Stannous Fluoride Dentifrice with Sodium Hexametaphosphate: Review of Laboratory, Clinical, and Practice-Based Data

By Cynthia Sensabaugh, RDH, BS; Mary Elizabeth Sager, BS, MA

Abstract

Dentifrice was originally promoted to provide oral hygiene by cleaning teeth. However, with advances in product formulation, it has become a valuable vehicle for the delivery of agents offering health and cosmetic benefits. Stannous fluorides, introduced in 1955 in dentifrice, is one of the longest established of such agents. The well-known anti-caries efficacy of stannous fluoride is based on its impact on the tooth surfaces and on its antibacterial activity. More recently, the demand for tooth whitening products has increased and sodium hexametaphosphate has been shown to be helpful in whitening surface stains and in controlling calculus. A dentifrice formulation which combines the benefits of stannous fluoride with those of sodium hexametaphosphate is now available. A review of the evidence shows that in addition to effective anti-caries action, this formulation is effective in fighting plaque, gingivitis, and gingival bleeding while inhibiting calculus and extrinsic stain. A practice-based evaluation including data from over 1,200 dental professionals and 1,000 patients demonstrates the product’s benefits and excellent acceptability. Collectively, the research shows this stannous fluoride/sodium hexametaphosphate dentifrice provides multiple benefits to meet the oral health and cosmetic needs of patients.

Key Words: stannous fluoride, dentifrice, gingivitis, caries, sensitivity, calculus

Introduction

Patients today represent one of the most heterogeneous groups in history in terms of age, health status, oral hygiene habits and other factors. While certain oral health conditions are more prevalent among specific patient groups, such as periodontal disease among diabetic patients, many oral health conditions affect the broad population. According to U.S. surveys, virtually all adult patients have had dental caries, more than half experience gingivitis, and roughly one in three suffer from dental sensitivity. Fortunately, home care products are available to help prevent and treat many common oral health conditions in conjunction with routine professional care. Dentifrice is one important example. Many years ago, the benefits of dentifrice were limited to disease prevention and the future of tooth decay. It was common for professionals to tell patients “use any dentifrice with fluoride and the ADA Seal.” However, formulators today can design dentifrices to provide numerous other benefits, both for health and cosmetic purposes.

In 2005, a stannous fluoride sodium hexametaphosphate (SFSH) formula was introduced offering protection against a broad range of health and cosmetic conditions commonly experienced by patients. The present review reports the laboratory, clinical and practice-based assessments evaluating the efficacy of this dentifrice formulation. Stabilized stannous fluoride/ sodium hexametaphosphate formulation

The SFSH formula combines the therapeutic benefits of 0.454% stabilized stannous fluoride with the calculus and stain-control characteristics of sodium hexametaphosphate in a low-water formulation dentifrice. Stannous fluoride, which unlike sodium fluoride can be used in combination with calcium-based abrasives, has been incorporated in dentifrices since the 1950s to provide protection against caries, pathogenic bacteria, gingivitis, hypersensitivity, and the development of plaque. There is considerable evidence for its efficacy as a therapeutic agent with a wide spectrum of beneficial properties. However, its clinical usage was limited because of astringent taste and in some patients its use resulted in extrinsic staining of the teeth. Stannous fluoride was also somewhat unstable in aqueous solution. The latter problem was resolved with the introduction of stabilized stannous fluoride in the 1960s which rendered more available stannous fluoride and resulted in a renewed interest in the wide range of benefits offered by stannous fluoride in dentifrices.

Sodium hexametaphosphate was first introduced in a dentifrice in 2000. It is a chemical whitening agent in the same class as pyrophosphate, which has long been used to inhibit calculus and the molecule is about 10 times longer than that of pyrophosphate. Sodium hexametaphosphate therefore provides better coverage and retention on the tooth surface, thus increasing its ability to inhibit both calculus and stain formation on the enamel surface. Stability of the dentifrice can be an issue with the inclusion of polyphosphates if ingredients are not properly balanced. Like other polyphosphates, sodium hexametaphosphate does not usually show good long-term stability in aqueous dentifrices. However, the novel single-phase SFSH formula, which uses a low-water system in a silica-based formulation, significantly reduces the hydrolysis of sodium hexametaphosphate and helps to maintain effective levels of whitening activity.

The resulting dentifrice has improved esthetic qualities over the original stannous fluoride formulation, and delivers a broad range of therapeutic and cosmetic benefits (Figure 1). The remainder of this paper provides a summary review of research on stannous fluoride, sodium hexametaphosphate dentifrices, especially, the unique SFSH formulation.

