



## HERBAL IRRIGANTS IN PEDIATRIC ENDODONTICS – A REVIEW

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### ABSTRACT

One of the key reasons behind the success of root canal treatment is the chemo -mechanical preparation, but Pediatric age groups being the ones that show more side effects due to the use of drugs has initiated a vast arena of research among herbal products. Considering the ineffectiveness, potential side effects and safety concerns of synthetic irrigants used, the herbal alternatives for endodontic usage might prove to be advantageous

**KEYWORDS:** Herbal irrigants, green tea, propolis, neem extract.

### INTRODUCTION

The aim of pediatric endodontic therapy is primarily focused on maintaining the primary teeth in their original form and function and to further facilitate the proper eruption of permanent successors. Preservation of primary teeth is integral for the harmonious development of occlusion, maintenance of arch length, optimum function of chewing and speech and preservation of healthy oral environment. Considering the fast development of caries in primary dentition, and consequently the damage caused to pulp due to the pulpal tissue contamination by bacteria and the toxins they produce, the endodontic treatment can be necessary.<sup>[1]</sup>

The role of clinician is to maintain strict asepsis in vital pulp situation and to attain antisepsis for necrosed pulps. This process mainly revolves around the chemomechanical preparation, where chemically active solutions are being used along with mechanical instruments of the root canal space. The root canal system is complex and accessory features, such as fins, cul de sacs, and intercanal communications, are often colonized by microorganisms once the tooth becomes infected.<sup>[2]</sup>

It has become increasingly clear that the endodontic diseases of both pulp and periradicular tissues is due to the presence of microorganisms, the success of treatment depends upon control of endodontic infection, which involves the elimination of microorganisms from the root canal. The root canal system consists of the lumen of the

main root canal(s) plus the dentinal tubules, accessory canals, canal ramifications, apical deltas, fins or transverse anastomoses, all of which are large enough to accommodate bacterial cells.<sup>[3,4]</sup>

For many years, intracanal irrigants have been used as an adjunct to enhance antimicrobial effect of cleaning and shaping in endodontic therapy. The constant increase in antibiotic resistant strains and side effects of synthetic irrigants has promoted researchers to look for herbal alternatives. There has been a growing trend to seek natural remedies as part of dental treatment and this approach may be termed phytotherapeutics or ethnopharmacology.<sup>[5]</sup>

### Ideal Requirements For Root Canal Irrigants.<sup>[6]</sup>

The ideal requisites of a root canal irrigant as given by Zehnder are

1. Broad antimicrobial spectrum
2. High efficacy against anaerobic and facultative microorganisms organized in biofilms
3. Ability to dissolve necrotic pulp tissue remnants
4. Ability to inactivate endotoxin
5. Ability to prevent the formation of a smear layer during instrumentation or to dissolve the latter once it has formed.
6. Systemically nontoxic when they come in contact with vital tissues, noncaustic to periodontal tissues, and with little potential to cause an anaphylactic reaction.

### Commonly Used Irrigants in Dentistry

- Sodium hypochlorite,
- chlorhexidine
- Saline,
- Distilled Water
- MTAD (Mixture of Tetracycline, Acid and Detergent)
- Tetraclean
- Qmix

### Herbal Irrigants Used As Root Canal Irrigants Green Tea and Triphala

Green tea is a beverage made from the evergreen plant *Camellia sinensis* and has been enjoyed for thousands of years due to its numerous health benefits. All these benefits are due to the presence of polyphenols available in them, even though the polyphenol content varies due to environmental factors like rainfall and season. The major polyphenols are the catechins: epicatechin (EC), epigallocatechin (EGC), epicatechin gallate (ECG), epigallocatechin gallate (EGCG), epigallocatechin (EG), and catechin (C). EGCG, among all is the most active component of green tea which provides most of its properties because it contains multiple chemically reactive hydroxyl groups. The exact mechanisms of EGCG's antibacterial activity are unknown, its believed that EGCG disrupts the cell membrane and prevents DNA supercoiling, ultimately leading to the destruction of the bacterial cell. *In vitro* experiments suggest that EGCG affects the growth of fungal pathogens, Gram-positive bacteria, and Gram-negative bacteria, but Gram-positive bacteria are particularly vulnerable to the polyphenols. Numerous human, animal and *in vitro* studies have shown anticariogenic, anti-inflammatory, thermogenic, probiotic and antimicrobial properties as well.<sup>[7]</sup>

