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REVIEW

# Triphala in endodontics: A review

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Triphala is an ancient Ayurvedic medicine with numerous advantages. It is an Ayurvedic blend of three different ayurvedic herbs. As a result, the composite material's efficiency will be greater than that of its elements. Shaping and cleaning are important aspects of successful endodontic treatment. A variety of chemicals are used to irrigate the root canals and kill the microorganisms that cause root canal infection. These compounds have their own set of drawbacks. As a result, ayurvedic medications are increasingly being employed in endodontics to offset the disadvantages of traditional chemicals. The effectiveness of triphala in endodontic applications is examined in this review.

**Keywords:** triphala, irrigation, chelation, natural herb, endodontic irrigant

## Introduction

Triphala been utilized in Ayurvedic (Indian) medicine for about 2,000 years. It is formed from the dehydrated and preserved powder of three distinctive fruits, thus bearing the names tri, meaning three, and phala, meaning fruit. (1) Triphala is a vedic compound made up of balanced portions of three dried astringent fruits: Amalaki (*Emblica officinalis*), Bibhitaki (*Terminalia bellirica*), and Haritaki (*Terminalia bellirica*) eaten without seed (*Terminalia chebula*). Triphala is a mixture made up of equal portions of the three tropical fruits mentioned above, all of which have the efficiency to reduce pain, inflammation, and reverse aging.(2) Tannic acid is the most important component. Headaches, constipation, and liver diseases have all been treated with it in Indian traditional medicine. (3) According to preliminary research, the tannic acid present in triphala has an antibacterial impact on a wide variety of bacteria. Triphala's benefits include its ease of use, economy, substantivity, good biocompatibility, and germicidal properties. (4, 5) Many of the biological features of triphala may be the reason for its vital role as an antioxidant. Tannic acid is the most abundant component in the ripe fruit of the above-mentioned three myrobalans (6).

Triphala has both nutritive and blood- and liver-cleansing effects. Its effectiveness as a lubricating laxative is limited due to the presence of anthroquinones. This polycyclic aromatic hydrocarbon helps with bile flow and peristalsis movement. It has a high nutritional value because it contains vitamin C and linoleic oil. Purgatives and demulcent laxatives are sought by persons suffering from bowel irregularities as a result of liver and gall bladder congestion. Except for constipation induced by a lack of vital energy, triphala is effective for all types of constipation. Herbal medicine is essentially a matter of perspective, with one approach focusing on tonification and the other on removal. However, overemphasizing tonification has one drawback: in extreme cases, it can lead to greater stagnation and congestion. Indicating expulsion by the abuse of laxatives is insufficient by then because it depletes minerals and vital vitamins from the body as well as causing an imbalance of good gut bacteria, resulting in weakness from constant fatigue and a reduction in RBCs (7, 8, 9).

The pharmacological effects of triphala are due to its formulation with tannins, quinones, flavones, flavonoids, flavonols, gallic acid, and vitamin C (5).

## Role of triphala in endodontics

The role of triphala in root canal therapy is explained below.

### As an irrigant

Artificial and unnatural chemical constituents are manufactured as liquid suspensions for their application as endodontic irrigants used in the cleaning of the root canal system, but they have adverse effects like toxicity, allergy, an unpleasant flavor, and are expensive (5).

Microorganisms in the oral cavity cause endodontic infections primarily, which are mainly caused by pathogens that can opportunistically penetrate necrotic pulp tissue inside the root canal and initiate infections. When a root canal is infected chronically, the aggregate facultative anaerobic bacteria count increases. The most persistent species in a non-healing root canal is *Enterococcus faecalis*, which is a gram-positive facultative anaerobe. The rhizosphere's microbial community is easily dislodged with sodium hypochlorite (NaOCl); however, it has certain limitations. Triphala has been demonstrated to have antibacterial activity against biofilms after 3 and 6 weeks. Herbal alternatives to sodium hypochlorite as root canal irrigants prevailed over sodium hypochlorite's numerous negative qualities. (9, 10) Triphala is a safe choice for frequently used root canal irrigants because it is made up of chemicals that have correct physiologic effects as well as anti-oxidant and anti-inflammatory qualities (5, 11).

