Herbal Mouthwash of Clove for Dental Infections

Miss Sanobar Illiyas Shaikh[1], Miss Ghadge Poonam Ramesh[2]
[1]*Assistant Professor, Shri Laxmanrao Trymbakrao Nakade Pharmacy College Dhorjalgaon Ne*
[2]*Shri Laxmanrao Trymbakrao Nakade Pharmacy College Dhorjalgaon Ne*

Abstract- Dental infections are common oral health problems affecting people of all age groups. These infections are mainly caused by pathogenic microorganisms such as bacteria and fungi, leading to symptoms like tooth pain, gum inflammation, bleeding, bad breath, and oral discomfort. The excessive use of synthetic mouthwashes and antibiotics often results in side effects such as tooth staining, altered taste sensation, dryness of mouth, and microbial resistance. Therefore, there is a growing interest in herbal mouthwashes that are safe, economical, and effective.

Clove (*Syzygium aromaticum*) is a well-known medicinal plant traditionally used in dentistry due to its analgesic, antibacterial, antifungal, and anti-inflammatory properties. The major active constituent of clove is eugenol, which exhibits strong antimicrobial and pain-relieving effects. The present study was aimed to formulate and evaluate a herbal mouthwash using clove extract for the treatment of dental infections. The mouthwash was prepared using aqueous and ethanolic extracts of clove and evaluated for parameters such as pH, clarity, taste, stability, and antimicrobial activity. Antimicrobial activity was assessed against common oral pathogens like *Streptococcus mutans*, *Staphylococcus aureus*, and *Candida albicans*. The results indicated that the formulated herbal mouthwash showed good physicochemical properties and significant antimicrobial activity. The study concludes that clove-based herbal mouthwash can be considered a safe and effective alternative to synthetic mouthwashes for dental infections.

Keywords- Clove, Herbal mouthwash, Dental infections, Eugenol, Antimicrobial activity, Oral hygiene

I.INTRODUCTION

Dental infections are among the most common health problems affecting the global population. These infections mainly involve the teeth, gums, and surrounding oral tissues and are caused by pathogenic microorganisms present in the oral cavity [1]. Dental infections include conditions such as dental caries, gingivitis, periodontitis, oral candidiasis, and dental abscesses [2]. Common symptoms of dental infections include toothache, gum swelling, bleeding gums, bad breath, difficulty in chewing, and oral discomfort [3].

The oral cavity provides a favorable environment for the growth of microorganisms due to the presence of moisture, nutrients, and suitable temperature. Bacteria such as *Streptococcus mutans*, *Staphylococcus aureus*, and fungi like *Candida albicans* are commonly associated with dental infections [4]. These microorganisms form biofilms on tooth surfaces, leading to plaque formation and subsequent dental diseases.

Synthetic mouthwashes containing chlorhexidine, alcohol, and fluoride are widely used for oral hygiene and treatment of dental infections. However, long-term use of these products may cause side effects such as tooth discoloration, altered taste sensation, burning sensation, dryness of mouth, and microbial resistance [5]. These limitations have increased the demand for herbal mouthwashes as safer alternatives.

