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TITLE: Botanical Breakthroughs: The Future of Phytodentistry in Oral Hygiene: A Narrative Review

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ABSTRACT

Herbal medicines are widely used nowadays in dentistry and medical practice because of their higher antimicrobial activity, anti-inflammatory properties, biocompatibility and antioxidant properties. Due to ease of accessibility, lesser side effects and beneficial properties, there is an exponential growth of Herbal medicine in medical and dental fields recently. *M. oleifera* likewise called the "Miracle Tree", is a widely used nourishing food substance that has been discovered beneficial both medicinally and economically, all elements under *M. oleifera* are considered to be a storehouse of valuable nutrients. *Curcuma longa* popularly referred to as turmeric is mainly used for its anti-inflammatory properties, it is also used as Oriental medicinal drugs to remedy dental illnesses, including toothache, gastritis, vomiting. Pomegranate (*Anar*) is another name for *Punica Granatam* is proven to help control oral infection and microbial counts in periodontitis and fungal infection related to dentures, it is also used as mouth wash popularly in as prophylactic treatment of dental plaque microorganisms. Guava, with its scientific name *Psidium guajava*, is an excellent antiplaque, antimicrobial, anti-inflammatory, and antioxidant agent used in treating oral diseases. All these Herbal Medicines have remarkable Ethnomedicinal and pharmacological properties, also have a significant role in oral health care. Natural herbs and their formulations are safer, and effective dosage forms can be used for better patient compliance with human beings. This review article highlights the importance of *Moringa oleifera*, *Curcuma longa*, *Punica Granatam* and *Psidium guajava* on Dentistry and its uses in medicinal fields.

Keywords: Herbal dentistry, *Moringa oleifera*, *Curcuma longa*, *Punica Granatam*, *Psidium guajava*, medicinal herbs

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INTRODUCTION

The use of plant based herbal medications in the pharmaceutical arena has garnered much attention in recent times owing to their vast natural activity, high safety margin, and affordable price. The current scenario showcases the supremacy of herbal medications over conventional pharmaceuticals employing them as dietary supplements has produced tremendous results in treating and preventing common illnesses. [1]

The plant *Moringa. Oleifera* [MO], commonly found in the equatorial and sub-equatorial regions, is a widely used nourishing food substance that has also shown to have both medicinal and economic benefits.[2] It is Quoted as the "Miracle Tree" as every part of the

tree is suitable for nutritional or industrial purposes.[3] When it comes to the field of dentistry, MO can be employed as a remedy for dental caries owing to the presence of methanolic extracts which exhibit an inhibitory property towards oral pathogens.[2]

Curcuma Longa [CL] which belongs to the Zingiberaceae own family, is popularly referred to as turmeric. The main curcuminoid in the widely used Indian spice turmeric is called curcumin. CL, commonly known as turmeric has anti-oxidant, anti-inflammatory, anti-viral, anti-fungal, anti-hyperglycaemic, anti-allergic, anti-cancerous properties[3], which can be attributed to the presence of flavonoid curcumin and numerous volatile oils. The efficacy of Curcumin in treating acute inflammation is at par with that of cortisone or phenylbutazone. Study on Chinese population shows the effectiveness of curcumin to treat dental decay.[4]

Pomegranate (Anar) or Punica Granutam has been used as an astringent, hemostatic, antidiabetic, anthelmintics, and for diarrhoea and dysentery. The antiseptic/antiviral and anti-inflammatory property of this fruit has enabled its use in the management of lesions of oral mucosa, genital herpes and also in infections related to periodontitis and dentures.[5] [12]

Guava, Psidium guajava, is a fruit rich in vitamin C and vitamin A [13] and is used for treating diarrhoea, dysentery, gastroenteritis, high blood pressure, high blood sugar, dental caries, and pain management. Guava is an excellent antiplaque, antimicrobial, anti-inflammatory, and antioxidant agent used in treating oral diseases.[6]

Role in general health:

Nutritive Importance of Moringa oleifera (MO):

Moringa oleifera has seven times the vitamin C of an orange [7] and four times vitamin A of an orange. On comparison with milk MO is observed to have two times more calcium.

