

Formulation and Evaluation of Herbal Toothpaste without Using any Harsh Chemical

Arnab Ghatak

K. R College of Pharmacy, Bengaluru, Karnataka, India
Corresponding Author Email: [ghatakarnab20\[at\]gmail.com](mailto:ghatakarnab20[at]gmail.com)

Abstract: A toothpaste is a paste or gel that is applied to the teeth with a toothbrush as an accessory to clean, maintain the health and appearance of our teeth, and to promote oral hygiene. Nowadays, we use commercial toothpaste that has a lot of chemicals in it, like sodium lauryl sulfate, which hurts our gum. Natural herbal preservatives and excipients, which we have developed to replace these harmful or costly chemicals, make our toothpaste more financially viable than commercial toothpaste. They are as smooth, semisolid, homogenous mass containing OK fixings which are fitting substances for oral wellbeing upkeep. The created toothpaste contains normal fixings like clove (disinfectant to battle against organisms), aloe (mitigating and antibacterial specialist), vajradanti (flushes the plaque arrangement), fenugreek (oil and dampen), turmeric (takes out agony and expanding), cinnamon (forestall toothache), pepper (decrease the gamble of tooth rot), amla (astringent properties), liquorice (stop the dying). Our goal was to create a toothpaste that could improve oral health. In addition to producing the mouth and tooth - friendly toothpaste. Gingivitis, tooth decay, cavities, bleeding gums, poor breath, and dental caries, among other dental diseases, can be treated with this toothpaste. The extractions utilized are purely plant - based and volatile oils, and no chemical preservatives are added.

Keywords: oral hygiene, economically viable, natural herbal extraction

1. Introduction

The area of the mouth that lies behind the teeth and gums, above the hard and delicate palates, below the tongue, and in contact with the internal portion of the mandible is known as the oral depression. The mouth cavity is the initial section of the digestive system. It contains the tongue, the floor of the mouth (beneath the teeth), the cheeks, the bony roof, and the teeth. "Oral health" refers to a person's mouth's condition, which has a big effect on their general health. Oral health is a state free of mouth and facial pain, oral infections and wounds, periodontal disease, tooth decay, tooth loss, and other illnesses and messes that should be evident in a person's capacity for chewing, biting, smiling, talking, and psychosocial well - being. There are two basic diseases that have an impact on dental health.

- 1) Cavities or gaps in teeth are caused by dental caries (tooth rot), which is caused by bacterial cycles that demineralize tooth surfaces.
- 2) Periodontal (gum) disease is a disorder in which inflammatory reactions to bacterial biofilm along the gum line cause damage to the tissues and bones that surround and support the teeth.

To protect, clean, and clean teeth, use toothpaste. It improves the effectiveness of oral hygiene. It has a pleasant flavor and aroma and freshens your breath. The key to maintaining a healthy mouth is to use toothpaste to brush your teeth two times every day. They might all be recalled for using a similar toothpaste;

- a) Plaque and math - decreasing agents,
- b) antibacterial agents,
- c) breath fresheners, and
- d) desensitizing agents are a few examples.
- e) Abrasives f. Fixtures for whitening.

In order to separate food, teeth, which are calcified structures in the mouth, are used. Different tissues that vary in thickness and hardness make up teeth.

The crown and the root are two important components of a tooth. The mandible (lower jaw) or the maxilla (upper jaw) contain the implanted tooth roots, which are covered by our gums. The crown is the part of the tooth that is visible and rises above the gums.