One of the main goals of biomechanical preparation in root canal therapy is to eradicate these germs from the root canal system. (1) Microorganisms, on the other hand, may persist following conventional root canal preparation in one of these: the tiny tubules of the dentin or the apical plug of the dentin. (12) Because of the exceedingly complicated root canal anatomy, mechanical instrumentation alone is unsuccessful in cleaning the root canal system. (13) As a result, watering should be used in conjunction with cleaning and shaping. Some of the irrigants employed are sodium hypochlorite (NaOCl), ethylenediaminetetraacetic acid (EDTA), citric acid, chlorhexidine gluconate, hydrogen peroxide, povidone-iodine, etc. (14). NaOCl is the most commonly recommended by doctors, according to scientific literature in regards to the irrigation's quality. However, there are still concerns about its impact on essential tissues. It causes inflammation and is cytotoxic in nature, causing severe pain and eventually necrosis of all essential tissues when it occurs through the root apex. As an added bonus, its high toxicity, obnoxious taste, and inefficiency in removing the debris attached to the enamel and dentin are also concerned. (15) Herbal alternatives are suggested as a way to get over the drawbacks of currently available irrigants (2).

In their systematic review, Kavalipurapu Venkata Teja et al discovered that triphala, green tea polyphenols, and *Morinda citrifolia* were employed in four studies (2, 16–18). Triphala was determined to be the most potent antibacterial agent among the nine herbal agents studied in the evidence-based complementary and alternative medicine study, followed by green tea polyphenol and *Morinda citrifolia* (19).

When comparing triphala to sodium hypochlorite in a study conducted by V P Reshma Raj et al., the Alamar blue assay revealed no cytotoxic characteristics against the L929 murine fibroblast cells (20).

In their review, Ummey Salma et al. discovered that Triphala had substantial antibacterial action against intestinal infections as well as significant biofilm inhibitory activity. This is due to the presence of tannic acid, which is its primary component. (16) In comparison to typical root canal irrigant, Triphala has the extra benefit of being an antioxidant and anti-inflammatory agent, making it a good alternative with no adverse effects like those of NaOCl (21, 22).

### As an antimicrobial agent

Although *Enterococcus fecalis* is a minor part of the microbial flora in infected canals, it is a tenacious bacterium that has a significant role in the pathogenesis of apical lesions after root canal therapy. It can live in the root canal as a planktonic bacterium or as a biofilm, and it is typically discovered mostly in failed root canal treatment cases (22–77%). (23) *E. fecalis* can withstand extreme environments due to biofilm formation and the organism's physicochemical features, which allow it to adapt to changing environmental and nutritional conditions. Biofilm protects bacteria against phagocytosis, antibodies, and antimicrobial agents, which makes them resistant in many ways. This can be linked to the extracellular matrix's protective barrier. (24) After 6 weeks, the mature biofilm exhibits symptoms of mineralization (6, 25).

Because of the fruits' high citric acid content, triphala is an efficient chelating agent and has shown promise in removing the smear layer. (26) Tannic acid, the main component of Triphala, has been shown in various studies to have properties like controlling the growth of bacteria and killing the bacteria mainly against gram-positive and gram-negative bacteria. Their method of action is to deactivate microbial adhesins, cell envelope transport proteins, and enzymes. (27) Quinones are highly reactive compounds. Vitamin K is a naphthoquinone with anti-thrombotic properties. They produce free radicals and form irreversible protein complexes, resulting in functional loss. They affect the cell wall, devouring the substrates. Flavonoids are antimicrobials that cause antimicrobial action by interacting with the cell walls and proteins of bacteria. Microbial membranes are disrupted by lipophilic flavonoids. When tested *in vitro*, they could eradicate *Vibrio cholerae*, *Shigella sonnei*, and *Streptococcus mutans*. They help in reducing the incidence of caries in the fissures. Gallic acid is found in every component of Triphala. It helps in

