



## HERBS IN PERIODONTOLOGY – A REVIEW

## Dentistry

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## ABSTRACT

The aim of this paper was to analyze the literature published in the research related to herbal medicine as adjunct in periodontal therapies. Since ancient times, herbal treatments have been widely used all over the world. Periodontal disorders have long been regarded as one of the most serious health issues and extremely common, affecting up to 90% of the world's population. Gingivitis is a moderate form of gum disease, whereas periodontitis is characterized by the irreversible loss of tooth supporting tissues. The use of plants and their extracts to improve oral health and promote oral hygiene has a long history. Herbal extracts offer a variety of effects, including anti-inflammatory, antibacterial, and analgesic properties. As they are economically feasible, safe and effective, hence these products can be used as alternatives for the treatment of gingivitis and periodontitis. Since there is an increase in use of herbs in dentistry, further studies are needed to evaluate their safety and effectiveness for clinical use. The purpose of this review is to examine the use of herbal extracts in periodontics, as well as their medicinal applications and side effects.

## KEYWORDS

Herbal extracts, Herbs, periodontal disease, Periodontics

## INTRODUCTION

Poor oral health has a significant impact on overall well-being and quality of life (Kassebaum et al., 2017). Poor oral health has been linked to a number of chronic and systemic disorders.<sup>1</sup>

Periodontal disease is a major public health issue that affects the global population and is the leading cause of tooth loss in the population. The tooth's supporting tissue structures are destroyed. One of the most common symptoms of periodontal disease is the microbial oral biofilm being the key etiological component<sup>2</sup> There is a well-established connection between oral diseases and the activities of microbial species that make up the oral cavity's micro-biota. There are over 750 species of bacteria in the oral cavity (50 percent of which have yet to be identified), and many of them have been linked to oral diseases.<sup>3</sup>

Access to dental healthcare is scarce in most developing countries, with emergency dental treatment or pain relief being the most common options. Dental diseases carry financial and social costs because of care and are typically a high-cost treatment that is out of reach for the average person in developing countries<sup>4</sup>

Natural phytochemicals derived from plants are replacing synthetic compounds in traditional therapy. It's important to note that two of the largest and most populous countries, China and India, have been using herbal medicine for the treatment of oral illnesses, including periodontal disease, for much more than 2000 years.<sup>5</sup>

## HISTORY

Plants have been used as medicines even before written history. In northern Iraq, a 60,000-year-old Neanderthal burial site known as "Shanidar IV" has yielded significant quantities of pollen from eight plant species, seven of which are now used as herbal remedies.

The Sumerians identified well-established medicinal uses for plants like laurel, caraway, and thyme in the written record, which dates back over 5,000 years.<sup>6</sup>

ANCIENT INDIA<sup>7</sup>

The Vedic era (1500-800 BC), the Brahman period (800 BC-1000 AD), and the Mongol period (1000 AD) are the three periods of Indian medicine.

The Vedic era is where great Indian knowledge books like the Rig-Veda were written. The Rig Veda mentions that doctors had herbal remedies for a variety of ailments.

Two major books were written during the Brahman era in Indian medicine:

- *Susruta Samhita* – 6<sup>th</sup> century BC
- *Charaka Samhita* – 120-162 AD

Susruta provides guidelines for proper teeth brushing and the use of mouth washes to cleanse the tongue in a section devoted to Preventive Dentistry.

Charaka the mouth, oral hygiene, and the treatment of oral diseases are all covered in detail. He defines the ideal toothbrush (Danta-Kashtha) as being made of a fresh twig of a tree in Chapter XVIV.

ANCIENT CHINA<sup>7</sup>

Garlic, mint, horseradish, and rhubarb were among the plants used in many Chinese prescriptions. A toothache remedy has been described in which a piece of garlic is roasted, crushed between the teeth, and then mixed with chopped horseradish seeds and reduced, to a paste with human milk; the paste is then formed into tablets, which are then inserted into the nose on the side opposite to where the pain is felt.

## LATER MIDDLE EASTERN AND MEDITERRANEAN CIVILIZATIONS

## THE HEBREWS

To relieve dental pain, the Hebrew material medica recommended pepper, salt, ginger, and cannell. Vinegar was to be smeared on the finger and then added to the sore tooth's edge.<sup>7</sup>

## GREECE, ROME

Plants were used as medicine by the ancient Greeks and Romans. Hippocrates' and particularly Galen's writings on Greek and Roman medicinal practices laid the groundwork for later western medicine.

