

Review Article

An analysis of scientific evidences for design of an ideal herbal dental formulation

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ABSTRACT

This study is an analysis of components of herbal tooth pastes to highlight important dental herbs for the development of an ideal formulation with evidence-based approach. In this study ten herbal toothpaste formulations were purchased from the market, codified and the herbs present in all were tabulated. A comparison of their established pharmacological actions has been made. As per analysis the requirement of analgesics and anti-inflammatory agents is not a daily requirement and adds to a question mark for their inclusion in the daily use toothpaste. Some of the toothpastes have not included any herb but the product is being sold under the cover of herbal toothpaste demonstrating that OTC companies are just trying to en-cash the positive wave towards herbal formulations. Only 20% formulations are using astringent, 10% are using antiviral and only 30% are using anti-carcinogenic which is indeed needed for daily use in toothpaste. More than 30% toothpastes are using anti-allergic components and not justified as it may suppress the immune system. There is a need of revision of criteria for using selected herbs for better therapeutic activity.

Keywords: Anti-cancer, Anti-microbial, Eugenol oil, Herbal toothpaste, Oral diseases

INTRODUCTION

The oral cavity serves as a major gateway for pathogens and microbes to enter the human body, making its hygiene essential for overall health and quality of life. Maintaining good oral health primarily depends on use of oral medicaments, such as toothpastes and dentifrices, which play a crucial role in preventing oral diseases. However, a closer look at many commercially available products reveals the inclusion of potentially harmful chemicals. Ingredients like sodium fluoride, listed among 100 chemicals with substantial developmental neurotoxicity evidence; sodium lauryl sulphate, a known skin irritant; triclosan, a pesticide and suspected human carcinogen; and hydrated silica, which may erode enamel, raise serious safety concerns when used long term.¹⁻³

Despite the wide availability of allopathic oral care formulations, awareness regarding their possible adverse effects has increased. This shift in perception has led to growing consumer preference for herbal products, viewed as safer alternatives. Consequently, many pharmaceutical companies have introduced numerous herbal-based dental formulations. However, this surge has also resulted in the irrational use of herbs, often without sufficient pharmacological validation. Herbal components in toothpaste formulations, due to their direct contact with the oral mucosa, can enter the bloodstream and potentially exert both therapeutic and adverse effects—especially with prolonged use. Many marketed herbal toothpastes contain multiple herbal extracts and make exaggerated claims about their efficacy. Yet, critical analysis often reveals a mismatch between the claimed

benefits and the actual pharmacological actions of these ingredients. This manuscript aims to examine and review the therapeutic mechanisms of key herbal ingredients used in dental products, with the objective of identifying the most effective and scientifically justified herbs for inclusion in an ideal, evidence-based oral care formulation.

IDEAL HERBAL COMPOSITION

Learning upon these very side effects of allopathic formulations, various herbal formulations have been introduced in the market for daily use. These formulations

have been designed on the basis of knowledge obtained from ancient literature and their classic use. These herbal formulations have not only gained significant popularity but have also proved to be as effective as allopathic formulations with minimal side effects. Various herbs have been used by our ancestors for protecting their oral cavity and fighting with various oral problems like bleeding gums, inflammation, tooth decay, tooth ache, loosening of gums, bad breath (halitosis) etc. After a thorough analysis of ancient use of various herbs by the ancestors authors have enlisted nine herbs (Table 1) that could be used in the formulation of ideal herbal toothpaste.

Table 1: Ideal herbs with their therapeutic and pharmacological actions as well as active components.

