



THE DENTAL GEL FOR THE PREPARATION OF HUMAN PERIODONTAL DISEASE: A REVIEW

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ABSTRACT :

The purpose of the study was to create and assess a dental gel with clove oil as its main ingredient for the treatment of periodontitis. Clove oil is chosen for the treatment of periodontitis because of its broad range of antibacterial activity against several periodontal infections. Using carbopol 934 as a gelling agent, clove oil as a therapeutic agent, polyethylene glycol as a co-solvent, methyl and propyl parabens as preservatives, and the necessary amount of distilled water as a carrier, clove oil gel is created.

Gingivitis and periodontitis are examples of inflammatory conditions that are generated by plaque and are usually referred to as periodontal disease. Gingivitis is a mild stage of disease that is characterized by swelling, minor bleeding, and redness of the gingival edge. It is brought on by an accumulation of supragingival plaque. A shift in the microbiota from a more Gram-negative to a more Gram-positive anaerobic flora is linked to gingivitis. The more advanced form of periodontal disease known as periodontitis causes the alveolar bone to resorb and the periodontal ligament that supports the tooth to separate.

In order to create a dental gel that would help treat periodontal illnesses, clove oil was added. The gel's physicochemical characteristics, such as its drug content, spreadability, extrusion ability, and in vitro antibacterial activity, were then assessed.

Keyword: periodontitis, dental gel, clove oil, carbopol 934, polyethylene glycol, methyl paraben, propyl paraben, distilled water, gingivitis, inflammatory conditions, plaque, periodontal disease, supragingival plaque, microbiota, Gram-negative, Gram-positive, anaerobic flora.

INTRODUCTION

Globally, periodontal disease is acknowledged as a serious public health issue that affects people of all ages, races, ethnicities, genders, and socioeconomic statuses. It is distinguished by the buildup of bacterial infections, mostly in the periodontal pockets, and the inflammation and deterioration of the gums, supporting bone, periodontal ligament, and cementum^[1].

Periodontal disease is a term used to describe inflammatory conditions caused by plaque buildup, including as periodontitis and gingivitis. Gingivitis is a mild stage of the disease that is characterized by swelling, minor bleeding, and redness of the gingival edge. It is brought on by a buildup of supragingival plaque.

A shift in the microbiota from a more Gram-negative to a more Gram-positive anaerobic one is linked to gingivitis. Resorption occurs as a result of periodontitis, a more advanced stage of periodontal disease.

The two most prevalent oral illnesses are periodontitis and gingivitis; gingivitis is the initial stage of the disease, characterized by inflammation of the soft tissue other than the teeth.^[1] On the other hand, periodontitis is defined by inflammation of the tissues that support the teeth, progressive loss of the alveolar bone and periodontal ligament, as well as the development of gingival recession and periodontal pockets.^[2-3]

This condition is caused by an immunological response resulting from an interaction between bacteria and inflammatory cells in the tissue around the teeth. These bacteria's released poisons and enzymes destroy the periodontium.^[3]

Red and swollen gums, gingival bleeding, foul breath, uneven teeth, loose teeth that may eventually fall out if left untreated, gingival recession or receding, and painful or itching gums are the seven main indicators of periodontal disease.^[4] *Porphyromonas gingivalis*, *Bacteroides forsythus*, and *Actinobacillus actinomycetemcomitans* are the primary microorganisms implicated in the course of the disease and have a significant role in the genesis of chronic periodontal disease. Dental plaque contains about 500 distinct types of bacteria. The majority of periodontal infections are Gram-negative, anaerobic bacteria.^[5]

In order to withstand antibiotics, bacteria in periodontal pockets form biofilms, or surfaces that cling to one another. Recently, highly resistant bacteria have been found to have pumps that aid in removing antibacterial medications from cells. In biofilms, bacteria can form connections with one another. This facilitates the spread of genes that function as antibiotic resistance and the development of antibiotic-resistant microorganism species.^[6]

Prompt disease management and essential care stop the disease's progression and stop growing bone degradation. In the absence of necessary maintenance and treatments, bone erosion may result in tooth loss.^[7] The most crucial part of treatment is reducing inflammation by getting rid of calculus and dental plaque.