Dioscorides (40-90 AD), a Greek physician, wrote *De Materia Medica*, the first European treatise on the properties and uses of medicinal plants.<sup>8</sup>

## BYZANTIUM

Paul of Aegina (625-690 AD) was the last of the great Byzantine physicians, and he left an enormous body of work in twelve volumes that were translated into English in 1844 by Francis Adams. In his document, he proposes a dentifrice made of white salts mixed with

honey and wrapped in fig-tree leaves and burned until reduced to the ashes.<sup>7</sup>

### ARABIAN MEDICINE

Rhazes, Hally Abbas, and Avicenna are the three great names of eastern Arabian medicine.<sup>7</sup>

### MIDDLE AGES

Arab traders had access to plant material from faraway places like China and India because of their trading community. Herbals, medical books, and translations of antiquity's classics arrived from both east and west.<sup>6</sup>

### MODERN ERA

The fifteenth, sixteenth, and seventeenth centuries were the Golden Age of Herbs, with many of them being published for the first time in English or other languages other than Latin or Greek. The anonymous Grete Herball of 1526 was the first herbal to be written in English.<sup>6</sup>

According to the World Health Organization (WHO), herbal medicine is used by 80% of the world's population for any form of primary health care. Herbal medicine is used by complementary medicine practitioners such as naturopaths in developed countries in addition to its use in developing countries.<sup>6</sup>

### CLASSIFICATION

Principles. Herbs can be categorized in a variety of ways. They are as follow:

1. According to the usage
2. According to the active constituents
3. According to the period of life

#### I. According to the usage<sup>8</sup>

##### A. Medicinal Herbs

Because of their soothing qualities, medicinal herbs are used in the production of medicines.

##### B. Culinary Herbs

Culinary herbs, such as mint, parsley, and basil, are perhaps the most used as cooking herbs due to their strong flavors.

##### C. Aromatic Herbs

Aromatic herbs are used for a variety of purposes due to their pleasant-smelling flowers or foliage.

##### D. Ornamental Herbs

Ornamental plants, such as lavender and chives, are used for decoration because they have brightly colored flowers and foliage.

#### II. According to the active constituents.<sup>8</sup>

##### A. Aromatic Herbs

The term Aromatic Herbs refers to the sweet odor that many of these herbs have.

**Stimulant Herbs:** Stimulant herbs, such as fennel, ginger, garlic, and lemon grass.

**Nerve Herbs:** Nerve herbs are Ginger and catnip.

##### B. Astringent Herbs

Peppermint, red raspberry,

##### C. Bitter Herbs

*Laxative Bitter herbs* include aloe, cascara, liquorice, pumpkin, senna, yellow dock, yucca, barberry, gentian, safflowers, and golden seal.

*Diuretic herbs* are Asparagus, blessed thistle, burdock, butcher's broom, buchu, chaparral, chickweed, corn silk, dandelion, dog grass, and grapevine.

##### D. Mucilaginous Herbs

Mucilaginous herbs are Althea, aloe, burdock, comfrey, dandelion, Echinacea, fenugreek, kelp, psyllium, slippery elm, dulse, glucomannan from Konjak root, Irish moss, and mullein.

E. Nutritive Herbs are rosehips, acerola, apple, asparagus, banana, barley grass, bee pollen, bilberry, broccoli, cabbage, carrot,

cauliflower, grapefruit, hibiscus, lemon, oat straw, onion, orange, papaya, pineapple, red clover, spirulina, stevia, and wheat germ.

### III. According to the period of life

A. Annual herbs have a one-year life cycle, so start them from seed. Herbs that grow every year include

- Anise
- Summer Savoury
- Biennial herbs are plants that live for two seasons and only bloom in the second.
- Caraway seeds, Teasel
- Viper's Buglos
- **Perennial herbs** Sweet marjoram, parsley, mint, sage, thyme, and chives are perennial herbs.

