ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor (RJIF): 8.4
IJAR 2024; 10(4): 374-377
www.allresearchjournal.com
Received: 19-02-2024
Accepted: 26-03-2024

Dr. Hemalatha DM
M.D.S., Assistant Professor, Department of Periodontics, Mahe Institute of Dental Sciences, Chalakkara, Mahe, Kerala, India

Dr. Anil Melath
M.D.S., Professor and Head, Department of Periodontics, Mahe Institute of Dental Sciences, Chalakkara, Mahe, Kerala, India

Dr. Subair K
M.D.S., Professor, Department of Periodontics, Mahe Institute of Dental Sciences, Chalakkara, Mahe, Kerala, India

Aswini Tharayil
Final Year Student, Mahe Institute of Dental Sciences, Chalakkara, Mahe, Kerala, India

Athira P Nair
Final Year Student, Mahe Institute of Dental Sciences, Chalakkara, Mahe, Kerala, India

Corresponding Author:
Dr. Hemalatha DM
M.D.S., Assistant Professor, Department of Periodontics, Mahe Institute of Dental Sciences, Chalakkara, Mahe, Kerala, India

Antiplaque agents in chemical plaque control: A review

Dr. Hemalatha DM, Dr. Anil Melath, Dr. Subair K, Aswini Tharayil and Athira P Nair

Abstract
Oral health surveys exhibit that even in countries with established oral hygiene practices, most people have relatively poor gum health. This is due to low interest in compliance with oral hygiene procedures. When examining compliance with oral hygiene habits, a number of factors stand out. Only about 50% of the population brushes their teeth more than once a day, brushing time is probably too short, and flossing is not very common. Many product forms are available to provide anti-plaque agents, including mouthwash, toothpaste, water-based gels, as well as dental floss, chewing gum, and lozenges. Each product form must provide a physically, chemically, and microbiologically stable environment for the intended active ingredient which aimed at allowing optimal bioavailability of the active ingredient at the site of action and promoting patient compliance. Antiplaque agents for topical administration must possess the following properties: high specific efficacy against a wide range of oral microorganisms, toxicological and environmental safety, oral persistence, absence of side effects, and Good chemical stability. Many classes of antiplaque agents have been identified, including positively charged organic molecules, metal salts, phenols, enzymes, peroxides, sugar substitutes, fluorides, and surface modifiers. To achieve optimal bioavailability, the administered drug must be compatible with the form of the product used. There are two main product forms: rinse and toothpaste.

Keywords: Plaque, dentifrice, oral hygiene practices, calculus, prophylaxis

Introduction
Dental plaque grows naturally on the tooth surface and forms part of the defense mechanism against exogenous microorganisms by acting as a colonization barrier [1]. This barrier effect is called resistance to colonization [2]. The accumulation of bacterial plaque on and around teeth is thought to lead to tooth decay and chronic systemic gingivitis. Therefore, it seems reasonable to assume that methods of preventing plaque formation or removing plaque from teeth is the ideal way to prevent further disease [3].
Plaque treatment uses mechanical procedures and chemicals that slow down plaque formation. Mechanical methods of plaque prevention include tooth brushing, oral hygiene practices, and professional prophylaxis. Currently, the most effective method for plaque control appears to be mechanical plaque control [4]. Plaque management is one of the most important tasks in dentistry and cannot be achieved or maintained without proper oral hygiene practices. Therefore, plaque management means protecting periodontal health. Optimal management of periodontal disease after treatment, and finally, prevention of disease recurrence in patients receiving periodontal disease treatment [5].

Plaque control
Plaque control means the regular removal and prevention of accumulations of the dental plaque on the teeth and adjacent gingival surfaces [5]. Objectives of plaque control is to control gingivitis, marginal periodontitis and also for the prevention of caries.

