
FORMULATION OF HERBAL TOOTHPASTE USING CLOVE AND NEEM EXTRACTS

^{*1}Amit Singh, ²Dr. R. B. Goswami

Student, Sagar Institute of Research Technology & Science-Pharmacy, Bhopal¹

Director, Sagar Institute of Research Technology & Science-Pharmacy, Bhopal²

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*Corresponding Author: Amit Singh

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Student, Sagar Institute of Research Technology & Science-Pharmacy, Bhopal1

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ABSTRACT

Herbal toothpaste is widely used for maintaining oral hygiene and preventing dental diseases due to its natural therapeutic properties and minimal side effects. The present study focuses on the formulation and evaluation of herbal toothpaste containing clove and neem extracts. Clove possesses strong antimicrobial, analgesic, and anti-inflammatory properties because of the presence of eugenol, while neem is well known for its antibacterial, antifungal, and plaque-reducing activities. The herbal toothpaste was prepared using natural ingredients such as calcium carbonate, glycerin, peppermint oil, gum acacia, and suitable preservatives along with clove and neem extracts. The formulated toothpaste was evaluated for various physicochemical parameters including color, odor, taste, pH, spreadability, foamability, homogeneity, stability, and abrasiveness. Antimicrobial activity against common oral pathogens was also assessed. The results showed that the prepared herbal toothpaste exhibited good consistency, acceptable pH, pleasant odor, satisfactory cleaning ability, and effective antimicrobial action. The formulation was found to be stable and safe for regular use. Therefore, the developed herbal toothpaste can serve as an effective natural alternative to conventional chemical-based toothpaste for maintaining oral health and preventing dental infections.

KEYWORDS: Herbal toothpaste, Antimicrobial screening, Dental caries.

I. INTRODUCTION

Oral hygiene plays a vital role in maintaining overall health and preventing dental disorders such as dental caries, plaque, gingivitis, bad breath, and periodontal diseases. Toothpaste is

one of the most commonly used oral care products for cleaning teeth and maintaining healthy gums. Conventional toothpastes generally contain synthetic chemicals, detergents, artificial flavors, and preservatives which may produce side effects such as tooth sensitivity, mouth irritation, and staining after prolonged use. Due to increasing awareness regarding the harmful effects of chemical-based products, the demand for herbal formulations has increased significantly in recent years.

Herbal toothpaste is prepared using medicinal plant extracts and natural ingredients that possess antimicrobial, anti-inflammatory, antiseptic, and analgesic properties. Herbal formulations are considered safer, eco-friendly, cost-effective, and suitable for long-term use. Among various medicinal plants, neem and clove are widely used in traditional medicine for oral care applications because of their excellent therapeutic benefits.

Neem (*Azadirachta indica*) is known for its strong antibacterial, antifungal, anti-inflammatory, and plaque-reducing properties. Neem extracts help in preventing gum infections, reducing plaque formation, and maintaining oral cleanliness. Clove (*Syzygium aromaticum*) contains eugenol, an active constituent responsible for its analgesic and antimicrobial activities. Clove is commonly used for relieving toothache, reducing oral infections, and providing freshness to the mouth.

The present study focuses on the formulation and evaluation of herbal toothpaste containing neem and clove extracts. The toothpaste was prepared using suitable natural excipients and evaluated for various physicochemical parameters such as color, odor, pH, spreadability, homogeneity, foamability, stability, and antimicrobial activity. The aim of the study is to develop an effective herbal toothpaste that can promote oral hygiene naturally with minimal side effects compared to synthetic commercial products.

II. ANATOMY AND PHYSIOLOGY OF TEETH

Teeth are important structures present in the oral cavity that help in chewing, biting, speaking, and maintaining the shape of the face. Human teeth are strong calcified structures embedded in the jaw bones. A healthy set of teeth is essential for proper digestion and overall oral health. The study of the structure and function of teeth is known as dental anatomy and physiology.

