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Review Article

Herbo-dentistry- A review

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Abstract

Phytotherapy is the study of the use of extracts from the natural origin as medicines or health-promoting agents. Plant products have long been used in dentistry as part of various dental materials right from impression materials to eugenol, which forms an integral part of the dental clinic. The use of herbs in dental practice is not limited to only material sciences. A single herb shows a variety of effects like anti-inflammatory, antibacterial, antifungal activity, and many more. Hence the incorporation of these herbs in dental practice will prove to be a valuable adjunct to dental treatment.

Introduction

Phytotherapy is the study of the use of extracts from the natural origin as medicines or health-promoting agents. Traditional phytotherapy is often used as a synonym for herbalism and regarded as alternative medicine [1]. The term "Phytodentistry" P implies the use of plants and their products in the process of treating disease directly or indirectly. A crucial role is played by phytotherapy in the treatment of stomatological problems.

It started with the use of miswak (chewing stick), and it is still relevant today as herbal toothpaste in many parts of the country. India is the largest producer of medicinal herbs and is appropriately called the botanical garden of the world. The use of this readily available, natural, and safe resource as a part of dental practice has great potential for a more "Natural and Green Dental Practice" [1].

Finding healing powers in plants is an ancient idea. Herbs have been used as a traditional form of medicine since time immemorial. The natural products derived from medicinal plants have proven to be an abundant source of biologically active compounds, many of which have been the basis for the development of new chemicals for pharmaceuticals [1].

Plant products have long been used in dentistry as part of various dental materials right from impression materials to eugenol, which forms an integral part of the dental clinic. The use of herbs in dental practice is not limited to only material sciences. A single herb shows a variety of effects like anti-inflammatory, antibacterial, antifungal activity, and many more. Hence the incorporation of these herbs in dental practice will prove to be a valuable adjunct to dental treatment [1].

Historical review and Indian system

Nature always stands out as an excellent representation to epitomize the outstanding marvel of symbiosis. Throughout the history of mankind, many infectious diseases have been treated with herbals. Finding healing powers in plants is an ancient idea. Medicinal plants play a vital role in the development of new drugs.

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Hippocrates, in the late fifth century BC, cited 300– 400 medicinal plants. In the first century AD, Dioscorides wrote De MateriaMedica, a medicinal plant catalog that became the prototype for modern pharmacopeias. The Bible offers descriptions of ~30 healing plants. It is also a fact that one-quarter of all medical prescriptions today are formulations based on substances derived from plants or plant-derived synthetic analogs, and according to the WHO, 80% of the world's population, primarily those of developing countries, rely on plant-derived medicines for their health care [2].

In this regard, India has a unique position in the world, where a number of recognized indigenous systems of medicine viz., Ayurveda, Siddha, Unani, Homeopathy, Yoga, and Naturopathy are being utilized for the health care of people. India is the largest producer of medicinal herbs and is called as botanical garden of the world [3].

According to Gurib-Fakim [3], there are four basic ways in which plants that are used by tribal peoples are valuable for modern medicine – Plants used as sources of direct therapeutic agents – Plants are also used as sources of starting points for the elaboration of semi-synthetic compounds – Plants can serve as sources of substances that can be used as models for new synthetic compounds. – Plants can also be used as taxonomic markers for the discovery of new compounds.

Review of dental applications

Endodontic irrigants: They are commonly used for root canal debridement as part of chemo-mechanical preparation. Local wound debridement in the diseased pulp space is the main step in root canal treatment to prevent the tooth from being a source of infection. Sodium hypochlorite solutions are recommended as the main irritants. This is because of their broad antimicrobial spectrum as well as their unique capacity to dissolve necrotic tissue remnants. In addition, chelating solutions are recommended as adjunct irrigants to prevent the formation of a smear layer and/or remove it before filling the root canal system [4]. Shovelton [5] presented 13 cases that had signs of emphysema of the face, the suborbital region, and neck. Also, sodium hypochlorite can lead to severe tissue reactions characterized by pain, swelling, hemorrhage, and potentially secondary infection or lasting paresthesia when injected beyond the dermis and into soft tissue. If the area becomes secondarily infected by pathogenic flora, there is a risk for sepsis and endocarditis. These chemical and toxicological concerns related to their use have renewed the interest in the search for newer alternatives [6].