The leaves of M.O leaves are adequately enriched with large amount of proteins, an unsaturated fatty acid and all essential amino acids. Vitamin A,D,C,B,E, along with carotenoids such carotene and xanthins, iron, zinc, calcium, and potassium are also present. [8]

The flora also serves as a storehouse for a number of important nutrients—polyunsaturated fatty acids, potassium, calcium antioxidants, along with protein act as dietary.[9] 10

Due to the high nutritional content in pods and seeds of M.O, they are used as fortified food ingredients in dairy products.[9,10]



Figure 1: Moringa oleifera leaf extract

Pharmacological actions	
1. Antimicrobial properties	Literature has extensively reported the antibacterial actions of various tissues of MO which includes: action of aqueous leaf extract against <i>S.aureus</i> , <i>E.coli</i> and <i>V. cholera</i> , methanol extract of leaves against <i>P.aeruginosa</i> and <i>Klebsiella pneumonia</i> to name a few. [11, 2,13].
2. Antifungal activity	Essential oil of MO has shown to inhibit growth of <i>P. aurantiogriseum</i> , <i>P. expansum</i> , <i>P. citrinum</i> , <i>P. digitatum</i> , and <i>A. niger</i> . For the treatment of HIV associated after-effects, the leaves have shown to reduce the early strides of the infectivity in the viral vector-based screening. Hence it can be concluded that MO may be used for the development and improvement of potential antiviral medicinal drugs.[13]
3. Cancer prevention and tumor-fighting activities	The extract of the leaves showed antimyeloma and antiproliferative cytotoxic, anti-hepatocarcinomic activities.[7]
4. Antioxidant properties	MO is known for its excessive levels of antioxidants characterized by the presence of 40 natural antioxidants including ascorbic acid, β -carotene in leaves, fruits and seeds. [14]
5. Anti- inflammatory properties	Extracts of leaf, fruit, seed, and root are used in

	the alleviation of inflammation-related diseases, i.e dermatitis, rheumatoid arthritis, bronchial asthma and allergic rhinitis. Ethanolic extracts of leaves have proven to be anti-inflammatory by reducing chemotactic oxidation of polymorphonuclear leukocytes.[16]
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Table 1: Pharmacological actions of *Moringa oleifera*

Curmuma Longa



Figure 2: Curmuma Longa leaves, flora, root.

Table 2: Pharmacological activities Of Turmeric (*Curcuma Longa*):

1. Gastrointestinal issues	Fresh turmeric extract is believed to have anti- helminthic properties. Curcumin exerts its effects by The Nuclear factor (NF)-B inhibition which diminishes the synthesis of adhesion molecules and inflammatory cytokines, minimising gastropathy induced by NSAIDS thus minimising stomach damage.[3]
2. Respiration issues	Turmeric boiled in milk and mixed with jaggery is given orally to relieve cough and rhinitis. Fresh juice of rhizome has relieving effects in patients suffering from bronchitis. A piece of burned turmeric rhizome is given for chewing to alleviate symptoms of dry cough, sore throat, and throat infection
3. Inflammatory issues	Curcumin has been proven to reduce some pathogenic components involved in inflammation, including hyaluronidase, Monocyte Chemoattractant protein -1(MCP-1), Interleukin-12. The advantage of

	curcumin as an anti-inflammatory chemical utilised in sepsis is characterised by the increase synthesis of Peroxisome Proliferator-activated receptor (PPAR), which results in the inhibition of inflammatory cytokines, its expression and release of TNF-8,9.[3]
4. Diabetes mellitus	Curcuma longa's freeze-dried rhizome powder, when dissolved in milk, may be a strong and safe dietary supplement with antidiabetic, hypolipidemic, and hepatoprotective properties. [3]

Punica Granatum



Figure 3: Punica Granatum (Pomogranate)

Table 3: Pharmacological actions of Punica Granatum

1. Antimicrobial activity	Research shows that punicalagin also known as the peel of pomegranate fruit, has antibacterial action against <i>S. aureus</i> and <i>P. aeruginosa</i> . [11] the pericarp extract of punica granatum exhibits strong antibacterial activity against the multiple resistant strains of <i>Salomonella typhi</i> . Herpes virus can be effectively treated by Pomegranate extracts. 19
2. Healing properties	The important aspects of Punica granatum which are responsible for the healing property are gallic acid and catechine. [18] According to a study, the presence of high content of phenolic compounds is seen in the methanolic extract of dried Punica granatum.

