



The Role of Herbal Ingredients in Oral Hygiene: A Review of Herbal Toothpaste

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ABSTRACT:

Toothpaste is a widely utilized product among individuals. Its primary function is to clean the teeth and mouth, while it also serves to address various dental disorders. Numerous dentists advocate for the use of toothpaste to manage conditions such as sensitivity and chronic gingivitis. Herbal toothpastes can be formulated using various herbal extracts derived from numerous medicinal plants known for their antibacterial and antimicrobial properties. Common ingredients in these herbal formulations include extracts from ginger, Cassia siminia, Celastrus paniculata, Vateria indica, Babul leaves, lemon oil, neem stem and bark, guava leaves, and Kalmi bark. The efficacy of these herbal toothpastes can be assessed through a range of tests, including physical examination, relative density, abrasiveness, spreadability, pH determination, homogeneity, foaming capacity, stability, moisture content, organoleptic evaluation, fragrance assessment, shape retention, storage stability, and total flavonoid content estimation. The primary aim of this review article is to consolidate existing information regarding herbal toothpaste, encompassing its introduction, various formulations, and the parameters for evaluation. This compilation may serve as a valuable resource for researchers interested in exploring this field further.

Keywords: Herbal toothpaste, Oral hygiene, Chronic gingivitis, Neem, Periodontitis, Ginger, Clove, Antiplaque.

INTRODUCTION:

Toothpastes represent a highly effective preventive measure for maintaining oral health. While many commercially available toothpastes claim to possess antimicrobial properties, there is a notable lack of comprehensive research to substantiate these claims. Historically, the use of toothpaste for cleaning teeth dates back over 2000 years, and traditional methods such as toothpicks and brushes continue to be relevant today. Contemporary toothpastes incorporate many principles that have evolved over centuries. In India, the use of natural or Ayurvedic remedies for oral health is deeply rooted in tradition, with numerous Ayurvedic toothpastes on the market asserting superior antimicrobial benefits.

Herbal-based toothpastes have been integral to oral hygiene since ancient times. The origins of toothpaste production can be traced back to China and India around 300-500 BC, where materials such as crushed bones, eggshells, and mussel shells served as abrasives for dental cleaning. The modern toothbrush emerged in the 19th century, coinciding with advancements in medicine that introduced chalk and soap into toothpaste formulations. Following independence, significant progress was made in developing various formulations, including the incorporation of sodium lauryl sulfate as an emulsifying agent. Currently, the emphasis in toothpaste development is on the effective release of active ingredients aimed at preventing and treating oral diseases.

Advantages of Herbal Toothpaste

1. Effective abrasive properties
2. Safe and gentle on the skin
3. Does not leave discoloration on teeth
4. Promotes oral hygiene and freshness
5. Provides enduring results
6. Economical and readily available
7. Should not pose any risk to oral tissues or fluids, nor cause tooth discoloration.
8. Must not damage the enamel surface of teeth and should be safe for gastrointestinal ingestion.

9. Should possess a pleasant fragrance and flavor, without causing harm to oral fluids and tissues.

Benefits of Applying Herbal Toothpastes

1. It aids in the prevention of dental diseases.
2. It effectively cleans the teeth.
3. It promotes oral airflow.
4. It helps to avert gum disease.
5. Herbal Toothpaste is formulated from natural components, including Ayurvedic elements, natural oils, minerals, and herbal extracts.
6. Consistent use of Herbal Toothpaste contributes to the resolution of dental issues.
7. Herbal Toothpaste is free from side effects.

Method of formulation:

There are two types of methods for formulation of toothpastes, viz.

1. Dry gum method,
2. Wet gum method,

Dry Gum Method:

Preparation of Base:

1. The solid components, including calcium carbonate, sodium fluoride, SLS, sodium CMC, methyl paraben, sodium benzoate, and sodium saccharin, were precisely measured according to the specified formula and subsequently passed through a sieve with a mesh size of 80 to ensure uniform particle size.
2. These ingredients were then combined using a mortar and pestle, where they were triturated with a carefully weighed amount of sorbitol until a semisolid consistency was achieved.

