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DENTIFRICE INGREDIENTS

Guide to Patient-Specific Recommendations

By Howard Strassler, DMD, FADM, FAGD, and Nisha Ganesh, DDS, MAEd

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ABSTRACT

Patients have a variety of oral conditions that require the dental profes- sional to provide recommendations for dentifrices based upon the prod- uct's ingredients. Dentifrices contain active ingredients or additives that perform specific functions. These ingredients and additives include abra- sives, fluorides, remineralizing agents, desensitizing agents, antiplaque agents, and anti-tartar ingredients. Toothpastes also contain detergents, humectants, thickeners, preservatives, flavoring agents, sweeteners, and coloring agents. This article will review the common ingredients in toothpastes and the role abrasives play in plaque and stain removal. It is the responsibility of the oral care professional to understand the ingredients in dentifrices so that patients can be provided specific recommendations based upon their individual needs.

EDUCATIONAL OBJECTIVES

At the completion of this program the participant will:

- Describe the importance of using dentifrices to maintain oral health
- Be able to list and describe ingredients in dentifrices
- List the different broad categories of dentifrices
- Understand the misconceptions about dentifrice abrasives
- Compare the differences in abrasives in dentifrices
- List the therapeutic agents in dentifrices
- Understand the basis for dentifrice recommendations to patients

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Introduction

Oral care products are important for maintaining dental health. Our patients can be overwhelmed by the large number of choices they have for toothpastes, mouth rinses, toothbrushes, and dental floss. Among the many oral care products that are available to patients, the most often used are toothbrushes and toothpastes. In a 2003 Lemelson-Massachusetts Institute of Technology study investigating what products people cannot live without, the toothbrush beat out the personal computer, automobile, microwave oven, and cell phone. In fact, 34% of teenagers and 42% of adults cited the toothbrush as being essential. Since most people use toothpaste when they brush, the importance of these products is directly linked.

Dentifrices are very important for the prevention of oral disease and maintaining good oral health. All toothpastes contain abrasives to help remove dental plaque (biofilm) and stains. The addition of fluoride improves the resistance of teeth to dental caries and can remineralize enamel and exposed dentin. Toothpastes can also provide esthetic benefits by removing stains on teeth and decreasing gingival inflammation.

The ingredients and formulation of toothpastes determine their performance characteristics. There are currently as many as 10 categories of toothpastes that a patient can select. Many of these categories can overlap such as desensitizing toothpastes with whitening or antigingivitis properties, or baking soda toothpastes with peroxide for plaque removal, stain removal, and periodontal care.

Other ingredients in dentifrices are added to improve handling characteristics, to maintain abrasives in a uniform suspension, and to provide acceptable taste and mouth feel. Additives may include antitartar (anticalculus) ingredients, remineralizing agents, detergents, flavoring agents, herbal agents, sweeteners, coloring agents, humectants, thickeners, and preservatives.[1-4]

The Federal Food, Drug, and Cosmetic Act defines cosmetics as "articles intended to be applied to the human body for cleansing, beautifying, promoting attractiveness, or altering the appearance without affecting the body's structure or functions." On the other hand, a drug is a substance intended for use in the "diagnosis, cure, mitigation, treatment, or prevention of disease." These substances are "intended to "affect the structure of any function of the body."[5,6] Some products, such as fluoride toothpastes qualify as both. Advertising and packaging claims, such as enamel remineralization, made by toothpastes are typically based upon their active ingredients. Active ingredients can be categorized by their preventive and therapeutic effect, which may include additives that perform specific functions. The U.S. Food and Drug Administration (FDA) may issue approval to market an "over the counter" (OTC) toothpaste with therapeutic claim such as caries prevention, desensitization, or reduction in gingival inflammation.[7] The effectiveness and formulation requirements of dentifrices are described in published FDA monographs.