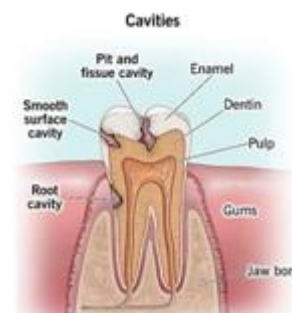


Figure 1

A lacquered, white, firm covering is used to protect the crown. The main component of polish is the mineral hydroxylapatite, a transparent calcium phosphate. Enamel is the body's toughest substance, yet it is also fragile, prone to damage, and vulnerable to erosion from abrasive substances or acidic foods. Dentin is the name of the layer that lies beneath the lacquer. Dentin is a calcified connective tissue with a natural collagenous protein framework that resembles bone. Despite being a protective layer, dentin is often not as hard as lacquer and is susceptible to decay. A healthy mouth, however, only has a little opening between the gums and enamel, revealing little to no dentin. The roof of a tooth is covered with cementum, a unique bone - like substance. About 45% of it is hydroxyapatite, 33% is collagen, and 22% is water. Cementum is expelled from cementoblasts in the crown of the tooth, and it is thickest there. It has a gentler yellowish hue than either the dentin or the veneer. Its crucial function is to provide as a conduit for the periodontal tendons to link to the tooth for stability.

Dental pulp refers to the central region of a tooth that is lined with delicate connective tissue. Veins and nerves are present in the pulp, which enters the tooth through an aperture near the peak of the root. Typically, the pulp is referred to as the tooth's nerve. After a thorough cleaning, a sparse biofilm known as the pellicle begins to coat the tongue, gums, and teeth very fast. Proteins in spit are what create the pellicle. Plaque, which resembles gel, develops on the pellicle as a result of bacterial growth and stains from food and drink. The calcium and phosphorus in tooth polish is broken down by the microorganisms in plaque when they consume the sugars and starches in food sources. Microscopic organisms can infiltrate the dentin and induce rot when enough demineralization has occurred. Another name for tooth decay or cavities is dental caries. Gum disease, a mild gum condition caused by plaque that can be seen below the gum line, can irritate the gums.

The minerals in saliva will bind with the plaque within two to fourteen days after plaque production to form calculus, or tartar, a calcified deposit. The hardened tartar can only be removed by a skilled cleaner.

Oral hygiene, or the practice of keeping the mouth clean, can help prevent dental caries, gingivitis, periodontal disease, bad breath, and other dental problems. It encompasses both private and occupational care. Dental experts advise routine tooth cleaning at least twice per day (morning and night) and after meals. In addition to areas between teeth, a toothbrush can remove most plaque and lower the pH of the tooth surface, which neutralizes corrosive acids. Additionally, flossing is seen as essential to maintaining dental hygiene. When used properly, dental floss eliminates plaque from the areas between teeth and along the gum line, where periodontal disease frequently starts and can result in cavities. Tartar can be removed during routine cleanings, which are normally carried out by dentists and dental hygienists. Tartar can still build even with regular brushing and flossing. A professional cleaning may also include tooth scaling, which removes deposits from teeth using a range of tools.

Care for teeth and gums

It is possible to maintain healthy gums and teeth throughout life with the right treatment. Less tooth decay and gum disease are likely to occur with healthy teeth and gums. To maintain healthy teeth and gums, follow these five simple steps:

Brushing, flossing, rinsing, eating healthfully, and going to the dentist

Tips for brushing teeth

Twice daily, ideally after each meal, brush your teeth. It is best to wait 30 minutes after eating so that any lacquer that has become softer from corrosive during eating can resolidify and not be brushed away. When you brush your teeth, plaque—a bacterial film that adheres to the teeth—is eliminated. When bacteria in plaque come into touch with food, they release acids into the environment. These acids result in cavities.

To scrub:

Apply a pea - sized amount of toothpaste to the soft toothbrush's head, and then brush at a 45 - degree angle against the teeth up to the gum line. As you brush the teeth, make a slight circular motion with the brush. Maintain this motion while you brush each tooth separately. Keep the tips of the bristles parallel to the gum line. Avoid pressing so firmly that the bristles are flat against the teeth. The toothbrush's only tips are used to clean teeth.) Let the bristle slip in between your teeth.

- Clean the chewing surfaces of the teeth from top to bottom. Make sure the fibers enter the craters and holes.
- Use the same tiny circular motion to brush the backs of the upper and lower teeth on the side that is exposed to the tongue.
- Move the toothbrush in a small circle while pointing the head in all directions toward the base of the mouth to clean between the bases of the front teeth.
- When brushing the inside of the top front teeth, angle the brush upward and downward with the tip of the head pointed toward the roof of the mouth. With the toothbrush, draw a little circle.
- Lightly brush your tongue from the bottom to the top, beginning at the back. Don't scour, please. This improves the scent of your breath and aids in the removal of microorganisms.
- After brushing your teeth for two to three minutes, rinse your mouth with water.
- Purchase a new toothbrush every three to four months.

