REVIEW ARTICLE

# Chlorhexidine: The Gold Standard Mouth Wash

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**ABSTRACT**

Chlorhexidine (CHX) is used as the broad spectrum antiseptic since 1950. It is a widely used mouth wash because of its antiplaque and antigingivitis properties. Antibacterial activity of CHX is mainly by disrupting bacterial cell membrane, which causes leakage of cellular constituents and brings about cell death. Bactericidal and bacteriostatic activity depends on the dosage. This article discusses various clinical applications, properties and adverse effects of CHX.

**KEYWORDS** chlorhexidine, mouth wash, antiplaque agent

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## INTRODUCTION

Chlorhexidine (CHX) is the gold standard mouth rinse against which the other newer mouth rinses are studied[1]. It has antiplaque and antigingivitis properties. It is effective against all the microbes against viruses and fungi also. Although many products have been used to control plaque and gingivitis, CHX is one of the most widely used and thoroughly investigated antiseptics. Years of documented research have established that CHX digluconate is safe, stable and effective in preventing and controlling plaque formation, breaking up existing plaque, and inhibiting and reducing the development of gingivitis[2]. (Gun solely 2010) The major advantages of CHX over other product is its substantivity, it binds to soft and hard tissues in the mouth enabling it to act for a longer period.

## HISTORY

CHX was developed by Imperial Chemical Industries in England during 1940s. It was marketed as a general antiseptic in the year 1950. In 1957, CHX was introduced for human use in Britain as an antiseptic for skin. Later it was widely used in medicine and surgery. Plaque inhibition was first investigated by Schroeder in 1969[3]. A definitive study for caries inhibition by inhibition of dental plaque was done by Loe and Schiott 1972[4].

### *Form*

CHX is available in various forms such as digluconate, acetate and hydrochloride salts which are sparingly soluble in water.

### *Structure*

CHX is a symmetrical molecule. It has four chlorophenyl rings and two biguanide groups connected by a central hexamethylene bridge. CHX is an antimicrobial agent. It acts on the inner cytoplasmic membrane hence it is a membrane active type of substance. It is dicationic at pH levels above 3.5. It prevents plaque accumulation; hence it is an antiplaque and antigingivitis agent[5] and reduces the adherence of *Porphyromonas gingivalis* to epithelial cells[6], it can be bacteriostatic or bactericidal depending on the dose. It acts against a wide array of bacteria including Gram positive and Gram negative bacteria, dermatophytes and lipolytic viruses. It also acts against fungi, yeasts and some viruses including Hepatitis B virus and human immunodeficiency virus. It acts against Streptococcus mutants making it anticariogenic in nature. Studies have also shown that CHX has the ability to neutralize pathogenic agents such as *Streptococcus aureus*, *P. gingivalis* and *Prevotella intermedia*[7].



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Another most important unique property of CHX is its substantivity. Substantivity refers to the oral retentiveness. It depends upon various factors such as concentration, pH, temperature and time of contact of the solution with oral structures.[8]

## Mechanism of action of CHX[9]

Dicationic positively charged CHX is attracted to the negatively charged bacterial cell wall with specific and strong adsorption to phosphate containing compounds

↓

Alters the integrity of the bacterial cell membrane and CHX is attracted to the inner cell membrane

↓

CHX binds to the phospholipids in the inner membrane and there is leakage of low molecular weight compounds like potassium ions

↓

By increasing the concentration of CHX there is progressive damage to the membrane

↓

There is coagulation and precipitation of the cytoplasm by the formation of phosphate complexes which include adenosine triphosphate and nucleic acids

↓

Cytoplasms of the cells are chemically precipitated, Bactericidal stage which is irreversible

## Clinical application of CHX[9–11]

It can be used as an adjuant to routine oral hygiene measures. It can be used after periodontal surgeries, in patients with fixed orthodontic appliances and fixed and removable prosthetic appliances, handicapped individuals who cannot perform proper brushing, hospitalized or bed ridden patients and in patients with intermaxillary fixations.

To prevent bacteraemia, patients are given preprocedural CHX mouth rinses. Other uses of CHX include sub gingival irrigation, management of denture stomatitis, hypersensitivity and for oral malodour. Full mouth disinfection has been introduced with scaling and root planing and the application of CHX into periodontal pockets with daily use of CHX rinses at home for 2 months. Wound healing is enhanced when CHX rinses are used before extractions and after scaling and root planing or periodontal surgery.

## Toxicology and safety[9]

Due to the dicationic nature of CHX the absorption through skin, mucosa and gastrointestinal tract is less, systemic toxicity due to topical application and ingestion is not reported. Neursensory deafness can occur if CHX is accidently introduced into the middle ear. Bacterial resistance has not been reported with long term use of CHX.

## Side effects[12]

The side effects of CHX include brownish discolorations of teeth, other restorative materials and the dorsum of the tongue. It also brings about alteration in the taste sensation and there can also be oral mucosal erosion. Rarely in some patients is unilateral or bilateral parotid swelling seen. Enhanced supragingival calculus formation occurs, which is due to precipitation of salivary proteins on the tooth surface, thereby increasing pellicle thickness.

