

The Scope of Phytodentistry in Nepal: A Review

Dashrath Kafle,¹ Shreya Kayastha,² Janardan Lamichhane³

¹⁻³Department of Biotechnology, Kathmandu University, School of Science, Dhulikhel, Kavrepalanchok, Nepal;

²Dental Department, Dhulikhel Hospital, Kathmandu University School of Medical Sciences, Dhulikhel, Kavrepalanchok, Nepal

Correspondence :

Dr. Dashrath Kafle. Email: dashrath07@yahoo.com

Guide:

Dr. Janardan Lamichhane. Email: ljanardan@ku.edu.np

ABSTRACT

There are about 3,50,000 plants on planet earth out of which around 50,000 to 80,000 have medicinal value. Many medicinal plants are on the verge of extinction. Though medicinal plants have long history associated with human evolution, in recent times importance of these plants has been over-shadowed by modern allopathic pharmacological products. The improper and over prescription of antibiotics have led to serious issues like antibiotic resistance and multidrug resistance of microorganisms. This has led to new debate in the scholarly world: “Will reintroduction of traditional medicine help to combat war with resistant pathogens?” However as there is lack of evidence, their day to day use in modern medical practice is not common. If the link between traditional and modern medicine can be established that will pave pathways for combining traditional and modern medicine. Medicinal plants have been used for centuries to cure diseases of different organs of human body. The applications of plant extracts are still existent in modern dentistry such as Agar-agar, Alginic acid, Clove oil, etc. In this review, the possibility of phytodentistry in 21st century is carefully evaluated and few common medicinal plants used to cure oral diseases since ages are explained with scientific references.

Keywords: Dental problems; dentistry; oral bacteria; phytodentistry; plants.

INTRODUCTION

Discovering healing powers in plants is ancient concept. Herbs have been integral part of ‘traditional medicine’ since time immemorial. Over centuries, diverse ethnic groups have used them and invaluable traditional knowledge has accumulated. Products from medicinal plants are abundant source of biologically active compounds, many of which have been basis for development of new chemicals for pharmaceuticals.¹ Nepal, though small landlocked country, is unique in geography from as low as 59 meters in terai plains to highest

peak 8848.86 metres. It has abundant ecological habitats reflecting biodiversity. Medicinal and aromatic plant being major component for biodiversity. Since dawn of time, ‘Ayurveda’ has been major source of health care in Nepal. Of total number of species found worldwide, it is estimated

Citation

Kafle D, Kayastha S, Lamichhane J. The scope of phytodentistry in Nepal: A review. *J Nepal Dent Assoc.* 2023 Jul-Dec;23(37):

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution CC BY 4.0 Licence.

© 2022 JNDA | Published by Nepal Dental Association

that Nepal provides habitat to 2.8% of these plants. Current plant checklist for Nepal records some 6,076 species of flowering plants² out of which about 700 species are thought to have medicinal value practised by local inhabitants as traditional medicine.³

A medicinal plant is any plant used to relieve, prevent or cure disease or to exert beneficial pharmacological effect on human body. Ayurveda is the scholarly traditional medical treatment philosophy which uses natural ingredients, predominantly parts of plants to cure illness. In Ayurveda different oral diseases are explained, along with their method of treatment. However in modern medicine, there is a miniature role of medicinal plant extracts to cure. So in the era of rapidly developing technology and material science, it will be a huge benefit to medical fraternity, if we could establish a link between ancient medicinal plants and modern practice of medicine with ample scientific evidence. In this article, authors have reviewed through the medicinal plants commonly used in Ayurveda that are available in Nepal. Additionally, plants and their effect, especially on oral microorganism have been elaborated.