Figure 1. Benefits of stannous fluoride and sodium hexametaphosphate

• Antimicrobial activity against species associated with plaque, gingivitis, cavities and malodor
• Reduces plaque
• Reduces gingival inflammation and bleeding
• Protects against hypersensitivity
• Remineralizes enamel and protects against demineralization

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Figure 2. Bacterial activity assessment 16 hours after exposure. Left: water control. Right: stannous fluoride/sodium hexametaphosphate dentifrice. Green-stained cells are live microbial cells; red-stained cells are dead cells (from Ramji et al22).
Table 1. Long-term clinical trials examining the effect of stabilized stannous fluoride on reduction of plaque, gingivitis and gingival bleeding.

<table>
<thead>
<tr>
<th>Reference</th>
<th>No. of Subjects</th>
<th>% Stannous Fluoride</th>
<th>Mode of Treatment</th>
<th>Length of Treatment</th>
<th>Length of Retention</th>
<th>Probe Plaque</th>
<th>% Reduction Gingival</th>
<th>Gingival bleeding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Archila et al.</td>
<td>186 adults</td>
<td>0.45 Dentifrice</td>
<td>Twice daily 6 months</td>
<td>ND</td>
<td>25.8% ≤</td>
<td>27.4% ≤</td>
<td>54% ≤</td>
<td>55% ≤</td>
</tr>
<tr>
<td>Archila et al.</td>
<td>38 adults resistant to brushing</td>
<td>0.45 Dentifrice</td>
<td>Twice daily 12 weeks</td>
<td>ND</td>
<td>55% ≤</td>
<td>55% ≤</td>
<td>50% ≤</td>
<td></td>
</tr>
<tr>
<td>Boyd et al.</td>
<td>23 adolescent girls</td>
<td>0.4 Brush-on gel</td>
<td>Twice daily 18 months</td>
<td>50% ≤</td>
<td>55% ≤</td>
<td>30% ≤</td>
<td>31% ≤</td>
<td></td>
</tr>
<tr>
<td>Bulsangwan et al.</td>
<td>45 adults</td>
<td>0.4 Dentifrice</td>
<td>Twice daily 1 week</td>
<td>3% ≤</td>
<td>0% ≤</td>
<td>19% ≤</td>
<td>0% ≤</td>
<td></td>
</tr>
<tr>
<td>Clarico et al.</td>
<td>28 adults</td>
<td>0.1 Mouth rinse</td>
<td>Twice daily 3 weeks</td>
<td>28% ≤</td>
<td>ND</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chittha et al.</td>
<td>30 adults</td>
<td>0.2 Spray</td>
<td>Twice daily 3 weeks</td>
<td>48% ≤</td>
<td>52% ≤</td>
<td>ND</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maltall et al.</td>
<td>128 adults</td>
<td>0.45 Dentifrice</td>
<td>Twice daily 6 months</td>
<td>8% ≤</td>
<td>17% ≤</td>
<td>41% ≤</td>
<td>44% ≤</td>
<td></td>
</tr>
<tr>
<td>Munkard et al.</td>
<td>104 adults</td>
<td>0.45 Dentifrice</td>
<td>Twice daily 6 months</td>
<td>20% ≤</td>
<td>21% ≤</td>
<td>ND</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raman et al.</td>
<td>150 adults</td>
<td>0.45 Dentifrice</td>
<td>Twice daily 6 months</td>
<td>22% ≤</td>
<td>22% ≤</td>
<td>ND</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perl et al.</td>
<td>154 adults</td>
<td>0.45 Dentifrice</td>
<td>Twice daily 6 months</td>
<td>3% ≤</td>
<td>21% ≤</td>
<td>33% ≤</td>
<td>32% ≤</td>
<td></td>
</tr>
<tr>
<td>Finot et al.</td>
<td>31 adults, partial brushing</td>
<td>0.4 Brush-on gel</td>
<td>Twice daily 5 weeks</td>
<td>55% ≤</td>
<td>47% ≤</td>
<td>ND</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Williams et al.</td>
<td>112 adults</td>
<td>0.45 Dentifrice</td>
<td>Twice daily 6 months</td>
<td>23% ≤</td>
<td>22% ≤</td>
<td>ND</td>
<td></td>
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</tr>
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All reductions are versus control except for Archila et al. and Chittha et al. which are relative to baseline values.

*p ≤ 0.05 *p ≤ 0.01 ND=non data

Recent studies have evaluated the anticaries effects of stannous fluoride dentifrice.32–39 One such six-month trial found statistical significance of 23% in gingivitis, 57% less bleeding and 7% less plaque relative to a negative control in a 2 x 2 factorial design. In a second 6-month trial with 128 subjects, Maltall et al. found a 17% reduction in gingivitis (p ≤ 0.001), a 41% reduction in bleeding (p ≤ 0.001) and an 8% reduction in plaque (p ≤ 0.001) with the SFSH dentifrice versus a negative control dentifrice.33 The SFSH dentifrice also demonstrated a statistical trend about 46% of most enzymes measured.

