

A Review on “Chlorhexidine Digluconate Mouthwash”

Rigio Josephpima and Mr. Bopesh Kumar

School of Pharmacy, Abhilashi University, Chailchowk, Mandi, H.P

Abstract: Oral hygiene is important for prevention and disease control, this review focuses on the chlorhexidine gluconate mouthwash for the purpose of oral hygiene and study its properties such as antimicrobial activity, its side effects, advantages and limitations.

The review is based on the alcohol free version of the stated formulation, alcohol free is chosen because of its less side effects, while alcohol causes a lot of unwanted side effects which we want to avoid due to reasons that are mentioned in this review further down.

The review also tells some evaluation parameters and its theoretical idea behind. The review concludes with the importance of oral hygiene, how the present chlorhexidine formulation can be improved via certain methods and new ingredients, this future perspective are just a thought which if applied would be good.

Required references are given from which the reader can possibly get more in depth and original idea though its not a recommended thing to do..

Keywords: Oral hygiene.

I. INTRODUCTION

Oral hygiene

Oral hygiene is defined as maintaining the cleanliness of mouth, teeth, gums, tongue basically the oral cavity for the purpose of preventing any oral diseases, therefore it is better to maintain oral health rather than to suffer the diseases due to negligence.

Oral health basically refers to oral being. If the teeth are healthy, it would indicate that your oral health is fine, likewise its for gums. Maintaining the oral health can indicate that u don't have any pain, infection, and your mouth is functioning properly.

As we have discussed before maintaining the oral hygiene is important for the prevention of disease, to keep the mouth healthy, and for the overall health of the mouth and the body.

Not keeping the oral cavity healthy can lead to cavities, cavities are caused because of bacterial action on the mouth. Sugar is one of the leading cause of cavities so it is recommended by health professionals to avoid sugar (too much), other conditions such as enamel damage are also caused by bacteria. There are certain methods done to remove plaque best dentist which might include cleaning my machines with medications.

Bacteria are always in our mouth, in the tooth surface, brushing can help us to slow down the bacterial growth.

One more very common oral disease is gingivitis which can be identified by gum inflammation, redness, swelling in the gums and plaque accumulation, this can also be prevented by brushing and limiting sugar intake.

Periodontal disease is also a oral disease which causes infection in supporting tissues, also it causes bone loss, affects tooth mobility, it is considered to be an advance gum disease. Same as other oral disease this disease too can be prevented by maintaining good oral health.

Not maintain good oral health also leads to bad breath, bad breath is the result of oral bacteria, food stuck on the mouth which results in unpleasant odor. Cleaning the tongue can reduce this unwanted effect.

The advantage of keeping the mouth healthy is that the teeth gets strong means they don't move in between the gums and will last long, also the gums will be healthy.

Healthy oral habits will also have a psychological advantage that would not be there if the teeth were unhealthy.



Surprisingly oral health is also connected to overall health such as systemics disease, diabetes, cardiovascular health if it is not maintained.

Maintaining the oral health will also benefit the person financially due to no need for costly treatment for diseases.

Methods to maintain the oral health are well known by everyone, brushing, using toothpaste, flossing, mouthwash liquid, dental visits.

In this review we are going to focus on mouthwash, its antimicrobial action, how it is formulated in the industry and in depth information.

In the end we need to have a habit of cleaning the mouth in order to prevent diseases.

Mouthwash

Mouthwash is basically a liquid, made by pharmaceutical companies, for the purpose of cleaning the mouth after brushing, as it aids the brushing.

it has anti microbial action therefore it kills bacteria by certain mechanism, anyway it reduces the microbial growth in the mouth therefore controlling the oral microorganism

it also controls the plaque accumulation by removing the bacterial biofilm and by cleaning the teeth.

mouthwash helps in the prevention of cavities especially the ones that consists fluoride in them.

also reduces bad breath because it reduces the odor causing bacteria and it also has deodorizing effect.

mouthwash as we discussed is not a replacement for brushing rather it is an adjunct means an addition, also same with flossing and other methods for cleaning.

mouthwash also does gives oral comfort for irritated gums and for healing.

mouthwash works inside the mouth and should not be ingested, the therapeutic agents may vary most commonly used are alcohol, chlorhexidine fluoride etc.

but chlorhexidine is the right one because it has better patient compliance, because of lesser irritability compared to alcohol also it has a broad-spectrum antimicrobial action.

