

## Herbal Irrigants: A literature Review

### Herbal Irrigants; A new Era in Endodontics: Literature Review

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#### ABSTRACT:-

##### Background:

With increasing reversion of trends towards more natural alternates, it has become the need of the hour for endodontics to catch up with the changing tides. This article mainly focuses on the different natural alternates to the mundane irrigants currently used.

**Aim:** The aim of this article is to review different herbal irrigants used in the field of endodontics

**Materials and methods:** A literature review is conducted using electronic databases “PubMed”, “Google Scholar” and “Scopus”, using keywords “Herbal Medicine” using the key words “Endodontics”, “Root canal Therapy”, “Irrigation”, “Herbal Endodontics” and “Endodontic Disinfection.” Out of 508 articles, only 58 articles were relevant for this study

##### Conclusion:

Any material with potential clinical application must go through a series of tests to demonstrate biocompatibility to the tissues of the oral cavity as well as marked advantages in terms of efficacy in root canal disinfection, when compared to contemporary irrigants.

**Keywords:-** Enterococcus Faecalis, Herbal extracts, Root canal Irrigants

## I. INTRODUCTION

The principal aim of endodontic treatment is biomechanically cleaning and shaped with hand and rotary instruments under constant irrigation.<sup>1</sup>This goal can be accomplished by using mechanical instrumentation and chemical irrigation, with medication of the root canal system between treatment sessions.<sup>2</sup>

One should completely understand the microbiology involved in the endodontic pathologies. Endodontic microbiology includes *Prevotella*, *Porphyromonas*, *Antinomies spp.* *Propionibacterium propionicum*, *Parvimonasmicra* (previously called *Peptostreptococcus micros* or *Micromonas micros*), *Streptococcus species*, and *Enterococcus faecalis*.

These micro-organisms in the oral cavity are most often opportunistic pathogens. They have the ability to invade and establish an infectious process. Longer the duration of root canal infection, greater the number of facultative anaerobes. *E. faecalis* is one of the most common organisms which can be cultured from the failed root canals that undergo retreatment. Biofilm around the bacteria, helps in resisting the destruction by making them a thousand times more resistant to phagocytosis, antibodies and antimicrobial agents. This is attributed to the protective barrier provided by the extracellular matrix. Biofilms also participate in gene exchange via horizontal gene transfer leading to spread of antibiotic resistance genes between different clinically relevant species, thus the micro-organisms have the ability to survive chemo-mechanical preparation. Hence, ideal intracanal irrigants are those which possess a good antimicrobial property to enhance the outcome of the instrumentation procedures.<sup>3-5</sup>

Sodium hypochlorite (NaOCl) has been the most widely used root canal irrigating solution for several decades. It is considered to be the gold standard due to its properties of tissue dissolution and antimicrobial activity making it the irrigating solution of choice for treatment of teeth with pulp necrosis. This holds true that

sodium hypochlorite has various undesirable characteristics such as tissue toxicity, risk of emphysema when overfilling, allergic potential, a disagreeable smell and taste. Moreover, it might not completely cleanse the surfaces of the root canal walls.<sup>7</sup>

Chlorhexidine (CHX) is effective against both gram-positive and gram-negative microorganisms since it is proven broad-spectrum antimicrobial agent and due its substantiveness. It is the most potent chemotherapeutic agent against many microbes. At low concentration, it is bacteriostatic and at high concentration bactericidal. Side effects of chlorhexidine produces staining of teeth, altered taste, and development of microbial resistance.<sup>8</sup>

Various irrigation activation systems such as sonic and ultrasonic systems have also been used to increase the efficacy of sodium hypochlorite in cleaning the canal system along with lateral canals and provide improved penetration of hypochlorite into the biofilms to eradicate the endodontic microbes.<sup>9</sup>

The use of herbal plant extracts for the eradication of microbes has been the topic of interest due to the drawbacks of sodium hypochlorite and chlorhexidine. Herbal extracts such as Morindacitrifolia, Green tea, Triphala, Azadirachta indica etc. have been used as irrigants in various studies. These studies have proven that herbal plant extracts eliminate microbes causing dental pathologies, thus proving its efficacy as an anti-microbial for oral infections.<sup>10</sup>

With the increasing popularity of traditional and holistic/alternative medicines due to their natural origin, easy availability, efficacy, safety and fewer side effects, the aim of this review is to enlist and describe various herbal extracts for use as effective endodontic irrigants.

