GIFT OF NATURE TO ENDODONTICS AS ROOT CANAL IRRIGANT:
A REVIEW

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ABSTRACT

Endodontic treatment aims complete disinfection of the entire root canal system which involves the use of chemical substances. The materials currently used for this purpose never achieved complete disinfection and also have other disadvantages like weakening of the tooth structure, predisposing to tooth fracture. Over the past decade, interest in drugs derived from medicinal plants has markedly increased. Traditional Medicines derived from medicinal plants are used by about 60% of the world’s population. In dentistry herbal medicines has been used as anti-inflammatory, antibiotic, analgesic, sedative and also as endodontic irrigant. This review focuses on various herbal drugs and products as well as their therapeutic application, and their future in endodontic irrigation.

KEYWORDS: Root canal irrigants; Enterococcus Faecalis; Herbal plants; Morinda citrifolia.

INTRODUCTION

The aim of root canal treatment is to clean root canal by considering biological, chemical and mechanical objectives. The pulp space is colonised with different microorganisms and bacterial infection in pulp space and periapical region and is one of the main causes for failure of root canal treatment.1 Recently more stress is on mechanical objectives with less attention to biological objectives which is very important for success of root canal treatment. The prime 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 maintaining proper isolation by use of rubber dam and “chemomechanical preparation”, in which chemically active solutions are used along with instrumentation of the root canal space to ensure successful endodontic treatment.\[2, 3\] Low prevalence of using rubber dam during endodontic procedures presents quality issues and its regular use will provide safety to professional and patient alike.\[4\] The most effective irrigants are sodium hypochlorite (NaOCl), 2% solution of chlorhexidine (CHX), which possess varying degree of antibacterial activity. NaOCl has excellent tissue dissolving and antimicrobial properties but has also several undesirable characteristics such as tissue toxicity, risk of emphysema when overfilling, allergic potential, disagreeable smell and taste, inability to remove the smear layer and mutagenic potential when mixed with CHX which forms a carcinogenic product, parachloroanaline.\[5, 6, 7\] Owing to the potential side effects, safety concerns and ineffectiveness of conventional allopathic formulations, consumption of preparations from medicinal plants has increased over the last few decades.\[5, 8\] Herbal or natural products have been used in dental and medical practice for thousands of years and have become even more popular today due to their high antimicrobial activity, biocompatibility, anti-inflammatory and anti-oxidant properties.\[9\] NaOCl has been the most widely used root canal irrigating solution for several decades due to its excellent properties of tissue dissolution and antimicrobial activity. This review focuses on different herbal products used as a root canal irrigants in endodontics.

**Acacia catechu**

The extracts of acacia catechu exhibit various pharmacological effects like anti-inflammatory, antioxidant and antimicrobial activities. Main chemical constituents of Acacia catechu willd are catechin, (-) epicatechin, epigallocatechin, epicatechin gallate, epigallocatechin gallate, rocatechin, phloroglucin, protocatechuic acid, quercetin, poriferasterol glucosides, poriferasterol acyglucosides, lupenone, lupeol, procyanidin AC, kaempferol, dihydrokaemferol, taxifolin, (+)-afzelchin gum and mineral.\[10\] It is highly active on oral pathogens and can be applied in Dental practice in the field of periodontics to treat dental caries, gingivitis, mouth sores and endodontics as root canal irrigant to treat E.faecalis which is found in infected root canal possibly causing failure in root canal treatment.\[11\]
Neem
Azadirachta indica A. Juss is a commonly seen medicinal tree in India, which is considered holy. Popularly known as “Indian neem/ Margosa tree” or “Indian lilac”, is well known in India and its neighboring countries for more than 2000 years as one of the most versatile medicinal plants having a wide spectrum of biological activity. Importance of neem tree has been recognized by US National Academy of Sciences where neem is entitled as ‘a tree for solving global problems’. Each part of the neem tree has some medicinal property and is thus commercially exploitable. Biologic activities and pharmacologic actions of neem are very well established with crude extracts and their different fractions from its leaf, bark, flowers, roots, seed and oil.[12] Interest on this substance is based on its properties like antibacterial, antifungal, antiviral, antioxidant, anti-inflammatory, antipyretic, analgesic and immune stimulant activity.[13] Furthermore, it also has an anti-adherence activity by altering bacterial adhesion and ability of organism to colonize.[14] In periodontal disease its biocompatibility to human periodontal ligament fibroblasts is an important factor favoring its clinical application.[15] 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 might occur via NaOCl accidents. Bitter taste associated with this plant can be altered by different formulations due to addition of sweeteners and flavors to increase the patient compliance and acceptability. A study showed significant differences in the zone of inhibition of diameters of neem extract and 2% NaOCl against E.faecalis and mixed culture.[16]