Chlorhexidine gluconate

it is an antiseptic agent with a broad range of spectrum in its antimicrobial action and it is used in oral healthcare. it is made up of biguanide compound which are cationic molecule, also this are water soluble gluconate salt and consists of antimicrobial properties. chlorhexidine works by interacting with the bacterial cell wall and by disrupting its cell membrane it leads to leakage of the bacterial intracellular contents causing bacterial death.

it is a broad spectrum compound and affects gram positive bacteria and gram negative bacteria and also fungus! uniquely it is absorbed by the oral tissues therefore has an prolonged retention in the mouth and sustained antimicrobial action (Long lasting effect). because of its antimicrobial action it helps in reduction of microorganism in the mouth, reducing the microorganism also leads to plaque control hence preventing gingivitis and maintaining the oral health.

therapeutically is used in periodontal therapy, post dental procedures, oral infection management etc.

the formulation of this mouthwash uses the chlorhexidine 0.12%.

it has advantage it terms of being a highly effective antiseptic, prolonged acting mouthwash, reduces plaque, and is considered a gold standard mouthwash.

but like everything it also has certain limitation such taste alteration, it increases calculus formation and is not recommended not for prolonged unsupervised use.

problem with alcohol mouthwash alcohol is also used in mouthwash and is also quite effective and in addition it also works as a preservative but it does cause oral dehydration of the tissues, reduces the saliva production and causes dry mouth because of which it can cause oral discomfort.

in addition to above problems, it also causes burning sensation, mucosal irritation and can be quite hard to use for the person with sensitive oral tissues. this irritation are not just sensation but real damage can also be taken by the user such as mucosal damage from prolonged use. addition to this taste perception is altered therefore there is lack of patient acceptance.



due to above mentioned side effects this formulation is not suitable for children, elderly patients, xerostomia sufferers and alcohol sensitive individuals.
therefore, there is a demand for alcohol free mouthwash.

Need for non-alcohol mouthwash

As discussed above the limitation of alcohol mouthwash, there is a search for a safer and more convenient mouthwash which avoids the dehydration, maintains the saliva level, and reduces xerostomia, the mouthwash should be less burning, have better tolerated in patient. it should also be safe for oral tissue. but with all this it should also be effective in dealing with microbes, plaque, and other oral health diseases. absence of alcohol also gives better tolerability.... so chlorhexidine mouthwash works quite nicely due to its non-alcohol need and does deals with all the problems mentioned above in some way or unto certain level.

Objective

The objective of this project is to review chlorhexidine mouthwash formulation, how is it made, the testing that are done to confirm its efficiency, to learn about the properties of chlorhexidine compound its, molecular structure, its effects, its uses in healthcare and specially in oral healthcare.

In this review the alcohol free version is the one which are going to deal with because of reasons mentioned before other than that we will also focus on the ingredients that are used in the formulation of chlorhexidine mouthwash and the reason they are specifically chosen.

We will also focus on the advantages and limitation of this specific formulation.

Literature review

Borrajó et al. 2002. did the study on chlorhexidine mouthwash which was alcohol free and compared it with alcohol containing chlorhexidine mouthwash and found out both were good at reducing plaque and also good at reducing gingivitis hence he concluded that alcohol was not necessary due to similar efficacy and alcohol being working as an irritant.

Todkar et al. 2012. also evaluated the alcohol and non alcoholic chlorhexidine mouthwashes and came to same conclusion as Borrajó that alcohol is not necessary when non alcoholic mouthwash of chlorhexidine do the same work without the side effects that alcohol causes.