Fortunately, if bacteria are not eliminated by daily brushing and flossing, gum disease can be avoided. Using toothpastes that stop plaque from growing again makes gum disease prevention simpler.

Normal tooth paste

The way a tooth looks and is perceived is the result of a complex interplay of factors, including lighting conditions, clarity, haziness, light scattering, sparkle, and the natural eye and mind.

The outside of teeth is polished with a thin coating. Blue, pink, and green colors are added to the tooth tone by the polish layer, which is more white and hazy. The underlying dentin layer is darker than enamel, yellow - brown in color, and less translucent than enamel. The majority of the tooth's structure is shaped by the dentin, which also greatly affects the color of the tooth overall. The dental pulp, a thin connective tissue, is located in the center of the tooth. The pulp appears pink or crimson because to its vascularity, but until tooth wear (or occasionally internal resorption) causes the thickness of these layers to decrease, it rarely shows through the enamel and dentin that cover it. The racial, gender, and geographic differences in tooth color. Generally speaking, females have slightly whiter teeth than do males. This is partially caused by the lower size of female teeth, which allows less dentin to show through the enamel. For the same reason, the larger molars and the canine (cuspid) teeth are often darker. Due to differences in the ratio of veneer to dentin, child teeth (deciduous teeth) are often whiter than the adult teeth that come after.



Figure 2

There are three stages of gum disease:

- **Gingivitis:** An inflammation of the gums brought on by plaque buildup at the gum line, gingivitis is the first stage of gum disease. Toxins are created when plaque is not removed by daily brushing and flossing, which can irritate the gum tissue and lead to gingivitis. During tooth cleaning and flossing, there can be some bleeding. Since the bone and connective tissue that support the teeth in place are not yet harmed, damage caused by gum disease at this early stage can be repaired.
- **Periodontitis:** At this point, the fibers and bone that support the teeth are irreparably injured. Below the gum line, the gums may start to form a pocket that collects food and plaque. Usually, better at-home care and proper dental care can help stop future harm.
- **Advanced periodontitis:** The tissues and bone that support the teeth are damaged during this last stage of gum disease, which can result in teeth shifting or becoming loose. Your bite may be affected, and teeth may need to be improved if rigorous therapy is unable to save them.

Gums and Brushing Technique:

One can be tempted to brush teeth as vigorously in the effort to keep teeth clean. However, because gums are formed of fragile tissue, cleaning them incorrectly could harm them. The greatest toothbrush has soft nylon bristles with blunted ends, whether it is a manual or electric toothbrush. The enamel of the teeth can be harmed by brushes with medium or hard bristles, which can also cause the gums to become swollen and red. Damage can be prevented by massaging and cleaning the teeth and gums with soft, circular motions. Although this action is frequently used, it can harm and irritate the gums, making them painful and more likely to bleed or retreat.

Gums and Flossing Technique:

Daily flossing can help eliminate plaque from areas that a toothbrush can't reach. To avoid making gums grow or drain, flossing should be done carefully. Instead than shoving the floss between the teeth, gently move it up and down while adhering to the contour of each tooth. At least once every day, floss above the gum line to get rid of additional plaque.

Gingivitis, periodontitis, advanced periodontitis, dental cavities, and other similar disorders are treated with our herbal toothpaste. This strategy can help prevent both tooth-

and gum - related problems. They are made entirely of herbal remedies that are beneficial for a number of dental problems. They lack substance, and even the additions come from the extraction of the spices. The botanical elements used in medical toothpaste include guava leaf powder, aloe, vajradanti, powders (fenugreek, curcumin, acacia, cinnamon, amla, sugarcane, licorice, and black pepper), oils (clove, coconut, neem, and peppermint), and honey. These common fixes help maintain oral health and cleanliness as well as being helpful in tooth-related situations^{42, 43}.