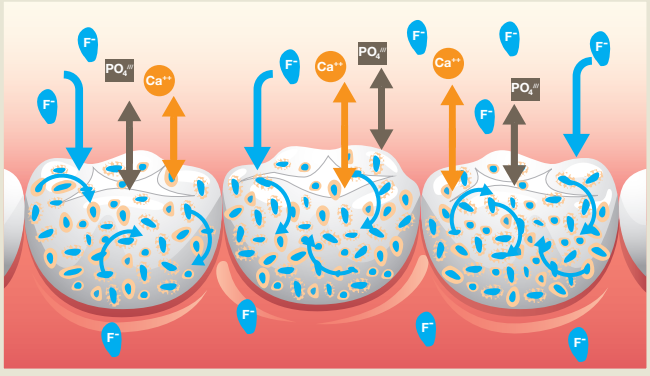

Figure 1. The effects of fluoride in a dentifrice is the incorporation within the enamel preventing demineralization and remineralizing acid-attacked enamel.

Toothpaste Ingredients and Their Functions

Anticaries (caries control)

Fluoride compounds have been shown to be effective for caries control (see Figure 1).[8-10] When patients brush with a fluoride toothpaste, the fluoride becomes incorporated into the enamel and exposed dentin. This helps to prevent demineralization by making the enamel and dentin less soluble in acids produced by cariogenic bacteria. It may also aid in remineralizing tooth structure that has lost mineral content due to acid attack.[11]

Table 1. Recommended portion control for fluoride dentifrices[15]	
Age	**Portion size on toothbrush head**
Child under age 3	smear of tooth (size of a grain of rice)
Child age 3 until age 6	pea-sized portion
Age 6 and older	strip of toothpaste

Anticaries claims can only be made for formulations containing active ingredients listed as safe and effective in the FDA Final Monograph for Anticaries Drug Products for Over-the-Counter Human Use.[12] These formulations include sodium fluoride, sodium monofluorophosphate, and stannous fluoride dentifrices that can contain anywhere between 850 ppm to 1150 ppm total fluorine. (Note that monofluorophosphate can also contain 1500 ppm total fluorine.)[12]

Fluoride toothpastes have been shown to be effective at reducing coronal and root caries[13] and may provide high caries risk patients with protection against them.[14] There has been concern that children taking fluoride supplements who may swallow small amounts of toothpaste during brushing may develop mild dental fluorosis.[15] To reduce the risk for fluorosis while maintaining the anticaries benefits of fluoride, the American Dental Association (ADA) issued updated recommendations on the use of OTC fluoride dentifrices in 2014.[16] For children under age 3, the ADA recommends using a smear of toothpaste no larger than a grain of rice. A pea-sized amount of toothpaste should be used from age 3-6, advancing to a strip of toothpaste for children over age 6[16] (Table 1).

Manufacturers of fluoride-containing dentifrices, who are FDA-regulation compliant, may submit their products for evaluation by the ADA Council on Scientific Affairs for the award of the ADA Seal of Acceptance. To be awarded the seal, the manufacturer must provide clinical and laboratory studies that evaluate safety and efficacy of the products being submitted. The seal may also be awarded for products with claims for controlling calculus, reducing gingivitis, desensitizing teeth, or teeth whitening.

Abrasives

Abrasives aid in the removal of dental plaque and stains from teeth and help reduce the risk for periodontal disease and dental caries.[2,3,17-20] An ideal dentifrice should have sufficient abrasivity to clean tooth surfaces without damaging enamel, dentin, root surfaces, and gingival tissues. So, how do we measure abrasivity and how do different dentifrice formulations compare?

The effectiveness of the dentifrice for removal of plaque and stains depends on the total formulation of the toothpaste and not solely on the hardness of the abrasive component.[21] When an abrasive is mixed in with all the components of a toothpaste, several factors contribute to the safety and effectiveness of a given product. Examples of such factors include grit size, volume, suspension, and uniformity of particles within the dentifrice. Furthermore, some manufacturers often combine one or more abrasives in toothpastes to act in a complementary fashion.