Triphala is one of the most well-known Indian Ayurvedic herbal formulation that consist of dried and powdered fruits of three medicinal plants namely Terminalia Bellerica, Terminalia Chebula and Emblica Officinalis. It is a very good chelating agent because of the fruits that are rich in citric acid, and thus, holds promise in the removal of smear layer. Triphala and GTPs are proven to be safe, containing active constituents that have beneficial physiologic effect apart from its curative properties like anti-oxidant, anti-inflammatory and radical scavenging activity and may have an added advantage over the traditional root canal irrigants.<sup>[5,7]</sup>

An *in vitro* study conducted to evaluate the antimicrobial efficacy of Triphala, GTPs, MTAD, and 5% Sodium Hypochlorite against *E. faecalis* biofilm formed on tooth substrate showed maximum antibacterial activity with NaOCl and statistically significant antibacterial results were observed with Triphala, GTPs and MTAD.<sup>[8]</sup>

### Propolis

Propolis, a resinous beehive product which is a potent antimicrobial, antioxidant and anti-inflammatory agent.<sup>[9]</sup> It is composed of resin and balsams (50-60%), pollen (5-10%), and many other constituents like amino acids, minerals, vitamins A and B complex, and highly active biochemical substance which is known as bioflavonoids (vitamin P), phenols, and aromatic compounds. Propolis has numerous usage in dentistry such as pulp capping agent, as storage media for avulsed teeth, for prevention of caries, and dentine hypersensitivity. The anti-inflammatory property of propolis is due to the presence of caffeic acid and phenethyl ester (CAPE) in propolis.<sup>[7]</sup>

A study conducted by Madhubala *et al.*, found that ethanolic extract of propolis was more effective than triantibiotic mixture at the end of 2 day time period against *E. faecalis*.<sup>[10]</sup>

An *in vivo* randomized controlled trial was conducted in a group of 60 children aged 6-12 years for assessment of the antimicrobial and inflammatory/irritant potential of propolis against mixed endodontic aerobic and anaerobic bacteria found that there was significant decrease in mean aerobic colony forming units count was seen in all irrigants tested.<sup>[11]</sup>

Similar, other studies conducted also proved Propolis to be an effective intracanal irrigant in eradicating *E. faecalis* and *C. albicans*.<sup>[12-15]</sup>

### Neem Extract

*Azadirachta indica* A. Juss is a commonly seen medicinal tree in India, which is considered very holy. It is Popularly known as "Indian neem/ Margosa tree" or "Indian lilac", its well known in India for more than 2000 years as one of the most versatile medicinal plants having a wide spectrum of biological activity.<sup>[5]</sup> Biologic activities and pharmacologic actions of neem are very well established with crude extracts and obtained from its leaf, bark, flowers, roots, seed and oil etc.<sup>[16]</sup>

Use of neem as an endodontic irrigant is advantageous because it is a biocompatible, antioxidant and thus not likely to cause any injuries to patients that is commonly seen with NaOCl. Bitter taste associated with this plant can be altered by different formulations due to addition of sweeteners and flavors to increase the patient compliance, acceptability and increase palatability.<sup>[17]</sup>

The leaf extract has several bioactive compounds that possess antibacterial capabilities. This may be attributed to the tetranortriterpenes that include, nimbin, nimbinin, nimbidinin, nimbolide and nimbidic acid. Nimbidin is a major crude bitter principle extract of neem which has been shown to be the key factor for its antibacterial activity. Nimbidin is also responsible for the anti-inflammatory action of neem.<sup>[18,19]</sup>

The Neem extract has been shown to have a wide spectrum of antibacterial efficacy against Gram positive, as well as Gram negative microorganisms. These effects have been particularly seen against *Streptococcus mutans* and *Enterococcus faecalis*. High levels of anti mycotic activity have also been reported with extracts from different parts of neem.<sup>[18]</sup>

Various studies have shown that aqueous and alcoholic extract of Neem leaf have been proved to inhibit *S. mutans* and also *E. faecalis*.<sup>[20-23]</sup>

### **Turmeric**

Turmeric [*Curcuma longa*] is extensively used in India and neighbouring countries as a spice, food preservative and coloring material. It has also found its use in traditional medicine for the treatment of numerous diseases. *C. longa*, botanically related to ginger [Zingiberaceae family], is a perennial plant having a short stem with large oblong leaves and rhizomes, which are often branched and brownish-yellow in colour.<sup>[5]</sup>

