A Comprehensive and Systematic Review on Plant Species Utilized for Dental Care Management in Himachal Pradesh, India

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Review

Abstract

Background: Mouth is a mirror that reflects the health of our body. There is a connection between oral health and other health systems of our body. Oral diseases and mouth disorders affect individuals of all age groups. These include bad breath, ulcers, pyorrhea, dental caries, gingivitis, edentulism, oral cancer, etc. There is an increasing demand of herbal remedies for toothcare nowadays. This paper offers a concise overview of research conducted on the utilization of plant resources for dental hygiene maintenance in Himachal Pradesh.

Methods: An extensive survey of literature was carried out by retrieving and screening a number of articles from various sources. Only relevant articles were selected and studied thoroughly.

Results: About 90 plant species which belong to 55 families are enumerated, of which Lamiaceae family is used most frequently with six species. Mostly, leaf parts are used to treat oral problems. 23 plant species are used as tooth powder or brushing sticks. Many plant species are used to cure oral problems like toothache (38 species), mouth ulcers (13 species), mouth sores (eight species), pyorrhea (four species), gum inflammation (two species) and mouth blisters (two species).

Conclusions: A number of plant species have been used since ages for toothcare management in Himachal Pradesh. These are economical, safe and have numerous benefits.

Keywords: Dental hygiene; Toothache; Oral health; Pyorrhea

Background

Oral health is representative of general health. According to WHO, oral health is the state of the mouth that enables the individual to perform essential functions of life like breathing, eating and speaking, and includes psychosocial dimensions. Oral health, from birth to death, is integral to general health and quality of life (WHO 2022a). Oral diseases are one of the major public health issues due to their high occurrence all over the world (Petersen 2003). A varied number of ailments and diseases are considered oral diseases such as dental erosion, dental caries, dental fluorosis, noma, oral cancers, and

periodontal diseases (Watt 2005). Although preventable, oral diseases are a major burden on health worldwide and affect individuals throughout their lives and cause discomfort, pain, disfigurement and even death.

The incidence of major dental problems is on the rise due to urbanization and lifestyle changes, as reported by the WHO Global Oral Health Data Portal in 2023. Several critical factors contribute to the increased occurrence of oral diseases, including poor dental hygiene habits, alcohol consumption, improper dietary practices, and smoking, as highlighted by Tadin *et al.* in 2022. Inadequate dental hygiene can lead to various issues such as periodontitis, dental cavities, and an increased risk of cancer, diabetes and cardiovascular diseases, as indicated by studies conducted by Wu *et al.* in 2020 and Tadin *et al.* in 2022. The interconnection between oral and systemic health is evident, with individuals with poor dental hygiene facing risks such as bacterial pneumonia, digestive problems in the elderly, infectious endocarditis, heart disease, stroke, and premature birth, as emphasized by Batra *et al.* in 2020. According to the WHO Global Oral Health Status Report of 2022, approximately 3.5 billion individuals worldwide are affected by oral diseases.

India faces significant challenges in oral hygiene, characterized by a lack of awareness among the population. Poor dental hygiene in the country can be attributed to factors such as limited awareness, ignorance, inadequate access to medical facilities, and financial constraints, as outlined by Kandwal *et al.* in 2020.

Plants have been used to promote dental hygiene and improve oral health for centuries. Some of these are used as natural brush, and others are used as a cure for toothache, bad breath, mouth ulcers and dental caries. A substantial amount of such knowledge has been perished over time due to inadequate written records, the downfall of civilizations and customs, and the loss of their particular knowledge of medicinal plants (Kathe 2006). Documenting traditional knowledge by means of ethnobotanical studies is significant for the conservation and sustainable utilization of these plant resources (Deka & Nath 2014). Nearly 80% of the world's population is dependent on traditional medicine, mainly plant extracts, for primary healthcare requirements. Over the last two decades, the popularity of conventional healthcare systems, especially herbal remedies, has surged tremendously in developed as well as in developing nations. (WHO 1993, 2003, Sukumaran *et al.* 2021). The orthodox treatment of oral health problems is very costly; it has remained a problem in most developed countries and a burden in the developing countries, especially among the poor population. (Petersen *et al.* 2005). Most people rely on private healthcare facilities due to lack of adequate infrastructure and shortage of skilled dental staff in public hospitals. These procedures are not just expensive, but also require frequent sessions. There are substantial discrepancies in oral health status between rural and urban inhabitants in developing nations like India, with enormous and increasing gaps in having accessibility to excellent healthcare, especially in the countryside. In such countries, safe, inexpensive and effective folk remedies, mainly based on plant products, are getting popular among both rural and urban population (Rajasekaran *et al.* 1996, Singh 2010).

Himachal Pradesh is situated between 30°22" to 33°12" North latitude and 75°47" to 79°4" East longitude. It is mostly mountainous and the altitudinal variation is from 350 to 7000 metres above mean sea level. It covers an area of 55,673 Km^2 and is divided into 12 administrative districts. It can be divided topographically into three zones, namely the lower or Shivalik hills, the Inner Himalaya or Mid-mountain and the Greater Himalaya or Alpine Zone (Balokhra 2006). It is a hilly state with enormous plant resources.

Numerous studies and explorations have been conducted by various researchers in the state to identify and document plants of ethnomedicinal importance. A number of plants having potential of promoting dental hygiene and preventing oral diseases have been reported by these researchers. Rawat *et al.* (2009) have found that 32 plant species are being used for dental hygiene in the Hamirpur district of Himachal Pradesh. Sood *et al.* (2011) have enumerated 446 plant species used in toothcare management in India. Kumar (2014) has recorded 120 species of plants belonging to 46 families which are being utilized by Indians for oral health care. Kumar (2018) has recorded 43 plants belonging to 30 families used for oral hygiene in district Kangra of Himachal Pradesh. Sikarwar *et al.* (2020) conducted extensive survey of ancient literature and ayurvedic literature and found that 21 species of plants are used as toothbrushes in Ayurveda and different parts of plants belonging to 49 species of plants are used as toothbrushes in various parts of India. Rathore and Shashni (2020) have documented 13 plant species used as Daatun (Tooth brushing sticks) by the rural communities in the district Kullu, Himachal Pradesh.

In this research endeavour, our aim is to meticulously analyze the existing body of literature that chronicles the wide array of plant species employed by the indigenous inhabitants of Himachal Pradesh. This employment primarily pertains to the toothcare management, showcasing the intricate relationship between traditional botanical knowledge and toothcare remedies.

Materials and Methods

Criteria, information sources and data extraction

A comprehensive literature survey was conducted by extracting numerous articles documenting information on the utilization of plants or plant components for dental care within the time frame of 2000 to 2023. Studies presenting ethnobotanical insights into the plant diversity of Himachal Pradesh in the context of tooth care practices were included. This involved searching through databases such as Google Scholar, ResearchGate, Science Direct, and PubMed. Furthermore, manual searches of reference list from the articles extracted from the primary search of research articles were conducted. The full-text versions of these articles were obtained and subjected to a screening process, whereby articles that did not meet the pre-established search criteria (studies documenting the data from other state) were excluded.

About 148 articles were found in the initial searches. Eventually, 122 articles relevant to the topic were selected to prepare this review, and 26 articles were excluded from the study. These include 64 research articles and guidelines, 51 review papers, six books and one portal. The botanical names of different plant species were validated using "WFO Plant List" and "Plants of the World Online" databases.

Results and Discussion

In this review, 90 plant species belonging to 55 families have been enumerated which have been used by the natives of Himachal Pradesh to maintain oral health – as natural toothbrushes and to prevent dental problems (Table 1).

