Review Article

Herbal Extracts in Endodontics

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Abstract

Endodontic treatment involves removal of infected tissue and microorganisms from within the root canal to prevent further infection of the periradicular tissues and to aid in healing of these tissues. This critical process involves the use of some chemical substances for disinfection of the root canal space. Herbal products have been used since ancient times in folk medicine. Many plants with biological and antimicrobial properties have been studied since there has been a relevant increase in the incidence of antibiotic resistance and toxicity. In dentistry, phytomedicines have been used as anti-inflammatory, antimicrobial, and antioxidant agents. In endodontics, trend of recent medicine to use biologic medication extracted from natural plants is seen because of the cytotoxic reactions of the most of the commercial intracanal medicaments and irrigants used and their inability to eliminate bacteria from dentinal tubules. This study gives a brief review of potential herbal extracts that can be applied in endodontics.

Keywords: *Endodontics, herbal extracts, intracanal, irrigants*

Introduction

An important objective of root canal treatment is to clean the root canal system thoroughly, free of microbiota and debris, so that it can be sealed with a microbial-tight filling. This process mainly revolves around a process called "chemomechanical preparation", wherein chemically active solutions are used along with mechanical instrumentation of the root canal space.[1] The most commonly used irrigant for this process is sodium hypochlorite (NaOCl) in concentrations ranging from 1% to 6%. It has outstanding antimicrobial potency and unique ability to dissolve pulp which makes it as the first choice of irrigant.[2] Along with NaOCl, other acidic substances are used to remove the smear layer consisting of dentin particles embedded in an amorphous mass of organic material that forms on the canal walls during instrumentation procedure.[3] Removing this layer consists of attached microbiota and their toxins from root canal walls which has to be removed and thus reducing the potential for bacterial survival and reproduction.[4] Calcium-chelating agents such as ethylenediaminetetraacetic acid (EDTA) or citric acid are used for smear layer removal purpose.

The undesirable properties of NaOCl include the unpleasant taste, toxicity, and its inability to remove the smear layer by itself, as it dissolves only organic material. However, many studies have shown the limited antimicrobial effectiveness of NaOCl *in vivo* which is also a major drawback. This may be attributed to lesser penetration ability to the most peripheral parts of the root-canal system such as fins, anastomoses, apical canal, lateral canals, and dentin canals. Recently, it has been concluded by *in vitro* studies that there is a detrimental effect on dentin elasticity and flexural strength on long-term exposure of dentin to high concentrations of NaOCl, thereby predisposing the tooth to vertical fracture, which has a hopeless prognosis.[5,6] All these drawbacks along with resistant strains being reported have prompted researchers to look for herbal alternatives.

Recently, dental treatment has a growing trend to seek natural remedies[7] and this approach may be termed phytotherapeutics or ethnopharmacology. This study provides a brief review of various herbal alternatives that are being researched for potential endodontic applications.

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Morinda Citrofolia

Morinda citrifolia (MC) (noni) is one of the traditional folk medicinal plants that have been used for over 2000 years in Polynesia.[8] It has been reported to have a broad range of therapeutic and nutritional value. noni is the common name for MC and is also called Indian mulberry, ba ji tian, nono or nonu, cheese fruit, and nhau in various cultures worldwide. It has been reported to have a broad range of applications against cancer, infection, arthritis, diabetes, asthma, hypertension, and pain. The roots, stems, bark, leaves, flowers, and fruits of the noni plant are all used in various combinations for herbal remedies.[9] The components identified in the MC plant are scopoletin, octoanoic acid, potassium, Vitamin C, terpenoids, alkaloids, anthraquinones (such as nordamnacanthal, morindone, rubiadin, and rubiadin-1-methyl ether, and anthraquinone glycoside), G-sitosterol, carotene, Vitamin A, flavone glycosides, linoleic acid, alizarin, amino acids, aucubin, L-asperuloside, caproic acid, caprylic acid, ursolic acid, and rutin.[10] These compounds have shown potency against infectious bacteria strains such as *Pseudomonas aeruginosa*, *Proteus morganii*, *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli*, *Salmonella*, and *Shigella*.[11,12]

The effectiveness of extract of MC with NaOCl and chlorhexidine (CHX) to remove the smear layer from root canal walls of instrumented teeth was compared and concluded that MC was as effective as NaOCl along with EDTA as an intracanal irrigant.[13] In another study, it was concluded that propolis and MC were effective against *Enterococcus faecalis* (*E. faecalis*) in dentin on extracted teeth when compared with 2% CHX gel, propolis, and calcium hydroxide as intracanal medicament.[14] MC appears to be the first juice to be identified as a possible alternative to the use of NaOCl as an intracanal irrigant.