Curcumin [diferuloylmethane], is the main yellow bioactive component which have a wide spectrum of biological actions, including antimicrobial, anti-inflammatory and antioxidant activities.<sup>[24]</sup>

It is believed 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 causing its antibacterial effect.<sup>[25]</sup>

Many studies have shown that curcumin has good antibacterial action against *E. faecalis* and can be used as a substitute to NaOCl for endodontic irrigation.<sup>[24-26]</sup>

### **Morinda Citrifolia [MC]**

Morinda citrifolia [Noni] is one of the traditional folk medicinal plants that has been used for over 2000 years. Noni is the common name for Morinda citrifolia and also has several names like Indian Mulberry, Painkiller bush, Beach mulberry, Ba Ji Tian, Nono or Nonu, Cheese Fruit, and Nhau in various cultures throughout the world.<sup>[5]</sup>

A number of major components have been identified in the Noni plant like 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 procerone.<sup>[27]</sup>

The main compound responsible attributed due to its contents alizarin, scopoletin, acubin and asperuloside. It is found that Aqueous, Ethanol, chloroform and

methanolic extracts from seeds, leaves, fruits and roots show antimicrobial activity.

In a study done by kandasamwamy et al., Morinda Citrifolia was found to have significant antibacterial activity.<sup>[28]</sup>

### **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.<sup>[5]</sup>

The antimicrobial effect of Liquorice extract is due to the Glycyrrhizin content present in them. The flavonoid content of Liquorice extract is also a strong inhibitor of oxygen consumption in bacterial cells.<sup>[29]</sup> The site of inhibition is thought to be between CoQ and cytochrome C in the bacterial respiratory electron transport chain.<sup>[30]</sup>

Liquorice at a concentration of 50% has an inhibitory effect on *Streptococcus mutans* and *Enterococcus faecalis*. Liquorice has also shown good antimicrobial activity against *Streptococcus Aureus*.<sup>[31]</sup>

In a study conducted by A E Badr et al., showed that liquorice extract had a potent bactericidal effect against *Enterococcus Faecalis*.<sup>[29]</sup>

### **Tea Tree Oil**

Tea tree [*Melaleuca alternifolia*] is a native Australian plant, the oil of which has many properties that makes its use in dentistry. It has antiseptic and antifungal properties. It also has mild solvent action, and thus could be used as a potential root canal irrigant for dissolving the necrotic pulp tissue. Tea tree oil's major active component is terpinen-4-ol [about 30- 40%]. This compound is the reason for its antibacterial and antifungal properties.<sup>[5]</sup>

In a recent study conducted to compare the antibacterial efficacy of tea tree oil, it was concluded that maximum antimicrobial activity was shown by 2% Chlorhexidine followed by tea tree oil and then 3% sodium hypochlorite.<sup>[32]</sup>

Similarly an in-vitro study showed that tea tree oil might be equally effective in disinfecting the root canal system in comparison with NaOCl.<sup>[33]</sup>

### **Garlic**

*Allium sativum*, commonly known as garlic, is a species in the onion genus, *Allium*. It has been used for both culinary and medicinal purposes. The garlic plant's bulb is the most commonly used part and has found its way into dentistry as well.<sup>[34]</sup>

*Allium sativum* yields allicin, an antibiotic and antifungal compound (phytoncide). It can be used to help

speed recovery from sore throat or other minor ailments because of its antibiotic properties. It also contains the sulphur containing compounds alliin, ajoene, diallylsulfide, dithiin, S-allylcysteine, and enzymes, B vitamins, proteins, minerals, saponins, flavonoids, and Maillard reaction products, are not sulfurcontaining compounds. Furthermore, a phytoalexin (allicin) was found in garlic, which is a nonsulfur compound with a  $\gamma$ -pyrone skeleton structure with - antioxidant, antimicrobial effects, antitumor promoting effects. The compound causes inhibition of aflatoxin B2 DNA binding, and neurotrophic effects. Allicin, which is an unstable compound formed from the allinin is found to be reason for the inhibition of fungal growth (Amagase *et al.*, 2001). The main antimicrobial effect of allicin is due to its chemical reaction with thiol groups of various enzymes (Ankri *et al.*, 1999).<sup>[35]</sup>

## CONCLUSION

Currently in the present word of evidence based medicine, all new materials intended for human usage should go through series of invitro and invivo tests to understand its effectiveness and biocompatibility. Herbal medicines being a current trend have been proved credible evidence and clinical judgement to be an effective as well as biocompatible to human tissues. It has advantages of ease of availability, reduced cost, reduced side effects and antimicrobial resistance when compared to conventional counterparts. Thus, this paper has taken into consideration the important herbal irrigants used as root canal irrigants.