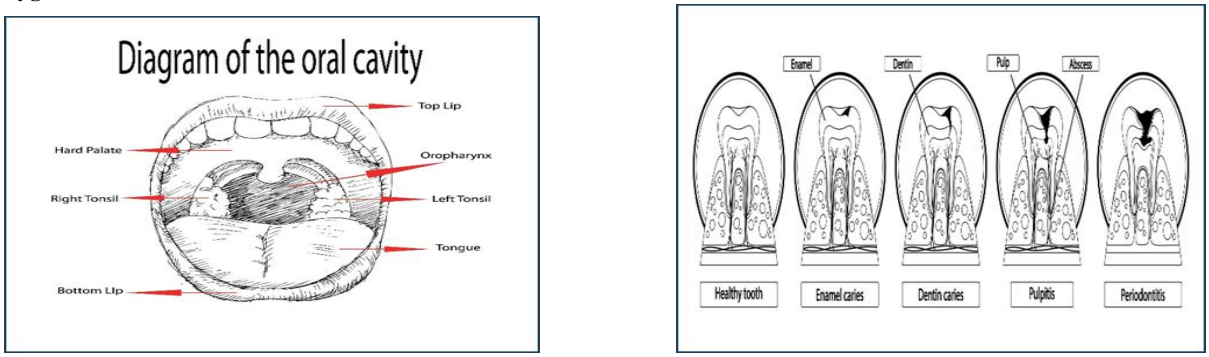


Figure 1: Structure of oral cavity and common dental infections

Herbal medicines have been used since ancient times for the treatment of oral diseases. Herbal mouthwashes are gaining popularity because they are natural, economical, and have minimal side effects [6]. Medicinal plants contain bioactive compounds that exhibit antimicrobial, anti-inflammatory, antioxidant, and analgesic properties. Clove (*Syzygium aromaticum*) is an aromatic dried flower bud belonging to the family Myrtaceae. It is widely used in traditional medicine and dentistry due to its strong medicinal properties [7]. Clove contains several bioactive compounds, among which eugenol is the major active constituent responsible for its antimicrobial, analgesic, and anti-inflammatory effects [8]. Clove oil is commonly used in dental practice for temporary pain relief and treatment of toothache.

Figure 2: Clove (*Syzygium aromaticum*) dried buds and plant

Eugenol exhibits strong antibacterial activity against oral pathogens and helps in reducing dental plaque and inflammation [9]. Therefore, clove can be considered an ideal herbal ingredient for the formulation of mouthwash intended for dental infections.

AIM OF THE STUDY

To formulate and evaluate a herbal mouthwash using clove extract for the treatment of dental infections.

OBJECTIVES OF THE STUDY

1. To collect and authenticate clove buds.
2. To prepare aqueous and ethanolic extracts of clove.
3. To formulate a herbal mouthwash using clove extract.
4. To evaluate the mouthwash for physicochemical parameters.
5. To study the antimicrobial activity against oral pathogens.
6. To assess the stability of the formulated mouthwash.

II.REVIEW OF LITERATURE

The literature review provides an overview of previous scientific studies related to clove, its active constituent eugenol, and their applications in dental and oral health. Several researchers have reported the antimicrobial, analgesic, anti-inflammatory, and antioxidant properties of clove, which make it a valuable medicinal plant for dental infections.

Clove has been widely used in traditional dentistry for the treatment of toothache, gum infections, and oral inflammation. Chaieb et al. reported that clove essential oil possesses strong antibacterial activity against oral pathogens, especially *Streptococcus mutans* and *Staphylococcus aureus* [10]. The study concluded that eugenol present in clove is responsible for disrupting bacterial cell membranes and inhibiting microbial growth.

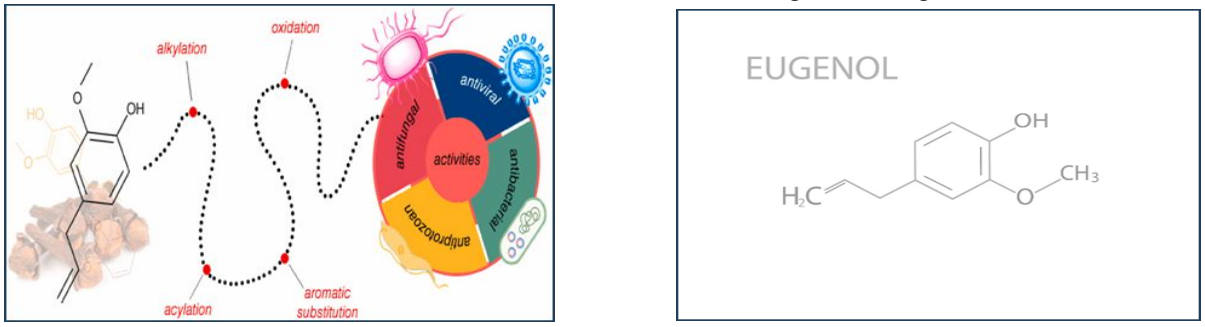


Figure 3: Antimicrobial mechanism of clove and chemical structure of eugenol

Prashar et al. investigated the antimicrobial properties of eugenol and observed significant inhibitory activity against several Gram-positive and Gram-negative bacteria [11]. The authors suggested that eugenol interferes with the enzyme system of microorganisms and reduces their metabolic activity.