The medicinal plants investigated as potential endodontic irrigants are chamomile, white tea tree, mustard tree, neem tree, Indian mulberry tree, and green tea extracts (GTEs). In addition, propolis, which is a resinous mixture that honeybees collect from tree buds, sap flows, or other botanical sources has also been investigated for endodontic purposes. Matricaria recutita and tea tree oil have been considered effective agents in removing the root canal smear layer. Both showed better properties than 2.5% sodium hypochlorite (NaOCl) and distilled water [7]. When a comparison of the cleaning effectiveness of chamomile hydroalcoholic extract and tea tree oil to 2.5% NaOCl solution as an intracanal irrigant for the removal of the smear layer was made, chamomile extract was found to be significantly more effective than distilled water and tea tree oil [8]. Also, a high antimicrobial activity of Salvadora persica extract against aerobic and anaerobic microorganisms was demonstrated at a 15% concentration [9]. Such antimicrobial effect of alcoholic extract of S. persica is believed to be due to its high chemical contents of chlorides, tannins, trimethylamine, Salvadoran, nitrate, thiocyanate, and sulfur [5]. Azadirachta indica is a common medicinal tree in India, which is considered holy. It is known for 2000 years as one of the most versatile medicinal plants having a wide spectrum of biological activity. In Sanskrit, it is called "arishtha" meaning reliever of sickness, and is regarded as the village dispensary of India [10].

In an *in vitro* study comparing the antibacterial efficiency of neem leaf extract and 2% sodium hypochlorite against Enterococcus faecalis, Candida albicans, and mixed culture, it was concluded that neem leaf extract has a significant antimicrobial effect against all the microorganisms. The use of neem as an endodontic irrigant might be advantageous because it is a biocompatible antioxidant and thus not likely to cause severe injuries to patients that might occur via NaOCl accidents [10]. Similarly, propolis and Morinda citrifolia juice were found to be effective against E. faecalis in the dentine of extracted teeth as antimicrobial irrigant [11]. Green tea polyphenols, the traditional drink of Japan and China, is prepared from the young shoots of the tea plant Camellia sinensis. The antimicrobial activity is due to the inhibition of bacterial enzyme gyrase by binding to the ATP-B subunit. Green tea exhibits antibacterial activity on E. faecalis pyknotic cells. It is also found to be a good chelating agent [12]. It is proven to be safe, containing active constituents that have beneficial physiologic effects apart from its curative property such as antioxidant, anti-inflammatory, and radical scavenging activity and may have an added advantage over the traditional root canal irrigants [13].

Propolis forms the bees' external immune defense system, making the beehive one of the most sterile environments known to nature. It is known that propolis exhibits several pharmacological properties such as antimicrobial, anti-inflammatory, healing, anesthetic, cytostatic and cariostatic properties [14]. The results of an *in vitro* analysis showed that the antibacterial activity of propolis against E. faecalis was between calcium hydroxide and chlorhexidine [15].

Propolis has been used as an intracanal medicament for endodontic purposes in various trials. It was found that propolis exhibited good *in vitro* antibacterial activity against E. faecalis in root canals, suggesting that it could be used as an alternative intracanal medicament [16,17]. Rezende, et al. evaluated the antimicrobial activity of two experimental pastes containing propolis extract associated with calcium hydroxide in primary molars of 4- to 8-year-old children. They concluded that the association between propolis and calcium hydroxide was effective in controlling dental infections *in vitro* [18]. Arctium lappa is a plant that is widely used in folk medicine all over the world for its well-known therapeutic applications. It has

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antibacterial and antifungal activity, diuretic, antioxidant and anxiolytic action, platelet anti-aggregating effect, and HIV-inhibitory action. In dentistry, A. lappa has been investigated due to its antimicrobial potential against oral microorganisms, specifically those associated with endodontic infections [11]. Pereira, et al. evaluated *in vitro* antimicrobial activity of rough extracts from leaves of A. lappa against E. faecalis, Staphylococcus aureus, Pseudomonas aeruginosa, Bacillus subtilis, and C. Albicans. They concluded that A. lappa constituents exhibited a great microbial inhibition potential against the tested endodontic pathogens [19]. Pulp-capping agents

