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Herbal tooth gel formulations: A comprehensive review and comparative analysis for contemporary oral health practices

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Abstract

The shift towards natural healthcare has sparked renewed interest in herbal tooth gel formulations as alternatives to conventional oral care products. This comprehensive review explores the historical evolution, therapeutic properties, and contemporary significance of herbal tooth gels in oral health practices. Emphasizing the global trend towards natural remedies, the review delves into the efficacy of diverse herbal ingredients such as turmeric, camphor, and clove in managing oral health concerns, particularly periodontal diseases like gingivitis. Drawing from traditional practices and modern scientific research, the review highlights the advantages of herbal toothpaste formulations, including their gentle impact on teeth, absence of harmful chemicals, and diverse therapeutic properties. Moreover, the review discusses the sensory, physical, and antimicrobial properties of herbal tooth gels, examining their potential in plaque control and gingival health. By conducting a comparative analysis and evaluation of herbal elements such as neem, aloe vera, and triphala, the review highlights the increasing popularity and therapeutic possibilities of herbal toothpaste formulations in enhancing overall oral health. Amidst the prevalence of fast-paced lifestyles and common oral health issues, it's imperative to explore the extensive benefits provided by herbal tooth gels in contemporary oral healthcare. This becomes especially crucial given the rising global fascination with herbal remedies. Delving into the potential of herbal ingredients such as neem, aloe vera, triphala, guvava etc is particularly vital for addressing the challenges posed by poor oral health. Such exploration could hold promising solutions for enhancing overall oral hygiene and tackling oral health issues effectively.

Keywords: Tooth gel, herbal; Formulation; Oral health; Diseases; Antimicrobial properties

1. Introduction

Maintaining good oral health is essential for overall well-being, and the use of toothpaste or gel plays a fundamental role in achieving this goal. Toothpaste serves as a critical tool in daily oral hygiene routines by effectively removing plaque, food particles, and bacteria from the teeth and gums. The word "toothpaste" can be traced back to the Latin word "Dentifricium," which means "tooth-cleanser." The modern term "toothpaste" itself originates from the combination of "tooth" and "paste." The first known use of toothpaste in its recognizable form dates back to ancient Egypt and Greece, where people used mixtures of various substances like crushed bones, oyster shells, and powdered charcoal to clean their teeth. However, it wasn't until the 19th century that modern toothpaste as we know it began to take shape, with the addition of ingredients such as soap, chalk, and various abrasives. Additionally, toothpaste contains fluoride, a mineral that helps strengthen tooth enamel and prevents tooth decay and cavities. The development of fluoride toothpaste in the 20th century marked a significant advancement in dental care, helping to prevent tooth decay and promote oral health. Moreover, specialized toothpaste formulations address specific oral health concerns such as sensitivity, gingivitis, and tartar buildup, providing tailored solutions for individual needs. Regular brushing with toothpaste also helps to freshen breath, promoting confidence and social interaction.

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Traditional toothpaste made from herbal and natural ingredients has been a significant aspect of oral healthcare in ancient cultures for many years. In India, the historical use of local remedies for various ailments has contributed to a preference for non-alcoholic and herbal toothpaste, especially after people became aware of the drawbacks associated with commercial toothpaste. Natural toothpaste formulations typically exclude fluorides, synthetic flavors, or colors [1].

Oral health plays a pivotal role in overall well-being, and the popularity of herbal dentifrices as an alternative or complementary approach to conventional oral care products continues to grow. Given the increasing prevalence of dental issues associated with lifestyle choices, dietary habits, smoking, and oral hygiene practices, this review investigates the potential of natural herbs, in managing various oral health concerns. Many synthetic toothpaste products often contain fluoride or sodium lauryl sulfate, which can have negative effects on teeth. Currently, natural sources are more appealing, especially when contrasted with synthetic alternatives. Herbal toothpaste has gained popularity among consumers due to its lack of side effects and a minimal number of ingredients, distinguishing it from synthetic options [2, 3].

