82-61-650-4210, Fax: +82-62-530-5810, E-mail: 7511272@naver.com

ABSTRACT

Objectives: This study was conducted to survey the currently available fluoride-containing oral hygiene products in Korea to provide consumers with information regarding the concentration and form of fluoride in each product, as well as to determine whether the information was easy to understand. **Methods:** A total of 64 types of domestic commercial oral hygiene products were purchased from an offline market and evaluated. **Results:** The domestic commercial toothpaste products contained fluoride in the form of sodium fluoride (NaF) and sodium monofluorophosphate (SMFP). In this study, toothpaste containing 1,000 ppm fluoride compounds accounted for the largest proportion (61.5%). Toothpastes containing below 1,000 ppm fluoride accounted for 34.6%, while toothpastes with fluoride above 1,000 ppm fluoride accounted for 3.9%. Toothpaste containing more than 1,000 ppm fluoride has not been popularized domestically. Mouthwash products contained fluoride compounds at less than 300 ppm concentration. Of the five types of mouthwash products, only two types had labels indicating fluoride concentration. In addition, the location of the labels indicating fluoride concentration differed between manufacturers and even within the same manufacturer. **Conclusions:** It is important to popularize toothpaste with fluoride levels above 1,000 ppm so that a broader selection of toothpaste can be offered to consumers in need. Standardized information needs to be provided for consumer convenience to aid in choosing appropriate oral hygiene products.

Key Words: Fluorides, Mouthwashes, Toothpastes

Introduction

The market growth rate of quasi-drug products in the market has been the highest in the last 3 years. In 2019, the output of quasi-drug products increased by 14.5%, compared with that in 2018; furthermore, the number of production companies and items increased by 14% and 8.8%, respectively [1]. Among all the product groups, toothpaste was listed top in output, and seven oral hygiene products were included in the top 10 items [1]. Since 2016, the sales rate of oral hygiene products has steadily increased. The most frequently used oral hygiene products are mouthwash, dental floss, and toothpaste.

As mentioned above, oral hygiene products are a top product in the output group, indicating that maintaining good oral health is closely associated with a good quality of life. Growing concerns regarding overall health care have led to this phenomenon; thus, providing accurate information to consumers is essential.

According to the World Dental Federation/International Organization for Standardization (FDI/ISO), toothpaste is defined as a substance used with a toothbrush to cleanse the tooth surface. Ingredients in toothpaste function as abrasive agents and preservatives and have medicinal properties [2].

Fluoride is the most commonly used active ingredient in toothpaste because of its caries-preventive effect. Its effects have been studied since 1940, and an attempt has been made to include fluoride compounds in toothpaste. A research team from Indiana University found that fluoride compounds in acidic environments reduced enamel solubility. Early clinical experimental results showed that fluoride compounds markedly reduced the incidence of dental caries [3].

Toothpaste was first introduced in South Korea in 1889 by the Lion Corporation of Japan. The first toothpaste, “Lucky” was released by LakHee Chemistry in 1954 [4]. However, the forms, functions, effects, and quality of toothpaste have changed since then. In 1970, the first fluoride toothpaste, containing sodium monofluorophosphate (SMFP), for children was released. The first adult toothpaste containing fluoride compounds was released in 1975. In 1985, a toothpaste containing both SMFP and sodium fluoride (NaF) was released. In 1990, the use of fluoride compounds was popularized in South Korea [5].

Among all the functions of toothpaste, preventive measures are very important. Fluoride compounds serve as the main components of anti-cavity function. The incidence of dental caries has started to decrease significantly in developing countries, and many preventive dentistry specialists state that the daily use of fluoride toothpaste is the main contributor to this [6]. Domestic toothpaste products usually contain fluoride compounds in the form of NaF or SMFP. NaF-containing toothpaste releases free fluoride ions (F^-), which are responsible for the anti-cavity effect. Similarly, F^- and fluorophosphate ions (PO_3F_2) are released from the SMFP-containing toothpaste. NaF is known to be more effective than SMFP [7]. According to domestic manufacturing standards, toothpaste can contain up to 1,500 ppm of fluoride; however, the limit usually used was 1,000 ppm, and it was adjusted to 1,450 ppm in 2014 [8]. According to Tanya et al. [9], compared with non-fluoride toothpaste, those with a fluoride concentration of 1,000 ppm suppressed the increase in DMFS in all age groups. Thus, it is necessary to classify toothpaste using a fluoride concentration of 1,000 ppm as the cutoff.

