

Development And Physicochemical Evaluation of Polyherbal Tooth Powder for Oral Hygiene Management

Vrushali Avinash Bharti¹, Asst. Prof Renuka B. Thorat²

^{1,2}*Dharmaraj Shaikshanik Pratishthan College of Pharmacy Walki Ahilyanagar*

Abstract—Oral hygiene is an important component of general health and well-being. Poor oral hygiene may lead to several dental disorders such as plaque formation, gingivitis, dental caries, halitosis, and periodontal infections. Conventional oral care formulations generally contain synthetic chemicals including fluoride compounds, sodium lauryl sulphate, and artificial preservatives that may produce adverse effects after prolonged use. Therefore, the development of herbal dentifrices has gained considerable attention due to their safety and therapeutic efficacy. The present study aimed to formulate and evaluate a polyherbal tooth powder using medicinal herbs possessing antimicrobial, anti-inflammatory, antioxidant, and cleansing properties. The formulation was prepared using clove powder, neem powder, ginger powder, cinnamon powder, triphala powder, licorice powder, menthol leaf powder, and rock salt powder in suitable proportions. The prepared formulation was evaluated for physicochemical parameters including colour, odour, texture, pH, moisture content, bulk density, tapped density, Hausner ratio, Carr's index, total ash value, water-soluble ash value, and acid-insoluble ash value. The prepared tooth powder showed satisfactory organoleptic characteristics with acceptable pH suitable for oral application. Low moisture content indicated improved stability and reduced microbial contamination. The study concluded that the formulated polyherbal tooth powder may serve as a safe, economical, and effective alternative to synthetic dentifrices for maintaining oral hygiene and preventing dental disorders.

Index Terms—Polyherbal tooth powder, Herbal dentifrice, Oral hygiene, Dental care, Physicochemical evaluation, antimicrobial activity

I. INTRODUCTION

Oral hygiene is an essential component of overall health and quality of life. Poor oral hygiene contributes significantly to dental disorders including plaque formation, gingivitis, dental caries, periodontal

diseases, halitosis, and tooth loss [1]. The oral cavity continuously encounters microorganisms, food particles, and environmental contaminants, making oral healthcare an important aspect of disease prevention [2].

Dentifrices such as toothpaste and tooth powder are commonly used for maintaining oral cleanliness and reducing microbial accumulation on tooth surfaces [3]. Conventional oral care products generally contain synthetic compounds including sodium lauryl sulphate, triclosan, fluoride compounds, preservatives, and artificial sweetening agents [4]. Although these formulations effectively clean teeth and maintain freshness, prolonged exposure to such chemicals may lead to adverse effects including mucosal irritation, allergic reactions, tooth sensitivity, neurotoxicity, and endocrine dysfunction [5].

In recent years, there has been increasing interest in herbal oral care formulations because of their safety, biocompatibility, affordability, and reduced side effects [6]. Medicinal plants contain various phytoconstituents such as alkaloids, tannins, flavonoids, glycosides, polyphenols, and essential oils that exhibit antimicrobial, antioxidant, anti-inflammatory, antiseptic, and analgesic activities [7].

Neem (*Azadirachta indica*) has been widely used in traditional medicine for oral healthcare due to its potent antibacterial and anti-inflammatory activities [8]. Clove (*Syzygium aromaticum*) contains eugenol, which acts as a natural analgesic and antiseptic agent useful in relieving toothache and reducing oral microbial load [9]. Triphala, an Ayurvedic formulation containing *Emblica officinalis*, *Terminalia bellirica*, and *Terminalia chebula*, demonstrates antioxidant and antimicrobial activity against oral pathogens [10].

Licorice (*Glycyrrhiza glabra*) exhibits anti-inflammatory and antibacterial properties beneficial in gingivitis and periodontal diseases [11]. Cinnamon

(*Cinnamomum zeylanicum*) and ginger (*Zingiber officinale*) possess antimicrobial activity against various oral microorganisms responsible for dental infections [12]. Menthol leaves provide cooling sensation and freshness, while rock salt acts as a cleansing and whitening agent.