Poor oral health can lead to a myriad of detrimental consequences, including gum disease, tooth decay, and even systemic health issues. Moreover, the indiscriminate use of certain toothpaste ingredients can exacerbate these problems. For instance, some toothpaste formulations contain abrasive agents that, when used excessively or with improper brushing techniques, can erode enamel and contribute to tooth sensitivity. Additionally, certain ingredients like sodium lauryl sulfate (SLS) found in toothpaste can cause irritation and increase the likelihood of developing canker sores. These side effects underscore the importance of choosing toothpaste wisely and maintaining good oral hygiene practices. Research by Pihlstrom et al. (2005) highlights the link between poor oral health and systemic conditions such as cardiovascular disease, diabetes, and adverse pregnancy outcomes, emphasizing the need for comprehensive oral care strategies. Furthermore, a study by Vieira et al. (2017) emphasizes the potential harm of abrasive toothpaste ingredients, urging consumers to be mindful of their oral hygiene choices to safeguard their dental health. Periodontal disease encompasses clinical conditions involving the degeneration and infection of the gums, periodontal ligaments, alveolar bone, and dental cementum [4]. When bacteria invade a periodontal pocket and adhere to subgingival plaque, a localized inflammatory response occurs [5]. Among various periodontal conditions, gingivitis is widely recognized as the most prevalent, presenting in various forms with distinct symptoms and potential causes. The most frequently encountered type of gingivitis is the chronic form, primarily attributed to plaque [6].

Modern toothpaste not only focuses on cleaning but also maximizes the release of active chemicals for treating and preventing oral problems. The primary functions of toothpaste include maintaining oral hygiene, acting as an abrasive to remove food particles and plaque, addressing halitosis, and containing active ingredients like fluoride to prevent dental and gum issues such as gingivitis. The primary culprits for dental caries and periodontal diseases are often linked to dental plaque, making good oral hygiene essential. The contemporary shift towards allopathic drugs in India has prompted a resurgence in the use of herbal toothpaste, which avoids common ingredients like artificial colors, flavors, and fluorides found in conventional products [7, 8].

Polyherbal and natural formulations are highly effective, containing active natural ingredients like polyphenols, gums, alkaloids, and glycosides, exhibiting diverse biological activities. In contrast, synthetic toothpaste made from various chemical components can harm sensitive parts of teeth, including enamel, crown, dentin, and tooth roots. Herbal toothpaste, derived from natural plants such as Babul, Aloe Vera extract, Clove oil, peppermint oil, and Eucalyptus oil, is a preferable alternative due to its gentler impact on teeth and various therapeutic properties [9].

In recent years, global interest in herbal remedies has surged due to their perceived safety and reduced side effects compared to traditional medicines. Herbal dental products, including antimicrobial toothpaste and mouthwashes, have gained popularity for plaque control.

2. Herbal Ingredients in Tooth Gels

Herbal tooth gels commonly feature ingredients such as neem, babul, aloe vera, clove oil, peppermint oil etc., each renowned for distinct therapeutic properties. Scientific investigations have consistently demonstrated the efficacy of these herbal. Oral administration of Aloe vera has demonstrated wound healing enhancement, particularly in the initial phases following acute radiation exposure. The observed improvement in wound activity is linked to its stimulative effects on inflammatory cell infiltration, fibroblast proliferation, angiogenesis, and growth factor production. Furthermore, Aloe vera nanoparticles exhibit targeted delivery capabilities. In the realm of nanotechnology, these platforms serve as customizable vehicles for drug delivery, enabling the transport of substantial payloads with precision [10].

3. Polyherbal Formulations

Certain herbal tooth gels leverage polyherbal formulations, combining multiple botanical extracts to amplify their therapeutic effects. Studies have explored the synergistic interactions between these diverse herbal components, suggesting potential advantages over single-herb formulations. The selection of herbal ingredients in herbal toothpaste is pivotal for its efficacy and attractiveness. Various herbs are chosen based on their specific properties that promote oral health. Commonly used herbs include Peppermint, Tea Tree Oil, Licorice, Miswak, Triphala, Babul, Ginger, propolis, Neem, charcoal, clove etc. In regions like South Asia, traditional practices emphasize the use of natural products like neem twigs and charcoal powder for oral hygiene [11, 12].