Fluoride compounds are also included in other oral hygiene products, such as mouthwash, dental floss, and toothbrushes. Mouthwash is used for a variety of purposes, such as to treat periodontitis, stomatitis, and bad breath; for disinfection after a procedure such as tooth extraction and implantation; and for dental caries prevention, aside from everyday disinfection of the mouth and throat and for cold prevention [10]. NaF, a fluorine compound in mouthwash for the prevention of dental caries, has been used worldwide since its efficacy in dental caries prevention was demonstrated by the American Dental Association (ADA) in 1960 [11]. Dental floss is an oral hygiene product that is effective in removing plaque between the teeth [12]. Flatt et al. [13] reported that fluoridated dental floss increased salivary fluoride levels for 30 min, thus effectively promoting the remineralization process. Fluoridated toothbrushes are products that contain fluoride. A fluoridated toothbrush releases fluoride from the bristles and is a product for individuals not using toothpaste due to allergy to a toothpaste component or not using fluoride-containing toothpaste due to concern over fluorosis. Zimmer et al. [14] showed that F^- are released immediately after brushing by incorporating fluoride compounds into a toothbrush. F^- can be incorporated into diverse products and can help protect individuals who are at a high risk of developing dental caries.

There are many factors to consider when choosing oral hygiene products, especially regarding fluoride concentration. There are numerous options, ranging from non-fluoride to high-fluoride products.

This study was conducted to survey the currently available fluoride-containing oral hygiene products in Korea to provide consumers with information regarding the concentration and form of fluoride in each product and to determine whether the information was easy to understand. As a result, by confirming the fluoride concentration in oral hygiene products, we would like to identify improvements to prevent dental caries and propose information on fluoride concentrations to help consumers choose oral hygiene products.

Methods

1. Materials

According to the Korea Ministry of Food and Drug Safety (MFDS), there are approximately 3,000 types of oral hygiene products on sale, including 12 types of oral hygiene tissue, 257 types of mouthwash, and 2,796 types of toothpaste products [15]. In this study, fluoride-containing oral hygiene products available to the general public were searched on the internet, and those sold in supermarkets and pharmacies in Gwangju Metropolitan City were purchased. As a result, 64-types of fluoride-containing oral hygiene products were selected, which were purchased from an offline market: one type of dental floss, two types of toothbrushes, four types of fluoride applicant, five types of mouthwashes, and 52 types of toothpaste. Of the study materials, fluoride applicant is an over-the-counter medical device that individuals apply to coat their teeth with fluoride ions using a tray for dental remineralization. The selected oral hygiene products were tested for the presence of fluoride compounds and their concentrations.

2. Methods

1) Analysis of fluoride concentration in toothpaste

The fluoride concentration, type, and labeled information status of 52 types of toothpaste were analyzed. Data for fluoride types and concentrations were collected by observing the product box and the online website of the MFDS. Each purchased toothpaste sample was checked for the location of the labels.

2) Analysis of fluoride concentration in mouthwash products

Five types of mouthwash products were analyzed for their fluoride concentrations and forms. The fluoride concentration in the mouthwash was determined using a fluoride electrode (Orion ionplus Fluoride Electrode 9609, Orion Research, Beverly, USA) and an ion analyzer (Expandable ionAnalyzer 940, Thermo Orion, Beverly, USA). One milliliter of 0.5, 1, 5, 10, 50, and 100 ppm diluted fluoride standard solution (Fluoride Standard, Thermo Electron Co., Beverly, USA) and 1 ml of TISAB II (Total Ionic Strength Adjustment Buffer II with CDTA, Thermo Fisher Scientific, Chelmsford, USA) solution were mixed in a 1:1 ratio, and their values were measured. A standard curve was constructed to determine the significance of the values.