Liquorice
Liquorice is the most commonly used crude drug and flavouring agent in kampo medicines (traditional Chinese medicines modified in Japan). A number of pharmaceutical effects of Liquorice are known - anti-inflammatory, antiviral and anticarcinogenic. Liquorice has been found to inhibit growth and adherence [plaque formation] of the cariogenic bacteria Streptococcus mutans.[17] The antibacterial activity of Liquorice and glycyrrhizin on different strains of S. mutans was also studied and Liquorice extract exhibited a more profound activity in both adherence and anti-bacterial assays than that of glycyrrhizin.[18] Glycyrrhizin, a triterpenoid compound, represents a mixture of potassium-calcium magnesium salts of glycyrrhizic acid that varies within a 2–25% range. Amongst the natural saponins, glycyrrhizic acid is a molecule composed of a hydrophilic part, two molecules of glucuronic acid and a hydrophobic fragment, glycyrrhetic acid.[19] The antimicrobial effect of Liquorice
extract against E. faecalis, may be related to the Glycyrrhizin. The mode of action of antibacterial effects of saponins seems to involve membranolytic properties, rather than simply altering the surface tension of the extracellular medium, thus being influenced by microbial population density.[20] The flavonoid content of Liquorice 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.[21] Liquorice 10% extract as root canal irrigant has potential activity against E. Faecalis and C. Albicans.[22] Liquorice extract either separately or as Liquorice/Ca(OH)₂ mixture had a potent bactericidal effect against Enterococcus faecalis and retained compatibility with fibroblasts in tissue culture compared to the commonly used root canal medicament Ca(OH)₂.[23]

Propolis
Propolis is a resin widely used in folk medicine for centuries. Propolis is a resinous material that honeybees [Apis mellifera L.] collect from various plant species and mix with wax and other substances. Studies on propolis applications have increased because of its therapeutic and biological properties. Current research involving propolis in dentistry spans many fields and highlights its antimicrobial and antiinflammatory activities, particularly in cariology, oral surgery, pathology, periodontics and endodontics.[24,25] 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.[26] Ethanolic extract of propolis inhibits hyaluronidase activity and hence has great potential as an anti-inflammatory agent.[27] The anti-inflammatory property of propolis is due to the presence of caffeic acid and phenethyl ester [CAPE] in propolis. 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 being a good antimicrobial and anti-inflammatory agent, can serve as a better intracanal irrigant and intracanal medicament.[9,28] Propolis had good invitro antibacterial activity against E.faecalis in the root canals, suggesting that it could be used as an alternative intracanal medicament. The antimicrobial activity of propolis with calcium hydroxide as intracanal, medicament against E.faecalis found that propolis was effective in eliminating the microorganisms.[29]

Carvacrol
Carvacrol is present in the essential oils of origanum vulgare, oil of thyme, pepperwort, bergamot and satureja khuzistanica jamsizad oil (SKJ oil). Carvacrol has inhibitory action on
e-coli and p-aeroginosa. The cause of antimicrobial property is attributed to action on several targets in bacterial cell and disruption of bacterial cell membrane. It also helps in repair of periapical tissues. This property is due to the presence of phenolic component which stimulates pulpal fibres, phenomena known as hormesis.[30]

**Aleo vera**

The fresh gel or mucilage from aleo vera can be used both as a moisturizing agent and for many therapeutic purposes. It has got anti-inflammatory, antibacterial, antifungal, antiviral, moisturizing, wound healing and pain relief properties. In dentistry it is used as a pulp capping and pulpotomy agent and also as a root canal irrigant. In a study anti microbial effect of water, alcohol, chloroform extracts of aloe vera gel were investigated and it was found that chloroform extract of aloe vera had significant anti microbial effect against E.faecalis.[31]

**Jieeryin solution**

This is a pure Chinese herbal compound and has heat clearing, detoxifying, antibacterial and anti-inflammatory effects. It is used for root canal irrigation with ultrasonics and is found to be effective against anaerobic bacteria.[32] 30% Jieeryin used as root canal irrigant with ultrasonics has similar effect in the cervical one third of the root canal as compared to NaOCl.[33]

**Salvadora Persica**

Its chewing sticks contain trimethyl amine, salvyadorime chloride and fluoride in large amounts.[34] In a study conducted by Nawal A.K.Al-Sabawi et al, alcoholic extract of Salvadora Persica was compared with 5.25% sodium hypochlorite, 0.2% Chlorhexidine and normal saline. It was shown that Salvadora Persica extract had a significant anti microbial effect against both aerobic and anaerobic bacteria with its efficacy being maximum at 15%.[35]

**Triphala**

Triphala is an Indian ayurvedic herbal formulation consisting of dried and powdered fruits of three medicinal plants Terminalia bellerica, Terminalia chebula, and Emblica officinalis. Triphala has been proven to be safe, containing active constituents that have beneficial physiologic effect apart from its curative property such as antioxidant, antiinflammatory, and radical scavenging activity[36] and may have an added advantage over the traditional root canal irrigants. A recent study showed that Triphala was as effective as NaOCl and a
doxycycline based irrigant on root canal biofilms that were 3 weeks old. It brought about a
eight log reduction in E. faecalis counts, when compared to saline. Moreover, Triphala is also
a very good chelating agent because of the fruits that are rich in citric acid, and holds promise
in the removal of smear layer.\textsuperscript{[37]}