Herb name	Botanical name	Active ingredients	Part used	Pharmacological activity	Therapeutic activity
Clove oil	<i>Eugenia caryophyllata</i>	Calcium, hydrochloric acid, iron, phosphorus, sodium, potassium, eugenol	Bud	Anti-fungal, anti-septic, analgesic, flavouring agent	Germicidal properties, sore gums, soothing effect against irritation, suppresses tooth decay and freshens breath
Babool	<i>Acacia arabica</i>	4-hydroxybenzoic acid, kaempferol, quercetin, catechin, ophioglonin, aromadendrin, phenol, epicatechin, catechon, 3,4,7 trihydroxyl-3, 5-dimethoxyflavone	Bark	Astringent, healing, haemostatic, anti-helminitic	Wound healing, fixation property, prevents bacterial growth, useful in healing spongy gums
Jeshthamadh	<i>Glycyrrhiza glabra</i>	Flavonoids, phytoestrogens, glycyrrhizin	Root	Astringent, analgesic, healing, anti-inflammatory, anti-septic, rejuvenating	Relieves pain, healthy and strong gums prevents infection and tooth decay
Minta/ pudina	<i>Mentha spicata</i>	Menthol, menthol stereoisomers, methofuran, terpinene, β -caryophyllene, pipertone oxide	Leaves	Anti-microbial, anti-bacterial, antifungal, flavoring, breath freshening	Freshens breath, oral hygiene, protects gums and oral tissue
Bakul	<i>Mimusops elengi</i>	Taraxerone, taraxerol, betulinic acid, spinasterol, sodium salt of betulinic acid, ursolic acid, fatty acid ester of alpha spinaesterol, vitamin C	Bark	Anti-fungal, anti-septic, anti-biotic	Oral hygiene, mouth wash, tooth strengthening, bad breadth, gums care
Vajradanti	<i>Barleria prionitis</i>	Flavonoids, sterols, glycosides, saponins (ulcer protecting), tanins, terpenoids and alkaloids,	Bark/ leaves	Heamostatic , analgesic, anti-inflammatory	Helps in periodontal diseases, tooth ache, reduces inflammation
Haldi	<i>Curcuma longa</i>	Cyclogenase-2 inhibitor, curcumin, cineole, volatile oils	Root	Anti-septic, anti-allergic, anti-cancer, anti-inflammatory	Helps in potent anti-microbial action, relieves inflammation
Akarkara	<i>Anacyclus pyrethrum</i>	Essential volatile oils, alkaloids, pellitorinos, pyretherin, alkamides, dehydro-anocycline lignane(sesamine) inuln (fructose), tanins	Bark	Stimulant, sialogogue, analgesic, antiseptic	Toothache relief, sore throat, tonsillitis, valuable sialogogues
Meswak	<i>Salvadora persica</i>	Silica, tannic acid, resins, solvaderine, sodium bicarbonate, fluoride, chloride, calcium, essential oil, benzyl nitrate and benzyl sothiocyanate	Bark	Antiseptic, antifungal, anti-viral	Abrasive, gingival inflammation, anti-cariogenic, bactericidal, decreases plaque accumulation, saliva determination, inhibits calculus formation

MECHANISM OF ACTION OF THE KEY COMPONENTS OF IDEAL HERBAL DENTAL CREAM

Eugenia caryophyllata (Clove)

It is widely used in herbal toothpaste for its antifungal, antiseptic, antiviral, analgesic, and flavoring properties.⁴ It contains active compounds such as calcium, phosphorus, potassium, sodium, and most notably eugenol, which provides a soothing effect and relieves dental pain. Clove oil is also used to treat sore gums, oral ulcerations, bad breath, and prevent cavities. Its germicidal action makes it a vital antiseptic in oral care.⁴

Eugenol suppresses sensory receptors involved in pain and inhibits prostaglandins and leukotrienes, reducing inflammation. GC-MS analysis of clove oil identifies Eugenol (88.58%), eugenyl acetate (5.62%), and β -caryophyllene (1.38%) as the primary active components.⁶ Eugenol also acts as an NMDA receptor antagonist, inhibiting pain signals.⁷ It depresses nerve conduction in A and C fibers, explaining its analgesic action. Caryophyllene exhibits anti-inflammatory activity in various models, supporting its therapeutic role in oral health.⁸

Barleria prionitis (Vajradanti)

Barleria prionitis is an annual shrub with its habitat in Asia (India and Sri Lanka) and South Africa. In India this plant is commonly used for treating toothache and also used as a haemostatic, analgesic, anti-inflammatory, antimicrobial in the oral products. The methanolic extract of *B. prionitis* bark shows much potent activity against all the tested oral fungi namely *S. cerevisiae* and *C. albicans*, than the standard drug amphotericin-B thus having a great potential to control candidiasis and other fungal infections.⁹

The anti-microbial activity of the methanolic extract of bark analyzed with disc diffusion method has been shown due to tannins, saponins, phenolic compounds, essential oils and flavonoids. These are chemically originated with iridoid glucoside esters, acetylbarlerin (6, 8-di-O-acetyl shanzhiside methyl ester), barlerin (8-O-acetyl shanzhiside methyl ester), shanzhide methyl ester and 6-O-acetyl shanzhiside methyl ester, verbascoside (6-O-trans-p-coumaroyl-8-O-acetylshanzhiside methyl ester).¹⁰ The crude extract of *Barleria prionitis* has been shown to be very effective against oral bacteria this degrades layer of enamel and triggers the formation of cavity.¹¹

Salvadora persica (Meswak)

Meswak (*Salvadora persica*), a member of the Salvadoraceae family, is an evergreen shrub widely recognized for its traditional use as a natural toothbrush, especially in Muslim communities. Its efficacy against dental issues has been well-documented. Chemically,

Meswak contains flavonoids, salvadorine, cyanogenic glycosides, lignans, saponins, alkaloids, tannins, linoleic and oleic acids, stearic acid, vitamin C, silica, and various salts such as sodium and potassium chlorides-all contributing to its antimicrobial action.¹² Silica acts as a mild abrasive for stain removal and whitening, while tannins help reduce gingival inflammation and plaque formation.¹³ Resins form a protective layer over enamel, reducing caries risk. Alkaloids like salvadorine stimulate gingival tissue and exhibit bactericidal properties. Vitamin C aids in tissue repair, and sodium bicarbonate serves as a mild germicide. Calcium supports enamel remineralization, working synergistically with saliva.

