

Fluoridation Mechanism and Effects

The three types of fluoride that are used to **fluoridate water** are

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Sodium fluoride,

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Sodium fluorosilicate

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Fluorosilicic acid.

The optimum level of fluoride in the communal water supply varies depending on the temperature and geographic location, its range from 0.7 1.0 ppm. This concentration allows

minimum dental fluorosis with maximum caries reduction.

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Community water fluoridation is safe and cost effective and should be introduced and maintained wherever it is socially acceptable and feasible.

A Systemic fluorid : •

Its benefit in pre and post eruptive phase •

Communal water fluoridation •

Alternative methods for C.W. F.: •

–School water fluoridation. •

–Home water fluoridation. •

- Fluoridated tablets. •

–Fluoridated salts. •

–Fluoridated milk. •

B- Topical fluoride: Its benefit in post eruptive phase

- **1. Self applied:**

- Dentifrices.
- Fluoridated mouth rinse.
- Fluoridated gel.



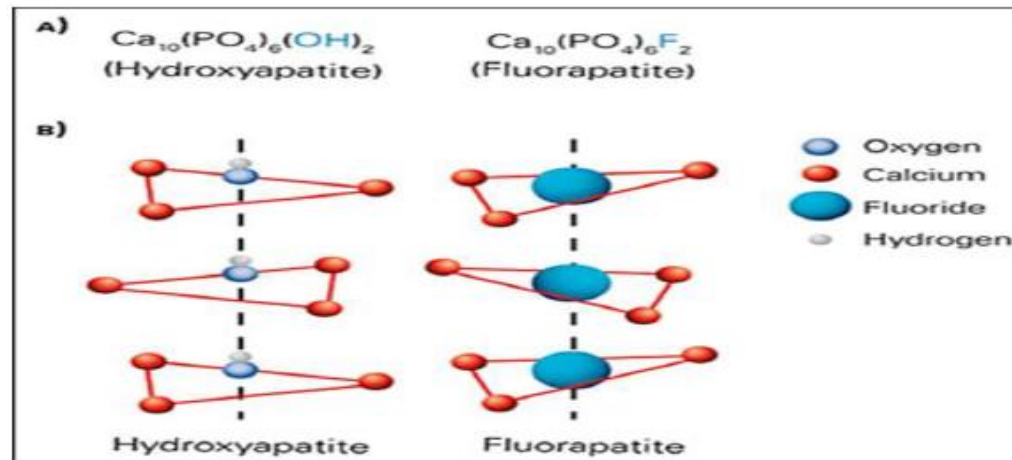
- **2. Professional fl. application:** In the form of solutions, gel, foam, varnishes, prophylactic paste or pumice. Many types of fluoridated agent used, mainly:

- Sodium fluoride (NaF).
- Stannous fluoride (SnF₂).
- Acidulated phosphate fluoride.
- Zirconium fluoride.
- Titanium fluoride.
- Amine fluoride.



In general, fluoride has many effects in relation to caries reduction (anti-caries effect) these include:

1- Decrease solubility of enamel in acid by converting hydroxyapatite into less soluble fluorhydroxyapatite/ fluorapatite.



2- Enhance remineralization of enamel in areas that have been demineralized by acids.

Side effects of fluoride:

Fluoride is a hazardous substance when large doses are taken acutely or when lower doses are taken chronically, it could cause:

Dental fluorosis, Reversible gastric disturbances, skeletal fluorosis and death



Chemical plaque control agents: They have proven to be an ideal adjunct to mechanical plaque control. They are designed to be used as supplements to mechanical plaque control procedures and not to replace them. They have ability to interfere with metabolic activity or adhesion of dental plaque.

Ideal properties of chemical plaque control agents:

- Should reduce plaque and gingivitis.
- Should prevent growth of pathogenic bacteria.
- Should prevent resistant bacteria.
- Should compatible with the oral tissues.
- Should not stain teeth or alter taste.
- Should exhibit good retentive properties.
- Should be inexpensive and easy to use.

Modes of action

1. Inhibition of bacterial colonization by interference with bacterial adsorption.
2. Inhibition of bacterial growth and metabolism (bactericidal and bacteriostatic effects).
3. Disruption of mature plaque by eliminating of existing plaque.
4. Modification of plaque biochemistry and ecology.

Chemoprophylactic agents are delivered as:

- Mouth rinses
- Dentifrices
- Gels (contains humectant, but without abrasives and foam agents).
- Sustained release devices and varnishes
- Chewing gums and lozenges (they increase the time of clearance of agents from the mouth).

