

CURATIVE EFFECT OF TRIPHALA IN MEDICAL AND DENTAL SCIENCES: A SCIENTIFIC REVIEW

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ABSTRACT

Advances in the field of alternative medicine have promoted the use of various natural products. Conventional drugs usually provide effective antibiotic therapy for bacterial infections, but there is an increasing problem of antibiotic resistance and a continuing need for new inventions. Hence, herbal drugs are being preferred over synthetic antibiotics. Triphala is such product which has innumerable benefits in the field of medicine which has procured appreciable importance in clinical research. It consists of equal parts of the *Emblica officinalis*, *Terminalia chebula*, and *Terminalia bellirica*. It is an antioxidant-rich herbal formulation and possesses diverse beneficial properties. It is a widely prescribed ayurvedic drug and is used in the ailments of all dosas. It is a polyherbal compound. It is necessary to corroborate the consistency of mixing or combining in attribute balance. The present review will focus on the comprehensive appraisal of Triphala and its several applications in medicine and dentistry.

Keywords: Alternative therapy, Dentistry, *Emblica officinalis*, *Terminalia chebula*, *Terminalia bellirica*, Triphala.

INTRODUCTION

Triphala is a traditional ayurvedic herbal formulation consisting of the dried fruits of three medicinal plants *Terminalia chebula* Retz. (Haritaki), *Terminalia bellirica* Roxb. (Bibhitaki), and *Emblica officinalis* (EO) Gaertn. (Amalaki) and also known as “three myrobalans.” Triphala means “three” (tri) “fruits” (phala) [1].

HARITAKI

Latin name: *Terminalia chebula* Linn.

Family: Combretaceae

Classical name: Haritaki

Sanskrit synonyms: Haritaki, Pathya, Abhaya, Avyatha, Vayastha, Haimavati, Shiva

Hindi name: Harre, Harad

English name: Chebulic Myrobalan [2]

Individual chemical ingredient: Tannins, anthraquinones, and polyphenolic compound [3].

T. chebula is a plant species belonging to the genus *Terminalia*, family Combretaceae. The fruit of the tree has been used as traditional medicine for a household remedy against various human ailments since antiquity. *T. chebula* has been extensively used in Ayurveda, Unani, and Homeopathic medicine and has become a cynosure of modern medicine. *T. chebula* is rich in tannin. The chief constituents of tannin are chebulic acid, chebulagic acid, corilagin, and gallic acid. *T. chebula* exhibited antibacterial activity against a number of Gram-positive and Gram-negative human pathogenic bacterial species. It also exhibits antifungal and antiviral properties. It has also shown antimutagenic/anticarcinogenic activity, antioxidant activity, adaptogenic and antianaphylactic activities, immunomodulatory activity, cytoprotective and radioprotective activity. It is also effective in hypolipidemia/hypercholesterolemia, improving gastrointestinal motility with antispasmodic activity, diabetes, retinopathy, and wound healing [3].

BIBHITAKI

Latin name: *Terminalia bellirica* Roxb.

Family: Combretaceae

Classical name: Bibhitaki

Sanskrit synonyms: Aksha, Kaliphala, Bhutavasa, Kalidruma, Karnaphala

Hindi name: Bahera, Baherha

English name: Belleric Myrobalan [2]

Individual chemical ingredient: Gallic acid, tannic acid, and glycosides [3].

T. bellirica Roxb. (Combretaceae), commonly known as “belleric myrobalan” and locally as “bahera,” is a large deciduous tree and found throughout central Asia and some other parts of the world. Its fruit is used in folk medicine to treat asthma, cancer, colic, diarrhea, dysuria, headache, hypertension, inflammations, and pain. The plant is reported to contain termilignan, thannilignan, anolignan B, gallic acid, ellagic acid, β-sitosterol, arjungenin, belleric acid, bellericosidem, flavonoids, and tannins. *T. bellirica* possesses antioxidant, antispasmodic, bronchodilatory, hypercholesterolemic, antibacterial, cardioprotective, hepatoprotective, hypoglycemic, and hypotensive properties [4].