Plants of family Lamiaceae are used most frequently having six plant species used for the same purpose, followed by Asteraceae (five species), Moraceae, Rutaceae (four species each), Caesalpiniaceae, Juglandaceae, Ranunculaceae (three species each), Acanthaceae, Anacardiaceae, Apiaceae, Combretaceae, Euphorbiaceae, Fabaceae, Fagaceae, Myrtaceae, Oleaceae, Poaceae, Rosaceae, Rubiaceae, Solanaceae, Urticaceae, Zingiberaceae (two species each), Amaryllidaceae, Annonaceae, Apocynaceae, Araceae, Asclepiadaceae, Asparagaceae, Aspleniaceae, Berberidaceae, Compositae, Convolvulaceae, Cornaceae, Crassulaceae, Geraniaceae, Gnetaceae, Lauraceae, Malvaceae, Meliaceae, Menispermaceae, Mimosaceae, Myricaceae, Oxalidaceae, Papaveraceae, Phyllanthaceae, Pinaceae, Plantaginaceae, Plumbaginaceae, Polygonaceae, Salicaceae, Smilaceae, Taxaceae, Thymelaeaceae, Umbelliferae and Verbenaceae (one species each) (Figure 1).

Lamiaceae stood out with the largest number of species, as this family has been found to include an immense variety of plant species with chemical constituents such as alkaloids, flavonoids, phenolics, terpenoids, and mainly essential oils. These components have applications in the pharmaceutical, cosmetic, and fragrance industries, and are also used in conventional and alternative medicine. (Nieto 2017, Bogale *et al.* 2023). The essential oils are primarily responsible for the biological applications of this plant family and these oils exhibit a wide range of activities, including but not limited to analgesic, antiallergic, antiangiogenic, anti-asthmatic, anticancer, antidepressant, anthelminthic, anti-hepatotoxic, anti-inflammatory, antimicrobial, antinociceptive, antioxidant, antiparasitic, antipyretic, antirheumatic, antiseptic, antitumor, antitussive, antiviral, carminative, cholinergic, immunoregulatory, neuroprotective and sedative properties (Ramos da Silva *et al.* 2021).

Most of the diseases are treated by using leaf parts (36%). Stem, wood and bark of 21% plant species, roots and rhizome of 18% species, fruits and seeds of 12% plant species, flowers and floral buds of 6% plant species, latex of 4% species and whole part of 3% plant species are used to maintain oral hygiene by people of Himachal Pradesh (Figure 2).

There are several reasons for the higher utilization of leaves compared to other plant parts. Leaves are primarily used due to their potency and rapid regeneration properties (Namukobe *et al.* 2011). They are also considered the site of secondary metabolite synthesis, which is pharmacologically effective against many diseases and can be easily prepared in various administration forms (Ahmad *et al.* 2014, Muluye & Ayicheh 2020). Many herbalists believe that plant leaves contain a wide range of bioactive chemical substances that are simple to extract (Siddique *et al.* 2021).

Additionally, collecting leaves may not be as detrimental to the plant's existence as gathering the entire plant, stem, or roots, which, if over-collected, could lead to the complete depletion of the original species (Zheng 2009, Evbuomwan *et al.* 2023). Furthermore, because leaves have less impact on a plant's survival rate compared to stem bark and roots, they are more suitable from a sustainable development and conservation perspective (Khan *et al.* 2021).

Table 1. Ethnomedicinal Plants Used for Toothcare Management in Himachal Pradesh, India

Botanical Name	Vernacular Name	Family	Mode of Application folk-uses	References
Acacia catechu (L.f.) Willd.	**khair**	Mimosaceae	Heart wood is used to extract 'katha' (Catechu, a brown coloured extract from the wood used as dye, food additive and tannin) applied to cure sores of mouth and twigs used to brush teeth.	Gautam *et al.* 2011
Achillea millefolium L.	**gandana**	Asteraceae	Leaves are used to get relief from toothache.	Kaur *et al.* 2017
Achyranthes aspera L.	**poothkanda**	Acanthaceae	Roots are used in the treatment of pyorrhea and toothache.	Verma *et al.* 2012
Ajuga bracteosa Wall. ex Benth.	**neel kanthi**	Lamiaceae	Leaves are chewed for curing toothache, throat infection and mouth ulcers.	Kumar *et al.* 2013
Allium sativum L.	**lahsun**	Amaryllidaceae	Leaves are used as mouth freshener.	Kumar 2018
Aloe vera (L.) Burm.f.	**ghretkumari**	Asparagaceae	Leaves are used to reduce dental plaque.	Radha *et al.* 2021
Anacyclus pyrethrum L.	**karkara**	Asteraceae	Flowers and roots are used to treat mouth ulcers, toothache and dental caries.	Kumar & Duggal 2019
Anemone obtusifolia (D.Don.) Mosyakin	**mingooa**	Ranunculaceae	Fresh root is chewed to cure toothache.	Boktapa & Sharma 2010
Anemone rivularis Buch.-Ham. ex DC.	**talpal**	Ranunculaceae	Fresh root is chewed to cure toothache.	Kaur *et al.* 2017
Annona squamosa L.	**sitaphal**	Annonaceae	Stem is used as toothbrush and leaves are used to cure toothache.	Kumar 2018
Argemone mexicana L.	**kandayi**	Papaveraceae	Dried and pulverized seeds are used to reduce gum problems.	Rani *et al.* 2013a
Arisaema flavum (Forsk.) Schott.	**_**	Araceae	The juice of its rhizome is applied on aching teeth.	Vidyarthi *et al.* 2013
Asplenium dalhousiae Hook.	**kukar kanke, trifakhi**	Aspleniaceae	The paste of leaves is used to get relief from mouth sores.	Rana *et al.* 2021
Azadirachta indica A. Juss.	**neem**	Meliaceae	Twigs are used for cleaning teeth and preventing oral infection and dental caries.	Rawat *et al.* 2009
Bauhinia vahlii Wight & Arnott	**torreya**	Caesalpiniaceae	Leaves are used as toothbrush.	Kumar & Duggal 2019
Bauhinia variegata L.	**kachnar, karail**	Caesalpiniaceae	Charcoal of its wood is used for cleaning teeth and curing toothache.	Pal *et al.* 2020
Berberis lycium Royle	**kasmal**	Berberidaceae	Roots are considered bactericidal while stem is used as natural toothbrush.	Rani *et al.* 2013b
Bidens biternata (Lour.) Merr. and Sherff.	**lumb**	Asteraceae	Flowers and fruits are dried and used to treat mouth ulcers.	Kaur *et al.* 2017
Boehmeria platyphylla D. Don	**handa**	Urticaceae	Leaves are utilized to stop bleeding of gums.	Kumar *et al.* 2021
Calotropis procera R. Br.	**ak**	Asclepiadaceae	Its latex is used to cure toothache arising due to dental caries.	Kumar 2018
Capsicum annum L.	**mirch**	Solanaceae	A mixture of its fruits and mustard oil is boiled and is poured inside ear to cure toothache.	Rawat *et al.* 2009
Carissa spinarum L.	**garna**	Apocynaceae	Extract of fruits is utilized to cure toothache.	Kumar *et al.* 2021
Carya illenoesis (Wang.) Koch.	**kagji-khod**	Juglandaceae	Leaves are used to clean teeth in order to keep gums healthy.	Kumar 2018