Incorporation of Herbal Ingredients:

3. Herbal extracts, in powdered form, were accurately measured, sieved, and incorporated into the base along with Aloe Vera gel and clove oil.
4. Finally, peppermint oil was introduced as a flavoring agent.

Bases

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

MATERIAL AND METHOD:

A specific formulation of herbal toothpaste is created by incorporating various ingredients, including Fenugreek Powder for its anti-inflammatory properties, Clove Oil as a dental analgesic, and Neem Powder known for its antimicrobial effects. Additionally, Aloe Vera gel is included to help prevent infections due to its antifungal, antiviral, and anti-inflammatory characteristics. Trikatu Powder serves as an anti-caries and antimicrobial agent, while Pomegranate Peel contributes antifungal and anti-inflammatory benefits. The mixture is combined with a base that contains Calcium Carbonate as an abrasive, Sodium Fluoride as an anti-caries agent, Sorbitol as a humectant, Sodium Lauryl Sulphate as a detergent and foaming agent, and Sodium CMC as a binding agent. Preservatives such as Methyl Paraben and Sodium Benzoate are utilized, along with Sodium Saccharin as a sweetening agent and Peppermint Oil for flavoring. This formulation is then compared and evaluated against commercially available herbal toothpaste. The method employed for creating the herbal toothpaste involves homogenization using a mortar and pestle to establish the toothpaste base.



Fig-1:Fenugreek powder



Fig-2:Clove oil



Fig-3:Neem powder



Fig-4:Aleo vera gel



Fig-5: Trikatu powder



Fig-6:Pomegranate peel

Selection of Herbal Ingredients

The selection of herbal ingredients in herbal toothpaste is a crucial aspect that contributes to its effectiveness and appeal. Various herbs are chosen for their specific properties that can promote oral health and hygiene.

Common herbs and plant extracts in toothpaste

The use of herbal components in oral hygiene products, including toothpaste and mouthwash, is a prevalent practice. Prominent herbs such as Peppermint (*Mentha piperita*), Tea Tree Oil, Licorice (*Glycyrrhiza glabra*), Miswak (*Salvadora persica*), Triphala, sanguinarine, Babul (*Acacia arabica*), Ginger (*Zingiber officinale*), propolis, Azadirachta indica (neem), charcoal, clove, and miswak are commonly employed. In rural areas of South Asia, the traditional use of natural items like neem twigs and charcoal powder for daily oral care highlights the cultural importance of herbal remedies. Additionally, numerous herbal and plant extracts have been acknowledged for their potential anti-inflammatory, antipyretic, analgesic, antibacterial, antiviral, anticarcinogenic, and antioxidant effects, as evidenced by various *in vitro*, *in vivo*, and animal studies.

The therapeutic properties and advantages of herbal ingredients in toothpaste enhance the overall efficacy and attractiveness of these natural oral care solutions. Key properties and benefits include:

- Antibacterial: Numerous herbal components, such as neem, clove, and tea tree oil, exhibit antibacterial characteristics that aid in eliminating harmful bacteria in the oral cavity, thereby preventing cavities and periodontal disease.
- Anti-inflammatory: Herbs like aloe vera, licorice, and ginger demonstrate anti-inflammatory effects, alleviating and diminishing gum inflammation.
- Antioxidant: Certain herbs, including green tea extract and Triphala, are rich in antioxidants that help neutralize free radicals, thereby supporting overall oral health.
- Analgesic: Clove is recognized for its pain-relieving qualities, offering alleviation from toothaches and associated discomfort.
- Astringent: Herbs such as babul and miswak serve as astringents, enhancing gum health by firming tissues and minimizing bleeding.
- Refreshing: Peppermint and menthol deliver a refreshing taste while aiding in the maintenance of fresh breath.
- Healing: Aloe vera possesses healing attributes that can support the recovery of oral tissues and foster a healthy oral environment.
- Caries Prevention: Substances like licorice and propolis are thought to assist in the prevention of dental caries.
- Anti-plaque: Herbal components such as miswak and sage are linked to anti-plaque effects, helping to inhibit plaque buildup on teeth.
- Mineralizing: Certain herbal ingredients, including Triphala, may play a role in remineralizing tooth enamel, thereby improving overall tooth strength.