Classification of plaque control
- Mechanical plaque control
- Chemical plaque control

Mechanical plaque control

Tooth brushing effectively removes plaque from the buccal, lingual and occlusal surfaces of teeth, but it cannot access the spaces between teeth, leaving those areas uncleansed. Achieving proper interdental oral hygiene necessitates the use of a interdental brush which is capable of reaching between the adjacent teeth. There appears to be evidence suggesting that combining flossing with tooth brushing offers a statistically significant advantage in reducing gingivitis compared to tooth brushing alone [6].

Classification of chemical plaque control

First generation antiplaque agents: This may reduce plaque by 20-50 %. They have poor substantivity. Eg: antibiotics, phenols, quaternary ammonium compound and sanguinarine

Second generation antiplaque agents: They reduce plaque by 70-90% and is better preserved than first generation. Eg:- bisbiguanides (chlorhexidine)

Third generation antiplaque agents- they prevent binding of microorganisms to the tooth and to each other. They have low retention capability. Eg:-Delmopinol

Modes of application of anti plaque agents

Anti plaque agents can be delivered in following ways -

Routine oral hygiene aids:- since interdental and subgingival sites are relatively difficult to reach with mouthwash, alternative methods of applying chemical antiplaque products are needed. A variety of home care devices, such as brushes, dental floss, and toothpicks, are used to apply antiplaque agents between teeth. The use of dental floss containing stanium fluoride has been shown to reduce bacterial growth [7, 10]

Mouth Rinses

Mouthwash is the most common and easiest way to administer antiplaque agents. Mixtures of flavored alcohols and nonionic surfactants are the most common vehicles for improving cosmetic properties. Direct damage to bacteria through electrostatic and hydrophobic interactions with bacterial enzymes can affect these compounds. Mouthwashes can mainly be classified into two groups. First and second generation mouthwash [7].

Dentifrice

Dentifrice can be used as a vehicle for antiplaque agents. Traditional toothpaste consists of abrasive and tensile components that work together to remove loosely attached substances such as plaque, film, and dirt. Fragrances and therapeutic agents, especially fluoride, are added for antipediatric effects (to freshen the mouth) [8].

Gels

Gels have been used as vehicles in many studies, particularly for interdental application of chlorhexidine using brushes, dental floss, or sticks. Toothpaste gel is just a clear, thick, water-based product with no abrasives or moisturizers. It is also compatible with most antimicrobial agents [7].

Chewing gums

Chewing gum is one of several possible vehicles for determining the chemical agents in the oral environment in adequate concentration to minimize plaque formation. e.g., chewing gum containing urea hydrogen peroxide, sorbitol-flavoured chewing gum, and chlorhexidine containing chewing gum [9]

Some of the anti-plaque agents are as follows

Chlorexidine

Administered topically to teeth to prevent supragingival development of dental biofilms like plaque, c hlorhexidine (CHX) is a bisbiguanide having bacteriostatic and bactericidal properties. It is regarded as the "gold standard" anti-plaque agent since it is the most researched, most potent, and anti-gingivitis medication. Broad-spectrum antiseptic CHX works well against viruses, yeasts, and both gram-positiv e and gram-negative bacteria [10]. It is a dicationic substance that binds to bacteria's negatively charged membrane phospholipids in an indiscriminate manner. CHX acts through a dose-dependent mechanism. At very low doses (0.02–0.06%), it is bacteriostatic; at higher concentrations (0.12–0.20%), it is bactericidal [11].

Apart from its instantaneous bactericidal action, CHX also forms a bond with the oral mucosa, which causes a gradual and extended antibacterial effect. The dicationic chlorhexidine molecule attaches to the pellicle using one cation and to the bacteria trying to colonize the tooth surface using the other, a phenomenon known as the 'Pin-Cushion Effect'. This extends the duration of chlorhexidine's action [13]. CHX is a common dental tool. It can be purchased as dental varnishes (1%, 10%, 40%), gels (0.12–1%), sprays (0.12–0.2%), and mouth rinses (0.02-0.3%). Mouthwashes and toothpastes also contain it. The most common application for CHX is as a gluconate component in cleaning solutions [18].