MEDICINAL PLANTS OF NEPAL

Indian subcontinent is the domicile of possibly the oldest scholarly traditional system of medicine called “The Ayurveda”. Nepal does have a long history of Ayurvedic medical practice. Plants form the primary bulk of medicines in these traditional medical systems. Evidence shows that 65–80% of people in developing countries use medicinal plants for their treatment.⁴ The [Food and Agriculture Organisation](#) has estimated that over 50,000 medicinal plants are used across the world. Among them, Nepal has been estimated to house around 10%, i.e. 700 species.³ Out of these the most commonly used plants for medical purpose are *Mentha*, *Ocimum sanctum*, *Azadirachta indica*, *Phyllanthus emblica*, *Cinnamomum tamala*, *Terminalia belerica*, *Zanthoxylum armatum*, *Cordyceps sinensis*, *Aloe vera*, *Centella asiatica*, *Curcuma longa*, *Terminalia*

chebula, *Acacia catechu*, *Bauhinia vahlii*, *Mahonia nepalensis*, *Berberia asiatica*, *Acorus calamus*. The medicinal plants have been used since ages by the people of Nepal for gastrointestinal disturbances, eye diseases, skin diseases, memory longevity, migraine, epilepsy, paralysis, tooth ache, constipation, helminthes infection, sprain, arthritis, cuts, wounds, scar, urinary complaints, asthma, pneumonia, jaundice, fever, bleeding disorders, and many other health problems.

MEDICINAL PLANTS AND ORAL DISEASES

Oral diseases continue to be a key health problem globally. The World Health Organisation (WHO) emphasise that the oral health is the basic human right however this right is not accessible to many people.⁵ Dental caries is the second most common disease in our community after the common cold. It affects more than 95 percent of the world population regardless of age, gender, ethnicity and place of residence.⁶ This indicates the need for improved diagnostic and therapeutic procedures in dentistry. Studies conducted on most commonly used irrigating solutions in dentistry showed that chlorhexidine (CHX) causes tooth discoloration, creates a burning sensation in the mouth and results in loss of taste. Sodium hypochlorite can cause allergy and tissue toxicity and calcium hydroxide cannot efficiently remove bacteria from the dentinal tubules. There is no denial that majority of the antibiotics used in dentistry are also associated with side effects. Moreover, not all people have access to synthetic drugs and thus, they may use easily available herbal medicines as an alternative.⁴ On the other hand, the rapid emergence of resistance to antibiotics amongst pathogens generates visions of the ‘potential post-antibiotic era threatening present and future medical advances’. Herbs are staging a comeback and herbal ‘renaissance’ is happening all over the globe.⁷

Plant products have long been used in dentistry as part of various dental materials right from impression materials to gutta-percha, which forms

an integral part of the dental clinic.¹ The use of herbs in dental practice is not just confined to material sciences. The field of dentistry also has begun to exploit herbal properties for the purpose of relieving tooth pain, gum inflammation and oral ulcerations. However, it is of utmost importance to understand the interactions of plant extracts with the body and other medications, as many of these extracts have anti-inflammatory effects and prevent bleeding, which is important in dental treatment. Antiseptics, antibacterial, antimicrobial, antifungal, antioxidant, antiviral, and analgesic agents derived from plants are of widespread interest in dentistry.⁴ The major medicinal plants of Nepal having reference to phytodentistry are enumerated and discussed below.

***Barleria prionitis* (Bhendekuro)**

Barleria prionitis (*B. prionitis*) is a Porcupine flower which is explained as Kuranta in Sanskrit (Figure 1). It is called Bhendekuro in Nepali and Vajradanti in Marathi. As the name vajradanti is associated with teeth, we can assume that this plant has been in use in dentistry since ancient period. *Barleria prionitis* belongs to family Acanthaceae. This plant is abundantly found in hilly regions of Nepal and India along with Burma, Srilanka, and Afghanistan. The parts of the plants having medicinal properties are bark, leaves, flower, stem and root.



Figure 1: *Barleria prionitis*.

