

Review

Fluoridex Daily Defense Toothpaste for Oral and Dental Health: A ReviewParisa Ziarati^{1,2,*}, Krishnan Umachandran³, Dickson Adom⁴, Mohamed A. El-Esawi⁵, Barbara Sawicka⁶¹*Nutrition & Food Sciences Research Center, Tehran Medical Sciences, Islamic Azad University, Tehran-Iran*²*Pharmaceutical Chemistry Department, Islamic Azad University, Tehran Medical Sciences, Tehran-Iran*³*General Manager - Org.Dev, NELCAST Ltd., 159, TTK Road, Alwarpet, Chennai - 600018, India*⁴*Department of Educational Innovations in Science and Technology Kwame Nkrumah University of Science and Technology, Kumasi-Accra, Ghana*⁵*Botany Department, Faculty of Science, Tanta University, Tanta, Egypt*⁶*Department of Plant Production Technology and Commodities Sciences, Faculty of Agrobiotechnology, University of Life Sciences in Lublin, Poland*

The lack of fluoride in toothpastes leads to the formation of a thin biofilm on the teeth supporting the growth of bacteria that attack and weaken enamel hydroxyapatite crystals. Maintenance and control of the mechanism of dental fluoride minimization, maintaining balance in the range of tooth decay, is the main function of fluoride toothpastes available on the market. Modern diet options are more and more frequent threats to increasing tooth decay indexes. Therefore, the frequent use of Fluoridex Daily tooth paste increases the resistance of teeth to acid dissolution and the penetration of fluoride ions to tooth enamel, which are crucial in avoiding tooth caries.

Keywords: Toothpaste; Dental Health; Fluoridex; Young people.

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Introduction

Toothpaste aims at protecting the teeth against plaque and gingivitis while producing clinically significance results even during unsupervised usage. Toothpaste is

effective with active agent for the delivery of fluoride. China and India are credited for developing toothpaste using crushed bones, oyster shells and crushed eggs in 300-500 BC [1]. The composition of toothpaste is complex with constituents that benefit oral health, reduced calculus formation, extrinsic dental stains, tooth hypersensitivity

* Correspondence: Parisa Ziarati, Pharmaceutical Sciences Branch, Islamic Azad University, Tehran – Iran (IAUPS) Islamic Azad University, Pharmaceutical Sciences Branch (IAUPS), Nutrition and Food Sciences Research Center. No 99, Yakhchal, Gholhak, Dr. Shariati, Tehran-Iran. Tel: +98-21-22640051; Fax: +98-21-22633986. Email addresses: ziarati.p@iaups.ac.ir

and halitosis. Toothpastes have a little value in periodontal disease management. The success of fluoride toothpastes has been a driver for researchers and manufacturers to seek agents which could be equally successful for reducing periodontal diseases [2]. The antimicrobial compounds in toothpastes enhance plaque inhibitory effects. In addition, toothpaste contains abrasives which help clean teeth [3]. Frequent use of Fluoridex Daily increases tooth resistance to acid dissolution and enhance penetration of the fluoride ion into tooth enamel, which are crucial in avoiding caries disease. Absence of fluoride leads to thin biofilm that aids the growth of bacteria which attack and weaken the hydroxyapatite crystals of the enamel. Interestingly, Fluoridex Daily is the most cost-effective toothpaste for combating caries as well as reducing its risk and recession in patients.

The Importance of Fluoride in Toothpaste: Fluoridex Daily Defense Toothpaste

Fluoride plays a major role in maintaining oral health through its detergent action that prevents the growth of microorganisms while removing plaque and debris from the tooth [4]. As a principal change agent, it reduces the health care problems with the addition of fluoride to toothpastes; hence its application on a daily basis will strengthen the enamel and heal the early carious lesion [2].

Fluoride containing triclosan/copolymer toothpastes with the 1000ppm provides effective plaque control and periodontal health, as the triclosan blocks lipid biosynthesis and specifically inhibits the enzyme enoyl-acyl carrier protein reductase (ENR), which contributes to antimicrobial efficiency [5].