Meswak also contains benzyl nitrate and BIT, known for antibacterial, antifungal, and chemopreventive properties. Other compounds, including N-benzyl-2-phenylacetamide and butanediamide derivatives, exhibit broad-spectrum antimicrobial effects. Trimethylene reduces plaque and acts as an anti-inflammatory agent.¹⁴ Fluoride contributes anti-decay benefits, and essential oils promote salivation and antiseptic effects. Chloride helps prevent calculus and removes surface stains.

Mechanistically, *S. persica* inhibits *Streptococcus mutans* colonization by raising plaque pH, thus preventing caries formation.¹⁵ Its aqueous extracts have demonstrated strong antibacterial activity against gram-positive and gram-negative oral bacteria, as well as antifungal effects against *Candida* species.^{17,18}

Glycyrrhiza glabra (Jesthamadh)

Liquorice (*Glycyrrhiza glabra*) is a hardy herb native to the Mediterranean and China, with glycyrrhizin (2-14%) as its primary sweet-tasting compound.¹⁹ It contains phytoestrogens like formononetin, glabrone, neoliquiritin, and hispaglabridin A & B. In oral care, it acts as an analgesic, astringent, anti-inflammatory, rejuvenator, and antiseptic.²⁰ Found in both herbal and allopathic toothpaste, liquorice helps prevent gum inflammation.²¹ Licoricidin and licorisoflavan A inhibit bacteria linked to dental caries and gingivitis.²²

Curcuma longa (haldi/turmeric)

Curcuma longa (Turmeric) is widely used in Indian medicine. Its rhizomes contain curcuminoids such as curcumin, demethoxycurcumin, and bis-demethoxycurcumin, known for antioxidant and anti-inflammatory effects.²³ Curcumin inhibits leukotrienes, platelet aggregation, and stabilizes lysosomal membranes. Turmeric oil is effective against pathogens like *B. subtilis*, *S. aureus*, *E. coli*, and *P. aeruginosa*.²⁴ It also inhibits MRSA (MIC: 125-250 $\mu\text{g/mL}$).²⁵ Novel curcumin compounds like indium-curcumin show superior antibacterial activity *in vitro*. Additionally, curcumin disrupts cytokinesis in *B. subtilis* by inhibiting Z-ring formation, impairing cell division.²⁶

Acacia Arabica (Babul)

Acacia arabica (Babul), a member of the Leguminosae family, is widely used in ethnomedicine for treating skin, stomach, sexual, and dental issues.²⁷ In dental creams, it serves as a natural astringent, freshens breath, maintains gingival integrity, and promotes oral tissue healing. It also acts as a haemostatic by aiding in clot removal and exhibits anti-helminthic, antimicrobial, and antibacterial properties essential for daily oral hygiene.²⁸ Extracts of *Acacia arabica* show antimicrobial activity against both gram-positive bacteria (*Staphylococcus aureus*, *S. epidermidis* and *E. coli*) and gram-negative strains like *Aspergillus Niger*. Alcoholic extracts from gum, leaves, and fruits exhibit strong *in-vitro* antibacterial action against *S. aureus*, *Salmonella typhimurium*, *Proteus vulgaris*, and *Pseudomonas aeruginosa*. Additionally, air-dried powdered extracts are effective against *Streptococcus pyogenes*, *Klebsiella sp.*, and *Salmonella typhimurium*, supporting its use in therapeutic toothpaste formulations.²⁹

Anacyclus pyrethrum (Akarkara)

Akarkara of family *Asteraceae* has got a very high medicinal value. The plant roots consist of anacycline, pellitorine, enetriyene alcohol, hydrocarolin, inulin traces of volatile oils, sesamin, amides.³⁰ The roots of the plant are believed exert stimulant, cordial and rubefacient action.

In dental cream it plays a significant role of a sialogogue that stimulates secretion of saliva from the salivary glands. It is well known that saliva plays significant role in cleansing of the oral cavity by flushing mechanism and it also prevents the oral mucosa from drying.³¹ Dryness of the oral mucosa leads to various problems like difficulty in speech, chewing and engulfing food particles. Akarkara is used in the cure of sore throat, tonsillitis and even plays role in tooth ache relief.³² The ethanolic extract of Akarkara is capable of scavenging H₂O₂ radicals that have potential of damaging oral mucosa. H₂O₂ can easily cross the cell membrane and exert an injurious effect on tissue through a number of different mechanisms such as perturbing intracellular Ca²⁺ monostat, increased intracellular ATP, inducing DNA Damage and inducing apoptosis.

