



**A STUDY OF DIFFERENT ANTIPLAQUE AGENTS USED IN DENTAL  
PRACTICES AND THEIR THERAPEUTICAL ADVANTAGES**

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**ABSTRACT**

Antiplaque drugs also called as chemical plaque aids, have been proven as an adjunct to mechanical plaque control to reduce the number of microorganisms on the tooth and adjacent gingival tissue, hence decreasing incidence of dental and periodontal disease. This thesis considers the main chemical agents which have been used in mouthwash and other vehicles to inhibit or decrease growth of the plaque.

**Keywords: Antiplaque drugs, dental plaque, microorganisms, mouth rinses**

**INTRODUCTION**

Dental plaque is typically the main etiological factor of: gingivitis, periodontitis [1].The dental plaque is considered to be one of the main factors in development of gingival and periodontal disease. Dental plaque is typically a structured, grayish yellow and resilient substance that is formed by adhesion to the

intraoral hard surfaces such as fixed and removable restorations. The two common effective methods are mechanical plaque and chemical plaque control [2,3].

The 2700 BC documents declare chemicals such as beer, wine, honey, alum, vinegar and even child urine were used as a mouth rinse by ancient Egyptian and Chinese cultures for thousand years [4].

The three main chemical plaque control agents are categorized as antiadhesive, antimicrobial, anti-pathogenic and plaque removal [4][22].

The main target of this article is based on different drugs known as an antiplaque agent in dentistry. The information enables dentists and oral hygienists to provide a widespread view of various chemical agents used for dental plaque removal.

## METHOD

The method of this review article is reading and collecting data from several books and articles and discussing the different results of them.

## RESULTS

Steps of plaque formation are shown in table 1 [6].

**Table1 Steps of plaque formation (6)**

| Steps of Plaque Formation | Description   |
|---------------------------|---|
| Association               | Dental pellicle forms on the tooth (normally on tooth), and provides bacteria surface to attach |
| Adhesion                  | Within hours, bacteria loosely binds to the pellicle.   |
| Proliferation             | Bacteria spreads throughout the mouth and begins to multiply.                                   |
| Microcolonies             | Microcolonies are formed. Streptococci secrete protective layer (slime layer).                  |
| Biofilm formation         | Microcolonies form complex groups with metabolic advantages.                                    |
| Growth or maturation      | The biofilm develops a primitive circulatory system   |

Dental plaque consists of almost 70-80% proliferating microorganisms, which containing Streptococcus mutans and Fusobacterium actinobacteria, mycoplasma, viruses, yeast and protozoa [6].

Classification of dental plaque:

**-Supra-gingival** plaque is located somewhere in and above the dentogingival junction. In such a case its plaque is most

commonly found at: 1. a gingival third of the crown of the tooth 2. interproximal regions 3. pits and fissures and other related surface irregularities [8].

**-Sub-gingival** plaque are below the dentogingival junction, classified into a tooth adherent, epithelial adherent and non-adherent zones.

Some significant differences between supra and sub-gingival plaque are as follows: only supra-gingival plaque can be observed without microscope. Indeed, subgingival plaque is relatively thin, while supra-gingival plaque gets nutrition from saliva and host diet in the oral cavity.

However, sub-gingival plaque acquires food only from the host cells and gingival crevicular fluid.

Chemical Plaque control can be classified into subgroups according to European Federation of Periodontology.

### 1) Antimicrobial agents:

Chemicals that have both a bacteriostatic or bactericidal effect in vitro that merely not able to be deducted to a proven efficacy in vivo against plaque [2].

### 2) Plaque reducing/inhibitory agents:

Chemicals that have only shown to reduce the quantity or affect quality of plaque which won't be enough to affect gingivitis or caries.

### 3) Antiplaque agents:

Chemicals that is effective on plaque sufficient to benefit gingivitis and caries [2].

#### 4) **Anti-gingivitis agents:**

Chemicals which decrease gingival inflammation with no influencing bacterial plaque, including anti-inflammatory agents [2].

Other Classification of Antiplaque drugs are **1) First generation agents 2) Second generation agents 3) Third generation agents**

Delivery form of chemical plaque agents can be classified as:

**1) Mouth rinses** are aqueous solutions are less complex in ingredients in comparison with tooth pastes but it is better to be made with flavor, color and preservatives to get a more pleasant taste. Mouthwashes contain thymol, menthol, eucalyptol and methyl salicylate. Also ethyl alcohol is a stabilizer agent and usually is less than 10 percent [8].

The main functions of anti-plaque mouthwashes are as follows:

1. To replace mechanical tooth brushing after oral or periodontal surgery and during the healing period.
2. After inter-maxillary fixation used to treat jaw fractures.
3. Following cosmetic jaw surgery, with acute oral mucosal or gingival infections

when pain and soreness prevents mechanical oral hygiene.

