

# Formulation Of Polyherbal Toothpaste for Prevention of Dental Caries and Gum Diseases

Vikash Gautam<sup>1</sup>, Nidhi Saxena<sup>2</sup>, Dr. R. B. Goswami<sup>3</sup>

<sup>1</sup>*Sagar Institute of Research Technology & Science Pharmacy, Bhopal*

<sup>2</sup>*Associate Professor, Sagar Institute of Research Technology & Science Pharmacy, Bhopal*

<sup>3</sup>*Professor, Sagar Institute of Research Technology & Science Pharmacy, Bhopal*

**Abstract**—Dental caries and gum diseases are common oral health problems caused by bacterial infection, poor oral hygiene, and plaque accumulation. Herbal formulations are gaining importance due to their natural origin, safety, and minimal side effects compared to chemicalbased dental products. The present study focuses on the formulation and evaluation of a polyherbal toothpaste prepared using medicinal plant extracts such as neem, clove, Tulsi, peppermint, and aloe vera. These herbal ingredients possess antibacterial, anti-inflammatory, antiseptic, and antioxidant properties that help in maintaining oral hygiene and preventing dental infections. The toothpaste was formulated using natural abrasives, binders, sweetening agents, and flavoring agents to improve texture and acceptability. Evaluation parameters including pH, spreadability, foamability, stability, homogeneity, and antimicrobial activity were analyzed. The formulated polyherbal toothpaste showed good physicochemical properties and effective antibacterial activity against oral pathogens responsible for dental caries and gum diseases. The study concludes that polyherbal toothpaste can be used as a safe, effective, and economical alternative to commercial synthetic toothpaste for improving oral health.

**Index Terms**—Polyherbal Toothpaste, Dental Caries, Gum Diseases

## I. INTRODUCTION

Oral hygiene plays a vital role in maintaining overall human health and well-being. Teeth and gums are essential parts of the oral cavity that help in chewing, digestion, speaking, and maintaining facial appearance. Poor oral hygiene can lead to several dental problems such as dental caries, plaque formation, gingivitis, bad breath, and periodontal diseases. Among these, dental caries and gum diseases

are the most common oral health disorders affecting people of all age groups worldwide. Dental caries occurs due to the demineralization of tooth enamel caused by acid-producing bacteria, while gum diseases are mainly caused by bacterial infections and inflammation of the gum tissues. Improper brushing habits, consumption of sugary foods, smoking, and poor oral care practices are major factors responsible for these conditions [1-3].

Toothpaste is one of the most commonly used oral care products for maintaining dental hygiene and preventing oral infections. Conventional toothpastes generally contain synthetic chemicals such as fluoride, triclosan, sodium lauryl sulfate, artificial sweeteners, and preservatives. Although these ingredients are effective in cleaning teeth and preventing bacterial growth, prolonged use may produce certain side effects including tooth sensitivity, mouth irritation, discoloration of teeth, and allergic reactions. Due to increasing awareness regarding the harmful effects of synthetic chemicals, there has been a growing interest in the use of herbal and natural products for oral healthcare [4, 5].

Herbal toothpaste formulations are gaining popularity because they are prepared using natural plant materials that possess medicinal properties and are considered safer than chemical-based formulations. Medicinal plants have been used since ancient times in traditional systems of medicine such as Ayurveda, Siddha, and Unani for treating oral and dental disorders. Herbal ingredients contain various bioactive compounds such as alkaloids, flavonoids, tannins, essential oils, and phenolic compounds that exhibit antibacterial, anti-inflammatory, antioxidant, antiseptic, and analgesic activities [6]. These properties help in reducing bacterial growth, preventing plaque formation,

soothing inflamed gums, and maintaining fresh breath. Polyherbal formulations are prepared by combining two or more herbal ingredients to achieve synergistic therapeutic effects. In polyherbal toothpaste, different medicinal herbs are incorporated together to enhance oral health benefits. Commonly used herbs in toothpaste formulations include neem, clove, tulsi, peppermint, aloe vera, babool, turmeric, and guava leaves. Neem possesses strong antibacterial and antifungal properties that help in preventing plaque and dental caries. Clove contains eugenol, which acts as a natural analgesic and antiseptic useful in relieving toothache and gum pain. Tulsi exhibits antimicrobial and antiinflammatory activities that protect against oral infections. Peppermint provides a cooling effect and freshens breath, while aloe vera helps in soothing gum inflammation and promoting healing [7-10].