In order to minimize pathogen microorganisms, dental root planing, scaling, and health education are all part of the nonsurgical first stage of treatment.^[8]

It has been demonstrated that nonsteroidal anti-inflammatory medications (NSAIDs) such as flurbiprofen, naproxen, and mefenamic acid are beneficial in the management of periodontal disease.^[9] Furthermore, antibiotics and antiseptics are utilized as well since certain microorganisms play a unique function in the progression of disease.

Tetracyclines, clindamycin, metronidazole, penicillins, and antiseptics like chlorhexidine are some of these antibiotics.^[10]

Systemic antibiotic misuse can result in bacterial resistance. There are no perfect or effective antibiotics for every infection because a large variety of bacteria can cause disease, and using multiple antibiotics at the same time can exacerbate negative effects.^[11] The usage of local therapeutic systems was prompted by the systemic antibiotics' side effects and the antiseptic mouthwashes' short-term effectiveness.

One benefit of these new systems is that fewer prescription medications are needed, lowering drug adverse effects, decreasing drug use frequency, and raising drug concentration in the target tissue.^[12] These innovative medication delivery methods include localized tetracycline fibers at the subgingival area, minocycline gel at the subgingival area, and gels containing metronidazole and chlorhexidine at the subgingival area.^[13-14]

The capacity of mucoadhesive drug delivery systems to stick to mucous membranes and release their drug content gradually has led to their introduction as new dosage forms. Mucoadhesive gel is one of the novel dosage forms available. Some characteristics of the optimum formulation are the syringe's ease of entry into the periodontal pocket, the drug's controlled release to the oral mucosa, the drug's ability to stay in the pocket without mechanically connecting to the teeth surfaces, and its nontoxic and allergenic nature.^[7] Given that the patient only needs to see the doctor once to apply medication to the periodontal pocket, it appears that this medication delivery method can help us save more time and money.

With antibacterial, anti-inflammatory, and antioxidant properties, the study aims to design and formulate a propolis mucoadhesive gel from carbomer 940, hydroxypropyl methylcellulose (HPMC), and NaCMC as an adjuvant therapy for periodontal disease in conjunction with dental root planing and scaling.

The buccal area of the mouth cavity is a desirable location to administer the preferred medication. Buccal delivery is the process of delivering the intended medication through the mouth cavity's buccal mucosa membrane. The mucosa lining buccal tissues provides a significantly softer environment of drug absorption than oral drug delivery, which presents a hostile environment for medicines, notably proteins and polypeptides, due

to acid hydrolysis and the hepatic first pass effect. Alternative medication administration methods, including nasal, ocular, pulmonary, rectal, and vaginal, have made it possible to distribute a wide range of chemicals.

Buccal drug absorption occurs by passive diffusion of the non-ionized species, a process governed primarily by a concentration gradient, through the intercellular spaces of the epithelium. The passive transport of non-ionic species across the lipid membrane of the buccal cavity is the primary transport mechanism. The buccal mucosa has been said to be a lipoidal barrier to the passage of drugs, as is the case with many other mucosa membranes and the more lipophilic the drug molecule, the more readily it is absorbed. The dynamics of buccal absorption of drugs could be adequately described by first order rate process.

Advantages:

- It has several benefits, including increasing tooth resistance to germs and plaque, remineralizing decayed teeth.
- Reducing sensitivity and discomfort by plugging exposed dentin tubules.
- It can be easy to use and affordable when compared to other fluoride treatments.

Disadvantages:

- It can produce nausea, vomiting, diarrhea, and stomach discomfort if used in high quantities.
- It can induce dental fluorosis, a disorder that alters the look of teeth, if used excessively or incorrectly in children under the age of six.
- It may have poor dimensional stability and low tear strength, which can compromise the accuracy and longevity of dental impressions.
- It may be inefficient or hazardous if used with incompatible materials or products, such as certain toothpastes, mouthwashes, or whitening agents.

Plants used in periodontal disease:

1. Aloe vera:



Figure 1 Aloe vera

Biological name: Aloe barbadensis miller

The potential benefits of aloe vera, a succulent plant with a long history of medical usage, in the treatment of periodontal disease have been investigated. Although studies are still being conducted, some point to potential benefits of aloe vera for oral health, especially when it comes to periodontal disease. Aloe vera has been studied in the following ways about its potential to treat periodontal disease.