Cassia occidentalis L.	**relu**	Caesalpiniaceae	Leaves are used to brush teeth.	Rani *et al.* 2013a
Cedrus deodara (Roxb. ex Lamb.) G. Don	**devdar**	Pinaceae	Leaves are utilized to get relief from toothache.	Radha *et al.* 2021
Cinnamomum tamala Nees & Ebem	**tej-patta**	Lauraceae	Leaves are used to clean teeth and to check inflammation of gums.	Rawat *et al.* 2009
Cissampelos pareira L.	**patindu**	Menispermaceae	The paste of roots is used to cure toothache.	Gautam *et al.* 2011
Citrus limon (L.) Burm.f.	**galgal**	Rutaceae	Leaves are used as mouth freshener and also to clean teeth.	Kumar 2018
Citrus medica L.	**nimbu**	Rutaceae	Rind of fruits and leaves with rock salt are used to clean teeth.	Rawat *et al.* 2009
Colebrookia oppositifolia Sm.	**gandusa**	Lamiaceae	Floral buds are chewed to cure bleeding of gums.	Kumar *et al.* 2013
Coriandrum sativum L.	**been**	Umbelliferae	Leaves are used as breath freshener.	Gautam *et al.* 2011
Cornus capitata Wall.	**thrimbal**	Cornaceae	Twigs are used to brush teeth.	Devi & Gupta 2022
Curcuma angustifolia Roxb.	**haldi**	Zingiberaceae	A mixture of its powdered rhizome, mustard oil and potash alum is used to treat pyorrhoea.	Kumar 2018
Curcuma domestica Valet.	**haldi**	Zingiberaceae	A mixture of turmeric powder and mustard oil is applied on gums to treat pyorrhea.	Vidyarthi *et al.* 2013
Cynodon dactylon (L.) Pers.	**doob**	Poaceae	Whole plant is used to get relief from toothache.	Radha *et al.* 2021
Daphne papyracea Wall. ex Steud.	**bursha**	Thymelaeaceae	The paste of roots or stem is applied on the gums for tooth extraction.	Pal *et al.* 2020
Debregeasia salicifolia (Roxb. ex D. Don) Rendle	**siyaru**	Urticaceae	Chewing fruits of this plant is considered good to get relief from toothache.	Kumar *et al.* 2013
Echinacea purpurea (L.) Moench	**kariyat**	Compositae	Its leaves and roots are used to treat mouth blisters and oral infections.	Radha *et al.* 2021
Eclipta alba Hassk.	**babri**	Asteraceae	Roots are used to cure toothache.	Kumar & Duggal 2019
Engelhardtia colebrookiana Lindl.	**samma**	Juglandaceae	Leaves are used for scouring teeth and for checking dental caries.	Rawat *et al.* 2009
Ephedra qerdiana Wall. ex Stapf.	**buchur**	Gnetaceae	Chewing of stem is performed to treat toothache.	Srivastava *et al.* 1992
Ficus benghalensis L.	**banyan**	Moraceae	Bark, latex and leaves are used to cure dental problems.	Kumar 2018
Ficus hispida L.	**daagrein**	Moraceae	Latex is used to cure toothache.	Rawat *et al.* 2009
Ficus palmata Forssk.	**fagad, fagar, phegda**	Moraceae	Latex is used to get relief from toothache.	Boktapa & Sharma 2010, Vidyarthi *et al.* 2013
Ficus religiosa L.	**peepal**	Moraceae	Its bark and leaves are used to treat sores of mouth and are also gargled to cure salivation.	Kumar 2018
Foeniculum vulgare Mill.	**bann-saunf**	Apiaceae	Seeds are used as mouth freshener.	Kumar & Duggal 2019
Geranium wallichianum D. Don ex Sweet	**ratanjot, sucha phulli**	Geraniaceae	Roots are used to cure toothache and stop bleeding of gums.	Sharma *et al.* 2005, Kumar *et al.* 2021
Heteropogon contortus L.	**jar**	Poaceae	Roots are used to cure ulcers of mouth.	Kumar & Duggal 2019
Hibiscus rosa sinensis L.	**china rose**	Malvaceae	Stem is used as toothbrush.	Kumar 2018

Hyoscyamus niger L.	**dhundun**	Solanaceae	Inhaling smoke of its seeds is performed to treat toothache occurring due to bacterial infection.	Srivastava *et al.* 1992
Ipomoea carnea Facq.	**ghodan**	Convolvulaceae	Juice of leaves is used to cure toothache.	Rawat *et al.* 2009
Jasminum grandiflorum L.	**chameli**	Oleaceae	Chewing of leaves is performed to treat gum infection and ulcers of mouth.	Rana & Masoodi 2014
Jasminum officinale L.	**sunna juhi**	Oleaceae	Leaves are used to cure toothache.	Vidyarthi *et al.* 2013
Jatropha curcas L.	**japhrota**	Euphorbiaceae	Twigs are used for brushing teeth and for treating dental caries.	Rawat *et al.* 2009
Juglans regia L.	**akhrot, khod**	Juglandaceae	Bark and rind of fruit are used for treating toothache. Root bark and leaves are used for cleaning teeth and preventing tooth decay.	Kumar *et al.* 2013, Rana & Masoodi 2014
Justicia adhatoda L.	**bainshta**	Acanthaceae	Twigs are used for brushing teeth	Pal *et al.* 2020
Lathyrus aphaca L.	**jangli mattar**	Fabaceae	Seeds are used to treat toothache.	Kumar *et al.* 2021
Mallotus philippensis (Lam.) Muell. Arg.	**khambhal**	Euphorbiaceae	Stem is used to clean teeth.	Kumar *et al.* 2013
Mangifera indica L.	**aam**	Anacardiaceae	Leaves are used to clean teeth.	Rawat *et al.* 2009
Mentha arvensis L.	**pudina**	Lamiaceae	Leaves are used as mouth freshener and also to cure toothache.	Kumar 2018
Murraya koenigii (L.) Spreng.	**gandhela**	Rutaceae	Stem and its branches are used as natural toothbrush to make gums stronger.	Verma *et al.* 2012, Radha *et al.* 2021
Myrica esculenta Buch.-Ham. ex D. Don	**kaaphal**	Myricaceae	Bark decoction is used to cure toothache.	Radha *et al.* 2021
Nepeta erecta Benth.	**chimulu**	Lamiaceae	Chewing of leaves is done to cure toothache.	Dutt *et al.* 2014
Ocimum sanctum L.	**tulsi**	Lamiaceae	Leaves are used to cure mouth ulcers.	Kumar & Duggal 2019
Oxalis corniculata L.	**khatti-meethi**	Oxalidaceae	The juice prepared from its leaves is used to cure dental problems.	Kaur *et al.* 2017
Phyllanthus emblica L.	**amla**	Phyllanthaceae	Leaves and roots are used to cure toothache and mouth blisters.	Radha *et al.* 2021
Pistacia integrimma J. L. Stewart ex Brand.	**kakarsingi**	Anacardiaceae	Leaves are chewed to prevent toothache.	Rawat *et al.* 2009
Plantago lanceolata L.	**isabgol**	Plantaginaceae	Its leaves along with black pepper are used to cure mouth ulcers.	Rana *et al.* 2021
Plumbago zeylanica L.	**chitra**	Plumbaginaceae	Paste of roots is used to prevent toothache and stem is used for cleaning teeth.	Kumar 2018
Potentilla atrosanguinea Lodd.	**kalmur**	Rosaceae	Whole plant is used to cure toothache.	Devi & Gupta 2022
Prunus cerasoides Buch.-Ham. ex D.Don.	**pajja**	Rosaceae	Leaves are used to cure oral infections.	Radha *et al.* 2021
Psidium guajava L.	**amrood**	Myrtaceae	Fruits are used in curing ulcers of mouth.	Kumar *et al.* 2021
Quercus dilatata Royle	**moru**	Fagaceae	Chewing of young leaves cures mouth sores.	Singh *et al.* 2018
Quercus glauca Thunb.	**ban**	Fagaceae	Leaves are used to cure toothache and other gum problems.	Radha *et al.* 2021
Rheum australe D. Don	**chuchi**	Polygonaceae	Roots in powdered form are used to treat mouth ulcers and as toothpowder.	Vidyarthi *et al.* 2013