Mimusops elengi (Bakul)

Bakul (*Mimusops elengi*) is revered in Hindu culture and literature, symbolizing love and beauty.³³ This evergreen tree, native to the Deccan Peninsula and Andaman Islands, is widely cultivated for its ornamental and shade value. Medicinally, the bark serves as a cooling agent, cardiogenic, stomachic, anti-helminthic, tonic, and astringent, traditionally used to treat gum disease, biliousness, and dental disorders.³⁴ The fruit acts as a bowel astringent, seeds help fix loose teeth and relieve head ailments, and the root is used as a gargle with

soothing effects on the gums.³⁵

Various extracts hexane, ethyl acetate, ethanol, and methanol exhibit strong antibacterial effects against *Streptococcus mutans*, a primary cause of dental caries. Bark extracts also show activity against other oral pathogens including *S. aureus*, *S. salivarius*, *S. sanguis*, *Lactobacillus acidophilus*, and *Candida albicans*, making Bakul a valuable herb in dental formulations.³⁶

Mentha spicata (Mint)

Mint (*Mentha* spp.), a genus in the *Lamiaceae* family, includes 18 species and 11 named hybrids, identified through morphological and phylogenetic analysis. Peppermint and spearmint are widely known for their essential oils, with menthol being the primary component responsible for the characteristic cooling sensation.³⁷ These oils are extensively used in both medicinal and culinary applications.

In oral care, mint contributes significantly to mouth and throat hygiene. It acts as an analgesic, antibacterial, antifungal, antiviral, anti-inflammatory, and anti-helminthic agent.³⁸ Besides enhancing flavor and providing breath freshness in dental creams, mint's essential oils show strong antimicrobial activity-particularly against *E. coli*, *Salmonella enteritidis*, *Helicobacter pylori*, and methicillin-resistant *S. aureus* strains.³⁹ Its efficacy stems from the oils' lipophilic nature, which disrupts bacterial membranes, as well as specific functional chemical groups.⁴⁰

OUTCOME

Ten herbal toothpaste formulations were purchased from the market, codified, and their herbal components tabulated (Table 2). The composition of each formulation and pharmacological actions of included herbs were compared and analyzed (Table 3). Herbs that can be safely used in crude form on daily basis were also identified (Table 4).

The study found that each formulation was developed with a specific therapeutic intent, and the inclusion or exclusion of herbs was based on the intended therapeutic purpose. However, it was also observed that most formulations contained analgesic and anti-inflammatory herbs, despite these not being required for daily use. Only 20% of the formulations included astringents, despite their daily necessity for oral health maintenance. Similarly, only 10% included antiviral components, and 30% included anti-carcinogenic agents, which are valuable for daily oral care. Alarming, some toothpaste formulations did not include any herbal ingredients, despite being marketed as herbal products, suggesting a trend among OTC brands to exploit the consumer demand for herbal products without delivering on efficacy. Additionally, 30% of the formulations included anti-allergic components, whose regular use may suppress the immune system and potentially lead to immunocompromised conditions.

Table 2: Herbal Toothpastes available as OTC products along with their ingredients.

Name of the tooth paste	Ingredients
Toothpaste A	Sodium monofluorophosphate 0.76% (0.1 w/v fluoride ion), sorbitol, SMC, treated water, silica, sodium lauryl sulphate, flavor, calcium carbonate, sodium saccharine, sodium methyl paraben, sodium propyl paraben.
Toothpaste B	Neem, citrus, clove, thyme, tea tree, betel leaf, mint, peppermint, eucalyptus, holy basil.
Toothpaste C	Calcium carbonate, sorbitol, water, silica, SLS, flavour, Meswak extract, cellulose gum, carrageenan, sodium silicate, sodium saccharin, formaldehyde
Toothpaste D	Aqua, calcium carbonate, glycerin, herbal extract, <i>Anacyclus pyrethrum</i> , <i>Acacia arabica</i> , <i>Mimosops elengi</i> , <i>Symplocos racemosa</i> , <i>Eugenia jambolana</i> , sodium benzoate, pectic enzyme, calcium oxide, sodium lauryl sulphate, eucalyptol, coriander seed oil, ginger root oil, sodium silicate, sodium saccharin
Toothpaste E	<i>Anacyclus pyrethrum</i> , <i>Azadirachta indica</i> , <i>Xanthoxylum alatum</i> , <i>Mentha spicata</i> , <i>Syzygium aromaticum</i> , <i>Piper sylvaticum</i> , <i>Barleria prionitis</i> , <i>Mimosops elengi</i> , <i>Embelia ribes</i> , <i>Curcuma longa</i> , <i>Salvadora persica</i> , <i>Quercus infectoria</i> , calcium carbonate, sodium sulfate
Toothpaste F	<i>Cinnamomum zeylancium</i> , <i>Acacia Arabica</i> , <i>Glycyrrhiza glabra</i> , <i>E. officinalis</i> , <i>Syzygium jambolanum</i> , <i>Barleria prionitis</i> , <i>Rubia cordifolia</i> , <i>Anacyclus pyrethrum</i>
Toothpaste G	Sodium monofluorophosphate, calcium carbonate, sorbitol, silica, sodium lauryl sulphate, sodium silicate, sodium benzoate, propyl paraben, D- limonene, aqua, glycerine, <i>Ocimum basilicum</i> , sodium silicate, sodium
Toothpaste H	Pomegranate, winged prickly ash, Indian gum Arabic tree, chebulic myrobalan, belleric myrobalan, amla, Indian gooseberry, vidanga, embelia, chinse chaste tree, five leaved chaste tree, <i>Salvadora persica</i> , <i>acacia farnesiana</i> , sweet acacia, <i>acacia catechu</i> , <i>mimosops elengi</i> , neem.
Toothpaste I	Sodium monofluorophosphate, calcium carbonate, sorbitol, silica, sodium lauryl sulphate, sodium silicate <i>Anacyclus pyrethrum</i> , <i>Acacia Arabica</i> , <i>Mimosops elengi</i> , cellulose gum, carrageenan, sodium silicate, sodium saccharin
Toothpaste J	Clove, neem, sunthi, menthe, tomar, pipali, aloe vera, Kapoor, sodium lauryl sulphate, carrageenans, spearmint, peppermint, calcium phosphate, calcium pyrophosphate, hydrated alumina, silica