4. For mentally or physically-handicapped patients who are unable to brush teeth themselves [9].

**2) Toothpaste** is used commonly to carry chemicals. They contain various ingredients such as

- Abrasives (silica, alumina, calcium carbonate)
- Detergents (sodium lauryl sulfate)
- Thickeners (like gums),
- Sweeteners (like saccharin)
- Humectants (like glycerin and sorbitol)

**3) Chewing gum:** Sugar free kinds are advantageous to dental health when used in complex with brushing. But it has a minimal effect on plaque control when used alone.

**4) Spray:** Used for plaque removal in mentally and physically handicapped individuals.

**5) Irrigators:** The water under pressure around the teeth is effective for debris removal, but not for plaque removal.

**6) Varnishes:** used for delivery tool of antiseptics in the oral cavity [24].

### **ANTIPLAQUE DRUGS USED IN DENTISTRY:**

#### **Chlorhexidine**

CHX is commonly used in different forms such as digluconate, acetate and hydrochloride salts that are soluble in

water it is an antimicrobial chemical that acts on the inner cytoplasmic membrane thus it is a membrane active type of substance. It is diatonic at pH levels above 3.5 that prevents plaque aggregation. Therefore, it is an antiplaque and anti-gingivitis chemical that decreases the Porphyromonas gingival adhesion to epithelial cells [2].

In fact, it is an antimicrobial chemical that acts on the inner cytoplasmic membrane thus it is a membrane active type of substance. It is diatonic at pH levels above 3.5 that prevents plaque aggregation. Therefore, it is an antiplaque and anti-gingivitis chemical that decreases the Porphyromonas gingival adhesion to epithelial cells [2]. CHX can stop plaque accumulation in a clean mouth, it will not cause a plaque reduction in an untreated mouth. Hence, it should never be given to patients in advance before the vital periodontal therapy has been done [9] figure 1.

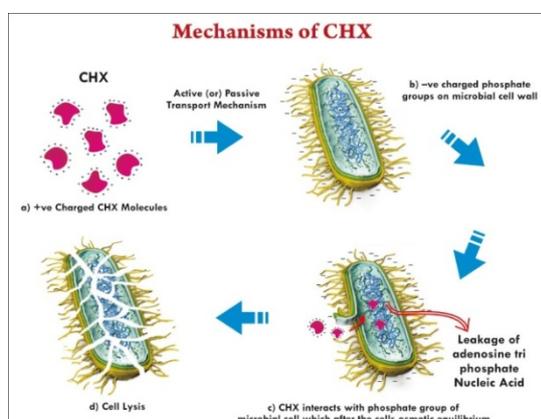


Figure 1: Mechanism of CHX [20]

Chlorhexidine is highly essential in the maintenance of immediate function implants as there is a relation between plaque and bleeding index showed a satisfactory result for 0.2% chlorhexidine gel as daily implant self care for 6 month period [10]. The main side effects of chlorhexidine consist of brown discoloration of the teeth, restorative materials and posterior surface of the tongue, taste perturbation and oral mucosal erosion. The bitter taste is such a difficult condition to mask as well as taste changes as well unilateral or bilateral parotid swelling [2] figure 2, 3.

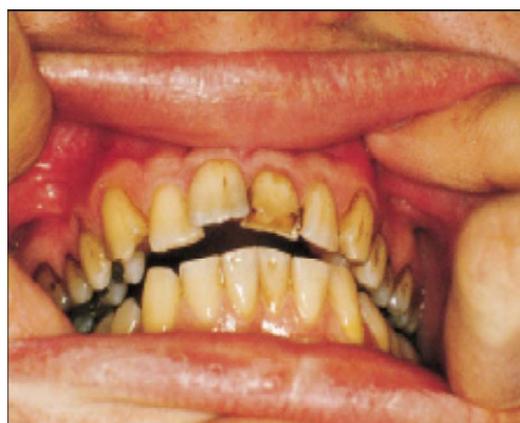


Figure 2: Teeth brown staining by chlorhexidine [9]



Figure 3: Chlorhexidine staining

It is unlikely that chlorhexidine becomes absorbed in the gut and displays relatively low toxicity. Basically, it does not cause any teratogenic changes while there is no evidence of synthesis of carcinogenic substances [2].