AMALAKI

Latin name: *Emblica officinalis* Gartn.

Family: Euphorbiaceae

Classical name: Amalaki, Dhatri

Sanskrit synonyms: Amalaki, Dhatri, Vyastha

Hindi name: Awala, Amla, Aonla

English name: Indian gooseberry [2]

Individual chemical ingredient: Vitamin C, carotene, nicotinic acid, riboflavin, and tannins [3].

Amalaki is known by the botanical name *E. officinalis* and also known in Sanskrit as Dhatri (The nurse), which is a reference to its incredible healing properties. Amalaki can be taken individually in powder form, a decoction or as a confection. Amalaki fruit is known to be one of the best rasayanas in Ayurveda, with antioxidant and antiaging properties. It has its beneficial role in cancer, diabetes, liver treatment, heart trouble, ulcer, anemia, and various other diseases. Similarly, it has application as immunomodulatory, antipyretic, analgesic, cytoprotective, antitussive, and gastroprotective agent. In addition, it is useful in memory enhancing, ophthalmic disorders, and lowering cholesterol level. It is also helpful in neutralizing snake venom and as an antimicrobial agent against *Escherichia coli*, *Klebsiella ozaenae*, *Klebsiella pneumoniae*, *Proteus mirabilis*, *Pseudomonas aeruginosa*, *Salmonella paratyphi A*, *S. paratyphi B*, and *Serratia marcescens*. The drug is not reported to have any side-effects even after prolonged use [5].

Triphala is a drug widely used in many disorders due to its various pharmacological activities. Triphala is one of the most commonly used ayurvedic preparations. The formulation generally consists of equal proportions of pericarps of this myrobalans.

Triphala has been described in the ancient ayurvedic text as a Tridoshic Rasayana, a therapeutic agent with balancing and rejuvenating effects on the three humors or constitutional elements in Ayurveda vata, pitta, and kapha. *T. chebula* Retz. and *T. bellirica* Roxb. have a warm energy, while EO Gaertn. is cool in nature. Triphala, being a combination of all three, is therefore balanced, making it useful as an internal cleansing, detoxifying formula. It is regarded as an important Rasayana and good purgative in ayurvedic medicine. Recipe for this traditional herbal supplement is described in the traditional Indian texts, the Charaka and Sushruta Samhita [2].

Triphala is used in ayurvedic medicine in treating a variety of conditions and also forms part of many other ayurvedic formulations. Conditions for which Triphala is employed include a headache, dyspepsia, constipation, liver conditions, ascites, and leucorrhoea. It is also used as a blood purifier that can improve the mental faculties and it possesses anti-inflammatory, analgesic, antiarthritic, hypoglycemic, and antiaging properties [6]. *T. chebula*, which acts as anticaries agents strongly inhibits the sucrose or glucan-induced aggregations of *Streptococcus mutans* [7] and strengthens the gums, prevents, and treats several diseases of mouth such as dental caries, spongy and bleeding gums, gingivitis, and stomatitis [1].

INGREDIENT WISE MAIN CHEMICAL CONSTITUENTS OF TRIPHALA

Tannins

Tannin is a general descriptive name for a group of polymeric phenolic substances capable of tanning leather or precipitating gelatin from solution, a property known as astringency. Many human physiological activities, such as stimulation of phagocytic cells, host-mediated tumor activity, and a wide range of antiinfective actions, have been assigned to tannins. One of their molecular actions is to complex with proteins through so-called non-specific forces such as hydrogen-bonding and hydrophobic effects, as well as by covalent bond formation. Thus, their mode of antimicrobial action may be related to their ability to inactivate microbial adhesins, enzymes, and cell envelope transport proteins [8].