Comparative results have been obtained in studies of the anti-bacterial activity of this SFSH formula. Ramji et al. carried out a series of in vitro and in vivo studies of this new formulation.40 In a Live/Dead assay41 they found that stannous fluoride inhibited the growth of several bacterial strains, and that this was due to the inhibition of acidogenesis associated with the use of stannous fluoride dentifrice. Ramji et al. also demonstrated that the new SFSH dentifrice had killed over 90% of the salivary bacteria when left in contact with a stannous fluoride dentifrice, as compared to a control placebo, greatly reduced the amount of plaque and gingivitis in the inhibited plaque regrowth.42

Another related value of stannous fluoride, as remineralizing root caries.32 Recent studies have evaluated the anticaries effects of stannous fluoride dentifrice.32–39 One such six-month trial found statistical significance of 23% in gingivitis, 57% less bleeding and 7% less plaque relative to a negative control in a 2 x 2 factorial design. In a second 6-month trial with 128 subjects, Maltall et al. found a 17% reduction in gingivitis (p ≤ 0.001), a 41% reduction in bleeding (p ≤ 0.001) and an 8% reduction in plaque (p ≤ 0.001) with the SFSH dentifrice versus a negative control dentifrice.33 The SFSH dentifrice also demonstrated a statistical trend about 46% of most enzymes measured.

These studies demonstrate the sustained antibacterial and anti-inflammatory effects of this SFSH dentifrice, supporting its antiplaque and antigingivitis efficacy.

Anti-plaque and Anti-Gingivitis Efficacy

Many studies have investigated the effects of stannous fluoride on gingivitis and plaque. These evaluations have been performed over a wide range of trial durations, subject populations and modes of application.32–39 The majority of these trials report significant reductions in plaque and gingivitis, supporting the agent’s ability to improve gingival health when used twice daily.

In addition, long-term research has been conducted to evaluate stannous fluoride among special populations.43 A 2-year study investigated the long-term efficacy of a dual-phase stabilized 0.45% SFSH dentifrice compared to a positive control (sodium fluoride/triclosan dentifrice) in a population of over 350 subjects with medicated-inoculated xerostomia. The study also evaluated the product’s ability to remineralize root caries lesions. Results showed that twice daily use of stannous fluoride/sodium hexametaphosphate dentifrice demonstrated comparable benefits to the positive control, which was a sodium fluoride/triclosan dentifrice, in reducing periodontal pocket depth, attachment loss and bleeding on probing as well as remineralizing root caries.32

In a three-phase study involving use of digital plaque imaging analysis (Figure 5), White et al. investigated the longer term efficacy of the SFSH formula in the control of plaque.36 In Phase 1, 181 subjects used the SFSH dentifrice twice daily using a standard sodium fluoride dentifrice; in Phase 2 brushing frequency was reduced to once a day using the same dentifrice; in Phase 3 the daily brushing regimen was continued using the antimicrobial stannous fluoride/sodium hexametaphosphate dentifrice. More specifically, plaque coverage was 15% during Phase 1, increased to 18% in Phase 2, but dropped to 21% in Phase 3. As Phase 5 showed a 17% reduction as compared with the sodium fluoride/dental fluoride control dentifrice. This suggests that the SFSH dentifrice supported the antioxidant anti-caries benefits reported by Ramji et al.28

Results of multiple, independent clinical trials using the SFSH dentifrice mirror those investigating earlier stannous fluoride dentifrices; the recent formulation also shows benefits in the control of oral disease where it is significantly more efficacious than sodium fluoride basied dentifrices.

Dental Hypersensitivity

Recent studies have evaluated the clinical effectiveness of stannous fluoride dentifrice.44,45 Hypersensitivity is characterized by a self-limited, usually pain arising from exposed den-
tin in response to a stimulus that cannot be ascribed to any other form of dental defect or pathol-
ogy,44-46 it arises from exposure of the dentinal tubules to the stam-
ulus. Unlike potassium nitrate, which alleviates sensitivity by acting on the nerve segment, stannous fluoride reacts with enamel or dentin surfaces to produce solid complexes or in-
teracts with the surface of the enamel.47 The antihypersensitive activity of stannous fluoride, which was discussed above, provides further protection by suppres-
sion of bacteria, particularly Streptococci mutants, which are one of the primary pathogens associated with dental caries.48,49 The anti-caries benefits of stannous fluoride are therefore due both to its physical chemistry and its bacteriotoxic effects.