Table 2. RDA numbers for some common toothpastes[20,31]	
Toothpaste	**RDA index**
Aquafresh Whitening	113[31]
Arm and Hammer Complete Care	53[21]
Arm and Hammer Advance White–Extreme Whitening	53[21]
Arm and Hammer Dental Care	35[31]
Colgate Total	70[31]
Colgate 2-in-1 Tartar Control	200[31]
Colgate Platinum	106[1]
Crest ProHealth Advanced Whitening	245[21]
Crest Extra Whitening	130[31]
Crest Multicare Whitening	144[31]
Mentadent	103[31]
Rembrandt Plus	94[31]
Sensodyne Extra Whitening	120[21]
Tom's Antiplaque and Whitening	164[21]

In most products, a thickening agent is used to hold the abrasive in a uniform suspension while in the tube and during brushing. Also included are surface-active agents such as sodium lauryl sulfate (SLS) to facilitate the removal of the dental biofilm and oral debris.[22] As for the abrasives used in dentifrices, some examples are carbonates, phosphates, silicas, and compounds that include alumina, clays, and oxides. Ideally abrasives should not interact with the active ingredients in the toothpaste.[21] Hydrated silica abrasive and baking soda are examples of abrasives that are compatible with most active ingredients.[23,24]

The hardness and pH of the abrasive can have a direct effect on tooth surfaces and are evaluated based upon their hardness relative to dentin.[25,26] Toothpastes with abrasives in the carbonate group have an alkaline pH and can act as a natural buffer in the oral cavity while other abrasives have a neutral pH. The alkaline pH of baking soda can also neutralize acid produced by plaque after exposure to sucrose[26] and aid in caries inhibition.[27]

Toothpaste abrasivity is measured using the Relative Dentin Abrasivity test (RDA) as described in the International Organization for Standardization (ISO) Standard 11069:2017 (American National Standards Institute/ADA Standard No. 130) Dentifrices - Requirements, Test Methods and Marking.[28] This creates a numerical RDA value for a toothpaste.[28-30] The test is performed by irradiating the dentin sample in a radioactive neutron flux. The radionuclide-tagged specimens are then mechanically brushed using the toothpaste being tested. This results in a dentin slurry that contains radioactively tagged dentin that can be measured to determine the amount of dentin lost due to abrasion. These data are used to create an RDA number that represents the relative abrasivity of the toothpaste.

The lower the RDA number, the less abrasive the toothpaste; the higher the RDA number, the higher the abrasivity of the toothpaste[21,31] (Table 2). To be considered safe and effective, the FDA recommends a maximum RDA of 200 while the ADA recommends an RDA value less than or equal to 250. There is clinical evidence that supports lifetime use of toothpastes with an RDA of 250 or less, with proper brushing technique, produces no wear of enamel and limited wear of dentin.[31] For patients with exposed dentin surfaces, dentifrices with lower RDA values are preferred.

Sodium bicarbonate (baking soda) is considered by some experts to be the most multifunctional of all abrasives used in dentifrices. Sodium bicarbonate exhibits the lowest Mohs hardness of abrasives typically used in dentifrices with a hardness similar to dentin[25,26] (Table 3). Although many abrasives are chemically inert, sodium bicarbonate has been demonstrated in clinical trials to aid in plaque removal, as well as to have an antibacterial effect.[32,33,28] Other ingredients combined with baking soda in a dentifrice formulation appear to further increase the effectiveness of stain removal.[21]

Table 3. Mohs hardness number of dentifrice abrasives[26]

Compound (Formula)	Mohs Hardness
Dentin	2.0 - 2.5
Baking soda	2.5
Dicalcium phosphate dehydrate	2.5
Calcium carbonate	3.0
Anhydrous dicalcium phosphate	3.5
Hydrated silica dioxide	2.5 - 5.0
Calcium pyrophosphate	5.0
Alumina	9.25

Tooth Whitening Relative to Dentifrice Use

Tooth whitening has become an important aspect of clinical dental practice. Currently available tooth whitening methods include professional and OTC bleaching with active peroxides, in-office stain removal, and the use of a stain-removing toothpaste at home.