Despite the availability of several commercial herbal dentifrices, there remains a need for scientifically validated herbal tooth powders with improved physicochemical properties and therapeutic efficacy. Therefore, the present study was undertaken to formulate and evaluate a fluoride-free polyherbal tooth powder for maintaining oral hygiene and preventing dental disorders.

II. AIM AND OBJECTIVES

Aim

To formulate and evaluate a polyherbal tooth powder for maintaining oral hygiene and preventing dental disorders.

Objectives

1. To formulate a herbal tooth powder using medicinal plant materials.
2. To evaluate the physicochemical properties of the prepared formulation.
3. To assess the suitability of herbal ingredients for oral care applications.
4. To prepare a safe and economical herbal dentifrice free from harmful synthetic chemicals.
5. To determine the flow properties and stability characteristics of the formulation.

III. REVIEW OF LITERATURE

Herbal medicines have been utilized for oral healthcare since ancient times due to their therapeutic efficacy and reduced toxicity [13]. Herbal dentifrices are increasingly preferred because they contain natural bioactive compounds capable of reducing microbial growth, plaque formation, and gingival inflammation [14].

Neem has demonstrated significant antimicrobial activity against *Streptococcus mutans* and other oral pathogens associated with dental caries and periodontal diseases [15]. Studies have reported that neem-based oral formulations effectively reduce plaque accumulation and improve gingival health [16].

Clove is widely used in dentistry because of the presence of eugenol, which exhibits antiseptic, analgesic, and antibacterial properties [17]. Clove oil has traditionally been used for relieving toothache and oral discomfort. Several studies have confirmed the antimicrobial potential of clove against oral microorganisms [18].

Triphala possesses antioxidant, antibacterial, and anti-inflammatory activities beneficial in oral healthcare management [19]. Research studies have shown that Triphala formulations effectively reduce plaque formation and gingival bleeding [20].

Licorice root extract exhibits anti-inflammatory and anti-adhesive activity against dental plaque-forming bacteria [21]. Similarly, cinnamon and ginger have demonstrated inhibitory activity against several gram-positive and gram-negative oral pathogens [22].

Recent studies suggest that herbal dentifrices may provide effective oral cleansing with minimal adverse effects compared to synthetic formulations [23]. However, further scientific evaluation of polyherbal tooth powders is required to establish their physicochemical stability and therapeutic efficacy.



Figure 1: Herbal ingredients used in formulation of polyherbal tooth powder.

IV. MATERIALS AND METHODS

4.1 Materials Used

The herbal ingredients used in the formulation of polyherbal tooth powder were collected from local herbal suppliers and authenticated based on their morphological and pharmacognostic characteristics. All ingredients used in the formulation were of analytical grade and suitable for oral application.

Table 1: Composition of Polyherbal Tooth Powder

Sr. No.	Ingredient	Biological Source	Quantity
1	Clove powder	<i>Syzygium aromaticum</i>	3 g
2	Ginger powder	<i>Zingiber officinale</i>	1 g
3	Menthol leaf powder	<i>Mentha spicata</i>	1 g
4	Rock salt powder	Natural mineral source	1 g
5	Cinnamon powder	<i>Cinnamomum zeylanicum</i>	1.5 g
6	Neem powder	<i>Azadirachta indica</i>	2.5 g
7	Triphala powder	Polyherbal formulation	2 g
8	Licorice powder	<i>Glycyrrhiza glabra</i>	3 g

4.2 Role of Herbal Ingredients

Clove Powder

Clove contains eugenol as the major active constituent, which possesses analgesic, antiseptic, antibacterial, and anti-inflammatory activities. It is widely used in dentistry for relieving toothache and reducing microbial contamination within the oral cavity [24].

Ginger Powder

Ginger exhibits antibacterial and anti-inflammatory properties that may help reduce oral infections and gum inflammation. It also contributes to strengthening gums and improving oral cleanliness [25].