The formulation of polyherbal toothpaste involves the use of herbal extracts along with excipients such as abrasives, binders, humectants, foaming agents, preservatives, sweeteners, and flavoring agents. The prepared toothpaste should possess acceptable physicochemical properties including suitable pH, smooth texture, foamability, spreadability, stability, and cleaning ability. Evaluation of herbal toothpaste is important to ensure its safety, effectiveness, and quality. Antimicrobial studies are also performed to determine the effectiveness of the formulation against oral pathogens responsible for dental caries and gum diseases [11, 12]. The present study focuses on the formulation and evaluation of a polyherbal toothpaste using various medicinal plant extracts for the prevention of dental caries and gum diseases. The study aims to develop a safe, effective, economical, and eco-friendly herbal toothpaste that can serve as an alternative to commercially available synthetic toothpastes. The formulated toothpaste may help in improving oral hygiene, reducing bacterial infections, strengthening gums, and maintaining healthy teeth without producing harmful side effects [13].

## II. REVIEW OF LITERATURE

S. Prasanth, R. R. Kumar, and P. Ramesh conducted a study on the formulation and evaluation of herbal toothpaste containing neem and clove extracts for maintaining oral hygiene and preventing dental infections. The authors highlighted that neem possesses strong antibacterial and antifungal

properties, while clove contains eugenol, which acts as a natural analgesic and antiseptic agent. In their research, the herbal toothpaste was prepared using natural ingredients along with suitable excipients such as abrasives, binders, and flavoring agents. The formulated toothpaste was evaluated for various physicochemical parameters including pH, foamability, spreadability, stability, and homogeneity. The results indicated that the herbal toothpaste showed satisfactory physical properties and effective antimicrobial activity against oral pathogens responsible for dental caries and gum diseases. The study concluded that herbal toothpaste containing neem and clove can serve as a safer and effective alternative to synthetic toothpaste formulations due to its natural therapeutic properties and minimal side effects.

A. Sharma and P. Gupta presented a comprehensive review on herbal toothpaste formulations and their therapeutic applications in oral healthcare. The authors discussed the increasing demand for herbal oral care products due to growing awareness regarding the harmful effects of synthetic chemicals used in commercial toothpaste. The review emphasized the medicinal importance of various herbs such as neem, tulsi, clove, peppermint, aloe vera, babool, and turmeric in maintaining oral hygiene. According to the study, these herbs possess antibacterial, anti-inflammatory, antioxidant, and antiseptic properties that help in preventing plaque formation, dental caries, gingivitis, and bad breath. The review also described the formulation components and evaluation parameters of herbal toothpaste, including pH, abrasiveness, foamability, and antimicrobial activity. The authors concluded that herbal toothpaste formulations are safe, economical, eco-friendly, and highly beneficial for long-term oral care management.

R. K. Patel and M. Singh investigated the antimicrobial activity of herbal dentifrice against oral pathogens associated with dental diseases. The study focused on evaluating the effectiveness of herbal formulations in controlling bacterial growth responsible for plaque accumulation, tooth decay, and gum infections. Various medicinal plant extracts known for their antimicrobial activity were incorporated into the dentifrice formulation. The prepared herbal toothpaste was tested against common

oral microorganisms using microbiological techniques. The results demonstrated significant antibacterial activity of the herbal dentifrice against oral pathogens compared to conventional formulations. The authors observed that the natural ingredients effectively reduced microbial growth without causing harmful side effects. The study concluded that herbal dentifrice can be used as an effective oral healthcare product for preventing dental caries and improving gum health through its natural antimicrobial properties. S. Rani and R. Hiremanth carried out research on the formulation and evaluation of polyherbal toothpaste for oral hygiene applications. The study aimed to develop a herbal toothpaste using multiple medicinal plant extracts with synergistic therapeutic effects. Different herbal ingredients possessing antibacterial, anti-inflammatory, and antioxidant activities were selected for the formulation process. The prepared toothpaste was evaluated for parameters such as consistency, pH, spreadability, stability, foamability, and cleaning efficiency. The results revealed that the polyherbal toothpaste exhibited good physicochemical characteristics and acceptable stability during storage conditions. Furthermore, the formulation showed effective cleansing action and antimicrobial activity against oral bacteria. The authors concluded that polyherbal toothpaste formulations can improve oral hygiene naturally and may reduce the dependence on synthetic oral care products.