Psidium Guajava



Figure 4: Psidium Guajava (Guava)

Table 4: Pharmacological actions of Psidium guajava

1.Antioxidant property	The extracts of Psidium guajava exhibits anti-oxidant property by scavenging hydroxyl radicals and reducing lipid peroxidation [21]
2. Cough Treatment	The water extract of Guava at doses of 2 and 5 g/kg, helped reduce the occurrence of cough.[22]
3.Antidiabetic activity	A 250 mg/kg oral dose of the water extract has shown statistically significant hypoglycemic action. [23]
4.Anti-cancer activity	The aqueous extract of the budding leaves of Psidium guajava has showed anti-prostate cancer action characterised by the reduction of the serum concentration of Prostate-Specific Antigen (PSA) and size of tumor mass as reported in literature. The essential leaf oil has its own cytotoxic impact on cervical cancer cells.[24]
5.Anti-inflammatory and analgesic activities	The leaves extract of P. guajava possesses anti-inflammatory and analgesic properties. The methanol extracts, hexane, ethyl acetate of Psidium guajava leaves showed dose-dependent antinociceptive effects in thermal and chemical tests of analgesics.[24]

ROLE IN ORAL HEALTH CARE

Moringa Oleifera

Dental caries is closely associated with cariogenic biofilm, an oral microflora containing an excessive quantity of *S. mutans*. Several studies conducted using MO leaf extracts confirmed antibacterial property against streptococcus strain of bacteria. Another study conducted on MO leaf extract in plain water and ethyl alcohol to examine the susceptibility of the *S. mutans* assay [2] also demonstrated antibacterial properties against this strain and inhibited the development of cariogenic microflora.

Extracts of fruits and leaves of MO have been discovered to be efficient against common periodontal pathogens. Furthermore, recently developed toothpastes with MO extracts demonstrated a higher bacteriocidal activity against *S. aureus* and *S. mutans* and even showed an antifungal effect against *Candida albicans*. [25] "Moringa" is a recently developed tooth powder formulation in which the dried seeds and leaves are mixed together to produce a cleansing action on the teeth and gums.

MO leaves at high concentrations are used to deal with oral infections, abscesses, and inflammations as an anti-inflammatory agent. Around 34 anti-inflammatory substances have been discovered in MO including caffeoylquinic acid, quercetin, which aids the action of MO against oral infections, abscesses and inflammations. [2,4]

Gargling using MO leaf extract is a powerful agent to reduce plaque formation in **early childhoods caries**. 10% of MO leaf extract solution can hinder the development of plaque. [2,4] The roots of MO have been effective in treating odontalgia when applied directly to the tooth surface. Its antibacterial activity is responsible for its capacity to relieve toothache. [25] Therefore its antibacterial activity is known for its function to treat every tooth problem. A study conducted in china suggested that MO leaf powder and seed powder containing dentifrices showed prevention against all dental-related issues, especially mouth ulcer, tooth decay, and periodontal problems. [26] In conclusion, Moringa can be effectively used to prevent almost dental related problems. [27,2,4]

Curcuma Longa

C. longa can be used in the following ways for the alleviation of odontogenic pain.

- As mouth wash: 5g of *C. longa* powder in 200 mL hot water at 100 C is blended with dried leaves of Guava and clove. This combination has been shown to provide immediate relief from tooth pain.

- Paste form: One teaspoon of *C.longa* with iodized salt and mustard oil (half teaspoon) is mixed to form a paste, which is rubbed over the gums to provide relief from periodontal problems.[28]

The usage of turmeric has a beneficial action when it comes to pit and fissure sealants as it gives a yellowish tint to the pit and fissure sealants and prevents initial caries through its antibacterial properties.[28]

Another remarkable feature of turmeric is to impart colour to dental plaque which is usually colourless. They may be available as a dye, usually in solution or pill form, which is known to stain plaque and thereby allow for its detection.[28]

The essential oil extracted from *C.longa* shows inhibitory effects against cariogenic activities of *S. mutans*, at concentrations from 0.5-4 mg/ml.[28]

C.longa mouth rinse can be effectively used as an adjuvant in the mechanical removal of plaque. The concentration of Curcumin 10 mg, which is dissolved in 100 ml of water, is effective in reducing oral pathogens and reducing periodontal infection. The pH of such solutions dispensed as mouthwashes has been adjusted to 4, and a study has proven that this mouthwash is as effective as a chlorhexidine mouth wash.[28]

On comparison with the chlorhexidine group and saline group employed for supplemental therapy in individuals with periodontitis, Curcumin 1% as subgingival irrigant resulted in a substantial reduction in bleeding on probing and redness. They particularly target the anti-inflammatory mediators and cause shrinking by reducing edema and blood vessel expansion, making them more effective anti-inflammatory agents than chlorhexidine and saline.[28]

Biomechanical preparation (BMP) is a very important step to control infection in root canal treatment. The effect of turmeric as an intracanal medicament in the root canal was investigated and compared with Sodium Hypochlorite. The results highlighted the superiority of turmeric over NaOCl, which had the disadvantages of bearing an unpleasant flavour and had constricted antimicrobial action. [28]