protecting liver cells, acts as an antioxidant, and inhibits the proliferation of cancer cells. Bioflavonoids and vitamin C aid in speeding up the healing process. The concentration of vitamin C is abundant in *E. officinalis* fruit juice and accounts for 45–70% of triphala's antioxidant properties. Triphala boosts neutrophil activity in stressful situations, prevents IL-4 levels from rising, and corrects low IL-2 and interferon levels. Triphala extracts aid in scavenging free radicals, which are responsible for producing reactive oxygen species by activating macrophages. It has the potential to be an immunostimulant and a substitute for allopathic immunomodulators. (28) Another component that inhibits vascular endothelial growth factor (VEGF) by inhibiting phosphorylation of the VEGF receptor-2 is chebulinic acid. Because this substance is benign and inexpensive, it can be employed in settings where VEGF suppression is required. (29) The extract from the T. chebula plant helps to prevent the growth of tooth plaque. It inhibits sucrose-induced adhesion and glucan-induced aggregation, both of which aid microbial colonization on the tooth's surface. This avoids the buildup of acids on the tooth surface as well as the demineralization of inorganic substances like enamel and dentin (5, 30).

*Lactobacillus* and *Streptococcus mutans* promote tooth plaque, microbial development, and gingival inflammation, which can be controlled by triphala. Triphala has a comparable effect on plaque as chlorhexidine mouthwash. The antibacterial activity is attributed to phenolic chemicals and tannins found in ayurvedic formulations such as Triphala Mashi. The activity is similar to that of triphala in that it inhibits the production of gram-positive and gram-negative bacteria in a dose-dependent manner. Triphala and its constituents have antimicrobial characteristics that are efficient against a wide range of germs. HIV-positive patients were shown to have *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Klebsiella pneumoniae*. Triphala and its components had antibacterial activity against both gram-positive and gram-negative bacteria, implying that active phytochemicals can pass through both bacterial cell walls. The liquified extract is active against *P. vulgaris*, *S. Aureus*, *S. epidermidis*, *B. subtilis*, and *S. typhimurium* and has an eradicator impact against *E. coli* and *E. aerogens*. 10 *Staphylococcus aureus*, *E. coli*, *Pseudomonas aeruginosa*, *Staphylococcus epidermidis*, *Salmonella typhii*, and *Enterobacter aerogenes* are all susceptible to the thriphala. *Salmonella typhimurium* is a kind of Salmonella. Triphala suppresses the growth of Enterococci, a type of bacteria that can cause nosocomial bacteremia, surgical site infections, and UTIs. Triphala had a wide inhibitory zone against Enterococci (9, 31).

Endodontic therapy is successful when the canal is disinfected and shaped with a mix of chemo-mechanical instrumentation. Irrigants for root canals help disinfect canal systems that are inaccessible to biomechanical pretreatment. Today, a large range of artificial irrigants are on the market; however, some exhibit ineffectiveness and some have adverse reactions and toxicity. Natural substitutes could be beneficial. The removal of all viable or dead tissues, bacteria, and microbial products from the root canal system is the goal of endodontic therapy. This can be accomplished through chemo-mechanical root canal debridement. (32) A combined action of mechanical canal preparation and irrigation is required to decrease the microbial content in the system due to the intricate architecture of the pulp dentin complex and the existence of numerous inconspicuous locations. *E. faecalis* is an enteric gram-positive bacterium that can grow in the root canal on its own. (33) It is most commonly found in those root canals that have had failed endodontic therapy (23, 34).

Tannic acid has been demonstrated to have antibacterial properties in preliminary investigations, although it is not as effective as chlorhexidine. It is safe and made of substances with adequate physiologic effects, as well as anti-oxidative and anti-inflammatory qualities, as compared to regularly used root canal irrigants. The benefits of triphala include its ease of use, economical, substantivity, minimal toxicity, and lack of microbial resistance. (17) It possesses anti-cariogenic and thermogenic properties, as well as the ability to operate as a probiotic. The antimicrobial activity of triphala was demonstrated in this work by measuring the zone of inhibition against *E. faecalis*, as Shakouie et al. had previously demonstrated (35, 36).

There is a need for an alternate disinfection measure due to the ongoing increase in antibiotic-resistant bacteria and the negative effects induced by synthetic medications (2).

The antibacterial action of triphala as an irrigant was shown to be comparable to that of NaOCl, according to Divia et al. (2). In a study by Paridhi Garg, triphala performed equally well as NaOCl (2, 6). Triphala extracts will be the irrigant of choice in endodontics, according to Saxena et al. (37), because they have various advantages over NaOCl.

