

# Formulation and Evaluation of Herbal Toothpaste

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**ABSTRACT:** The herbal toothpaste is more acceptable in public opinion than chemical-based synthetic formulations in the current oral dental care scenario due to their safety and efficacy in reducing dental caries and preventing other dental disorders to which this generation is prone. In this composition, we used Pomegranate peel powder. It has an anti-microbial, anti-bacterial, anti-inflammatory, anti-plaque, and anti-oxidant properties. The toothpaste were evaluated to determine important physical characteristics such as pH, abrasiveness, cleaning ability, spreading ability, foaming ability, and anti-microbial activity in order to develop a more effective and stable product. The purpose of this project is to make herbal toothpaste. This research proves that our herbal toothpaste formulation is excellent as it gets in terms of performance.

## I. INTRODUCTION

### Oral Hygiene:

Oral hygiene is the practice of keeping the mouth and the teeth clean to prevent dental problems, like dental cavities, gingivitis, periodontal (gum) diseases and bad breath. There are also oral pathologic conditions in which good oral hygiene is required for healing and regeneration of the oral tissues.

There is much more to oral health than beautiful and healthy teeth. It is fundamental to overall health and affects the wellbeing and quality of life of every individual [1]. Oral health affects an individual's oral functions and social interactions, and it is closely linked to overall health and quality of life [2,3,4].

Oral health is an integral part of overall health, and each influences the other [5,6,7]. Improper diet, smoking, alcohol intake, and poor oral hygiene practices are the most significant factors influencing the occurrence of various oral diseases. Diet affects the development of dental caries, dental erosion, periodontitis, oral cancer, and many other diseases of the soft tissues of the oral cavity. Smoking has been linked to oral cancer, gingival and periodontal disease, periimplantitis, tooth discoloration, halitosis, taste bud changes,

and difficulty healing wounds after surgery. High alcohol intake is associated with an increased risk of developing oral cancer or other potentially malignant disorders, periodontitis, dental caries, and xerostomia. Poor oral hygiene can lead to the development of dental caries and periodontitis, and is also associated with heart disease, cancer, and diabetes [7,8,9,10,11].

Many of these oral diseases are preventable through education about risk factors. Oral hygiene is a critical factor in maintaining good oral health, and subsequently is related to overall health and quality of life. The most effective method for preventing dental caries or periodontitis is the removal of dental plaque by regular and proper mechanical cleaning of the teeth, a key step in maintaining oral health [12,13].

The smile is a distinguishing feature of each person. There are countless types of smiles, however, in dentistry and especially referring to dental aesthetics, some differences are usually made to catalog their appearance.

A smile is determined by the position of the lips, gums and teeth. According to the shape of these and the visibility they present when smiling, we find the most characteristic types of smiles.

The color of teeth significantly impacts a person's smile by influencing perceptions of attractiveness, health, and confidence. Whiter teeth are often associated with youthfulness and good hygiene, enhancing the overall appeal of a smile. Conversely, yellow or discolored teeth may evoke negative impressions, potentially making someone appear less healthy or less confident. A bright smile can boost self-esteem, encouraging more frequent smiling, which in turn positively affects social interactions. [14]

### Tips for oral hygiene:

Oral health is closely linked with overall health. This link is currently a hot topic for science and research.

Experts recommend these tips for optimal oral health:

- Brush your teeth twice a day, with fluoride toothpaste, for two minutes each time.

- Floss (it doesn't matter if you floss before or after brushing).
- Don't snack between meals.
- Don't drink sugary beverages.
- Don't smoke.
- Limit your alcohol intake [15]

#### Different dosage forms available to maintain oral hygienic condition:

- Tooth powder
- Tooth paste
- Gargle
- Mouth wash
- Mouth fresheners

#### Tooth Powder:



Traditional toothpaste powder, more correctly known as "toothpowder", existed before toothpaste was invented. In the 1800s, it was simply a combination of baking soda, salt, burnt eggshells, or chalk to remove mouth odor and clean your teeth.

Today, you'll find that there have been some interesting advancements in oral care products. In fact, modern tooth powder is simply dehydrated toothpaste that has been powdered. Unfortunately, there isn't much research on tooth powder's effectiveness.

However, a study in 2017 suggests that toothpowders are more effective than traditional toothpaste in plaque control and gingivitis.

An analysis in 2013 also concluded that toothpowders were as effective as toothpaste in controlling plaque, removing stains, and reducing gingivitis. Another study concluded otherwise: toothpowders were inferior to toothpaste in plaque removal.

