Botanicals in endodontics: A review

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Abstract

Herbs and other natural products are used for various medicinal purposes. Alternative therapies are used to treat various diseases to combat side effects of allopathic medicine. Most of the herbal preparations are derived from leaves, root, seeds, and flowers. These preparations have a variety of uses in dentistry. This review article aims at a comprehensive overview of natural products used in endodontics as chelating agents, root canal irrigants, as storage media of avulsed tooth and various other uses.

Introduction

Since ancient times, herbs are used for many medicinal purposes. There has been an increase in antibiotic misuse and resistance of microorganisms to them. Hence, many plants with biological and antimicrobial properties have gained importance. Medicinal plants are seen to be a potential source of phytotherapy drugs and molecules.[¹]

According to the WHO, herbal medicine is defined as plant derived material or preparation which contains raw or processed ingredients from one or more plants with therapeutic values. Herbal preparations that are derived from various sources such as roots, seeds, leaves, stem, and flowers have been used in dentistry as anti-inflammatory, antibiotic, analgesic, sedative, and also as endodontic irrigants. Vast numbers of microorganisms have been inhabitants of oral cavity and in anatomic irregularities of the root canal system. Chemomechanical preparation of root canal reduces the number of bacteria; medicaments are required to reduce the microbial count in the root canal. This article makes an effort to understand the various alternative medicine products in endodontics.

Ethnopharmacology

Morinda citrifolia (Indian Mulberry, Noni, Nono, Ba Ji Tian, Cheese fruit, Nonu, Nahu)

Commonly available as noni, this is indigenous to tropical countries. Noni juice has found to have broad range of therapeutic effects. These include antibacterial, anti-inflammatory, antiviral, analgesic, hypotensive, antitumor, antihelminthic, anti-inflammatory, and immune-enhancing effects.[²] Major components identified in these plants are scopoletin, vitamin C, octanoic acid, potassium, L-asperuloside, terpenoids, alkaloids, alizarin, anthraquinones, vitamin A, carotene, linoleic acid, amino acids, caproic acid, caprylic acid, rutin, and putative proxeronine. These compounds are shown to be effective against bacterial strains such as Pseudomonas aeruginosa, Staphylococcus aureus, Bacillus subtilis, Proteus morganii, Escherichia coli, Salmonella, and Shigella. In a study which compared antimicrobial activity of 2% chlorhexidine (CHX) gel, propolis, M. citrifolia, and Ca(OH)₂ on Enterococcus faecalis, it was concluded that M. citrifolia and propolis was effective against E. faecalis.[³]
Propolis (propolis resin, bee glue)

It is believed that Aristotle is the person who has coined the term propolis. The word propolis (Greek word) means “before the city” or “defender of the city.” Propolis is a resinous mixture of tree buds, sap flows or other botanical sources that honey bees collect. Location, season, and vegetation of the area from which propolis is extracted influence, the composition and biological activity.[4] Once the propolis is collected, the bees mix it with wax flakes and their saliva in the hive. Beehive is the most sterile environment because propolis forms the external immune defense system.[5]

Pharmacologically active components in propolis are phenolics, aromatics, and flavonoids. The compounds in propolis are resin and balsam (50-70%), essential oil, sand wax (30-50%), and pollen (5-10%). The other components found in propolis are amino acids, minerals, vitamin A, B complex, and E. A highly active biochemical substance known as bioflavanonoid (vitamin P) is also found.[6] It has anti-inflammatory, antimicrobial, antioxidant, anesthetic, and cytotoxic properties. Caffeic acid and phenethyl ester in propolis give anti-inflammatory property. In endodontics, propolis has been used as intracanal medicament and also as an endodontic irrigant.[7]

Propolis is used as a storage medium for avulsed teeth, to maintain the viability of periodontal ligament cells. Caffeic acid and phenethyl ester in propolis impart anti-inflammatory properties. Ethanol extract of propolis promotes bone regeneration and induces hard tissue bridge in pulpotomies or pulp capping cases.[5]

Antibacterial activity of propolis was compared against CHX and Ca(OH)₂, against E. faecalis. It was concluded that propolis samples were antimicrobially effective; however, it did not exceed CHX.[7]

Aloe barbadensis miller (Aloe vera)

