

# Review on Formulation of Polyherbal Toothpaste Using Medicinal Plants

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## ARTICLE INFO

### Article History:

Accepted: 20 Dec 2023

Published: 07 Jan 2024

### Publication Issue :

Volume 11, Issue 1

January-February-2024

### Page Number :

47-54

## ABSTRACT

Toothpaste is a gel or paste formulation product and is used to clean and maintain oral hygiene with the aid of toothbrush. But some of these substances show undesirable side effects such as tooth staining and altered taste. India is that the largest producer of healthful herbs and is termed the "Botanical Garden of the world". The objective of the present review to formulate herbal toothpaste containing natural ingredients like clove fruit, Neem leaves, Honey and Acacia powder, Betel, Peppermint, Turmeric, Guava etc. which were traditionally used for tooth cleaning. They not only show antimicrobial property for naturally action diseases however even have essential concentration of bound phytochemical present in them which will profit our body in some ways. Based on increased usage of herbal cosmetics we tried to make a comprehensive review on herbal toothpaste that helps to maintain a proper oral hygiene and free from periodontal disorder, reduce stain, gingivitis, calculus and caries. The present review gives basic information regarding antimicrobial potential of various herbs, formulation excipients, that can be used in preparation of toothpaste. Herbal toothpaste which can be used as a tool for proper oral hygiene and to overcome the side effect of the conventional toothpaste by synthetic ingredients.

**Keywords:** Herbal Toothpaste, Anti-Microbial Screening, Periodontal Disorder, Gingivitis, Calculus, Dental Caries.

## I. INTRODUCTION

This In India, medicines are utilized by approximately 60% of the world's population. These medications are not confined to primary healthcare

needs and are not limited to rural areas in developing countries; they are also widely used in developed nations where modern medicines are the primary choice. Traditional medicines, on the other hand, are derived from medicinal plants, minerals, and other

organic sources, exclusively utilizing medicinal plants for herbal remedies. In the Western world, there has been a notable increase in the use of herbal medicines, with approximately 40% of the population reporting the use of herbal remedies for medical conditions within the past year<sup>1</sup>. The intensity of infections caused by certain pathogenic microorganisms that may lead to mortality as well as morbidity in immune-suppressed patients is a significant concern in developing countries<sup>2</sup>.

Oral hygiene refers to the routine practice of maintaining a clean and healthy mouth, which includes preventing diseases and addressing issues such as bad breath. This is typically achieved through regular tooth brushing, known as dental hygiene, and cleaning the spaces between the teeth. Many dental problems are associated with the teeth, including gum disease, cavities (caries), and bad breath<sup>3</sup>. Maintaining oral health often involves regulating and maintaining a balanced population of microorganisms, typically in the interplay between the periodontal micro-flora and the host. This balance results in a stable clinical condition with minimal inflammation in the gum tissues<sup>4</sup>.

Dental caries is an infectious microbial disorder that leads to localized damage and degradation of tooth tissue. If left untreated, it can lead to tooth loss, pain, infection, and, in extreme cases, even death. *Streptococcus mutans* is considered the causative bacterium in dental plaque and caries. These *S. mutans* bacteria produce acids that damage tooth structures when exposed to fermentable carbohydrates like sucrose, fructose, and glucose. The combination of acid, bacteria, food debris, and saliva in the mouth results in the formation of dental plaque. Dental diseases can cause severe pain and have been linked to other health conditions, including heart disease, diabetes, Bacterial pneumonia, low birth weight or extreme high birth weight of one's baby, Osteoporosis and high blood pressure. The pain can be exacerbated by temperature extremes and consumption of sweet foods and drinks<sup>5</sup>.

Toothpastes are the most common preventive means in oral health care. Herbal toothpaste contains extracts from medicinal plants, offering potent antibacterial and anti-fungal properties. This natural composition helps control the build-up of plaque and tartar, promoting healthy and strong gums and teeth, and reducing the risk of cavities and tooth decay. Unlike traditional toothpaste, herbal toothpaste avoids the use of chemical preservatives and instead incorporates glycerine and common salt as natural preservatives<sup>6</sup>.