Additives to dentifrices including abrasives, peroxide, and other chemicals that break down or dissolve tooth surface stains, and the addition of the chemical blue covarine can contribute to remediation of tooth staining.[34-36]

Abrasives such as baking soda can play a major role in tooth whitening. In one 6-week study, use of a dentifrice containing sodium bicarbonate as an abrasive resulted in a 45% reduction in stain from baseline.[37] In an 8-week study, baking soda dentifrice inhibited the formation of chlorhexidine staining at the same level as a nonbaking-soda fluoride dentifrice, thought to occur through lifting of the stain.[38,39] Fluoride dentifrice with baking soda, calcium, and phosphate in another study was found to impart a high gloss and enamel luster.[40] The addition of an alumina abrasive to a toothpaste has also been shown to effectively remove extrinsic stain from teeth.[41,42] Alumina abrasive toothpastes and polishing pastes have been shown to be less abrasive to composite resin restoratives.[43,44] These results parallel abrasive research that has demonstrated that alumina is the abrasive of choice when polishing composite resins.[45]

Chlorhexidine gluconate mouth rinses that are prescribed for patients with periodontal disease often cause extrinsic staining of teeth. Clinical trials have shown that toothpastes with a variety of abrasives including dicalcium phosphate, baking soda, and alumina effectively reduce chlorhexidine staining of the natural dentition.[38,42,46]

The effectiveness of hydrogen and carbamide peroxide preparations using trays and in-office bleaching to whiten teeth is well accepted.[47,48] Tooth whitening with peroxide bleaching results from the breakdown of extrinsic enamel stains and their removal from the tooth surface. This occurs when the peroxide degrades into water and oxygen. The oxygen ion penetrates the enamel-dentin when placed in close contact with the tooth. The oxygen ion then attaches to the double bond of the extrinsic stain, breaking the double bond and allowing the stain to be dissipated. The addition of low concentrations of hydrogen and carbamide peroxide to whitening dentifrices can also achieve this effect.[49,50]

In recent years, novel tooth whitening products including dentifrices containing blue covarine combined with a silica abrasive have entered the market. These products do not remove extrinsic surface staining from a tooth. Instead, blue covarine deposited on the tooth acts as a complementary color to the inherent yellow color of a tooth, making the tooth appear to be whiter.[36,51,52] Although charcoal-containing dentifrices have recently gained popularity for tooth whitening, there are no current studies that support the effectiveness of these products.[53]

Antiplaque/Antigingivitis

Some dentifrices are formulated with ingredients intended to provide an added antiplaque/antigingivitis benefit. The FDA has provided guidance to manufacturers when making the claim for antiplaque/ antigingivitis. In 2005, the FDA published Guidance for Industry – *Gingivitis: Development and Evaluation of Drugs for Treatment or Prevention*. There exists a proposed monograph that outlines guidelines, including specific test requirements, to demonstrate efficacy for products that treat or help prevent gingivitis in adults and children.

A variety of active ingredients have been added to dentifrices to provide an antiplaque and antigingivitis effect. Stannous fluoride has been shown to be both bactericidal and bacteriostatic and can alter bacterial growth and inhibit its adhesion.[54,55] Stannous fluoride has also demonstrated anti-inflammatory properties in in vitro testing.[56] In a review of

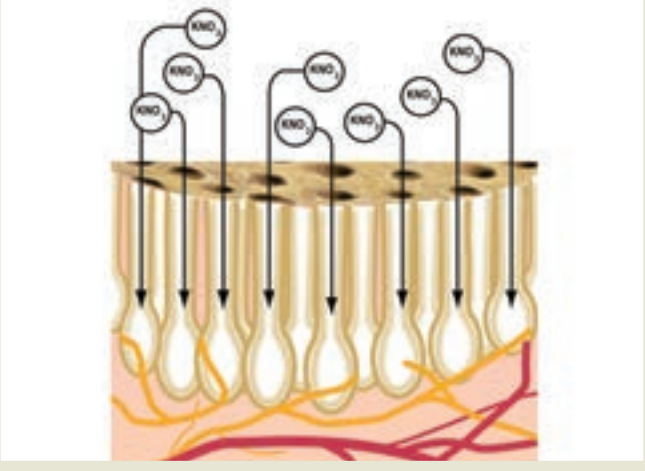

Figure 2. The desensitizing effect of a 5% potassium nitrate within a toothpaste is to block neural transmission by depolarizing the nerves and preventing repolarization.