Quinones

Quinones are aromatic rings with two ketone substitutions. They are ubiquitous in nature and are characteristically highly reactive. The individual redox potential of the particular quinone-hydroquinone pair is very important in many biological systems. Vitamin K is a complex naphthoquinone with antihemorrhagic activity. In addition to providing a source of stable free radicals, quinones are known to complex irreversibly with nucleophilic amino acids in proteins, often

leading to inactivation of the protein and loss of function. For that reason, the potential range of quinine antimicrobial effects is great. Probable targets in the microbial cell are surface-exposed adhesins, cell wall polypeptides, and membrane-bound enzymes. Quinones may also render substrates unavailable to the microorganism [8].

Flavones, flavonoids, and flavonols

Flavones are phenolic structures containing one carbonyl group (as opposed to the two carbonyls in quinones). The addition of a 3-hydroxyl group yields a flavonol. Flavonoids are also hydroxylated phenolic substances but occur as a C6-C3 unit linked to an aromatic ring. Since they are known to be synthesized by plants in response to microbial infection, it should not be surprising that they have been found *in vitro* to be effective antimicrobial substances against a wide array of microorganisms. Their activity is probably due to their ability to complex with extracellular and soluble proteins and to complex with bacterial cell walls. More lipophilic flavonoids may also disrupt microbial membranes. These compounds have been shown to inhibit *Vibrio cholera* O1, *Shigella*, *S. mutans in vitro*. Inhibition of isolated bacterial glycosyltransferases in *S. mutans* and reduction of fissure caries by about 40% has also been demonstrated [8].

Gallic acid

Gallic acid is a common phytoconstituent present in all three herbs used in Triphala. It is reported to possess hepatoprotective and antioxidant activity. It also suppresses the growth of cancer cells [9].

Vitamin C

Fruit juice of EO contains the highest Vitamin C (478.56 mg/100 mL) content. The fruit, when blended with other fruits, boosted their nutritional quality in terms of Vitamin C content. Vitamin C in EO accounts for approximately 45-70% of the antioxidant activity [5]. Evidence has been reported for the relation between Vitamin C and periodontal disease. Significant gum bleeding can occur in Vitamin C deficiency. Vitamin C along with bioflavonoid helps to speed up the healing process [10].

Commercially available

Triphala tablet, Triphala choorna

Formulation of choornam: This is a dry fine powder form of the drug choornam, which can be used both internally and externally.

Decoction form: This form can be used as an eyewash or mouthwash [3].

Medical implications

Antioxidant activity of Triphala

Triphala is effective in inhibiting γ -radiation-induced damage in microsomal lipids and plasmid pBR 322 DNA. Triphala is rich in polyphenols (38±3%) and tannins (35±3%). Polyphenolic contents in Triphala are responsible for the antioxidant and radioprotective ability and reduce the oxidative stress by converting reactive oxygen free radicals to non-reactive products. Triphala significantly prevents cold stress-induced oxidative stress. Cold stress-induced oxidative stress is measured by lipid peroxidation (LPO), enzymatic superoxide dismutase, catalase, non-enzymatic (Vitamin C) antioxidation status. Administration of Triphala (1 g/kg/body weight/48 days) prevents cold Stress-induced oxidative stress and elevation in LPO and corticosterone levels. The antioxidant property can be correlated to the prevention of cold stress-induced oxidative stress. Triphala and the individual ingredients of Triphala effectively inhibit γ -radiation-induced strand break formation in plasmid DNA. They inhibit radiation-induced LPO and possess the ability to scavenge free radicals like DPPH and superoxide. Triphala mixture is more effective as it possesses combined activity of all the three ingredients. Superoxide radical scavenging activity of Triphala using xanthine and xanthine oxidase activity showed that in addition to reacting with superoxide radical, Triphala also inhibited uric acid formation. Triphala is rich in phenols/polyphenols (38±3%), tannins (35±3%), and flavonoids were absent. High-performance

liquid chromatography analysis revealed that gallic acid content was 73 ± 5 mg/g and increased to 150 ± 5 mg/g on acid hydrolysis.