An adult human normally has 32 permanent teeth, while children have 20 temporary or deciduous teeth. Based on their functions, teeth are classified into four types: incisors, canines, premolars, and molars. Incisors are used for cutting food, canines for tearing, premolars for crushing, and molars for grinding food during mastication.

Each tooth consists of two main parts: the crown and the root. The crown is the visible portion above the gum line, while the root remains embedded within the jaw bone and supports the tooth firmly. The tooth is mainly composed of four tissues: enamel, dentin, pulp, and cementum.

1. Enamel:

Enamel is the outermost hard protective layer of the tooth crown. It is the hardest substance in the human body and protects the tooth from mechanical damage and decay.

2. Dentin:

Dentin lies beneath the enamel and forms the major portion of the tooth. It is less hard than enamel and contains microscopic tubules that transmit sensations such as pain and temperature.

3. Pulp:

The pulp is the innermost soft tissue region containing blood vessels, nerves, and connective tissues. It provides nourishment and sensory function to the tooth.

4. Cementum:

Cementum covers the root portion of the tooth and helps attach the tooth to the periodontal ligament, which connects the tooth to the jaw bone.

The teeth are supported by surrounding structures collectively known as the periodontium, which includes gums (gingiva), periodontal ligament, alveolar bone, and cementum. These supporting tissues maintain tooth stability and protect against infection.

Physiologically, teeth play a major role in mastication by breaking food into smaller particles, which aids digestion. Teeth also assist in speech articulation and improve facial appearance. Saliva present in the oral cavity helps protect teeth by neutralizing acids, washing away food particles, and preventing bacterial growth.

Poor oral hygiene can lead to dental problems such as plaque formation, dental caries, gingivitis, periodontal disease, tooth sensitivity, and bad breath. Therefore, maintaining proper oral hygiene through regular brushing and the use of effective herbal toothpaste is essential for healthy teeth and gums.

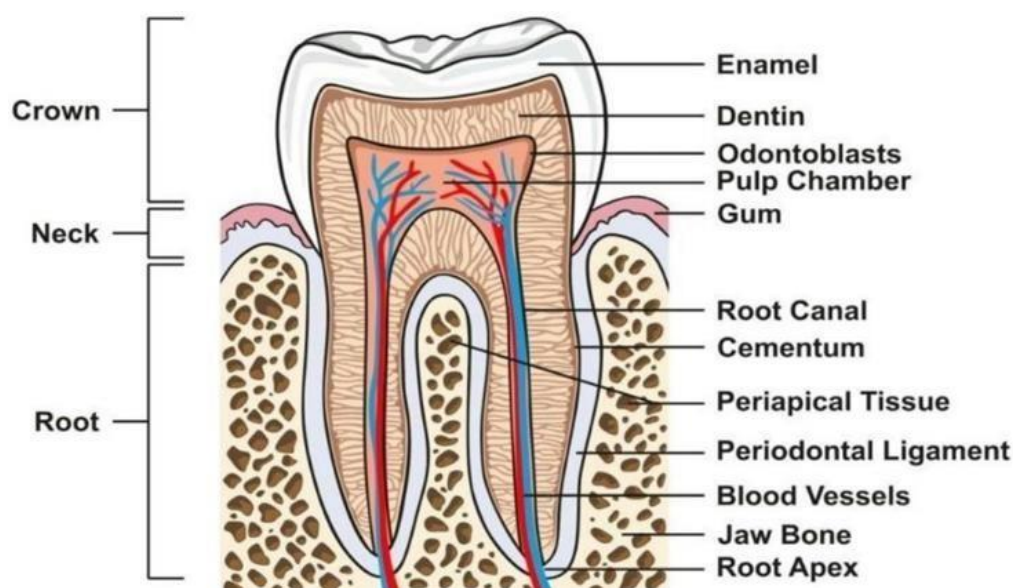


Figure 1: Anatomy and physiology of teeth.

Table 1: Formulation excipients used in toothpaste.