Robinia pseudo-acacia L.	**rasinia**	Fabaceae	Bark in powdered form is used to cure toothache.	Rawat *et al.* 2009
Rubia cordifolia L.	**majith**	Rubiaceae	Leaves are used to treat sores of mouth.	Radha *et al.* 2021
Salix oxycarpa Anderss	**beunce**	Salicaceae	Chewing of root bark is done to cure dental caries, pyorrhoea and toothache.	Rawat *et al.* 2009
Salvia officinalis L.	**sage**	Lamiaceae	Infusion of leaves is used to cure inflammation of oral cavity.	Kumar 2018
Sedum ewersii Ledeb.	**kanseri**	Crassulaceae	Fresh juice of whole plant is applied for treating ulcers of mouth.	Rana *et al.* 2021
Smilax aspera L.	**belda**	Smilaceae	Seeds are used to cure sores of mouth.	Devi & Gupta 2022
Spilanthus oleracea L.	**akarkara**	Asteraceae	Flowers are used in the treatment of mouth sours and leaves are used to treat gum infections.	Gautam *et al.* 2011
Syzygium aromaticum (L.) Merr. & L.M. Perry	**laung**	Myrtaceae	Its floral bud is used to cure caries cavities.	Kumar 2018
Taxus wallichiana Zucc.	**brahmi, nagdaun**	Taxaceae	Decoction of bark is used to treat ulcers of mouth.	Rana *et al.* 2021
Terminalia arjuna Roxb.	**arjun**	Combretaceae	Powdered bark is used in mouthwashes.	Kumar & Duggal 2019
Terminalia chebula Retz.	**harar**	Combretaceae	Fruits are used in curing toothache and mouth sores and ulcers.	Kumar 2018
Thalictrum reniforme Wall.	**garvin**	Ranunculaceae	Chewing of roots is done to prevent inflammation of gums.	Rawat *et al.* 2009
Vitex negundo L.	**banha**	Verbenaceae	Decoction prepared from its bark and leaves is used to cure toothache.	Verma *et al.* 2012
Wendlandia heynei Sant. & Merch.	**panseera**	Rubiaceae	Twigs are used for brushing teeth.	Kumar 2018
Zanthoxylum armatum DC.	**timbar, timur, tirmer, tirmira**	Rutaceae	A mixture of its fruit powder and black pepper is used as a remedy for tooth decay. Fruits and leaves are chewed to treat mouth ulcers. Pulverized seeds and stem are used to clean teeth.	Verma *et al.* 2012, Vidyarthi *et al.* 2013, Kumar *et al.* 2013