Methods of crude herbal preparation: -

Psidium Guajava: It's made by first gathering the leaves from the college campus as needed, carefully cleaning them with distilled water, drying them in the shade, and then grinding them in a blender. After being sieved to achieve uniform particle size, the powder is kept in an airtight container.

(Gel) Aloe vera: Pick fresh aloe leaves from the plant, wash them in distilled water, and then trim and peel the upper and lower aloe skin's tips and bottoms. The skin was then peeled, submerged in water, and rinsed to get rid of the liquid's yellowish gelatinous color. The gel that has been scooped is re-mixed until it is frothy and liquid.

Barleria Prionitis (Powder): After being plucked from the garden, the leaves are thoroughly cleansed with distilled water, dried in the shade, and then crushed in a blender. After being sieved to achieve uniform particle size, the powder is kept in an airtight container.

Glycyrrhiza glabra: Local herbal stores sell dried liquorice roots. They are then mixed till a fine powder is produced after additional washing and drying to remove particles. To obtain homogeneous particles, shift through. Once collected, the powder is put in an airtight container.

Acacia arabica is the name for powdered acacia gum, which is available from herbal stores. The gums are further dried. A sufficient amount of gum was measured, collected in a mortar, and powdered.

To create curcumin, clean the turmeric root, slice it into incredibly thin pieces, and allow it to air dry before processing it into turmeric powder and keeping it in a closed container.

Trigonelafoenum graecum powder is made from fenugreek seeds that are purchased from neighborhood retailers. They are sanitized in order to remove the stones.

To make cinnamon powder, place the cinnamon sticks in a blender and process on high speed for 30 seconds. Check and stir, then repeat. After filtering the powder into a basin, combine the final larger portion one more time.

Pepper: Place the pepper on a dry pan. To dry roast, allow 4–5 minutes. It has begun to cook. Let it go. Blend it in a blender until a powdery substance develops.

Amla powder: Amla must be cut into pieces and dried in the sun for a few days before being combined with the

remaining ingredients in a blender. The ingredients should be sifted through a sieve once you have a fine powder.

Formulation: There are two of toothpaste formulation procedures,

- 1) Dry gum method
- 2) Wet gum method

Dry Gum method

- The solid ingredients, calcium carbonate, Fenugreek, liquorice powder, neem powder, amla, guava leaf, cinnamon powder, black pepper powder were weighed accurately as mentioned in the formula and sieve with sieve no.80 so as to maintain the particle size.
- These ingredients were also mixed in a mortar and pestle, then triturated with precisely weighed honey, aloe vera, and coconut oil until a semisolid substance was created.
- Addition clove oil.
- At the end, peppermint oil was added as a flavour.

Ingredients	Quantity (per 20gm contains)
Calcium carbonate (Abrasive agent)	10gm
Fenugreek powder ⁶⁻⁹ (surfactant)	0.6gm
Aloevera ³⁸⁻⁴⁰ (Humectant)	8.5gm
Acacia gum ³³ (Binding agent)	0.5gm
Coconut oil (Liquid phase)	1.1gm
Liquorice powder ³¹ (Sweetening agent)	0.2gm
Honey	0.2gm
Peppermint oil ⁴³ (Flavouring agent)	0.5ml
Neem powder ³⁵ (Preservative)	0.1gm
Amla powder ³⁰	0.1gm
Guava leaf powder ³⁴ (Anti - caries)	0.3gm
Cinnamon powder ²³⁻²⁵	0.2gm
Clove oil ¹⁻³ (Essential oil)	1ml
Black Pepper Powder ²⁶⁻²⁷ (Anti - plaque)	0.2gm



Figure 3: Powder formed



Figure 4: Liquid phase

2. Evaluation

Herbal immune booster tea was created and put through organoleptic, physical, and phytochemical testing before being evaluated.

Organoleptic Test:

Under the organoleptic test the test for colour, odour, appearance, smoothness and texture which can be done manually was performed.

S. No.	Parameters	Observations
1	Colour	Yellowish
2	Odour	Characteristics
3	Appearance	Paste
4	Taste	Sweet
5.	Stability	Stable
6.	Spread ability	Easily spread
7.	Foamability	Good
8.	Abrasiveness	low abrasive

Physical Test:

PH: In a 50 mL measuring glass, add 10 mL of newly bubbled, cold water (at 27°C) to 10 grams of toothpaste to create a half - fluid suspension. To achieve the ideal suspension, thoroughly combine. Using a PH meter, quickly determine the suspension's PH.