Active Ingredients

1. Neem (*Azadirachta indica*)

Properties: Antibacterial, antifungal, anti-inflammatory.

Benefits: Helps fight oral infections, reduces plaque, prevents cavities, and soothes gum inflammation.

2. Clove Oil (*Syzygium aromaticum*)

Properties: Antimicrobial, anesthetic, antioxidant.

Benefits: Relieves toothache, fights oral bacteria, and helps maintain gum health.

3. Peppermint Oil (*Mentha piperita*)

Properties: Antimicrobial, anti-inflammatory, refreshing.

Benefits: Provides a fresh breath, reduces oral bacteria, and soothes gums.

4. Tea Tree Oil (*Melaleuca alternifolia*)

Properties: Antibacterial, antifungal, antiviral.

Benefits: Fights infections, reduces bad breath, and aids in healing gum inflammation.

5. Tulsi (Holy Basil) (*Ocimum sanctum*)

Properties: Antibacterial, antioxidant, anti-inflammatory.

Benefits: Helps prevent plaque formation and fights against oral pathogens.

6. Miswak (*Salvadora persica*)

Properties: Antibacterial, abrasive.

Benefits: Provides mechanical cleaning of teeth, strengthens gums, and fights plaque formation.

7. Aloe Vera (*Aloe barbadensis*)

Properties: Anti-inflammatory, soothing, antimicrobial.

Benefits: Heals gum inflammation, soothes irritated oral tissues, and helps in maintaining oral health.

8. Licorice (*Glycyrrhiza glabra*)

Properties: Antimicrobial, anti-inflammatory.

Benefits: Reduces tooth decay, fights oral infections, and promotes healthy gums.

9. Eucalyptus Oil (*Eucalyptus globulus*)

Properties: Antibacterial, anti-inflammatory.

Benefits: Helps reduce plaque, prevents gum disease, and freshens breath.

10. Turmeric (*Curcuma longa*)

Properties: Antibacterial, anti-inflammatory, antioxidant.

Benefits: Helps in reducing plaque, preventing gum diseases, and soothing oral inflammation.

11. Myrrh (*Commiphora myrrha*)

Properties: Antiseptic, anti-inflammatory.

Benefits: Treats gum infections, heals mouth ulcers, and promotes overall gum health.

12. Cinnamon Oil (*Cinnamomum verum*)

Properties: Antibacterial, antifungal, anti-inflammatory.

Benefits: Fights bad breath, reduces oral bacteria, and provides a pleasant taste.

13. Propolis

Properties: Antimicrobial, anti-inflammatory.

Benefits: Promotes oral healing, prevents plaque formation, and supports gum health.

14. Fennel (*Foeniculum vulgare*)

Properties: Antibacterial, antioxidant.

Benefits: Helps in fighting bad breath and maintaining oral freshness.

15. Camphor (*Cinnamomum camphora*)

Properties: Antimicrobial, analgesic.

Benefits: Provides relief from toothache and fights infections.

16. Guava Leaf Extract (*Psidium guajava*)

Properties: Antibacterial, anti-inflammatory.

Benefits: Helps in controlling gingivitis and reducing oral infections.

17. Ginger (*Zingiber officinale*)

Properties: Anti-inflammatory, antioxidant.

Benefits: Soothes gum irritation, helps in reducing bad breath, and promotes oral health.

Evaluation of Herbal Toothpaste

The evaluation process ensures the toothpaste is effective, safe, and stable.

1. Physical Evaluation

- Appearance: Check for color uniformity and the presence of any lumps or air bubbles.
- Consistency: The toothpaste should have a smooth, homogeneous texture.