The aerial parts (stem, leaves, and flowers) are used in catarrhal affections of children, glandular swellings, boils, fever, toothache, inflammation and gastrointestinal disorders and bark in whooping cough as an expectorant and diaphoretic.⁷ The root paste is used to be externally applied to disperse boils and glandular swellings, whereas the flowers are used internally for the treatment of migraine, internal abscesses, oedema, haemoptysis, urethral discharges, seminal disorders and reduce obesity. The whole plant is used in stiffness of limbs, enlargement of scrotum and sciatica. The crude extract of this plant in oil is also traditionally recommended in arresting the graying of hair, arthritis and gout.⁸

Phytochemical composition and dental applications:

B. prionitis has been found to have five iridoidglucoside esters, acetylbarlerin, barlerin, shanzhiside methyl ester, 6-O-acetyl shanzhiside methyl ester, and verbascoside. Number of studies have found that crude extracts obtained from the bark of the *B. prionitis* can be used to treat the bacterial oral infections caused by *Bacillus* sp., which has shown comparable inhibition zone with the standard antibiotic drugs used to treat oral infections and the fungal oral pathogens especially *Candida albicans* and *Saccharomyces cerevisiae* which has shown greater inhibition zones than the antifungal drugs often used to treat fungal pathogens.^{7,9} It is interesting to note that even crude extracts of *B. prionitis* has shown good activity against *Streptococcus mutans* where modern antibiotic therapy is not effective.¹⁰ According to the Handbook of Ayurvedic Medicinal Plants, among the many medicinal purposes of *Barleria prionitis*, one of its major uses is to strengthen the gums and bring relief to toothache by applying the paste of its leaves with salt.¹¹ In a nutshell, *Barleria* seems to have good anti-carious properties along with its effect on curing gingivitis, periodontitis as well as oral mucosal ulcers.

Centella asiatica (Ghodtapre)

Centella asiatica (*C. asiatica*) is commonly known as Indian pennywort or Asiatic pennywort which is known as Mandukaparni in Sanskrit and Brahmi or Ghodtapre in Nepali (Figure 2). This plant comes under family Umbellifere (Apiceae). *C. asiatica* is found in most tropical and subtropical countries growing in swampy areas, including parts of Nepal, India, Pakistan, Sri Lanka, Madagascar, and South Africa and Eastern Europe.¹² The leaves of this plant are the portion in which its medicinal value is stored.



Figure 2: Leaves of *Centella asiatica*.

Centella asiatica is often called one of the ‘miracle elixirs of life’ because legend has said that an ancient Chinese herbalist lived for more than 200 years as a result of using this herb.¹³ It is considered to be a very useful medicinal plant to prevent ageing. The medicinal uses of this plant have been described in traditional literature worldwide for treatment skin problems, wound healing revitalising the nerves and as a brain tonic.

Phytochemical composition and dental applications:

The primary active constituents of *Centella asiatica* are saponins (also called triterpenoids), which

include asiaticosides in which a trisaccharide moiety is linked to the aglycone asiatic acid, madecassoside and madasiatic acid. These triterpene saponins and their sapogenins are mainly responsible for wound healing and vascular effects by inhibiting the production of collagen at the wound site. The application of *C. asiatica* mouth was is found to have improved plaque and gingival indices and reduction of IL-1 β as well.¹³ Another study by Sastravaha et al. has also found that *Centella asiatica* is very effective on treating periodontal pocket and attachment loss.¹⁴

Azadirachta indica (Neem)

This plant is commonly known as Neem in Nepal and India (Figure 3). The English name is Persian lilialc and Arishta is the Sanskrit name *A. indica* falls under family Meliaceae Neem tree grows in abundance in tropical and semi-tropical regions like India, Bangladesh, Pakistan, and Nepal.¹⁵ The plant has versatile and widespread application in traditional medicine. It is found to be rich source of antioxidants and the fruits, seeds, oil, leaves, barks and roots have medicinal value.¹⁵



Figure 3: Neem plant.

This plant is commonly known as “The village pharmacy” or “Divine tree” because of its many health properties,¹⁶ Neem tree has been treasured long back since centuries for cleaning the teeth, inflammation, infections, skin diseases, consumption as a tonic and eradicating bed bugs, book worms, etc. (Table 1).