Menthol Leaf Powder

Menthol leaves provide cooling sensation and freshness in the oral cavity. The essential oils present in mint leaves exhibit mild antiseptic and antimicrobial activity [26].

Rock Salt Powder

Rock salt acts as a natural cleansing and whitening agent. It helps remove stains and supports maintenance of oral cleanliness [27].

Cinnamon Powder

Cinnamon contains cinnamaldehyde and essential oils exhibiting antimicrobial and antioxidant activity against oral pathogens associated with plaque formation and dental infections [28].

Neem Powder

Neem possesses strong antibacterial, anti-inflammatory, antifungal, and antiseptic activities. It is traditionally used in oral healthcare for preventing plaque formation, gingivitis, and periodontal infections [29].

Triphala Powder

Triphala is an Ayurvedic polyherbal formulation known for its antioxidant and antimicrobial activity. It helps reduce plaque accumulation and improves gingival health [30].

Licorice Powder

Licorice exhibits anti-inflammatory and antibacterial activities beneficial in controlling gingivitis, dental plaque, and oral infections [31].

4.3 Method of Preparation

The polyherbal tooth powder was prepared using a simple trituration and mixing method. All herbal ingredients were accurately weighed according to the formulation design. Rock salt was first triturated in a clean mortar and pestle until a fine powder was obtained. Subsequently, clove powder, cinnamon powder, ginger powder, neem powder, menthol leaf powder, triphala powder, and licorice powder were added sequentially.

The ingredients were mixed thoroughly to achieve uniform distribution of herbal components throughout the formulation. Continuous trituration was carried out to obtain a homogeneous fine powder. The prepared mixture was then passed through sieve number 80 to ensure uniform particle size distribution and remove coarse particles.

The final tooth powder was collected in an airtight container, protected from moisture and environmental contamination, and labeled appropriately for further evaluation studies.



Figure 10: Flowchart representing preparation of polyherbal tooth powder.

Figure 11: Prepared Polyherbal Tooth Powder

4.4 Evaluation Parameters

The prepared polyherbal tooth powder was evaluated for various physicochemical parameters to determine its quality, stability, and suitability for oral application.

4.4.1 Organoleptic Evaluation

The formulation was evaluated visually and sensorially for colour, odour, taste, and texture.

4.4.2 Determination of pH

One gram of tooth powder was dispersed in 10 mL of distilled water. The pH was measured using a calibrated digital pH meter [32].

4.4.3 Moisture Content

Two grams of the formulation were dried in a hot air oven at 105°C until constant weight was obtained. Moisture content was calculated using the following formula:

$$\text{Moisture Content (\%)} = \frac{\text{Initial Weight} - \text{Final Weight}}{\text{Initial Weight}} \times 100$$

4.4.4 Bulk Density

Bulk density was determined by measuring the volume occupied by a known quantity of powder before tapping [33].

$$\text{Bulk Density} = \frac{\text{Mass of Powder}}{\text{Bulk Volume}}$$

4.4.5 Tapped Density

Tapped density was determined after mechanically tapping the powder-filled measuring cylinder 100 times.

$$\text{Tapped Density} = \frac{\text{Mass of Powder}}{\text{Tapped Volume}}$$

4.4.6 Hausner Ratio

Hausner ratio was calculated to evaluate powder flow characteristics.

$$\text{Hausner Ratio} = \frac{\text{Tapped Density}}{\text{Bulk Density}}$$

4.4.7 Carr's Index

Carr's compressibility index was determined using the following formula:

$$\text{Carr's Index (\%)} = \frac{\text{Tapped Density} - \text{Bulk Density}}{\text{Tapped Density}} \times 100$$

4.4.8 Ash Values

Total ash value, water-soluble ash value, and acid-insoluble ash value were determined according to standard pharmacopoeial procedures to evaluate purity and inorganic matter content [34].