Anti-Inflammatory Properties:

Compounds in aloe vera have been shown to have anti-inflammatory effects. An important factor in the context of periodontal disease is gum inflammation. According to some research, aloe vera may aid in reducing gum inflammation and hence aid in the treatment of periodontal disorders.

Antibacterial Effects:

Aloe vera is proven to be antibacterial against a range of microbes. Dangerous bacteria in the mouth play a role in the onset and advancement of periodontal disorders. The antibacterial properties of aloe vera may aid in limiting the growth of harmful bacteria and encouraging a more hygienic oral environment.

Reduction of Plaque Formation:

The potential of aloe vera to lessen dental plaque production has been studied. As gum disease is preceded by plaque accumulation, periodontal disease management and prevention may benefit from measures aimed at reducing plaque.

Gingival Health:

Studies have looked into the usage of aloe vera in mouthwash and toothpaste, among other oral hygiene products. With these formulations, we want to take advantage of aloe vera's potential benefits for protecting gingival health and treating or preventing periodontal diseases.

2. Tea tree oil:

Figure 2 Tea tree oil

Biological name: *Melaleuca alternifolia*

The potential benefits of tea tree oil, which is extracted from the leaves of *Melaleuca alternifolia* tea trees, have been studied in relation to the treatment of periodontal disease. The oil is of interest in the field of oral health because of its well-known antibacterial and anti-inflammatory qualities. The following are some methods that tea tree oil's potential for treating periodontal disease has been investigated.

Antimicrobial Properties:

Antimicrobial activity of tea tree oil has been shown against a range of bacteria, fungi, and viruses. The antibacterial qualities of tea tree oil may help to inhibit the formation of harmful microorganisms in the oral cavity in the setting of periodontal disease, where bacterial infections are a major factor.

Reduction of Gingival Inflammation:

Gum inflammation is one of the hallmarks of periodontal disease. The anti-inflammatory qualities of tea tree oil may relieve gingival inflammation and benefit those who suffer from gum disease.

Plaque and Tartar Control:

The possibility of tea tree oil helping to reduce tooth plaque and tartar development has been investigated. Interventions aimed at reducing plaque formation, which is a precursor to gum disease, may help prevent and treat periodontal illnesses.

Gingival Health Maintenance:

Some mouthwash and toothpaste formulations contain tea tree oil as an active component. The purpose of these formulations is to capitalize on the possible advantages of tea tree oil in preserving gingival health and averting periodontal problems.

3. Clove:

Figure 3 Clove

Biological name: *Syzygium aromaticum*

Some of the ways that clove has been studied for its use in periodontal disease include the following: clove oil, which is derived from the buds of the *Syzygium aromaticum* tree, contains compounds like eugenol, which contribute to its antimicrobial, antiinflammatory, and analgesic properties. Clove has been used traditionally for its medicinal properties, including its potential benefits in managing periodontal disease.

Antimicrobial Effects:

Antimicrobial activity of clove oil against a variety of microorganisms, including those linked to periodontal disorders, has been proven. The primary active ingredient in clove oil, eugenol, has been demonstrated to impede the development of fungi and bacteria, indicating possible advantages in the management of oral microbial infections.

Anti-Inflammatory Properties:

A major component of periodontal disorders is inflammation. People who suffer from gingivitis or periodontitis may find relief from their condition thanks to the antiinflammatory qualities of clove oil.

Analgesic (Pain-Relieving) Effects:

The use of clove oil as a natural painkiller dates back many years. It could relieve the discomfort in the teeth brought on by periodontal disorders. For those who are in pain because of gum inflammation or other oral health problems, this analgesic characteristic may be helpful.

Reducing Plaque Formation:

Clove oil may help prevent tooth plaque from forming, according to certain research. Interventions aimed at reducing plaque may help prevent and treat periodontal illnesses since gum disease is preceded by plaque development.

4. Peppermint:

Figure 4 Peppermint

Biological name: *Mentha piperita* L

The possible health advantages of peppermint, particularly peppermint oil made from the leaves of the *Mentha × piperita* plant, have been investigated. This includes the possibility of using peppermint oil to treat periodontal disease. Menthone and menthol are two of the active ingredients in peppermint oil,

which give it its antibacterial, anti-inflammatory, and breath-freshening qualities. The following are some methods via which peppermint's possible connection to periodontal disease has been investigated:

Antimicrobial Effects:

Antimicrobial effects of peppermint oil have been established against a range of microorganisms, including those linked to periodontal disorders. The growth of harmful germs in the oral cavity may be inhibited by the antibiotic effect.