This herbal toothpaste has the potential to address various dental issues, including gingivitis, tooth decay, cavities, gum bleeding, bad breath, and dental caries. It is also believed to possess anti-smoking and anti-cancer properties. Furthermore, it aids in preventing tooth decay, combating bad odour, fighting germs and bacteria to reduce tartar and plaque formation, and offering protection against gum swelling. Notably, this toothpaste is particularly suitable for individuals with sensitive teeth, as it does not contain artificial flavours, gelatin, or chalk powder. The herbal ingredients are readily soluble in saliva, providing a refreshing and soothing effect in the mouth<sup>6</sup>.

Plants with therapeutic properties have been beneficial for oral health for thousands of years across the world. Traditional medicine, which incorporates these plant-based remedies, offers several advantages over conventional treatments, with fewer side effects such as allergies<sup>7</sup>. Neem has been known for its antibacterial activity since ancient times. It has been used for various purposes, including as an astringent, antiseptic, insecticide, anti-ulcer agent, and for cleaning teeth in cases of pyorrhoea and other dental diseases. Neem leaf extracts have demonstrated excellent antiviral and antihyperglycemic activity both in vitro (in a laboratory setting) and in vivo (on animals). Additionally, neem has shown strong broad-spectrum antibacterial activity in in vitro studies<sup>8</sup>.

#### **The ideal properties of toothpaste**

- Non-toxic and non-irritant, ensuring it is safe for use.

- Effective abrasive properties for thorough cleaning.
- Affordable, making it accessible to a wide range of consumers.
- Easily available, ensuring widespread availability.
- Pleasant taste to encourage regular use.
- Minimal side effects for user comfort.
- Ability to maintain oral cleanliness and freshness.
- Long-lasting effects for lasting protection.
- No staining of teeth, preserving their appearance<sup>9</sup>.

## II. MATERIALS AND METHODS

### Collection:

#### a. Sample collection:

Leaves of neem (*Azadirachta indica*), Peppermint (*Mentha piperita*), Turmeric (*Curcuma longa*), Clove (*Syzygium aromaticum*), Betel (*Piper betle*) and Guava (*Psidium guajava*) sample were collected from local market of Lucknow. The sample were stored at room temperature (37 °C) until further use.

#### b. Drying

Drying of the leaves of Neem (*Azadirachta indica*), Peppermint (*Mentha piperita*), Turmeric (*Curcuma longa*), Clove (*Syzygium aromaticum*), Betel (*Piper betle*) and Guava (*Psidium guajava*) was done for one week at room temp.

#### c. Crushing

Crushing of the leaves was done with the help of pestle and mortar at room temperature. The crushed sample was stored at room temp.

#### d. Aqueous extraction

Extraction is that the crucial start within the analysis of healthful plants, as a result of it is necessary to extract the required chemical elements from the plant materials for any separation and characterization. The fundamental operation enclosed steps, similar to pre-washing, drying of plant materials or freeze drying, grinding to get the same a sample and sometimes homogeneous extraction humanizing the dynamics of analytic abstraction and conjointly increasing the interaction of sample superficial with the solvent system. Proper actions ought to be taken to assure

that potential active constituents don't appear to be lost, distorted or destroyed throughout the preparation of the extract from plant samples.