## II. LITERATURE REVIEW

### MORINDA CITRIFOLIA:-

Morinda citrifolia (MCJ), also known as “Cheese plant”, “Indian Mulberry” or commonly “Noni”, grows widely throughout the Pacific and is one of the most significant sources of traditional medicines among Pacific island societies. This small evergreen tree or shrub is native to South-eastern Asia (Indonesia) to Australia, and now has a pantropical distribution.<sup>7</sup>

### Chemistry:-

A number of major components have been identified in the noni plant, which includes 6 $\alpha$ -hydroxyadoxoside, 6 $\beta$ , 7 $\beta$ -epoxy-8-epi-splendoside, americanin A, scopoletin, octoanoic acid, terpenoids, alkaloids, anthraquinones, bistosterol, carotene, flavone glycosides, linoleic acid, alizarin, acubin, L-asperuloside, caproic acid, caprylic acid, ursolic acid, rutin, and proxeronine which are responsible for its anti-bacterial properties.

### Mechanism of action:-

Morinda Citrifolia juice acts by depolymerization of hydrosoluble pectins, while pectinases and hemicellulases in Morindacitrifolia juice leads to differential disassembly of bacterial cell wall polymers.<sup>15</sup>

### Applications:-

The medicinal applications, both traditional and modern cover a vast array of conditions and illnesses.<sup>14</sup>

According to Murray et al 6% Morinda citrifolia along with EDTA has shown effective smear removal than 5.25% Sodium Hypochlorite. When MCJ is to be used as an endodontic irrigant, a flush of EDTA, followed by a final flush of MCJ, is recommended. Due to it being a biocompatible antioxidant and not likely to cause severe injuries to patients that might occur through NaOCl accidents, Morinda Citrifolia juice is advantageous than NaOCl. Preclinical and clinical trials are needed to evaluate biocompatibility and safety before MCJ can be conclusively recommended as an intracanal irrigating solution, but the in vitro observations, the effectiveness of MCJ when used with a rinse of EDTA appear promising.<sup>15,16</sup>

Also, 6% MCJ followed by a final flush of 17% EDTA which is regarded as an effective solution does not affect the microhardness of root canal dentin.<sup>17,18</sup> The shear bond strength of resin sealers was also not affected when Morinda citrifolia is used as an irrigant than chlorhexidine, thus can be used as a better alternative to that of chlorhexidine.<sup>19</sup>

### TRIPHALA:-

Triphala [three (tri) fruits (phala)] is a plant-derived composition developed in India. This is an ayurvedic rasayana consisting of Amulaki (*emblica officinalis*), Bibhitaki (*Terminalia bellirica*) and Halituki (*terminalia chebula*). The powder is a combination of drying *Terminalia bellirica*, *Terminalia chebula* and *Emblica officinalis* fruits.<sup>20</sup>

**Chemistry:-**

Triphala constituents a number of compounds such as Tannin, Quinones, flavins, flavonoids, flavanols, gallic acid and Vitamin C.

**Mechanism of Action:-**

Tannins have the ability to inactivate microbial adhesins, enzymes, and cell envelope transport proteins. Quinones targets on the microbial cell by acting on surface-exposed adhesins, cell wall polypeptides, and membrane-bound enzymes. Lipophilic flavonoids in Triphala may also disrupt microbial membranes.

**Applications:-**

It has been used in Indian traditional medicine for treatment of headaches, constipation and hepatic disorders, Initial studies have shown to have a bacteriostatic or bactericidal effect of tannic acid present in triphala fruits to have an effect on gram-positive and gram-negative pathogens.<sup>20</sup>

According to Shakouie et al, Triphala was more effective on cultures of *E. faecalis* compared to 0.5 and 1% NaOCl when the zones of inhibitions were evaluated during disc diffusion bioassay . Its fruit is rich in citric acid, which may aid in removal of smear layer thereby acting as chelating agent and also found to be alternative to sodium hypochlorite for root canal irrigation.<sup>21</sup> Also, 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 8 log reduction in *E. faecalis* counts, when compared to saline.<sup>22</sup> In vitro study has also proven that Triphala does not have any effect on the micro-hardness on dentin when concentration of 0.05% Triphala has been used as an endodontic irrigant.<sup>23</sup>