P. Kaur and S. K. Sharma reviewed the role of natural herbal products in oral care and their significance in preventing oral diseases. The authors explained that herbal medicines have been traditionally used in Ayurveda and other medicinal systems for treating toothache, gum inflammation, mouth ulcers, and bad breath. The review highlighted the pharmacological properties of medicinal plants commonly used in oral care products, including antibacterial, anti-inflammatory, analgesic, and antioxidant effects. The study emphasized that herbal formulations are generally safer than synthetic products because they produce fewer adverse reactions and are suitable for long-term use. The authors also discussed the advantages of herbal toothpaste, mouthwash, and tooth powders in maintaining oral hygiene and reducing dental infections. The review concluded that herbal oral care products have strong potential for future

development due to their therapeutic effectiveness and natural origin.

V. Kumar, A. Verma, and N. Yadav studied the preparation and evaluation of herbal toothpaste using medicinal plants for oral healthcare applications. The research focused on developing a toothpaste formulation containing herbal extracts with antibacterial and anti-inflammatory properties. Various ingredients such as neem, tulsi, clove, and peppermint were incorporated into the formulation to enhance oral hygiene and freshness. The prepared toothpaste was evaluated for physicochemical properties including pH, consistency, spreadability, foamability, and stability. Antimicrobial testing was also performed against oral pathogens responsible for dental caries and gum diseases. The results indicated that the herbal toothpaste possessed acceptable physical characteristics and significant antimicrobial activity. The study concluded that herbal toothpaste formulations prepared using medicinal plants can effectively prevent oral infections and promote healthy teeth and gums naturally.

M. S. Ali investigated the antibacterial activity of neem and clove extracts in herbal dentifrice formulations. The study aimed to evaluate the effectiveness of these herbal ingredients against microorganisms responsible for oral infections and plaque formation. Neem extract was selected for its strong antimicrobial and antifungal properties, while clove extract was used because of its antiseptic and analgesic effects. The herbal dentifrice was prepared using suitable excipients and subjected to microbiological evaluation. The results showed that the combination of neem and clove extracts exhibited excellent antibacterial activity against common oral pathogens. The study also reported that the herbal dentifrice was safe, stable, and effective in reducing microbial growth. The author concluded that herbal dentifrice containing neem and clove extracts can be used as a natural alternative to chemical-based oral care products.

P. D. Patil and S. G. Patil conducted research on the formulation development and evaluation of herbal toothpaste using natural medicinal ingredients. The study focused on developing a safe and effective toothpaste capable of maintaining oral hygiene and preventing dental diseases. Herbal ingredients with

known antibacterial and anti-inflammatory activities were selected for the formulation. Various evaluation tests including pH determination, foamability, spreadability, homogeneity, and stability studies were carried out to assess the quality of the prepared toothpaste. The results demonstrated that the herbal toothpaste possessed good physicochemical properties and acceptable antimicrobial effectiveness against oral pathogens. The authors emphasized that herbal toothpaste formulations are beneficial due to their natural composition, lower toxicity, and improved patient acceptability compared to synthetic products.

K. Mehta and R. Sharma discussed the applications of herbal medicine in oral healthcare and highlighted the importance of medicinal plants in preventing dental disorders. The review explained that herbal medicines contain bioactive compounds such as flavonoids, alkaloids, tannins, and essential oils that contribute to their therapeutic properties. The authors described the role of herbal ingredients like neem, clove, tulsi, aloe vera, and peppermint in controlling bacterial growth, reducing inflammation, and maintaining fresh breath. The study also emphasized the increasing popularity of herbal oral care products due to consumer preference for natural and safer alternatives. According to the authors, herbal formulations are economical, biodegradable, and less harmful compared to synthetic oral care products. The review concluded that herbal medicine has significant potential in the development of effective oral healthcare formulations.

S. B. Patil conducted a study on the evaluation of physicochemical parameters of herbal toothpaste formulations. The research mainly focused on assessing the quality, stability, and effectiveness of herbal toothpaste prepared using medicinal plant extracts. Different evaluation tests such as pH measurement, spreadability, foamability, abrasiveness, homogeneity, and stability analysis were carried out to determine the suitability of the formulation for oral use. The results showed that the herbal toothpaste exhibited appropriate pH and satisfactory physical characteristics required for maintaining oral hygiene. The study also indicated that the herbal ingredients provided antimicrobial and cleansing effects without causing irritation or harmful side effects. The author concluded that proper evaluation of physicochemical

properties is essential for ensuring the safety, stability, and quality of herbal toothpaste formulations intended for oral healthcare applications.