Ennibi et al. in 2012 did similar work on the same topic as the previous people and found out that both were effective in reducing plaque and gingival inflammation and in addition to this he also found out that higher chlorhexidine concentration showed better plaque control.

Marrelli et al. in 2015 studied the chlorhexidine and found out its plaque accumulation controlling effect but also noticed the long term effect of it which included tooth staining.

Jose et al. 2015. did six week randomized clinical trial on alcohol free chlorhexidine mouthwash and saw the plaque reduction patients, gingival health improvement.

Papaioannou et al. 2016. tested the alcohol free chlorhexidine mouthwash and found out its plaque inhibition property, antibacterial effect and stated that there is no loss of therapeutic action after alcohol is removed and is a better alternative to alcohol based formulation.

Kulkarni et al. in 2017 compared the non alcoholic chlorhexidine mouthwash with essential out mouthwash and found that both had significant plaque and gingival reduction and there was no significant difference in their effects concerning both mentioned disease above. He concluded that alcohol free formulation are preferred more due less side effects.

Systematic review (2017) collective study showed the plaque reduction effect of chlorhexidine and found out to be an effective adjunct to tooth brushing. But tooth staining was reported frequently therefore it was recommended only for short term use.



Gupta et al. (2021) studied both alcohol and non alcoholic version of chlorhexidine mouthwash and found both to be effective with similar efficacy but alcohol caused greater irritation and non alcohol was better tolerated and non alcohol was better for prolonged use.

Perez-Nicolas et al. (2023) reviewed mouthwash used in elderly population and found chlorhexidine to be effective against oral pathogens, and figured out that alcohol free was preferable in dry mouth.

Brookes et al. (2023) found out that chlorhexidine is a highly effective antimicrobial agent but prolonged use can disrupt the oral microbiome balance.

McGrath et al. (2023) he concluded that chlorhexidine is a gold standard mouthwash and has strong evidence for oral health and found out that alcohol free version is gaining clinical acceptance and future research is being done on it for a safer version.

Overview

Chemical information

Chemical name - chlorhexidine, chlorhexidine digluconate (mouthwash form).

Molecular formula

$C_{22}H_{30}Cl_2N_{10}$

Molecular weight

505.45 g/mol

Extras

It is a cationic compound, and is water soluble.

Mechanism of action

It is an broad-spectrum antiseptic agent , also it can act as bacteriostatic at low concentrations and bactericidal at high concentration, it has an long lasting effect due to its ability to stick on mouth surface.

It works against gram positive bacteria especially against streptococcus mutans which results in plaque reduction and prevents bacterial colonization. Because of broad spectrum action it is also effective against gram negative bacteria too.

Mainly the way it kills the bacteria is by binding to the bacterial cell wall and then disrupting its cell membrane, by disrupting its cell membrane it increases the bacterial cell wall permeability causing leakage of intracellular contents and bacterial cell death.

Uses

Gingivitis - by controlling plaque, reducing the gingival infection, decreasing the bleeding and by preventing the further growth of gingival progression.

Periodontitis - chlorhexidine helps in controlling periodontal pathogens.

Post surgical oral care - this formulation of mouthwash is also used after oral surgery for preventing infection.

Need for Alcohol-free Mouthwash

Alcohol can cause dehydration in the mouth, and also tissue sensitivity, which can result in discomfort in oral cavity while using the mouthwash and in addition to all this alcohol can also cause inflammation because of which there is less tolerability from the patient therefore an alcohol alternative is required which will have better mucosal compatibility and can be used for longer time.

Even if some people may be able to use alcohol based mouthwash people with sensitive oral tissues are not able to use it properly, people such as children and elderly patients, children can swallow the mouthwash which is not an ideal thing for a child. Children and elders have fragile mucosa so the need to be watchful of what they use. Keeping this concerns it is important for an alternative.