**AZADIRACHTA INDICA:-**

It is known as Indian neem/margosa tree. Neem is the most commonly used as a traditional medicine as a source of many therapeutic agents in the Indian culture and grows well in the tropical countries. Its twigs provide a chewing stick and are widely used in the Indian sub-continent.<sup>24</sup>

**Chemistry:-**

AzadirachtaIndica constituents a number of compounds such as Nimbidin, Nimbidinin, Sodium nimbidate, Nimbin, Nimbolide, Gedunin, Azadirachtin, Mahmoodin, Gallic acid, Margolonone and polysaccharides.

**Mechanism of Action:-**

Nimbidin, Nimbolide and Mahmoodin inhibits the cell membrane synthesis of the bacteria. Furthermore, it also has an anti-adherence activity by altering bacterial adhesion and ability of organism to colonize.<sup>25-27</sup>

**Applications:-**

Earlier studies on neem have showed that it contains active substances with multiple medicinal properties.<sup>25</sup> Studies have proven that AzadirachtaIndica has anti-bacterial, anti-ulcer, anti-diabetic effect. Also, due to its anti-oxidant property it is used in treatment of cancers. Interest on this substance is also on its anti-viral, anti-inflammatory, anti-pyretic actions.<sup>26</sup> It has been shown that neem is highly effective in the treatment of periodontal disease. Its biocompatibility to human periodontal ligament fibroblasts is an important factor favouring its clinical application<sup>[27]</sup>.

Addition of sweeteners and other formulations can alter the bitter taste of neem.<sup>28</sup> A study on AzadirachtaIndica conducted using agar well diffusion showed significant inhibitory zones against *E. faecalis*.<sup>29</sup> Also, a study was conducted comparing 5 herbal extracts and minimal inhibitory concentrations was assessed, resulted that Neem was highly efficient than 5.25% NaOCl in reducing *Enterococcus faecalis* and *Candida albicans* within the root canals when compared with other extracts and a minimum inhibitory concentration of 1.25 mg/ml against *E. faecalis* was evaluated.<sup>30</sup> Another study, showed significant differences in the zone of inhibition of diameters of neem extract and 2% NaOCl against *E. faecalis* and mixed culture<sup>31</sup>. Thus, it can be used an alternative to sodium hypochlorite due to its oxidizing nature.

**GREEN TEA:-**

It is a tea made solely from the leaves of camellia sinensis.<sup>32</sup>

**Chemistry:-**

They contain polyphenols and flavins which result in denaturation of proteins as well as enhances the anti-oxidant effect of green tea.

**Mechanism of action:-**

The antimicrobial activity is due to inhibition of bacterial enzyme gyrase by binding to ATP B sub unit.

**Applications:-**

Green tea extracts shows a wide range of beneficial physiological and pharmacological effects. Among these are slowing the catabolism of catecholamines, strengthening capillaries (“vitamin P effect”), exerting an anti-inflammatory effect by enhancing the effectiveness of ascorbic acid, inhibiting angiotensin-converting enzyme, having a hypocholesterolemic action, and inhibiting the growth of implanted malignant cells.<sup>32</sup> Green tea exhibits antibacterial activity on *E. Faecalis* planktonic cells. It is also found to be a good chelating agent. In vitro studies done on green tea have proven that green tea has significant antimicrobial activity on *E. Faecalis* after agar well test and after evaluation of colony forming units.<sup>22</sup>

**TREE TEA OIL:-**

A volatile essential oil, Tea tree oil (TTO) derived mainly from the Australian native plant *Melaleuca alternifolia*. It is over the counter available in Australia, Europe, and North America and is marketed as a remedy for various ailments.<sup>33</sup>

**Chemistry:-**

It consists of Terpinen-4-ol which is a major component in tree tea oil and responsible for its antibacterial and fungal properties.<sup>35,36</sup>

**Mechanism of action:-**

Terpinen-4-ol acts on the bacterial cell wall by affecting the permeability of cell membrane thus preventing bacterial growth. Also, it affects the oxygen consumption of bacteria thus unable to grow quickly.