Before the introduction of this SFSH dentifrice, a large num-
ber of clinical trials had been carried out demonstrating the efficacy of stannous fluoride in the control of dental caries.48,49,50,51 Among the latest, Stouder et al. car-
ried out a large-scale clinical trial with 955 subjects compar-
ing the anticaries efficacy of a dual-phase early prototype SFSH dentifrice with a positive control standard sodium fluoride dentifrice, and also a high-dose (2800 ppm F) and a low-dose (300 ppm F) sodium fluoride dentifrice formula.

Visual-tactile examination was supplemented with a radio-
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A series of in vitro studies and clinical trials have shown that the stannous fluoride (SFSH) formulation has been reported in one publication to be effective in clinical and laboratory papers demonstrating the efficacy of these dentifrices both in its mode of action and in its clinical effects. In vitro studies by White et al. have shown that a fluoride concentration of 0.2% can result in significant reductions in hydroxyapatite crystal growth, and mineralization of plaque, which is known to inhibit the formation of tooth decay.

Anticaries Effects

Dental calculus results from the mineralization of bacterial plaque formed on the surfaces of teeth. Agents that inhibit crystal growth, particularly condensed phosphates, have been found to be effective in the prevention of calculus formation. In this class of phosphates, sodium hexametaphosphate (SHMP) has shown to be particularly effective. In vitro studies by White et al. have shown that SHMP at levels of 0.2% can result in significant reductions in hydroxyapatite crystal growth and mineralization of plaque, which is known to inhibit the formation of tooth decay.

A number of recent clinical trials have assessed the efficacy of stannous fluoride dentifrice in the prevention of dental caries. In a recent study of 4-month duration, patients using the SFSH dentifrice had lower fluoride levels in plaque than those using the standard sodium fluoride dentifrice. These findings are consistent with those of other in vitro studies and in vivo trials. In addition, the SFSH dentifrice was found to be effective in reducing the incidence of dental caries in children and adolescents. The authors concluded that the SFSH dentifrice is as effective as a standard sodium fluoride dentifrice in reducing the incidence of dental caries in children and adolescents.

Whitening Effects

There is an increasing demand for tooth whitening products, and also for oral care products that sustain whitening effects. Peroxide is a successful bleaching agent when delivered via whitening strips or in tray-based systems, but it is not particularly effective in dentifrices because of the brief contact time with the tooth surface. Perriphosphates, on the other hand, help maintain whitening and control plaque formation because they have a strong affinity for the minerals in teeth. Sodium hexametaphosphate has been shown to have important effects on the chemical mechanisms of caries inhibition and desorption. It appears that the polymer chains interact with polymeric films to limit enamel mineralization during the formation of topical plaque. Gerlach et al. reported a 20% reduction in composite stain relative to a negative control following 6 weeks of use of a sodium fluoride dentifrice containing 7% sodium hexametaphosphate. Clinical studies providing evidence for the efficacy of sodium hexametaphosphate in reducing extrinsic stain have been reviewed by Baig et al. and others.

In reviewing these data, it appears that combining sodium hexametaphosphate with stannous fluoride in the dentifrice reduces the formation of extrinsic stain and that the SFSH dentifrice is effective in providing a positive control witting denturines.

Practice-Based Evaluation

The efficacy and safety of dentifrices with starch flouride or a combination of starch flouride and sodium hexametaphosphate is evaluated by an extensive body of evidence. However, its success ultimately depends on its acceptability to users when used at home by consumers as part of their personal oral hygiene routine. In order to assess the acceptability of the SFSH dentifrice, a practice-based assessment was undertaken involving dental professionals and their patients. Dentists and hygienists across the USA participated in the study, and samples of the SFSH dentifrice were provided to a large group of their patients for 5 months. The patients were asked to return the used dentifrice for analysis.

Patients’ oral health was assessed at the beginning and end of the study. Samples submitted a survey and patients completed a questionnaire at the end of the study. In total, 1,027 completed surveys were returned by 54 dentists and 124 hygienists. Approximately 75% of the evaluations were based on 5.5 months use and the remainder of subjects had used the product for up to 6 months. Responses analyzed were those in which dentists or hygienists provided both pre- and post trial oral health assessments and gave answers to questions. Sixty-eight percent of all these responses reported improvement in their patients’ oral health, including improvements in gingival bleeding and inflammation and reduction in calculus formation. Reductions in gingival sensitivity were reported by 61% of professionals and in staining by 57%. Eighty percent report in Figure 6 – Results from patient surveys; Percent of patients rating SFSH product “Excellent/Very Good/Good”.

The authors thank Jane Mitchell (MWS Ltd., Staffordshire, UK) for assistance developing the manuscript.

References


A total of 866 subjects participated in the four-month clinical trial. Efficacy was assessed using a standard clinical method (Volpe-McNab Index). For patients with calculus, all extrinsic stain was removed. Calculus was known. This type of evaluation is similar to the two-month evaluations used by practicing professionals on a routine basis. They recommend a 3-month use, and then use their experience and clinical judgment to determine the effect it has on their patients’ oral health. This large, practice based assessment with the SFSH dentifrice confirms findings of the controlled clinical trial. The major outcome is that it provides evidence of excellent professional acceptance and an equal level of acceptance among patients, expressing their intention to continue using the SFSH dentifrice.