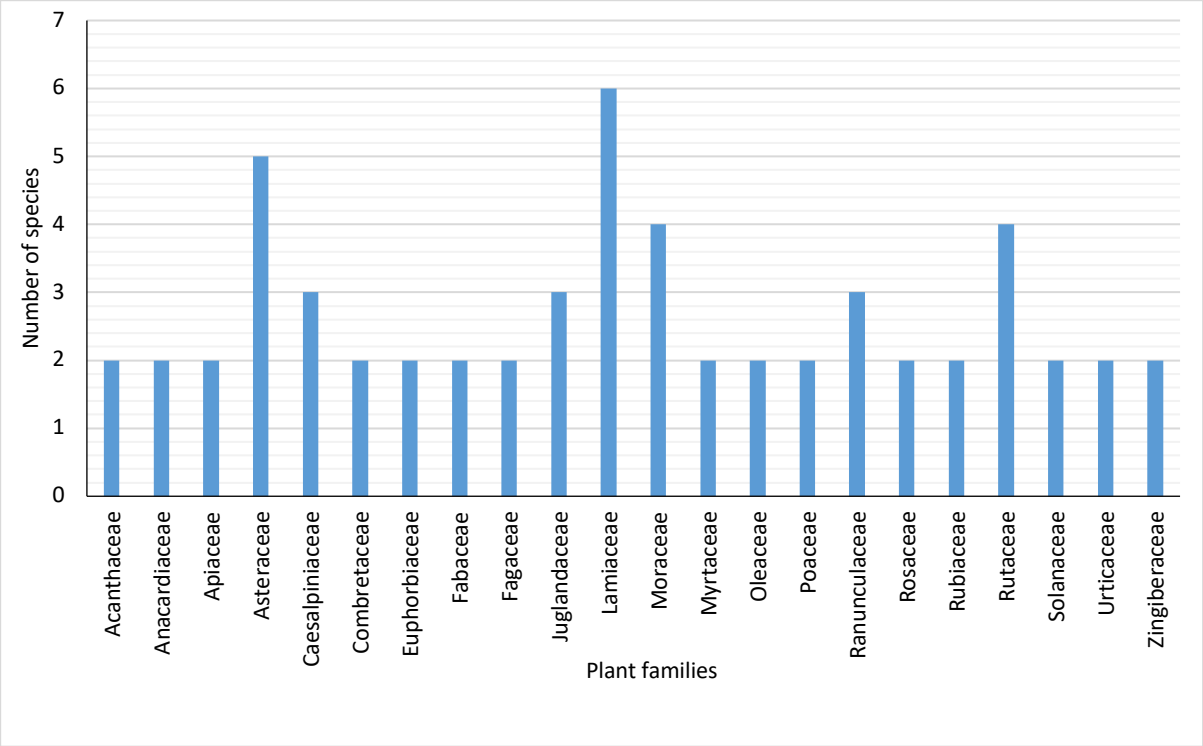

Figure 1. Major plant families used for maintaining oral hygiene

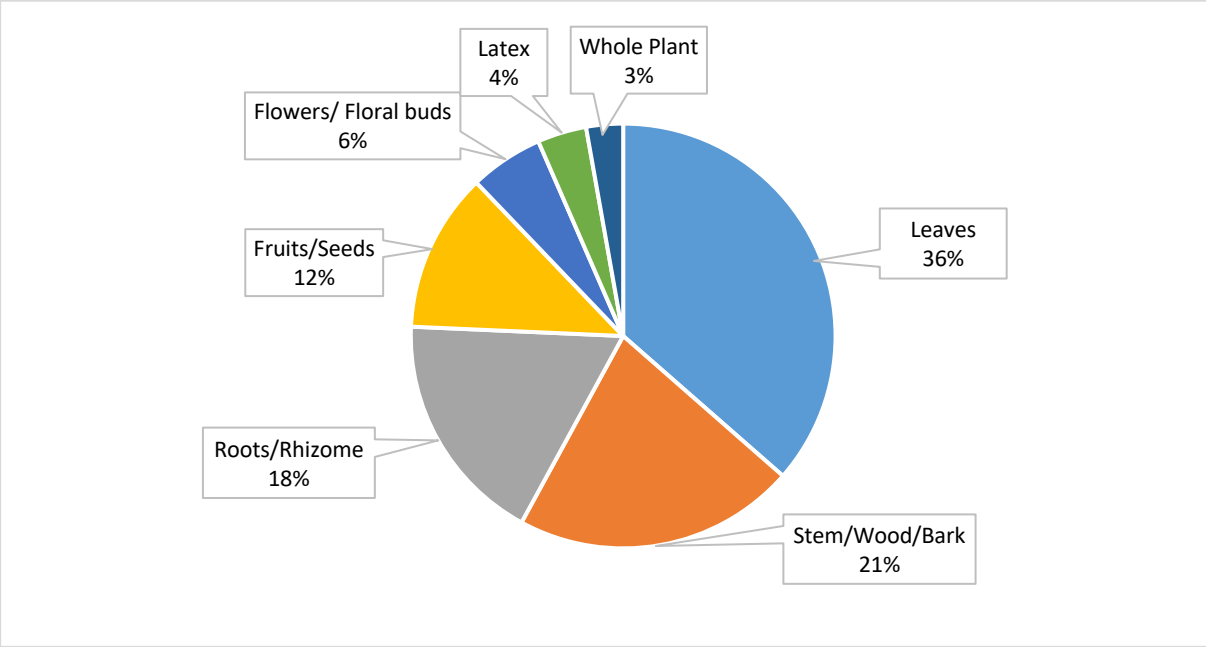

Figure 2. Percentage of parts of plants used for maintaining oral health

Total 23 plant species are used as toothbrushes or as tooth powder, namely as described in Table 2. These plants contain various phytochemical constituents in their respective parts. The heartwood extract of *Acacia catechu* is rich in alkaloids, ascorbic acid, carbohydrates, catechins, epicatechins, tannins, and terpenoids (Adhikari *et al.* 2021). The stem of *Azadirachta indica* contains nimbinone, nimbionone, nimbonolone and nimbonone (Saleem *et al.* 2018). The leaves of *Bauhinia vahlii* exhibit the presence of tannins (Chopra *et al.* 1956) while the wood of *Bauhinia variegata* contains β-sitosterol, flavanone, glycoside and lupeol (Khare 2008). *Berberis lycium*'s stem is rich in alkaloids like berberine and palmatine (Bhardwaj & Kaushik 2013). The leaves of *Engelhardtia colebrookiana* contain alkaloids, cardiac glycosides, coumarins, flavonoids, phlobatannins, steroids and terpenoids (Faisal *et al.* 2018). The stem of *Jatropha curcas* exhibit the presence of alkaloids, curacycline A, curcain, flavonoids, glycosides, phenols, saponins, steroids, tannins and terpenoids (Laxane *et al.* 2013). The

twigs of *Justicia adhatoda* contain adhatodic acid and alkaloids (adhatodine, anisotine, vasicine, vasicinone, vasicoline and vasicolinone) (Akbar 2020). *Wendlandia heynei*'s stem contains alkaloids, β-carotene, flavonoids, lycopene, saponins, tannins and terpenoids (Maryam *et al.* 2019).

Table 2. Plants with their reported chemical constituents used as toothbrush/tooth powder

Name of Plant	**Plant Part Used**	**Phytochemical Constituents**	**Source of Information**
Acacia catechu (L.f.) Willd.	Heart wood extract (Katha)	Alkaloids, Ascorbic acid, Carbohydrates, Catechins, Epicatechins, Tannins, Terpenoids and triterpenoids	Adhikari *et al.* 2021
Azadirachta indica A. Juss.	Stem	Nimbinone, Nimbionone, Nimbonolone, Nimbonone	Saleem *et al.* 2018
Bauhinia vahlii Wight & Arnott	Leaves	Tannins	Chopra *et al.* 1956
Bauhinia variegata L.	Wood	β-sitosterol, Flavanone glycoside & Lupeol	Khare 2008
Berberis lycium Royle	Stem	Alkaloids (Berberine-$CHCl_3$ & Palmatine-$CHCl_3$)	Bhardwaj & Kaushik 2013
Carya illenoesis (Wang.) Koch.	Leaves	Fatty acids, Gallic acid, Phenolic acids & Proanthocyanidins or Condensed tannins (CT)	Villarreal-Lozoya *et al.* 2007
Cassia occidentalis L.	Leaves	Emodin, Oxymethyl-anthraquinones, Physcion, Toxalbumin	Chopra *et al.* 1956, Chopra *et al.* 1969
Cinnamomum tamala Nees & Ebem	Leaves	Cinnamaldehyde, Limonene, Linalool, α and β-pinene	Khare 2008
Citrus limon (L.) Burm.f.	Leaves	Coumarins & Psoralins	Khare 2008
Citrus medica L.	Fruits & Leaves	Coumarins, β-D-glucoside, Diosmin, Limonin, Limetin, Nobiletin, β-sitosterol, Scoparone, Scopoletin, & Umbelliferon	Khare 2008
Cornus capitata Wall.	Twigs	Cornin & Phlorin	Bhakuni *et al.* 1986
Engelhardtia colebrookiana Lindl.	Leaves	Alkaloids, Cardiac glycosides, Coumarins, Flavonoids, Phlobatannins, Steroids & Terpenoids	Faisal *et al.* 2018
Hibiscus rosa sinensis L.	Stem	Cyclopropanoids, 2-hydroxysterculate, Malvalate, Methyl-2-hydroxysterculate, Methyl sterculate & β-sitosterol	Khare 2008
Jatropha curcas L.	Stem	Alkaloids, Curacycline A, Curcain, Flavonoids, Glycosides, Phenols, Saponins, Steroids, Tannins & Terpenoids	Laxane *et al.* 2013
Juglans regia L.	Leaves & Root bark	Essential oil, Napthoquinones (Juglandic acid, Juglandin, Juglone) & Tannins	Khare 2008
Justicia adhatoda L.	Twigs	Adhatodic acid & Alkaloids (Adhatodine, Anisotine, Vasicine, Vasicinone, Vasicoline and Vasicolinone)	Akbar 2020
Mallotus philippensis (Lam.) Muell. Arg.	Stem	Friedelin & Kamaladiol-3-acetate	Khare 2008
Mangifera indica L.	Leaves	Flavonoids (Catechin), Phenolic acids (Ellagic acid & Gallic acid), Terpenes (Friedelin, Lupeol, Indicol, β-sitosterol, Taraxerol & Taraxone) & Xanthones (Mangiferin)	Khare 2008
Murraya koenigii (L.) Spreng.	Stem	Carbazole alkaloids	Khare 2008
Plumbago zeylanica L.	Stem	Naphthoquinone (Plumbagin)	Khare 2008

Rheum australe D. Don *(= Rheum emodi)*	Roots	Anthraquinones, Chrysophanol, Cinnamic acid, Emodin, Gallic acid, Glycosides (Sennoside A and B), Rhein, Rheinolic acid, Tannins & Volatile oil	Khare 2008
Wendlandia heynei Sant. & Merch.	Stem	Alkaloids, β-carotene, Flavonoids, Lycopene, Saponins, Tannins & Terpenoids	Maryam *et al.* 2019
Zanthoxylum armatum DC.	Seeds & Stem	Limonene, Linalool and Methyl cinnamate (Volatile constituents) and Tambulin (flavonoid)	Singh & Singh 2011

A total of 38 species are used to get relief from toothache as described in Table 3. Of them, 13 species are used to cure mouth ulcers which include *Ajuga bracteosa, Anacyclus pyrethrum, Bidens biternata, Heteropogon contortus, Jasminum grandiflorum, Ocimum sanctum, Plantago lanceolata, Psidium guajava. Rheum austral, Sedum ewersii, Taxus wallichiana, Terminalia chebula* and *Zanthoxylum armatum*. Eight species are used to treat mouth sores – *Acacia catechu, Asplenium dalhousiae, Ficus religiosa, Quercus dilatata, Rubia cordifolia, Smilax aspera, Spilanthus oleracea* and *Terminalia chebula*. Four plant species – *Achranthes aspera, Curcuma angustifolia, Curcuma domestica* and *Salix oxycarpa* - are used to cure pyorrhea. Two plant species i.e., *Cinnamomum tamala* and *Thalictrum reniforme* are used to treat gum inflammation while *Echinacea purpurea* and *Phyllantus emblica* are used against mouth blisters.