If seen more deeply ethanol penetrates the skin and causes inflammation and also can cause problems in people with ulcers and with post surgical wounds.



Ingredients used in formulation

Active ingredient - chlorhexidine gluconate (0.12%-0.2%)

<i>Ingredient</i>	<i>Function</i>
Purified Water:-	Vehicle
Glycerin:	Humectant
Sorbitol:-	Sweetener
Sodium Saccharin:-	Sweetening agent
Peppermint Flavour:	Flavouring agent
Tween 80: -	Solubilizer
Sodium Benzoate:-	Preservative

Preparation (general method)

Step 1

First, we need to prepare the base which involves taking purified water as the vehicle and adding glycerin or sorbitol for moisture retention and for other purpose after that we need to stir it continuously.

Step 2

Then we need to add sodium saccharin to mask the bitter taste of chlorhexidine with that also the flavouring agent.

Step 3

Now add chlorhexidine slowly with continuous stirring.

Step 4

Now ph is checked using a ph meter if needed buffer is added to maintain the ph at required amount of 5.5-7

Step 5

Next water is added to make up the final volume.

Step 6

Solution created is than filtered for removal of suspended particles and for clarity.

Step 7

Fill the solution in a suitable bottle with proper sealing to ensure protection from contamination and degradation.

Evaluation parameter

Appearance

First we need to check the visual appearance of the solution regarding its color uniformity, there should not be any precipitation in it or suspended particles visible in it because we have filtered the solution, the solution should be clear. All this should be okay in order for the product to be acceptable.

Ph determination

Analyst measure the ph of the solution using ph meter, stable ph ensures stability, oral mucosal compatibility and less irritation.



Viscosity

Assessment of flow is measured using certain methods, evaluation of viscosity also includes mouthfeel evaluation, ease of rinsing etc.

Stability studies

To test the stability of the formulation different storage conditions are tested on the product while monitoring pH changes, degradation, shelf life.

Advantages

The advantages include absence of ethanol, reduced mucosal dehydration, lower tissue irritation, better long term use. Without alcohol there is no stinging because of less nerve stimulation which results in comfortable rinsing experience and better patient satisfaction and increased patient adherence. It is suitable for patient with xerostomia because of no drying effect. If any patient has oral ulcers, post surgical wounds, no alcohol formulation is a great help. It is also safer for children because they have sensitive tissues, likewise for elderly patients.

Limitations

Prolonged use of chlorhexidine can lead to tooth staining due to less bacteria concentration on the mouth which leaves the food residue such as tea, coffee, tobacco. Other than this the taste receptors in the mouth gets less sensitive after use resulting in reduced taste perception. On prolonged use can also lead to calculus formation in the teeth due to certain reasons. It is good as a preventive measure rather than a treatment for plaque. Some people may have mucosal irritation. Higher manufacturing cost

Future perspectives

In future there might be optimization of alcohol free systems, also enhancement on the stability of chlorhexidine for better solubility techniques with better effectiveness. Better flavor masking approaches might also be required or are being developed with better taste profile which can increase the patient acceptance. The side effects that are known now might be reduced in the future such as finding the solution for tooth staining. The delivery System could be changed such as controlled release formulation, and formulation with sustained antimicrobial activity. Natural ingredients can be incorporated in it such as herbal extracts for synergistic effects, expanded therapeutic effect and improved patient variability. For all these to be possible longer studies may need to be done and maybe some are still done presently.

II. CONCLUSION

Ok so the conclusion is that chlorhexidine mouthwash is an ideal mouthwash specifically the alcohol free version due to less side effects compared to alcohol containing version. Mouthwash are important a person because it can clean the areas that normal cleaning techniques cannot reach such as, brushing, flossing. Because of its antimicrobial property chlorhexidine is selected even though it might have certain side effects such as tooth staining being the most prevalent. He review also focuses on the formulation of the mouthwash step by step and the evaluation and testing of the solution to ensure safety and standard of the solution.



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