Table 3: Classification of toothpastes available OTC according to their pharmacological properties.

Oral ailment	Analgesic	Anti-microbial	Anti-fungal	Anti-cariogenic	Anti-septic	Anti-inflammatory	Sialogogue	Flavouring agent	Astringent	Healing	Anti-allergic	Anti-carcinogenic	Anti-viral
Toothpaste A	√		√	√				√					
Toothpaste B	√		√		√		√	√	√			√	
Toothpaste C	√	√	√	√	√	√		√		√	√		
Toothpaste D	√	√	√	√	√	√	√	√	√	√	√	√	√
Toothpaste E	√	√		√	√	√	√	√				√	
Toothpaste F	√	√			√	√	√	√					
Toothpaste G	√	√			√	√		√			√		
Toothpaste H	√	√	√	√	√			√					
Toothpaste I	√		√		√			√					
Toothpaste J	√		√	√									

Table 4: Herbs for daily use in crude form classified according to the purpose.⁴¹⁻⁵⁹

Dental problem/ usage	Common name	Botanical name	Plant part used
Toothache	Rasinia	<i>Robinia pseudo-acacia</i>	Bark is used in powdered form.
	Kakarsingi	<i>Pisticia integerrima</i>	Leaves
	Chitra	<i>Plumbago zeylanica</i>	Root is crushed into paste form and used as an analgesic
	Ak	<i>Ipomoea carnea</i>	Juice of leaves
	Daagrein	<i>Calotropis procera</i>	Latex
	Mirch	<i>Capsicum annum</i>	Fruit boiled in mustard oil is poured in the ear
	Ghodan	<i>Ficus hispida</i>	Latex
Periodontal/ gingival problems	Kandayi	<i>Argemone Mexicana</i>	Pulverised seeds
	Neem	<i>Azadirachta indica</i>	Twigs
	Tej-patta	<i>Cinnamon tamala</i>	Leaves
	Haldi	<i>Curcuma augustifolia</i>	Powdered rhizome
	Karkara	<i>Spilanthes oleracea</i>	Inflorescence
Gingival health	Gandhela	<i>Murraya panicula</i>	Stem
	kagji khod	<i>Carya illinoensis</i>	Leaves
Toothbrush	Puthkanda	<i>Achyranthus aspera</i>	Root
	Tirmir	<i>Zanthozylum armatum</i>	Twig
	Bana	<i>Vitex negundo</i>	Twig
	Khod	<i>Jatropha curcas</i>	Twig
	Meswak	<i>Salvadora persica</i>	Twig
	Handa	<i>Boehmeria platyphylla</i>	Leaves
Abrasive agent	Kashmal	<i>Berberis lyceum</i>	Peeled stem
	Relu	<i>Cassia occidentalis</i>	Leaves
	Tej patta	<i>Cinnamomum tamala</i>	Leaves
	Guava	<i>Psidium guajava</i>	Leaves and stem
	Paza	<i>Prunus cerasoides</i>	Twigs
	Chitra	<i>Plumbago zeylanica</i>	Stem
	Kagji-khod	<i>Carya illinoensis</i>	Leaves
	Gandhela	<i>Murraya paniculata</i>	Stem
	Nimbu	<i>Citrus medica</i>	Leaves and rind of the herb
	Aam	<i>Mangifera indica</i>	Leaves
	Khod	<i>Juglans regia</i>	Bark and leaves
	Galgal	<i>Citrus limon</i>	Leaves

Table 5: Classifying the ideal herbs with their therapeutic properties.