Table 3. Plants with their reported chemical constituents used to cure tooth problems

Name of Plant	**Used against**	**Phytochemical Constituents**	**Source of Information**
Acacia catechu (L.f.) Willd.	Mouth sores	Alkaloids, Ascorbic acid, Carbohydrates, Catechins, Epicatechins, Tannins, Terpenoids and triterpenoids	Adhikari *et al.* 2021
Achillea millefolium L.	Toothache	Coumarins, Flavonoids, Proazulene & Tannins	Nascimento *et al.* 2000
Achyranthes aspera L.	Pyorrhea, Toothache	Aliphatic acids (n-hexacos-14-enoic acid, trans-13-docasenoic acid), Ecdysone, Ecdysterone, Oleanolic acid, Phytosterols (Strigmasta-5,22-dien-3-β-ol)	Ghimire *et al.* 2014
Ajuga bracteosa Wall. ex Benth.	Mouth ulcers, Toothache	Cerotic acid, Ceryl alcohol, Flavonoids, Glycosides, Phenols, Phytosterols (α-sitosterol, β-sitosterol & Stigmasterol) & Tannins	Ali *et al.* 2019
Aloe vera (L.) Burm.f.	Dental plaque	Fatty acids (1,2-benzenedicarboxylic acid, butyl octyl ester, diisooctyl ester, n-hexadecanoic acid, oleic acid, squalene & tetradecanoic acid	Lakshmi & Rajalakshmi 2011
Anacyclus pyrethrium L.	Dental caries, Mouth ulcers, Toothache	Anacyclin, Inulin, Pellitorin, Phenylethylamine, Polyacetylenic amides I-IV and Sesamin	Usmani *et al.* 2016
Anemone obtusifolia (D.Don.) Mosyakin	Toothache	Alkaloids, Coumarins, Fats and oils, Flavonoids, Lactones, Lignans, Phenolic compounds, Saccharides, Saponins, Steroids & Triterpenoids	Hao *et al.* 2017
Anemone rivularis Buch.-Ham. ex DC. *(=Eriocapitella rivularis)*	Toothache	Acetophenone, Coumarins, 5,6-dimethyl-decane, 4,5-diethyl-octane & 3-ethyl-2-methyl-hexane, Flavonoids, Lignans, Lactones, Phenolic compounds & Steroids	Hao *et al.* 2017
Annona squamosa L.	Toothache	Acetogenins (Murihexocin C), Alkaloids (Anonaine, Aporphine, Corydine, Dienone, Glaucine, Lanuginosine, Roemerine), Diterpenes (Annomosin A, Annosquamosin C-G)	Ma *et al.* 2017

Arisaema flavum (Forsk.) Schott.	Toothache	Lectins, 13-phenyltridecanoic Acid, Asparagine, Cysteine, Glycine, Norvaline, Ornithine, β-setosteryl Galactoside	Ali & Yaqoob 2021
Asplenium dalhousiae Hook.	Mouth sores	Flavonoids & Phenols	Al-Assar *et al.* 2021
Azadirachta indica A. Juss.	Dental caries & Oral infection	Terpenoids (Isonimbinolide, Nimbinone, Nimbionol, Nimbionone, Nimbonone & Nimbonolone)	Saleem *et al.* 2018
Bidens biternata (Lour.) Merr. and Sherff.	Mouth ulcers	Alkaloids, Chalcone glycosides, Flavonoids, Glycosides, Phenols, Phytic acid, Quercetin, Steroids, Tannic acid & Terpenes	Zahara *et al.* 2015
Boehmeria platyphylla D. Don *(= Boehmeria virgata var. macrostachya)*	Gum bleeding	Flavonoids, Polyphenols	Islam *et al.* 2016
Calotropis procera R. Br.	Toothache	Cardenolides (Afrogenin, Afroside, Calactoprocin, 12β-Hydroxycalactin, Procegenin A and B, Syriogenin & Uzarigenin), Steroids & Terpenoids (α-calotropeol, β-calotropeol, 3-epi-Moretenol & Lupeol)	Wadhwani *et al.* 2021
Capsicum annum L.	Toothache	Alkaloid glycosides (Solanidine, Solanine & Solasodine), Capsaicinoids (Capsaicin, 6,7-dihydrocapsaicin, Homocapsaicin, Homodihydrocapsaicin & Nordihydrocapsaicin), Carotenoids (Capsanthin, Capsorubrin) & Steroidal glycosides (Capsicoside A-D)	Fathima 2015
Carissa spinarum L.	Toothache	Alanine, Carindone, Carinol, Carissol (an epimer of α-amyrin), Carissone, Citric acid (Vitamin C), Digitoxigenin, Lupeol, Saponins, Sterols, Steroids, Sugars	Berhanu *et al.* 2020
Cedrus deodara (Roxb. ex Lamb.) G. Don	Toothache	Flavonoids (Cedrusone A, Myricetin, Quercetin), Flavonoid glycosides and Polysaccharides (Arabinose, Glucose, Mannose, Xylose)	Sinha 2019
Cinnamomum tamala Nees & Ebem	Gum inflammation	Alfapinene, Camphene, Essential Oil (Curcumenol, Eugenol, Germacrene & Sabinene), Limonene & Methyl ether of Eugenol	Mal *et al.* 2018
Cissampelos pareira L.	Toothache	Alkaloids (Aporphines, Azafluoranthenes, Benzylisoquinolines, Bis-benzylisoquinolines, Protoberberines & Tropoloisoquinolines), Arachidic acid, Oleic acid, Quercetin, Tetracosane & Thymol	Kumari *et al.* 2021a
Curcuma angustifolia Roxb.	Pyorrhea	Alkaloids, Borneol, Eicosanoic acid, Eucalyptol, ɣ-sitosterol, 5-hydroxymethylfurfural, n-hexadecanoic acid, Oleic acid, Spathulenol, Steroids & Tannins	Mehra & Jain 2019
Curcuma domestica Valet. *(=Curcuma longa)*	Pyorrhea	Polyphenols (Curcuminoids-Curcumin, Bisdemethoxycurcumin & Demethoxycurcumin) Polysaccharides &	Niranjan & Prakash 2008

