



Herbal Sealers in Endodontics – A Systematic Review

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ABSTRACT

Root canal infections usually occur due to many micro-organisms, among which most frequent are the obligatory anaerobes. One of the predominantly found microbes is *Candida albicans* that requires special attention. Herbs have and are being used for health ailments and avoiding diseases that include epidemics for decades. A lot of plants are used as Phytomedicines in the dental profession because they have various biological and antimicrobial effects. Various irritants are used such as NaOCl, Chlorhexidine, hydrogen peroxide, ethylenediaminetetraacetic acid (EDTA), citric acid etc. to eradicate microbes. However, these irrigants may have several disadvantages. In Endodontics, plants and their extract can be used as irrigant and intracanal medicament to prevent the potential side effects caused by conventional chemical agents. Less toxic herbal products are being used since ancient era, and they are *Triphala*, *Morinda citrifolia*, *Propolis*, *Azadirachta indica*, *Carvacrol*, *Green tea*, *Orange oil*, *tea tree oil*, *Arctium lappa*, *Garlic extract* etc. Most commonly used are *Triphala*, *Morinda citrifolia*, *Propolis*, *Azadirachta indica*, *Green tea*, *Garlic extract*. Such herbal preparations are derived from the roots, leaves, seeds, stems and flowers of medicinal plants. This systematic review aims to enlighten and focus on various herbal products that can be used in endodontics to eradicate the root canal infection and to create the environment necessary for periapical healing. This is essential for successful Root canal treatment.

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INTRODUCTION

Root canal infections usually occur due to many micro-organisms, among which most frequent are the obligatory anaerobes. One of the predominantly found microbes is *Candida albicans* that requires special attention. They commonly occur in long-standing periapical infection. They also occur in retreatment cases. Another main micro-organism commonly occurring in the biofilm is *Enterococcus faecalis* (Schirrmeister et al., 2009). Both micro-organisms have a unique feature of surviv-

ing harsh conditions. They can modify their occurrence according to the environment. This is mainly because of their physicochemical properties and biofilm formation (Waltimo et al., 2004).

Endodontic therapy aims for disinfection as well as cleanliness of the canal. The primary objective of this therapy is to make the root canals free from microbes and debris that are mainly responsible for pulp and periapical infection. This can be achieved by chemical treatment of the root canal system. This treatment comprises of biomechanical preparation, irrigation and interappointment medicaments (Sundqvist et al., 1998). Complete disinfection of the root canal and creating favourable conditions are required for periapical healing (Chandak et al., 2017). However large proportions of the root canal remain untouched during instrumentation leading to the catastrophe of the root canal treatment. Irrigation helps in proper disinfection as well as eradication of infected micro-organism. Various irritants are used, such as NaOCl, Chlorhexidine, hydrogen peroxide, ethylenediaminetetraacetic acid (EDTA), citric acid etc (Zehnder, 2006). However, these irrigants may have several disadvantages.

Less toxic herbal products are being used since ancient era, and they are *Triphala*, *Morinda citrifolia*, *Propolis*, *Azadirachta indica*, *Carvacrol*, *Green tea*, *Orange oil*, *tea tree oil*, *Arctium lappa*, *Garlic extract* etc. Most commonly used are *Triphala*, *Morinda citrifolia*, *Propolis*, *Azadirachta indica*, *Green tea*, *Garlic extract*.

Propolis is an effective anti-inflammatory, antioxidant, antimicrobial agent. This is due to the presence of phenolic compounds. Also, there are flavonoids and other aromatic compounds. It is a brownish resinous element. It is collected from plants and is used to keep the environment sterile (Kandaswamy et al., 2010).

The ayurvedic Rasayana known as *Triphala* consists of *Amulaki* / *Nelli* (*Emblica officinalis*), *Bibhitaki* / *Bulu* (*Terminalia bellirica*) and *Halituki* / *Aralu* (*Terminalia chebula*) (Biradar et al., 2008). It has been suggested to be used in Endodontics. It also is used as an anticaries agent, and as a mouth rinse.

Indian Neem is also named as *Azadirachta Indica*, and it has anti-adherence property. Due to this bacterial cell adhesion is transformed. It affects the colonizing property of bacteria. It is also a good antioxidant. It shows antimicrobial activity against *E.faecalis* and *C.albicans* (Chandak et al., 2018).