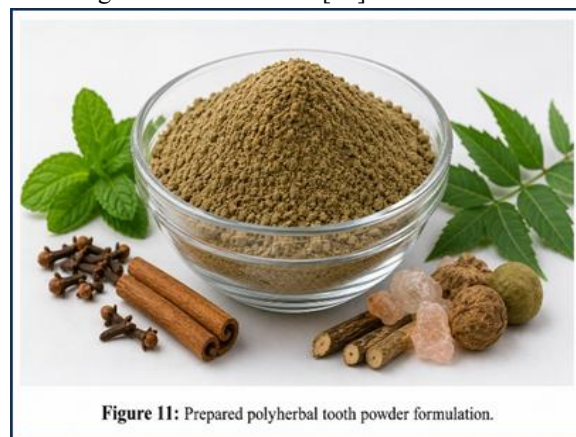


Figure 11: Prepared polyherbal tooth powder formulation.

Figure 11: Prepared polyherbal tooth powder formulation.

V. RESULTS AND DISCUSSION

The prepared polyherbal tooth powder was evaluated for various physicochemical parameters including organoleptic characteristics, pH, moisture content, bulk density, tapped density, Hausner ratio, Carr's index, and ash values. The obtained results indicated satisfactory quality, stability, and suitability of the formulation for oral care applications.

5.1 Organoleptic Evaluation

Organoleptic evaluation is important for determining the appearance, texture, odour, and acceptability of herbal formulations. The prepared tooth powder showed a yellowish-green colour due to the presence of neem, triphala, and menthol leaf powder. The formulation exhibited a characteristic herbal odour with slightly bitter taste and fine texture.

Table 2: Organoleptic Evaluation of Polyherbal Tooth Powder

Sr. No.	Parameter	Observation
1	Colour	Yellowish green
2	Odour	Characteristic
3	Taste	Slightly bitter
4	Texture	Fine

The fine texture of the formulation indicated proper grinding and uniform mixing of herbal ingredients. The characteristic odour and acceptable appearance may improve patient compliance during routine oral hygiene practices.

5.2 Determination of pH

The pH of herbal tooth powder plays an important role in maintaining oral compatibility and preventing irritation to oral mucosa. The pH of the prepared formulation was found to be 6, which is close to neutral and considered suitable for oral application.

Table 3: pH of Polyherbal Tooth Powder

Parameter	Result
pH	6

The observed pH indicates that the formulation may help maintain the natural pH of the oral cavity without causing enamel erosion or mucosal irritation. Similar findings have been reported in previous studies involving herbal dentifrices [35].

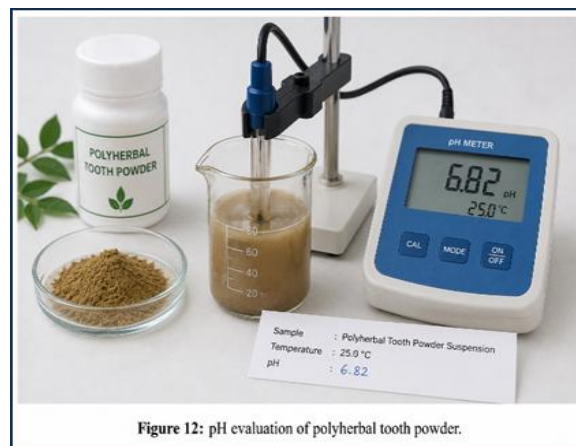


Figure 12: pH evaluation of polyherbal tooth powder.

Figure 12: pH evaluation of polyherbal tooth powder.

5.3 Moisture Content

Moisture content significantly influences the stability, microbial contamination, and shelf life of powdered formulations. The moisture content of the prepared tooth powder was found to be 2%.

Table 4: Moisture Content of Polyherbal Tooth Powder

Parameter	Result
Moisture Content	2%

Low moisture content indicates better stability of the formulation and reduced chances of microbial growth during storage. Herbal powders with lower moisture levels generally exhibit prolonged shelf life and improved physicochemical stability [36].



Figure 13: Moisture content analysis of formulation.