### III. MATERIAL AND METHODS Materials

The materials used for the formulation of polyherbal toothpaste were collected from local herbal stores and pharmaceutical suppliers. Fresh and dried herbal ingredients such as neem leaves, clove, tulsi leaves, aloe vera gel, and peppermint oil were selected because of their antibacterial, anti-inflammatory, antiseptic, and antioxidant properties beneficial for oral healthcare [14, 15]. Calcium carbonate was used as an abrasive agent for cleaning teeth, glycerin was used as a humectant to maintain moisture, sodium lauryl sulfate was used as a foaming agent, sodium benzoate was used as a preservative, and distilled water was used as the vehicle for preparation of the toothpaste formulation.

Table 1: Materials Used

S. No.	Material	Function
1	Neem Extract	Antibacterial agent
2	Clove Extract	Analgesic and antiseptic
3	Tulsi Extract	Anti-inflammatory agent
4	Aloe Vera Gel	Healing and soothing agent
5	Peppermint Oil	Flavoring agent
6	Calcium Carbonate	Abrasive
7	Glycerin	Humectant
8	Sodium Lauryl Sulfate	Foaming agent
9	Sodium Benzoate	Preservative
10	Distilled Water	Vehicle





#### Methods Preparation of Herbal Extracts

The selected medicinal plants such as neem and tulsi leaves were washed thoroughly with distilled water to remove dust and impurities. The plant materials were shade dried for several days and then powdered using a grinder [16, 17]. The powdered materials were subjected to extraction using ethanol or distilled water through maceration or Soxhlet extraction methods. The obtained extracts were filtered and concentrated for further use in toothpaste preparation.

Clove extract and aloe vera gel were prepared separately and stored under suitable conditions.

#### Formulation of Polyherbal Toothpaste

The toothpaste was prepared by mixing all ingredients in suitable proportions. Initially, calcium carbonate was triturated properly to obtain a smooth base. Glycerin and distilled water were added slowly with continuous stirring to form a homogeneous paste. Herbal extracts of neem, clove, tulsi, and aloe vera were then incorporated into the mixture. Sodium lauryl sulfate was added to provide foaming action, while sodium benzoate was included as a preservative. Finally, peppermint oil was added for flavor and freshness. The prepared formulation was mixed thoroughly until a smooth and uniform toothpaste consistency was obtained.

#### Evaluation Parameters

The formulated polyherbal toothpaste was evaluated for various physicochemical and antimicrobial parameters.

##### 1. Physical Appearance

The toothpaste was visually examined for color, odor, texture, and homogeneity.

##### 2. pH Determination

The pH of the toothpaste was measured using a digital pH meter to ensure suitability for oral use.

##### 3. Spreadability

Spreadability was determined by placing a small quantity of toothpaste between two glass slides and measuring its spreading capacity.

##### 4. Foamability

Foamability was evaluated by shaking the toothpaste solution in a measuring cylinder and observing foam formation.

##### 5. Stability Study

The formulation was stored at room temperature and observed for changes in color, odor, texture, and phase separation over a specific period.

##### 6. Antimicrobial Activity

The antimicrobial activity of the toothpaste was evaluated against oral pathogens using agar well diffusion method. The zone of inhibition was measured to determine antibacterial effectiveness.

##### 7. Irritation Test

The toothpaste formulation was tested for any irritation or harmful effects on oral tissues to ensure safety during use.

The overall methodology confirmed the successful formulation and evaluation of a stable and effective polyherbal toothpaste suitable for maintaining oral hygiene and preventing dental caries and gum diseases.

## IV. RESULTS AND DISCUSSION

The formulated polyherbal toothpaste was successfully prepared using various medicinal plant extracts such as neem, clove, tulsi, peppermint, and

aloe vera along with suitable excipients including abrasives, binders, humectants, sweetening agents, and flavoring agents. The prepared formulation was evaluated for different physicochemical and antimicrobial parameters to determine its effectiveness, stability, and suitability for oral healthcare applications. The obtained results demonstrated that the herbal toothpaste possessed acceptable quality characteristics and showed promising activity against oral pathogens responsible for dental caries and gum diseases [18-22].

The physical appearance of the formulated toothpaste was found to be smooth, homogeneous, and free from any gritty particles. The color and odor of the toothpaste were acceptable due to the presence of natural herbal ingredients and flavoring agents. The formulation exhibited good consistency and spreadability, which ensured easy application during brushing. The pH of the toothpaste was found to be within the acceptable range for oral preparations, indicating that the formulation is safe for teeth and gums and does not cause irritation or enamel damage during regular use.

Foamability and cleansing ability are important parameters for evaluating toothpaste formulations. The prepared polyherbal toothpaste showed satisfactory foam formation and good cleaning action due to the balanced composition of ingredients used in the formulation. Adequate foamability helps in effective removal of food particles, plaque, and microorganisms from the tooth surface. The spreadability test confirmed that the toothpaste could spread uniformly on the toothbrush and teeth surface, which improves cleaning efficiency and user acceptability [23, 24].