Prolonged usage of CHX has been linked to transitory changes in taste (dysgeusia) and discoloration of teeth locally. Unattractive brownish pigments build up on the tongue, teeth, and prosthetic crowns, which has an impact on patient compliance. Additionally, in vitro studies have demonstrated its cytotoxic effect against human cells, which can result in necrotic cell death and apoptosis. [18]

Cetylpyridinium HCL

The cationic quaternary ammonium compound with broad-spectrum antibacterial activity is called cetylpyridinium chloride, or CPC. It has been used as an antiseptic agent in oral hygiene products for the last fifty years. It quickly destroys germs, especially gram-positive bacteria and yeast, and possesses both bacteriostatic and bactericidal properties. Additionally, it has strong antiviral properties against specific viruses. The cationic component of CPC is thought to adhere to intraoral tissue proteins and negatively charged bacterial surfaces with ease, causing the antiplaque effect. It interacts with the cell membrane and causes cellular components to seep out, which slows cell growth and causes cell death. When used in conjunction with brushing, CPC mouth rinses result in a slight but noticeable adjuvant reduction of plaque and gingival irritation [12].

Fluorides

Fluorides are mainly utilised to improve enamel remineralization and lower the incidence of caries. Fluorides have been widely acknowledged for their antibacterial and cariostatic properties, and their widespread application has been linked to a recent decrease in tooth cavities in Western nations. Fluorides mainly work by forming

fluorohydroxyapatite crystals, which are more resistant to organic acids than dental enamel's hydroxyapatite crystals. Additionally, it has been demonstrated to lessen the production of organic acid in cariogenic bacteria like Streptococcus mutans [13, 14].

Fluorides can be applied topically in a variety of forms, including toothpastes, gels, foams, varnishes, and mouth rinses. Fluoride toothpastes are the most commonly used since fluorides are thought to be the most significant active component in toothpaste. Fluorides are crucial for preventing cavities, although everyday consumption of fluorides over an extended period of time More than 1 mg/l or 0.1 mg/kg at the time of tooth development results in dental fluorosis, which is typified by the creation of hypomineralized enamel. In both permanent and deciduous teeth, dental/enamel fluorosis manifests clinically as a moderate opaque white or brown mottling of enamel accompanied by pits and fractures [15].

Stannous Chloride

Another salt that contains stannous, stannous chloride (SnCl2), is added to mouthwashes and toothpastes because it significantly reduces the erosion of enamel and dentine. In vitro, in situ, and in vivo studies have all demonstrated its anti-erosive properties. Miller discovered its antiseptic properties in 1884, and it also has an antibacterial impact on mouth germs [19, 20].

Zinc

Human body contains zinc, a trace element that is vital, in bone, muscle, and skin. Additionally, saliva, teeth, and dental plaque all naturally contain it. It is proposed that the oral mucosa serves as the primary oral zinc reservoir [16].

In order to reduce oral malodor by inhibiting volatile sulphur compounds, control plaque, and prevent calculus formation through crystal growth, zinc is added to toothpastes and mouth rinses. It functions primarily by targeting the cytoplasm and glycolytic enzymes of bacterial cells and by blocking the process of glycolysis. It possesses a broad spectrum of antibacterial activity. Specific to individual bacteria, the inhibitory activity of zinc salts on microbial glycolysis is pH-dependent. As demonstrated by Streptococcus salivarius and Streptococcus sobrinus, the maximum inhibition occurs at pH 7. It is retained in plaque and saliva for several hours after application and has good oral substantivity. According to in vitro research, zinc is absorbed by the salivary pellicle through binding to the tooth surface coated in pellicle and then desorbing into the saliva. It has been demonstrated that applying zinc frequently causes a buildup effect in plaque [17].

Herbs

In recent years, there has been a rise in the use of herbs and plant extracts in toothpastes and mouthwashes. The emergence of multidrug resistant pathogens and the need for economical, safe, and effective alternatives has led to the increase in the use of natural phytochemicals derived from plants in oral hygiene products. Aloe, curcumin, eucalyptus oil, licorice, neem, and tea tree oil are some of the herbs and plant products commonly studied for use in toothpastes and mouthwashes.