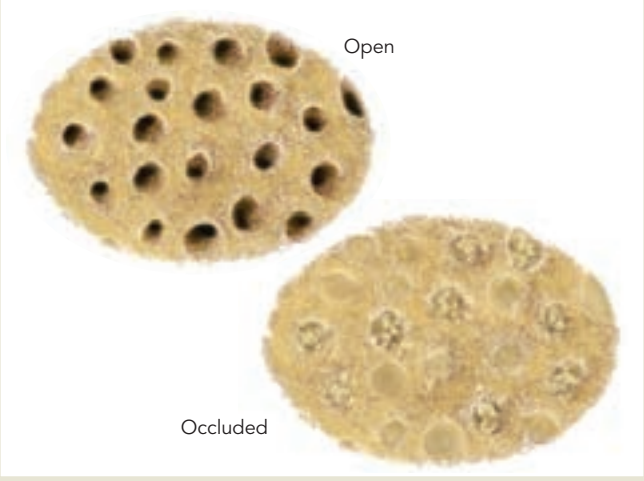

Figure 3. Surface blocking (occluding) agents in desensitizing dentifrices block the dentinal tubules and reduce dentin hypersensitivity.

clinical trials, stannous fluoride was found to be more effective than sodium fluoride in reducing gingivitis.[57] In the past, there was evidence of tooth staining when using stannous fluoride dentifrices. Recent innovations in stabilized stannous fluorides include ingredients that inhibit stain formation, including pyrophosphates, triphosphates, sodium hexametaphosphate, and zinc phosphate.

Other antiplaque/antigingivitis agents include triclosan/copolymer. A dentifrice containing 0.3% triclosan/copolymer received FDA approval in the 1990s. Clinical trials over 6 to 9 months demonstrated plaque and gingivitis reductions of 22%.[58] At the current time, however, no triclosan/copolymer dentifrices are marketed in the U.S.

Relief of Dentin Hypersensitivity – Desensitizing Toothpastes

Dentin hypersensitivity, also referred to as tooth sensitivity, root sensitivity, or just sensitivity, is described by patients as sharp, short-lasting tooth pain.[59] Dentin hypersensitivity has been referred to as one of the most painful and least successfully treated chronic dental conditions of the teeth.[60] The most common treatment for dentin hypersensitivity is the use of OTC toothpastes that work by either prevention of neural transmission or surface occlusion of dentinal tubules.

The most popular desensitizing ingredient in toothpastes is potassium nitrate. According to the FDA monograph, a toothpaste with a claim for desensitizing must contain 5% potassium nitrate, or more recently 0.454% stannous fluoride. Potassium nitrate reduces dentin hypersensitivity through a depolarizing/repolarizing effect on the odontoblastic processes in the dentinal tubules, resulting in reduced pain-sensing ability[61,62] (Figure 2). Arginine bicarbonate/calcium carbonate complex and stabilized stannous fluoride have also been shown to provide a dentin desensitizing effect by surface occlusion of open dentinal tubules through precipitant deposition on exposed dentin surfaces[63,64] (Figure 3).

Anticalculus/Antitartar effects

Calculus is a form of hardened dental plaque that is caused by the precipitation of minerals that are naturally occurring in saliva and crevicular fluid. The rough and hardened surface provides an enhanced surface for additional dental plaque formation. To reduce calculus buildup after routine dental cleanings, toothpastes add "antitartar" ingredients that reduce calculus buildup on teeth. These ingredients include tetrapotassium pyrophosphate, tetrasodium pyrophosphate, disodium pyrophosphate, copolymer polyethylemethylmaleic acid, papain and citroxaine.[1,65]

Remineralizing agents

Remineralizing agents like amorphous calcium phosphate have recently been added to toothpastes, but there is currently no FDA monograph describing therapeutic effects of these ingredients. Soluble calcium and phosphate are described as enhancing remineralization, preventing dental caries, reducing enamel and/or dentin erosion by binding to enamel and dentin.