Triphala

Triphala, an Indian ayurvedic herbal formulation, is a combination of three medicinal plants, namely *Terminalia bellerica*, *Terminalia chebula*, and *Emblica officinalis*. It has proven antioxidant, anti–inflammatory, and radical scavenging activities.[15] Triphala was similarly effective as NaOCl and a doxycycline-based irrigant on root canal biofilms that were 3 weeks old. Moreover, Triphala has chelating action due to the presence of fruits rich in citric acid and thus may aid in the removal of smear layer.[16]

Turmeric

Turmeric (*Curcuma longa* [*C. Longa*]) is extensively used as a spice, food preservative, and coloring material in India, China, and Southeast Asia. It has been used in traditional medicine for the treatment of numerous diseases. *C. Longa* is botanically related to ginger (*Zingiberaceae* family). It is a perennial plant having a short stem with large oblong leaves and bears ovate, pyriform, or oblong rhizomes, which are often branched and brownish yellow in color. It is also considered as auspicious and is a part of religious rituals. In old Hindu medicine, it is extensively used for the treatment of sprains and swelling caused by injury.[17] In recent times, traditional Indian medicine uses turmeric powder for the treatment of biliary disorders, anorexia, cough, diabetic wounds, hepatic disorders, rheumatism, and sinusitis. The coloring principle of turmeric is the main component of this plant and is responsible for the anti-inflammatory property.[18]

Curcumin (diferuloylmethane), the main yellow bioactive component of turmeric, has antimicrobial, anti-inflammatory, and antioxidant activities.[19] The components of turmeric are named curcuminoids (curcumin [diferuloylmethane], demethoxycurcumin, and bisdemethoxycurcumin). These components are polyphenols with a strong antioxidant function.[20] Curcumin is responsible for the biological activities of turmeric. It has been hypothesized that curcumin inhibits the assembly of a protein-filamenting temperature-sensitive mutant Z (FTSZ) protofilaments and also increases the GTPase activity of FTSZ. The perturbation of the GTPase activity of FTSZ assembly is lethal to bacteria.[21] For an irrigant to be effective against biofilms, the action on biofilms should involve the elimination of the extracellular polymeric substance matrix as well as the bacteria because this matrix could act as an additional source of nutrients and/or as a suitable surface for further cell growth.[22]

Curcumin in aqueous preparations exhibits phototoxic effect against Gram-positive and Gram-negative bacteria.[23] Many studies have focused on the *in vitro* phototoxic effect of curcumin in various aqueous preparations against Gram-positive *E. faecalis* and Gram-negative *E. coli* bacteria.[24] Curcumin in surfactant preparations showed its potential as a photosensitizer (PS) in antibacterial photodynamic therapy *in vitro*. The killing effect depended on curcumin concentration, radiant exposure, postirradiation incubation time, bacteria species, and pharmaceutical preparation. The exact mechanism by which curcumin causes light-induced cell death has not yet been established, but it is generally accepted that a prerequisite for photosensitization of a microbial cell is the binding of the PS to the outer membrane.[25]

Licorice

Licorice is the crude drug and flavoring agent that is commonly used in Kampo medicines (traditional Chinese medicines modified in Japan).[26] Liquorice is known for its anti-inflammatory, antiviral, and anticarcinogenic activities.[27] The growth and adherence (plaque formation) of the cariogenic bacteria *Streptococcus mutans* were markedly inhibited by liquorice.[28] Licorice extract exhibited a more profound activity in both adherence and anti-bacterial assays than that of glycyrrhizin.[29,30]

Glycyrrhizin, a triterpenoid compound, imparts the sweet taste of licorice root. This compound has a mixture of potassium-calcium-magnesium salts of glycyrrhizic acid that varies within a 2%–25% range. Among the natural saponins, glycyrrhizic acid is a molecule composed of a hydrophilic part, two molecules of glucuronic acid and a hydrophobic part, glycyrrhetic acid.[31] The antimicrobial effect of licorice extract against *E. faecalis* may be related to the glycyrrhizin. The antibacterial effect of saponins involve membranolytic properties.[32] The flavonoid content of licorice extract is also a strong inhibitor of oxygen consumption in bacterial cells; the site of inhibition is thought to be between CoQ and cytochrome C in the bacterial respiratory electron transport chain.[33]