Figure 5: pH test

Homogeneity: When normal power is given at 27°C, the toothpaste should release a homogenous mass from the folding cylinder or another suitable holder. In addition, the weight of the contents should be gradually applied and should dislodge from the fold of the holder.

Sharp and edge - grating particles: To check for any sharp or edge - grating particles, the items were placed on the finger and scraped across the margarine paper for 15 - 20 cm. I went through a cycle like that quite a bit. There were no sharp edges or points on any of the particles.



Figure 6: Sharp edge test

Formability: Using 2g of homemade toothpaste and 5ml of water in an estimating chamber, the combustibility of the mixture was calculated. The mixture was then vigorously shaken multiple times to determine the results. An estimate of the total amount of foam was made.



Figure 7: Foamability check

Assurance of dampness and unstable matter to test for moisture and other unexpected materials, 5 grams of handmade toothpaste were placed in a porcelain dish with a diameter of 6 to 8 cm and a depth of 2 to 4 cm. It was dried at 105 degrees Celsius in a burner.

Assurance of spread capacity: The slide and drag characteristics of the adhesive dictate the spread capacity technique. No sliding was permitted, thus 1 - 2g of handmade toothpaste was measured out and sandwiched between two glass slides measuring 10 x 10 cm. Following that, the slides were moved in restricting bearings. After three minutes, determine the amount of toothpaste that has spread (in cm). redoing the analysis after calculating the average of three readings.



Figure 8: Spreadability test

Tube extrudability

A clean, collapsible plastic tube with a 5 mm nasal tip aperture was filled with the formulation, and pressure was applied to the tube using a finger. The tube's extrudability was then determined by measuring the amount of paste that emerged from the tip when pressure was applied to it.

3. Result

S. No.	parameters	results
01	pH test	08
02	Homogeneity	Homogenous
03	Spread capacity	2.56
04	Sharp edge test	No sharp edge
05	Tube extrudability test	Good

4. Discussion

To make the herbal toothpaste mixture, natural ingredients like clove, aloe vera, vajradanti, neem, and guava leaf were employed. Evaluation tests of the goods were carried out in order to compare the various qualities of developed herbal toothpastes. All of the findings of the parameter evaluation were presented in tables. In the current study, the proposed herbal toothpaste generated outcomes that were on par with,

and occasionally even slightly superior to, those of the herbal toothpastes that were commercialized. It was visually determined that the prepared herbal toothpaste was a yellowish brown tintodor was discovered by breathing the product's Aromatic and Characteristic scents. The taste of the formulation was manually evaluated. when all samples were kept at a temperature of 34 +/- 30C for a total of 30 days. It confirmed the consistency of the toothpaste. For ten days, all collapsible tubes were stored under normal settings at a temperature of 45 to 20 C without exhibiting any evidence of corrosion or inside damage. All commercially available herbal toothpaste packaging, including Colgate Vedshakti, Dabur Red, Dabur Meswak, and Patanjali Dantkanti, showed good tube inertness, it was thus established. The smoothness was measured by rubbing the paste formulation between the fingertips. Herbal toothpaste's pH was assessed and contrasted with that of other commercially available herbal toothpastes. It turned out to be 8. It has been demonstrated that specifically prepared herbal toothpaste loses the least amount of moisture during drying. The activity becomes more harsh and contagious. Because it loses less after drying compared to other toothpastes on the market, it has been observed that specially formulated herbal toothpaste minimizes the chance of loss more than other toothpastes. For antibacterial efficacy, commercially available herbal toothpaste and specially formulated herbal toothpaste were examined. It was discovered that carefully formulated herbal toothpaste has good antibacterial action and is equally as efficient as brand - name toothpaste 44.