Herb name	Analgesic	Anti-microbial	Anti-fungal	Anti-cariogenic	Anti-septic	Anti-inflammatory	Sialagogue	Flavoring agent	Astringent	Healing	Anti-allergic	Anti-carcinogenic	Anti-viral
Clove	√	√		√	√			√					√
Meswak		√	√	√	√								√
Haldi	√	√			√	√				√	√	√	
Babool		√	√						√	√			
Bakul		√	√		√								
Vajradanti	√	√	√			√							
Mint/ Pudina		√						√					
Liquorice root	√	√	√		√	√			√				
Akarkara	√				√		√						

Among the ten formulations analyzed, toothpaste coded E was identified as the most effective in terms of both composition and intended therapeutic benefits. Of the nine most important herbs recommended for ideal toothpaste formulations, Meswak (*Salvadora persica*) and Vajradanti (*Barleria prionitis*) were found to have the broadest therapeutic actions (Table 5). However, the widespread inclusion of analgesics in daily-use toothpastes was deemed unnecessary and potentially harmful due to the risk of increasing pain threshold over time.

CONCLUSION

The study concludes that although herbal toothpaste formulations are widely marketed, many do not meet the necessary therapeutic criteria for daily oral care. The inclusion of analgesic and anti-inflammatory herbs, despite their limited relevance to daily needs raises concerns about long-term side effects such as increased pain threshold. Furthermore, essential components like astringents, antiviral, and anti-carcinogenic agents are underrepresented in current market formulations, while unjustified components such as anti-allergic agents are often overused.

These findings highlight the need for stricter evaluation and formulation standards for OTC herbal toothpaste products. A more rational, evidence-based selection of herbs focused on long-term safety and daily utility is essential to ensure that such products provide genuine health benefits rather than just appealing marketing narratives.

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REFERENCES

- Yazicioglu O, Ucuncu MK, Guven K. Ingredients in commercially available mouthwashes. *Int Dental J*. 2024;74(2):223-41.
- Boyer IJ, Bergfeld WF, Heldreth B, Fiume MM, Gill LJ. The cosmetic ingredient review program-Expert safety assessments of cosmetic ingredients in an open forum. *Int J Toxicol*. 2017;36(5):5S-13.
- Rodu B, Cole P, Mandel JS. Evaluation of the national toxicology program report on carcinogens. *Regulatory Toxicol Pharmacol*. 2012;64(1):186-8.
- Amruthesh S. Dentistry and Ayurveda-IV: Classification and management of common oral diseases. *Indian J Dental Res*. 2008;19(1):52-61.
- Lee SH, Moon JY, Jung SJ, Kang JG, Choi SP, Jang JH. Eugenol inhibits the GABAA current in trigeminal ganglion neurons. *PLoS One*. 2015;10(1):e0117316.
- Ahamad J. Characterization of essential oil composition of *Syzygium aromaticum* Linn (Clove) by GC-MS and evaluation of its antioxidant activity. *J Angiotherapy*. 2023;7(1):1-6.
- Asl MK, Nazariborun A, Hosseini M. Analgesic effect of the aqueous and ethanolic extracts of clove. *Avicenna J Phytomed*. 2013;3(2):186-9.
- Nisar MF, Khadim M, Rafiq M, Chen J, Yang Y, Wan CC. Pharmacological properties and health benefits of eugenol: A comprehensive review. *Oxidative Med Cellular Longevity*. 2021;2021(1):2497354.
- Nkere CK, Iroegbu CU. Antibacterial screening of the root, seed and stem bark extracts of *Picralimanitida*. *Afr J Biotechnol*. 2005;4(6):522-6.
- Cowan MM. Plant products as antimicrobial agents. *Clin Microbiol Rev*. 1999;12(4):564-82.
- Ahmad H, Rajagopal K. Biological activities of *Salvadora persica* L. Meswak). *Med Aromat Plants*. 2013;2(4):1-5.
- Noumi E, Snoussi M, Hajlaoui H, Valentin E, Bakhrouf A. Antifungal properties of *Salvadora persica* and *Juglans regia* L. extracts against oral *Candida* strains. *Europ J Clin Microbiol Infect Dis*. 2010;29:81-8.
- Hattab FN. Meswak: the natural toothbrush. *J Clin Dentistr*. 1997;8:125-9.
- Angaji EB, Angaji SM. Antimicrobial effects of four medicinal plants on dental plaque. *J Med Plants Res*. 2009;3(3):132-37.
- Mehanna N, Reid G. Effect of Meswak (Middle Eastern tree bark) on oral pathogens and potential for probiotic applications. *J Med Food*. 2010;13(3):729-32.
- Ajdic D, McShan WM, McLaughlin RE, Savic G, Chang J, Carson MB, et al. Genome sequence of *Streptococcus mutans* UA159, a cariogenic dental pathogen. *Proceedings National Academy Sci*. 2002;99(22):14434-9.
- Salehi P, Moumeni DS. Comparison of the antibacterial effects of persica mouthwash with chlorhexidine on *Streptococcus mutans* in orthodontic patients. *Daru J Pharmaceut Sci*. 2006;14(4):178-82.
- Almas K, Stakiw J. The effect of miswak extract from *Salvadora persica* stored for 18 years on microbes *in vitro*. *Egyptian Dental J*. 2000;46(1):227-30.
- Dahanukar SA, Kulkarni RA, Rege NN. Pharmacology of medicinal plants and natural products. *Indian J Pharmacol* 2000;32(4):81-118.
- Pandey D, Dubey V, Singh A. Therapeutic potential of *Glycyrrhiza glabra* L. in managing oxidative stress-induced disorders. *J Drug Res Ayurved Sci*. 2024;9(2):S149-59.
- Cho S, Park JH, Pae AN, Han D, Kim D, Cho NC, et al. Hypnotic effects and GABAergic mechanism of licorice (*Glycyrrhiza glabra*) ethanol extract and its major flavonoid constituent glabrol. *Bioorganic Medicinal Chem*. 2012;20(11):3493-501.
- Motsei ML, Lindsey KV, Van Staden J, Jäger AK. Screening of traditionally used South African plants for antifungal activity against *Candida albicans*. *J Ethnopharmacol*. 2003;86(2-3):235-41.