There are various materials in routine use for pulp capping, the aim being to induce reparative dentinogenesis across the exposed pulp. Calcium hydroxide is generally accepted as the material of choice. Numerous researchers have advocated direct bonding of pulp exposure although this remains controversial [20]. Herbal products may also be a viable option for pulp capping. Propolis is the most investigated plant product in this regard. Parolia, et al. investigated the response of human pulp tissues that were mechanically exposed to propolis and compared it with two existing and commonly used pulp capping agents [mineral trioxide acetate (MTA) and Dycal]. There was more pulp inflammation in teeth treated with Dycal than with propolis and MTA on the 15th as well as on the 45th day. Propolis and MTA showed bridge formation in more teeth, and the bridges were in closer proximity to pulp-capping material than teeth treated with Dycal on the 45th day. The response of pulps to propolis as a pulp capping agent was comparable to MTA and Dycal [21].

Retreatment agents: Eucalyptus oil and orange oil were reported as being as effective as chloroform and xylene to dissolve or soften gutta-percha. Orange oil is readily available, inexpensive, and displays a solvent effect that is close to that of chloroform. In addition, it has antimicrobial activity. Orange solvent has the advantage over other plant-derived solvents such as eucalyptus oil in that its viscosity is closer to that of water and it can thus easily be administered through an endodontic irrigating syringe. In addition, the orange solvent has a pleasant smell, which is easily acceptable to patients [22,23].

Dental traumatology

Dental avulsion is a traumatic injury characterized by the complete displacement of the tooth from its socket, with damage to the periodontal ligament, cementum, alveolar bone, gingival, and pulp tissues. The most indicated procedure for this kind of dental trauma is re-implantation, which is a surgical technique consisting of reinserting a tooth in its socket after it has been extracted on purpose or accidentally [24].

Healing following avulsion and replantation is dependent on the extent of pulpal and periodontal ligament tissue damage. Therefore, immediate replantation is the recommended treatment of choice for an avulsed permanent tooth. To achieve a more favorable prognosis following tooth replantation, the use of an appropriate interim transport medium is usually advocated. Numerous studies have researched and advocated the use of media like saliva, milk, Hank's balanced salt solution (HBSS), and ViaSpan. However, current research has indicated the use of newer herbal agents as promising interim transport media for an avulsed tooth [25]. The plant-based herbal media in this regard includes propolis, red mulberry juice, garden sage extracts, coconut water, and GTEs.

Ozan, et al. determined the ability of the juice of Morus rubra fruit to serve as a temporary storage medium for the maintenance of PDL cell viability of avulsed teeth. Results showed that the efficacy of 4.0% and 2.5%M. Rubra at 3, 6 and 12h was found to be significantly better than HBSS. At 24h, 4% M. Rubra was found to be similar to HBSS. Thus the results showed that juice of the fruit sample of M. rubra studied at a concentration of 4% was a more effective storage medium than other groups. Hence the juice of the fruit of M. Rubra can be recommended as a suitable transport medium for avulsed teeth [26].

Polat, et al. determined the ability of Salvia officinalis extracts to serve as a storage medium for the maintenance of PDL cell viability of avulsed teeth. The results showed that 2.5% S. Officinalis was a more effective storage medium than the other experimental solutions [27]. In another investigation, skimmed and whole milk, followed by natural coconut water and HBSS, were the most effective media in maintaining the cell viability of PDL fibroblasts.

GTE has been reported to have remarkable anti-inflammatory, antioxidant and anticarcinogenic effects. Hwang, et al. investigated *in vitro* the efficacy of GTE as a storage medium for avulsed teeth. The result indicates that there was no difference in cell viability between GTE and HBSS media, whereas GTE showed higher cell viability than other media. Thus, the efficacy of GTE in maintaining the viability of human PDL cells is similar to that of HBSS and higher than that of milk. Therefore, it was concluded that GTE could be a suitable, alternative storage medium for avulsed teeth [28].

Dental caries prevention: It is postulated that the phytomedicines aid in dental caries prevention as well as treatment by combating bacteria through various modes as follows [29].