Morinda Citrifolia Juice (MCJ) is derivative from *Morinda Citrifolia* which is a fruit-bearing tree of the coffee family. It has a chelating ability. It removes

the smear layer effectively. It also has antimicrobial activity against anaerobic bacteria that is *E. faecalis* and *C. albicans* (Jainkittivong et al., 2009).

Green tea extracts and garlic extracts are also effectively used in endodontics. They have antimicrobial, antioxidant, and anti-inflammatory property.

Many in-vitro and ex-vivo studies have been carried out to analyze the effectiveness of these herbal medicaments against *Candida Albicans* infection in root canals.

METHODOLOGY

Research Question

Whether using herbal sealers is an effective treatment against *Candida albicans* in case of retreatment of Root canals ??

Procedure

“Using the PRISMA guidelines statement, this systematic review was conducted. Reviewing all the abstracts and all texts, the studies are carefully chosen according to the inclusion and exclusion criteria and are reported below. None of the manuscript authors was contacted during this process. Disagreements between authors were evaluated, and the studies were eliminated through discussion among researchers until a consensus was reached.”

Search strategy

“Two independent researchers conducted searches in PubMed/Medline, Web of Science, and Scopus to identify studies published in English without restriction on year of publication.” The keywords used were “herbal sealers”, “herbal irrigants”, “*Candida albicans*”, “*Triphala*” and “propolis”, “*Morinda Citrifolia* juice”, “*Green tea* and *garlic extracts*”.

The search details were herbal medicaments (all fields) AND ((*Triphala* OR *Propolis* OR *Morinda Citrifolia* juice OR *Green tea* extract OR *Garlic extract*)) AND ((efficacy against *Candida albicans* in root canal infection)).

Criteria for Inclusion and Exclusion

Included were

“The inclusion criteria for this review included studies published in English without restrictions on the year of publication and studies which evaluated and compared the efficacy of *Triphala*, *Propolis*, *Morinda Citrifolia* juice, *green tea* extract, *garlic extract* against *Candida albicans* in root canal infection.

The types of studies were in vitro and ex vivo studies using human cells, prospective studies, retrospective studies.”

Excluded were

“Studies that resulted in cytotoxicity of sealers, in vivo studies were excluded.”

Criteria for selection of the studies

“First, studies were selected by analysis of the titles. If the title indicated inclusion, the abstract was evaluated carefully, and articles considered eligible for review (or in case of doubt) were selected for reading. Due to the lack of randomized clinical trials and prospective and retrospective studies, this review included in vitro studies and ex vivo studies using human root canals. For this reason, the patient-intervention-comparison-outcome (PICO) system was adapted: population (studies that evaluated human root canals), intervention (evaluation of herbal medicaments), comparison (comparison of the Triphala, Propolis, Morinda Citrifolia juice, Green tea extract, Garlic extract), and outcomes (which medicament is effective against candida *Albicans* in root canal infection).”

RESULTS

“The preliminary screening of the retrieved studies was conducted using titles and abstracts. The corresponding full text was read when the results were unclear. The authors independently evaluated the studies and discussed the results until a decision was reached by consensus. Among the 15 studies, five studies were screened for inclusion.” One ex vivo study, four in vitro studies included in the study. Figure 1 summarises the details and results of the search strategy.

DISCUSSION

Root canal treatment aims at eradication of microbes from the root canal. It also aims at prevention of microbial recontamination in the treated root canal. Micro-organisms commonly occurring in the Endodontic reinfection are *Candida albicans* and *Enterococcus faecalis*. Therefore the elimination of these microbes is essential for successful root canal therapy. Commercially various irrigants and medicaments are used for treatment. They are Sodium hypochlorite, Chlorhexidine, EDTA etc. however, there are some drawbacks. Herbal extracts have been tried for their antibacterial and antifungal properties. Hence this study aims at analyzing the efficacy of various herbal extracts against *Candida albicans* in infected root canals.