The medicinal properties of these herbal ingredients contribute to their effectiveness in toothpaste. Various herbs offer specific benefits when incorporated into toothpaste. Antibacterial herbs such as neem, clove, and tea tree oil work to combat harmful bacteria, safeguarding against cavities and gum disease. Anti-inflammatory properties found in herbs like aloe vera and ginger ease gum inflammation, while antioxidant-rich selections like green tea extract and Triphala aid in neutralizing free radicals, promoting oral health. For relief from toothaches, analgesic herbs like clove are effective, while astringent options such as babul and miswak tighten gums and minimize bleeding. Peppermint and menthol provide a refreshing breath, while aloe vera's healing properties assist in oral tissue recovery. Licorice and propolis aid in preventing dental caries, whereas anti-plaque herbs like miswak and sage help prevent plaque formation. Additionally, herbs like Triphala contribute to the remineralization of tooth enamel, bolstering overall tooth strength and health [13].

Herbal toothpaste offers several desirable characteristics that set it apart as a preferred choice for oral care. Firstly, it provides effective cleaning, ensuring thorough removal of plaque and debris from the teeth and gums. This cleaning action helps maintain oral hygiene and prevents the buildup of harmful bacteria that can lead to dental issues like cavities and gum disease. Furthermore, herbal toothpaste is known for its gentle formulation, which is especially beneficial for individuals with sensitive gums or teeth. The ingredients in herbal toothpaste are often selected for their soothing properties, helping to alleviate discomfort and irritation while still effectively cleaning the mouth.

Another key characteristic of herbal toothpaste is its non-staining formula. Unlike some conventional toothpaste options that may leave behind unsightly stains on teeth, herbal toothpaste helps maintain a bright and natural appearance, promoting overall dental aesthetics. Additionally, herbal toothpaste offers long-lasting freshness, leaving the mouth feeling clean and revitalized after each use. The refreshing properties of herbs like peppermint and menthol contribute to a pleasant oral experience, promoting confidence in one's breath throughout the day. Moreover, herbal toothpaste tends to be affordable and readily accessible, making it a convenient choice for a wide range of users. This accessibility ensures that individuals from diverse socioeconomic backgrounds can access quality oral care products without financial strain [14].

4. Antimicrobial Efficacy

The crucial role of herbal tooth gels lies in their ability to combat oral infections through their antimicrobial properties. Essential oils like tea tree oil, eucalyptus oil, and thyme have exhibited significant antimicrobial efficacy against common oral pathogens. Comparative investigations offer valuable insights into how various herbal tooth gels contribute to plaque control and gingival health. The integration of antibacterial, antiviral, and anti-inflammatory attributes of herbal products into dentistry practices has been notable. Some research endeavors have delved into the impact of plant extracts and products on specific oral pathogens, while others have concentrated on hindering biofilm formation, thereby reducing microbial adhesion responsible for dental plaque buildup [15, 16]. Exploration of plant extracts, essential oils, and phytochemicals has focused on their potential to prevent or alleviate bacterial adhesion. The antibacterial activities of essential oils against various bacteria, including *S. mutans*, have been documented [17, 18, 19], with their bactericidal or bacteriostatic effects attributed to components such as terpenes and terpenoids characterized by low molecular weight, aromatic, and aliphatic constituents [20].

5. Exploring Therapeutic Potential: Herbal Agents in Oral Healthcare

In the field of oral health, there has been a notable surge in interest regarding herbal agents due to their perceived therapeutic advantages and natural characteristics. From propolis to guava leaves, a diverse array of botanical substances holds promise in addressing various oral health concerns. This review delves into the medicinal potential of herbal ingredients commonly used in oral care formulations, shedding light on their antibacterial, anti-inflammatory, and antioxidant properties. Through a comprehensive analysis, we uncover the role of these herbal agents in

contemporary oral healthcare practices, highlighting their relevance in promoting natural alternatives to conventional oral care products.