3) Analysis of other oral hygiene products

One type of dental floss, two types of toothbrushes, and four types of fluoride applicant were checked for information label status. Data were collected by observing the box and the online websites of the MFDS.

Results

1. Fluoride concentration in toothpaste

In the 52 kinds of toothpaste examined in this study, the fluoride concentrations varied widely. Seven toothpastes for kids contained 290-1,000 ppm fluoride as either NaF or SMFP <Table 1>, and 45 toothpastes for adults contained 132-1,450 ppm fluoride as either NaF or SMFP <Table 2>.

Label locations of fluoride concentrations varied among the toothpastes. Some products had labels on the outside portion of the box, whereas others had labels on the toothpaste tube. Some products had labels both inside and outside the box, but others included information only in one location <Table 1, 2>.

Table 1. Selected commercial kids' toothpaste products in the decreasing order of fluoride concentration and location of the labels

Product name	Fluoride concent - ration (ppm)	Fluoride type	Manufacturer	Labels (Outside portion of the box)	Labels (On the tube)
Doctor Zenni lime flavor toothpaste	1,000	SMFP	Dong - il Pharmacy	Yes	No
Doctrust T	1,000	NaF	Aseapharm company	Yes	No
Perioe Kids clear toothpaste step 2	597	NaF	LG household & health care	Yes	Yes
No Brand Kids toothpaste strawberry flavor	594	SMFP	Kolmar	No box	Yes
2080 line friends kids toothpaste strawberry flavor	502	SMFP	Aekyung industrial company	Yes	Yes
Dental clinic 2080 Kids O toothpaste green apple	500	NaF	Aekyung industrial company	Yes	Yes
BerBer kids Alvin toothpaste natural strawberry flavor	290	SMFP	Dong - il Pharmacy	Yes	No

NaF = Sodium fluoride

SMFP = Sodium monofluorophosphate

No box = Products not contained in the box

Table 2. Selected commercial adult toothpaste products in the decreasing order of fluoride concentration and location of the labels

Product name	Fluoride concent - ration (ppm)	Fluoride type	Manufacturer	Labels (Outside portion of the box)	Labels (On the tube)
Curaprox enzycal 1450	1,450	NaF	Cosmedical solution research	Yes	Yes
Colgate Maximum Cavity Protection Great regular flavor	1,450	SMFP	Colgate - palmolive company	Yes	No
2080 K Herbal mint	1,000	NaF	Aekyung industrial company	Yes	Yes
2080 Pure black clean charcoal mint toothpaste	1,000	NaF	Aekyung industrial company	Yes	Yes
2080 pure salt toothpaste pink mint	1,000	NaF	Aekyung industrial company	Yes	Yes
2080 pure toothpaste mint blast	1,000	SMFP	Aekyung industrial company	Yes	Yes
Gumguard toothpaste	1,000	SMFP	Dong - a pharm company	Yes	Yes
Neo medical silver toothpaste	1,000	SMFP	Korea life science corporation	Yes	Yes
New fine toothpaste	1,000	SMFP	Kumho - dp	Yes	No
Doctrust double X	1,000	NaF	Aseapharm company	Yes	No
Doctrust 1	1,000	SMFP	Aseapharm company	Yes	No
Dental clinic 2080 new shining white toothpaste	1,000	NaF	Aekyung industrial company	Yes	Yes
Dental clinic 2080 Smart care toothpaste	1,000	SMFP	Aekyung industrial company	Yes	Yes
Dentiste sensitive care toothpaste	1,000	NaF	Cilantro	No	No
Dongui Cheongeuncha toothpaste	1,000	SMFP	Aekyung industrial company	Yes	Yes
Laulu fresh grapefruit toothpaste	1,000	SMFP	Dong - il Pharmacy	Yes	No
Reach Madecapair toothpaste fresh mint	1,000	NaF	LG household & health care	Yes	Yes
Medi - night toothpaste	1,000	SMFP	Kumho - dp	Yes	No
Median new balance toothpaste apple mint	1,000	SMFP	Amore pacific	Yes	No