As mentioned in Table 1, Raghavendra and Balsaraf (2014) did in vitro study to assess the antifungal efficacy of *Azadirachta indica* (Neem), 3% NaOCl, 2%

CHX. The zones of inhibition were noted of the three materials. A statistically significant difference was not found amid the zone of inhibition of neem leaf extract and 3% NaOCl. However statistically significant difference was found amid neem leaf extract and 3% NaOCl with 2% CHX. Antimicrobial potential of the neem is better. This is found to be specially related to gingivitis and periodontitis (Vinothkumar *et al.*, 2013). Neem can be used as an endodontic irrigant. This is attributed to its biocompatibility and antioxidant property. Neem does not cause severe injuries in the oral cavity which may occur due to sodium hypochlorite accidents. Bacterial and fungal adhesion is prevented by neem. It is due to its anti-adherence activity. Neem has constituents called Nimbidin and nimbolide (Jainkittivong *et al.*, 2009). These are responsible for antibacterial and antifungal properties. This causes bacterial and fungal cell wall lysis (Prabhakar *et al.*, 2010). Results attained from this study was neem extract was efficacious against *C. Albicans*. Hence the author concluded that the Effectiveness of neem leaf extract was comparable to 3 % sodium hypochlorite.

As mentioned in Table 1, Jose *et al.* (2015) performed an in vitro study to evaluate and compare the efficacy of herbal medicaments such as green tea extract, garlic extract and neem extract comparable to the efficacy of sodium hypochlorite against *Candida albicans* in root canal infection (Sundaram *et al.*, 2016). They measured the zones of inhibition. Mean diameter of 4.2 cm for candida *Albicans* was found in NaOCl. Mean diameter of inhibition for *C. Albicans* was 2.7 cm by green tea extract and 2.8 cm for garlic extract. He concluded that sodium hypochlorite was best among the four solutions. However, it was toxic when used injudiciously. Green tea extract showed better result against *C. Albicans* as compared to garlic extract and neem extract. But not as good as Sodium hypochlorite. Herbal medicaments are less tissue toxic as compared to sodium hypochlorite. Green tea polyphenols show antioxidant, anti-cariogenic, anti-inflammatory, probiotic and antimicrobial properties. It prevents biofilm formation. Natural fluoride is also present in green tea (Jainkittivong *et al.*, 2009). It is helpful in the prevention of caries. The content Catechin, mainly epigallocatechin-3-gallate present in green tea, is beneficial. Garlic has minerals (Selenium) and many sulphur compounds. The pungent odour and many of its medicinal effects are attributed to sulphur compounds. An unstable compound formed from Allicin present in garlic named allicin is responsible for inhibition of fungal growth (Amagase *et al.*, 2001). This compound inhibits both sproutings of spores and development of hyphae.