Sl.no	Excipients	Concentration range	Types	Uses
1.	Abrasives	9-13%	Dicalcium phosphate, Alumina, calcium carbonate	Remove food debris, stains as well as polishes the tooth surface.
2.	Humectants	37-45%	Glycerol, xylitol, water, PEG 8[Polyethylene glycol esters]	Provide moisture content and prevent formation of plug-in nozzle
3.	Binding agents	0.8-2.5%	Agar, Carrageenan, Gum tragacanth, Isapgol mucilage	Stability and consistency of the toothpaste can be
4.	Preservatives	0.05-0.5%	Formaldehyde, Benzoic acid, Parabens, Phenolics, citric acid.	Prevents growth of micro-organisms and
5.	Foaming agents	1-2%	Sodium lauryl sulphate, Sodium stearyl lactate, Amine fluorides, Dioctyl sodium sulfosuccinate	Assist in penetration of plaque deposition and enables
6.	Flavours	1-6%	Clove oil, Peppermint, Eucalyptus, Spearmint, aniseed, Fennel,	aniseed, Fennel,
7.	Colours	1-2%	Titanium chlorophyll diox	Impart colour to the toothpaste

Table 2: Herbs used in Dentistry.

S.no	Herbs	Biological	Chemical constituents	Uses
1.	Ginger	Ginger consists of the rhizome of <i>zingiber officinale</i> , family <i>Zingiberaceae</i> Roscoe and dried in the sun.	Curcumene, phenolic compounds include gingerol, parasols, and shogaol.	Stomachic, carminative, stimulant, flavoring agent, Reduce inflammation and pain, anticariogenic and antimicrobial.
2.	Neem	Neem consist of the fresh or dried leaves and seed oil of <i>Azadirachta Indica</i> , family <i>Meliaceae</i>	Diterpenes (sugiol), nimbiol (bark), triterpenes: beta-sitosterol, stigasterol (leaf), limonoids, Rutin, Nimbin	Antibacterial, Anti-inflammatory, Antiviral, Antisclerotic Toothache reliever.
3.	Aloe vera	Aloe is obtained from the dried juice of leaves of <i>Aloe barbadensis</i> , <i>Aloe ferox</i> , <i>Aloe perryi baker</i> . It is also known as <i>Curacao aloe</i> , <i>Cape aloe</i> , and <i>socotrine aloe</i> , family	Aloin, flavonoids, sterols, amino acids, aloeride.	Antiviral, Antifungal, treatment of mouth ulcer, denture adhesive, osteitis, plaque and gingivitis.

III.MATERIALS & METHODS

The materials used for the formulation of herbal toothpaste were collected from herbal stores and laboratory suppliers. Neem extract and clove extract were selected as the main active herbal ingredients due to their antimicrobial and anti-inflammatory properties.

Table 3: Batch formula: Active Ingredients.

Sr.No.	Ingredients	Quantity Given	Uses
1	Fenugreek Powder	2.5gm	Anti-inflammatory
2	Clove oil	0.02 gm	Dental Analgesic
3	Neem Powder	0.05gm	Antimicrobial
4	Aloe Vera gel	6gm	Antifungal, Anti-Viral Anti-inflammatory,
5	Trikatu Powder	0.03 gm	Anti-caries, Anti- Microbial
6	Pomegranate peel	1.6 gm	Antifungal, Anti- inflammatory

Other ingredients used in the formulation included calcium carbonate as an abrasive agent, glycerin as a humectant, gum acacia as a binding agent, sodium benzoate as a preservative, peppermint oil as a flavoring agent, saccharin sodium as a sweetening agent, and purified water as the vehicle.