Licorice

The herb licorice, or Glycyrrhiza glabra, is indigenous to Mediterranean and Asian regions. Licorice is used as a natural sweetener and flavouring in foods, beverages, and candies because of its sweet taste. Furthermore, because licorice root has so many health benefits, it has been used for centuries in Ayurvedic and traditional Chinese medicine. Glycyrrhizic acid and glycyrrhetic/glycyrrhetinic acid (GA), two of licorice's rich secondary metabolites, are thought to be responsible for the pharmacological effects of the herb. Antimicrobial, antiviral, antiulcer, anti-inflammatory, hepatoprotective, and immunoregulatory properties are just a few of the numerous pharmacological advantages of liquorice. Numerous research studies demonstrate the potential of licorice in the management of a wide range of illnesses, including cancer, bacterial and hepatic infections, immunodeficiency, atherosclerosis, and gastric ulcers. [21]

Curcumin

Curcuma longa Linn, is the plant that yields curcumin, a naturally occurring polyphenol. Although it is mostly grown in China, India, and other Asian nations, turmeric is also widely used in other regions of the world. It is used in food colouring, cosmetics, and cooking as a spice. Additionally, for thousands of years, it has been used to treat inflammatory illnesses and bacterial infections in Chinese and Ayurvedic medicine. The main curcuminoid and most extensively studied active ingredient in turmeric is curcumin. It has a range of therapeutic effects, such as cardiovascular, hepatoprotective, anti-inflammatory, hypoglycemic, antimicrobial, and anticarcinogenic qualities. Numerous diseases, including diabetes, pulmonary disease, cardiovascular disease, arthritis, and Alzheimer's, have been demonstrated to have potential benefits from it [19, 20].

Conclusion

Dentistry emphasizes the crucial role of managing plaque, urging each patient to take daily responsibility for their oral health. Optimal oral health hinges on periodontal therapy, an essential part of dental care. It's vital for every patient to be educated and motivated to maintain consistent plaque control. Successful plaque management not only aids individuals with gum and periodontal issues in restoring their health but also curtails its progression.

References

1. Van der Ouderaa FJ. Anti-plaque agents. Rationale and prospects for prevention of gingivitis and periodontal disease. J Clin Periodontol. 1991;18(6):447-54. doi: 10.1111/j.1600-051x.1991.tb02315.x. PMID: 1890227.
2. Marsh PD. Microbiological aspects of the chemical control of plaque and gingivitis. J Dent Res. 1992;71(7):1431-8. doi: 10.1177/00220345920710071501. PMID: 1629460.
3. Addy M. Plaque control as a scientific basis for the prevention of dental caries. J R Soc Med. 1986;79 Suppl 14(Suppl 14):6-10. PMID: 3543355; PMCID: PMC1290094.
4. Vyas T, Bhatt G, Gaur A, Sharma C, Sharma A, Nagi R. Chemical plaque control - A brief review. J Family Med Prim Care. 2021;10(4):1562-1568. doi: 10.4103/jfmpc.jfmpc_2216_20. Epub 2021 Apr 29. PMID: 34123892; PMCID: PMC8144784.
5. Sälzer S, Slot DE, Van der Weijden FA, Dörfer CE. Efficacy of inter-dental mechanical plaque control in managing gingivitis--a meta-review. J Clin Periodontol.