### IV. Based on their origin, evolution and the forms of current usage<sup>9</sup>

#### Category 1: Indigenous herbal medicines

In terms of composition, treatment, and dosage, it has long been used in a particular community or area and is very well accepted by the local population.

#### Category 2: Herbal medicines in systems

Medicines in this group have been used for a long time, have unique ideas and definitions, and have been recognized by nations. Ayurveda, Unani, and Siddha are the three types of Indian medicine.

#### Category 3: Modified herbal medicines.

These are herbal medicines that have been changed in some way, including dose, dosage type, mode of administration, herbal medicinal ingredients, methods of preparation, and medical indications.

#### Category 4: Imported products with herbal medicine base

This category includes all imported herbal medicines, both raw materials and finished goods.

### VARIOUS HERBS AND THEIR USES IN THE MANAGEMENT OF PERIODONTAL DISEASE

#### Aloe vera

The Liliaceae family includes *A. vera*, a succulent plant species. There are 300 different species of *A. vera*. *Aloe barbadensis* Miller and *Aloe arborescens* are the only two species of *A. vera* that have been examined. A central mucilaginous component and peripheral bundle sheath cells are two distinct parts of the *A. vera* leaf. *A. vera* gel is a tasteless, jelly-like, thin, and clear material produced by parenchymal tissue found in the interior region of aloe leaves.<sup>10</sup>

Antibacterial, antioxidant<sup>11</sup>, anti-inflammatory, antiviral, and antifungal properties are among the pharmacological activities of *A. vera*. *A. vera* has a long history of usage in the treatment of dental problems. It is particularly beneficial in the treatment of gingivitis and periodontitis. It reduces inflammation and gingival bleeding while also acting as an antibacterial. It also contains anti-inflammatory properties. *A. vera*'s carboxypeptidase reduces pain by inactivating bradykinin by about 67 percent, and it also contains chemicals that block arachidonic acid oxidation and have anti-PG production capabilities, which may aid to reduce inflammation.<sup>12</sup> The formation of free oxygen radicals was inhibited by *A. vera*, and the alternative and chemical pathways of complement activation were depleted. It treats aphthous ulcers, denture stomatitis, cracked and split corners of the mouth, and has antifungal characteristics. In 2017, *Ashouri Moghaddam et al. published a study that demonstrated the efficacy of using A. vera gel locally to chronic periodontitis patients in addition to scaling and root planing.*<sup>13</sup>

*In a 2016 study comparing the efficacy of A. vera mouthwash and chlorhexidine on periodontal health, A. vera mouthwash was found to be just as effective as chlorhexidine in reducing plaque and gingivitis.*

#### Curcumin

Turmeric is a spice plant whose rhizome contains the polyphenol curcumin. Turmeric contains three different forms of curcuminoids: curcumin (diferuloylmethane), demethoxycurcumin, and bisdemethoxycurcumin. Curcumin's powerful anti-inflammatory properties are linked to a variety of processes and molecular targets. First, it inhibits the activation of nuclear factor kappa-B (NF- $\kappa$ B), a crucial signalling molecule involved in the development of the inflammatory response as well as cell proliferation, oncogenesis, and cell transformation.<sup>14</sup> Second, curcumin inhibits cyclooxygenase-2, an

enzyme that catalyses the formation of PGs and is connected to most form of inflammation ,including periodontitis.It also inhibits the creation of inducible nitric oxide synthase (a powerful pro-inflammatory molecule regulated by NF-B) and promotes its destruction directly. Curcumin has antibacterial and antifungal effects, according to studies. It works as a bacteriostatic and bactericidal agent against a variety of bacteria, including Staphylococcus aureus, Gram-positive bacteria like Pseudomonas aeruginosa and Klebsiella pneumoniae, and fungal species like Candida albicans and Paracoccidioides brasiliensis.. Curcumin's antibacterial activities have been linked to a variety of mechanisms of action.<sup>15</sup> Curcumin has been shown to limit bacterial cell division and promote bacterial membrane permeabilization, resulting in long-term damage and cellular death in Gram-positive and Gram-negative bacteria.<sup>16</sup> Curcumin has been shown to have synergistic antibacterial effects with antibiotics such as vancomycin, cefixime, and tetracycline against P. aeruginosa and S. aureus by inhibiting their pathogenicity, quorum sensing, and biofilm initiation in several studies.<sup>17</sup> *Curylofo-Zotti et al. compared natural and chemically modified curcumin on periodontal inflammation and related bone resorption in an experimental periodontitis model in 2018 and discovered that chemically modified curcumin is more capable of reducing LPS-induced periodontitis.*<sup>18</sup>

