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The Dental Gel For The Treatment Of Human Periodontal Diseases

Ranjan Himanshu[1]*
, Tiwari Yogesh[2]*
1Student, B. Pharma, Dev Bhoomi Institute of Pharmacy and Research, Dehradun
2Assistant Professor, School of Pharmacy and Research, Dev Bhoomi Uttarakhand University, Dehradun

ABSTRACT

The study's objective was to develop and evaluate a dental gel that uses turmeric and clove oil as its primary component to treat periodontitis. Because of its wide range of antibacterial action against various periodontal infections, clove oil is used in the treatment of periodontitis. Dental gel is made with the help of carbopol 934, methyl and propyl parabens as preservatives, polyethylene glycol as a co-solvent, clove oil and turmeric as a therapeutic agent, and the required quantity of distilled water as a carrier.

The symptoms of gingivitis, a moderate stage of the disease, include gingival edge redness, swelling, and slight bleeding. The accumulation of supragingival plaque is the cause of it. Gingivitis is associated with a change in the microbiota from a more Gram-negative to a more Gram-positive anaerobic flora. The more severe kind of periodontal disease known as periodontitis results in the separation of the periodontal ligament that supports the tooth and the resorption of the alveolar bone.

Clove oil and turmeric was added to a dental gel to aid in the treatment of periodontal diseases. Next, the physical properties of the gel were evaluated, including its drug content, spreadability, extrusion ability, and in vitro antibacterial activity.

Keywords: Periodontitis, Clove oil, Turmeric, Antimicrobial activity, Gingivitis.

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. 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 [2].

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 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]

ETIOLOGY OF PERIODONTITIS:

When the invisible, sticky layer of bacteria-filled plaque remains on teeth for longer than two or three days, it can become tartar (calculus), a hard deposit that forms beneath the gum line. Tartar harbours bacteria and makes plaque extremely tough to remove. The longer plaque and tartar are left on the teeth, the more they irritate and inflame the gingiva, which promotes the formation of pockets between the gums and teeth. More germs accumulate in the deepening pockets, causing illness and ultimately tissue and bone loss [15].

TYPES OF PERIODONTITIS:

1. Mild periodontitis
2. Moderate periodontitis
3. Advanced periodontitis
4. Refractory periodontitis

COMMON PATHOGENS OF PERIODONTITIS:

1. T.forsynthia
2. P.intermedia
3. F.nucleatum
4. A.actinomycetocomitans

SIGNS AND SYMPTOMS:

- Tender, red, or swollen gums
- Bleeding gums during tooth brushing or flossing
- Gums that recede
- Deep pockets, or the gap between teeth and gums
- Tooth sensitivity that seems out of the ordinary
- Areas around teeth and gums
- Persistent foul breath

DIAGNOSIS:

When you see a dentist or dental hygienist, they will:

1. Look into your gums and make a note of any redness.

2. To find and measure any pockets surrounding the teeth, use a tiny measuring tool known as a "probe." The depth of these pockets in a healthy mouth is typically one to three millimetres. Typically, this pocket depth test is painless.

3. Inquire about your medical history to find out about any illnesses or risk factors (such diabetes or smoking) that might be connected to gum disease.

The dentist may additionally:

4. Take an x-ray to check for any bone loss

5. Suggest that you see a periodontist. "Periodontists are experts in the diagnosis and treatment of gum disease and may provide you with treatment options that are not offered by your dentist".

TREATMENT:

Different approaches might be taken to treat periodontitis according on how stiff it is. To stop further damage, managing periodontitis involves thoroughly cleaning the bacterial pockets. A periodontist, dentist, and dental hygienist can supervise periodontitis by enforcing a rigorous daily regimen of proper oral hygiene.