Nassar et al. evaluated the antifungal activity of clove oil and found that it exhibited strong inhibitory effects against *Candida albicans*, which is commonly associated with oral candidiasis [12]. The study highlighted the potential use of clove-based formulations for fungal infections in the oral cavity.

Gupta and Saxena reviewed the role of herbal products in dentistry and reported that clove is one of the most commonly used medicinal plants for oral hygiene due to its analgesic and antiseptic properties [13]. The authors emphasized that clove oil is widely used in dental practice for temporary fillings and pain relief.

Alqareer et al. conducted a clinical study to evaluate the analgesic effect of clove oil in patients suffering from toothache. The results demonstrated that clove oil significantly reduced pain and inflammation compared to placebo [14].

Raghavendra et al. compared the antimicrobial activity of herbal mouthwashes and synthetic mouthwashes and observed that clove-based mouthwash showed comparable antibacterial activity with fewer side effects [15].

These studies clearly indicate that clove possesses strong antimicrobial and analgesic properties and has great potential for application in herbal mouthwash formulations for dental infections. However, limited experimental studies are available on the formulation and evaluation of clove-based herbal mouthwash using standardized parameters. Therefore, the present study was undertaken to formulate and evaluate a herbal mouthwash using clove extract for dental infections.

Table 1: Summary of Previous Studies on Clove and Dental Applications

Sr. No.	Author	Year	Study Focus	Major Findings
1	Chaieb et al.	2007	Clove oil	Strong antibacterial
2	Prashar et al.	2006	Eugenol	Antimicrobial
3	Nassar et al.	2007	Clove oil	Antifungal
4	Gupta & Saxena	2014	Herbal dentistry	Analgesic
5	Alqareer et al.	2006	Clinical study	Pain relief
6	Raghavendra et al.	2009	Mouthwash	Comparable activity

III.MATERIALS AND METHODS

3.1 Materials Required

Dried clove buds (*Syzygium aromaticum*), distilled water, ethanol (95%), glycerin, sodium saccharin, peppermint oil, methyl paraben, propyl paraben, sodium benzoate, phosphate buffer, nutrient agar medium, Mueller Hinton agar, Petri dishes, test tubes, beakers, conical flasks, measuring cylinders, centrifuge, water bath, incubator, pH meter, UV–visible spectrophotometer, micropipettes, and analytical balance were used in the present study [16].

3.2 Collection and Authentication of Plant Material

Dried clove buds were purchased from the local market of Shevgaon, District Ahilyanagar, Maharashtra, India. The collected plant material was cleaned to remove dust and impurities. The clove buds were authenticated by the Department of Pharmacognosy. The authenticated buds were powdered using a mechanical grinder and stored in an airtight container for further use [17].

Figure 4: Collected clove buds and powdered clove

3.3 Preparation of Clove Extract

The powdered clove buds were subjected to extraction using maceration method. About 50 g of clove powder was soaked in 250 ml of ethanol (95%) for 48 hours with occasional shaking. The mixture was filtered using Whatman filter paper and the filtrate was concentrated using a water bath. The concentrated extract was stored at 4°C until further use [18].

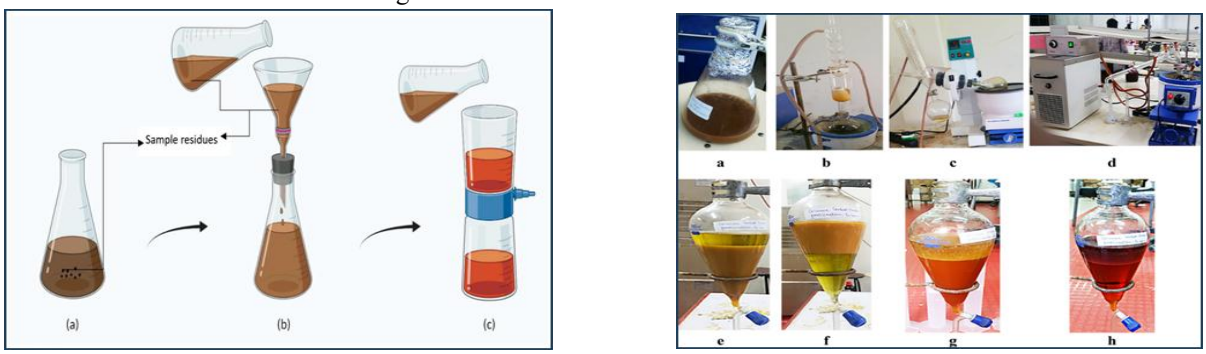


Figure 5: Extraction process of clove (maceration / Soxhlet method)