Some toothpastes have combined fluorides and calcium and phosphate to reduce caries, treat enamel defects, reduce acid erosion, and prevent dimpling of the enamel surfaces that can affect the esthetic appearance of teeth. In

a comparison of three different toothpastes, the addition of soluble calcium (calcium phosphate) with a sodium bicarbonate and fluoride enhanced the microhardness of enamel when compared to a regular fluoride-containing toothpaste with no sodium bicarbonate or soluble calcium.[66] Charig and coworkers investigated four different techniques to assess surface changes to enamel. Their findings indicated that a calcium-containing bicarbonate toothpaste deposits calcium into enamel deformities under a wide variety of conditions.[67]

Other Toothpaste Ingredients

To be a viable commercial product, the paste or gel should have a shelf life that allows it to remain consistent in regard to various characteristics such as viscosity, mixture, effects, mouth feel, and flavor. It must also maintain the ability to deliver a stable, reproducible mixture when delivered from a tube. Ingredients that are critical to maintaining that structural integrity include the following:

- Detergents are responsible for the foaming action of toothpastes and for assisting in stain removal. SLS is the most commonly used detergent in toothpastes; however, for a very small number of patients SLS has been reported to cause adverse effects on oral soft tissues. SLS in toothpastes significantly increased the incidence of desquamation of the oral mucosa compared with toothpastes containing the detergent cocamidopropyl-betaine (CAPB). Patients with a history of recurrent aphthous ulcers should use toothpastes that are SLS-free.[68,69]
- Humectants provide for toothpaste texture and help the toothpaste maintain their moisture. Some common humectants in toothpastes are glycerine, sorbitol, and water. Xylitol is also a humectant.
- Thickeners are added to a toothpaste to provide body to the toothpaste. Some thickeners are carrageenan and xanthan gum.
- Preservatives prevent microbial growth in the toothpaste. Some common preservatives used in toothpastes are methyl paraben and sodium benzoate.
- Flavoring agents are added to improve the taste and acceptability of toothpastes. They can range from minty flavors to cinnamon to fruity flavors.
- Herbal agents such as aloe vera, sodium carrageenan, echinacea, goldenseal, and bee propolis have been added to toothpastes. Currently there are no controlled, long-term studies that demonstrate the efficacy of these agents.[70]
- Sweeteners also improve the taste of toothpaste. Most toothpaste sweeteners are artificial and are not able to be used by cariogenic bacteria.
- Coloring and opaquing agents are added to provide toothpastes with a pleasing appearance. A toothpaste can have a translucent appearance or an opaque appearance, which is due to the addition of titanium dioxide.

Classification of Toothpastes

While many toothpastes have multiple ingredients that may influence professional recommendations, toothpastes can be informally divided into categories based on consumer preferences.[34,70] In many cases, toothpastes provide multiple functions based upon the ingredients present in the formulation. These broad categories of toothpastes are:

- Caries prevention – cavity protection
- Enamel care
- Anti-tartar (calculus)
- Antigingivitis
- Gum health
- Antiplaque
- Remineralizing – calcium phosphate-fluoride containing
- Cosmetic (tooth whitening – stain removal); note: typical whitening toothpastes are significantly less abrasive than smokers' toothpastes.
- Desensitizing
- Multicare toothpastes

- Natural (no artificial ingredients)
- Toothpastes for patients with reduced salivary flow or xerostomia

These categories are informal, and there is no regulatory oversight of manufacturers unless they make a therapeutic claim for a product (such as prevention of caries, reduction in tooth sensitivity, antigingivitis activity, etc.) or they engage in false and misleading advertising.

Conclusions

Consumers are faced with a bewildering array of oral hygiene and healthcare products. Many dentifrices today include more than one active ingredient with multiple potential benefits such as anticaries, whitening, and/or desensitizing effects. Many of these products are also less abrasive and are kinder to enamel, dentin, and restorative materials.