MATERIAL AND METHOD

Material:

List of Glassware:

Table 1: List of glassware

Serial no.	Particular
1.	Beaker
2.	Stirring rod
3.	Petri dish
4.	Spatula
5.	Measuring cylinder

Properties of Ingredients:

Table 2: Properties of Ingredients

Serial no.	ingredients	properties
1.	*Curcuma longa* powder	Anti-bacterial activity
2.	Clove oil	Anti-microbial activity
3.	Glycerine	Lubricant
4.	Sodium saccherin	Sweetener
5.	Sodium methyl paraben	Preservative
6.	Sodium propyl paraben	Anti-microbial preservative
7.	Xanthun gum	Gelling agent
8.	Polyethyl glycol	Cosolvent
9.	Distilled water	Solvent

Preparation of gel:

Gel are prepared by soaking xanthan gum in water and using triethanolamine to bring its pH down to 6.4. Dissolve weighed amount of turmeric powder into water and filter it. Weighed amounts of sodium saccharin, sodium methyl and propyl paraben were added to the filtrate. After measuring the precise amount of clove oil is added to it. This mixture was then stirred and poured to the beaker containing xanthan gum. The necessary amount of propylene glycol was added to it and continually mixed until a homogeneous product was formed. Distilled water was used to make up the volume, and vigorous stirring was done. Following preparation, each gel was evaluated.

Figure 3: Xanthun gum

Physicochemical characteristics of clove oil:

Physical and chemical properties of the clove oil, including its acid value, ester value, solubility, density, and refractive index, were measured and recorded in Table 2.

Physicochemical characteristics of Turmeric:

Physical and chemical properties of the clove oil, including its acid value, ester value, solubility, density, and refractive index, were measured and recorded in Table 3.

Evaluation of gel formulation. Physical appearance:

- **Colour**

  We examined the formulation's colour on a white backdrop.

- **Consistency**

  A cutaneous application was used to verify uniformity.

- **Greasiness**

  The application on the skin contributed to the greasiness.

- **Odour**

  By sniffing it, the fragrance of the gels was determined.

Determination of pH:

Using a pH paper, the gel's pH was measured by fully submerging the pH paper in the gel system.[6]

Determination of viscosity:

The oldest viscosity measurement technique was the capillary viscometer, which measured the amount of time it took for a volume of liquid to travel the length of a capillary tube.[7]

Determination of spreadability:

A glass slide apparatus and a modified wooden block were used to measure spreadability. The device was made up of a pulley and a wooden block with a fixed glass slide. Using a string, a pan was fastened to another glass slide that was movable. A fixed glass slide was filled with a measured amount of gel for the purpose of measuring spread ability. A moveable glass slide with a pan attached was put on top of the fixed glass slide such that the gel was sandwiched between the two slides for five minutes. Currently, the pan was filled with roughly 50 grams of weight. It was noted how long it took for the slides to separate. The spread ability was calculated using the formula below.[7]

$$S=M.L/T.$$

where S is the gram-wise spreadability. T is the time in seconds, M is the mass in grams, and cm/sec.

Determination of extrudability:

It was calculated using a gel-filled tube with a 5 mm aperture at the tip. The amount of gel that protruded out the tip when pressure was applied to the tube was measured and recorded.[8]

Determination of homogeneity:

Once the gels were placed within the container, all of the generated gels were visually inspected to ensure homogeneity. Their appearance and the existence of any aggregates were examined.[16-17]

Determination of syringeability:

When treating severe periodontitis, an injectable system rapid relief was used to administer the medication straight into the periodontal pocket. This perspective examined the syringeability of gel compositions using a 21 G needle.[17]

Determination of stability study:

The optimised batch's semisolid mucoadhesive dosage form was chosen for the centrifugal test, thermal test, freeze-thaw test, cooling-and-heating test.[18]

RESULT AND DISCUSSION

The formulations were created using xanthan gum at various concentrations and clove oil and turmeric at the same concentration. Table 1 lists the composition of the formulation. Every one of the three formulation batches had its physical attributes assessed. Each formulation had the distinct clove oil smell and had a pale yellow colour. All of the formulations had pH values between 6.4 and 6.7, which is well within the buccal cavity's typical pH range of 6-7. This indicates that the gels that are made will not cause any irritation.