The introduction of fluoride as one of the active ingredients in toothpastes was approved by the American Dental Association (ADA) in 1960 though its great

significance was earlier noted in 1914 [6]. Fluoride toothpastes contain a cationic agent called chlorhexidine that slows down the development of dental plaque [7]. Fluoride toothpaste offers the standard treatment for dental caries (Costa, 2011). It also reduces coronal and root caries by 20% to 30% among adults [8]. The widespread use of fluoride toothpaste has contributed to a dramatic reduction in caries incidence worldwide. Daily brushing with fluoride toothpaste is acknowledged as the most cost-effective method for preventing caries and the dissolution of the hydroxyapatite crystals [9]. Fluoride toothpaste like Fluoridex Daily Defense, offers antimicrobial protection for up to eight hours. Low concentrations of fluoride in toothpastes still remain in the saliva for 2-6 hours after brushing [8]. The fluoride from the toothpaste released in the oral cavity is stored as a dental biofilm on the enamel surface, providing the teeth with considerable anti-caries resistance [1]. It makes the surface of the enamels of the teeth smooth and not pit or fissure (Gilbert, 1995). All the types of fluoride such as sodium fluoride, sodium monofluorophosphate, amine fluoride and stannous fluoride [6] are all very effective for the treatment of caries. They also prevent bad breath in the mouth and oral cavity which is usually caused by the oral bacterium *Streptococcus mutans* [10]. Unlike the other brands of toothpaste, Fluoridex Daily Defense provides important clinical feedback as a result of its ability to stain visible or hidden carious lesions.

The Health Implications of Inappropriate Fluoride Compositions in Toothpastes

The success of fluoride toothpaste has driven manufacturers in reducing periodontal diseases because it reduces caries in both the primary and permanent dentitions, with worldwide widespread reduction in dental caries cases. Though fluoride was initially added to

toothpastes with the aim of preserving the product and protecting the teeth, inappropriate composition is hazardous to the oral health of a person. The excess use of fluoride can cause dental fluorosis. Therefore, the recommended amount of fluoride should be used included in toothpastes. Fluoride toothpaste reduces the number of streptococcal colony forming units of dental plaque [5]. Fluoride and casein phosphopeptide-amorphous calcium phosphate is recommended for application as a topical coating after the teeth with high caries risk have been brushed with fluoridated toothpaste [11]. Fluoride ion is not mutagenic in standard bacterial systems and has the potential of inducing chromosome aberrations in higher dosages leading to acute burning in the mouth, sore tongue, nausea, vomiting as well as diarrhea accompanied by salivation, hematemesis, and epigastric cramping abdominal pain. In addition, higher and uncontrolled percentages of some fluoride compounds could lead to fluorosis, a situation which is not health-risky but leads to the undesirable browning of the teeth. Costa in 2011 [1] contends that 1000 ppm concentration of fluoride is recommended for children under the age of 3 years, while 1350-1500 ppm, often referred to as a pea-sized amount is appropriate for young people between the ages of 3 to 6 years old. It must be noted that the inappropriate concentration of fluoride with the exception of those

prescribed by a qualified medical doctor in treating particular cases of tooth infection, can result in serious health implications such as severe burns and sore in the mouth. Franzman et al., in 2006 [12] warn that the inappropriate concentrations of fluoride among children below the age of 3 years can result in fluorosis development on the incisors and first molars.

Constituents and Composition for Oral Health and Enhanced Plaque Inhibitory Effects

Dental plaque usually forms when there is the presence of sucrose, resulting in more cariogenic and enamel mineral loss [27]. Fluoride helps strengthen enamel and prevent cavities. It inhibits enzyme growth, such as reducing the IgA protease synthesis that results in serious dental plaque [4]. Toothpaste's abrasiveness is measured by its Relative Dentin Abrasivity (RDA). It should be noted that the higher the quantity of RDA in a toothpaste, the greater its dentin abrasiveness potential [13]. Selecting toothpastes with low RDA can prevent both sensitivity and structural compromises that can cause the need for future restorative dentistry [3].