- Spreadability: Evaluate by spreading a small amount on a flat surface to check if it spreads easily without excess effort.

2. pH Measurement

The pH of the toothpaste should be neutral or slightly alkaline (6-7.5). This can be determined using a pH meter.

3. Foaming Ability

Although herbal toothpaste may foam less than commercial products with synthetic surfactants, a small amount of natural foaming should be present.

Foam stability and volume can be measured by shaking a mixture of the toothpaste with water.

4. Abrasiveness Test

Abrasiveness is crucial to ensure the toothpaste does not damage the enamel.

Abrasivity can be measured using a **RDA (Relative Dentin Abrasivity) value**.

5. Antibacterial Activity

The antibacterial efficacy of herbal toothpaste can be tested using agar diffusion methods against oral pathogens like *Streptococcus mutans*.

6. Stability Testing

Conduct stability tests at different temperatures and humidity levels to evaluate the product's shelf life. The product should not separate or degrade under different storage conditions.

7. Organoleptic Evaluation

Evaluate the sensory properties such as taste, smell, and mouthfeel by conducting a sensory panel test with volunteers

Objectives of Stability Testing

1. **To ensure product integrity:** The toothpaste should remain stable (i.e., no physical separation, color change, or odor development).
2. **To confirm the efficacy of active ingredients:** Herbal extracts and essential oils should retain their therapeutic properties.
3. **To check the microbial stability:** The toothpaste should not allow microbial growth, especially in the absence of synthetic preservatives.
4. **To determine shelf life:** Assess how long the toothpaste remains usable under normal and extreme conditions.

Types of Stability Tests

1. Accelerated Stability Testing

- Simulates long-term storage conditions in a shorter period by exposing the product to elevated temperatures and humidity levels.
- Common conditions:
 - **40°C ± 2°C** (high temperature)
 - **75% ± 5% RH (relative humidity)** for a period of 3 to 6 months.

2. Long-term Stability Testing

- Conducted under real-time storage conditions to determine the actual shelf life.
- Common conditions:
 - **25°C ± 2°C**
 - **60% ± 5% RH**, typically over 12 to 24 months.

3. Intermediate Stability Testing

- This test involves moderate storage conditions to bridge the gap between accelerated and long-term testing.
- Common conditions:
 - **30°C ± 2°C**
 - **65% ± 5% RH** over 6 to 12 months.

Parameters for Stability Testing

Stability testing evaluates the product's various attributes under different environmental conditions:

1. Physical Stability

Appearance: Check for changes in color, texture, or separation of phases (i.e., separation of water from the toothpaste base).

Consistency: The toothpaste should maintain a smooth texture without drying out, hardening, or becoming runny.

pH: Measure the pH periodically to ensure it remains stable within the desired range (typically 6-7.5). A drastic change in pH may indicate product degradation.

Odor: Herbal toothpaste containing essential oils can develop off-odors over time. Evaluate changes in fragrance.

Taste: Regularly check the flavor to ensure it remains palatable and does not develop a bitter or unpleasant taste.

2. Chemical Stability

Active Ingredient Potency: Herbal extracts and essential oils may degrade over time. Using chromatographic methods (such as HPLC), you can measure the concentration of key active compounds (e.g., neem extract, clove oil) at regular intervals to ensure they remain effective.

Moisture Content: Excessive moisture loss or absorption can affect the consistency and spreadability of the toothpaste. Evaluate the moisture content using a moisture analyzer.

Oxidation: Monitor for the oxidation of any natural oils or herbal extracts, which can affect efficacy and lead to rancidity or color changes.

3. Microbiological Stability

Microbial Contamination: Herbal products without synthetic preservatives are more prone to microbial contamination. Regular microbiological testing (e.g., total viable count, tests for *Escherichia coli*, *Staphylococcus aureus*, and fungi) should be performed to ensure the product remains free from harmful microbes.

Preservative Efficacy Test: If natural preservatives (e.g., tea tree oil, grapefruit seed extract) are used, check their effectiveness over time. This can be done by inoculating the toothpaste with specific microorganisms and monitoring their growth.