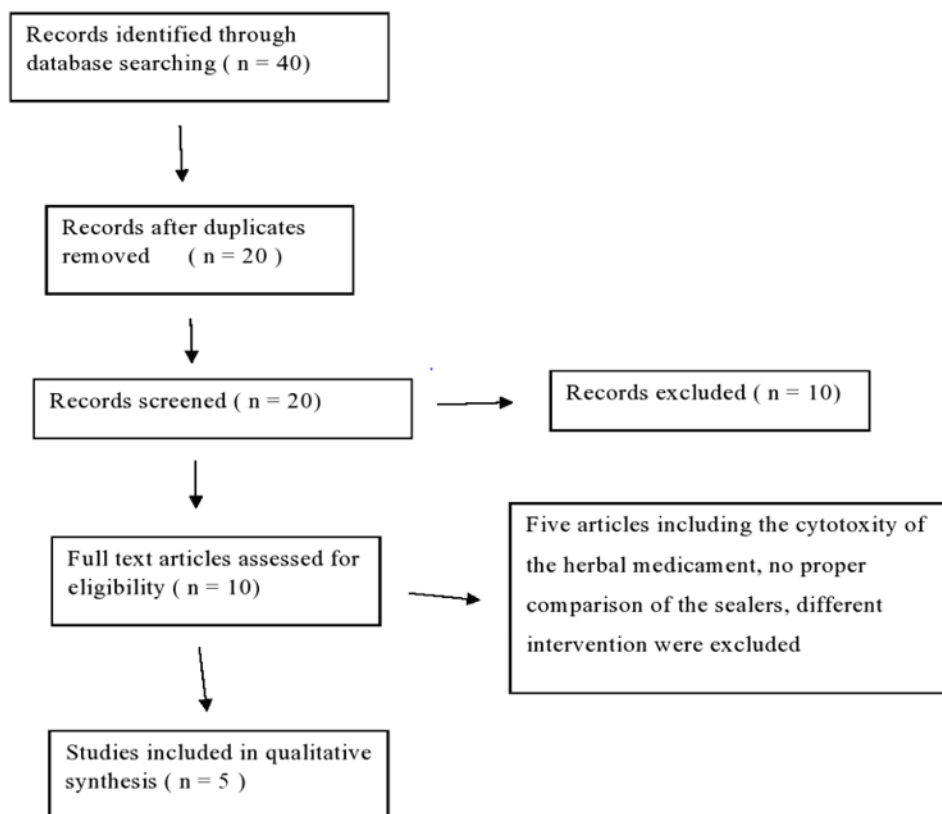


Figure 1: Prisma Flow Diagram

The allicin elicits antimicrobial effect due to its chemical reaction with the thiol group of various enzymes (Ankri and Mirelman, 1999). Hence the author concluded that green tea and garlic extract are effective against *C. Albicans*. Further research is necessary to conclude the Effectiveness of herbal extracts against *C. Albicans*.

As mentioned in Table 1, Jyothi and Gopal (2016) performed an in- vitro study comparing the antimicrobial efficacy of 0.3% Propolis, 10% neem, 10% Triphala and 5% sodium hypochlorite on *Candida albicans* and *Enterococcus faecalis* biofilm in root canal infection. The data obtained were analyzed digitally by colony count. Triphala and NaOCl showed no statistically significant difference. NaOCl, Triphala and neem showed no statistically significant difference. Propolis showed little antibacterial activity against *C. Albicans*. Triphala is effectively used in endodontics. Its efficacy is comparable to sodium hypochlorite. It is as effective as sodium hypochlorite. Triphala has antimicrobial property because of its formulation that has three medicinal plants in equal portions. They are Terminalia bellerica, Terminalia chebula, Emblica officinalis. These three combined results in additive/ synergistic effect (Pujar, 2011). Triphala also has antioxidant property. Efficacy of Triphala can

be partially due to this property. Propolis has good antimicrobial property. But is less as compared to Triphala and sodium hypochlorite. Propolis contains flavonoids and various esters of caffeine acid. The antimicrobial effect of propolis can be attributed to this. Propolis contains an unidentified, water-soluble, ultraviolet absorbing component. This hinders bacterial DNA dependent RNA polymerases (Simuth et al., 1986). Propolis have variable composition. Neem is another herbal extract showing good antimicrobial property similar to Triphala and sodium hypochlorite. Alkaloids, glycosides, flavonoids, steroids, anthraquinone and tannic acid are present resulting in its antimicrobial property. Hence the authors concluded that Triphala is effective against *Candida albicans* formed in the infected root canal. Further research is needed on herbal extracts to conclude their Effectiveness.

As mentioned in Table 1, Wijesinghe et al. (2018) performed an experiment evaluating and comparing the antimicrobial and anti-candida activity of Chlorhexidine gluconate, Triphala and Munamal pothu (bark of Mimusops elengi). The results were calculated by testing the zones of inhibition. CHX had a zone of inhibition for all ten test strains of *Candida* species.

Table 1: Presents the reported efficacy of herbal medicaments against *Candida Albicans* in root canal infection

Study	Study type	Population	Intervention	Comparison	Outcome	Method
(Raghavendra and Balsaraf, 2014)	In-vitro	<i>Candida albicans</i> (ATCC 10231)	NaOCl, Neem, Chlorhexidine	Neem 3% NaOCl 2% CHX	Herbal products show significant inhibitory effects against <i>C.albicans</i>	Agar Diffusion test. Zones of inhibition were recorded.
(Jose et al., 2015)	In-vitro	<i>Enterococcus faecalis</i> (ATCC 29212), <i>Candida albicans</i> (ATCC 10231)	Green Tea, Neem, Garlic extract, NaOCl.	Group 1-Green tea, Group 2-Neem leaf extract, Group 3- Garlic extract, Group 4- 2.5% NaOCl.	Herbal products show significant inhibitory effects against <i>C.albicans</i> .	Agar diffusion test. Zone of inhibition was recorded.
(Jyothi and Gopal, 2016)	In-vitro	<i>C. Albicans</i> [ATCC 10231] <i>E. faecalis</i> ATCC (29212)	Propolis, Neem, Triphala, NaOCl	Group 1- 0.3% Propolis, Group 2- 10% Neem, Group 3- 10% Triphala, Group 4- 5% NaOCl, Group 5- Positive control, Group 6 - Negative control.	Herbal products show significant inhibitory effects against <i>C.albicans</i> .	It is analyzed digitally for colony count.