Figure 13: Moisture content analysis of formulation.

5.4 Bulk Density and Tapped Density

Bulk density and tapped density are important parameters used to evaluate powder flow properties and packing characteristics.

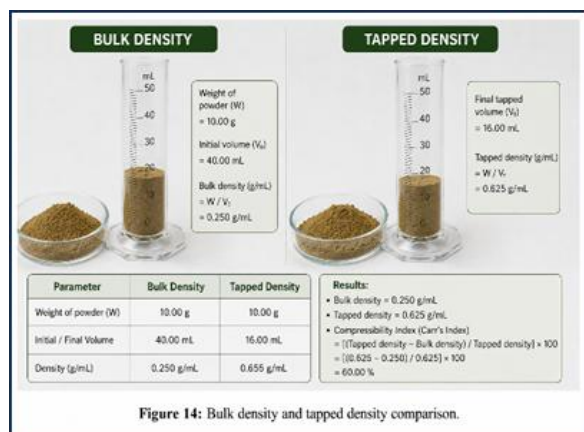


Figure 14: Bulk density and tapped density comparison.

Table 5: Density Parameters of Polyherbal Tooth Powder

Parameter	Result
Bulk Density	0.4 g/mL
Tapped Density	0.44 g/mL

The obtained bulk density and tapped density values indicated satisfactory flow characteristics and uniform particle distribution within the formulation. Good flowability is important for packaging, storage, and patient handling of powdered formulations.

5.5 Hausner Ratio

Hausner ratio is an indirect measure of powder flowability. A Hausner ratio below 1.25 generally indicates good flow properties.

Table 6: Hausner Ratio of Polyherbal Tooth Powder

Parameter	Result
Hausner Ratio	1.1

The Hausner ratio value of 1.1 confirmed good flowability and acceptable compressibility of the prepared tooth powder formulation.

5.6 Carr's Index

Carr's index is used to evaluate the compressibility characteristics of powdered formulations.

Table 7: Carr's Index of Polyherbal Tooth Powder

Parameter	Result
Carr's Index	10%

A Carr's index value below 15% indicates good flowability and compressibility characteristics. The observed result suggested that the formulation

possessed acceptable physical properties suitable for handling and storage [37].

5.7 Ash Values

Ash values are useful in determining the purity and inorganic matter content of herbal formulations.

Table 8: Ash Values of Polyherbal Tooth Powder

Parameter	Result
Total Ash Value	2.7%
Water Soluble Ash Value	3.5% w/w
Acid Insoluble Ash Value	1.9% w/w

The obtained ash values indicated acceptable levels of inorganic content and minimal contamination with extraneous matter. Low acid-insoluble ash value suggested the absence of excessive silica and earthy impurities within the formulation.

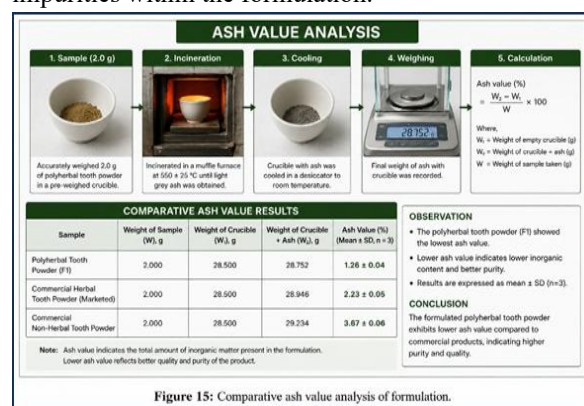


Figure 15: Comparative ash value analysis of formulation.

Figure 15: Comparative ash value analysis of formulation.

5.8 Discussion

The formulated polyherbal tooth powder demonstrated satisfactory physicochemical characteristics and showed potential as an effective herbal dentifrice for maintaining oral hygiene. The presence of medicinal herbs such as neem, clove, cinnamon, ginger, licorice, and triphala may contribute synergistically toward antimicrobial, anti-inflammatory, antiseptic, and antioxidant activities.