5. Conclusion

The investigation's results allow for the following conclusions to be formed. This herbal toothpaste, which is essential for maintaining oral hygiene and avoiding dental cavities, is safer and has fewer negative effects than synthetic toothpaste with a chemical foundation. All commercially available herbal toothpaste and lab - made variants were compared to the Bureau of Indian Normal standards. A properly prepared toothpaste can protect teeth and gums from diseases like E. coli by acting as an antibacterial agent. Herbal toothpaste was found to be as effective to commercially available toothpastes in an exploratory in - vitro trial in terms of all toothpaste assessment parameters.

By enhancing organic components to generate more and safer natural medicines, the developed herbal toothpaste has a promising future in dental research and treatment for the general population, society, and country. It was observed that the herbal toothpaste created was of exceptional grade. According to the study, herbal toothpaste is more frequently recommended in dental searches and is also safer and associated with less negative effects than synthetic preparation. The toothpaste's composition allows for both pathogen - fighting antimicrobial action and oral hygiene maintenance. contrast of the market structure and the formulation. Therefore, it is demonstrated that the commercially available formulations (Colgate, Dabour Red, and Dantakanti) possess a comparable level of captivating intensity and patronizing attention. The development of

herbal toothpaste has a bright future in the field of public health and the research of natural remedies⁴⁵.