Sr. 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, PEG8 (Polyethylene glycol esters)	Provide moisture content and prevent formation of plug in nozzle tube
3.	Binding agent	0.8- 2.5%	Agar, Carrageenan, Gum Tragacanth, Isapgol mucilage	Stability and consistency of the toothpaste can be maintained
4.	Preservatives	0.05- 0.5%	Formaldehyde, Benzoic acid, Parabens, Phenolics, Citric acid,	Prevents growth of microorganisms and provide stability
5.	Foaming agent	1-2%	Sodium lauryl	Assist in penetration

			sulphate, Sodium stearyl lactate, Amine Fluorides, Dioctyl sodium sulfosuccinate	n of plaque deposition and enables dispersion
6.	Flavors	1-6%	Clove oil, Aniseed, Papermint, Eucalyptus, Fennel, Spearmint	Key constituent that impact on consumer acceptability
7.	Colours	1-2%	Titanium dioxide, Chlorophyll	Impart colour to the toothpaste
8.	Sweeteners	18-24%	Saccharine, Aspartame, Sorbitol, Xylitol	Mask Palatable taste

#### Formulation Excipient Used in Toothpaste<sup>10-11</sup>

##### Herbs used in Dentistry:

#### 1. Clove:

Synonyms: Caryophyllum, Clove flower, clove bud, Lavang

Biological Source: Dried flower, Buds of *Eugenia caryophyllus*

Family: *Myrtaceae*

Chemical constituents: Galic acid, Oleanolic acid, Ellagic acid

Uses: Control of Gingivitis, Halitosis, Plague

#### 2. Neem:

Synonyms: *Melia azadirachta*

Biological Source: It consist of leaves and other aerial parts of *Azadirachta indica*

Family: *Meliaceae*

Chemical constituents: Tannins, Saponins, Phenols, Flavonoids, Alkaloids

Uses: enhance antibacterial and antifungal properties.

#### 3. Turmeric:

Synonyms: Indian saffron, Haldi

Biological source: It consist of Dried as well as fresh rhizoms of plant known as *Curcuma longa* Inn

Family: *Zingiberaceae*

Chemical constituents: Bisdemethoxycurcumin, Demethoxycurcumin, Curcuminoids

Uses: Relief from gum inflammation and act as an antibacterial agent

#### 4. Piper betle:

Synonyms: Piper chawya, Piper malamiris, Piper densum

Biological source: Betel leaf is from the betel piper or pan plant (*Piper betle*)

Family: *Piperaceae*

Chemical constituents: Leaves consist of Starch, sugar, diastases, volatile oil includes safrole, piper betol, Eugenol

Uses: Exhibit antimicrobial property against wide spectrum of microorganism such as *Protus vulgaris*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Streptococcus pyrogen*.

#### 5. Peppermint:

Synonyms: Red gum, *Eucalyptus amlgdalina*, peppermint gum

Biological source: Stem, leaves, and flowers of *Mentha piperita* L. plant

Family: *Lamiaceae*

Chemical constituents: Menthol, Menthone, Menthyl acetate, 1,8-cineole

Uses: Mouth freshner, reduce gum inflammation, act as antiseptic and antibacterial

## 6. Guava:

Synonyms: Apple guava, common guava, yellow guava, lemon guava, cherry guava

Biological source: Fruit of Psidium guajava

Family: Myrtaceae

Chemical constituents: It consist of vitamin A, Vitamin C, iron, phosphorus, calcium, saponin, oleanolic acid, flavonoids

Uses: Reduces gum inflammation, control plaque

### PROCEDURE:

1. Measure and gather all the ingredients and equipment you'll need.
2. In a mortar and pestle, triturate the Neem, Clove, Peppermint, Guava, Betel, and Turmeric extracts along with Para hydroxybenzoic acid and Sodium chloride. Ensure that they are well mixed and have a uniform consistency.
3. Add the Sodium lauryl sulphate and continue triturating to achieve a uniform mixture.
4. Incorporate the desired amount of Sodium saccharin as the sweetener. The quantity can vary according to your taste preferences.
5. Add Glycerine as the humectant and triturate well.
6. Incorporate Acacia gum as a binder, and triturate until the mixture is homogeneous.
7. Gradually add demineralized water while triturating to make up the total mixture to 100g.
8. Use the sodium hydroxide solution to adjust the pH of the mixture to the desired level. Be cautious when using sodium hydroxide, as it can be caustic, and add it incrementally while monitoring the pH.
9. Finally, add Clove oil to mask any bitter taste, and triturate well to ensure it is evenly distributed.
10. After completing all the steps, you should have a toothpaste-like mixture. Transfer it to a suitable container for storage and use.