2015;42Suppl16:S92-105. doi: 10.1111/jcpe.12363. PMID: 25581718.
6. Newman HN. Modes of application of anti-plaque chemicals. J Clin Periodontol. 1986;13(10):965-74. doi: 10.1111/j.1600-051x.1986.tb01435.x. PMID: 3540027.
7. Cummins D, Creeth JE. Delivery of antiplaque agents from dentifrices, gels, and mouthwashes. J Dent Res. 1992;71(7):1439-49. doi: 10.1177/00220345920710071601. PMID: 1629461.
8. Gazi MI. The finding of antiplaque features in Acacia Arabica type of chewing gum. J Clin Periodontol. 1991;18(1):75-7. doi: 10.1111/j.1600-051x.1991.tb01123.x. PMID: 2045522.
9. Varoni E, Tarce M, Lodi G, Carrassi A. Chlorhexidine (CHX) in dentistry: state of the art. Minerva Stomatol. 2012;61(9):399-419. English, Italian. PMID: 22976567.
10. Eick S, Seltmann T, Pfister W. Efficacy of antibiotics to strains of periodontopathogenic bacteria within a single species biofilm - an in vitro study. J Clin Periodontol. 2004;31(5):376-83. doi: 10.1111/j.0303-6979.2004.00490.x. PMID: 15086620.
11. Jenkins S, Addy M, Wade W. The mechanism of action of chlorhexidine. A study of plaque growth on enamel inserts in vivo. J Clin Periodontol. 1988;15(7):415-24. doi: 10.1111/j.1600-051x.1988.tb01595.x. PMID: 3183067.
12. Haps S, Slot DE, Berchier CE, Van der Weijden GA. The effect of cetylpyridinium chloride-containing mouth rinses as adjuncts to toothbrushing on plaque and parameters of gingival inflammation: a systematic review. Int J Dent Hyg. 2008;6(4):290-303. doi: 10.1111/j.1601-5037.2008.00344.x. PMID: 19138180.
13. Bradshaw DJ, Marsh PD, Hodgson RJ, Visser JM. Effects of glucose and fluoride on competition and metabolism within in vitro dental bacterial communities and biofilms. Caries Res. 2002;36(2):81-6. doi: 10.1159/000057864. PMID: 12037363.
14. Kaufmann M, Bartholmes P. Purification, characterization and inhibition by fluoride of enolase from Streptococcus mutans DSM 320523. Caries Res. 1992;26(2):110-6. doi: 10.1159/000261494. PMID: 1521304.
15. Kirsch J, Hannig M, Winkel P, *et al*. Influence of pure fluorides and stannous ions on the initial bacterial colonization *in situ*. Sci Rep. 2019;9:18499.
16. Lynch RJ. Zinc in the mouth, its interactions with dental enamel and possible effects on caries; a review of the literature. Int Dent J. 2011;61Suppl3(Suppl 3):46-54. doi: 10.1111/j.1875-595X.2011.00049.x. PMID: 21762155; PMCID: PMC9374993.
17. Gilbert RJ, Ingram GS. The oral disposition of zinc following the use of an anticalculus toothpaste containing 0.5% zinc citrate. J Pharm Pharmacol. 1988;40(6):399-402. doi: 10.1111/j.2042-7158.1988.tb06303.x. PMID: 2901470.
18. Hemalatha DM, Anil M, Arjun MR, Prathyusha Prakash, Pavithra. Chlorhexidine: An Ally to trust; Int. J Drug Res. Dental Sci. 2023;5(3):37-45.
19. Tilak JC, Banerjee M, Mohan H, Devasagayam TP. Antioxidant availability of turmeric in relation to its medicinal and culinary uses. Phytother Res. 2004;18(10):798-804. doi: 10.1002/ptr.1553. PMID: 15551376.
20. Araújo CC, Leon LL. Biological activities of Curcuma longa L. Mem Inst Oswaldo Cruz. 2001;96(5):723-8. doi: 10.1590/s0074-02762001000500026. PMID: 11500779.
21. Sharma S, Sogi GM, Saini V, Chakraborty T, Sudan J. Effect of liquorice (root extract) mouth rinse on dental plaque and gingivitis - A randomized controlled clinical trial. J Indian Soc Periodontol. 2022;26(1):51-57. doi: 10.4103/jisp.jisp_517_20. Epub 2022 Jan 1. PMID: 35136317; PMCID: PMC8796775