1. Inhibitors of bacterial growth – Inhibitors of acid production and acidurance
2. Inhibition of exopolysaccharide synthesis
3. Inhibition of bacterial adherence
4. Increase the susceptibility of the microorganism through the action of secondary metabolites.

Chen, et al. examined the effects of filtered garlic extracts on the acid production and the growth of S. mutans. Results showed that garlic extracts could enhance the rate of acid production and inhibit the growth of S. mutans. They concluded that despite the stimulation of acid production, garlic might prevent dental caries by the stimulation of salivary secretion

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and inhibition of bacterial growth in the oral cavity. Thus, garlic may have the potential to prevent dental caries [30].

Rasooli, et al. assessed the antimicrobial and biofilm formation preventive properties of Mentha piperita and Rosmarinus officinalis essential oils and chlorhexidine against S. mutans and Streptococcus pyogenes. The minimal bactericidal concentrations of the M. Piperita and R. officinalis oils and chlorhexidine were 6,000, 2,000, 8,000ppm, and 1,000, 4,000, 1,000ppm for S. mutans and S. pyogenes, respectively [31].

Kim, et al. evaluated the antibacterial effects of turmeric on an S. mutans biofilm by examining the bactericidal activity, inhibition of angiogenesis, and morphological alteration. It showed a similar bactericidal effect to that of chlorhexidine but the dose of turmeric was one-twentieth that of chlorhexidine. Turmeric has strong bactericidal activity, inhibitory effects on acidogenesis, and alters the microstructure of S. mutans biofilm. Thus, turmeric has the potential to be anti-S. mutans therapy for the prevention of dental caries [32].

These include: – a direct bactericidal effect against S. mutans and S. sobrinus; – prevention of bacterial adherence to teeth; – inhibition of glucosyltransferase, thus limiting the biosynthesis of sticky glucan; – inhibition of human and bacterial amylases. Studies in animal models show that these *in vitro* effects can translate into caries prevention. A limited number of clinical trials in men suggest that regular tea drinking may reduce the incidence and severity of caries. If substantiated, this could offer a very economical public health intervention [33].

Libério, et al. reviewed the *in vitro* and *in vivo* effects of propolis on S. mutans growth, bacterial adherence, glucosyltransferase activity, and caries indicators. Investigations carried out with crude propolis extracts, isolated fractions, and purified compounds showed reductions in S. mutans counts and interference with their adhesion capacity and glucosyltransferase activity, which are considered major properties in the establishment of the cariogenic process [34].

Vanka, et al. evaluated the antibacterial effect of neem mouthwash against salivary levels of S. mutans and lactobacillus tested for 2 months. Also, its effect in reversing incipient carious lesions was assessed. Results showed that S. mutans were inhibited by neem mouthwashes, with or without alcohol as well as chlorhexidine [35].

Herb based dental materials

Traditional herbs have an array of applications as biomaterials. Almost all modern dental materials have their roots in these phyto compounds. The commonly used materials in the routine dental practice of herbal origin include zinc oxide eugenol cement, impression materials (agar-agar and alginate), gutta-percha root canal filling material, citric acid, camphorated monochlorophenol medicament and thymol [2].

Herbs acting on oral mucosal lesions

Mucosal lesions include gingivitis, aphthous ulcers, thrush, and various bacterial and viral lesions. Many of these conditions are self-limiting; consequently, herbal treatments are generally palliative in character. A variety of herbs are found to have a beneficial effect on the treatment of these lesions like Aloe vera, rhatany, gum myrrh, licorice, myrtle, coriander, garlic, clove, and so on.

It has been reported that A. vera gel accelerates the healing of aphthous ulcers and reduces the pain associated with them. Ninety patients with histories of recurrent aphthous ulcers were separated into three groups, with each group receiving a different treatment (either acemannan hydrogel i.e. A. vera, freeze-dried acemannan hydrogel, or an unspecified over-the-counter product as an active control) four times a day. The groups using acemannan hydrogel in either form healed faster than those using the over-the-counter remedies. The report noted that compared with other remedies for aphthous ulcers, the acemannan hydrogel did not have the disagreeable taste and texture associated with traditional therapies and did not sting when applied [2].