4. Packaging Integrity

Container Compatibility: The toothpaste's container (tube, jar, etc.) should not react with the product or degrade over time. Conduct testing to ensure that the packaging material remains stable and does not leach substances into the product.

Leakage and Sealing: Test the packaging for leakage, especially at elevated temperatures, and ensure the seal remains intact.

Procedure for Conducting Stability Testing

1. Sample Preparation:

- Divide the toothpaste samples into batches and place them in appropriate packaging.
- Label each sample according to the storage condition (e.g., 25°C/60% RH, 40°C/75% RH).

2. Storage:

- Store the samples in stability chambers with controlled temperature and humidity.
- Common time points for evaluation are 0, 1, 3, 6, 9, and 12 months for long-term testing and 0, 1, 3, and 6 months for accelerated testing.

3. Periodic Evaluation:

- At each time point, evaluate the samples based on the parameters mentioned (appearance, pH, active ingredient potency, etc.).
- Document all observations, measurements, and test results.

4. Data Analysis:

- Compare results across different time points to identify trends in product stability. If significant changes occur (e.g., color fading, separation), the product may have a shorter shelf life than anticipated.
- Based on the results, determine the product's shelf life under both normal and extreme conditions.

Acceptance Criteria

Physical stability: No major changes in color, consistency, or odor over time.

Chemical stability: The concentration of active ingredients should remain within 90-110% of the initial concentration.

Microbial stability: Total viable count should remain within acceptable limits, with no growth of harmful pathogens.

Packaging integrity: No signs of leakage, deformation, or interaction with the product

RESULT AND DISCUSSION:

The evaluation tests for the formulated herbal toothpaste were conducted in accordance with the standards established by the Bureau of Indian Standards IS 6356-1993 for various herbal toothpaste samples, including Vedshakti, Dabur Red, Patanjali, Dantakanti, Meswak, and the formulated toothpaste sample. All samples met the BIS criteria and were determined to be of high quality.

The assessment of the formulated herbal toothpaste aimed to compare its properties with those of commercially available toothpastes. The results of the evaluated parameters were presented in tabular form. The current study revealed that the formulated herbal toothpaste exhibited comparable, and in some instances superior, results when contrasted with the marketed herbal toothpastes.

A visual assessment of the formulated herbal toothpaste indicated a yellowish-brown color. The product's aroma was characterized as aromatic and distinctive, determined through olfactory evaluation. The taste was assessed through direct testing of the formulation.

All toothpaste samples demonstrated good consistency and a smooth texture, showing no signs of deterioration, such as phase separation, gassing, or fermentation, when stored at a temperature of $34 \pm 2^\circ\text{C}$ for 30 days. This observation confirmed the stability of the toothpaste.

The interior of all collapsible tubes exhibited no signs of corrosion or damage under normal storage conditions at a temperature of $45 \pm 2^\circ\text{C}$ for 10 days. This finding confirmed that the containers for both the formulated herbal toothpaste and the marketed herbal toothpastes, including Colgate, Vedshakti, Dabur Red, Dabur Meswak, and Patanjali Dantkanti, demonstrated good inertness.

Smoothness was evaluated by rubbing the paste formulation between the fingers. The pH of the formulated herbal toothpaste was measured and compared to other marketed herbal formulations, yielding a value of 9.10, which complies with the BIS limit as illustrated in Figure 5.

The formulated herbal toothpaste exhibited superior foamability compared to commercial formulations. Additionally, the loss on drying for the formulated herbal toothpaste was found to be lower than that of other marketed herbal toothpastes.

CONCLUSION:

The existing formulation exhibits favorable organoleptic qualities, as well as effective spreading, foaming, abrasive characteristics, and in vitro antimicrobial activity. Additionally, it is free from harmful chemical substances and incorporates herbal powders that contain a diverse array of natural compounds beneficial for dental health and the oral cavity, distinguishing it from conventional toothpastes. This design holds promising potential for future development and widespread application.

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