Moreover, most tooth powder formulations don't contain fluoride or any type of cavity-fighting ingredient. If cavities are a

concern, you may be better off sticking to toothpaste. [16]

#### Tooth Paste:



Toothpaste is a gel or paste form that comes in different formulations.

They have been a main stay in the industry not only for their essential role in maintaining oral hygiene but also for the diverse options available in the market.

Typically, toothpaste contains fluoride which is particularly beneficial for preventing tooth decay and strengthening tooth enamel.

However, studies suggest that toothpaste formulated with Nano hydroxyapatite may be effective in addressing dental issues while posing fewer potential risks for systemic toxicity than fluoride, especially for those with sensitive teeth.

Our modern oral hygiene with toothpaste, toothbrush and floss began only in the 1950s, not very long ago. But the quest for a clean mouth dates back at least 5,000 years. Around 3,000 BC, the ancient Egyptians developed dental paste made of oxen hooves, myrrh, eggshells, pumice and water. Talk about legacy: A pumice mixture is still used today by dentists and dental hygienists to professionally clean and polish your teeth.

The early Chinese were said to apply ground fishbone to their teeth for the same purpose, and the ancient Romans and Greeks allegedly used crushed bones and oyster shells. Arabs evidently tried fines and during the Middle Ages, and the Europeans experimented with table salt. It all sounds quite tough on the tooth enamel. It wasn't until the late 1700s that the first modern toothpaste appeared, usually homemade. Some used burnt bread among the ingredients or dragon's blood, a natural, dark red plant resin.

In 1824, a dentist named Peabody (first name unknown) was the first person to add soap to dental paste, followed by John Harris in the 1850s, who added chalk as an ingredient. About 20 years

later, Colgate mass-produced the first toothpaste in a jar. A landmark change occurred in 1892. Dr. Washington Sheffield, an American dentist, thought it unsanitary for multiple people to dip their toothbrushes into one jar of toothpaste. So that year, he developed the first toothpaste in a collapsible tube. Paint tubes used by artists supposedly inspired him. [16]

Currently, toothpaste serves two basic functions - therapeutic and preventive. In general, American Dental Association-approved toothpaste contains fluoride and other active ingredients which serve specific functions such as tooth whitening, plaque removal, minimizing gingivitis, and preventing halitosis (bad breath) and tooth erosion. [17]

#### Ingredients used:

- i. Abrasive agents such as silica abrasives or enzymes to remove built-up stains on the teeth.
- ii. Detergents like sodium lauryl sulfate and sodium N-lauryl sarcosine which help to produce better foam, and which have a cleansing action on plaque and other oral debris.
- iii. Flavoring agents, particularly sugar-free substances like saccharin, to make the toothpaste palatable or even attractive to the user.
- iv. Humectants like glycerol to protect the toothpaste against water loss.
- v. Binding agents like mineral colloids, natural gums, seaweed colloids or synthetic cellulose to give it body and so stretch out the toothpaste for a longer period.
- vi. Peroxides like hydrogen and carbamide peroxides to reveal stains from lingering. [17]

#### Active ingredients that are typically found within approved toothpaste brands include:

- i. Anti-caries agents (e.g. fluoride) which enhances the dental remineralization process and helps repair early tooth decay.
- ii. Anti-hypersensitivity agents which including potassium salts, stannous fluoride, amorphous calcium phosphate, casein phosphor peptide, and calcium sodium phosphor silicate - which help to minimize tooth sensitivity.
- iii. Anti-microbial agents such as stannous fluoride, triclosan, and zinc citrate, which

help to prevent the accumulation of plaque. [17]

#### Composition of toothpaste:

Toothpastes generally contain the following components:

- a. Water (20–40%)
- b. Abrasives (50%) including aluminum hydroxide, calcium hydrogen phosphates, calcium carbonate, silica and hydroxyapatite
- c. Fluoride (usually 1450 ppm) mainly in the form of sodium fluoride. Stannous fluoride and sodium monofluorophosphate have also been used
- d. Detergents, mainly sodium lauryl sulfate (SLS) with concentration ranges of 0.5–2%
- e. Antibacterial agents such as triclosan or zinc chloride
- f. Flavorings including spearmint, peppermint, and wintergreen
- g. Remineralizers in some toothpastes containing hydroxyapatite nanoparticles and calcium phosphate
- h. Humectants including glycerol, xylitol, sorbitol, polyethylene glycol, and propylene glycol
- i. Anti-sensitivity agents in sensitive toothpastes containing strontium chloride and potassium nitrate or arginine.
- j. Anti-calculus agents such as sodium polyphosphate or zinc citrate. [18]

#### Efficacy:



A good toothpaste should contain ingredients that help:

#### a. Remineralizer teeth:

Remineralization is the process of replenishing minerals in tooth enamel, making teeth stronger and more resistant to decay. Remineralizers are agents that help reverse early stages of tooth decay by redepositing minerals such as calcium and phosphate onto the tooth surface.