TABLE:3 Dental gel formulation composition of gel formulation

Ingredients	F1	F2	F3
Curcuma longa powder	0.6	0.6	0.6
Clove oil	0.75	0.75	0.75
Glycerine	3.0	3.0	3.0
Sodium saccherin	0.3	0.3	0.3
Sodium methyl paraben	0.054	0.054	0.054
Sodium propyl paraben	0.006	0.006	0.006
Xanthan gum	0.6	0.5	0.7
Polyethyl glycol	4.5	4.5	4.5
Distilled water	q.s	q.s	q.s

TABLE:4 physicochemical properties of clove oil

s.no	parameter	Clove oil procured	Clove oil standard
1.	Colour	Pale yellow	Pale yellow
2.	Odour	Aromatic	Aromatic
3.	Acid value	3.66	3.84
4.	Ester value	37.21	38.22
5.	Solubility in ethanol	Freely soluble	Freely soluble
6.	Density	1.02g/ml	1.05g/ml
7.	Refractive index	1.492	1.532

TABLE:5 physicochemical properties of curcuma longa powder

s.no	Parameter	Curcuma L. procured	Curcuma L. standard
1.	Colour	Bright yellow	Bright yellow
2.	Odour	Earthy mustard like	Earthy mustard like
3.	pH	5.90	5.90
4.	Solubility in ethanol	Fully soluble	Fully soluble

Figure 4: curcuma longa powder

TABLE:6 Characteristic of gel formulation

Formulation	Appearance	pH	adibility(g-cm/sec	Extrudability %	homogenity
F1	Pale yellow	6.6	18.23	94.15	Very good
F2	Pale yellow	6.7	18.30	94.18	Good
F3	Pale yellow	6.6	17.47	94.10	Good

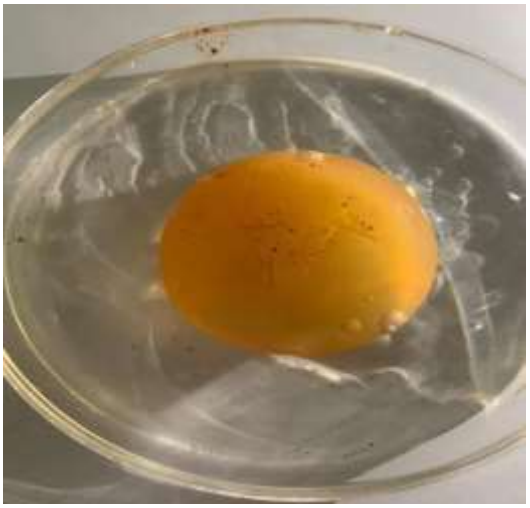

Figure 5: Dental gel formulation

The gel's spreadability was determined to be between 15.59 and 18.20 gm-cm/sec, indicating that they can spread evenly and smoothly. The mixtures had a shiny, transparent appearance. All formulations had acceptable tube extrudability and homogeneity.

In comparison to other formulations, the gel formulations of clove oil F1 demonstrated high physicochemical qualities. All formulations had pH values between 6.4 and 6.7, which is well within the buccal cavity's typical pH range of 6-7.

CONCLUSION

The discovery of antibacterial properties in clove oil and Curcuma longa (turmeric) powder against bacteria like Lactobacilli acidophilus, Streptococcus salivarius, and Streptococcus sanguis underscores the commitment to finding practical solutions for periodontal health. This revelation highlights the importance of incorporating both conventional and innovative ingredients in the formulation of dental gels to address the complex nature of periodontal disease.

While these findings hold promise, additional clinical research is crucial to validate the effectiveness and safety of these natural remedies in dental gels. Rigorous studies are needed to assess their therapeutic potential, optimal dosages, and potential side effects in the context of periodontal treatment.

The ongoing quest for improved dental gels represents a transformative opportunity in the management of periodontal disease. By harnessing the antibacterial and anti-inflammatory properties of natural ingredients like clove oil and turmeric, alongside conventional therapeutic agents, dental gels have the potential to revolutionize periodontal care. However, a comprehensive approach that prioritizes scientific validation and patient safety is essential in realizing the full potential of these innovative treatments.

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