The clinical pulp response and radiographic indicators following pulpotomy in four groups of primary molar teeth treated with formocresol (control), propolis extract, turmeric gel, and calcium hydroxide, respectively, were compared and evaluated in the study. To assess the effectiveness of the treatment, the patients were monitored for six months for clinical and radiographic indications and symptoms. All experimental groups demonstrated equivalent clinical and radiographic success rates when compared to the control (formocresol) group and the turmeric gel used in this study may present practical alternatives for paediatric endodontic therapy.[29]

Punica Granatum

Components of Pomegranate have different functions that might favor oral health along with decreasing the risk of gingival infection.[30]

Four weeks of mouth washing three every day, with the aqueous extract of Pomegranate altered salivary pH important to oral health. Different measures reduced overall protein (which led to plaque formation), faded properties of aspartate aminotransferase, attenuated α -glucosidase function, increased activity on antioxidant enzyme ceruloplasmin, and augmented free radical scavenging ability. Accordingly, pomegranate extracts in the oral health market, along with toothpaste and mouth rinse, can be a possible choice.[31] A study was conducted to show the effect of hydroalcoholic extract (HAE) from the fruit on dental plaque microflora. The effects were compared to the standard, which was chlorhexidine. The results showed antibacterial property in HAE towards some microflora which may be a potential substitute in plaque removal treatment.[31]

Results of another study implied that p granatum mouth rinse has an antiplaque effect. Moreover, it shows that the extract is valuable against *Porphyromonas gingivalis*, *Prevotella intermedia* strains and *Aggregatibacter actinomycetemcomitans*, strain in vitro. The end outcome endorsed that pomegranate mouth wash has to be studied further with its prophylactic advantages.[32]

Psidium Guajava

A tender leaf of Guava in the paste form has been used historically to obtain good oral hygiene. *Psidium Guajava* shows antimicrobial activities against different strains of cariogenic bacteria. The components in Guava which show antimicrobial activity is particularly attributed to flavonoids, guajaverin, and quercetin. The stem has also shown antimicrobial activity because of the concentration of tannins.[33]

The periodontal pathogens such as *Fusobacterium nucleatum* (Fn), *Porphyromonas gingivalis* (Pg), *Prevotella intermedia* (Pi), *Aggregatibacter actinomycetemcomitans* (Aa) are effectively inhibited by quercetin. It also shows antimicrobial properties against different cariogenic strains. Primary colonizers of teeth such as *Actinomyces*, *S. sanguinis*, *Streptococcus mitis* (*S. mitis*), and *S. sanguinis* showed lesser adherence to acquired pellicle with guava extracts had been applied.

Mouthwash possessing guava leaves extract possess a deep impact on inflamed gums. Piper beetle and Guava aqueous extract have been discovered to have antiplaque function through their effect on ultrastructure on bacterial species by way of interfering with the normal cell

cycle. The cytotoxic action of Guava may be beneficial in using Guava as an additive for the development of dental and oral health products. The extracts confirmed in vitro activity against plaque by inhibiting the enlargement, adhesion, and dental plaque bacteria co-aggregation. Guava extracts can hinder plaque formation without disturbing overall oral homeostasis. Therefore, as an extraordinary antibacterial and antiplaque agent, Guava can be a great addition to primary periodontal treatment.[33]

CONCLUSION

Globally, the usage of herbal medicine is still growing quickly. In many national healthcare contexts, many people increasingly use herbal medications or items for their health. Herbal extracts have been used in dentistry for a variety of purposes, including pain relief, inflammation reduction, antimicrobial plaque agents, histamine release prevention, antiseptic properties, antioxidant properties, antimicrobial properties, antifungal properties, and antibacterial properties. They also promote recovery and are successful in reducing microbial plaque in gingivitis and periodontitis, which boosts immunity.

The most affordable and reliable option to offer appropriate nutrition and treat and prevent a number of ailments is *Moringa oleifera*, *Curcuma longa*, *Punica granatum*, and *Psidium guajava*. Fortifying foods and preserving the use of traditional medicines may benefit from the secondary metabolites and increased concentrations of phytochemicals that go along with other vital ingredients. Therefore, rather than accepting bounties in exchange for food aid from wealthy nations, the poorer countries should encourage the planting and usage of *M. oleifera*.

Natural herbs and their preparations are less dangerous, and efficient dose forms can be employed to improve patient compliance in people. Numerous critical issues related to the use of natural remedies and their formulation, which are a more recent area of research, were highlighted in the majority of scientific papers issued by the WHO and other international health regulatory bodies.

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