Moghadamnia, et al. evaluated the efficacy of licorice bioadhesive hydrogel patches to control the pain and reduce the healing time of recurrent aphthous ulcers. Licorice patches caused a significant reduction in the diameter of the inflammatory halo and necrotic center compared with the placebo group. According to the results of this study, a licorice bioadhesive hydrogel patch can be effective in the reduction of pain and the inflammatory halo and necrotic center of aphthous ulcers [36].

The clinical efficacy of a paste containing Myrtus communis (Myrtle) in the treatment of recurrent stomatitis was evaluated. The data indicated a significant reduction in ulcer size, pain severity, erythema, and exudation level with the paste. Also, the patients' overall assessment of treatment improved after applying a paste containing myrtle. No side effects were reported [2].

Mazzanti, et al. evaluated the antiviral activity of a hydroalcoholic extract of lemon balm. It was found that the cytopathic effect of the herpes simplex virus (HSV-2) was reduced with the use of lemon balm. The maximum inhibiting effect (60%) was obtained with 0.5 mg/mL. The authors support the use of lemon balm for treating herpes simplex lesions and encourage clinical trials on this medicinal plant [37].

Similarly, Schuhmacher, et al. examined the virucidal effect of peppermint oil against the herpes simplex virus. The 50% inhibitory concentration of peppermint oil for herpes simplex virus plaque formation was determined to be 0.002% and 0.0008% for HSV-1 and HSV-2, respectively. Peppermint oil exhibited high levels of virucidal activity against HSV-1 and HSV-2 in viral suspension tests. Considering the lipophilic nature of the oil that enables it to penetrate the skin, peppermint oil might be suitable for topical therapeutic use as a virucidal agent in recurrent herpes infection [38].

Hosseini, et al. evaluated the effectiveness of purslane in the treatment of oral lichen planus (OLP). Approximately 83% of the purslane patients showed partial to complete clinical

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improvement but 17% had no response. A partial to complete response was observed in all purslane-treated patients. According to these findings, purslane is clinically effective in the treatment of OLP [39,40].

Periodontal uses

The prevention of gingivitis by daily and effective supragingival plaque control using toothbrushing and dental floss is necessary to arrest a possible progression to periodontitis. Although mechanical plaque control methods have the potential to maintain adequate levels of oral hygiene, clinical experience, and population-based studies have shown that such methods are not being employed as accurately as they should by a large number of people. Therefore, several chemotherapeutic agents such as triclosan, essential oils, and chlorhexidine have been developed to control bacterial plaque, aiming at improving the efficacy of daily hygiene control measures. The interest in plants with antibacterial and anti-inflammatory activity has increased as a consequence of current problems associated with the wide-scale misuse of antibiotics that induced microbial drug resistance. Natural products such as Astronium urundeuva, Calendula, A. vera, Curcuma zedoaria, and other herbal products have been tested with effective results.

A wide range of antimicrobial agents and herbal products are added to dentifrice and mouth rinsing solutions to prevent caries or biofilm formation. Among the herbal products available in the market today, Parodontax® (GlaxoSmithKline, Middlesex, UK) has been widely tested in dentistry [2].

Besides sodium bicarbonate and sodium fluoride (1,400 ppm), it contains the following herbal products: Matricaria chamomilla (Asteraceae) has anti-inflammatory properties that reduce gingival inflammation; Echinacea purpurea (Asteraceae) stimulates immune response; S. officinalis (Lamiaceae) has antihemorrhagic properties; Commiphora myrrha (Burseraceae) has natural antiseptic properties and M. Piperita (Lamiaceae) has analgesic, antiseptic and anti-inflammatory properties. Ozaki, et al. reported that both Parodontax® and a triclosan dentifrice were effective in reducing plaque and gingival indices.

Pistorius et al. reported a significant reduction in the gingival index for an herbal-based mouth rinse containing S. Officinalis, M. Piperita, menthol, M. chamomilla, C. Myrrha, Carum carvi (Umbelliferae), Eugenia caryophyllus (Myrtaceae) and E. purpurea. They concluded that the mouth rinse could be used daily in patients with periodontal diseases as an adjunctive procedure to reduce gingival inflammation. The commonly investigated phytomedicines in this regard are medicinal aloe, bloodwort, neem tree, mustard tree, pomegranate, and Indian gum tree [2].

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