Table 2. To be continued

Product name	Fluoride concent - ration (ppm)	Fluoride type	Manufacturer	Labels (Outside portion of the box)	Labels (On the tube)
Bamboosalt himalaya pinksalt toothpaste ice calming mint	1,000	NaF	LG household & health care	Yes	Yes
Sensodyne multi care toothpaste	1,000	NaF	GlaxoSmithKline consumer health care Korea	Yes	Yes
Sensodyne Fresh gel toothpaste	1,000	NaF	GlaxoSmithKline consumer health care Korea	Yes	No
Sensodyne Fresh toothpaste	1,000	NaF	GlaxoSmithKline consumer health care Korea	Yes	Yes
Scaling care strong mint toothpaste	1,000	NaF	LG household & health care	Yes	Yes
Silver snow toothpaste	1,000	SMFP	Korea life science corporation	No box	Yes
Bamboosalt natural fresh herb alpha toothpaste	1,000	NaF	LG household & health care	Yes	Yes
Clyden whitening solution new toothpaste	1,000	NaF	LG household & health care	Yes	Yes
Perioe total solution toothpaste	1,000	SMFP	LG household & health care	Yes	Yes
Perioe 46 cm long lasting cool herb mint	1,000	SMFP	LG household & health care	Yes	Yes
Perioe new fresh alpha toothpaste	1,000	SMFP	LG household & health care	Yes	Yes
Perioe cavity care advanced toothpaste	1,000	SMFP	LG household & health care	Yes	Yes
Perioe total 7 ayurveda therapy medical herb ginger mint toothpaste	1,000	NaF	LG household & health care	Yes	Yes
AIOBIO F toothpaste	995	NaF	Kumho - dp	Yes	No
BerBer Aire toothpaste grapefruit mint flavor	977	SMFP	Dong - il Pharmacy	Yes	Yes
Glister multi - action fluoride toothpaste	950	NaF	Amway	Yes	Yes
Clinpro Tooth Crème vanilla mint	950	NaF	3M	Yes	Yes
Zact plus toothpaste	924	SMFP	Lion Korea	Yes	Yes
Parodontax daily fluoride toothpaste	923	NaF	GlaxoSmithKline consumer health care Korea	Yes	Yes
Perioe breath care alpha toothpaste	920	SMFP	LG household & health care	Yes	Yes
No Brand Pro Rich toothpaste	792	SMFP	Kolmar	Yes	No
Doctrust Pro	497.5	NaF	Aseapharm company	Yes	No
Premium Dentitacx toothpaste	264	SMFP	Shinhwa pharmacy	Yes	Yes
Dr. Clevos Original toothpaste	132	SMFP	Kolmar	Yes	Yes
Dentrix	132	SMFP	Dongkook pharm	Yes	No
Insadent Dr. toothpaste	132	SMFP	Dongkook pharm	Yes	Yes

NaF = Sodium fluoride

SMFP = Sodium monofluorophosphate

No box = Products not contained in the box

Toothpaste products are classified into three groups based on fluoride concentration: below 1,000 ppm, 1,000 ppm, and above 1,000 ppm. Toothpaste containing 1,000 ppm of fluoride compounds accounted for the largest portion (61.5%). Toothpaste containing below 1,000 ppm fluoride accounted for 34.6% of all toothpastes surveyed, while 3.9% of the toothpastes surveyed had fluoride concentration above 1,000 ppm <Table 3>.