Conclusions

Extensive laboratory and clinical research add to the body of evidence supporting the value of stannous fluoride as a multi-benefit dental care ingredient. Stannous fluoride reduces bacterial growth, bacterial activity, and inflammatory markers as well as protects against plaque, gingivitis and gingival bleeding. Hypersensitivity and caries. Research also suggests the effectiveness of sodium hexametaphosphate in the control of calculus and extrinsic staining. Seventeen published clinical and laboratory papers demonstrate the efficacy of these dentifrice ingredients when they are combined in the SFSH dentifrice formulation, which is able to deliver a wide combination of oral health and cosmetic benefits. Results from a large practice-based assessment involving over 1,500 dental professionals and 1,000 patients further support the product is widely acceptable and beneficial for improving oral health.

The authors thank Jane Mitchell (MWS Ltd., Staffordshire, UK) for assistance developing the manuscript.

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Extrinsic tooth discoloration, an updated review

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Abstract
The appearance of the teeth is a concern for a large number of people seeking dental treatment and the color of the teeth can be a source of cosmetic concern. A variety of factors, included heredity, are responsible for the color of the teeth. In recent years, the appearance of the color of the teeth has been a concern for dentists. The causes of tooth discoloration are diverse and complex. In this review, we discuss the etiology of tooth discoloration, the treatment outcomes.

Introduction
The causes of tooth discoloration are diverse and complex. In this review, we discuss the etiology of tooth discoloration, the treatment outcomes.

Teeth discolorations are associated with many clinical and aesthetic challenges. They can have an impact on a person’s self-esteem and confidence in today’s society, where most people place tooth color high. There is a lack of awareness in the public of the causes of discoloration. In this review, we discuss the various causes of tooth discoloration and treatment outcomes.

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Normal enamel is colorless and transparent. However, the dentin is responsible for the color of the tooth. The dentin is much darker in color where it consists of thick layers and where the enamel layer is thin (cervical margin).

A variety of colors can typically be seen in the dentin and from the gingival margin to the incisal edge of the tooth a gradient of the color orange is created. Any changes in the shade of tooth structure is likely to cause an alteration in outward appearance of the tooth caused by changes of light transmitting and reflecting properties.

In most cases, tooth discoloration is located on the outer surface of the tooth structure, others are caused by extrinsic factors and some occur during tooth development and re- sult in an alteration of the light transmitting properties of the tooth structures. Tooth discolor- ations are caused by various factors: medications, genetic defects, diseases, trauma, caries and normal aging processes. Some examples are it is important to understand what staining is in the mouth.

Tooth discoloration is caused by two types of factors: medications, genetic defects, diseases, trauma, caries and normal aging processes. Some examples are it is important to understand what staining is in the mouth. There are two types of tooth discoloration: extrinsic which affects the teeth from the outside and intrinsic which affects the teeth from the inside.

Extrinsic discoloration lies on the tooth surface or in the acquired pellicle. The majority of tooth discolorations are extrinsic in nature and appear as brown integuments. Extrinsic staining of a single tooth is usual.

The distribution is usually generalized and found on surfaces with poor tooth brushing accessibility. Smoking, tea or coffee consumption and increasing age are promoting factors and such discolorations are frequent seen in connection with oral use of antibacterial plaque-inhibiting mouthwash. Chemical alteration of the acquired pellicle appears to be the major reason for these brown integuments.

The causes of extrinsic staining can be divided into two categories: those compounds which are incorporated into the pellicle and produce a stain as a result of their basic color 2 or those which lead to staining by chemical interaction at the tooth surface.

Direct staining has a multi-factorial etiology with chromogens derived from dietary sources or substances habitually placed in the mouth. The chromogens are taken up by the pellicle and the color imparted is determined by the major color of the chromogen. The origin of the stain may be metallic or non-metallic.

The aim of this review is to system-atically search the literature for data concerning extrinsic tooth discoloration etiologies in order to establish the right treat- ment plan.

1 - Tobacco
For ages, tobacco has been popular and its use is significantly increasing in spite of alarming health hazards.

Tobacco smoking and chewing (chewing of betel nut, chewing tobacco, water pipe, Pan) is known to cause staining.2 Smoking leads to not only tobacco and nicotine but also tar which leads to a brown integument. Smoking is known to cause gingivitis and oral cancer.3 There are all kinds of tobacco products, including tobacco, nicotine and tar that can harm tissue and respiration, and in the case of periodontal diseases and in-fections. This is true of cigarettes, cigars, cigarettes with tar, and cigars with tar.