### Tulsi

Tulsi (Ocimum sanctum) has a chemical makeup that is highly complex and contains a variety of biologically beneficial chemicals and nutrients. Antibacterial agents are found in the leaves of O. sanctum, mostly in the form of essential oils. The five principal ingredients of these essential oils are eugenol, caryophyllene, germarene-A, clemene, and caryophyllene oxide.

Other biologically active molecules found in the form of phytochemicals include ursolic acid, rosmarinic acid, and oleanolic acid. Because of their antibacterial qualities, these essential oils and biologically active chemicals are efficient against Gram-positive and Gram-negative bacteria.<sup>19</sup> By promoting cellular potassium release, they can harm microbial strains' cytoplasmic membranes. These mechanisms that are efficient against bacteria that cause systemic disease may have also worked against the periodontal pathogen A. actinomycetemcomitans seen in human dental plaque.In a review of the literature, only a few research have looked at the antibacterial activity of O. sanctum against oral disease-causing bacteria. *Gupta et al. discovered that the efficiency of O. sanctum mouthrinse in decreasing plaque and gingivitis is comparable to that of chlorhexidine in a clinical research.*<sup>20</sup> *Mallikarjun et al. published an in vitro study in 2016 that demonstrated the antibacterial effectiveness of Tulsi leaf extract against Aa.*<sup>21</sup> Tulsi is also thought to have an immunomodulatory effect, boosting the levels of interferon, interleukin-4, and T helper cells, strengthening the host's immune response to infections.

### Pineapple

The tropical fruit pineapple (Ananas comosus) is high in vitamins, enzymes, and antioxidants. The Bromeliaceae family includes the plant. The therapeutic properties of pineapple are due to bromelain, an elementary extract from the fruit. It comprises a variety of proteinases as well as other substances. It has antiedematous, fibrinolytic, anti-inflammatory, and antithrombotic properties in vitro and in vivo, and can be used as a substitute for nonsteroidal anti-inflammatory drugs, glucocorticoids, and immunomodulators.<sup>22</sup>

Bromelain is thought to reduce the risk of antibiotic toxicity by boosting the absorption of antibiotics, allowing for better distribution in tissues. *Bromelain's antibacterial properties were demonstrated in a 2014 study against a variety of aerobic and anaerobic microbes (S. mutans, P. gingivalis, Escherichia coli and A. actinomycetemcomitans).*<sup>23</sup>

*The anti-plaque and anti-gingivitis efficacy of a dentifrice containing bromelain was demonstrated in a 2017 study.* Despite the fact that the side effects are minor, researchers have restricted its use in patients.

### Grape seed extract

Extract from grape seeds Grape seed extract (GSE) is made from Vitis vinifera seeds. It is a naturally occurring polyphenolic molecule that has also been proposed as an effective immunomodulator agent due to its proanthocyanidin concentration. The anti-inflammatory action of GSE is demonstrated by its ability to regulate the release and gene

expression of pro-inflammatory and anti-inflammatory cytokines.<sup>24</sup>

Toker et al. published a study in 2018 that demonstrated that GSE administration can minimise periodontal inflammation and alveolar bone loss by lowering MMP-8 and HIF-1 $\alpha$  levels.<sup>25</sup>

### Pomegranate

Pomegranate is the popular name for Punica granatum, a member of the Punicaceae family. The word "pomegranate" comes from the Latin word "pomum," which meaning "apple." and seeded ("granatus").<sup>26</sup> Ellagitannins, flavonoids, punicic acid, anthocyanins, anthocyanidins, and estrogenic flavones are the most beneficial components of pomegranate. The peel of the pomegranate has been found to have anti-inflammatory, antimutagenic, and antifungal properties. Pomegranate juice possesses anti-oxidant, antihypertensive, anti-atherosclerotic, and anti-aging benefits due to the tannin content. Vasconcelos et al. investigated the antibacterial activity of pomegranate gel against S. mutans, Streptococcus mitis, and Candida albicans in 2006 and discovered that it is effective in inhibiting microbial adhesion[In 2016, Aparecida Procópio Gomes et al. investigated and demonstrated the antibacterial activity of P. granatum against P. gingivalis.]<sup>27</sup> It has also showed antibacterial activity against the most common periodontal pathogens, A. actinomycetemcomitans (Aa), P. gingivalis (Pg), and P. intermedia (Pi). As a result, it can be used in combination with mechanical debridement to treat gingivitis and periodontitis.<sup>28</sup>