**Applications:-**

Due to its antimicrobial properties, TTO is incorporated as the active ingredient in many topical formulations for the treatment of cutaneous infections. It can also be used as a mild solvent along with its antiseptic properties.<sup>34</sup>

A comparative clinical study investigating the antimicrobial activity of *A. sativum*, tea tree (*Melaleuca alternifolia* – Myrtaceae) oil, and chlorhexidine showed that tea tree oil presented the best antimicrobial activity, followed by chlorhexidine and garlic, which had similar results.<sup>35</sup> It can be used as root canal irrigant, but it is less effective compared to EDTA and NaOCl. The toxicity of tea tree oil is less when compared to NaOCl.<sup>36</sup>

**SALVADORA PERSICA SOLUTION (MISWAK-SIWAK):-**

*Salvadora Persica*, is a medical plant whose roots, twigs or stems have been used for centuries as oral hygiene tools in many parts of the world, particularly in the Arabian world.<sup>37</sup>

**Chemistry:-**

Its chewing sticks contain trimethyl amine, salvadorime chloride and fluoride in large amount. Siwak contains essential oils and a variety of other chemical compounds, i.e. Anorganic compound, such as triethylamine, alkaloids, flavonoids, anthraquinone, tannins, saponins, sterols, Vitamin C. Miswak leaves such as benzyl nitrile, eugenol, thymol, isothymol, eucalyptol, iso-terpinolene, and beta-caryophyllene.

**Mechanism of action:-**

Tannins and flavonoids present in Miswak interfere with cell's permeability by wrinkling the cell walls. Alkaloids cause cell wall layers to not fully form and cause cell death by disrupting components of the peptidoglycan in the bacterial cell.<sup>39</sup>

**Applications:-**

Extracts of *Salvadora Persica* possess various antiplaque, anti-periodontal, anti-caries, anti-inflammatory and antimicrobial effects which have been demonstrated in various studies.<sup>37,38</sup> Study conducted

on *Salvadora Persica* when compared with chlorhexidine as an irrigant when assessed on Scanning electron Microscopy proved that *Salvadora Persica* removed more smear layer as compared to Chlorhexidine.<sup>39</sup>

Study was conducted to assess the antimicrobial efficacy of 10% water extract of *Salvadora Persica*. After counting of Colony forming units it was evaluated that 10% water extraction of *Salvadora Persica* is an effective antimicrobial agent when utilized clinically as an irrigant in the endodontic treatment of teeth with necrotic pulps.<sup>40</sup>

Also, another study was conducted to assess the antimicrobial activity of *Salvadora Persica* comparing it with three other irrigants and bacterial colony units were evaluated. The study concluded that miswak could be a good natural substitute to sodium hypochlorite.<sup>41</sup>

#### **GERMAN CHAMOMILE:-**

German Chamomile also known as *Matricaria Chamomilla* L belongs to Asteraceae family is one of the very important medicinal plants native of Europe of south and east Europe.<sup>34</sup>

#### **Chemistry:-**

Flower of chamomile plant contain a wide variety of active chemical components (chamazulene, capric acid and caprylic acid). Also, it consists of flavonoids, terpenoids and other chemical constituents.

#### **Mechanism of action :-**

German Chamomile oil targets the cell wall and membrane, thereby disturbing ATP production and pH homeostasis.

#### **Applications:-**

Its pharmacological properties includes anti-inflammatory, antiseptic, healing, sedative and spasmolytic action.<sup>42</sup>

Study conducted on different content and composition of Chamomile using different irrigation regime proved that irrigation at field capacity of 70% is suitable as an endodontic irrigant but if water supply is sufficient 85% field capacity of German Chamomile can be used.<sup>43</sup>

Another study proved that efficacy of chamomile to remove smear layer was superior to NaOCl alone but less than NaOCl combined with EDTA when examined under scanning electron microscopy.<sup>34</sup>

#### **GARLIC (ALLIUM SATIVUM):**

Garlic (*Allium sativum*) has long been known to have antibacterial, antifungal and antiviral properties.<sup>46</sup>

#### **Chemistry:-**

The active constituents are several complex sulphur-containing compounds such as Diallyl sulphide (allicin), Allin, Ajoene and Flavonoids that are rapidly absorbed, transformed and metabolized.