Triphala against stress

Triphala supplementation has a protective effect against stress. Triphala administration for 48 days (1 g/kg/animal body weight) prevents cold stress-induced behavioral and biochemical abnormalities such as an increase in immobilization, with decrease in rearing, grooming and ambulation behavior, significant increase in LPO and corticosterone levels. Triphala prevents noise stress-induced changes in antioxidant and cell-mediated immune response in rats. Changes induced by noise stress at 100 dB for 4 hr/d/15 days were controlled by Triphala at 1 g/kg/body weight/48 days.

Triphala in wound healing

The ointments prepared from Triphala extracts show significant wound closure *in vivo*. The granulation tissue shows reduced bacterial count, increase in collagen, hexosamine, and uronic acid. Collagen sponges incorporated with Triphala when used to close wounds showed increase thermal stability, water uptake capability, faster wound closure, improved tissue regeneration. Epigallocatechin gallate interaction with collagen contributes to this quick wound healing activity.

Triphala in arthritis

The efficacy of Triphala on monosodium urate crystals-induced inflammation for gouty arthritis was compared with non-steroidal anti-inflammatory drug indomethacin. Triphala treatment inhibited paw volume, levels of lysosomal enzymes, LPO and inflammatory mediator tumor necrosis factor- α , β -glucuronidase, and lactate dehydrogenase level were reduced. Triphala exerted a strong anti-inflammatory effect against gouty arthritis. Triphala (1 g/kg/body weight) was evaluated for its antiarthritic effect against indomethacin (3 mg/kg/body weight) in arthritis-induced rats by Freund's adjuvant (0.1 ml). Levels of lysosomal enzymes, tissue marker enzymes, glycoproteins, and paw thickness increased in arthritis-induced animals. The physical, biochemical changes observed in arthritic animals were altered significantly to near normal conditions after oral administration of Triphala [11].

Analgesic, antipyretic, and ulcerogenic activities

Most of the presently available anti-inflammatory drugs show analgesic, an antipyretic effect associated with gastric damage. Therefore, an attempt was made to ascertain whether Triphala exhibits analgesic and antipyretic activities without any gastric damage. Increased body temperature and pain are known as the main reactions of the body against an inflammatory stimulation. Therefore, it is generally essential to possess analgesic and antipyretic activities for an anti-inflammatory compound [12]. The analgesic, antipyretic, and ulcerogenic activities of Triphala (500/1000 mg/kg body wt) were compared with the non-steroidal anti-inflammatory drug indomethacin (10 mg/kg body wt) on the experimental models in mice and it was found that Triphala at both the dose levels produced excellent analgesic and antipyretic effect, with the absence of gastric damage. Acetic acid acts indirectly by inducing the release of endogenous mediators of pain sensitive to non-steroidal anti-inflammatory drug and opioids. The mechanism of analgesic action of the Triphala could probably be due to the blockade of the effect or the release of the endogenous substances that excite pain nerve ending similarly to non-steroidal anti-inflammatory drugs. The Triphala ointment showed strong antibacterial, wound healing, and antioxidant activities during the management of infected wounds [13].

Antidiabetic activity

The oral administration of Triphala extract (100 mg/kg body weight) has reduced the blood sugar level in normal and in alloxan (120 mg/kg) diabetic rats significantly within 4 hrs and continued daily administration of the drug produced a sustained antidiabetic effect [13].