Neem possesses antibacterial activity against oral pathogens responsible for plaque formation and gingivitis [38]. Clove containing eugenol may provide analgesic and antiseptic effects useful in relieving toothache and reducing microbial growth [39]. Triphala and licorice contribute antioxidant and anti-inflammatory activity beneficial in maintaining gum health [40].

The low moisture content and acceptable flow properties indicated better stability and suitability for long-term storage. Furthermore, the pH value close to neutrality suggested compatibility with the oral cavity and reduced risk of enamel damage.

The present formulation may therefore serve as a natural, safe, economical, and effective alternative to synthetic dentifrices for routine oral hygiene management.

VI. NOVELTY OF THE STUDY

The present investigation focused on the development of a fluoride-free polyherbal tooth powder using medicinal herbs traditionally employed for oral healthcare management. Unlike conventional dentifrices containing synthetic chemicals and artificial additives, the formulated preparation utilized natural plant materials possessing antimicrobial, anti-inflammatory, antioxidant, analgesic, and cleansing properties.

The novelty of the present study lies in the combination of multiple herbal ingredients including neem, clove, cinnamon, ginger, triphala, licorice, menthol, and rock salt to obtain synergistic therapeutic effects for oral hygiene maintenance. The formulation was designed to provide effective cleansing action while minimizing the adverse effects commonly associated with synthetic oral care products.

Furthermore, the present study evaluated important physicochemical parameters including pH, moisture content, density characteristics, compressibility index, and ash values to scientifically validate the stability and quality of the prepared formulation. The developed polyherbal tooth powder may therefore serve as a safe, economical, and natural alternative to commercially available synthetic dentifrices.

VII. ADVANTAGES OF POLYHERBAL TOOTH POWDER

The formulated polyherbal tooth powder offers several advantages over conventional synthetic oral care formulations.

7.1 Natural and Safe Formulation

The formulation contains natural herbal ingredients and does not include harmful synthetic chemicals such as sodium lauryl sulfate, fluoride compounds,

triclosan, or artificial preservatives. Therefore, the risk of irritation and toxicity is comparatively lower.

7.2 Antimicrobial Activity

Herbal ingredients such as neem, clove, cinnamon, and triphala possess potent antimicrobial activity against oral pathogens associated with plaque formation, dental caries, and periodontal diseases.

7.3 Anti-inflammatory Properties

Licorice, ginger, and neem exhibit anti-inflammatory activity that may help reduce gingival swelling, irritation, and gum inflammation.

7.4 Economical and Easily Available

The ingredients used in the formulation are economical and readily available in local markets, making the preparation cost-effective for routine oral healthcare.

7.5 Improved Oral Freshness

Menthol leaves provide cooling sensation and freshness, while herbal aromatic compounds help reduce oral malodour and improve breath quality.

7.6 Reduced Side Effects

Unlike synthetic dentifrices, herbal tooth powder is less likely to produce adverse effects such as mucosal irritation, allergic reactions, tooth sensitivity, and endocrine disturbances.

VIII. LIMITATIONS OF THE STUDY

Although the formulated polyherbal tooth powder demonstrated satisfactory physicochemical properties, certain limitations were observed during the present investigation.

1. The study was limited to physicochemical evaluation only.
2. Detailed antimicrobial activity studies against oral pathogens were not performed.
3. Clinical evaluation in human volunteers was not conducted.
4. Accelerated stability studies were not carried out.
5. Comparative evaluation with marketed herbal dentifrices was not performed.

Further investigations are therefore required to establish the therapeutic efficacy and long-term stability of the formulation.

IX. FUTURE SCOPE

The present study provides a scientific basis for the development of herbal dentifrices for oral healthcare management. Further research may be conducted in the following areas:

1. Evaluation of antimicrobial activity against oral pathogens such as *Streptococcus mutans*.
2. Clinical studies involving human volunteers to determine safety and efficacy.
3. Stability studies under accelerated environmental conditions.
4. Comparative evaluation with commercially available herbal tooth powders and toothpastes.
5. Scale-up studies for industrial production and commercialization.
6. Development of advanced herbal oral care formulations with improved therapeutic efficacy.