The most widely used agents are:

Chlorhexidine (CHX): This antiseptic agent has both bactericidal and bacteriostatic activity depending on its concentration. Chlorhexidine is a cationic compound that binds to the hydroxyapatite of tooth enamel, the pellicle, plaque bacteria, the extracellular polysaccharide of the plaque, and especially to the mucous membrane. The chlorhexidine adsorbed to the hydroxyapatite is believed to inhibit bacterial colonization and prevent pellicle formation. Chlorhexidine may also inhibit the enzyme glucosyltransferase, which is essential for microbial accumulation on tooth surfaces, and the metabolic enzyme phosphoenolpyruvate phosphotransferase, which is involved in the transport and phosphorylation of glucose across the membrane.

After binding, the agent is slowly released in an active form over 8 to 12 hours. Also, CHX is effective against gram +ve and yeast organisms. Tooth paste should be used before rinsing with chlorhexidine. Two daily rinses with 10 ml of 0.2% solution of chlorhexidine gluconate will completely inhibited the development of dental plaque, calculus and gingival inflammation. It can be used in concentration of 0.12% in 15 ml twice daily.

Unpleasant taste and brown discoloration of teeth and filling are the side effects related to CHX.

Triclosan: It is phenol derivative included in mouthwashes and toothpaste. It has a broad spectrum of activity against gram positive, negative bacteria and yeasts. Dentifrice products containing a zinc citrate and triclosan combination have shown to be effective in reducing acid production and plaque formation and in preventing gingivitis.

Essential oil mouthwashes or Listerine: They are effective in controlling plaque and gingivitis because the **oil alters the bacterial cell wall**. The active ingredients (essential oils) used in these mouth rinses include a combination of **thymol, menthol, eucalyptol, and methyl salicylate**. Although the **safety** of essential oils is well established, some patients can have **difficulty tolerating the burning sensation associated with the alcohol content**. In addition, **slight extrinsic staining** has been reported with the use of essential oils rinses, which is a possible transient (short-term) side effect of any antimicrobial agent. Essential oil mouthrinses are indicated for patients who need and are compliant with antiplaque/antigingivitis mouthrinses. Listerine Antiseptic was antiplaque and antigingivitis mouthrinse to be approved by the ADA in 1988. Patients are advised to rinse twice daily with one-half ounce of Listerine for 30 seconds in addition to their usual oral-hygiene regimen. Microorganisms do not develop a resistance to the antibacterial effects of essential oils, such as clove oil (eugenol) and thyme oil (thymol). As with chlorhexidine, just rinsing with an essential oil mouthrinse is unlikely to be effective in treating periodontitis because the solution does not reach the depths of the periodontal pockets. For the dental professional, these mouthrinses are recommended in patients prior to aerosol-generating procedures. Unless the dental professional uses an effective dry-field technique in a 30-second period, the bacterial aerosol generated by an ultrasonic scaler that removes calculus, an air-powered tooth polisher, or a slow-speed or high-speed hand piece can be roughly equivalent to the aerosols received from a patient directly sneezing into the dental provider's face.

Enzymes: Certain enzymes are bactericidal to microorganisms. They would be able to breakdown already formed matrix of plaque and calculus. Enzymes like Mutanase and amyloglucosidase.

Sanguinarine extracts (SE): It is a herbal preparation obtained from the blood root of *Sanguinaria canadensis* plant. They are effective against Gram-positive and Gram-negative microorganisms, including oral microorganisms. SE may increase saliva-mediated aggregation. SE seems to exert a bactericidal effect by interfering with essential steps in the synthesis of the microbial cell wall.

Metal ions: Salts of zinc and copper are the most commonly used. These are effective plaque inhibitors at high concentration. Metallic salts reduce the glycolytic activity in microorganisms and delay bacterial growth. They have unpleasant taste with dry mouth and staining.

Antibiotics: Vancomycin, erythromycin and kanamycin have been used as agents for plaque control. 5

Dentifrices: They are substance used with toothbrush for purpose of cleaning the accessible surfaces of teeth. They may contain the followings:

- The therapeutic agent like fluoride to inhibit dental caries.
- Antimicrobial agent such as chlorhexidine to reduce microorganisms.
- An anti-calculus agent as zinc chloride or citrate to dissolve calculus.