3.4 Formulation of Herbal Mouthwash

The herbal mouthwash was prepared by dissolving the required quantity of clove extract in distilled water. Glycerin was added as a humectant, sodium saccharin as a sweetening agent, peppermint oil as a flavoring agent, and preservatives were added to enhance shelf life. The solution was mixed thoroughly to obtain a clear and homogeneous mouthwash [19].

3.5 Composition of Herbal Mouthwash

Table 2: Composition of Clove Herbal Mouthwash

Ingredient	Quantity	Function
Clove extract	2 ml	Antimicrobial
Distilled water	90 ml	Vehicle
Glycerin	5 ml	Humectant
Sodium saccharin	0.2 g	Sweetener
Peppermint oil	0.1 ml	Flavor
Sodium benzoate	0.2 g	Preservative
Methyl paraben	0.1 g	Preservative

3.6 Evaluation Parameters

The formulated mouthwash was evaluated for physicochemical parameters such as color, odor, taste, clarity, pH, stability, and antimicrobial activity [20].

3.7 Determination of pH

The pH of the mouthwash was measured using a digital pH meter. About 10 ml of mouthwash was taken and the pH was recorded. The experiment was performed in triplicate and the average value was calculated [21].

3.8 Clarity and Stability Test

The clarity of the mouthwash was checked by visual inspection against a white background. Stability studies were carried out by storing the formulation at room temperature for 30 days and observing for changes in color, precipitation, and turbidity [22].

3.9 Antimicrobial Activity

The antimicrobial activity of the herbal mouthwash was evaluated using the agar well diffusion method against *Streptococcus mutans*, *Staphylococcus aureus*, and *Candida albicans*. The zones of inhibition were measured after incubation at 37°C for 24 hours [23].

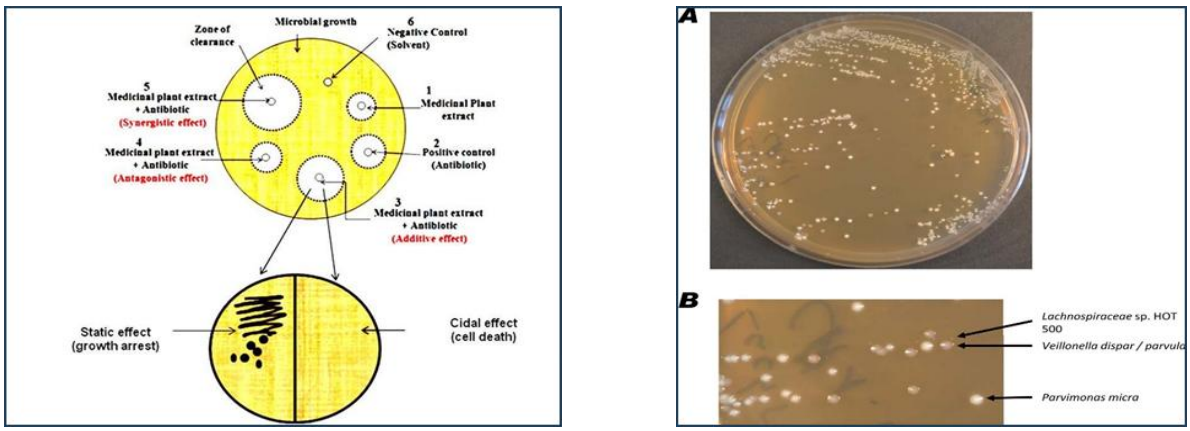


Figure 6: Agar well diffusion method for antimicrobial study

IV.RESULTS AND EVALUATION STUDIES

4.1 Physical Evaluation

The formulated clove herbal mouthwash was evaluated for physical parameters such as color, odor, taste, and clarity. The mouthwash was found to be clear, light brown in color with a pleasant clove odor and acceptable taste. No precipitation or turbidity was observed, indicating good formulation quality.