Remineralization can help:

- Reverse early stages of tooth decay
- Strengthen tooth enamel
- Reduce sensitivity
- Prevent cavities
- Improve oral health

b. Minimize teeth sensitivity:

It can be done by using a soft-bristled toothbrush, Avoid teeth grinding and clenching, Avoid using bleaching products, Use a humidifier to reduce dry mouth. Avoid extreme temperature changes when eating or drinking. Use a toothpaste specifically designed for sensitive teeth and also avoid too much force while brushing.

c. Remove plaque and bacteria:

Toothpaste contain-

- Sodium bicarbonate (baking soda): Helps neutralize acid and remove plaque and bacteria.
- Sodium benzoate: Exhibits antimicrobial properties, helping reduce bacteria growth.
- Triclosan: An antibacterial agent that kills bacteria and helps prevent plaque buildup.
- Chlorhexidine: An antimicrobial ingredient that reduces bacteria growth and helps control plaque.
- Essential oils (e.g., eucalyptus, peppermint, tea tree oil): Have antimicrobial properties, helping reduce bacteria growth.
- Hydrated silica: A mild abrasive that helps remove plaque and surface stains.
- Potassium nitrate: Helps reduce sensitivity and also has antimicrobial properties.
- Stannous acid: Helps prevent plaque buildup and reduces bacteria growth.
- Cetylpyridinium chloride: An antibacterial ingredient that helps reduce bacteria growth.
- Domiphen bromide: An antibacterial ingredient that helps reduce bacteria growth.

d. Brighten teeth:

- Toothpaste contains mild abrasives, hydrogen peroxide.
- Use activated charcoal, avoid tobacco and nicotine.

Shelf life of tooth paste and tooth powder:

Toothpaste typically has a stable shelf-life of up to two years, while tooth powder, due to its dry composition, may have a longer shelf-life under appropriate storage conditions. However, you can consider using Nano hydroxyapatite toothpaste tablets for a longer shelf-life while being eco-friendly, mess-free, and convenient to travel.[19]

Is Tooth Powder better than Tooth Paste:

Toothpaste is more convenient than tooth powder and often contains ingredients that are better for your oral health, but neither of them is as effective and convenient as toothpaste tablets. While both can clean teeth, toothpaste is the go-to for most people due to its simplicity and effectiveness in oral care routines, holding a distinct advantage over tooth powder. Plus, toothpaste with Nano hydroxyapatite offers a wide range of unique benefits that can be tailored to your specific oral health needs such as:

- teeth remineralization
- teeth whitening
- reducing teeth sensitivity
- and controlling biofilm.

Therefore, comparing toothpaste and tooth powder, it's clear that toothpaste, especially with advanced features like Nano hydroxyapatite, offers a convenient, effective, and personalized approach to oral care. It's a standout choice for those seeking a well-rounded dental routine. [19]

## NATURAL INGREDIENTS AND THEIR USES

Ingredients	Uses
1. Fenugreek powder	Anti-inflammatory activity
2. Neem powder	Anti-microbial activity
3. Aloe Vera gel	Prevent infections for its anti-fungal, anti-viral and anti-inflammatory activity
4. Baking soda	Abrasive properties
5. Sea salt	Alkaline properties
6. Guar gum	Thickening agent
7. Turmeric	Anti-inflammatory, anti-microbial and anti-fungal activity
8. Pomegranate peel	Anti-fungal and anti-inflammatory activity
9. Banana peel	Anti-bacterial activity
10. Strawberries	Teeth whitening activity
11. Guava leaves	Anti-microbial, anti-bacterial, anti-inflammatory, analgesic and provision of minerals
12. Pineapple	Teeth whitening activity
13. Essential oil	Extremely effective at benefiting gum health, purifying the breath controlling harmful bacteria and even helping to whiten the teeth
14. Orange oil	Teeth whitening activity
15. Lemon oil	Anti-septic activity
16. Lime oil	Anti-bacterial activity
17. Grapefruit oil	Refreshing citrus aroma
18. Bergamot oil	Prevent bad breath and anti-microbial activity
19. Cinnamon oil	Anti-oxidant activity
20. Tea tree oil	Anti-septic activity
21. Myrrh oil	Anti-oxidant, anti-bacterial and anti-fungal activity
22. Peppermint oil	Flavoring agent
23. Ginger oil	Anti-inflammatory activity
24. Clove oil	Dental analgesic activity
25. Coconut oil	Anti-microbial, anti-inflammatory, anti-fungal and teeth whitening activity
26. Alum	Anti-caries and anti-bacterial activity