The function of toothpaste in conjunction with toothbrush is:

- Minimizing plaque buildup.
- Anti-caries action.
- Removal of stains.
- Mouth fresher.

Composition of dentifrices: A dentifrice contains a number of ingredients that serve a definite purpose in providing adequate plaque control thus preventing caries and periodontal disease. The following are the common ingredients:

- **Abrasive agents** (Calcium carbonate, silicas): These agents have a mild abrasive action which aids in eliminating plaque and remove stained pellicle from tooth surface. The degree of dentifrice abrasiveness depends on the **inherent hardness of the abrasive, size of the abrasive particle, and the shape of the particle**. The most common types of abrasives used are carbonates, phosphates, and silicas. Carbonates include calcium carbonate (chalk) and sodium carbonate (baking soda). Calcium carbonate is highly effective abrasive, although the calcium ion limits the amount of soluble fluoride in toothpaste up to 7 ppm. Phosphate abrasives include calcium pyrophosphate and dicalcium phosphate dihydrate. Silicas, such as silicon oxides, mechanically cleanse the tooth, are chemically inert, and do not react with other dentifrice ingredients. When toothbrush abrasion damage does occur, it usually appears as a V-shaped notch in the cementum apical to the cemento-enamel junction. This area is vulnerable because enamel is about 20 times harder than dentin or cementum.

- Binding agents (Water soluble agents): These agents control stability and consistency of toothpaste and effects ease of dispersion of the paste in the mouth.
- Detergents: They are producing the foam which aid in the removal of food debris and also dispersion of the paste in the mouth. Sodium lauryl sulfate is the most widely used detergent. It is stable, possesses some antibacterial properties, and has a low surface tension, which facilitates the flow of the dentifrice over the teeth. Sodium lauryl sulfate is active at a neutral pH, has a flavor that is easy to mask.
- Humectants (Glycerin, mannitol, glycerol): These agents aid in reducing the loss of moisture from the toothpaste and prevent hardening. These humectants are non-toxic, but bacterial growth can occur in their presence. For this reason, preservatives such as sodium benzoate, dichlorinated phenols, and alcohols are added to prevent their growth. At high concentration (>40%), humectants act as preservatives.

Flavoring agents: They render the product pleasant to use and leave a fresh taste in the mouth after use. Spearmint, peppermint, wintergreen, cinnamon, and the most recently introduced flavor, vanilla give toothpaste a pleasant taste, aroma, and refreshing aftertaste. It is difficult to formulate a flavor that is universally acceptable because people have different color and taste preferences. Some manufacturers use essential oils such as thymol which can provide a “medicinal” taste to the product.

Anti-calculus agents (soluble pyrophosphates or zinc citrate): These agents are designed to inhibit the mineralization of plaque. Dentifrices containing these agents are labeled as tartar control toothpastes.

- Sweeteners and coloring agents (Sorbitol, mannitol): They serve a dual role as sweetening agents and humectants. Glycerin also serves as a humectant, adds to the sweet taste. A new sweetener in some dentifrices is xylitol.

- Anti-caries agents (NaF, MFP, SnF₂): These agents aid in the control of caries.
- Essential-oil dentifrices, Listerine as anti-halitosis.
- Desensitizing agents: Potassium nitrate is commonly used, it reduces the reaction of nerves in the teeth to stimuli such as heat and cold. It is known to desensitize the nerve by penetrating through the length of the dentinal tubules and to depolarize sensory nerve endings located at the dentin–pulpal interface.
- Whiteners (hydrogen peroxide or carbamide peroxide): The dentifrices (contain whiteners) control stain via physical methods (abrasives) and chemical mechanisms (surface active agents or bleaching/oxidizing agents). Carbamide peroxide breaks down to form urea and hydrogen peroxide. Hydrogen peroxide, in turn, forms a free radical that contains oxygen, which is the active bleaching molecule. Papain, a naturally occurring enzyme that destroys protein is rapidly diluted by saliva. Home-bleaching products can contain other chemicals to aid in the delivery of the bleaching agent. Glycerin or propylene glycol is commonly added to thicken the solution and prolong contact with the tooth surface.
- Baking soda dentifrices: Baking soda (sodium bicarbonate) had a long history of use as an oral-hygiene aid. They are known to reduce plaque and gingivitis, remove extrinsic stain, and reduce malodor. Baking soda dentifrices actually contain only a small amount of baking soda in addition to the standard fluoride compatible abrasives.