## REFERENCES

- Rajwinder Kaur, Reetu Singh, Kunal Sethi, Sunny Garg, Saurav Miglani, Sunila Vats. Irrigating Solutions in Pediatric Dentistry: Literature Review and Update. *J Adv Med Dent Scie* 2014;2(2):104-115.
- Sushma Jaju and Prashant P. Jaju. Newer Root Canal Irrigants in Horizon: A Review. *International Journal of Dentistry* 2011; Article ID 851359.
- P.N. Abbott, et al. an SEM of the effects of defects of different irrigation sequences and ultrasonics. *I.E.J.*, 1991; 24: 308-316.
- Jose F. Seueira. Efficacy of instrumentation techniques and irrigation regimens in reducing the bacterial population with in root canals. *J.O.E.*, 2002; 28(3): 181-184.
- Prasanna Neelakantan, Nithya Jagannathan, Nabeel Nazar. Ethnopharmacological approach in Endodontic Treatment: A Focused Review *International Journal of Drug Development and Research*, 2011; 3(4): 68-77.
- Ismail S, Adyanthaya A, sreelakshmi N. Intracanal irrigants in pediatric endodontics: A review. *IJADs*, 2017; 3(4): 245-251.
- Pujar M, Makandar S. Herbal usage. In *Endodontics: a review*. *IJCD*, 2011; 2(1): 34-37.
- J. Prabhakar, M. Senthikumar, M. S. Priya et al. Evaluation of Antimicrobial Efficacy of Herbal Alternatives (Triphala and Green Tea Polyphenols), MTAD, and 5% Sodium Hypochlorite against *Enterococcus faecalis* Biofilm Formed on Tooth Substrate: An *In Vitro* Study. *J Endod*, 2010; 36: 83-86.
- Nara A, Chandra DP, Anandakrishna L, Dhananjaya G. Comparative evaluation of antimicrobial efficacy of MTAD, 3% NaOCl and propolis against *E. Faecalis*. *Int J Clinic Ped Dent* 2010; 3(1): 21-25.
- Madhubala MM, Srinivasan N, Ahamed S. Comparative evaluation of propolis and triantibiotic mixture as an intracanal medicament against *Enterococcus faecalis*. *J Endod* 2011; 37: 12879.
- Jolly M, Singh N, Rathore M, Tandon S, Banerjee M. Propolis and commonly used intracanal irrigants: Comparative evaluation of antimicrobial potential. *J Clin Pediatr Dent*, 2013; 37: 243-9.
- Arsilan S, Ozbilge H, Kaya EG, Er O. In vitro antimicrobial activity of propolis, BioPure MTAD, sodiumhypochlorite, and chlorhexidine on *enterococcus faecalis* and *Candida albicans*. *Saudi Med J.*, 2011; 32(5): 479-483.
- Ghorbanzadeh S, Loodaricheh SA, Samizade S, Zadsirjan S. Irrigants in endodontic treatment. *Int J Contemp Dent Med Rev*, 2015; Article ID: 030515.
- Sonarkar S, Purba R. Bioactive materials in conservative dentistry. *Int J Contemp Dent Med Rev*, 2015; Article ID: 340115.
- Swetha B, Mathew S, Murthy BV, Shruthi N, Bhandi SH. Determination of biocompatibility: a review. *Int Dent Med J Adv Res.*, 2015; 1(1): 1-6.
- Subapriya R and S. Nagini, Medicinal properties of neem leaves: a review. *Curr Med Chem and Anti-Cancer Agent*, 2005; 5: 146-149.
- Botelho M, Araujo Dos Santos, Martins J, Carvalho C, Paz M, Azenha C, Ruela R, Queiroz D, Ruela W, Marino G, Ruela F, Efficacy of a mouthrinse based on leaves of neem in the treatment of patients with chronic gingivitis, *J Medicinal Plants Research*, 2008; 2: 341-346.
- Bohora A, Hegde V, Kokate S. Comparison of the antibacterial efficiency of neem leaf extract and 2% sodium hypochlorite against *E. faecalis*, *C. albicans* and mixed culture – An in vitro study. *Endodontology*, 2010; 22: 8-12.
- Dubey S, Chaodary M, Gupta P. Comparative study of the antimicrobial efficiency of Neem leaf extract, Sodium hypochlorite and Biopure MTAD -An *in vitro* study. *Indian journal of dental advancements*, 2012; 4: 740-743.
- Lakshmi T, Krishnan V, Rajendran R, Madhusudhanan N. *Azadirachta indica*: A herbal panacea in dentistry – An update. *Pharmacognosy reviews*, 2015; 9: 41-44.
- Mistry KS, Sanghvi Z, Parmar G, Shah S. The antimicrobial activity of *Azadirachta indica*, *Mimusops elengi*, *Tinospora cardifolia*, *Ocimum sanctum* and 2% chlorhexidine gluconate on