A. vera belongs to Liliaceae family which contains about 360 species. It grows in hot and dry climate.[3] Leaves of the A. vera plant contain clear gel. A. vera juice that is used is produced by the green part of the leaf that surrounds the gel. Main chemical constituents in this gel are aloins, anthaquinoine, and barbadoins. A. vera gel has inhibitory effect on Streptococcus pyogenes and E. faecalis.[3] Studies have shown greater antimicrobial efficacy in endodontics;[9] however, some studies have shown its antimicrobial effect to be lesser than calcium hydroxide.[10]

Azadirachta indica (Indian neem, Indian lilac or margosa tree)

In Sanskrit, it is called “arishtha” meaning “reliever of sickness.”[11] Active ingredients isolated are nimboline, nimbim, nimbidinon, nimbin, and nimbidic acid.[12] Neem extract alters bacterial adhesion and prevents microbial colonization.[5] This product is effective against Candida albicans and E. faecalis. Antioxidant and antimicrobial properties make it a potential agent as an alternative to sodium hypochlorite for root canal irrigation.[13] Bitter taste of this solution can be altered by addition of sweeteners and flavors.[5]

Zingiber officinale (ginger)

This is a herbaceous plant to which turmeric and cardamom also belong. The extract of Z. officinale is used as intracanal medicament. The analgesic, healing, and anti-inflammatory activity are due to the presence of volatile oils, Gingerol, and Shogoal. Gingerol inhibits the production of prostaglandins E2, interleukin-1β, cyclogegnase-2, and nitric oxide synthesis stimulated by LPS, which helps in treating chronic inflammation.[14]

Cinnamomum zeylanicum (true cinnamon)

This is obtained from Lauraceae family. It has anti-inflammatory, analgesic, and analgesic properties. The yellow-colored essential oil extracted has its antimicrobial property because of the presence of cinnamaldehyde. The essential oil is obtained from cinnamon bark. In endodontics, it is used as root canal irrigant. The active ingredient which causes antibacterial activity is cinnamaldehyde compound. It causes microbial cell death by inhibiting amino acid decarboxylation activity in the cell leading to energy deprivation.[15]

Curcuma longa Linn (turmeric)

Curcumin is a member of ginger family. The active constituents found are flavonoid curcumin, tumerone, atlantone, and zingiberone. Curcumin is effective against E. faecalis, streptococcus intermedius, and E. coli. In a study comparing the efficacy of curcumin and sodium hypochlorite, it was concluded that the antibacterial activity was similar to sodium hypochlorite.[12]

Acacia nilotica (babool, gum Arabic tree)

This species is native to Indian subcontinent and Africa. It has good antimicrobial, antioxidant, antifungal, and antimicrobial activity.[6] Babool is antibacterial against Streptococcus mutans and E. faecalis. Active ingredients which have antimicrobial action are phenolics compounds, tannins, essential oil, and flavonoids.[3]

Acacia catechu wild

The heartwood and bark of tree are used for its medicinal purposes. Active ingredients are catechin, eocatechin, epigallocatechin, gallocatechin, gallate, phloroglucin, protocatechuic acid, quercetin, procyanide, kaempferol, D-galactose, and epicatechin. These have a significant antioxidant and antimicrobial effects. This has been used in endodontics as it was found to be effective against E. faecalis.[16]

Arctium lappa Linn (greater burdock)

Roots, seeds, and immature flower stalks may be used for medicinal purposes. The active ingredients found are mulcilage, polyacetylenes, guaianolide, arctin, and lignans. It has
antibacterial, antifungal, antioxidant, and effect. Because of the antimicrobial action, it is used as an intracanal medicament in endodontics.

**Orange oil**

Orange oil is an essential oil produced by the rind of orange fruit. It is composed of mostly d-limonene (90%), and octanal which is a long chain aliphatic hydrocarbon alcohols and aldehydes. In endodontics, it is used as an alternative to xylene or chloroform for gutta-percha and root canal sealer softening, thus helping in nonsurgical endodontic retreatment.

*Psidium guajava* Linn (guava)

The essential oil is obtained from the fruits and leaves. It is rich in cineol, triptenens, tannins, and flavonoids. A very high amount of antimicrobial activity is seen especially against *E. faecalis* from its ethanol extract.

**Carvacrol**

Present as a thymol isomer in essential oil of *Origanum vulgare* (oregano). It has antibacterial activity by increasing the permeability of bacterial cell membranes nonselectively. It makes microorganisms sensitive to antimicrobial agents. The presence of phenolics components in carvacrol helps in repair of periapical tissues. This stimulates pulpal fibers through phenomena known as hormesis.