### EVALUATION PARAMETERS:

- **Physical Examination:**

- i. **Colour-** Formulated toothpaste was evaluated for its colour.

- ii. **Odour-** Odour was found by smelling the product.
- iii. **Taste-** Taste was checked manually by tasting the formulation
- iv. **Relative density-** Relative density was determine by weight in gram taken in 10 ml formulation and 10 ml distilled water using RD bottle.

- **Abrasiveness-**

Extrude the content 15-20 cm long on the butter paper, repeat the same process for at least ten collapsible tubes. Press with the contents of the entire length with fingertip for the presence of sharp- and hard-edged abrasive particles. Toothpaste shall not contain such particles.

- **Determination of spreadability:**

In this method slip and drag characteristic of paste involve. Formulated paste (2g) placed on the ground slide under study. The formulated paste placed like sandwich between this slide and another glass slides for 5min to expel air and to provide a uniform film of the paste between slides. Excess of the paste was scrapped off from the edges. The top plate was then subjected to pull of 80g with the help of string attached to the hook and time (sec) required by the top slide to cover a distance of 7.5cm was noted. A short interval indicated better spreadability.

Formula was used to calculate spreadability:

$$S=M \times L / T$$

Where, S= Spreadability

M= Weight in the pan (tied to the upper slide)

L= Length moved by the glass slide

T=Time (sec) taken to separate the upper slide from the ground slide.

- **pH determination:**

pH of formulated herbal toothpaste was determined by using pH meter. 10g of toothpaste placed in 150ml of beaker. Allow the 10ml of boiled and then cooled water. Stir vigorously to make a suspension.

- **Homogeneity:**

The toothpaste shall extrude a homogenous mass from the collapsible tube or any suitable container

by applying of normal force at  $27 \pm 20^\circ\text{C}$ . in addition bulk of contents shall extrude from the crimp of container and then rolled it gradually.

• **Foaming:**

The foamability of formulated toothpaste evaluated by taking small amount of formulation with water in measuring cylinder initial volume was noted and then shaken for 10 times. Final volume of foam was noted.

Determination of froth power

Foaming power =  $V_1 - V_2$

$V_1$ - Volume in ml of foam with water.

$V_2$ - Volume in ml of water only.

• **Stability:**

The stability study was performed as per ICH guideline. The formulated paste was filled in collapsible tube and stored at different temperature and humidity conditions,  $25^\circ\text{C} \pm 2^\circ\text{C} / 60\% \pm 5\% \text{RH}$ ,  $30^\circ\text{C} \pm 2^\circ\text{C} / 65\% \pm 5\% \text{RH}$ ,  $40^\circ\text{C} \pm 2^\circ\text{C} / 75\% \pm 5\% \text{RH}$  for the period of three months and studied for appearance, pH and spreadability.

• **Moisture content:**

Toothpaste (10 gm) weighted in a Porcelain dish and dried it in the oven at  $105^\circ\text{C}$ . It was cooled in desiccators. The loss of weight is recorded as percentage moisture content and calculated by the given formula.

% Moisture =  $\frac{\text{Original sample weight} - \text{dry sample weight}}{\text{Original sample weight}}$

• **Determination of lead:**

The colour produced with sample solution containing hydrogen sulphide was compared with standard lead solution.

## PHYTOCHEMICAL TEST

### a. Saponin

- 2 ml sample was dissolved in 6ml distilled water.
- Shaked well. Froth formation took place.
- Stability of the froth confirms the presence of saponin in the samples

### b. Tannin

- 1 ml sample was dissolved in 1 ml 5%  $\text{FeCl}_3$ .
- Appearance of dark blue or greenish black colour confirms presence of tannin the sample.
- If no colour changes then heating mantle is used for changing the colour.