- common endodontic pathogens: An *in vitro* study. *European journal of dentistry*, 2014; 8: 172-177.
22. Bhargava K, Kumar T, Aggarwal S, Zinzarde S, Sanap A, Patil P. Comparative evaluation of the antimicrobial efficacy of neem, green tea, triphala and sodium hypochlorite: An *in vitro* study. *Journal of dental research and review*, 2015; 2: 13-6.
  23. Arindam Dutta. Comparative antimicrobial efficacy of *Azadirachta indica* irrigant with standard endodontic irrigants: A preliminary study. *J Conserv Dent*, 2014; 17(2): 133-137.
  24. Neelakantan P, Subbarao C, Subbarao CV. Analysis of Antibacterial Activity of Curcumin against *Enterococcus Faecalis*. *International Journal of Current Research and Review*, 2011; 3: 37-42.
  25. Rai D, Singh JK, Roy N, Panda D. Curcumin inhibits FtsZ assembly: an attractive mechanism for its antibacterial activity. *Biochemical Journal*, 2008; 410: 147-55.
  26. Marickar RF, Geetha RV, Neelakantan P. Efficacy of contemporary and novel Intracanal medicaments against *Enterococcus faecalis*. *The Journal of clinical pediatric dentistry*, 2014; 39: 47-50.
  27. Levand O, Larson HO. Some chemical constituents of *Morinda citrifolia*. *Planta Med*, 1979; 36: 186-7.
  28. Kandaswamy D, Venkateshbabu N, Gogulnath D, Kindo AJ. Dentinal tubule disinfection with 2% chlorhexidine gel, propolis, morinda citrifolia juice, 2% povidone iodine, and calcium hydroxide. *International endodontic journal*, 2010; 43: 419-23.
  29. Badr, A. E., N. Omar, and F. A. Badria. "A laboratory evaluation of the antibacterial and cytotoxic effect of Liquorice when used as root canal medicament." *International Endodontic Journal*, 2010; 44(1): 51-58.
  30. Bodet C, La VD, Gafner S, Bergeron C, Grenier D. A Liquorice extract reduces lipopolysaccharide induced proinflammatory cytokine secretion by macrophages and whole blood. *J Periodontol*, 2008; 79: 1752-61.
  31. Hegde V, Kesaria DP. Comparative evaluation of antibacterial activity of neem, propolis, turmeric, liquorice, and sodium hypochlorite as root canal irrigants against *E. faecalis* and *C. albicans* An *in vitro* study. *Endodontology*, 2013; 25: 38-45.
  32. Kamath U, Sheth H, Ramesh S, Singla K. Comparison of the antibacterial efficacy of tea tree oil with 3% sodium hypochlorite and 2% Chlorhexidine against *E. faecalis*: An *in vitro* study. *Journal of Contemporary Dentistry*. 2013; 3: 117-120.
  33. Sadr Lahijani MS, Raof Kateb HR, Heady R et.al. The effect of German chamomile [*Marticaria recutitia* L.] extract and tea tree [*Melaleuca alternifolia* L.] oil used as irrigants on removal of smear layer: a scanning electron microscopy study. *Int Endod J.*, 2006; 39: 190-95.
  34. Ambareen Z, Chinappa A. Go Green Keep the Root Canal Clean. *International Journal of Dental Sciences and Research*, 2014 2(6): 21-25.
  35. Jose J, Shoba K, Aman S, Tomy N, Sheena and Christie. Comparative evaluation of antimicrobial activity of green tea extract, garlic extract, neem leaf extract and sodium hypochlorite as root canal. *Int J Curr Microbiol App Sc*, 2015; 4(10): 384-391.