Table 3. Percentage of toothpaste divided according to fluoride concentration

Unit: N(%)

Division	Below 1,000 ppm	1,000 ppm	Above 1,000 ppm	Total
Kids	5 (71.4)	2 (28.6)	0 (0.0)	7 (100.0)
Adults	13 (28.9)	30 (66.7)	2 (4.4)	45 (100.0)
Total	18 (34.6)	32 (61.5)	2 (3.9)	52 (100.0)

2. Fluoride concentration in mouthwash products

Five mouthwash products were examined, and they contained 99-240 ppm fluoride (in the form of NaF) <Table 4>. The highest concentration was found in Listerine natural green tea mild (240 ppm), and the lowest was in All care gargle (99 ppm). Only two of these mouthwashes displayed the fluoride concentration on the label <Table 4>.

Table 4. Selected commercial mouthwash products for fluoride concentration analysis

Product name	Fluoride concentration (ppm)	Fluoride type	Manufacturer	Presence of labels of fluoride concentration	Fluoride concentration on labels
All care gargle	99	NaF	Ecworld	Yes	0.02 g / 100 ml
ChikaChika mouthwash	230	NaF	Samil pharmacy	Yes	226
Garglin original	115	NaF	Dong - a Pharm Co.	No	-
Listerine natural green tea mild	240	NaF	Johnson & Johnson	No	-
Peerioe total 7 strong mint flavor	140	NaF	LG household & health care	No	-

NaF = Sodium fluoride

- : There is no label indicating fluoride concentration

3. Other oral hygiene products

The seven oral hygiene products contained fluoride in either NaF or HF forms. Information regarding the fluoride concentration was shown on the labels in only three products <Table 5>.

Table 5. The other commercial oral hygiene products selected

Product name	Fluoride type	Manufacturer	Presence of labels of fluoride concentration	Fluoride concentration on labels
2080 fluoride dental floss	NaF	C & C	Yes	600 ppm
Bulsooneca tooth remineralizing pudding tray adult	-	JW - shinyak	No	Not stated
Bulsooneca tooth remineralizing pudding tray kids	-	JW - shinyak	No	Not stated
Fluo pudding adult	NaF & HF	Haerim dentech	Yes	2.55% NaF & 0.08 HF
Fluo pudding kids	NaF & HF	Haerim dentech	Yes	2.55% NaF & 0.08 HF
Fluoride tooth brush	-	O - Zone	No	Not stated
Hayachi fluoride slim tooth brush	-	Dentalcare	No	Not stated

NaF = Sodium fluoride

HF = Hydrofluoric acid

Discussion

This study examined the concentration and form of fluoride in fluoride-containing oral hygiene products sold in Korea. First, the fluorine compounds contained in the 52 kinds of toothpaste were either NaF or SMFP. The concentrations ranged from 132 to 1,450 ppm. Among them, toothpaste containing 1,000 ppm of fluoride compounds accounted for the largest portion (61.5%). Toothpaste products containing below and above 1,000 ppm fluoride accounted for 34.6% and 3.9%, respectively. Thus, the results revealed that toothpastes with fluoride concentrations above 1,000 ppm are rare in the market.

The European Commission on Consumer Product Safety stated that the anti-cavity effects of toothpaste vary according to fluoride concentration. A higher fluoride concentration has a greater anti-cavity effect than a lower fluoride concentration [16]. Furthermore, Walsh et al. performed a qualitative meta-analysis to evaluate the anti-cavity effect of fluorides. Compared to the control group, it was reported that the DMFT prevention rate of 1,000/1,055/1,100/1,250 ppm fluoride was 23%, and 2,400/2,500/2,800 ppm fluoride was 36%. In contrast, 440/500/550 ppm fluoride had no effect on the prevention of dental caries [17]. Although the limit was adjusted, its regulation differed between quasi-drug production standards and approval regulations. Despite the clinically proven effects of high fluoride concentrations, it can not be sold because of the difference in limitations [18]. In case of people with a high risk of dental caries, whose purpose is to prevent caries, high-fluoride-containing products are beneficial. It seems important to popularize high-fluoride-toothpaste so that a broader selection of toothpaste can be offered to consumers who are in need.