**Garlic**

Allium Sativum, commonly known as garlic has been used for both culinary and medicinal
purposes. The main active component of garlic is allicin. It is antibacterial and has immune
regulatory functions. Allicin destroys cell wall and cell membrane of root canal bacteria and
is used as an alternative to NaOCl.\textsuperscript{[34]}

**Tea tree oil**

Tea tree [Melaleuca alternifolia] is a native Australian plant, the oil of which has many
properties that favor its use in dentistry. It is an antiseptic as well as an antifungal agent. It
also has mild solvent action, and hence could hold 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\%]. This compound is responsible for its antibacterial and
antifungal properties. An in vitro study showed that tea tree oil which might disinfect the root
canal system as effective as NaOCl. Further, the toxicity of tea tree oil is lesser than
NaOCl.\textsuperscript{[38]}

**Morinda Citrifolia [MC]**

Among the medicinal plants discovered by the ancestors of Polynesians, Morinda citrifolia
[Noni] is one of the traditional folk medicinal plants that has been used for over 2000 years in
Polynesia.\textsuperscript{[39]} 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 throughout the world. It has been reported
to have a broad range of health benefits for cancer, infection, arthritis, diabetes, asthma,
hypertension, and pain. A number of major components have been identified in the Noni
plant such as scopoletin, octoanoic acid, potassium, vitamin C, terpenoids, alkaloids,
anthraquinones [such as nordamnacanthal, morindone, rubiadin, and rubiadin-1-methyl ether,
anthraquinone glycoside], G-sitosterol, carotene, vitamin A, flavone glycosides, linoleic acid,
Alizarin, amino acids, acubin, L-asperuloside, caproic acid, caprylic acid, ursolic acid, rutin,
and a putative proxerol.\textsuperscript{[40]} An in vitro study compared the effectiveness of the juice of
MC with NaOCl and Chlorhexidine to remove the smear layer from root canal walls of
instrumented teeth. It was concluded that the efficacy of MC was similar to NaOCl in conjunction with EDTA as an intracanal irrigant.\textsuperscript{[41]} The antimicrobial activity of 2\% CHX gel, propolis, MC juice and calcium hydroxide has been compared on E. faecalis infected root canal dentin at two different depths and three intervals. It was concluded that Propolis and MC were effective against E. faecalis in dentin on extracted teeth\textsuperscript{[30]}. MC appears to be the first juice to be identified as a possible alternative to the use of NaOCl as an intracanal irrigant.

**Turmeric**

It contains protein, fat, minerals, carbohydrates and moisture. It has anti-inflammatory, antioxidant, antibacterial, antifungal, antiviral activities. It is proven to be safe as a root canal irrigant, effective against E. faecalis and with added advantages of ease of availability, cost effectiveness and other biological activities would appear prudent to replace the traditional root canal irrigant with this herbal extract.\textsuperscript{[42]}

**Spilanthes Calva DC**

Spilanthes Calva DC is an important herb for oral health care. It is non toxic to human beings and has anti bacterial and anti fungal activities. Moulshree Dube et al compared the anti bacterial efficacy of methanolic extract of Spilathes Calva DC roots with 2\% Chlorhexidine 3\% sodium hypochlorite and doxycycline at different concentrations against E. faecalis. From the study, it was concluded that Spilanthes Calva DC root extract had comparable anti bacterial activity to sodium hypochlorite. Thus it may have potential as a root canal irrigant.\textsuperscript{[43]}

**Myrtus Communis**

This plant has anti bacterial activity against both gram positive and gram negative organisms. In a study by Rajaa T Sulieman, the anti bacterial effect off Myrtus communis alcoholic extract solution when used as an intracanal irrigant was evaluated and compared with the currently used root canal irrigants. It was found that Myrus communis showed anti microbial effect at different dilutions, the best being at 35\% concentration. Its effect was comparable to 5.25\% sodium hypochlorite and 0.2\% Chlorhexidine solution and showed nearly similar effect.\textsuperscript{[44]}
CONCLUSION

Though a vast number of plants have not been studied for their medicinal properties, these may become new sources of medicinal activity. It is believed that the plants (traditional medicine) will be a major source of new chemicals and raw materials for the pharmaceutical industry in near future. The major advantages of using herbal alternatives are easy availability, cost effectiveness, increased shelf life, low toxicity and lack of microbial resistance reported so far. The in vitro observations of herbal products appear promising but preclinical and clinical trials are needed to evaluate the biocompatibility and safety factor before they can conclusively be recommended as alternatives to synthetic root canal irrigating solutions.

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