		Sesquiterpenes (Arturmerone, Bisacumol, Curcumenol, Curcumenone, Curlone & Turmerone)	
Cynodon dactylon (L.) Pers.	Toothache	Carotenoids (β-carotene, Neoxanthin & Violaxanthin), Flavonoids (Apigenin, Orientin, Luteolin & Vitexin), Glycosides, Phenolics, Phytosterols, Saponins & Volatile oils	Ashokkumar *et al.* 2013
Debregeasia salicifolia (Roxb. ex D. Don) Rendle	Toothache	Anthraquinone, Flavonoids, Phytosterols (β-sitosterol & stigmasterol), Tannins, Triterpenes (Lupeol, Oleanolic acid, Pomolic acid, Tormentic acid, Ursolic acid, Uvaol)	Almubayedh & Ahmad 2018
Echinacea purpurea (L.) Moench	Mouth blisters	Alkylamides, Caffeic acid esters (Cichoric acid, Caftaric acid & Echinacoside), Flavonoids, Glycoproteins, Limonene, Phenolic compounds, Polyacetylenes & Polysaccharides	Burlou-Nagy *et al.* 2022
Eclipta alba Hassk.	Toothache	Alkaloids (Ecliptine, Nicotine), Coumestan, Ecliptal, Heptacosanol, Hentriacontanol, Saponins (α-amyrin, Eclalbatin, Oleanic acid & Ursolic acid) & Stigmasterol	Mithun *et al.* 2011
Engelhardtia colebrookiana Lindl.	Dental caries	Alkaloids, Cardiac glycosides, Coumarins, Flavonoids, Phlobatannins, Steroids & Terpenoids	Faisal *et al.* 2018
Ephedra qerdiana Wall. ex. Stapf.	Toothache	Alkaloids (Ephedrine, Ephedroxane), Carboxylic acid, Catechins, Ephedradinnes A-D, Flavones, Flavonols, Gallic acid, Herbacetin, Polyphenols, Quercetin, Tannins etc.	Choudhary *et al.* 2021
Ficus hispida L.	Toothache	β-amyrine, β-sitosterol, Bergaptine, 2,6-dimethyl-1,7-octadiene-3,6-diol, Hispidin, Linalool, Linalool oxide, Oleanolic acid & Terpineol	Smruti *et al.* 2021
Ficus palmata Forssk.	Toothache	Alkaloids, Cardiac glycosides, Flavonoids, Tannins & Terpenoids	Joshi *et al.* 2014
Ficus religiosa L.	Mouth sores & Salivation	Alkaloids, Amino acids, Flavonoids, Glycosides, Phenol content, Polyphenolic compounds, Saponins, Steroids, Sterols & Tannins	Sandeep *et al.* 2018
Geranium wallichianum D. Don ex Sweet	Gum bleeding & Toothache	Steroids (β-sitosterol, β-sitosterol-glactoside, stigmasterol) and terpenoids (ursolic acid)	Ismail *et al.* 2012
Heteropogon contortus L.	Mouth ulcers	Alkaloids, Cardiac glycosides, Flavonoids, Phenols, Resins, Saponins, Steroids, Tannins, Terpenoids & Triterpenes	Yadav *et al.* 2022
Hyoscyamus niger L.	Toothache	Alkaloids (Atropine, Hyoscyamine, Hyoscypikrin, Scopolamine), Coumarinolignans, Flavonoids, Flavonoid glycosides, Glycerides, Lignans, Phenolics, Saponins, Steroidal glycosides & Withanolides	Chopra *et al.* 1956, Begum 2010

Ipomoea carnea Facq.	Toothache	Alkaloids, Glycosides, Reducing sugars & Tannins, 1, 2 diethyl phthalate, 3-diethylamino-1- propanol, hexa decanoic acid, hexatriacontane, n-octadecanol, octacosane, stearic acid, swainsonine & Calystegines	Fatima *et al.* 2014, Bhalerao & Teli 2016
Jasminum grandiflorum L.	Mouth ulcers	Alkaloid (Jasminine, Oleanolic acid, Sambacin I-III, Salicyclic acid), Flavonoids, Glycosides (Iridoid and Secoiridoid glycosides), Saponins & Terpenoids	Arun *et al.* 2016
Jasminum officinale L.	Toothache	Alkaloids, Carbohydrates, Coumarins, Flavonoids, Saponins, Tannins & Terpenoids	Dubey *et al.* 2016
Jatropha curcas L.	Dental caries	Alkaloids, Curacycline A, Curcain, Flavonoids, Glycosides, Phenols, Saponins, Steroids, Tannins & Terpenoids	Laxane *et al.* 2013
Juglans regia L.	Toothache & Tooth decay	Juglansin, Juglon, Organic acids (Caffeic acid, Oleic acid, p-coumaric acid, Syringic acid), Flavonoids, Steroids (β-sitosterol, Betulinic acid, Daucosterol & Lupeol) & Tannins (Glansrins A-C)	Panth *et al.* 2016
Lathyrus aphaca L.	Toothache	β-N-oxalylaminoalanine	Khare 2008
Mentha arvensis L.	Toothache	Eugenol, Flavonoids (Isorhoifolin, Menthoside and Quercetin), Terpenes (Carvacrol, Carvomenthone, α-menthol, Isomenthol, Limonine), Thymol and Vitamin K	Thawkar *et al.* 2016
Myrica esculenta Buch.-Ham. ex D. Don	Toothache	Diarylhetanoids (16 bromomyricanol, Myricanol & Myricanone), Flavonoids (Myricetin), Flavonoid Glycosides, Proanthocyanidin, Steroids (β-sitosterol, Stigmasterol & Taraxerol), Tannins, Terpenes & Volatile compounds	Sood & Shri 2018
Nepeta erecta Benth.	Toothache	Flavonoids, Phenolic acids (Caffeic acid, p-coumaric acid, Gallic acid), Steroids (β-sitosterol, Stigmasterol) & Terpenes (Nepetalactones, Nepetalic acid, Geraniol),	Sharma & Cannoo 2013
Ocimum sanctum L.	Mouth ulcers	Fatty acid derivatives, Flavonoids (Apigenin, Cirsimaritin, Eupatorin, Gardenin etc.), Neolignans, Phenolics (Gallic acid, Rosmarinic acid, Vanillin), Terpenoids (Carnosic acid, Ursolic acid) & Volatile oil (Eugenol)	Singh & Chaudhuri 2018
Phyllanthus emblica L. *(=Emblica officinalis)*	Mouth blisters, Toothache	Flavanone glycosides, Phenolic glycosides (Gallic acid, Ellagic acid), Quercetin, Sterols (Trihydroxysitosterol & 5α,6β,7α-acetoxysitosterol), Terpenoids (Phyllaemblicin A-C, Phyllaemblic acid)	Variya *et al.* 2016
Pistacia integrimma J. L. Stewart ex Brand.	Toothache	Phenolic acids, carotenoids, terpenoids (monoterpenes, triterpenes), flavonoids (catechins), saponins, tannins & steroids	Bibi *et al.* 2015

Plantago lanceolata L.	Mouth ulcers	Flavonoid glycosides (Hesperidin & Hyperoside), Phenolic acids (Chlorogenic acid & Rosmarinic acid) & Verbascoside	Bahadori *et al.* 2020
Potentilla atrosanguinea Lodd.	Toothache	Tannins, p-coumaric acid, Kaempferol, Rutin & Tiliroside	Tomczyk & Latte 2009, Kumari *et al.* 2021 b
Psidium guajava L.	Mouth ulcers	Comarins, Ellagitannins, Essencial Oils, Flavonoids & Triterpenes	Nascimento *et al.* 2000
Quercus dilatata Royle	Mouth sores	Fatty acids, Flavonoids, Glycosides, Phenolic acids (Gallic acid & Ellagic acid), Tannins & Terpenoids	Taib *et al.* 2020
Quercus glauca Thunb.	Toothache	Caffeic acid, Galloylquinic acid, Homogentisic acid, Kaempferol, Protocatechuic acid, Quercetin, Quinic acid	Taib *et al.* 2020
Rheum australe D. Don	Mouth ulcers	Anthraquinones (Aloe-emodin, Chrysophanol, Emodin, Physcion & Rhein), Flavonoids (Desoxyrhapontigenin, Epicatechin, Eugenol, Gallic acid, Maesopsin, Quercetin, Rhapontigenin & Rutin) & Stilbenoids (Piceatannol)	Pandith *et al.* 2018
Robinia pseudoacacia L.	Toothache	Flavonoids (Apigenin, Diosmetin, Isovestitol, Luteolin, Mucronulatol, Quercetin, Robinin, Secundiflorol), Glycosides, Phenols, Steroids, Tannins & Terpenoids	Patra *et al.* 2015, Kaloo *et al.* 2018
Rubia cordifolia L.	Mouth sores	Anthraquinones (β-sitosterol, Manjistin, Mollugin, Purpurin, Rubilactone & Scopoletol), Bicyclic hexapeptides, Iridoids (Alizarin, Garancin, Manjistin & 6-methoxygeniposidic acid), Naphthoquinones (Mollugin, Epoxymollugin, Furomollugin, etc.), Oleananes Triterpenoid (Rubiarbonol & Rubiprasin A-C)	Patil *et al.* 2009
Salix oxycarpa Anderss *(=Salix seriocarpa)*	Dental caries, Pyorrhea & Toothache	Flavonoids, Glycosides, Lignans, Organic acids, Phenolics, Procyanidins, Sterols & Terpenes	Tawfeek *et al.* 2021
Sedum ewersii Ledeb.	Mouth ulcers	Alkaloids, Carbohydrates, Coumarins, Flavonoids (Kaempferol, Quercetin), Phenols (Hydroquinone & Phloroglucinol), Phenolic acids (Gallic acid, Ferulic acid, Syringic acid) & Tannins	Korul'kin 2001
Smilax aspera L.	Mouth sores	Anthocyanins (Cyanidins – Cyanidin 3-O-rutinoside & Pelargonidins - Pelargonidin 3-O-rutinoside), Steroids, Sarsapogenin & Tiogenin	Chopra *et al.* 1956, Longo & Vasapollo 2006
Spilanthus oleracea L.	Mouth sores	Acetylenes, Alkaloids, Alkylamides (N-Isobutylamides & Spilanthol), Alkyl ketones, Coumarins, Flavonoids, Hydrocarbons, Lactones & Terpenoids	Paulraj *et al.* 2013
Taxus wallichiana Zucc.	Mouth ulcers	Diterpenes (Cephalomannine, Tasumatrol, Taxacustin, Taxamairin F,	Sharma & Garg 2015