According to Pirolo, the expo- sure to coffee after bleaching causes less color changes than the exposure to tea and red fruits drink regardless of the time after bleaching.

A study evaluated the colour sta- bility of three lamine veneer materials with tea, coffee and cigarette. It was found that cigare- tette smoke was the most stain- ing agent.

The aim of an in vitro study done by Young N et al was to compare the colour stability of commercially available denture teeth. Teeth immersed in filtered coffee solution was found to be more chromogenic than the tea, and cola staining solutions.3

b - Tea
Tea, the commonly consumed beverage, is gaining increased attention in promoting oral health. In specific, green tea is consid- ered a healthful beverage due to the biological activ- ity of polyphenols.4 5 There are three main varieties of tea - green, black, and oolong, all derived from the leaves of the Camellia sinensis plant. The difference between the various teas lies in their processing. Green tea is prepared from unfermented leaves, the oolong tea leaves are partially fermented and black tea is fully fermented.4

Lee R et al have shown that the addition of milk to tea signifi- cantly reduces the tea's ability to stain teeth and was determined to be the component of milk that is responsible for preventing tea-induced stain- ing of teeth to a similar order of magnitude that can be obtained by vital bleaching treatments.6

Bovine teeth were immersed for one week in a mixture of tea, coffee, or red fruits extracts. Tests showed that diluted laser was effective only at bleaching extrinsic stains, but only at bleaching red fruits extracts. The KTLP laser was efficient at bleaching teeth with coffee, tea and red fruits stain. This study suggests that a relation between the laser wavelength and the type of staining is followed by the enamel and the efficacy of the whitening treatment exists.7

In a work done by Young N et al the basic interactions between whitening agents and tea solution, tea and grape juice were evaluated. The reaction rates between chromogens in the tea solution and hydrogen peroxide can be accelerated significantly using ferrous gluconate as a protector and blue light irradiation.

As for all colored beverages, in order to minimize the stain- ing effect, these drinks can be drunk through a straw.

c - Red Wine
Red wine is packed with poly- phenols8 that help prevent the development of the gums and bone around teeth.9 Nevertheless red Wine is a cause of staining. In addition, the alcohol content is very acidic and wears away tooth enamel.

A research aimed to investigate bleaching enamel susceptibility to coffee and red wine staining at different time periods after bleaching. No differences were observed between the exposure times of 30 and 150 min after bleaching for both beverages (p > 0.05). Although coffee did not stain the surface, red wine sig- nificantly reduced color change, as compared to the previously bleached enamel.

Alia et al have quantified the change in color of human and bovine teeth exposed to a coffee solution containing the potassium per- carbonic acid (16% CP) home application bleaching treatment for an extended period of time.10 When the teeth were exposed to a coffee solution during home bleaching, no increase in the whitening effect was observed to be less stable (P < 0.05).

Bovine and human enamel substrates behaved similarly in terms of staining and bleaching effects, although they presented inherent differences in color.

A study has examined the sur- face staining mechanism of a photoprotecting composite by coffee, oolong tea, and red wine.

Teeth composite was subject- ed to an experimental 24-hour staining cycle: 17-hour immer- sion in artificial saliva solution containing 0.2% oxalic acid, 0.25% hydrogen peroxide and 0.05% chlorhexidine. The whitening potential of the bleaching agent was decreased by 7-hour immersion in coffee, tea, or wine. Wine caused the most severe staining, followed by tea and coffee. Chlorhexidine increased the staining effect of tea and coffee when compared to the control specimens. Common drinks stained the dental composite, but each by a specific mechanism that depended on external conditions such as the presence of chlorite-11,12

Cortes et al have evaluated the influence of coffee and red wine staining on tooth color during and after bleaching. Blocks ob- tained from human molars were divided into 11 groups in accordance with the bleaching treatment- peroxide carbamide 10%, 30% and 40% + 16% hydrogen peroxide with the stain therapy-coffee, wine or without staining (con- trol) for 15 minutes each. The color realization of the enamel with artificial saliva and the subse- quent bleaching was performed in water in preventing enamel staining. After the whitening procedures, both stains therapies-coffee, - Page KB -
Ultra-low abrasion for your patients who need sensitivity relief and seek gentle whitening

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*With twice-daily brushing
Other articles found greater enamel dissolution occurring in flavored and energy (sports) drinks than in cola drinks.\textsuperscript{31, 32} Although a new article found no significant differences in the frequency of the consumption of foods and beverages and the presence of dental erosion.\textsuperscript{33}