Products	Remarks
ClinPro 5000 1.1% NaF	Claimed for proven prescription-strength toothpaste, remineralizes lesions throughout, not just on the surface, and delivers more fluoride to the tooth. It contains 1.1. % NaF and 5000 ppm fluoride ion, tri-calcium phosphate ingredient (TCP). It releases a high level of fluoride plus calcium and phosphate components found naturally in saliva. It is gentle to clean white, with low abrasion and replaces conventional toothpaste regimen. It helps strengthen enamel, reverses white spot lesions and available namely in vanilla mint, bubble gum and spearmint flavors.
Control Rx	To prevent dental cavities, Control Rx is used as a medication to prevent tooth decay in patients through their drinking water at a low level. It prevents tooth decay in patients who have dryness of the mouth and an increased incidence of tooth decay, having undergone radiation treatments in

	head/neck.
SF 5000 Plus	This makes the teeth more resistant to decay and bacteria which causes cavities. Applying a thin ribbon of medicine and brushed for 2 minutes, spitted out, and rinsed in case of children; adults, need not rinse but restrain from eating and drinking for at least 30 minutes.
Fluoridex	Fluoridex is a line of prescription-strength fluoride toothpastes and a mouth rinse indicated for the treatment and prevention of dental caries and available exclusively through dental professionals. Variants available include daily defense which inhibits bacterial activity and enhances remineralization; sensitivity relief comes up with 5% potassium nitrate; sensitivity relief SLS offers in addition has sodium lauryl sulfate; enhanced whitening in addition to the anti-caries and professional-strength fluoride, silica is added to help remove surface stains without the use of hydrogen peroxide; daily renewal rinse offers prescription-strength caries protection and dental desensitization for sensitivity.
Prevident 5000 Plus / Dry Mouth	Similar to Control Rx, Fluoride topical should be used immediately after brushing or flossing your teeth, just before bedtime.
Prevident Booster	Unique liquid gel formula, better remineralization after 10 / 20 days, mild cleaning system with low abrasion, helps reverse white-spot lesions, enables faster fluoride dispersion, optimized fluoride delivery and produces a temporary shift in pH, resulting in an 86% improvement in fluoride uptake. It is ideal for patients with high caries risk, crown / bridge work, and orthodontic decalcification.
Prevident Sensitive	Similar to Control Rx, it should not be used if the level of fluoride in the drinking water is greater than 0.7 parts per million (ppm)
Pro-Den Rx	Topical fluoride treatment containing 1.1% Neutral Sodium Fluoride and 5000 ppm F ion, when used daily, aids in the prevention of dental caries. It has active ingredients of Carboxymethyl cellulose sodium, flavor, phosphoric acid, purified water, sodium hydroxide and sucralose. Cover brush head with Pro-DenRx 1.1% Neutral Sodium Fluoride Gel and brush around all tooth surfaces and gum line for at least two minutes. Spit out gel.
Topex Renew	A re-mineralizing paste, 5,000 ppm neutral sodium fluoride and 5% Calcium sodium phosphosicliate, to treat tooth sensitivity and root caries, available in mint flavor.

Fluoridex Daily Increases Tooth Resistance and Penetrates into Tooth Enamel

After eating, the acidic environment in the mouth has pH decreased, casein phosphopeptide proteins release amorphous calcium and phosphate, create a supersaturated state of calcium and phosphate around the tooth.

Cariogenic challenge diffuse fluoride, calcium, and phosphate present on the biofilm into the enamel, and promote remineralization [13]. Dental caries result when the rate of demineralization exceeds the rate of remineralization and the lattice work is destroyed. Fluoride prevents and controls cavities by slowing down demineralization and bacteria growth. It causes a reduction in extracellular polysaccharide production which assists in minimizing the adherence of bacteria to the dental hard tissues [4]. It does that by hardening softened dentin by making it more resistant to acid or abrasion. Fluoride, calcium and phosphate aids in strengthening the weak lattice work to prevent cavitations. It offers quick relief from dentinal hypersensitivity. Fluoroapatite is more resistant to acids. Fluoridex contains 1.1% Neutral Sodium Fluoride and 5000 ppm F. For a higher dosage, fluoride varnishes which contain 5% Sodium Fluoride can be used. 22600 ppm F applied on white (invisible) or yellow colored teeth are less F ingestion compared to tray delivered gels and foams. The effectiveness of fluoride toothpastes as an antimicrobial agent is concentration dependent [5].