Phytochemical composition and dental applications:

Neem plant contain various phytochemical compounds such as flavonoids, catechins, anthocyanins, quercetins, saponins, tannins, limonoids, gallicacid and other minor polyphenols; all known to produce effects over important cellular mechanisms at a molecular level.¹⁶ The compounds essentially present in leaves are nimbin, nimbanene, 6-desacetylnimbinene, nimbandiol, nimbolide, ascorbic acid, n-hexacosanol and aminoacid,

7-desacetyl-7-benzoylazadiradione, 7-decacyl-7-benzoylgedunin, 17-hydrozadiradione and nimbiol.¹⁶ Vanka *et al.* studied acetone extract of *Azardirachta indica* showed maximum inhibitory activity against *Streptococcus mutans*, whereas the chloroform, ethanol and methanol extracts were with sensible inhibitory effect on all tested organisms, that is, *Streptococcus mutans*, *Streptococcus salivarius*, *Fusobacteriumnucleatum*.¹⁷

***Curcuma longa* (Turmeric)**

The English name of *Curcuma longa* (*C. longa*) is Turmeric/Curcumin which is most commonly used household spices in Nepal known as Nepali Besar (Figure 4). This plant falls under the Family: Zingiberaceae.

C. longa is cultivated extensively in South Asian countries, including India, China, Nepal, Vietnam

Table 1: Uses of neem in dentistry.

Anti-inflammatory	<ul style="list-style-type: none"> • Antigingivitis • Suppresses macrophage and neutrophil functions relative to inflammation • Anti-complement activity
Immunomodulation	<ul style="list-style-type: none"> • Cell mediated and humoral responses • Against mitogenic and antigenic challenge
Anti-carious	<ul style="list-style-type: none"> • Against <i>S. mutans</i>, <i>S. mitis</i>, <i>S. sanguis</i>, <i>S. salivarius</i>
Endodontic irrigant	<ul style="list-style-type: none"> • Against <i>E. faecalis</i> and <i>C. albicans</i>
Dental erosion therapy	<ul style="list-style-type: none"> • Layer formation over enamel • Mechanical barrier against caries
Anti-fungal	<ul style="list-style-type: none"> • Against <i>C. albicans</i>
Periodontal therapy	<ul style="list-style-type: none"> • Anti-plaque, Antigingivitis • Against <i>P. gingivalis</i>
Cancer therapy	<ul style="list-style-type: none"> • Arrest tumour cell growth and proliferation by affecting p53 gene • Prevents mutagenic effects of 7,12-dimethylbenz(a)anthracene • Modulation of dysregulated CCR5 signals • Procarcinogen activation and oxidative damage, upregulating anti-oxidant and carcinogen detoxification • Inhibition of invasion and angiogenesis



Figure 4: *Cicuma longa* plant.

and other counties with a tropical climate. An orange pulp contained inside the fleshy rhizome constitutes the source of turmeric medicinal powder.¹⁸

Curcumin has been used tremendously in ayurvedic medicine for centuries, as it is nontoxic and has a variety of therapeutic properties including antioxidant, analgesic, antiinflammatory, antiseptic activity, and anticarcinogenic activity.¹⁸ It is believed to be a bitter digestive and a carminative. Also, it is employed by Unani practitioners to expel phlegm or kapha, opening out the blood vessels to improve blood circulation.¹⁹

Phytochemical composition and dental applications:

The major active constituent of turmeric is the flavonoid curcumin (diferuloylmethane) and others are various oils including tumerone, atlantone, and zingiberone.¹⁸ Some dental applications of Turmeric are: dental pain, periodontal problem, local drug delivery system, oral irrigant, pit and fissure sealants, plaque detecting agent, anti-cancer agent.

Mentha (Pudina)

English name: Mint; **Sanskrit name:** Putiha;
Nepali name: Pudina; **Family:** Labiatae.

The *Mentha* plants are widely distributed and can be found in many environments (Figure 5). Its



Figure 5: *Mentha* plant.

leaves are the most important part from which oil is extracted.