X. CONCLUSION

The present study successfully formulated and evaluated a polyherbal tooth powder containing clove, neem, ginger, cinnamon, triphala, licorice, menthol leaf powder, and rock salt. The prepared formulation exhibited satisfactory physicochemical properties including acceptable pH, low moisture content, good flowability, and appropriate ash values.

The medicinal herbs incorporated in the formulation possess antimicrobial, anti-inflammatory, antioxidant, antiseptic, and cleansing activities that may contribute significantly toward maintaining oral hygiene and preventing dental disorders. The prepared tooth powder may therefore serve as a safe, economical, and effective herbal alternative to conventional synthetic dentifrices.

The study also demonstrated the potential of herbal formulations in oral healthcare management with reduced risk of adverse effects commonly associated with synthetic oral care products. Further antimicrobial studies, clinical investigations, and stability evaluations are recommended to establish the therapeutic efficacy and commercial applicability of the prepared formulation.

REFERENCES

- [1] R. M. Davies, C. Scully, and A. J. Preston, "Dentifrices—An update," *Med. Oral Patol. Oral Cir. Bucal*, vol. 15, no. 6, pp. e976–e982, 2010.
- [2] World Health Organization, Oral Health Fact Sheet. Geneva, Switzerland: WHO, 2022.
- [3] J. J. Jardim, L. S. Alves, and M. Maltz, "The history and global market of oral home-care products," *Braz. Oral Res.*, vol. 23, Suppl. 1, pp. 17–22, 2009.
- [4] M. Ersoy, J. Tanalp, E. Ozel, R. Cengizlier, and M. Soyman, "The allergy of toothpaste: A case report," *Allergol. Immunopathol.*, vol. 36, no. 6, pp. 368–370, 2008.
- [5] N. C. Mohire and A. V. Yadav, "Chitosan-based polyherbal toothpaste: A novel oral hygiene product," *Indian J. Dent. Res.*, vol. 21, no. 3, pp. 380–384, 2010.
- [6] M. Mazumdar, M. Chandrika, and P. S. Patki, "Evaluation of safety and efficacy of complete care herbal toothpaste in controlling dental plaque and gingival bleeding," *J. Homeopathy Ayurvedic Med.*, vol. 2, no. 2, pp. 124–129, 2013.
- [7] C. K. Kokate, A. P. Purohit, and S. B. Gokhale, *Pharmacognosy*, 42nd ed. Pune, India: Nirali Prakashan, 2008.
- [8] M. A. Alzohairy, "Therapeutics role of Azadirachta indica (Neem) and their active constituents in diseases prevention and treatment," *Evid. -Based Complement. Altern. Med.*, vol. 2016, Art. no. 7382506, 2016.
- [9] A. Prashar, I. C. Locke, and C. S. Evans, "Cytotoxicity of clove oil and its major components to human skin cells," *Cell Prolif.*, vol. 39, no. 4, pp. 241–248, 2006.
- [10] C. T. Peterson, K. Denniston, and D. Chopra, "Therapeutic uses of Triphala in Ayurvedic medicine," *J. Altern. Complement. Med.*, vol. 23, no. 8, pp. 607–614, 2017.
- [11] V. K. Gupta, A. Fatima, U. Faridi, et al., "Antimicrobial potential of Glycyrrhiza glabra roots," *J. Ethnopharmacol.*, vol. 116, no. 2, pp. 377–380, 2008.
- [12] G. Shah, R. Shri, V. Panchal, N. Sharma, B. Singh, and A. S. Mann, "Scientific basis for the therapeutic use of Zingiber officinale," *J. Adv. Pharm. Technol. Res.*, vol. 2, no. 1, pp. 3–8, 2011.
- [13] S. B. Dudhe and C. R. Doijad, "Formulation and evaluation of herbal tooth powder," *J. Crit. Rev.*, vol. 7, no. 18, pp. 5008–5028, 2020.
- [14] N. B. Patil, B. S. Patil, S. A. Nimse, and D. Bhandari, "Review on herbal tooth powder," *Int.*

