



To Develop And Evaluate Dental Gel Containing Clove As The Chief Constituent For The Treatment Of Periodontitis

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Abstract: Periodontal disease is a prevalent chronic inflammatory condition affecting the tissues supporting teeth. While conventional antibiotic therapies offer moderate success, emerging resistance has driven interest in herbal alternatives. This review explores the development and evaluation of a clove oil-based dental gel as a promising phytotherapeutic approach for treating periodontitis. Clove (*Syzygium aromaticum*), particularly its active constituent eugenol, exhibits antimicrobial, anti-inflammatory, analgesic, and antioxidant properties. The gel formulated using Carbopol 934 and clove oil demonstrated favorable physicochemical properties, stability, and antimicrobial efficacy against *Streptococcus salivarius*, suggesting potential as a natural alternative in oral healthcare.

Index Terms - *Syzygium aromaticum*, Eugenol, Periodontitis, Dental Gel, Herbal Medicine, Carbopol 934, Clove Oil

I. INTRODUCTION

Periodontitis is a multifactorial infectious disease caused by pathogenic microbial biofilms. Left untreated, it can result in tooth loss and systemic complications. Traditional treatment includes mechanical debridement and the use of antimicrobials. However, side effects and resistance associated with synthetic agents necessitate the exploration of plant-based therapies. Herbal formulations offer a viable, biocompatible alternative with minimal adverse effects.

Clove, widely used in traditional medicine, is known for its therapeutic properties in oral health. Eugenol, the main active compound, plays a vital role in analgesia, inflammation control, and microbial suppression, making it a promising candidate for the development of dental applications.

1.1 PLANT PROFILE

1.1.1 Synonym:

Caryophyllum, clove flower, clove bud, launge.

1.1.2 Biological source: ☐ Clove consists of dried flower buds of *Eugenia caryophyllus* (Myrtaceae). It



Fig .1

should contain not less than 15% (v/v) of clove oil

1.1.3 Chemical constituents: ☐ 15-20% of volatile oil, 10-13% of tannins (gallotanic acid), chromone and eugenin. ☐ The volatile oil contains eugenol (about 70 to 90%), eugenol acetate, methylamylketone, caryophyllenes and small quantities of ester and alcohols.

1.1.4 Uses: ☐ Dental analgesic, carminatives.

Stimulant, flavouring agent,
an aromatic and antiseptic.

1.1.5 Pharmacological Activities

- **Antibacterial:** Effective against periodontal pathogens including *P. gingivalis* and *S. salivarius*.
- **Anti-inflammatory:** Inhibits COX-2 and lipoxygenase pathways.
- **Analgesic & Anesthetic:** Used traditionally for toothaches.
- **Antioxidant & Antifungal:** Provides systemic protection and oral health support.

2. Method and Materials

2.1 Materials: The dental gel of clove oil was prepared using following chemical apparatus and instrument.

2.1.1 Chemicals: Clove oil, Carbapol, Polyethylene glycol, Glycerine, Methyl Paraben, Propyl Paraben, Honey Distilled water.

2.1.2 Apparatus: Apparatus such as beaker, glass slide, measuring cylinder, test tube, mortar pestle volumetric flask, sonicator apparatus.

2.1.3 Instruments: pH meter, Mechanical stirrer, Viscometer, Incubator, Auto-clave.

4.1 Materials Use

1 Clove oil (Active pharmaceutical ingredients)

2 Carbopol 934 (Gelling agent)

3 Polyethylene glycol (Co-solvent)

4 Glycerin (Drug solubiliser)

5 Methyl paraben (Preservatives)

6 Propyl paraben(Preservatives)

7 Honey (Sweetening agent)

4.2 Preparation Process

The gel was prepared through carbopol hydration, neutralization, and the incorporation of clove oil and excipients, followed by homogenization.

4.3 Method for the preparation of dental gel:

- 1) Soaking: soaked carbopol 934 in water.
- 2) Neutralization: Neutralize with triethaloamine to pH 9.4.
- 3) Addition of preservative: Addition of propyl and methyl Paraben.
- 4) Addition of co-solvent and API: Addition of propylene glycol and clove oil in another test tube.
- 5) Addition of sweetener: Finally honey is added.
- 6) Stirring: Stirring is done until a homogeneous product is formed.

4.4 Physicochemical Parameters

- Saponification value : 41.09
- Solubility in ethanol : 1.02 g/ml
- Ester value: 37.43
- Acid value : 3.66
- Density : 0.93 g/mol

4.5 Evaluation parameter:

Appearance: All the formulations of clove oil gel where pale yellow in colour.

Consistency: The consistency was checked by applying on skin.