All over the world in different culture, *Mentha* has been consumed traditionally as anti-parasitic, anti-helminthic, anti-microbial, emmenagogue, anti-pruritic, anti-septic, carminative, anti-pyretic, sedative, digestive, analgesic, anti-inflammatory, anti-diarrhoea, anti-spasmodic and for significantly more diseases.²⁰

Phytochemical composition and dental applications:

The prime categories of phytochemicals contained in *Mentha* are:

1. Flavenoids, including apigenin-7-O-glucoside, apigenin-7-O-rutinoside, apigenin-7-O-glucoronide, iso-orientin, hypolaetin, 5,3',4'-trihydroxy-6,7,8-trimethoxyflavonen, 5,7-dihydroxymenone-7-rutinoside, eriodictyol-7-rutinoside, and longitin.
2. Essential oil components, primarily including limonene and carvone.
3. Miscellaneous constituents, such as cinnamates, salvianolic acid L and dedihydrosalvianolic acid, rosmarinic acid.²⁰

Mentha is used in making oral dentifrices as it can provide overall freshness in breath and also keep

away bad breath. The essential oil from *Mentha* is used topically to treat oral mucosal inflammation and also as an antimicrobial and an ingredient in many analgesic creams.²¹ It has strong antibacterial activity against *S. mutans* and *Lactobacilli* responsible for dental caries and antifungal activity against *Candida albicans*.^{20,21} The effectiveness of peppermint alcoholic extract against radiation-induced effects is due to its antioxidant and free radical scavenging activities.²¹

***Ocimum sanctum* (Tulsi)**

English name: Holy basil; **Sanskrit, Nepali name:** Tulsi, **Family:** Labiatea

Ocimum sanctum is native to the Indian subcontinent and widespread as a cultivated plant throughout the Southeast Asian tropics. Its usable parts are leaves and flowers.



Figure 6: *Ocimum sanctum* plant.

It is described as a sacred and medicinal plant in ancient literature and is frequently mentioned as one of the main pillars of herbal medicine.²² This plant has been used for a wide range of conditions ranging from relatively minor illnesses, such as cold or a cough to various severe conditions, as a hepatoprotective, immunomodulatory, analgesic, antipyretic, diaphoretic, radioprotective, antidote

for poisoning and for disorders including those of mouth, throat, lungs, heart, blood, kidney, eyes, digestive, metabolic, reproductive and nervous system.^{22,23}

Phytochemical composition and dental applications:

The antibacterial agents present in *Ocimum sanctum* are Eugenol, Ursolic acid, 14-tetradecahydro-1H-picene-4a-carboxylic acid, Carvacrol, Linalool, Limatrol, Caryophyllene, Methyl carvicol, Cirsilineol, Circimaritin, Isothymusin, Apigenin, Orientin, Vicenin.^{22,24}

The holy basil containing mouthwash is found by various workers, to be comparable to chlorhexidine with respect to its anti-plaque action and reduction in the periodontal indices.^{22,24} Mallikarjun et al.'s in vitro test revealed its effective antimicrobial property against *A. actinomycetemcomitans*, similar to that of doxycycline suggesting its possible use as an effective and affordable "adjunct" along with the standard care in the management of periodontal conditions.²³ In addition to this, A.M. Luke et al. performed an in vitro study to demonstrate *O. sanctum* to be a cytotoxic agent against oral squamous cancer cell line, by gradually decreasing cell density of CA9-22 mouth cell line at OD570 from the level of 5 mg/L to 30 mg/L of both aqueous and dry extract of the plant.²⁵

***Terminalia chebula* (Harro)**

English name: *Black or chebulic myrobalan*; **Sanskrit name:** Haritaki; **Nepali name:** Harro, **Family:** Combretaceae.

Terminalia chebula is a medium to large deciduous tree found throughout South and Southeast Asia, including India, Sri Lanka, Bhutan, Nepal, Bangladesh, Myanmar, Cambodia, Laos, Vietnam, Indonesia, Malaysia, Pakistan and Thailand. The fruits of 'Harro' bear very high medicinal properties.