Oral healthcare professionals have a responsibility to understand the preventive and therapeutic activity, as well as the risks and benefits, of OTC dentifrices in order to guide patients in choosing the products that will meet their personal and clinical needs.[7,1]

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1. **In a 2003 Lemelson-Massachusetts Institute of Technology study investigating what products people cannot live without, of the ones listed below, what was the highest rated with 34% of teenagers and 42% of adults?**
   a. Microwave oven
   b. Cell phone
   c. Toothbrush
   d. Automobile

2. **Claims made by toothpastes are based upon their ingredients. When a therapeutic claim is made by a toothpaste, e.g., desensitizing teeth or caries reduction, it must be substantiated by research submitted to the FDA.**
   a. Both statements are true
   b. The first statement is true, the second statement is false
   c. Both statements are false
   d. The first statement is false, the second statement is true

3. **The primary effect of fluoride in toothpaste is:**
   a. desensitizing teeth
   b. removing plaque and stain from teeth
   c. anticaries
   d. whitening teeth

4. **All the following fluoride compounds are used in toothpastes EXCEPT:**
   a. Stannous fluoride
   b. Sodium monophosphate fluoride
   c. Sodium fluoride
   d. Fluoridated peroxide

5. **The addition of fluorides that fall under the FDA Monograph for Anticaries Drug Products for OTC Human Use has been proved to be therapeutic and effective for caries control.**
   a. True
   b. False

6. **Fluoride provides its therapeutic benefit by becoming incorporated in the enamel and dentin, preventing demineralization and remineralizing demineralized tooth structure associated with acid produced by cariogenic bacteria.**
   a. True
   b. False

7. **There has been concern that children receiving fluoride supplements and swallowing a dentifrice with fluoride developed enamel discoloration, referred to as:**
   a. amelogenesis imperfect
   b. dentinogenesis imperfect
   c. fluorosis

8. **To control potential fluorosis, the ADA recommends children under age 3 use a smear of toothpaste about the size of a grain of rice and from age 3 to 6, a pea-sized amount.**
   a. True
   b. False

9. **The ADA seal of acceptance program is based upon research supporting a claim. All of the following have an ADA seal of acceptance program EXCEPT:**
   a. Tooth whitening
   b. Desensitizing teeth
   c. Preventing tooth decay
   d. Best-tasting toothpaste

10. **The addition of abrasives to toothpastes performs what primary functions?**
    a. Desensitizing teeth
    b. Removing plaque and stain from teeth
    c. Remineralizing teeth
    d. Sealing margins of restorations

11. **Toothpaste abrasivity is measured by the**
    a. Richter scale
    b. Relative dentin abrasivity (radioactive abrasivity) RDA test
    c. Standard & Poor's

12. **Sodium bicarbonate (baking soda) is the most multifunctional of all abrasives in dentifrices. Baking soda has been shown to provide what benefit(s) when used in a dentifrice?**
    a. Plaque removal
    b. Antibacterial activity
    c. Safe to enamel and dentin when removing stain
    d. All the above

13. **Trials comparing plaque removal of a hydrated silica, dicalcium phosphate and sodium bicarbonate (baking soda) abrasive dentifrice found that**
    a. all abrasives worked the same
    b. baking soda dentifrice removed a higher percentage of plaque
    c. none of the abrasives was effective at removing plaque

14. **The ability of a toothpaste to clean teeth requires an abrasive agent mixed with a thickening agent to keep the abrasive particles in a uniform suspension in the tube. The addition of flavoring ingredients creates a foaming effect that facilitates the loosening of calculus from the teeth.**
    a. Both statements are true
    b. The first statement is true, the second statement is false
    c. Both statements are false
    d. The first statement is false, the second statement is true

15. **Abrasives used in toothpastes include all the following EXCEPT:**
    a. carbonates
    b. phosphates
    c. lauryl sulfates
    d. silicas

CEQuiz

16. **Sodium bicarbonate (baking soda) used as an abrasive in toothpastes is beneficial because it has a _____ pH that neutralizes acid in plaque after exposure to sucrose.**
    a. highly acidic
    b. mildly acidic
    c. alkaline
    d. neutral

17. **RDA values for toothpastes refers to a toothpaste's**
    a. abrasivity
    b. anticaries potential
    c. antitartar potential
    d. whitening effects

18. **The lower the RDA number, the less abrasive the toothpaste. The FDA recommends a maximum RDA of 200, and the ADA recommends dentifrices at or below a 250 RDA as safe with no wear of enamel but with limited wear of dentin.**
    a. True
    b. False