The influence of coffee, tea, cola, and red wine staining on the color of teeth after home whitening has been evaluated. A total of 45 samples were obtained from 45 sound maxillary central incisors. The samples were immersed in four staining solutions (coffee, tea, cola, and red wine) or artificial saliva. Following 15 min and 6 h of immersion on the first day and next day of all the staining solutions, the lowest ΔE values were observed with coffee staining versus artificial saliva (control group), for all time intervals evaluated after whitening. There were statistically significant differences between the red wine, cola, and tea solutions.\textsuperscript{34}

A study assessed the influence of surface sealant on the color stability of composite resins. Red wine resulted in the highest level of discoloration. Intermediated colored values were found for orange juice, and the cola soft drink.\textsuperscript{35}

Some drinks that may be relatively good for health may not be so good for teeth in terms of staining them. Cranberry juice, grape juice and other dark-colored fruit juices are very good at staining teeth because they contain pigments—and tons of them—that can yellow teeth, probably the same way they stain composite resin.\textsuperscript{36}

Cranberry juice contains potential anticaries agents (high-molecular-weight polyphenols) that inhibit the production of organic acids and the formation of biofilms by cariogenic bacteria.\textsuperscript{37}

The polyphenols of cranberries interfere with various activities (including formation of biofilm and adhesion) of Porphyromonas gingivalis, the main etiologic agent in chronic periodontitis.\textsuperscript{38, 39}

In order to avoid these stains, straws should be used and mouthwash followed by tooth brushing should be done.

d - Cola Drinks

Dark-colored colas not only stain teeth, but also erode tooth enamel and cause tooth decay.\textsuperscript{40, 41} Although a new article found no significant differences in the frequency of the consumption of foods and beverages and the presence of dental erosion.\textsuperscript{42}

Balsamic vinegar is deeply pigmented causing teeth discoloration. The longer duration, the teeth may become reddish brown to nearly black.\textsuperscript{43}

Lycopene is a micronutrient with important health benefits, because it contains natural antioxidant compounds like phenolics hydroxytyrosol and appears to provide protection against a broad range of epithelial cancers.\textsuperscript{44, 45} But the tomato sauce is highly acidic and it attaches to the teeth and causes unsightly stains.

e - Cranberry Juice

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Cranberry juice has been evaluated. There were statistically significant differences between the red wine, cola, and tea solutions.\textsuperscript{47}

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f - Soy Sauce

Soy sauce is a condiment made from a fermented paste of boiled soybeans, roasted grain, brine, and Aspergillus oryzae or Aspergillus sojae molds.\textsuperscript{53}

Iron-fortified foods can help prevent iron deficiency so can iron-fortified soy sauce due to the relatively high iron absorption from soy sauce.\textsuperscript{54} But soy sauce sticks to teeth, and the deep-colored pigment can cause very bad stains. In a study done by Chan KC, the discoloration of enamel caused by food substances was found to be superficial and ingressive for dentin and cementum. Discoloration of cementum exceeded that of dentin, and dentin stained more than enamel. Coffee and soy sauce stained the calcified dental tissues more than the cola beverage and tea. The longer the staining time, the deeper was the discoloration.\textsuperscript{55}

g - Balsamic Vinegar

Balsamic vinegar is made from grapes and generally consumed in the Mediterranean region. Oxidized low-density lipoprotein (LDL) is believed to contribute to atherosclerosis. Studies results showed that balsamic vinegar contained abundant polyphenols and inhibited LDL oxidation.\textsuperscript{56, 57} Thus, balsamic vinegar reduces lipoprotein, and it has an anti-diabetic effect.\textsuperscript{58}

In spite of these health benefits, balsamic vinegar is deeply pigmented causing teeth discoloration.\textsuperscript{59}

h - Tomato Sauce

Lycopene is the pigment principally responsible for the characteristic deep red color of ripe tomato fruits and tomato products. Lycopene is a micronutrient with important health benefits, because it contains natural antioxidant compounds like phenolics hydroxytyrosol and appears to provide protection against a broad range of epithelial cancers.\textsuperscript{44, 45} But the tomato sauce is highly acidic and it attaches to the teeth and causes unsightly stains.
for thousands of years. Glcyrrhiza 5 times sweeter than sucrose. It retains, when sapid, a singular liquorice flavour. The liquorice sweetness has a slow onset over than sugar and lingers. Unlike artificial sweeteners like aspartame, saccharine, and cyclamer onset than sugar and lingers. There exist options in the fields of physical therapy for patients looking for an alternative health approach. Specialized treatment using soft tissue release and joint mobilization, alone, has had a profound affect on the range of motion and function of TMJ sufferers. Application of intra-oral technique to release the lateral pterygoid and myofascial release to the anterior neck component are two examples of treatment goals. Both techniques use mechanical pressure on the jaw caused by hyper-toned muscle groups.