Terminalia chebula has been long called the "King of Medicine" in Asian countries and is always listed at the top of the list "Ayurvedic Materia Medica"

because of its extraordinary power of healing.^{11,26} The plant possesses multiple pharmacological and medicinal activities, such as anti-diabetic, anti-mutagenic, anti-oxidant, anti-bacterial, anti-fungal, anti-viral, hepato-protective, anti-inflammatory, anti-caries, gastric motility and wound healing activity.^{26,27}

Phytochemical composition and dental applications:

The photochemical tests have shown that *T. chebula* contains polyphenols, terpenes, anthocyanins, flavonoids, alkaloids and glycosides.²⁷ *T. chebula* is one of the constituents of triphala, and triphala mouthwash has been proven to be an alternative to chlorhexidine.²⁶ *T. chebula* inhibits the growth of dental plaque bacteria as well as plaque bacteria-induced inflammation and effectively abolishes Lipopolysaccharide-induced osteoclastic bone resorption in vitro.²⁷ It has also been observed to cause a significant reduction in Plaque index, Gingival index, and Gingival Bleeding Index scores.²⁶ Carounanidy et al. have documented a definite reduction in the microbial count and activity

of *Streptococcus mutans* and *Lactobacilli*, decrease in the buffer capacity and an increase in the pH resulting in a marked anti-cariogenic effect.²⁸

CONCLUSION

The combination of glorious Ayurvedic history with indigenous medicinal plants of Nepal along with their evidence based effect on controlling oral diseases has mammoth potential. The identification of plants and their phytochemical composition, extraction of plant products, identifying their effect on oral pathogen as well as finding Minimum Inhibitory Concentration (MIC) of those extracts should be the next step to develop phytodentistry in Nepal. The careful evaluation of these maneuvers can lead to the development of prototype products to care oral diseases which can be later developed into industrial scale. This will contribute to introduce products from Himalayan Kingdom into international market and help national economy as well.

Conflict of interest: None.



REFERENCES

1. Hotwani K, Baliga S, Sharma K. Phytodentistry: use of medicinal plants. J Complement Integr Med. 2014;11(4):233-51.
2. Press JR, Shrestha KK, Sutton DA, Natural History M, Tribhuvana Vvl, Central Department of B. Annotated checklist of the flowering plants of Nepal. London: Natural History Museum; 2000.
3. Uwe Schippmann DJLaABC. Impact of Cultivation and Gathering of Medicinal Plants on Biodiversity: Global Trends and Issues. Biodiversity and the Ecosystem Approach in Agriculture, Forestry and Fisheries. 2002.
4. Bahareh Nazemi Salman SV, and Mahshid Mohebbi Rad. Use of herbs and medicinal plants in dentistry: a review. Journal Dental School. 2017;35(2):58-64.
5. 2011 UNGAPDotH-IMotGAotPaCoNDRAL.
6. Kassebaum NJ, Smith AGC, Bernabé E, Fleming TD, Reynolds AE, Vos T, et al. Global, Regional, and National Prevalence, Incidence, and Disability-Adjusted Life Years for Oral Conditions for 195 Countries, 1990-2015: A Systematic Analysis for the Global Burden of Diseases, Injuries, and Risk Factors. J Dent Res. 2017;96(4):380-7.
7. Kamal Rai Aneja RJ, Chetan Sharma. Potency of Barleria prionitis L bark extracts against oral diseases causing strains of bacteria and fungi of clinical origin. New York Science Journal. 2010;3(11):5-12.
8. D. Banerjee AKM, S. Mahapatra, P. Banerji. Barleria prionitis Linn.: A review of its traditional uses, Phytochemistry, Pharmacology and toxicity. Research journal of Phytochemistry. 2012;6(2):31-41.
9. Singh B, Bani S, Gupta DK, Chandan BK, Kaul A. Anti-inflammatory activity of 'TAF' an active fraction from the plant Barleria prionitis Linn. Journal of ethnopharmacology. 2003;85(2-3):187-93.
10. Gupta D, Gupta RK, Jain A, Bindhumadhav S, Sangeeta, Garg P, et al. Assessment of Effectiveness of Barleria prionitis on Oral Health. Pharmacognosy Res. 2016;8(3):169-72.