Greasiness : The greasiness was assisted by the application on the skin.

Determination of viscosity: Viscosities of the formulated gels was determined using Brooke field viscometer, spindle no. 7 and spindle speed 60 rpm at 25-C was used gels, the corresponding dial reading on the viscometer was noted.

Determination of spreadability: Spreadability was determined using following formula, $S = \frac{M.L}{T}$ Where, S is the spreadability in grams.cm/sec. M is the mass in grams, T is the time in seconds.

Determination of extrudability: It was determined by sign a tube filled with the gel having a tip of sim opening and by measuring the amount of gel that extruded through the tip when a pressure was applied on the tube was noted down.

4.6 Physico-chemical characteristics of clove oil:

1) Acid value The acid value is defined as the number of milligrams of Potassium hydroxide required to neutralize the free fatty acids present in one gram of fat. It is a relative measure of rancidity as free fatty acids are normally formed during decomposition of triglycerides. Oil sample, phenolphthalin indicator, ethanol, sodium hydroxide.

Apparatus: Chemicals: Burette, stand, conical flask, measuring cylinder.

$$\text{Formula for acid value: } (\text{Mol.wt} \times N \times V) / W_s \text{ 2)}$$

Saponification Value: Saponification value is defined as the number of milligrams of KOH required to neutralize the fatty acids resulting from complete hydrolysis of 1 gm of sample of oil or fat. **Chemicals:** Oil sample, ethanol, phenolphthalein indicator, 0.1N KOH, 0.1N HCL. **Apparatus:** Conical flask, pipette, burette, beaker, round bottom flask, water bath, reflux condenser. **Calculation and Observations:** Saponification value = $\frac{\text{mg of KOH consumed by 1 g clove oil}}{\text{Weight of KOH} = \text{Normality of KOH} \times \text{Equivalent weight} \times \text{volume of KOH in litres}}$ Volume of KOH consumed by 1 g of oil = [blank- test]

$$\text{Formula for Saponification value} = ((B-T) \times N \times 56.1) / W_t \text{ of oil}$$

Ester value: Ester value = Saponification value - Acid value Solubility

Density: Density = Mass of oil/Volume of oil

Stability study: Physical stability study tests of the formulation was carried for one weeks at temperature of 37°C. the formulation was found to be physically stable at temperatures of 37°C within one week .

Antimicrobial Activity. Agar cup plate method was used for screening of antimicrobial activity of clove oil gel. Different concentrations of clove oil gel were placed aseptically in cups of agar plate which was previously inoculated with culture. The plates were left at ambient temperature for 30 min prior to incubation at 37 °C for 24hrs. The broad spectrum antibiotic i.e., tetracycline were used as a positive control for obtaining comparatively results. Plates were observed after 24-48 hrs incubation for the appearance of the zone of inhibition. Antimicrobial activity was evaluated by measuring the diameter of zones of inhibition (mm) of microbial growth.

3 RESULT AND DISCUSSION

3.1 Identification test:

A) Physicochemical characteristics of clove oil:

1 Colour Pale yellow Pale yellow

2 Odour Aromatic Aromatic

3 Acid value 3.61 3.84

4 Ester value 36.18 38.22

5 Soluble in ethanol 1.02g/ml 1.05g/ml



Figure no .Dental clove oil gel

The optimized batch of procured clove oil was characterized for the following parameters:

□ Acid value: 3.66 □ Ester value: 37.43

□ Saponification value: 41.09

□ Density: 0.93gm/mol The formulations were developed by using clove oil of same concentration and carbopol 934 at different concentrations All the formulations were pale yellow in colour and had characteristic odour of clove oil.

The pH of all formulations range from 6.4-6.7, which was well within the normal pH range of buccal cavity 6-7. The spreadability of the gels was found to be in the range of 15.59-18.20 g-cm/sec, confirming that these gels may spread smoothly and uniformly. The formulations were glossy and translucent. The homogeneity and tube extrudability of all formulations was good. The drug content of the formulations was ranged from 89.8% - 95.40% Table-6. The formulation F3 was found to have maximum drug content. The gel formulations of clove oil F1 showed good physicochemical properties as well as good drug content compared to other formulations. Hence, these formulations were further selected for anti microbial studies. The results of anti microbial studies showed that gel formulation of clove oil F3 showed a maximum zone of inhibition *S.salivarius*.

4. SUMMARY AND CONCLUSION

The clove oil was found to have antimicrobial activity against *Streptococcus salivarius*. The formulations developed from clove showed significant results so it can be further used commercially to develop dental gels after conducting clinical trials on human beings. Nevertheless further research is still needed in order to determine if they efficiently could substitute the synthetic antibiotics or uses in combinations.

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