### Fluoride

Fluoride is typically found in foods and water. It can also be used directly to the teeth by fluoridated toothpastes and mouth rinses. The available over the counter rinses tend to contain low concentrations of fluoride while stronger dose needs a doctor's prescription. [11] It inhibits demineralization and develops re-mineralization rate of enamel. Fluoride's key role in re-mineralization is explained once bacteria break down carbohydrate and forming acid. Fluoride is released from dental plaque in reacting to lower pH levels at the tooth surface. [11] Fluorides used in dentistry

1. Sodium fluoride (NaF)
2. Stannous fluoride (SnF<sub>2</sub>)
3. Sodium mono-fluoro-phosphate
4. Amine fluoride

The toxic dose is stated by body weight in kg multiplied 5mg fluoride. Typical symptoms include vomiting, excess salivary rate and mucus discharge. Other symptoms such as cold, wet skin, convulsion at higher dose are also seen to some extent. [12] The fluorosis issue is a

constant intrinsic white-to-brown discoloration of enamel. Sources of ingested fluoride diet, beverages dentifrice consumption and previous supplementations depend on the supposed lower fluoride intake. The widely accepted classification for fluorosis is Dean's index. It classifies fluorosis to normal, questionable, very mild, mild, moderate and severe forms. Grading are according to enamel structure, color and the surface involvement [12].figure4



Figure 4: Fluorosis [13]

### Enzymes

**First group:** Although they are not antimicrobial agents, but more plaque removal agents potency to destroy early plaque matrix. Therefore, dislodging bacteria from tooth surface dextranase, mutanase and various proteases in dental plaque control contained relatively poor substantivity and unpleasant local side effects.

**Second group:** Stimulated host defense mechanism, glucose oxidase and amyloglucosidase catalyzed alteration of

endogenous and exogenous thiocyanate to hypothyrocyanite via salivary lactoperoxidase enzymes. Hypothyrocyanite is likely to produce inhibitory effects on oral bacteria, especially streptococci by interfering with their toothpaste metabolism like enzymes and thiocyanate.

### Antibiotics

Some antibiotics tested for plaque prevention or reduction that is shown in table 2.

**Table 2: Some antibiotics tested for plaque prevention or reduction [14]**

| Agent        | Spectrum |
|--------------|----------|
| Actinobolin  | Broad    |
| Streptomycin | Broad    |
| Tetracycline | Broad    |
| Erythromycin | Gram +   |
| Penicillin   | Gram +   |
| Vancomycin   | Gram +   |
| Polymyxin    | Gram -   |

### Phenol and essential oils

Listerine is found in this category and is a complex of phenol related essential oils, thymol and methyl salicylate containing moderate plaque inhibitory and some antigingivitis effects [15]. Listerine tends to be slightly more effective than triclosan mouthwash in terms of plaque inhibition. Its anti-inflammatory effects in the home use studies can be due to its ant oxidative activity [9]

### Triclosan

Triclosan has been used in many commercial toothpastes and mouthwashes producing moderate plaque inhibitory

effects once used in combination with zinc [16].

### Quaternary ammonium compounds

Despite the fact they carry greater oral retention and equivalent antibacterial activity of chlorhexidine, they are still less effective in inhibiting plaque and gingivitis. The main reason is that the compounds are rapidly dissolved from the oral mucosa. Also the antibacterial properties of these compounds are reduced once adsorbed onto a surface may be related to the monocationic nature of these compounds [17].

### Natural products

Sanguinarine: it produces moderate reductions in plaque and gingivitis. Sanguinarine tend to be an effective plaque inhibitory component, but less effective than chlorhexidine (9).

Propolis: It is used in homoeopathic therapies such as anantiseptic, anti inflammatory and bacteriostatic agent.

Due to these properties it has been mended as a constituent of a plaque- inhibitory mouthwash [9].

### Detergents

Sodium lauryl sulfate is a widely used synthetic detergent in toothpaste. It can interact with the fluoride on dental enamel. It is suggested that this interaction can decrease the cariostatic effect of fluoride [19].

### Amine alcohol

This group contains of Delmopinol which decrease plaque growth and acts as anti-gingivitis and Octapinol that is not used nowadays [18].

### Oxygenating agents

These agents such as hydrogen peroxide, and peroxy carbonate in mouth rinses are beneficial on acute ulcerative gingivitis by inhibiting anaerobic bacteria [9].

### Metal ions

A number of metal ions have been investigated for their effects on plaque, zinc, copper and tin also have plaque inhibitory. They also have activity due to the stannous ion or the surface active amine portion of the molecule reactions.(9)

### DISCUSSION & CONCLUSION

Many of the agents that have noticeable plaque inhibitory activity have been discussed in this article however these agents have side effects. These side effects can be; tooth stain production, alteration of taste and erosion of the oral mucosa which can limit their long term use. Clinical judgment is done by practitioners as to which product or group of products may be most suitable for the patient. It has to be decided which delivery system is also best for their patients. Based on the scientific validity of the materials selected and their relationship to the patient's specific needs, clinical judgments must be made.

Chemical plaque-inhibitory mouthwash should be used along with tooth brushing as it has a major effect on improving the oral health of the individual. A chemical plaque control agent which has various clinical applications in dentistry, particularly in Periodontics dentistry is chlorhexidine. It has various formulations and clinical application which has made it to be known as the gold standard chemical plaque control agent.

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