23. Sharifi-Rad J, Rayess YE, Rizk AA, Sadaka C, Zgheib R, Zam W, et al. Turmeric and its major compound curcumin on health: bioactive effects and safety profiles for food, pharmaceutical, biotechnological and medicinal applications. *Front Pharmacol*. 2020;11:550909.
24. Mun SH, Joung DK, Kim YS, Kang OH, Kim SB, Seo YS, et al. Synergistic antibacterial effect of curcumin against methicillin-resistant *Staphylococcus aureus*. *Phytomedicine*. 2013;20(8-9):714-8.
25. Rai D, Singh JK, Roy N, Panda D. Curcumin inhibits FtsZ assembly: an attractive mechanism for its antibacterial activity. *Biochemical J*. 2008;410(1):147-55.
26. Rajvaidhya S, Nagori BP, Singh GK, Dubey BK, Desai P, Jain S. A review on *Acacia Arabica*-an Indian medicinal plant. *Int J Pharmaceut Sci Res*. 2012;3(7):1995.
27. Andhare A, Bharambe S, Pawar A, Sutar D. Antimicrobial Sensitivity of Plant Extracts of *Acacia arabica*, *Prosopis juliflora*, *Abutilon indicum*, and *Bryonia laciniosa* on *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Escherichia coli*. *Qeios*. 2023;27:1-16.
28. Sujith K, Suba V, Darwin CR. Neuropharmacological profile of ethanolic extract of *Anacyclus pyrethrum* in albino Wistar rats. *Int J Pharmaceut Sci Res*. 2011;2(8):2109.
29. Elazouzouzi H, Fadili K, Cherra A, Amalich S, Zekri N, Zerkani H, et al. Phytochemistry, Biological and Pharmacological Activities of the *Anacyclus pyrethrum* (L.) Lag: A Systematic Review; *Plants*. 2022;11:2578.
30. Bendjeddou D, Lalaoui K, Satta D. Immunostimulating activity of the hot water-soluble polysaccharide extracts of *Anacyclus pyrethrum*, *Alpinagalanga* and *Citrullus colocynthis*. *J Ethnopharmacol*. 2003;88(2-3):155-60.
31. Sharma V, Thakur M, Chauhan NS, Dixit VK. Evaluation of the anabolic, aphrodisiac and reproductive activity of *Anacyclus pyrethrum* DC in male rats. *Scientiapharmaceutica*. 2009;77(1):97-110.
32. Kar B, Kumar RS, Karmakar I, Dola N, Bala A, Mazumder UK, et al. Antioxidant and *in vitro* anti-inflammatory activities of *Mimusops elengi* leaves. *Asian Pacific J Trop Biomed*. 2012;2(2):S976-80.
33. Baliga MS, Pai RJ, Bhat HP, Palatty PL, Boloor R. Chemistry and medicinal properties of the Bakul (*Mimusops elengi* Linn): A review. *Food Res Int*. 2011;44(7):1823-9.
34. Shahwar D, Raza MA. *In vitro* antibacterial activity of extracts of *Mimusops elengi* against gram positive and gram negative bacteria. *Afri J Microbiol Res*. 2009;3(8):458-62.
35. Purnima A, Koti BC, Thippeswamy AH, Jaji MS, Swamy AV, Kurhe YV, et al. Antiinflammatory, analgesic and antipyretic activities of *Mimusops elengi* Linn. *Indian J Pharmaceut Sci*. 2010;72(4):480.
36. Imai H, Osawa K, Yasuda H, Hamashima H, Arai T, Sasatsu M. Inhibition by the essential oils of peppermint and spearmint of the growth of pathogenic bacteria. *Microbios*. 2001;106:31-9.
37. Sivropoulou A, Kokkini S, Lanaras T, Arsenakis M. Antimicrobial activity of mint essential oils. *J Agricultural Food Chem*. 1995;43(9):2384-8.
38. Imai H, Osawa K, Yasuda H, Hamashima H, Arai T, Sasatsu M. Inhibition by the essential oils of peppermint and spearmint of the growth of pathogenic bacteria. *Microbios*. 2001;106:31-9.
39. Bakkali F, Averbeck S, Averbeck D, Idaomar M. Biological effects of essential oils—a review. *Food Chem Toxicol*. 2008;46(2):446-75.
40. Varga L. Effect of acacia (*Robinia pseudo-acacia* L.) honey on the characteristic microflora of yogurt during refrigerated storage. *Int J Food Microbiol*. 2006;108(2):272-5.
41. Dang GK, Parekar RR, Kamat SK, Scindia AM, Rege NN. Antiinflammatory activity of *Phyllanthus emblica*, *Plumbago zeylanica* and *Cyperus rotundus* in acute models of inflammation. *Phytotherapy Res*. 2011;25(6):904-8.
42. Iqbal Z, Lateef M, Jabbar A, Muhammad G, Khan MN. Anthelmintic activity of *Calotropis procera* (Ait.) Ait. F. flowers in sheep. *J Ethnopharmacol*. 2005;102(2):256-61.
43. Kwon YS, Lee JM, Yi GB, Yi SI, Kim KM, Soh EH, et al. Use of SSR markers to complement tests of distinctiveness, uniformity, and stability (DUS) of pepper (*Capsicum annuum* L.) varieties. *Molecules*. 2005;19(3):428-35.
44. Haraguchi M, Gorniak SL, Ikeda K, Minami Y, Kato A, Watson AA, et al. Alkaloidal components in the poisonous plant, *Ipomoea carnea* (Convolvulaceae). *J Agricultural Food Chemistry*. 2003;51(17):4995-5000.
45. Bhattacharjee I, Chatterjee SK, Chatterjee S, Chandra G. Antibacterial potentiality of *Argemone mexicana* solvent extracts against some pathogenic bacteria. *Memórias do Instituto Oswaldo Cruz*. 2006;101:645-8.
46. Koul O, Isman MB, Ketkar CM. Properties and uses of neem, *Azadirachta indica*. *Canad J Botany*. 1990;68(1):1-1.
47. Rao CV, Vijayakumar M, Sairam K, Kumar V. Antidiarrhoeal activity of the standardised extract of *Cinnamomum tamala* in experimental rats. *J Natural Med*. 2008;62:396-402.
48. Doble B, Dwivedi S, Dubey K, Joshi H. Pharmacognostical and antimicrobial activity of leaf of *Curcuma angustifolia* Roxb. *Int J Drug Discov Herb Res*. 2011;1(2):46-9.
49. Bhandari P. Curry leaf (*Murraya koenigii*) or Cure leaf: Review of its curative properties. *J Med Nutrit Nutraceut*. 2012;1(2):92.
50. Osorio E, Flores M, Hernández D, Ventura J, Rodríguez R, Aguilar CN. Biological efficiency of polyphenolic extracts from pecan nuts shell (*Carya Illinoensis*), pomegranate husk (*Punica granatum*)