### c. Flavonoids

- 2  $\mu\text{l}$  samples was drop wise added into 20 ml  $\text{NaOH}$ .
- Again Conc.  $\text{HCL}$  was added drop wise, appearance of yellow colour
- Confirms the presence of flavonoids in the sample.

### d. Carbohydrates

- Fehling's reagent was prepared by mixing Fehling A and Fehling B solution.
- For Fehling A- 0.35g  $\text{CuSO}_4$  was dissolved into 5 ml distilled water followed by addition of 2-3 drops of Conc.  $\text{H}_2\text{SO}_4$ .
- For Fehling B- 1.75g  $\text{NaK}$  tartarate was dissolved in 5 ml distilled water, 1.25g  $\text{NaOH}$  was added in the solution and mixed well to dissolve it.
- Then Fehling A and Fehling B was mixed well in the ratio of 1:1( $\text{FA} + \text{FB} = 10\text{ml}$ ).
- Now 1ml Fehling's reagent was dissolved in 2ml sample and heated for over 20 mins.
- Appearance of red ppt. confirms the presence of carbohydrates in the sample.

### e. Protein

- 500 $\mu\text{l}$  of 1%  $\text{CuSO}_4$  was prepared and 500 $\mu\text{l}$  of 5%  $\text{NaOH}$  was prepared.
- Mixed together.
- Sample was added in the solution, occurrence of purple colour confirms protein in the sample.

### f. Alkaloids

- 500 $\mu\text{l}$  extract was centrifuged and 500 $\mu\text{l}$  Wagner's reagent was mixed into it.
- Shaked well and left for some time.

- Reddish brown colour appears and confirms presence of alkaloids
- g. Starch solution**
- Add the sample
  - Add 2-3 drops of yellow iodine solution
  - Stir with glass rod
  - The iodine solution will turn blue/black colour then starch is Present.
- h. Fat test**
- Press the small quantity of extracts between two filter
  - Paper the strain on one filter indicated the presence of fixed oils.
- i. Terpenoid test**
- 500µl sample was dissolved in 250µl chloroform.
  - 625µl Conc. H<sub>2</sub>SO<sub>4</sub> was added to the solution.
  - Reddish brown ppt. of the solution confirms presence of terpenoids
- j. Phenol test**
- 500µl extract was dissolved in distil water. 2 drops of aq.
  - FeCl<sub>3</sub> was added.
  - Appearance of blue colour or green colour indicates presence of phenols.
- k. Coumarin test**
- Take a look at 10% NaOH was additional to the extracts and CHCl<sub>3</sub> was additional for observation. • Yellow colour that show the presence of Coumerin.
- l. Quinones test**
- Take a look at dilute 10% NaOH was additional to the 1ml of crude extracts.
  - Blue-greening experienced or red coloration indicated the presence of quinones.

### III.CONCLUSION

Compared to synthetic toothpaste, herbal toothpaste is safer and more palatable in dental studies, with fewer adverse effects. Toothpaste with herbal ingredients can be used to treat a variety of dental

conditions. Toothpaste containing various herbs is thought to be as safe as regular toothpaste, easily available, and possessing good abrasive and antimicrobial properties. Through the prevention of oral diseases like pyorrhoea and cavities, it aids in the eradication of oral bacteria.

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**Cite this article as :**

Kaspate Shubham, Kamble Esha, Kharabe Khushi, "Review on Formulation of Polyherbal Toothpaste Using Medicinal Plants ", *International Journal of Scientific Research in Science and Technology (IJSRST)*, Online ISSN : 2395-602X, Print ISSN : 2395-6011, Volume 11 Issue 1, pp. 47-54, January-February 2024. Available at doi : <https://doi.org/10.32628/IJSRST52310661>

Journal URL : <https://ijsrst.com/IJSRST52310661>