Sr. No	Ingredients	Quantity	Uses
1	Calcium Carbonate	41gm	Abrasive
2	Sodium Fluoride	0.9gm	Anti caries agent[12]
3	Sorbitol	44gm	Humectant
4	Sodium lauryl Sulphate	1.5gm	Detergent and foaming agent
5	Sodium CMC	1.8gm	Binding agent
6	Methyl paraben	0.2gm	Preservative
7	Sodium benzoate	0.1gm	Preservative
8	Sodium saccharine	0.2gm	Sweetening agent
9	Peppermint oil	q.s	Flavoring agent

Method of Preparation

The herbal toothpaste was prepared by the standard trituration method. Initially, calcium carbonate and gum acacia were accurately weighed and mixed uniformly in a clean mortar. Neem extract and clove extract were then added gradually to the dry mixture with continuous stirring to obtain a homogeneous blend. Glycerin was added slowly to form a smooth paste consistency. After proper mixing, saccharin sodium and sodium benzoate dissolved in a small quantity of purified water were incorporated into the formulation. Peppermint oil was added at the final stage to provide flavor and freshness. The prepared toothpaste was triturated thoroughly until a smooth and uniform paste was obtained. The final formulation was transferred into a clean, airtight container and stored at room temperature for further evaluation.

Evaluation Parameters

The formulated herbal toothpaste was evaluated for various physicochemical parameters as follows:

1. Organoleptic Evaluation

The color, odor, taste, and appearance of the prepared toothpaste were observed visually.

2. pH Determination

The pH of the toothpaste was determined using a digital pH meter by preparing a 1% aqueous solution of the formulation.

3. Homogeneity

The toothpaste was checked for smoothness and uniform distribution of ingredients by visual inspection and touch.

4. Spreadability

Spreadability was determined by placing a small amount of toothpaste between two glass slides and observing the ease of spreading.

5. Foamability

Foamability was evaluated by shaking a measured quantity of toothpaste solution in a graduated cylinder and observing foam formation.

6. Stability Study

The formulated toothpaste was stored at room temperature and observed for changes in color, odor, consistency, and phase separation over a specified period.

7. Antimicrobial Activity

The antimicrobial activity of the herbal toothpaste was evaluated against common oral microorganisms using suitable microbiological methods to determine its effectiveness in controlling oral pathogens.

The obtained results were recorded and analyzed to determine the quality, stability, and effectiveness of the prepared herbal toothpaste formulation.

IV.RESULTS AND DISCUSSION

The formulated herbal toothpaste containing neem and clove extracts was successfully prepared and evaluated for various physicochemical and antimicrobial parameters. The obtained results demonstrated that the formulation possessed satisfactory characteristics suitable for oral hygiene applications.

Organoleptic Evaluation

The prepared toothpaste showed a smooth and homogeneous appearance with a light brown color due to the presence of herbal extracts. The formulation possessed a pleasant odor and refreshing taste because of peppermint oil. No grittiness or phase separation was observed, indicating proper mixing and uniform distribution of ingredients.

pH Determination

The pH of the herbal toothpaste was found to be within the acceptable range for oral formulations. The formulation showed a nearly neutral pH, which is suitable for maintaining oral health and preventing enamel damage or irritation to the gums.

Spreadability and Homogeneity

The toothpaste exhibited good spreadability and consistency, allowing easy application on the toothbrush. Homogeneity testing confirmed that all ingredients were uniformly distributed without the presence of lumps or coarse particles.

The present study demonstrated that herbal toothpaste formulated with neem and clove extracts possesses desirable physicochemical and antimicrobial properties. Neem is known for its antibacterial and anti-inflammatory action, which helps prevent gum diseases and plaque formation, whereas clove provides analgesic and antiseptic effects useful in relieving toothache and oral discomfort.

The formulated toothpaste showed acceptable pH, satisfactory spreadability, stability, and cleaning ability. The antimicrobial study confirmed that the herbal ingredients effectively inhibit the growth of oral pathogens responsible for dental caries and gum infections. Compared to synthetic toothpaste, the herbal formulation offers the advantage of reduced side effects and improved biocompatibility.

Therefore, the developed herbal toothpaste can be considered a safe, economical, and effective natural oral care product suitable for daily use.