## CHX staining[13,14]

There is degradation of CHX molecule to release parachloralanine. Catalysis of maillards reaction takes place, which is a non-enzymatic browning reaction. Protein denaturation and metal sulfide formation occurs and there is precipitation of anionic dietary chromogens.

# REVIEW RESULTS

Mel Rosenberg had done a study to assess the day long reduction in oral malodor of novel two phase oil: water mouth rinse (TPM), as compared to a placebo rinse and 0.2% CHX mouth rinse. Both TPM and CHX brought about a significant decrease in oral malodor as well as microbial load as compared to the placebo rinse, but the CHX rinse was more superior to TPM in both the clinical parameters[15].

Carlos Alfredo Franco Neto study was to evaluate the effect of two CHX rinsing solutions (0.12% and 0.2%) on plaque and gingival bleeding. No differences were observed in terms of antiplaque efficacy between the 0.12% and 0.20% CHX rinsing solutions[16].

MPC Van Leewen conducted a systematic review to compare essential oil mouth wash with respect to CHX mouth wash with respect to plaque and parameters of gingival inflammation. The review demonstrates that compared to essential oil mouth wash CHX mouth wash provided better results for plaque. For long-term control of gingivitis essential oil mouth wash is not different from CHX. In patients with gingival inflammation essential oil mouth wash can be a reliable indicator to CHX. However in case where plaque control is the main focus such as post-surgery wound healing, CHX mouth wash is the first choice[17].

Papaionnou performed a study to compare the clinical efficacy of alcohol and alcohol-free mouth rinses. It was concluded that non-alcoholic chlohexidine mouth rinse had comparable levels of action as compared to the alcoholic mouth rinse[18].

Daniëlle conducted a study to systemically evaluate the efficacy of CHX mouth rinses on plaque, gingival inflammation and staining in gingivitis patients. Various randomized controlled trials were included in the study, and it was concluded that CHX mouth wash provided significant decrease in the plaque and gingivitis scores, but significant increase in the staining scores[19].

Najafi et al. conducted a study to compare the efficacy of two concentrations of digluconate CHX solutions (0.12% and 0.2%) on gingival indices and the level of dental staining during 14 days. It was concluded that the lower concentrations of CHX should be prescribed, decreasing side effects, since higher concentrations do not seem to be more effective in controlling dental plaque and gingivitis[20].

Mirzadeh et al. performed a study to evaluate and compare the clinical efficacy of these two forms. This study was performed on 24 patients with gingival index (GI) = 2. Patients were divided into two groups according to the one who received gel or mouthwash. At baseline, scaling was performed on both groups, and then a 2-week period was spent before measuring plaque indices (PI), gingival bleeding indices (GBIs) and gingival indices (GIs). After this period, the groups received either gel or mouthwash, and after 4 weeks, indices were recorded again. Both gel and mouthwash groups showed an improvement in all indices during treatment compared to baseline ($p < 0.05$). No significant difference in GI, GBI or PI was observed between two groups ($p > 0.05$). This study showed that both methods of using CHX (gel or mouthwash) are effective in reducing plaque and gingival indices, but none of these two methods have any preference against the other one[21].

Gunsolley conducted a systematic review of the literature to evaluate the efficacy of antigingivitis and antiplaque products in six-month trials. He searched electronic databases from 6-month randomized clinical studies that evaluated both antiplaque and antigingivitis properties of dentifrices or mouth rinses. In addition, the author solicited unpublished studies from manufacturers. This systematic review provides strong evidence that antiplaque, antigingivitis agents are efficacious. Coupled with reports showing that the relative efficacy of these agents is similar to that of flossing, these results suggest that for optimum gingival health, adults should add an antiplaque, antigingivitis agent to their oral hygiene regimen[22].

Solís et al. performed a study to evaluate the degree of staining and clinical efficacy of a CHX mouthwash with an antidiscoluoration system (ADS) versus 0.2% CHX mouthwash (traditional). Secondary objectives are to evaluate the patient "compliance" factor according to patterns assigned by the clinician and to observe the side effects of the two mouthwashes. This comparative study was carried out on a sample of 15 non-smoking patients with chronic periodontitis at the Department of Periodontology, International University of Catalunya, Barcelona, Spain. All patients used either 0.2% CHX mouthwash (control group = bottle B) or CHX with ADS (test group = bottle A) for 15 days. Each patient first rinsed with a randomly assigned mouthwash for 15 days followed by a 15-day washout period. Subsequently, each patient used a second mouthwash. Before each cycle, a full dental prophylaxis was performed. The plaque, gingival, and Brecx staining indexes were used. The test group with ADS had less staining than the control group during a usage period of 15 days. However, the two mouthwashes seemed to be equally effective as antiplaque and antigingivitis agents[23].

Halita is the name of a mouth rinse containing 0.05% of CHX, 0.05% Cetylpyridinium chloride and 0.14% of zinc lactate. It is used in the management of halitosis. Zinc is added as it has the ability to convert volatile sulfur compounds and it also acts synergistically with CHX. Other clinical benefits include its use as a root canal irrigant and in atraumatic restorative treatment where CHX containing glass ionomer cement[24,25].

## CONCLUSION

Mechanical plaque control agents cannot reach all the areas in the mouth where as mouth washes can access all those areas. CHX is the gold standard mouth wash because of its superior antiplaque properties and its duration of action.

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