Label locations of fluoride concentrations varied between different toothpastes. Some products included labels on the outside portion of the box, whereas others were included on the toothpaste tube. Not only the location of the labels but also the number of labels were different for each product. Some products included labels both inside and outside the box, whereas others included information only in one location. Variations were observed within the same company. As can be seen from Table 2, GlaxoSmithKline consumer healthcare products and Sensodyne fresh gel toothpaste included labels only outside the box. On the other hand, Sensodyne Multicare or Parodontax daily fluoride toothpaste from the same company included the labels both on the tube and outside portion of the box. To maximize accessibility to information, manufacturers should include labels at both locations. Moreover, label sizes differed between products. one type of toothpaste label was large enough for consumers to recognize at a glance. However, the labels of other toothpaste were small; thus, it was difficult to obtain the requisite information by just looking. The label size should be larger to improve the readability.

Surprisingly, there was no place to find information about the fluoride concentration in oral hygiene products online. Although the MFDS provides information such as product name, manufacturer, and active ingredients, there was no exact value provided for fluoride concentration. Therefore, consumers must go offline and rely only on labels located on the product box. Official websites should provide online information so that consumers can access data on fluoride concentration prior to purchasing products.

Five mouthwash products containing 99-240 ppm fluoride in the form of NaF were examined. According to the Centers for Disease Control and Prevention (CDC), the fluoride concentration of mouthwash products for daily rinsing and caries prevention is 0.05% NaF solution (230 ppm) [19]. ChikaChika mouthwash (230 ppm fluoride) and Listerine natural green tea mild (240 ppm fluoride) met the CDC standards. The other three types of mouthwash products (All care gargle (99 ppm fluoride), Garglin original (115 ppm fluoride), Perioe total 7 strong mint flavor (140 ppm fluoride)) contained less than 230 ppm fluoride. To promote anti-cavity effects, increasing the fluoride content in mouthwash products is suggested. In three out of five mouthwashes no information on fluoride concentration was found on the label. To help consumers make choices, such information should be provided on product labels.

Campus et al. [20] reported that the fluoride concentration in saliva increased after the use of toothpaste and mouthwash containing fluoride. This finding demonstrates the effect of fluoride in toothpaste and mouthwashes, not only that after topical application to tooth surfaces but also that following the elevation of salivary fluoride concentration. In a study by Flatt et al. [13], salivary fluoride concentration was elevated for 30 min after the use of fluoride-containing dental floss, suggesting the release of fluoride from the floss. Therefore, increased salivary fluoride concentration after the use of a fluoride-containing toothbrush or dental floss may be effective in preventing dental caries and causing tooth remineralization.

The seven other oral hygiene products contained fluoride in either NaF or HF form. In only three products, information regarding the fluoride concentration was shown on the label. Fluoride concentration should be specified on the product labels of all dental hygiene products, including mouthwashes, to provide consumers with correct information. Toothpaste and mouthwash products are classified as quasi-drug products, whereas dental floss, tongue cleaners, and toothbrushes are classified as industrial products [21]. According to the Ministry of Health and Welfare (MOHW), there are an average of 51 complain reports to the Korea Consumer Agency (KCA) annually. Of all complaint reports, 62.5% were product-related problems, including hazardous contaminants or lacerations related to product use [22]. The 14-year-old and older age group reported 50% of the total complaints, indicating that it is not just a matter of children's safety issues. The safety management of industrial products seems inadequate, and stricter regulations are suggested. Additionally, for consumer convenience, standardized information regarding fluoride concentration should be provided on the product label as well as online for all dental hygiene products, as this practice will help prevent consumer complaints.

There are approximately 3,000 types of commercial domestic products. In this study, the number of oral hygiene products studied was significantly small so as to represent all commercial products; however, this investigation is meaningful. There have been many studies on the effects of fluoride and its contents; however, there have been no studies on the information status for the practical use of oral hygiene products. In the future, studies with larger sample size and more detailed methodology will result in more reliable data.

Conclusions

This study was conducted to survey the currently available fluoride-containing oral hygiene products in Korea to provide consumers with information regarding the concentration and form of fluoride in each product and to determine whether the information was easy to understand. Thus, confirming fluoride concentration in oral hygiene products and providing this information on the product labels can aid customers in selecting the appropriate oral hygiene products, thus helping to prevent dental caries.