- and creosote bush leaves (*Larrea tridentate* Cov.) against plant pathogenic fungi. Industrial Crops Products. 2010;31(1):153-7.
51. Dwivedi S, Dubey R, Mehta K. *Achyranthes aspera* Linn. (Chirchira): a magic herb in folk medicine. Ethnobotanical Leaflets. 2008;2008(1):89.
 52. Kala CP, Farooquee NA, Dhar U. Traditional uses and conservation of timur (*Zanthoxylum armatum* DC.) through social institutions in Uttaranchal Himalaya, India. Conservation Society. 2005;3(1):224-30.
 53. Zheng CJ, Tang WZ, Huang BK, Han T, Zhang QY, Zhang H, Qin LP. Bioactivity-guided fractionation for analgesic properties and constituents of *Vitex negundo* L. seeds. Phytomedicine. 2009;16(6-7):560-7.
 54. Imanshahidi M, Hosseinzadeh H. Pharmacological and therapeutic effects of *Berberis vulgaris* and its active constituent, berberine. Phytotherapy Res. 2008;22(8):999-1012.
 55. Yadav JP, Arya V, Yadav S, Panghal M, Kumar S, Dhankhar S. *Cassia occidentalis* L.: a review on its ethnobotany, phytochemical and pharmacological profile. Fitoterapia. 2010;81(4):223-30.
 56. Bhandari P. Curry leaf (*Murraya koenigii*) or Cure leaf: Review of its curative properties. J Med Nutrit Nutraceut. 2012;1(2):92-6.
 57. Arias BA, Ramón-Laca L. Pharmacological properties of citrus and their ancient and medieval uses in the Mediterranean region. J Ethnopharmacol. 2005;97(1):89-95.
 58. Scartezzini P, Speroni E. Review on some plants of Indian traditional medicine with antioxidant activity. J Ethnopharmacol. 2000;71(1-2):23-43.
 59. Del Río JA, Fuster MD, Gómez P, Porras I, Garcia-Lidón A, Ortuño A. Citrus limon: a source of flavonoids of pharmaceutical interest. Food Chemistry. 2004;84(3):457-61.

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