References

- [1] Cortés - rojas d. f., de souza c. r., oliveira w. p. clove (*syzygium aromaticum*): a precious spice. *asian pac. j. trop. med.* 2014; 4: 90–96. doi: 10.1016/s2221 - 1691 (14) 60215 - x. [pmc free article] [pubmed] [crossref] [google scholar].
- [2] Shan b., cai y. z., sun m., corke h. antioxidant capacity of 26 spice extracts and characterization of their phenolic constituents. *j. agric. food chem.* 2005; 53: 7749–7759. doi: 10.1021/jf051513y. [pubmed]
- [3] Jones cg. chlorhexidine: is it still the gold standard? *periodontol 2000.* 1997; 15: 55–62. [pubmed] [google scholar]
- [4] [http://dx. doi. org/10.22159/ajpcr.2017. v10i12.18587](http://dx.doi.org/10.22159/ajpcr.2017.v10i12.18587) khare, c. p. indian medicinal plants: an illustrated dictionary. springer science, new york, 2007, 1, 82 - 83.
- [5] Khan r, adil m, danishuddin m, et al. in vitro and in vivo inhibition of streptococcus mutans biofilm by trachyspermum ammi seeds: an approach of alternative medicine. *phytochem* 2012; 19: 747 - 55.
- [6] Kumari, o. s.; rao, n. b. and gajula r. g. phytochemical analysis and anti - microbial activity of trigonella foenum graecum (methi seeds). *journal of medicinal plants studies.* 2016; 4 (4): 278 - 281.
- [7] *Pdr for herbal medicines.* 2nd ed. montvale. nj: medical economics company; 2000. p.776. back to cited text no.20
- [8] Çıkrıkçı s, mozioglu e, yılmaz h. biological activity of curcuminoids isolated from curcuma longa. *rec nat prod.* 2008; 2: 19–24. [google scholar]
- [9] Waghmare pf, chaudhary au, karhadkar vm, jamkhande as. comparative evaluation of turmeric and chlorhexidine gluconate mouthwash in prevention of plaque formation and gingivitis: a clinical and microbiological study. *j contemp dent pract.* 2011; 12: 221–2.
- [10] s m sabir 1, a zeb 2, m mahmood 3, s r abbas 4, z ahmad 5, n iqbal 1
- [11] m. k. nelson, j. l. dahlin, j. bisson, j. graham, g. f. pauli, and m. a. walters, 2017, *journal of medicinal chemistry*, vol.60, pp.1620.
- [12] ali a, akhtar n, et al. acacia nilotica: a plant of multipurpose medicinal uses. *journal of medicinal plants research* 2012; 6 (9): 1492 - 1496.
- [13] meena pd, kaushik p, et al. anticancer and antimutagenic properties of acacia nilotica (linn.) on 7, 12 - dimethylbenz (a) anthracene - induced skin papillomagenesis in swiss albino mice. *asian pacific journal of cancer prevention* 2006; 7: 627 - 632.
- [14] Malviya s, rawat s, et al. medicinal attributes of acacia nilotica linn - a comprehensive review on ethno pharmacological claims. *int j of pharm and life sci* 2011 June; 2 (6): 830 - 837.
- [15] Katiyar s, patidar d, et al. some indian traditional medicinal plants with antioxidant activity: a review. *International journal of innovative research in science, engineering and technology* 2013; 2 (12): 7303 - 7314.
- [16] Khare cp. indian medicinal plants. india: springer; 2007: 4 - 5.
- [17] Anonymous. medicinal plants in folklores of northern India. 1st ed. New Delhi: ccrum; 2001: 23.
- [18] Hakeem mah. bustan ulmufradat. new delhi: idarae kitabulshifa; 2002: 120.
- [19] Kabeeruddin m. ilmudadvianafeesi. new delhi: ejaz publishing house; 2007: 245.
- [20] Syed hm. hamdard pharmacopeia of eastern medicine. chatterjee a, pakrashi sc. the treatise on Indian tainter dr, grenis at. spices and seasonings. a food technology handbook. 2nd ed. new york: wiley - vch; 2001. p.256.
- [21] Nwofia ge, kelechukwu c, nwofia bk. nutritional composition of some piper nigrum (l.) accessions from nigeria. *int j med arom plants.* 2013; 3: 247–54.
- [22] In vitro cariostatic effects of cinnamon water extract on nicotine - induced streptococcus mutans biofilm *abdulaziz m alshahrani 1 2, richard l gregory 3*
- [23] antibacterial effects of cinnamon (*cinnamomum zeylanicum*) bark essential oil on *porphyromonasgingivalis* wijesekera, 2004)
- [24] <https://viccolabs.com/blogs/vicco-laboratories/a-to-v-of-dental-health>
- [25] Phytochemical and pharmacological profile of emblica officinalis linn *deshmukh chinmay devidas*, choudhari shraddha pramod*
- [26] <https://healthiersteps.com/licorice-root-for-teeth-how-to-use-it-and-what-benefits-you-can-expect>
- [27] hatano t, takagi m, ito h, yoshida t. acylated flavonoid glycosides and accompanying phenolics from licorice. *phytochemistry.*
- [28] *Acacia nilotica* (l.): a review of its traditional uses, phytochemistry, and pharmacology: *luqman jameel rather, shahid - ul - islam, faqeer mohammad*
- [29] *Guava (psidium guajava l.) leaves: nutritional composition, phytochemical profile, and health - promoting bioactivities*
- [30] M, maharishi tomar, ryszard amarowicz, vivek saurabh, m. sneha nair, chirag maheshwari, minnu sasi, uma prajapati, muzaffar hasan, surinder singh, sushil changan, rakesh kumar prajapat, mukesh k. berwal, and varsha satankar
- [31] *Azadirachta indica: a herbal panacea in dentistry – t. lakshmi, vidya krishnan, r rajendran, and n. madhusudhanan*
- [32] Ali a. textbook of pharmacognosy. new delhi, india: publication and information directorate; 1993.
- [33] Kokate c., purohit a. p., gokhale s. b. pharmacognosy. maharashtra, india: nirali prakashan; 2010.
- [34] George d, bhat ss, antony b. comparative evaluation of the antimicrobial efficacy of aloe vera on tooth and two popular commercial toothpastes: an in vitro study. *gen dent.* 2009; 57: 238–41.
- [35] Atherton p. aloe vera revisited. *br j phytother.* 1998;
- [36] Shelton m. aloe vera, its chemical and therapeutic properties.
- [37] Telci i., sahbaz n., yilmaz g., tugay m. e. agronomical and chemical characterization of spearmint (*mentha spicata l.*) originating in turkey. *econ. bot.* 2004; 58: 721–728
- [38] Bhat n, reddy jj, oza s. vinayak km. evaluation of efficacy of chlorhexidine and a herbal mouthwash on

dental plaque: an invitro comparative study.

International j pharm bio sci 2013; 4 (3): 625 - 632.

- [39] Henley - smith cj, botha fs, lall n. the use of plants against oral pathogens. " microbial pathogens and strategies for combating them: science, technology and education 2013; 1375 - 84.