Advantage of Natural Toothpaste

Free from Harmful Chemicals: Natural toothpaste does not contain harsh chemicals such as parabens, artificial colors, synthetic preservatives, and excessive fluoride, reducing the risk of side effects.

Safe for Long-Term Use: Herbal ingredients are generally safer and more biocompatible, making natural toothpaste suitable for regular and prolonged use.

Antimicrobial Properties: Natural ingredients such as neem and clove possess antibacterial and antifungal activities that help prevent plaque formation, tooth decay, and gum infections.

Reduces Gum Inflammation: Herbal components have anti-inflammatory properties that help reduce swelling, bleeding gums, and oral irritation.

Provides Natural Freshness: Essential oils and herbal extracts provide long-lasting freshness and help control bad breath naturally.

Less Tooth Sensitivity: Natural toothpaste is usually mild and causes less irritation or sensitivity compared to chemical-based toothpaste.

Eco-Friendly and Biodegradable: Herbal formulations are environmentally friendly because they contain biodegradable natural ingredients.

Cost-Effective: Many herbal ingredients are easily available and economical, making natural toothpaste affordable for consumers.

Promotes Overall Oral Health: Natural toothpaste helps maintain healthy teeth and gums while reducing the risk of oral diseases.

Suitable for Different Age Groups: Due to the use of mild herbal ingredients, natural toothpaste can be safely used by both children and adults.



Table 4: Comparison of natural vs conventional toothpaste.

Aspect	Natural Toothpaste	Conventional Toothpaste
Chemical Composition	Herbal ingredients, no synthetic additives	Fluoride, synthetic detergents, artificial colors
Environmental Impact	Recyclable packaging, biodegradable ingredients	Non-recyclable packaging, synthetic additives
Oral Health Benefits	Antibacterial, anti-inflammatory, antiseptic properties	Effective in oral care, but may have synthetic chemicals
Holistic Well-being	Herbal extracts provide therapeutic benefits	Focuses on oral hygiene only
Common Ingredients	Neem, clove, turmeric, banyan tree bark, sage, licorice root, cardamom	Fluoride, SLS, artificial colors

Table 5: Ingredients of natural toothpastes.

Ingredient	Description and Benefits
Neem (Azadirachta indica)	Possesses antibacterial, antifungal, and antiseptic properties. Effective against gum diseases, cavities, and dental plaque.
Clove (Syzygium aromaticum)	Offers analgesic properties, providing relief from toothaches. It also has strong antimicrobial and antifungal effects.
Turmeric (Curcuma longa)	Known for its anti-inflammatory, antiseptic, and antioxidant properties. Effective in maintaining gum health and preventing oral infections.
Banyan Tree Bark (Ficus benghalensis)	Helps in strengthening teeth and gums.
Sage (Salvia officinalis)	Reduces oral bacteria and freshens breath.
Licorice Root (Glycyrrhiza glabra)	Soothes irritation and inflammation in the mouth.

**NEEM****CLOVE**

V.CONCLUSION

The present study successfully formulated and evaluated a herbal toothpaste containing neem and clove extracts. The herbal ingredients were selected because of their excellent antimicrobial, anti-inflammatory, analgesic, and plaque-reducing properties, which are beneficial for maintaining oral hygiene and preventing dental disorders. The prepared toothpaste showed satisfactory physicochemical characteristics such as good appearance, pleasant odor, acceptable pH, smooth consistency, adequate foamability, and good spreadability.

The antimicrobial evaluation indicated that the formulation was effective against common oral microorganisms responsible for dental caries and gum infections. The stability study also confirmed that the toothpaste remained stable without significant changes in color, odor, or

consistency during storage. The use of natural herbal ingredients makes the formulation safer and more suitable for long-term use compared to conventional chemical-based toothpastes. Therefore, the formulated herbal toothpaste containing neem and clove extracts can be considered an effective, economical, and safe alternative for promoting oral health and maintaining proper dental hygiene naturally.

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