Studying the 64 types of domestic commercial oral hygiene products purchased from an offline market and evaluated, we found the following:

1. Domestic commercial toothpaste products contain fluoride in the form of NaF and SMFP. In this study, toothpaste containing 1,000 ppm of fluoride compounds accounted for the largest proportion (61.5%); toothpastes with fluoride concentration below 1,000 ppm accounted for 34.6% and those with concentrations above 1,000 ppm, for 3.9%. Therefore toothpastes with fluoride concentrations above 1,000 ppm have not been popularized domestically.
2. Mouthwash products contained less than 300 ppm fluoride concentration. For daily-use purposes, mouthwash products should contain 0.05% NaF (230 ppm). In this study, ChikaChika mouthwash and Listerine natural green tea mild mouthwashes met the standards. Of the five types of mouthwash products, only two included labels indicating fluoride concentration.
3. Location of the labels indicating fluoride concentration differed between manufacturers and even within the same manufacturer.
4. There was no information regarding fluoride concentration available online.

According to the results above, it seems important to popularize high-fluoride toothpaste so that a broader selection of toothpaste can be offered to consumers who are in need. Furthermore, it is considered that improvements should be made to the information-labeling system. Standardized information should be provided for consumer convenience to aid in choosing appropriate oral hygiene products.

Conflicts of Interest

The authors declared no conflicts of interest.

Authorship

Conceptualization: CU Oh, KH Kim; Data collection: CU Oh; Formal analysis: KH Kim; Writing - original draft: CU Oh, KH Kim; Writing - review & editing: CU Oh, KH Kim

References

1. Ministry of Food and Drug Safety. 2019 Ministry of food and drug safety industrial trend analysis. Cheongju: Ministry of Food and Drug Safety; 2019: 62-5.
2. International Organization for Standardization. Dentistry - toothpastes - requirements, test methods and marking. Geneva: International Organization for Standardization; 1995: 2.
3. Kim BI. Dentrifice. In: textbook of oral care products. 2nd ed. Seoul: CharmYun; 2016: 52-68.
4. Song GB. Toothpaste, oral mouthwash and gums. In: primary preventive dentistry. 6th ed. Kwon HK: Seoul; DaehanNarae Publishing. 2006: 96-105.
5. Park YM. Functions of toothpaste. In: world of toothpaste. 1st ed. Seoul: Gunja Publishing; 2003: 63-81.
6. Lagerweij MD, Loveren CV. Declining caries trends: are we satisfied?. *Curr Oral Health Rep* 2015;2(4):212-7. <https://doi.org/10.1007/s40496-015-0064-9>
7. Tenuta LM, Zamataro CB, Del Bel Cury AA, Tabchoury CP, Cury JA. Mechanism of fluoride dentifrice effect on enamel demineralization. *Caries Res* 2009;43(4):278-85. <https://doi.org/10.1159/000217860>
8. Ministry of Food and Drug Safety. Medicines etc standard manufacturing standards some revision notices. Cheongju: Ministry of Food and Drug Safety; 2014: 1-9.
9. Walsh T, Worthington HV, Glenny AM, Marinho VC, Jeroncio A. Fluoride toothpastes of different concentrations for preventing dental caries. *Cochrane Database Syst Rev* 2019;3(3):CD007868. <https://doi.org/10.1002/14651858.CD007868.pub3>
10. Ministry of Health and Welfare. 2010 Korean National Oral Health Survey: II Survey report. Seoul: Ministry of Health and Welfare; 2011: 123.
11. White WE. Monofluorophosphate - its beginning. *Caries Res* 1983;17(Suppl 1):2-8.
12. Kiger RD, Nylund K, Feller RP. A comparison of proximal plaque removal using floss and interdental brushes. *J Clin Periodontol* 1991;18(9):681-4. <https://doi.org/10.1111/j.1600-051x.1991.tb00109.x>
13. Platt CC, Warren-Morris D, Turner SD, Chan JT. Effects of a stannous fluoride - impregnated dental floss on *in vivo* salivary fluoride levels. *J Dent Hyg* 2008;82(2):19.
14. Zimmer S, Barthel CR, Wagner T, Wille M, Roulet JF. Fluoride release from a toothbrush. *J Clin Dent* 2000;11(4):114-7.
15. Ministry of Food and Drug Safety. Drug information search[Internet]. Ministry of Food and Drug Safety. [cited 2020 Aug 03]. Available from: <http://nedrug.mfds.go.kr/searchDrug#>.
16. European Commission. The safety of fluorine compounds in oral hygiene products for children under the age of 6 years. Brussels: European Commission; 2005: 3-6.
17. 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.CD007868.pub2>
18. Gunchinews. Industry, new products, first commercial 1,500 ppm toothpaste[Internet]. Gunchinews. [cited 2020 Jul 28]. Available from: <http://www.gunchinews.com/news/articleView.html?idxno=52326>.
19. Centers for Disease Control and Prevention. CDC, oral health home, community water fluoridation, water fluoridation basics[Internet]. Centers for Disease Control and Prevention. [cited 2020 Aug 06]. Available from: <http://www.cdc.gov/fluoridation/basics/fluoride-products.html>.
20. Campus G, Lalli MR, Carboni R. Fluoride concentration in saliva after use of oral hygiene products. *Caries Res* 2003;37(1):66-70. <https://doi.org/10.1159/000068220>
21. Ministry of Health care and Welfare. Quasi - drug criteria revision. Sejong: Ministry of Health care and Welfare; 2010: 2.
22. EJA News. Social, health, inadequate management of toothbrush, dental floss[Internet]. EJA News. [cited 2020 Jul 25]. Available from: <http://www.ejanews.co.kr/news/articleView.html?idxno=213651>.