Table 3: Physical Characteristics of Clove Herbal Mouthwash

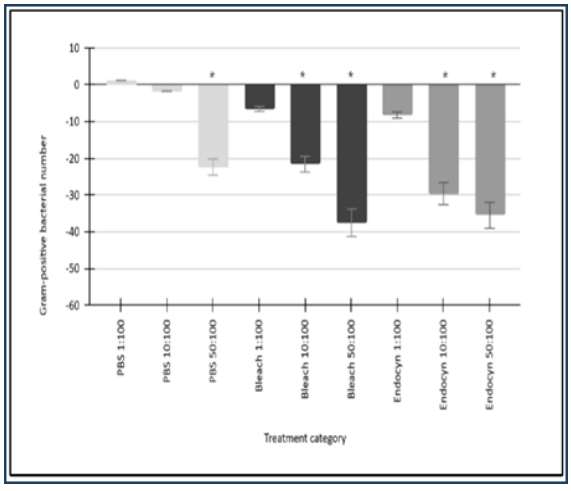
Parameter	Observation
Color	Light brown
Odor	Pleasant clove odor
Taste	Acceptable
Clarity	Clear
Precipitation	Absent
Turbidity	Absent

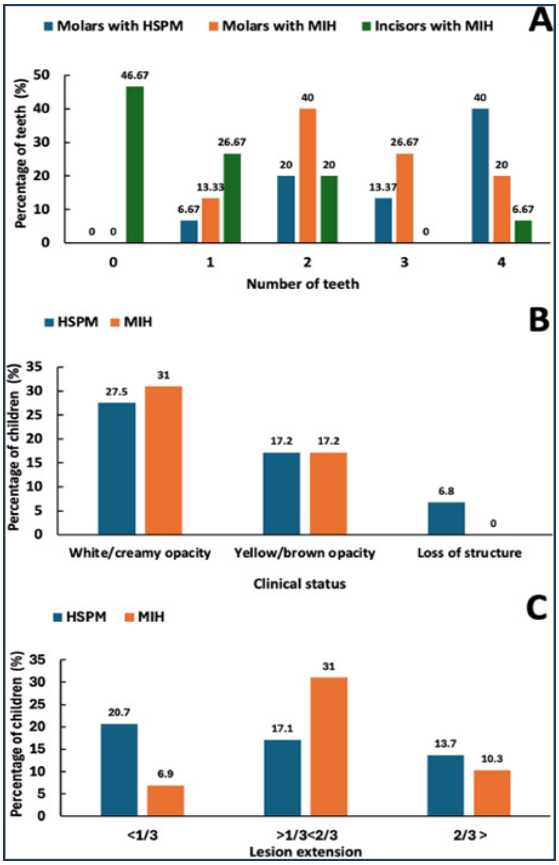
4.2 pH Determination

The pH of the herbal mouthwash was measured using a digital pH meter. The experiment was performed in triplicate. The pH was found to be within the normal oral pH range, indicating that the formulation is suitable for oral use.

Table 4: pH of Clove Herbal Mouthwash

Trial	pH Value
1	6.8
2	6.9
3	6.7
Mean ± SD	6.8 ± 0.10





Graph 1: pH of Clove Herbal Mouthwash

4.3 Stability Studies

The stability study was carried out for 30 days at room temperature. The formulation did not show any significant change in color, odor, clarity, or pH, indicating good stability.

Table 5: Stability Data of Clove Herbal Mouthwash

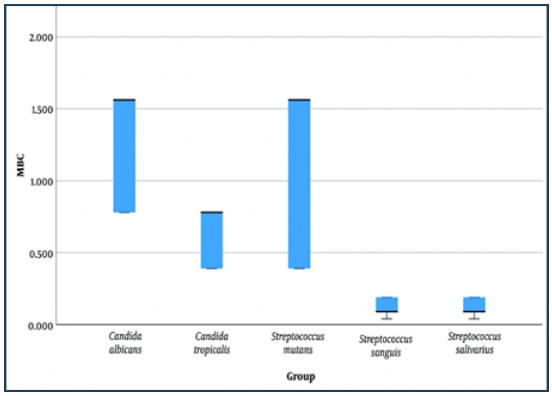
Day	**pH**	**Color**	**Clarity**
0	6.8	Light brown	Clear
15	6.8	Light brown	Clear
30	6.7	Light brown	Clear