Here are some reasons why herbal ingredients are considered better than synthetic ones in toothpaste:

1. Gentler: Herbal toothpaste doesn't contain harsh chemicals or detergents, which can irritate gums and teeth.
2. Natural ingredients: Herbal toothpastes contain ingredients like chamomile, echinacea, sage, rhatany, myrrh, and peppermint oil, which have various benefits. For example, chamomile has anti-inflammatory properties, while peppermint oil has analgesic, antiseptic, and anti-inflammatory properties.
3. Environmentally friendly: Herbal toothpaste is often environmentally friendly and cruelty-free.
4. Toxicity concerns: Some synthetic ingredients have been linked to health issues, such as hormone disruption, cancer, and reproductive

problems. Herbal ingredients are less likely to be toxic.

5. Fewer allergies and sensitivities: Herbal ingredients are less likely to cause allergic reactions or sensitivities compared to synthetic ingredients.
6. Holistic approach: Herbal ingredients often address overall oral health, rather than just focusing on a single issue like whitening or plaque removal.
7. Transparency and control: With herbal ingredients, you can choose what goes into your toothpaste, allowing for greater control over your oral health.
8. No artificial sweeteners: Herbal ingredients like stevia or xylitol replace artificial sweeteners, promoting a healthier diet.



9. Supports overall wellness: Herbal ingredients can contribute to overall wellness, rather than just treating oral health in isolation. [20]

### INGREDIENTS PROFILE

From the above 26 natural ingredients we have selected pomegranate peel powder due to its anti-microbial activity

#### Pomegranate peels:

Biological name: Punicagranatum

Family: Lythraceae

Kingdom: Plantae

Genus: Punica

Synonyms: Punicafloida, Punica nana L, Punicaspinosa Lam, Rhoepunica St.-Lag.

Phytochemicals: Polyphenols, Gallic acid, Ellagic acid, Lignans. Phenolic compounds, Triterpenoids and Phytosterols

Uses: Anti-bacterial, Anti-inflammatory, Anti-microbial, Anti-plaque, Anti-oxidant.

Pomegranate peels are one of the agricultural wastes which pose to the environment in huge amounts around the world from canning plants, juice production and food processing. Pomegranate peels are possessing verity of elements and substances such as protective agents, antimicrobial, enzymes and antioxidants which can obtained them and utilized from the residue in many easy and simple ways.

A shrub or small tree growing 5 to 10 m (16 to 33 ft) high, the pomegranate has multiple spiny branches and is long-lived, with some specimens in France surviving for 200 years. P. granatum leaves are opposite or sub opposite, glossy, narrow oblong, entire, 3–7 cm ( $1\frac{1}{4}$ – $2\frac{3}{4}$  in) long and 2 cm ( $\frac{3}{4}$  in) broad. The flowers are bright red and 3 cm ( $1\frac{1}{4}$  in) in diameter, with three to seven petals.[21] Some fruitless varieties are grown for the flowers alone.[22]

The pomegranate is rich in symbolic and mythological associations in many cultures.

The pomegranate is thought to have originated from Afghanistan and Iran before being introduced and exported to other parts of Asia, Africa, and Europe.[23,24,25] It was introduced into Spanish America in the late 16th century and

into California by Spanish settlers in 1769. They are widely cultivated throughout West Asia and Caucasus region, South Asia, Central Asia, north and tropical Africa, the drier parts of Southeast Asia, and the Mediterranean Basin. [26] The fruit is typically in season in the Southern Hemisphere from March to May, and in the Northern Hemisphere from September to February. [27,28]

Ingredients for tooth paste:

1. Active ingredient (Pomegranate peel powder)
2. Calcium carbonate
3. Glycerol
4. Acacia
5. Sodium lauryl sulphate
6. Sodium benzoate
7. Peppermint oil

## II. MATERIALS AND METHOD

### Collection of pomegranate peel:

Fresh pomegranate peel of (Punicagranatum) peel was collected. The peel was gently rinsed with water, sundried to remove the moisture and powdered using a blender. The powder was then passed through sieve number 85 to get uniform particle size. Pomegranate peel powder was stored in an air tight container for further studies.