국내시판 불소함유 구강위생용품의 실태조사

초록

연구목적: 본 연구는 국내에서 시판되고 있는 구강위생용품을 조사하고 구강위생용품에 함유된 불소 농도와 형태에 대한 정보를 제공하기 위해 시행하였다. **연구방법:** 국내 시판 구강위생용품을 선택하여 총 67개를 오프라인 시장에서 구매하여 평가하였다. **연구결과:** 국내 시판중인 치약 중 1,000 ppm의 불소 농도를 함유한 치약이 59.3%로 가장 많은 비중을 차지했으며, 불소를 함유하지 않은 치약은 3.7%, 1,000 ppm 이하의 불소 농도를 함유한 치약은 33.3%, 1,000 ppm 이상의 불소 농도를 함유한 치약은 3.7%로 나타났다. 선택한 구강양치액 제품의 불소 이온농도를 측정해본 결과, 300 ppm 이내의 불소 이온농도를 나타냈다. 또한 6개의 구강양치액 중 2개의 제품만이 불소 농도를 표기하고 있었다. 구강위생용품의 불소 함량을 나타내는 정보는 제품 종이상자 및 제품 자체에 표기되어 있으나, 거의 모든 표기는 뒷면에 작성되어 있으며 일부 제품에서는 제품 자체에 표기되어 있지 않은 경우도 있었다. 또한 표기된 정보 내용도 제조업체 간, 제조업체 내에서도 상이함을 확인되었다. **결론:** 1,000 ppm 이상의 높은 불소 농도를 함유한 치약을 포함한 다양하고 효과적인 불소 농도의 구강위생용품들이 제공됨으로써 소비자들에게 더 넓은 선택의 폭을 제시하면 좋을 것으로 생각된다. 또한, 국내에서 시판 중인 구강위생용품에 대한 소비자에게 제공되는 정보가 다소 적은 것으로 사료되어, 소비자의 구강위생용품 선택에 대한 편의를 위해 명확한 기준 및 정보 표기에 대하여 개선해야 할 것으로 생각된다.

색인: 구강양치액, 불소, 치약