**Allium sativum** Linn (raon – garlic)

Alliiin a compound in garlic is a sulfur containing compound.[3] The medicinal effects and pungent odor is because of the presence of sulfur compounds.[11] This compound is converted to active ingredient “allicin” when crushed.[3] Allicin is an unstable compound formed from alliiin. Allicin exhibits antimicrobial action because of its action with thiol groups on various enzymes.[11] The cell wall and cell membrane of root canal bacteria are destroyed in the presence of allicin. Studies have been done where this is used as an irrigant alternative to sodium hypochlorite.

**Camellia sinensis** (chai-tea)

This is a traditional drink of China and Japan, prepared from tea plant shoots *Camellia sinensis*. Microbiologically active ingredients found in green tea are catechins and flavins.[3] Catechins present are catechin, epicatechin gallate, epicatechin, epigallocatechin, and epigallocatechin-3-gallate. The unfermented tea has antioxidative properties. This property is imparted by the presence of polyphenols in the leaves. Both green and black teas have been used for its medicinal qualities.[3] Catechins affect membrane dependent cellular process such as cell cycle, signaling, arachidonic acid metabolism, and mitochondrial functionality. Cell membrane of the bacteria has a bilipid layer to which epigallocatechin gallate binds and causes lipid vesicles aggregation. This causes leakage of cell contents. This leads to membrane expansion, membrane thinning, and loss of cell structure leading to cell death. Catechins inhibit DNA gyrase enzyme and thus interferes with DNA replication process.[12] The effectiveness of green tea polyphenols has been studied against *E. faecalis*.[3]

**Triphala**

Three medicinal plants *Terminalia bellerica*, *Terminalia chebula*, and *Emblica officinalis* constitute the Indian Ayurvedic formulation Triphala. These are obtained from dried and powdered fruits of the above-mentioned herbs. These agents have anti-inflammatory, antioxidant, and radical scavenging activity. The citric acid present in the fruit helps in removal of smear layer and thus can be used as a chelating agent. It can also be used as an alternative to sodium hypochlorite as a root canal irrigant because of its medicinal properties.[5]

**Meswak**

This is a medicinal plant, *Salvadora persica*, wherein the roots, twigs or stems have been used for oral hygiene purposes. Studies have shown that 15% alcoholic extract of Meswak has antimicrobial effect similar to sodium hypochlorite and CHX.[6]

**Rhus lancea** (Searis lancea, L.f.) F.A. Barkley

Commonly known as African sumac, it is one of the most commonly found trees in South Africa. The active ingredients found are gallic tannins and gallic acid. These exhibit antibacterial, antifungal, antioxidant, and bactericidal properties. It has been found that gallic acid reduces periapical inflammation. The water extract of the plant is seen to help in opening up of blocked dentinal tubules.[3]

**Papain**

From the latex of leaves and fruits of *Carica papaya*, Caricaceae family, a proteolytic enzyme called papain is extracted. The main ingredients of the latex are papain and chymopapain.[17] The previous studies on papain have come to the conclusion that 0.8% papain gel has been used as an irrigating solution.[18]

**Fenugreek** *(Trigonella foenum-graecum)*

This is a medicinal plant seen commonly in India, North Africa, Southeastern Europe, and West Asia. It has biocompatible antioxidant property.[19]

**Phytic acid**

Inositol hexakisphosphate (IP6) or phytic acid is found in whole grains, cereals, nuts, and legumes. It is a major storage form of phosphorus in plant seeds and bran. Phytic acid is also found in mammalian cells at a concentration of 10-100 µ/ml. It is a highly negatively charged molecule that acts as chelator of multivalent cations such as calcium, magnesium, and iron. The pH of the material is 1.6, and this acidity contributes to better extraction of calcium. It is used as a final rinse on surface of prepared root canal.[20]
Conclusion

Herbs and other natural products are used to reduce inflammation and soothe the irritation of the tissues. These products are popular due to their ease of availability, economic efficiency, low toxicity, and lack of microbial resistance. Research which was done on the phytochemicals present in the above-mentioned herbs and their products have shown the action against oral microorganisms such as *S. mutans*, *C. albicans*, and other pathogens. However, further research is necessary to incorporate these into routine endodontics practice.

References

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