The biocompatibility of licorice was good with fibroblast cells when compared to calcium hydroxide, which was severely toxic to the cells. This may be due to the presence of pentacyclic triterpenoid structure, which may resemble the phospholipid bilayer of the cell in containing polar (hydrophilic moiety) and nonpolar (hydrophobic moiety) components. The licorice extract has a slight acidic pH 6, while calcium hydroxide is a very polar and strong alkali (pH 12).[34]

Propolis

Propolis is a resinous material that are collected by honeybees (*Apis mellifera* L.) from various tree buds to fix honeycombs. Many researches have proved its antioxidant, antibacterial, antifungal, antiviral, anti-inflammatory, antitumor, and immune-modulating properties.[35] At present, research involving propolis in dentistry includes many fields and highlights its antimicrobial and anti-inflammatory activities, particularly in cariology, oral surgery, pathology, periodontics, and endodontics.[36,37]

The chemical composition of this atoxic natural substance is complex. Flavonoids and cinnamic acid derivatives have been considered as the main primary biologically active components.[38] Propolis exhibits pharmacological properties such as antimicrobial, anti-inflammatory, healing, anesthetic, cytostatic, and cariostatic properties. Inhibition of hyaluronidase activity was exhibited by ethanolic extract of propolis in a study and hence has great potential as an anti-inflammatory agent.[39]

In dentistry, propolis has been used for the treatment of aphthous ulcers, *Candida albicans*, acute necrotizing ulcerative gingivitis, gingivitis, and periodontitis and, recently, as a storage medium for avulsed teeth to maintain the viability of the periodontal ligament cells. The anti-inflammatory property of propolis is due to the presence of caffeic acid and phenethyl ester. Ethanol extract of propolis presents good properties for endodontic use, such as promoting bone regeneration and inducing hard tissue bridge formation in pulpotomies or pulp capping. Propolis can serve as a better intracanal irrigant and intracanal medicament as it has good antimicrobial and anti-inflammatory properties.[40,41]

Propolis was effective in eliminating the microorganisms when used as an intracanal medicament along with calcium hydroxide.[14]

Tea Tree Oil

Tea tree (*Melaleuca alternifolia*) is a native Australian plant. The oil of tea tree has many properties that favor its use in dentistry. It has antiseptic and antifungal properties. It also has mild solvent action and hence might have potential applications in root canal treatment for dissolving the necrotic pulp tissue. Tea tree oil's major active component is terpinen-4-ol (typically 30%–40%) which is responsible for its antibacterial and antifungal properties. *In vitro* studies have shown that tea tree oil is as effective as NaOCl. Further, the toxicity of tea tree oil is lesser than NaOCl.[42,43]

Neem

Azadirachta indica A. Juss is a common medicinal tree seen in India, which is considered holy. Popularly known as "Indian neem/Margosa tree" or "Indian lilac," known for more than 2000 years as one of the most versatile medicinal plants having a wide spectrum of biological activity. Neem is entitled as "a tree for solving global problems" by the US National Academy of Sciences.[44] Each part of the neem tree has some medicinal properties and is thus commercially exploitable. The crude extracts and their different fractions from its leaf, bark, flowers, roots, seed, and oil have various biologic activities and pharmacologic actions.[45]

The medicinal properties include antibacterial, antifungal, antiviral, antioxidant, anti-inflammatory, antipyretic, analgesic, and immune stimulant activity.[46] It also has an anti-adherence activity by altering bacterial adhesion and colonizing ability.[47] It has been shown that neem is highly effective in the treatment of periodontal disease.[48]

Use of neem as an endodontic irrigant might be advantageous because it is a biocompatible antioxidant and thus not likely to cause the severe injuries to patients that occurs when NaOCl is used.[48] Bitter taste associated with this plant can be altered by different formulations due to addition of sweeteners and flavors to increase the patient compliance.[46] A study showed significant differences in the zone of inhibition of diameters of neem extract and 2% NaOCl against *E. faecalis* and mixed culture.[49]

Conclusion

Literature has concluded that many plant extracts have potential endodontic application. However, most of the researches are *in vitro* or *ex vivo*. These compounds should be subjected to animal and human studies to determine its effectiveness, biocompatibility, and drug interactions.

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Conflicts of interest

There are no conflicts of interest.

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