Punicic acid, the main component of pomegranates, is a powerful anti-inflammatory with the ability to reduce PG production. It can also suppress NF-B activity, which is a promising strategy for treating periodontitis and preventing inflammation-induced bone resorption.<sup>29</sup> The wound-healing effects of pomegranate extract are well-known. It has been shown to promote fibroblast migration and proliferation, collagen production, and angiogenesis

## ROLE OF PHYTOTHERAPEUTICS IN THE MANAGEMENT OF PERIODONTAL DISEASE

**Table 1: Plant products, components and action<sup>30</sup>**

Plant products	Components present	Various actions of the components	Role in the management of periodontal diseases
Aloe vera	Vitamins, enzymes, minerals, sugars, lignins, saponins, salicylic acids, and amino acids	Antibacterial, antioxidant, antiviral and antifungal actions	Local drug delivery system in periodontal pockets Inhibit periodontopathic bacteria It also reduces bleeding, inflammation, and swelling of the gums and acts as a powerful antiseptic
Curcumin	Curcuminoids: Curcumin, dethoxy curcumin, and bisdemethoxycurcumin Volatile oils (turmerone, atlantone, and zingiberene), sugars, proteins, and resins	Antibacterial, antifungal actions	Acts both as bacteriostatic and bactericidal for several pathogenic Gram-positive bacteria as well as Gram-negative bacteria Subgingival irrigation reduces bleeding on probing and redness and pocket probing depth
Tulsi	Eugenol, caryophyllene, germarene-A, clemene and caryophyllene oxide Phytochemicals such as ursolic acid, rosmarinic acid and oleanolic acid	Antibacterial properties, immunomodulatory action	Effective against Gram-positive and Gram-negative bacteria Immunomodulatory effect acts by increasing the levels of interferon, interleukin-4 and T helper cells that will strengthen host response to infections

Pineapple	Bromelain	Fibrinolytic, antiedematous, antithrombotic, and anti-inflammatory, antibacterial	Antibacterial efficacy against all the isolated strains of both aerobic and anaerobic microorganisms (Streptococcus mutans, Escherichia coli, Porphyromonas gingivalis, and Aggregatibacter
Grape seed extract	Polyphenolic compounds, mainly monomeric catechin and epicatechin, gallic acid, and	Immunomodulatory agent, antioxidant, anticarcinogenic, anti-inflammatory effects	Inhibit osteoclast differentiation, reduce osteoclast activity, and stimulate bone formation Bacteriostatic effect on the anaerobes
Pomegranate	Ellagic acid ellagitannins (including punicalagins), punicic acid, flavonoids, anthocyanidins,	Anti-inflammatory, antimutagenic, and antifungal activity	Anti-bacterial properties against periodontal pathogens and antiplaque effect Significantly improves clinical signs of chronic periodontitis

### FUTURE PERSPECTIVE

Periodontal disease is a chronic inflammatory condition that causes the tooth's supporting components to deteriorate. It can range from gingivitis to periodontitis in terms of clinical presentation. Plaque accumulation is the primary cause of this disease. Aloe Vera has a variety of impacts on humans, including promoting wound healing, acting as an anti-inflammatory, and acting as an antibacterial and antiviral. Turmeric is one of the most commonly used herbal treatments in recent clinical trials for periodontal infections (Curcuma longa). Curcumin (diferulolymethane), a yellow-colored bioactive component of turmeric, is thought to exert a wide range of biological effects. Curcumin has long been utilised in Ayurvedic medicine because it is nontoxic and has a wide range of medicinal characteristics, including antioxidant, analgesic, anti-inflammatory, and antiseptic properties.