		Taxawallin, Taxol & Taxusabietane), Flavonoids, Lignans, Phytosteroids & Sterols (β-sitosterol & Daucosterol)	
Terminalia chebula Retz.	Mouth sores, Mouth ulcers, Toothache	Tannins (chebulic acid, chebulagic acid, corilagin), phenolic acids (gallic acid, ellagic acid), steroids (β-sitosterol), terpenoids (triterpenes), and flavonoids (flavonol glycosides)	Upadhyay *et al.* 2014
Thalictrum reniforme Wall.	Gum inflammation	Alkaloids (Berberine, Glaucine, Isocordyline, Jatrorrhizine, Magnoflorine) & Chlorogenic acid	Bajpai *et al.* 2017
Vitex negundo L.	Toothache	Carotene, Flavonoids (Casticin, Chryso-Splenol, Vitexicarpin & Vitexin), Monoterpenes agnuside & Vitamin C	Bansod & Harle 2009
Zanthoxylum armatum DC.	Mouth ulcers, Tooth decay	Terpenoids (Geraniol, Linalool, Linanyl acetate, Phellandrene and Sabinene), & Carbonyl compounds (Cuminal, Cuminic aldehydes, Cinnamic aldehyde and Dimethylic ether of phloroacetophenone)	Singh & Singh 2011

Various phytochemicals are present in these plants and their respective parts such as *Achillea millefolium* contain coumarins, flavonoids, proazulene and tannins in its leaves (Nascimento *et al.* 2000). The roots of *Achyranthes aspera* are rich in aliphatic acids, ecdysone, ecdysterone, oleanic acid and phytosterols (Ghimire *et al.* 2014). *Ajuga bracteosa* leaves contain cerotic acid, ceryl alcohol, flavonoids, glycosides, phenols, phytosterols and tannins (Ali *et al.* 2019). The leaves of *Aloe vera* shows the presence of compounds like 1,2-benzenedicarboxylic acid, n-hexadeconic acid, oleic acid and tetradeconic acid (Lakshmi & Rajalakshmi 2011). Flowers and roots of *Anacyclus pyrethrium* have anacyclin, inulin, pellitorine, phenylethylamine, polyacetylenic amides and sesamin (Usmani *et al.* 2016). *Anemone obtusifolia* roots contain alkaloids, coumarins, fats and oils, flavonoids, lactones, lignans, phenolic compounds, saccharides, saponins, steroids and terpenoids, while roots of *Anemone rivularis* are rich in acetophenone, coumarins, 5,6-dimethyldecane, 4,5-diethyloctane, 3-ethyl-2-methyl-hexane, flavonoids, lignans, lactones, phenolic acids and steroids (Hao *et al.* 2017). The leaves and stem of *Annona squamosa* are rich in alkaloids like anonaine, aporphine, corydine, dienone, lanuginosine; acetogenins and diterpenes (Ma *et al.* 2017). *Boehmeria platyphylla* leaves contain flavonoids and polyphenols. *Calotropis procera*'s latex is composed of cardenolides, steroids and terpenoids (Islam *et al.* 2016). The fruits of *Capsicum annum* contain alkaloid glycosides, capsaicinoids, carotenoids and steroidal glycosides (Fathima 2015). The rhizomes of *Curcuma domestica* are rich in polyphenols known as curcuminoids (curcumin, bisdemethoxycurcumin and demethoxycurcumin), polysaccharides and sesquiterpenes like curcumenol and turmerone (Niranjan & Prakash 2008). The bark, latex and leaves of *Ficus hispida, Ficus palmata* and *Ficus religiosa* contain alkaloids, cardiac glycosides, flavonoids, saponins, sterols, tannins and terpenoids (Joshi *et al.* 2014, Sandeep *et al.* 2018, Smruti *et al.* 2021). Leaves of *Jasminum grandiflorum* and *Jasminum officinale* exhibit the presence of alkaloids like jasminine, sambacin; flavonoids, glycosides, saponins, tannins and terpenoids (Arun *et al.* 2016, Dubey *et al.* 2016). *Zanthoxylum armatum*, commonly known as toothache tree, is rich in terpenoids such as geraniol, linanyl acetate and sabinene; and carbonyl compounds like cuminal, cuminic aldehyde and cinnamic aldehyde (Singh & Singh 2011). Similarly, the predominant phytochemical constituents present in other plant species which are used to cure tooth problems are summarized in Table 3. Most of these plants contain phytochemicals in the form of alkaloid, flavonoids, steroids, tannins and terpenoids.

Conclusions

In conclusion, our study underscores the critical link between oral health and overall systemic well-being. The rich traditional knowledge of utilizing 90 plant species by the natives of Himachal Pradesh for oral hygiene is a testament to the longstanding cultural practices that offer not only economic advantages but also safety and diverse health benefits. Despite the effectiveness of these natural remedies, a shift towards modern oral care products among the younger generation is evident, leading to a potential loss of this valuable heritage.

It is imperative to bridge this gap in awareness and appreciation for the indigenous knowledge surrounding oral health practices. Documenting and preserving this traditional wisdom not only contributes to ongoing research but also serves as a crucial resource for educating the public about the untapped potential of natural remedies. The market introduction of items like bamboo brushes, neem wood tongue scrapers, clove toothpaste, and herbal tooth powder reflects a positive shift towards safer alternatives that protect against the adverse effects of chemical-laden toothpaste and toothbrushes. Beyond their health benefits, these eco-friendly products have also emerged as a source of income for many families. In essence, the preservation and promotion of traditional oral care practices not only contribute to individual well-being but also foster economic sustainability and environmental responsibility.

The integration of indigenous knowledge into modern practices represents a harmonious synergy between tradition and progress, ensuring a healthier and more sustainable future for oral health.

Declarations

Ethics approval and consent to participate: All the data related to the present study is included in the manuscript.
Consent for publication: Not applicable
Availability of data and materials: All the data related to the present study is included in the manuscript.
Conflict of Interest: Authors declare that there is no conflict of interest.
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