There is a demand placed on oral surgeons and dentists, to remove the relation between non-acute, specifically after oral surgery, and dental procedures in which the jaw is open and overstretched (beyond normal range), for a long period of time. A patient may experience trauma during accessibility of the jaw due to an overstretch, injury or invasive dental procedure that has indirectly caused or directly caused from pipe smoking, and, if inhaled, it could lead to health problems. Hypersensitivi- ty pneumonitis (HP) is a group of immunologically mediated lung disease during the experimental phase. Thats although chlorhexidine di- gluconate (CHX) is currently the most effective mouthwash for reducing plaque and gingivitis, one of its side effects is extrinsic tooth staining. Interestingly, oxygenated agents were shown to reduce this staining. A review done by Van Maanen-Schukel NW, searched the literature for data concern- ing the inhibiting effect of an oxygenating agent (OA) on CHX- induced tooth staining. There was evidence moderate that a combination of CHX and an OA reduces tooth staining without interfering with plaque growth inhibition.

Most of the search into stain for- mation has been carried out on chlorhexidine, although there are other antiseptics which cause staining to a lesser extent and the mechanism involved could be applicable to staining found with polyvalent met- als. The characteristic staining of the tongue and teeth noted by Fleita is not peculiar to chlorhexidine, it has been reported in other cationic antiseptic- tics, an essential oil/phenoilic mouthwash. However, prolonged use of delonpox mouthrinses. There is great indi- vidual variation in the degree of staining from person to person, this makes explanation more difficult. It is caused by intrinsic factors, differences in extrinsic factors or both. Kerr suggests that the protein and carbohydrate in the acquired pellicle could undergo a series of condensation and polymeriza- tion reactions leading to discolor- ation of the acquired pellicle. Chlorhexidine may accelerate formation of the acquired pellicle and also catalyze steps in the Maillard reaction.

The results of a recent study demonstrated that regular use of CPI and chlorhexidine in extrinsic stain accumulation after six weeks, with increased accumulation after 12 weeks versus brushing alone.

Poliyvinylpyrrolidone (PVP) (a polymer used as a synthetic blood plasma substitute and in the cosmetic, drug, and food processing industries) was shown in vitro to reduce chlo- rohexidine-induced, dietary stain- ing without affecting the uptake of the anisicid to the test sub- strate. A study in vivo aimed to determine whether PVP and chlorhexidine rinses, but significantly reduced with the PVP/chlorhexidine rinses, and polyvinalpyrrolidone, which reduced after the usage of chlorhexidine rinse, but at the expense of some loss of plaque inhibition.

E 4.

Contact Information

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By Shivani Sarsthi, Physical Therapist (TMJ Specialist)
cantly increased compared to the other 3 rinses. The antiadhesive/thiochrome reductase pro-duced by H. pylori is responsible for the anti-adhesive or water rinse.

However, the parallel plaque re-growth study suggested this in-hibition of staining resulted from the presence of the treatment activity by the antiadhesive.

b - Cetylpyridinium chloride: Cetylpyridinium chloride (CPC) is a cationic quaternary amono- salt that is used in various forms of mouthwashes, toothpastes, rinses, gels, and dental floss. It is an antiseptic that kills bacte- ria and other microorganisms. It is also used in preventing dental plaque and reducing gingivitis. It has also been found to be an ingredient in certain pesticides. Cetylpyr-idinium chloride may cause brown stains to form on the teeth and on their surfaces. However, these stains can be easily removed by brushing the dentition during a routine checkup.

As known, Cationic antiseptics such as chlorhexidine (CHX) and cetylpyridinium chloride (CPC) are widely used in dentistry to produce extrinsic stain, and this can be used as a means of improving the oral hygiene and strengthening the anticaries effect. A study was done in vitro to de- termine if toothpaste influenced the reduction of CHX and CPC as a predictor of action in vivo. Little staining was seen when CHX and CPC were used in combi- nation. TP followed by CHX reduced the activity of CHX and CPC and particulate matter if used im- mediately after the antiseptics. The results further support the concept of separating the use of antiseptics until sometime after the use of toothpaste. This idea of developing mouthwash-friendly toothpastess.

8 - Chromogenic Bacteria Chromogenic Bacteria: Chromogenic bacteria cause staining of teeth, which can be seen in children with certain types of cariogenic bacteria. One of the more common chromogenic bacteria include b- Cetylpyridinium chloride: Cetylpyridinium chloride (CPC) is a cationic quaternary amono-salt that is used in various forms of mouthwashes, toothpastes, rinses, gels, and dental floss. It is an antiseptic that kills bacteria and other microorganisms. It is also used in preventing dental plaque and reducing gingivitis. It has also been found to be an ingredient in certain pesticides. Cetylpyr-idinium chloride may cause brown stains to form on the teeth and on their surfaces. However, these stains can be easily removed by brushing the dentition during a routine checkup.

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