#### **Mechanism of Action:-**

Allicin present in garlic destroys cell wall and cell membrane of root canal bacteria.<sup>49</sup>

#### **Applications:-**

Garlic's is used to prevent and treat cardiovascular disease by lowering blood pressure and cholesterol. It is also used as an antimicrobial and as a preventive agent for cancer. Numerous randomized trials suggest that garlic alters HDL/LDL ratios.<sup>44</sup> Also, the presence of Diallyl Sulphide in garlic which is a flavouring component of garlic has said to eliminate factors which cause colon cancer.<sup>45</sup> Studies conducted on Garlic have proven that essential oil of garlic can be used as antimicrobial against various micro-organisms.<sup>46,47</sup>

An vitro study was conducted to compare the antimicrobial efficacy of garlic extract with 2% chlorhexidine and calcium hydroxide using polymerised chain reaction. The study proved that chlorhexidine had better antimicrobial efficacy followed by garlic extract on *E. Faecalis*.<sup>48</sup> Another study was conducted to compare the antimicrobial efficacy of garlic extract with aloe vera and sodium hypochlorite by evaluating the antibiotic susceptibility testing of these irrigants against *E. Faecalis*. It proved that Garlic extracts had significant zones of inhibition on the culture media proving to be better than sodium hypochlorite.<sup>49</sup> Thus, Garlic extracts can be used as irrigant alternative to NaOCl.

#### **Acacia nilotica (Babool):**

Acacia nilotica (L.) also known as "Acacia arabica", " Gum arabica", " Babool" is an imperative multipurpose plant. It is a medium sized tree and is broadly scattered in tropical and subtropical countries.<sup>50</sup>

**Chemistry:**

Acacia nilotica is a rich source of phenolics viz. condensed tannin, gallic acid, protocatechuic acid pyrocatechol, catechin, epigallocatechin-7-gallate, and epigallocatechin-5,7- digallate. Epicatechin, dicatechin, quercetin, gallic acid, leucocyanidin gallate, sucrose and catechin- 5-gallate are compounds usually present in barks of babool.<sup>51</sup>

**Mechanism of Action:**

Extracts of Acacia Nilotica damage electrolytic and essential cellular constituents (proteins and nucleic acids) of pathogens, altering the cell integrity and cell wall permeability indicating that acacia extracts damaged the cellular membrane of the pathogens.

**Applications:**

Babool extracts aid as an anti-cancer, antimutagenic, spasmogenic, vasoconstrictor, anti-pyretic, anti-asthmatic, cytotoxic, anti-diabetic, anti-platelet agregatory, anti-plasmodial, molluscicidal, anti-fungal. Inhibitory activity against Hepatitis C virus (HCV) and human immunodeficiency virus (HIV)-I, antioxidant activities, anti-bacterial, antihypertensive and anti-spasmodic activities, and are also engaged for the treatment of different ailments in the indigenous system of medicine have also been proven. Cold,cough, diarrhoea, dysentery, fever, gall bladder, hemorrhoid, ophthalmia, sclerosis, tuberculosis and small pox, leprosy as well as bleeding piles, leucoderma and menstrual problems are cured by babool extracts.<sup>52</sup>

A study conducted using acacia extracts on different bacteria proved that extracts of Acacia possessed anti-bacterial activity against *Streptococcus mutans* and *E.faecalis*.<sup>53</sup> Also, in another study conducted using extracts of liquorice, clove, cinnamon, babool were investigated for their anti microbial activity. It was shown that babool at a concentration of 50% had the highest activity against *E.faecalis*.<sup>54</sup>

**III. CONCLUSION**

Any material with potential clinical application must go through a series of tests to demonstrate biocompatibility to the tissues of the oral cavity as well as marked advantages in terms of efficacy in root canal disinfection, when compared to contemporary irrigants. Literature has addressed many plants with potential source for new therapies in endodontics. The studies listed have shown important medicinal activities of plants, with great demand to inhibit or suppress bacteria and their biofilm. Thus, we can say that herbal extracts may be a dawn of a new era in this modern age of endodontics and further studies on these herbal extracts can be done which would help in enhancing its use in this era of dentistry.

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