Caries Weaken Enamel by Accumulating the Growth of Bacteria

Dental caries is a disease of the hard tissues of the teeth caused by imbalance and overtime in the interactions between cariogenic bacteria in dental plaque and fermentable carbohydrates, mainly sugars [15]. It is initiated by acid-producing bacteria on dental biofilms causing carious lesions. Dental biofilms is carcinogenesis, preventing the function of acid producers during caries formation, and are reservoirs and diffusion barriers for caries-preventive components [14]. The use of fluoridated toothpaste has been endorsed as having an efficacy rate of 25% higher than non-fluoridated toothpastes for the

reduction of caries [4]. Its use is seen as the primary intervention for the prevention of caries [15]. The use of fluoridated toothpastes has a historical track record of removing dental decay. The survey conducted by SCCNFP in 2003 [24] indicated that the tremendous reduction in dental decay and its related diseases in the early 1970s in industrialized countries were due to the introduction, widespread and daily use of fluoridated toothpastes. In a recent study by Lippert in 2017 [16] on the high efficacy of fluoride in removing tooth caries in comparison with Strontium and Theobromine, the findings from the study indicated that fluoride was the best in ensuring the re-hardening of softened dentin. Strontium was only seen as helpful in fighting caries when it was assisted with fluoride. This indicates the quintessential and unparalleled role that fluoride plays in the prevention of caries.

Fluoridex Daily Combats Caries Risk and Recession Patients

Fluoridex Daily is one of the best toothpastes that contains high aggregate of fluoride that puts up the most effective and strong resistance against caries in both deciduous and permanent teeth [13]. The fluoride content hampers the caries in patients by enhancing tooth mineralization, reversal of tooth demineralization and inhibits the growth of the acid-producing bacteria that causes caries [8]. Fluoride toothpaste also mitigates the dental plaque and the bacterial biofilm that causes caries [17]. Toothpastes with 1000 ppm to 1500 ppm fluoride concentration are the most effective for the treatment of caries infection in patients [13]. This also spares patients of the emotional distress that is often an additional unfavorable situation aside from the pain of the caries disease [15].

Risks associated with Higher Dosage of Fluoride

From the RDA table as per the 2015 Integrative Oral Medicine, the value range of 100-150 is highly abrasive, and Fluoridex Daily Defense has a RDA value of 117, which means it is highly abrasive. Unfortunately, such an abrasive can strip away tooth enamel, making teeth sensitive to heat, cold, and sweets. A secondary problem from the abrasiveness of the paste is the notching of the tooth at the gum line causing a structural compromise. Often a filling is necessary to protect the future integrity of the tooth [3]. In very rare cases, excessive dosage of fluoride results in skeletal fluorosis, which is a crippling bone disease [8]. Studies have shown that children between the ages of 2-5 years swallow 30-50% of the toothpaste they use for brushing their teeth. Due to the high dosage of fluoride in the toothpaste, their tooth develops fluorosis [13]. The extent of the fluorosis is dependent on the timing, duration and dose that were ingested [8]. To help curb fluorosis development in children, a reduction of the high dosage of fluoride in toothpaste at 500-550 ppm is recommended [18]. Lewis and Milgrom in their study in 2003 [8] also recommended a small pea-size quantity of toothpaste per brushing for young people below the age of 6 years. In a similar vein, the United States Institute of Medicine recommends the daily use of fluoride not exceeding 0.05 to 0.07 mg/kg for children up to 12 years of age with parents supervising their brushing [4].

Deterioration of Oral Health and Fluorosis - Study of Products in the Market

The epidemiology studies on dental caries and dental fluorosis; impact on people's well-being and quality of life studied risk factors for dental caries and dental fluorosis through the use of fluoride vehicles in dental practice and

the population; on the efficacy and cost effectiveness of fluoride vehicles. Relative variables in dental caries consist of the level of fluoride in the drinking water, the individual's oral health knowledge and behavior including the daily use of brush and tooth cleaning practices [19]. Decay in the primary dentition leads to the danger of infection and causes damage to the underlying permanent dentition. In recognition of the need to ensure that people have lifelong exposure to optimal fluoride levels, introduction of fluoride toothpastes and water fluoridation programs should be supported along with addressing the toothpaste and tooth brushing issues in order to control dental fluorosis. High concentration fluoride gels and foams containing more than 1.5mg/g fluoride ion may be used by young people aged 10 years or more who are at an elevated risk of developing caries in situations where other fluoride vehicles are unavailable or impractical. Fluoride levels in water depend on the average maximum daily air temperature. The fluoride level in water fluoridation programs in cooler climates is higher than that in warmer climates as people in cooler climates consume fewer fluids than people in warmer climates, hence a flat dose-response is not a solution in controlling it [20].