Due to their broad biological action, higher safety margin, and lower costs, herbal medications are favoured over conventional drugs. Furthermore, conventional medications are known to have a variety of negative effects, and long-term use has led to antibiotic resistance. As a result, herbal medications are increasingly being used as dietary supplements to treat or prevent common illnesses. In both emerging and developed countries around the world, herbal medication and other herbal healthcare ingredients are in great demand and have a rapidly growing market.

Furthermore, the antioxidant properties of these herbs can help to reduce the oxidative burden caused by the disease's chronicity. Despite the fact that numerous studies have demonstrated the effectiveness of herbal medicines as an alternative to conventional therapy, there is still a gap in research about the clinical application of these substances in periodontics.

In dentistry, the use of medicinal plants as anti-inflammatory, antiseptic, and antibacterial agents has led in the development of new tooth paste and therapeutic agents, in a field where long-term dependability is critical. More study is needed to support and continue this pioneering effort, since it is necessary to prove the efficacy, potency, and effectiveness of these herbal plants in order to further establish herbal medication as a reliable therapy method for periodontal therapies.

### CONCLUSION

Herbs have been utilised in dentistry as antioxidants, antiseptics, and analgesics with great success. Antibiotics can be replaced with these natural phytotherapeutic substances. They'll boost your immunity and aid in the recovery of oral infections. These medications' antimicrobial properties have been discovered to be particularly beneficial in the treatment of periodontal disorders. However, well-controlled clinical trials are required before adopting it in everyday practise to justify the use of these traditional therapeutic procedures in the dentistry sector and to determine whether they have therapeutic benefits, either alone or in combination with other conventional therapies.