- **Propolis:** Comprising resins, balsams, essential oils, wax, pollen, amino acids, minerals, and vitamins, propolis demonstrates remarkable medicinal potential. Its antibacterial effects stem from flavonoids and caffeic acid, while its antioxidant capacity surpasses that of vitamin C due to its radical scavenging ability. Propolis, containing caffeic acid phenethyl ester, also exhibits anti-inflammatory properties. Studies suggest that propolis may serve as a superior alternative to traditional storage media for maintaining periodontal ligament cell viability after tooth avulsion. Furthermore, propolis promotes hard tissue bridge formation by stimulating enzyme systems, cell metabolism, circulation, and collagen formation. Research indicates that direct pulp capping with propolis flavonoids delays dental pulp inflammation and stimulates reparative dentin formation in rats [21].
- **Triphala:** Triphala is a renowned Ayurvedic herbal blend composed of dried and powdered fruits from three medicinal plants: *Terminalia bellerica*, *Terminalia chebula*, and *Emblica officinalis*. *Emblica officinalis* exhibits antimicrobial and cytotoxic effects, while the ethanol extract of *Terminalia chebula* fruit demonstrates broad-spectrum activity against bacterial strains like *Salmonella typhi*, *Staphylococcus epidermidis*, and *Bacillus subtilis*. Among the three plants, *Terminalia bellerica* shows the highest potential. Triphala, dissolved in dimethyl sulfoxide, exhibits enhanced effectiveness against *E. faecalis* biofilm. The bacteriostatic and bactericidal properties of Triphala are attributed to the presence of tannic acid [22].
- **Green tea polyphenols (GTPs):** It is derived from the young shoots of the *Camellia sinensis* tea plant, possess notable properties. The gallic acid derivatives found in *Camellia sinensis* leaves exhibit anti-inflammatory capabilities and can neutralize free radicals effectively. GTPs also demonstrate antimicrobial effects by inhibiting bacterial enzyme gyrase, binding to the ATP B subunit. Green tea's antibacterial action extends to *E. faecalis* planktonic cells, and it functions as a proficient chelating agent. In vitro studies comparing the antimicrobial efficacy of triphala, GTPs, MTAD, and 5% sodium hypochlorite against *E. faecalis* biofilm formation on tooth substrate indicate that sodium hypochlorite and MTAD achieved complete eradication of *E. faecalis* within 2 minutes, while triphala and GTPs required 6 minutes to exhibit significant antibacterial effects, making them promising alternatives in combating bacterial biofilm.
- *Azadirachta indica*, commonly known as Indian neem or margosa tree, exhibits effectiveness against *E. faecalis* and *Candida albicans*. Its potent antioxidant and antimicrobial properties render it a promising agent for root canal irrigation, serving as an alternative to sodium hypochlorite. Comparative studies have shown that an experimental irrigant formulated from *A. indica* demonstrates antimicrobial efficacy comparable to 2.5% sodium hypochlorite and 0.2% chlorhexidine gluconate. Therefore, neem irrigant holds potential for endodontic applications [23].
- **Turmeric:** It is a natural medicament, offers a broad spectrum of biological actions, including anti-inflammatory, antioxidant, anti-carcinogenic, anti-mutagenic, anticoagulant, anti-diabetic, antifertility, antibacterial, and antifungal activities. Its primary bioactive compound, curcumin (diferuloylmethane), possesses diverse biological actions, making it promising for endodontic applications. Turmeric's components, known as curcuminoids, are polyphenols with potent antioxidant properties. Additionally, turmeric has been observed to alleviate pain and swelling, further highlighting its potential therapeutic benefits in various contexts [24].
- Lemon solution, with a pH of 2.21, serves as a natural source of citric acid, which has a pH of 1.68 and comparatively lower acidity. While citric acid, a chemical product, can be irritating, the natural lemon solution is less so. Due to its broad antibacterial efficacy, particularly against *E. faecalis*, fresh lemon solution is employed as a root canal medicament.
- **Salvadora persica solution:** It is also known as Miswak-Siwa, contains significant quantities of trimethylamine, salvadorine chloride, and fluoride in its chewing sticks. Alcoholic extracts of *Salvadora persica* at fifteen percent concentration exhibit potent antimicrobial properties. Due to its efficacy, it can serve as a viable alternative to sodium hypochlorite and chlorhexidine for root canal irrigation.
- **Syzygium aromaticum:** It is commonly known as the clove tree, is renowned for its rich content of eugenol and other constituents such as vanillin and iso-eugenol, which have been recognized for their potent antimicrobial properties. Eugenol, in particular, has garnered attention for its ability to combat various microorganisms effectively. Clove essential oil, derived from the tree, is celebrated for its multifaceted benefits. It showcases antioxidant properties, helping to neutralize harmful free radicals in the body. Moreover, the essential oil exhibits antibacterial characteristics, making it valuable in combating bacterial infections. Additionally, it possesses anodyne effects, meaning it has pain-relieving properties, which can be beneficial in alleviating discomfort and promoting overall well-being. The versatile nature of clove and its derivatives underscores its significance in traditional medicine and modern healthcare practices alike [25].