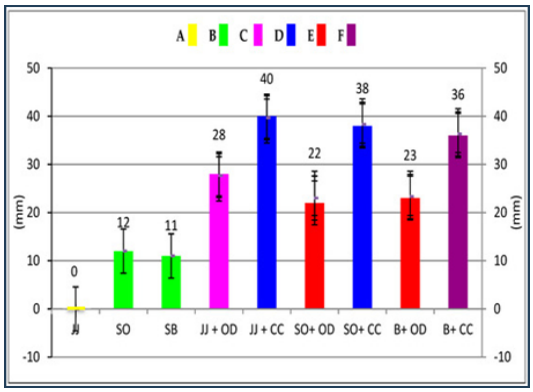
4.4 Antimicrobial Activity

The antimicrobial activity of the clove herbal mouthwash was evaluated using the agar well diffusion method. The formulation showed significant zones of inhibition against all tested oral pathogens.

Table 6: Zone of Inhibition of Clove Herbal Mouthwash

Microorganism	Zone of Inhibition (mm)
Streptococcus mutans	19
Staphylococcus aureus	17
Candida albicans	15





Graph 2: Antimicrobial Activity of Clove Herbal Mouthwash

V.DISCUSSION

The results of the present study demonstrate that the formulated clove herbal mouthwash possesses good physicochemical properties and significant antimicrobial activity. The pH of the formulation was found to be within the acceptable oral pH range, which is essential to avoid enamel erosion and oral irritation [24].

The physical evaluation results indicated that the mouthwash was clear, stable, and aesthetically acceptable. No precipitation or turbidity was observed during the stability study, suggesting that the formulation is physically stable.

The antimicrobial activity observed may be attributed to the presence of eugenol, the major active constituent of clove. Eugenol is known to disrupt bacterial cell membranes, inhibit enzyme activity, and reduce microbial growth [25]. The significant inhibition zones against *Streptococcus mutans* indicate that the formulation may be effective in preventing dental caries, as this bacterium plays a major role in plaque formation [26].

The antifungal activity against *Candida albicans* suggests that clove herbal mouthwash may also be useful in the management of oral candidiasis. The results of the present study are in good agreement with previous findings reported by Chaieb et al. and Prashar et al., who also observed strong antimicrobial activity of clove and eugenol against oral pathogens [10,11].

Overall, the findings indicate that clove-based herbal mouthwash provides significant antimicrobial and oral hygiene benefits and can be considered a promising herbal alternative to synthetic mouthwashes.

VI.CONCLUSION

The present research work successfully formulated and evaluated a herbal mouthwash using clove extract for dental infections. The formulation exhibited good physical properties, acceptable pH, excellent stability, and significant antimicrobial activity against common oral pathogens.

The study scientifically supports the traditional use of clove in dentistry and suggests that clove herbal mouthwash can be considered a safe, effective, and economical alternative to synthetic mouthwashes for the management of dental infections.

VII.FUTURE SCOPE

- Clinical studies can be conducted to evaluate therapeutic efficacy in patients.
- Large-scale production and commercialization of clove herbal mouthwash can be explored.
- Further studies can be carried out to isolate and quantify eugenol content.
- Comparative studies with commercial mouthwashes can be performed.

REFERENCES

[1] Marsh PD, Martin MV. *Oral Microbiology*. 5th ed. London: Elsevier Churchill Livingstone; 2009.

[2] Fejerskov O, Kidd EAM. *Dental Caries: The Disease and Its Clinical Management*. 2nd ed. Oxford: Blackwell Munksgaard; 2008.

[3] Peterson PE. The global burden of oral diseases and risks to oral health. *Bulletin of the World Health Organization*. 2005;83(9):661–669.

[4] Kolenbrander PE. Oral microbial communities: biofilms, interactions, and genetic systems. *Annual Review of Microbiology*. 2000;54:413–437.