### REFERENCES

- Efficacy of a commercially available multi-herbal formulation in periodontal therapy A Suchetha I, Ashit G Bharwani , Journal of Indian Society of Periodontology 26/08/21, 22:09
- Phytotherapy: a non-surgical therapeutic approach in periodontics – A review Bhardwaj A, Bhardwaj SV. Role Of Medicinal Herbs In Prevention And Treatment. Ann Ayurvedic Med 2012;1(3):95-10
- Bairwa R, Gupta P, Gupta VK, Srivastava B. Traditional Medicinal Plants: Used In Oral Hygiene. Int J Pharma Chem Sci 2012;1(4):94
- Hossam Abdelatty Eid Abdelmagyda, Dr Shishir Ram Shetty, Dr Manea Musa Musleh Al-Ahmari. Herbal medicine as adjunct in periodontal therapies- A review of clinical trials in past decade. Journal of Oral Biology and Craniofacial Research 9 (2019) 212-217
- Herbalism [Internet]. 2017 [cited 10 January 2017]. Available from: <http://www.emuho.com/herbalism78940.htm>.
- Carranza F SG. History of Periodontology. Chicago: Quintessence Publishing Co, Inc; 2009.
- Industrial Use of Medicinal and Aromatic Plants [Internet]. 2017 [cited 10 January 2017]. Available from: <http://Industrial Use of Medicinal and Aromatic Plants>.
- Patel V, Patel NM, Patel PM. Review on Quality Safety and Legislation for Herbal Products. Int J Res Ayurveda Pharm. 2011;2(5):1486-9.
- Wynn RL. Aloe vera Gel: Update for dentistry. Gen Dent 2005;53:6-9.
- Yagi A, Kabash A, Okamura N, Haraguchi H, Moustafa SM, Khalifa TI, et al. Antioxidant, free radical scavenging and anti-inflammatory effects of aloeosin derivatives in Aloe vera. Planta Med 2002;68:957-60.
- Bautista-Pérez R, Segura-Cobos D, Vázquez-Cruz B. In vitro antibiodykinin activity of Aloe barbadensis Gel. J Ethnopharmacol 2004;93:89-92.
- Ashouri Moghaddam A, Radafshar G, Jahandideh Y, Kakaei N. Clinical evaluation of effects of local application of Aloe vera gel as an adjunct to scaling and root planning in patients with chronic periodontitis. J Dent (Shiraz) 2017;18:165-72
- Luque I, Gélinas C. Rel/NF-kappa B and I kappa B factors in oncogenesis. Semin Cancer Biol 1997;8:103-11.
- Shahi SK, Shukla AC, Bajaj AK, Banerjee U, Rimek D, Midgely G, et al. Broad spectrum herbal therapy against superficial fungal infections. Skin Pharmacol Appl Skin Physiol 2000;13:60-4.
- Rai D, Singh JK, Roy N, Panda D. Curcumin inhibits FtsZ assembly: An attractive mechanism for its antibacterial activity. Biochem J 2008;410:147-55.
- Rudrappa T, Bais HP. Curcumin, a known phenolic from Curcuma longa, attenuates the virulence of Pseudomonas aeruginosa PAO1 in whole plant and animal pathogenicity models. J Agric Food Chem 2008;56:1955-62
- Curylofo-Zotti FA, Elburki MS, Oliveira PA, Cerri PS, Santos LA, Lee HM, et al. Differential effects of natural curcumin and chemically modified curcumin on inflammation and bone resorption in model of experimental periodontitis. Arch Oral Biol 2018;91:42-50.
- Mondal S, Mirdha BR, Mahapatra SC. The science behind sacredness of Tulsi (Ocimum sanctum Linn.). Indian J Physiol Pharmacol 2009;53:291-306. 55.
- Gupta D, Bhaskar DJ, Gupta RK, Karim B, Jain A, Singh R, et al. A randomized controlled clinical trial of Ocimum sanctum and chlorhexidine mouthwash on dental plaque and gingival inflammation. J Ayurveda Integr Med 2014;5:109-16.
- Mallikarjun S, Rao A, Rajesh G, Shenoy R, Pai M. Antimicrobial efficacy [Downloaded free from <http://www.srjms.in> on Tuesday, June 8, 2021, IP: 249.120.44.50] Pai, et al.: Role of phytotherapeutics in the management of periodontal disease SRM Journal of Research in Dental Sciences [Volume 10 | Issue 2 | April-June 2019 89 of Tulsi leaf (Ocimum sanctum) extract on periodontal pathogens: An in vitro study. J Indian Soc Periodontol 2016;20:145-50.
- Pavan R, Jain S, Shradha, Kumar A. Properties and therapeutic application of bromelain: A review. Biotechnol Res Int 2012;2012:976203.
- Praveen NC, Rajesh A, Madan M, Chaurasia VR, Hiremath NV, Sharma AM. In vitro evaluation of antibacterial efficacy of pineapple extract (Bromelain) on periodontal pathogens. J Int Oral Health 2014;6:96-8.
- Ahmad SF, Zoheir KM, Abdel-Hamid HE, Attia SM, Bakheet SA, Ashour AE, et al. Grape seed proanthocyanidin extract protects against carrageenan-induced lung inflammation in mice through reduction of pro-inflammatory markers and chemokine expressions. Inflammation 2014;37:500-11
- Toker H, Balci Yuce H, Lektumur Alpan A, Gevrek F, Elmastas M. Morphometric and histopathological evaluation of the effect of grape seed proanthocyanidin on alveolar bone loss in experimental diabetes and periodontitis. J Periodontol Res 2018;53:478-86
- Salgado AD, Maia JL, Pereira SL, de Lemos TL, Mota OM. Antiplaque and antigingivitis effects of a gel containing Punica granatum Linn extract: A double-blind clinical study in humans. J Appl Oral Sci 2006;14:162-6
- Aparecida Procópio Gomes L, Alves Figueiredo LM, Luiza do Rosário Palma A, Corrêa Geraldo BM, Isler Castro KC, Ruano de Oliveira Fugisaki L. Punica granatum L. (Pomegranate) extract: In vivo study of antimicrobial activity against Porphyromonas gingivalis in Galleria mellonella model. ScientificWorldJournal 2016;2016:8626987
- Somu CA, Ravindra S, Ajith S, Ahamed MG. Efficacy of a herbal extract gel in the treatment of gingivitis: A clinical study. J Ayurveda Integr Med 2012;3:85-90
- Ishikawa I. Host responses in periodontal diseases: A preview. Periodontol 2000 2007;43:9-13
- Yan H, Peng KJ, Wang QL, Gu ZY, Lu YQ, Zhao J, et al. Effect of pomegranate peel polyphenol gel on cutaneous wound healing in alloxan-induced diabetic rats. Chin Med J (Engl) 2013;126:1700-6