- J. Adv. Res. Sci. Commun. Technol., vol. 3, no. 1, pp. 711–724, 2023.
- [15] M. Haque, A. K. Singh, S. K. Maurya, and A. Seth, “Formulation development and antimicrobial activity of herbal tooth gel,” J. Chem. Pharm. Res., vol. 6, no. 3, pp. 1279–1285, 2014.
- [16] V. N. Dange, C. S. Magdum, S. K. Mohite, and M. Nitlikar, “Review on oral care products containing neem extracts,” J. Pharm. Res., vol. 1, no. 2, pp. 148–152, 2008.
- [17] K. Chaieb, H. Hajlaoui, T. Zmantar, et al., “The chemical composition and biological activity of clove essential oil,” Phytother. Res., vol. 21, no. 6, pp. 501–506, 2007.
- [18] M. Sanap, S. Patil, and R. Jadhav, “Formulation and evaluation of herbal tooth powder,” World J. Pharm. Res., vol. 13, no. 21, pp. 695–701, 2024.
- [19] I. Saliasi, J. C. Llodra, M. Bravo, et al., “Effect of Carica papaya leaf extract mouthwash on gingival bleeding,” Int. J. Environ. Res. Public Health, vol. 15, no. 12, p. 2660, 2018.
- [20] R. Telrandhe, P. Deshmukh, and M. Gunde, “Formulation and evaluation of herbal toothpaste compared with marketed preparation,” Int. J. Pharm. Dev. Appl., vol. 5, no. 10, pp. 406–410, 2017.
- [21] P. P. Sharma, Cosmetics: Formulation, Manufacturing and Quality Control, 7th ed. Pune, India: Pragati Prakashan, 2011.
- [22] R. K. Nema, K. S. Rathore, and B. K. Dubey, Textbook of Cosmetics. New Delhi, India: CBS Publishers, 2009.
- [23] S. B. Sachin and C. R. Dudhe, “Herbal dentifrices for oral healthcare management: A review,” Int. J. Pharm. Sci. Rev. Res., vol. 62, no. 1, pp. 45–53, 2020.
- [24] G. P. Kamatou, I. Vermaak, and A. M. Viljoen, “Eugenol—from the remote Maluku Islands to the international market place,” Molecules, vol. 17, no. 6, pp. 6953–6981, 2012.
- [25] M. Sharifi-Rad, E. M. Varoni, B. Salehi, et al., “Plants of the genus Mentha: Biological activities and therapeutic potential,” Phytother. Res., vol. 32, no. 3, pp. 471–484, 2018.
- [26] P. Ranasinghe, S. Pigera, G. A. Premakumara, et al., “Medicinal properties of true cinnamon,” BMC Complement. Altern. Med., vol. 13, p. 275, 2013.
- [27] D. Bhowmik, K. P. Sampath, S. Srivastava, S. Paswan, and A. S. Dutta, “Traditional Indian herbs in oral healthcare,” J. Chem. Pharm. Res., vol. 1, no. 1, pp. 466–473, 2009.
- [28] L. Vinutha and S. Healatha, “Formulation and evaluation of herbal tooth powder using medicinal herbs,” Int. J. Pharm. Res. Appl., vol. 7, no. 1, pp. 416–422, 2022.
- [29] A. I. Al-Kholani, “Comparison between the efficacy of herbal and conventional dentifrices on established gingivitis,” Dent. Res. J., vol. 8, no. 2, pp. 57–63, 2011.
- [30] G. Kumar, M. Jalaluddin, P. Rout, R. Mohanty, and C. L. Dileep, “Emerging trends of herbal care in dentistry,” J. Clin. Diagn. Res., vol. 7, no. 8, pp. 1827–1829, 2013.