Anti-Inflammatory Properties:

One important component of periodontal disorders is inflammation. The antiinflammatory qualities of peppermint oil may help to lessen gum inflammation and may offer relief to those who suffer from gum disease.

Breath Freshening:

content and inherent scent of peppermint contribute to its breath-freshening The menthol qualities. Keeping your breath fresh can be beneficial to your overall dental health, even though it isn't a direct treatment for periodontal disease.

Reduction of Plaque and Gingivitis:

According to certain research, peppermint oil may help lower gingivitis and tooth plaque. Periodontal disease prevention and management require efficient plaque control.

5. Neem:



Figure 5 Neem

Biological name: Azadirachta indica

Many civilizations have long utilized neem (Azadirachta indica) for its therapeutic qualities, which may include helping to treat periodontal (or gum) disease. Neem's antibacterial, antifungal, and anti-inflammatory qualities are exhibited by a number of its constituents, including azadirachtin, nimbidin, and nimbin, which may explain why it is effective for maintaining dental health. The following are some ways that neem is believed to help with periodontal disease.

Antibacterial Properties:

Neem has proven to be effective against a variety of bacteria, including those that cause periodontal infections. It might aid in preventing the growth of gum disease-causing bacteria like Porphyromonas gingivalis and Prevotella intermedia.

Anti-inflammatory Effects:

A major contributing factor to periodontal disease is inflammation. Neem is thought to possess anti-inflammatory qualities that may aid in lowering gum inflammation and potentially easing the symptoms of periodontitis and gingivitis.

Antifungal Properties:

Neem's antifungal qualities may help treat oral infections, including those brought on by fungi like Candida albicans.

Plaque and Tartar Control:

Neem may aid in reducing the buildup of tartar and plaque on teeth. Maintaining dental hygiene may be aided by the consistent use of mouthwash or toothpaste containing neem.

Review of literature:

1. Voleti Kumar Vijaya et al. (2016): Globally acknowledged as a significant public health issue, periodontal disease affects people of all ages, socioeconomic backgrounds, racial and cultural backgrounds, and genders. It is typified by an accumulation of bacterial pathogens, primarily in the periodontal pockets, and inflammation and degeneration of the gums, supporting bone, periodontal ligament, and cementum.

2. Sonali Mahaparale et al., (2019): Gingivitis and gum disease are examples of inflammatory conditions that are generally referred to as periodontal disease. Gingivitis is a mild stage of disease characterized by swelling, minor bleeding, and redness of the gingiva marginae. It is brought on by an accumulation of supragingival plaque.
3. Gupta AK, et al., (2013): The treatment of periodontal disease involves the use of clove oil dental gel. This gel is intended to ease gum pain. One such product with several advantages is clove oil, which has grown significantly in importance in clinical studies. Clove oil is the dental gel's active component.
4. Ungphaiboon S et al., (2005): Localized tetracycline fibers at the subgingival area, minocycline gel at the subgingival area, and gels combining metronidazole and chlorhexidine at the subgingival area are some of these cutting-edge medicine delivery techniques.
5. Ates DA et al., (2003): There is a reduction in the requirement for prescription drugs thanks to these new technologies. reducing side effects, cutting down on drug usage, and increasing drug concentration in the intended tissue
6. Dheepika B et al., (2014): Nonsteroidal anti-inflammatory drugs (NSAIDs) such mefenamic acid, naproxen, and flurbiprofen have been shown to be helpful in the treatment of periodontal disease.

CONCLUSION:

In summary, a promising direction in oral healthcare is the creation and development of dental gels for the treatment of periodontal disease. Many formulations including strong components, like anti-inflammatory drugs and antibacterial chemicals like Aloe Vera, have been investigated through careful research and innovation.

These developments demonstrate the dedication to identifying practical remedies for periodontal health. A comprehensive strategy taking into account both conventional and innovative ingredients is essential as dental gels continue to develop. Nevertheless, additional clinical research is necessary to confirm the effectiveness and security of these mixtures. The continued search for improved dental gels has the potential to completely transform the treatment of periodontal disease.

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