11. Kapoor LD. Handbook of Ayurvedic Medicinal Plants. 2018.
12. Kashmira J, Gohil JPA, AKG. Pharmacological review on *Centella asiatica*: A potential herbal cure-all. *Indian Journal of Pharmaceutical Sciences*. 2010;72(5):546-56.
13. TalatMohammadi S, MarenahallyRangaraju, Vivekananda, DasappaShivaprasad, Aratrika Mukherjee. Clinical Evaluation of *CentellaAsiatica*(Gotukola) mouthwash as an adjunct to mechanical plaque control. *World Journal of Advanced Scientific Research*. 2018;1(2):59-75.
14. Grindwit Sastravaha GG, Preecha Sangtherapitikul, Wolf-Dieter Grimm. Adjunctive Periodontal Treatment with *Centellaasiatica* and *Punicagranatum* Extracts: A Preliminary study. *Journal of the International Academy of Periodontology*. 2003;5(4):106-15.
15. Alzohairy MA. Therapeutics Role of *Azadirachta indica* (Neem) and Their Active Constituents in Diseases Prevention and Treatment. *Evid Based Complement Alternat Med*. 2016;2016:7382506.
16. Islas JF, Acosta E, G-Buentello Z, Delgado-Gallegos JL, Moreno-Treviño MG, Escalante B, et al. An overview of Neem (*Azadirachta indica*) and its potential impact on health. *Journal of Functional Foods*. 2020;74.
17. N. C. J. Packia Lekshmi NS, S.Viveka, J. Raja Brindha and S. Jeeva. The inhibiting effect of *azadirachta indica* against dental pathogens. *Asian Journal of Plant Science and Research*. 2012;2(1):6-10.
18. Nagpal M, Sood S. Role of curcumin in systemic and oral health: An overview. *J Nat Sci Biol Med*. 2013;4(1):3-7.
19. Chaturvedi TP. Uses of turmeric in dentistry: an update. *Indian J Dent Res*. 2009;20(1):107-9.
20. Mohammad Hosein Farzaei RB, Ali Ghobadi, Fatemeh Farzaei, Fariba Najafi. Pharmacological activity of *Mentha longifolia* and its phytoconstituents. *Journal of Traditional Chinese Medicine*.37(5):710-20.
21. Fayed MAA. *Mentha piperita* l - A promising dental care herb mainly against cariogenic bacteria. *Universal Journal of Pharmaceutical Research*. 2019.
22. Gupta D, Bhaskar DJ, Gupta RK, et al. A randomised controlled clinical trial of *Ocimum sanctum* and chlorhexidine mouthwash on dental plaque and gingival inflammation. *J Ayurveda Integr Med*. 2014;5(2):109-16.
23. Mallikarjun S, Rao A, Rajesh G, et al. Antimicrobial efficacy of Tulsi leaf (*Ocimum sanctum*) extract on periodontal pathogens: An in vitro study. *J Indian Soc Periodontol*. 2016;20(2):145-50.
24. Hosamane M, Acharya AB, Vij C, et al. Evaluation of holy basil mouthwash as an adjunctive plaque control agent in a four day plaque regrowth model. *J Clin Exp Dent*. 2014;6(5):e491-6.
25. Luke AM, Patnaik R, Kuriadom ST, et al. An in vitro study of *Ocimum sanctum* as a chemotherapeutic agent on oral cancer cell-line. *Saudi J Biol Sci*. 2021;28(1):887-90.
26. Esther P, Elanchezhiyan S, Daniel R, Meenalochani T, Pavithra T, Surya D. Evaluation of clinical efficacy of *Terminalia chebula* in plaque-induced gingivitis: A randomised control trial. 2017;7(1):21-4.
27. Lee J, Nho YH, Yun SK, Hwang YS. Use of ethanol extracts of *Terminalia chebula* to prevent periodontal disease induced by dental plaque bacteria. *BMC Complement Altern Med*. 2017;17(1):113.
28. Carounanidy U, Satyanarayanan R, Velmurugan A. Use of an aqueous extract of *Terminalia chebula* as an anticaries agent: A clinical study. *Indian J Dent Res*. 2007;18(4):152-6.