The stability study revealed that the prepared toothpaste remained stable under normal storage conditions without any significant changes in color, odor, texture, or phase separation. This indicates that the formulation possesses good shelf stability and can maintain its effectiveness over a longer period of time. The homogeneity test showed uniform distribution of ingredients throughout the formulation, which is essential for obtaining consistent therapeutic activity. Antimicrobial evaluation of the polyherbal toothpaste demonstrated significant inhibitory activity against common oral microorganisms responsible for dental plaque, tooth decay, gingivitis, and bad breath. Neem and clove extracts exhibited strong antibacterial

effects due to the presence of bioactive compounds such as eugenol, flavonoids, and tannins. Tulsi and aloe vera contributed anti-inflammatory and antioxidant properties that help in reducing gum swelling and promoting oral tissue healing. Peppermint provided a cooling sensation and maintained fresh breath for a longer duration. The synergistic combination of multiple herbal ingredients enhanced the overall antimicrobial effectiveness of the toothpaste formulation.

The results obtained from the study indicate that the formulated polyherbal toothpaste can effectively maintain oral hygiene and prevent dental infections naturally. Compared to synthetic toothpaste formulations, the herbal toothpaste showed better safety profile with minimal chances of adverse effects such as tooth sensitivity, irritation, or allergic reactions. In addition, the use of natural medicinal plants makes the product economical, eco-friendly, and suitable for long-term daily use. The study also supports the growing demand for herbal healthcare products due to increased awareness regarding the harmful effects of chemical-based formulations.

Overall, the formulated polyherbal toothpaste demonstrated satisfactory physicochemical characteristics, stability, and significant antimicrobial activity against oral pathogens. The study confirms that herbal toothpaste can serve as a safe and effective alternative to commercial synthetic toothpaste for the prevention of dental caries, gum diseases, and maintenance of overall oral health.

Table 2: Composition of Polyherbal Toothpaste Formulation

S. No.	Ingredients	Quantity (%)	Function
1	Neem Extract	5%	Antibacterial agent
2	Clove Extract	3%	Analgesic and antiseptic
3	Tulsi Extract	4%	Anti-inflammatory agent
4	Aloe Vera Gel	5%	Soothing and healing agent
5	Peppermint Oil	1%	Flavoring and freshening agent
6	Calcium Carbonate	25%	Abrasive agent
7	Glycerin	15%	Humectant

8	Sodium Benzoate	0.5%	Preservative
9	Sodium Lauryl Sulfate	2%	Foaming agent
10	Distilled Water	q.s.	Vehicle

Table 3: Evaluation Parameters of Polyherbal Toothpaste

Parameters	Observation/Result
Color	Light Green
Odor	Pleasant Herbal Odor
pH	6.8 – 7.2
Homogeneity	Good
Spreadability	Excellent
Foamability	Good
Stability	Stable
Antimicrobial Activity	Effective against oral pathogens
Irritation Test	No irritation observed
Overall Acceptability	Satisfactory

## V. CONCLUSION

The present study successfully focused on the formulation and evaluation of a polyherbal toothpaste for the prevention of dental caries and gum diseases using various medicinal plant extracts such as neem, clove, tulsi, peppermint, and aloe vera. The prepared herbal toothpaste demonstrated satisfactory physicochemical characteristics including acceptable pH, smooth texture, good spreadability, foamability, homogeneity, and stability. The herbal ingredients used in the formulation possess significant antibacterial, anti-inflammatory, antiseptic, antioxidant, and analgesic properties that contribute to maintaining proper oral hygiene and protecting the oral cavity from microbial infections. The antimicrobial studies confirmed that the formulated toothpaste was effective against common oral pathogens responsible for plaque formation, dental caries, bad breath, and gum inflammation. Unlike synthetic toothpaste formulations, the polyherbal toothpaste provides a natural and safer alternative with

minimal side effects and better patient acceptability. The combination of multiple herbs in a single formulation produced synergistic therapeutic effects that enhanced the overall effectiveness of the toothpaste. In addition, the use of natural ingredients makes the product economical, ecofriendly, and suitable for long-term use. Therefore, the formulated polyherbal toothpaste can be considered an effective herbal oral care product for maintaining healthy teeth and gums, preventing dental diseases, and promoting overall oral health. Further clinical and microbiological studies may be carried out to evaluate its long-term safety, efficacy, and commercial applicability in the field of herbal dentistry and oral healthcare.

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