19. **Patients using chlorhexidine have a chief complaint of extrinsic staining of their teeth. Reduction of chlorhexidine staining can be accomplished by using toothpastes that contain the abrasives dicalcium phosphate, baking soda, and alumina.**
    a. Both statements are true
    b. The first statement is true, the second statement is false
    c. Both statements are false
    d. The first statement is false, the second statement is true

20. **Recently some manufacturers have introduced charcoal-containing dentrices for tooth whitening. Currently no studies support the effectiveness of charcoal-containing dentrices.**
    a. True
    b. False

21. **Which of the following toothpaste ingredients is used to treat dentin hypersensitivity:**
    a. sodium lauryl sulfate
    b. fumed silica
    c. potassium nitrate
    d. calcium carbonate

22. **Potassium nitrate works by creating a depolarizing effect on the odontoblastic processes in the dentinal tubules. The nerve endings of the odontoblastic processes then repolarize and have a reduced pain-sensing ability.**
    a. Both statements are true
    b. The first statement is true, the second statement is false
    c. Both statements are false
    d. The first statement is false, the second statement is true

23. **All the following are antiplaque additives in toothpastes EXCEPT:**
    a. triclosan
    b. papain
    c. stannous fluoride
    d. sodium monocarbonate crystals

24. **In recent years remineralizing agents have been added to toothpastes. The remineralizing agent most commonly used is:**
    a. interfacial calcium carbonate
    b. amorphous calcium phosphate
    c. stannous calcium peroxide
    d. calcium carbonate

25. **Detergents are responsible for the foaming action of toothpastes. Which of the following is a detergent that may increase the frequency of recurrent aphthous ulcers:**
    a. hydrogen peroxide (HP)
    b. sodium peroxide (SP)
    c. sodium lauryl sulphate (SLS)
    d. sodium monophosphate fluoride (SMF)

26. **Antitartar ingredients that have been added toothpastes include all of the following EXCEPT:**
    a. tetrapotassium pyrophosphate
    b. tetrasodium pyrophosphate
    c. disodium pyrophosphate
    d. hydrogen peroxide

27. **In order to extend the shelf life of toothpastes, preservatives are added to prevent the growth of microbes in toothpaste. Common preservatives added to toothpastes are**
    a. benzoyl peroxide
    b. methylated arginine
    c. methyl paraben and sodium benzoate
    d. potassium dioxide

28. **In order for a dental paste or gel to be referred to as a toothpaste it must contain which of the following ingredients:**
    a. fluoride
    b. calcium peroxide
    c. abrasive
    d. triclosan

29. **According to this article, there are broad categories of toothpastes, many of which provide multiple functions based upon the ingredients in the formulations.**
    a. True
    b. False

30. **Dental professionals and patients should read the labels and ingredients of toothpastes to assure they are selecting one that will provide them with the effects they need and want.**
    a. True
    b. False

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EDUCATIONAL OBJECTIVES

- Describe the importance of using dentifrices to maintain oral health
- Be able to list and describe ingredients in dentifrices
- List the different broad categories of dentifrices
- Understand the misconceptions about dentifrice abrasives
- Compare the differences in abrasives in dentifrices
- List the therapeutic agents in dentifrices
- Understand patient recommendations for dentifrices need to be type and ingredients based

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Please evaluate this course using a scale of 5 to 1, where 5 is excellent and 1 is poor.

1. Clarity of objectives ..... ⑤ ④ ③ ② ①
2. Usefulness of content ..... ⑤ ④ ③ ② ①
3. Benefit to your clinical practice ..... ⑤ ④ ③ ② ①
4. Usefulness of the references ..... ⑤ ④ ③ ② ①
5. Quality of written presentation ..... ⑤ ④ ③ ② ①
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3.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	18.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
4.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	19.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
5.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	20.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
6.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	21.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
7.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	22.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
8.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	23.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
9.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	24.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
10.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	25.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
11.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	26.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
12.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	27.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
13.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	28.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
14.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	29.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
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