Continued on next page

Table 1 continued

Study	Study type	Population	Intervention	Comparison	Outcome	Method
(Wijesinghe et al., 2018)	In-vitro	<i>C. albicans</i> : ATCC10231. <i>C. tropicalis</i> : ATCC13803. <i>C. parapsilosis</i> : ATCC22019 <i>C. glabrata</i> : ATCC90030 <i>C. dubliniensis</i> : MYA 580 3 Gram +ve cocci, 2 Gram -ve cocci.	Chlorhexidine, Triphala, Mimusops elengi.	Group 1- 0.2% CHX, Group 2- Triphala, Group 3- Mimusops elengi (Munamal)	Herbal products show significant inhibitory effects against <i>C.albicans</i>	agar well diffusion method. zone of inhibition was measured
(Sardana et al., 2018)	Ex-vivo		Morinda citrifolia, Triphala, NaOCl, Chlorhexidine.	Group 1- Morinda citrifolia Group 2- Triphala Group 3- 1% NaOCl Group 4- 2% CHX Group 5- Control group Group 6- Distilled water.	Herbal products show significant inhibitory effects against <i>C.albicans</i> .	agar well diffusion method. Zone of inhibition was recorded

Zone of inhibition by Triphala was against *C. Albicans*, *C. tropicalis* and *C. paraprotopolis*. Munamal pothu did not show any zone of inhibition against *C. Albicans*. Chlorhexidine gluconate is acceptably used in endodontics. It has an action against free-living planktonic cells. This showed its usefulness in the prevention of microbial colonization and viability. Yet using it for longer duration can show side effects, such as staining teeth, development of resistance, altering the taste sensation. Triphala possesses anti-inflammatory, antioxidant, antimicrobial activity against broad spectrum microbes (Gomes et al., 2013; Salam et al., 2015). Microbes include bacteria, yeasts, dermatophytes (Gomes et al., 2013). The active phytochemicals include tannic acid, chebulic acid and flavonoids that show activity against *C. albicans* (Jyothi and Gopal, 2016). Hence to conclude Chlorhexidine gluconate is a potent antifungal and antimicrobial agent against *C. Albicans*. Triphala is as potent as Chlorhexidine with lesser side effects.

As mentioned in Table 1, Sardana et al. (2018) performed an ex-vivo study exploring the role of *Morinda citrifolia* and Triphala juice against *Candida albicans* and *Enterococcus faecalis* present in root canal infection. The colony-forming unit was calculated for each sealer. The microbial count was reduced in CHX and Triphala. Chlorhexidine used in this study was found to be an efficient antifungal agent as compared to an antibacterial agent. *Morinda citrifolia* juice (MCJ) is from the traditional folk medicinal plant used by Polynesians. Acubin, L-asperuloside, Alizarin, and some anthraquinones are present in MCJ are believed to express its antibacterial activity (Murray et al., 2008). MCJ was found effective in removing the smear layer, particularly when combined with EDTA. But it was not as efficient as NaOCl and EDTA. MCJ is a biocompatible oxidant. Hence it did not cause grave injuries if extruded out (Jainkittivong et al., 2009). An Indian Ayurvedic herbal formulation – Triphala, consists of dried and powdered fruits of three medicinal plants. They are *Terminalia bellerica* (Bihara/belericmyrobalan), *Terminalia chebula* (Harad/chebulic myrobalan), and *Emblica officinalis* (Amla/gooseberry). It has good antimicrobial activity. Triphala is also an excellent chelating agent. This is because the fruits are rich in citric acid. This results in an effective smear layer removal (Prabhakar et al., 2010). Hence the overall results showed that Triphala holds antibacterial efficacy against *E. faecalis*. MCJ holds better antifungal efficacy against *C. albicans*. Yet further studies are required to conclude the benefits of these herbal extracts.

Herbal sealers are safe, economical, readily avail-

able, biocompatible, have a good shelf life, are antioxidant, anti-inflammatory and have fewer chances of microbial resistance.

CONCLUSION

Candida albicans is conspicuously found microbe in failed root canal treatment. *C. albicans* cannot be eradicated with conventional root canal sealers. Hence the sealers having good biocompatibility and least microbial resistance is required for elimination of *Candida albicans*. Hence herbal sealers are an effective treatment against *Candida albicans* in case of retreatment.

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Conflict of Interest

The authors declare that there is no conflict of interest for this study.

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