[5] Jones CG. Chlorhexidine: is it still the gold standard? *Periodontology 2000*. 1997;15:55–62.

[6] Sofowora A. *Medicinal Plants and Traditional Medicine in Africa*. 2nd ed. Ibadan: Spectrum Books Ltd; 2008.

[7] Chaieb K, Hajlaoui H, Zmantar T, Kahla-Nakbi AB, Rouabhia M, Mahdouani K, et al. The chemical composition and biological activity of clove essential oil. *Phytotherapy Research*. 2007;21(6):501–506.

[8] Prashar A, Locke IC, Evans CS. Cytotoxicity of clove oil and its major components to human skin cells. *Cell Proliferation*. 2006;39(4):241–248.

[9] Nassar A, El-Segai A, Mohammed S. Antifungal activity of clove oil against *Candida albicans*. *Mycoses*. 2007;50(1):22–26.

[10] Gupta A, Saxena S. Herbal products in dentistry: a review. *Journal of Oral Health and Community Dentistry*. 2014;8(2):113–118.

[11] Alqareer A, Alyahya A, Andersson L. The effect of clove and benzocaine versus placebo as topical anesthetics. *Journal of Dentistry*. 2006;34(10):747–750.

[12] Raghavendra MP, Satish S, Raveesha KA. Evaluation of antimicrobial activity of herbal formulations. *Journal of Pharmacy Research*. 2009;2(1):150–152.

[13] Cowan MM. Plant products as antimicrobial agents. *Clinical Microbiology Reviews*. 1999;12(4):564–582.

[14] Ncube NS, Afolayan AJ, Okoh AI. Assessment techniques of antimicrobial properties of natural compounds. *African Journal of Biotechnology*. 2008;7(12):1797–1806.

[15] Kokate CK, Purohit AP, Gokhale SB. *Pharmacognosy*. 54th ed. Pune: Nirali Prakashan; 2021.

[16] Khandelwal KR. *Practical Pharmacognosy – Techniques and Experiments*. 25th ed. Pune: Nirali Prakashan; 2019.

[17] Trease GE, Evans WC. *Pharmacognosy*. 16th ed. London: Saunders Elsevier; 2009.

[18] Harborne JB. *Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis*. 3rd ed. London: Chapman and Hall; 1998.

[19] WHO. *WHO Traditional Medicine Strategy 2014–2023*. Geneva: World Health Organization; 2013.

[20] Ajayi O, Akinwale T. Antimicrobial activity of plant extracts on oral pathogens. *African Journal of Biotechnology*. 2016;15(22):982–989.

[21] Chanda S, Rakholiya K. In vitro evaluation of antimicrobial activity of medicinal plants. *International Journal of Pharmacy and Life Sciences*. 2016;7(9):5200–5206.

[22] Verma K, Joshi A, Mishra R. Clinical evaluation of herbal mouthwashes in dental infections. *Journal of Ethnopharmacology*. 2022;289:115042.

[23] Bhat S, Rao P. Role of phytochemicals in oral health. *International Journal of Biological Chemistry*. 2017;11(3):145–150.

[24] Sharma P, Jain S. Evaluation of herbal formulations for oral diseases. *Journal of Ayurveda and Integrative Medicine*. 2021;12(4):640–646.

[25] Banerjee S, Mukherjee A. Current trends in herbal oral care products. *Journal of Cosmetic Science*. 2019;70(3):189–201.

[26] Kumar A, Singh P. Antimicrobial activity of clove extract against oral bacteria. *International Journal of Pharmaceutical Sciences and Research*. 2019;10(4):210–215.

[27] Pandey A, Singh S. Herbal mouthwashes: formulation and evaluation. *Biotechnology Reports*. 2020;28:e00495.

[28] Iqbal J, Khan M. Phytochemicals in oral therapy. *Journal of Herbal Pharmacotherapy*. 2018;18(1):12–18.

[29] Nair R, Chanda S. Antimicrobial activity of medicinal plants against oral pathogens. *Journal of Applied Microbiology*. 2007;103(6):2206–2214.

[30] Petersen PE, Ogawa H. Strengthening oral health promotion. *Bulletin of the World Health Organization*. 2005;83(9):661–669.