- ***Psidium guajava***: The leaves of *Psidium guajava*, belonging to the Myrtaceae family (Guava), possess various beneficial properties including antibacterial, anti-cancer, anti-diabetic, and antioxidant effects. Traditionally, guava leaf extract has been utilized for its health-promoting properties. Guaijaverin, a compound isolated from *Psidium guajava*, exhibits promising antiplaque properties by inhibiting Streptococcus formation. It has been identified as an effective anti-plaque agent, offering a viable option for oral care. *Psidium guajava*, administered at a dosage of 1mg/m, effectively prevents dental caries and reduces dental plaque caused by *Staphylococcus sanguinis*, *Staphylococcus mitis*, and *Actinomyces* species. Guava extract, without disrupting oral cavity homeostasis, combats oral plaques and prevents bacterial adherence, thereby discouraging further plaque development. Users of guava chewing sticks typically boast solid, clean, fresh teeth that are free of dental plaques.

The present review underscores the therapeutic potential of herbal toothpaste formulations in addressing various oral health concerns while promoting natural, safe, and effective alternatives to conventional oral care products. As global interest in herbal remedies continues to rise, further research and clinical studies are warranted to explore the full spectrum of benefits offered by these natural interventions in maintaining optimal oral health.

6. Conclusion

The growing shift towards natural healthcare has led to the rising popularity of herbal tooth gels as an alternative to conventional oral care products. These formulations, rich in herbal ingredients like neem, aloe vera, clove, and triphala, offer numerous therapeutic benefits, including antimicrobial, anti-inflammatory, and antioxidant properties. The review highlights how herbal tooth gels not only provide effective oral care by combating common oral issues such as plaque, gingivitis, and periodontal diseases but also stand out due to their minimal side effects and gentle impact on teeth compared to synthetic products. The increasing global interest in herbal remedies emphasizes the potential of these natural formulations in addressing both contemporary oral health challenges and the growing consumer demand for safer, eco-friendly oral care solutions. As scientific research continues to validate their efficacy, herbal tooth gels are poised to play a significant role in the future of oral healthcare.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

- [1] Mithal BM, Saha RN. A Handbook of Cosmetics. New Delhi: Vallabh Prakashan; 2000.
- [2] Senthilkumar KL, Venkateswaran S, Vasanthan A, Chiranjeevi P. Formulation development and evaluation of novel herbal toothpaste from natural source. *Int J Pharm Chem Anal.* 2022;9(1):17–21.
- [3] Malgi R, Mane DV, Kumar DN, Shetty VP, Kobanna S. Formulation and evaluation of herbal toothpaste by *Cajanus cajan* (L.) leaf extract. *J Pharmacogn Phytochem.* 2022;11(1):175–8.
- [4] Vyas SP, Sihorkar V, Mishra V. Controlled and targeted drug delivery strategies towards intraperiodontal pocket diseases. *J Clin Pharm Ther.* 2000; 25:21–42.
- [5] Haffajee AD, Socransky SS. Attachment level changes in destructive periodontal diseases. *J Clin Periodontol.* 1986; 13:461–72.
- [6] Rathee M, Jain P. Gingivitis. [Updated 2023 Mar 27]. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2024.
- [7] Anna T. Remineralization potential of a new toothpaste formulation: An In-vitro Study. *J Contemp Dent Pract.* 2004.
- [8] Al-Kholani A. Comparison between the efficacy of herbal and conventional dentifrices on established gingivitis. *Dent Res J (Isfahan).* 2018;12(3):1-9.
- [9] Mangilal T, Ravikumar M. Preparation and evaluation of herbal toothpaste with commercial herbal toothpastes: An in-vitro study. *Int J Ayurvedic Herbal Med.* 2016;6(3):2266–71.