### FORMULATION OF HERBAL TOOTHPASTES

The formulations of tooth paste were prepared by using the following ingredients via, pomegranate peel powder, Acacia arabica gum powder, calcium carbonate; glycerol, sodium lauryl sulphate, sodium benzoate and peppermint oil (Table 1). Weigh the required quantity of calcium carbonate is added into mortar and pestle and followed by glycerol is added into it and triturated evenly to make a smooth paste. Subsequently Acacia arabica gum powder, sodium lauryl sulphate and pomegranate peel powder were added and mixed well to make the paste uniform. Consequently, sodium benzoate and pepper mint oil were added and mixed well until the toothpaste attains the desired consistency. Paste was packed and stored in plastic jar.

**aTable 01:**

Composition ratio of ingredients used in tooth paste formulation

Ingredients	Property	F1	F2	F3	F4
Calcium	Abrasiveness	2g	4.3g	5g	3.5g
Acacia arabicagum	Binder and Thickening agent	0.5g	0.3g	0.5g	0.5g
Glycerol	Humectant activity	25ml	21ml	20ml	21ml
Pomegranate peel	Anti-fungal and Anti-inflammatory activity, Anti-microbial, Anti-oxidants, protective agents	1.5g	2.9g	3g	4g
Sodium lauryl sulphate	Foaming agent	0.5g	1g	1g	0.5g
Sodium benzoate	Preservative activity	0.5g	0.5g	0.5g	0.5g
Peppermint oil	Flavoring agent, reduces plaque built up, improves salivary buffer capacity, and decreases salivary S. mutant count.	3drops	3drops	3drops	3 drops

### III. RESULTS

Various ingredients involved in the tooth paste formulation includes pomegranate peel powder, calcium carbonate, Acacia arabica gum powder, glycerol, sodium lauryl sulphate, sodium benzoate and pepper mint oil. The formulations of toothpaste were prepared by using the above

ingredients and their properties were studied to identify the best formulation (Table 1). The physical and chemical characteristics like pH, abrasiveness, foaming activity, spreading ability, cleaning ability, anti-microbial activity of different concentrations of toothpaste showed significant variations.

**Table 02 :**

Evaluation tests of toothpaste	F1	F2	F3	F4
pH	8	9	8	10
Abrasiveness	3	2	2	1
Foaming ability	4cm	6cm	4.2cm	8cm
Spreading ability	3.5cm	5.5cm	4.5cm	6.5cm
Cleaning ability	++	++	++	+++
Anti-microbial activity	0.3cm	0.5cm	0.4cm	0.6cm

### IV. DISCUSSION

The primary objective of this study was to determine efficacy in terms of antimicrobial properties of pomegranate peel in toothpaste formulation. Various concentrations were prepared with a view to preserve its anti-microbial activity.

Four formulations of each toothpaste (F1, F2, F3, and F4) were prepared by varying the concentrations of the ingredients and their properties were studied to identify the best formulation (Table 1). The physical and chemical characteristics of different toothpaste formulations showed significant variations (Table 2).

The pH of the toothpaste formulations was in the alkaline range of 8–11 in which F1, F2, F3 was showing proximately pH and F4 showed the required pH . Similar patterns were observed for abrasiveness and foaming ability tests also. Rubbing F1, F2, F3, F4 against the glass slides, created more scratches in F1, F2, F3 than F4. Regarding the foaming ability, the F1, F2, F3 toothpaste showed lower foaming ability and F4 exhibited the highest value. Even though the four formulations have shown fewer foaming properties but they show very good spreading ability. F4 formulation has showed highest spreading than F1, F2, F3 respectively. Based on the color change

appeared on the pigmented eggs F4 has shown better ability of cleaning stains (+++) and comparatively another formulation (++) has shown less change in color.

The anti-microbial activity of toothpaste containing four different concentration were evaluated in which F4 showed highest anti-microbial activity compared to F1, F2, F3.

## V. CONCLUSION

The main purpose of this research is study anti-microbial activity. The herbal toothpaste plays an important role in maintaining oral hygiene and avoiding dental caries, and it is also safer and has less negative effects than chemically based synthetic toothpaste. Toothpaste that has been specially formulated is capable of maintaining tooth and oral hygiene and it also has antimicrobial activity against microorganism such as *Staphylococcus aureus*. Four formulation of herbal toothpaste at different concentration were prepared and evaluated according to physico-chemical parameters such as pH, abrasiveness, foaming ability, spreading ability, cleaning ability and anti-microbial activity. Among those four formulation F4 passed in all physico-chemical properties. As the concentration of pomegranate peel powder increases antimicrobial activity also increases.

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