Early loss of primary teeth can result in a loss of space for the permanent teeth resulting in crowding and a need for orthodontic treatment. Hence, many industrialized countries adhere to the recommendations with regard to the levels of fluoride in water and the use of fluoride toothpastes. Thus, there is a significant improvement in the control of dental caries due to the greater availability of fluoride through automatic fluoridation (i.e. water, salt, milk) and an increase in the use of fluoride toothpastes [21]. Though many people use fluoride toothpastes but they are unaware that their toothpaste contains fluoride [22]. Promotion of brands, purchase incidence, quantity decisions and purchase frequency depend upon the effectiveness of price and use. Owing to this, toothpaste manufacturers have a remarkable track record in tackling

competition in oral care across the globe by augmenting capacities and attaining large scale benefits, gaining ability to roll out higher quality and premium products faster and bringing logistics costs lower by being closer to suppliers and large markets. Toothpaste market depends on the relative prices, socio-economical status, brand loyalty, and household size as marketing mix variables affect different consumer buying behavior [23].

Continuous surveillance and survey data helps in establishing the trends in oral health. As the mouth is an integral part of the body, oral health is an essential component of overall health and quality of life. Though socioeconomic inequality affects oral health, it is more influenced by young people and their families, the community and the dental health system. Thus, any early detection and treatment can help to improve the health status [24]. Dental fluorosis does not occur in temperate areas at concentrations below 1.5mg–2 mg of fluoride per liter of drinking-water. The greater amount in warmer areas is mainly through the water at lower concentrations by drinking. Even when concentrations in drinking-water are below 1.5 mg/liter, it is also possible for fluoride intake through the elevation of air and food. In addition, skeletal fluorosis occurs when drinking-water contains 3–6 mg of fluoride per liter. Crippling skeletal fluorosis occurs usually when drinking-water contains over 10 mg of fluoride per liter [25]. Dental fluorosis is an acute, chronic and endemic problem on dental public health and very prone to affecting children across the globe. Epidemiologically, fluorosis has been reported from various regions of the world including Africa, Saudi Arab, India, China, Pakistan, Tanzania, Brazil, Kenya, Taiwan, and Malawi through high levels of fluoride in drinking water. Dental fluorosis is a sign of fluoride toxicity and clinically ranges from very mild to severe, by staining and pitting of the teeth. Prevalence is dependent upon the fluoride intake in the early stage of life mostly through ingesting toothpaste. This is a major risk factor for dental fluorosis, causing symptoms of acute fluoride

toxicity. Young people swallow more fluoride from toothpaste alone than is recommended from all sources combined. High incidence of endemic fluorosis is mainly due to the fact that large areas contain high level of fluoride in the drinking water sources [26-29].

Market Research on Fluoridex Toothpastes

Water fluoridation should be continued as it remains an effective, efficient, socially equitable and safe population approach to the prevention of caries. The level of fluoride in the water supply should be within the range 0.6–1.1mg/L with variations within that range according to the mean maximum daily temperature; hence low fluoride toothpaste with 500-550 PPM fluoride has risk-benefit balance in relation to caries and fluorosis. Fluoride supplements in the form of drops or tablets can be chewed and spited. People may be cautioned against the use of fluoride mouth-rinse though it could be used with supervision and care on those who have an elevated risk of developing caries. Fluoride mouth-rinse should be used and spat out, not swallowed; in situations where toothpaste is not available and ensured that it is not a substitute for brushing with fluoridated toothpaste [20].

The ability to alter fluoride levels in toothpastes is reviewed over the following products which includes ClinPro 5000 1.1% NaF, Control Rx, SF 5000 Plus, Fluoridex, Prevident 5000 Plus, Prevident Dry Mouth, Prevident Booster, Prevident Sensitive, Pro-Den Rx, and Topex renew.

Conclusion

Maintaining and controlling the mechanism for

minimizing dental fluorosis, with balance against dental caries rates is the main function of these fluoridex toothpastes available in the market. However, the modern dietary options such as bottled non fluoridated water coupled with sugar dense drinks are an increasing menace being reflected in rising rates of dental caries. These areas are the basis for further research into dietary changes, fluid intake, environmental influences on oral health and offer more challenges to the control of dental decay. Innovation appears during crises. Now, fluoride coat or varnish is also available for those including young people, who have elevated risk of developing caries. Hence, there is a requirement for controlling fluoride dental products such as toothpastes, rinses and coats which are superfluous with free ionized fluoride to check the anti caries and damage to oral health.

Conflicts of Interest

None of the authors have any conflicts of interest associated with this study.

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