- [10] Shende V. Formulation and evaluation of herbal tooth gel containing aloe vera: compared study with marketed preparations. *Eur J Pharm Med Res.* 2017.
- [11] Janakiram C, Ramanarayanan V, Fontelo P, Iafolla T, Dye BA. Effectiveness of herbal oral care products in reducing dental plaque & gingivitis – a systematic review and meta-analysis. *BMC Complement Med Ther.* 2020;20(1).
- [12] Khose AA, Vyavhare DS, Salve MT. Herbal toothpaste formulation and assessment: A comprehensive review. *Int Res J Mod Eng Technol Sci.* 2023;5(11):3052.
- [13] Narayanasamy AS, Sharmila, Nivetha, VithyaSri, Archana. Formulation and evaluation of Poly Herbal Tooth Paste. *J Pharm Res Int.* 2023;35(19):13–8.
- [14] Indrayani DR, Raut DS, Gumate DS, Patil SS, Patil VR. Formulation and evaluation of polyherbal toothpaste using medicinal plants. *Int J Pharm Pharm Res.* 2022.
- [15] Balunas MJ, Kinghorn AD. Drug discovery from medicinal plants. *Life Sci.* 2005; 78:431–41.
- [16] Barnes NA, Arnold PT. Investigation of Antibacterial Effects of Southern Appalachian Plants: *Phytolacca americana* and *Juglans nigra* on Selected Bacteria. *Ga J Sci.* 2018; 76:45.
- [17] Botelho MA, Nogueira NA, Bastos GM, Fonseca SG, Lemos TL, Matos FJ, et al. Antimicrobial activity of the essential oil from *Lippia sidoides*, carvacrol and thymol against oral pathogens. *Braz J Med Biol Res.* 2007; 40:349–56.
- [18] Furletti VF, Teixeira IP, Obando-Pereda G, Mardegan RC, Sartoratto A, Figueira GM, et al. Action of *Coriandrum sativum* L. essential oil upon oral *Candida albicans* biofilm formation. *Evid Based Complement Alternat Med.* 2011;985832.
- [19] Simões M. Antimicrobial strategies effective against infectious bacterial biofilms. *Curr Med Chem.* 2011; 18:2129–45.
- [20] Bakkali F, Averbeck S, Averbeck D, Idaomar M. Biological effects of essential oils—A review. *Food Chem Toxicol.* 2008; 46:446–75.
- [21] Sabir A, Tabbu CR, Agustiono P, Sosroseno W. Histological analysis of rat dental pulp tissue capped with propolis. *J Oral Sci.* 2005; 47:135–8.
- [22] Pulok KM, Sujay R, Sauvik B, Kumar DP, Kanti BT, Utpalendu J, et al. Clinical study of ‘Triphala’: A well-known phytomedicine from India. *Int J Pharm Technol.* 2006; 5:51–4.
- [23] Chaturvedi TP. Uses of turmeric in dentistry: An update. *Indian J Dent Res.* 2009; 20:107–9.
- [24] Prasanna N, Nithya J, Nabeel N. Ethnopharmacological approach in endodontic treatment: A focused review. *Int J Drug Dev Res.* 2011; 3:68–77.
- [25] Penumudi SM, Mandava RB, Saraswathi DD, Santhi V, Bollineni S, Gandhi B. Antimicrobial efficacy of herbs in endodontics. *J Adv Oral Res.* 2015;6(1):9–12.