Triphala showed increased effectiveness in a microbial reduction in the root canal, according to Divya et al. (37) and Bhargava et al. (38) Triphala was found to be more effective against endodontic bacteria. This is due to its formulation, which contains equal amounts of three different ayurvedic botanicals. Furthermore, diverse compounds may aid in boosting the efficacy of active chemicals and assisting in an additive impact. (26) When compared to 0.5% and 1% NaOCl, triphala was more effective on *E. faecalis* cultures, indicating stronger antibacterial activity (36).

## As a chelating agent

After instrumentation, a layer of tooth particles, microbes, dead cells, and blood together called a smear layer accumulates across the walls of the dentin, according to the literature. Dentine, pulp tissue remains, the odontoblastic process, and microorganisms make up the smear layer. It

interferes with root canal sealant adhesion and its penetration into the dentinal tubules. It was found that neutral EDTA solutions weaken organic and inorganic contents in dentine. Because the quantity of non-collagenous proteins (NCP) diminishes in the apical third, Hulsmann hypothesized that EDTA eliminates not only calcium ions but also calcium linked to N. (39) This portion has a low degree of EDTA decalcification. It is worth noting that Triphala showed enhanced smear layer removal with substantial erosion in the apical thirds, based on the findings (40).

Smear material later contains tooth debris that extends a few micrometers into dentinal tubules and has an overall thickness of 2–5 m. Smear plugs can occur as a result of the canal preparation process, which forces smear components into dentinal tubules at different distances. The superficial smear layer and the smear layer material that was packed into the dentinal tubules for a depth of up to 40 m were discovered to be two separate components of the smear layer. Due to capillary action, when surface active agents were utilized within, the smear was pushed up to a depth of 110 m as a result of adhesion pressures between dentinal tubules and smear, as well as capillary action. Several methods for removing intraradicular smears have been proposed. Various artificial substances have been utilized as root canal irrigants because of their efficacy in removing the smear layer and disinfecting the teeth, but they also have drawbacks such as toxicity and allergy potential (5).

In their investigation, Susan et al. (5) reported that triphala was very successful and nearly as effective in removing the smear layer. Because of the fruits' high citric acid content, it is an excellent chelating agent and hence has promise for removing the smear layer. (41) In the coronal and middle thirds of the root, triphala was as effective as sodium hypochlorite at removing the smear layers, whereas sodium hypochlorite was better at removing smear layers in the apical third (20).

### Effect on microhardness of root dentin

Microhardness, permeability, roughness, wettability, and other physicochemical features of human root canal dentin may be influenced by the irrigating solutions. Microhardness testing reveals the loss of inorganic structures in the tooth. The amount of hydroxyapatite in the intertubular substance and the degree of mineral content help determine the intrinsic hardness properties of the dentin structure. As a result, a decrease in dentin microhardness leads to an increase in the incidence of crack formation and tooth fractures (42, 43).

The decrease in root dentin hardness could be due to a decrease in intertubular dentin matrix stiffness produced by the heterogeneous distribution of the mineral phase within the collagen matrix. (44) Additionally, the concentration of NaOCL used determines the microhardness of root dentin. The elastic modulus and flexural strength are inversely proportional to the concentration of NaOCL. (45) Because of its chelating properties, EDTA has a negative softening potential on calcified dentin. The decrease in microhardness of dentin was anticipated since the root dentin's complete cationic receptors are saturated with calcium ions. (46) The results of microhardness tests after doing the root canal irrigation produced values of 5% NaOCL and 17% EDTA in this investigation and were consistent with existing data, which showed a reduction in microhardness values after treatment.

When compared to 5% NaOCL and 17% EDTA, triphala showed reduced degradation in the microhardness of root dentin in a study by Vaishnavi Elika et al. When triphala was employed as an irrigant, Mahsa et al. (47) found that there was no drastic reduction in the microhardness of root canal dentin. The citric acid in triphala fruits, which acts as a mild chelating agent, could be the most likely cause of this effect.

## Conflict of interest

The authors declare that the review was done in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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