Antimicrobial activity of Triphala

Triphala controls dental plaque, gingival inflammation, and microbial growth caused by *S. mutans* and *Lactobacillus*. Triphala controls

plaque from baseline, and its activity is comparable to commonly available mouthwash chlorhexidine. Ayurvedic formulations such as Triphala Mashi exhibit antimicrobial activity attributed to phenolic compounds and tannins in Triphala. The activity is comparable to that of Triphala. It inhibits the dose-dependent growth of Gram-positive and Gram-negative bacteria. Triphala and its individual fruit components have a potent antibacterial action against a wide spectrum of bacterial isolates such as *Pseudomonas aeruginosa*, *K. pneumonia*, *Shigella sonnei*, *Staphylococcus aureus*, *V. cholera*, isolated from HIV-infected patients. Triphala and its individual components showed the antibacterial effect on both Gram-positive and Gram-negative bacteria, which suggests the ingress of active phytochemicals through both the bacterial cells walls. Triphala churna has antibacterial activity against various bacterial pathogens. The aqueous extract has activity against *Staphylococcus epidermidis*, *S. aureus*, *Proteus vulgaris*, mildly antibacterial against *Salmonella typhimurium*, *Bacillus subtilis*, and negligible/no inhibitory effect against *E. coli* and *E. aerogenes*. The acetone, ethanol, and methanol extracts of Triphala churna possess highest antibacterial potential against *S. epidermidis*, *S. aureus*, *P. vulgaris*, and no antibacterial activity against *E. coli*, *Enterobacter aerogenes*, and *P. aeruginosa*. The three fruits constituting Triphala show potent antibacterial activity against *E. coli*, *S. aureus*, *P. aeruginosa*, *P. vulgaris*, *S. epidermidis*, *Salmonella typhi*, *S. typhimurium*, *E. aerogenes*. Daily intake of Triphala controls enteric infections in human beings. Triphala possesses antibacterial activity against pathogens such as *Salmonella*, *Staphylococcus*, *Pseudomonas*, and *E. coli*, *Bacillus* isolated from wounds of workers and students. Triphala Mashi formulation has lesser antibacterial activity as compared to Triphala. Triphala inhibits the growth of *Enterococci*, which causes nosocomial bacteremia, surgical wound/urinary tract infections. Triphala exhibited a large zone of inhibition against *Enterococci* [11].

Dental implications

Anticaries activity

Despite several antiplaque agents available in the market, the search for an effective agent still continues. Several undesirable side-effects associated with these agents stimulated the search for alternate agents. Plants or plant products used in folk dental practices or prescribed in Unani, homeopathic, or ayurvedic remedies are now gaining attention given their acclaimed medicinal properties. *T. chebula* is valuable in the prevention and treatment of several diseases of the mouth such as dental caries, spongy and bleeding gums, gingivitis, and stomatitis. The extract could successfully prevent plaque formation on the surface of the tooth as it inhibited the sucrose-induced adherence and the glucan-induced aggregation, the two processes which foster the colonization of the organism on the surface of the tooth. Thus, the extract of *T. chebula* may be an effective agent in the treatment of carious teeth, owing to its ability to inhibit the growth and accumulation of *S. mutans* on the surface of the tooth. This would prevent the accumulation of acids on the surface of the tooth, and thus the further demineralization and the breakdown of the tooth enamel.

Triphala as a root canal irrigant

Primary endodontic infections are caused by oral microorganisms, which are usually opportunistic pathogens that may invade a root canal containing necrotic tissue and establish an infectious process. The number of facultative anaerobic bacteria increases when the root canal remains infected for long periods. *Enterococcus faecalis*, a facultative anaerobic Gram-positive coccus is the most common *Enterococcus* sp. cultured from non-healing endodontic cases. Sodium hypochlorite (NaOCl) is an efficient irrigant used in eliminating *E. faecalis* biofilms *in vitro*, but its main disadvantages are its unpleasant taste, high toxicity, and its inability to remove the smear layer. Triphala has shown significant antibacterial activity against 3 and 6 weeks biofilms. The use of herbal alternatives as a root canal irrigant might prove to be advantageous considering the several undesirable characteristics of NaOCl.

Anticollagenase activity of Triphala

Matrix metalloproteinases play a key role in periodontal destruction, and this knowledge leads to a new concept involving the chemotherapeutic inhibition of these enzymes. Doxycycline is most potent tetracycline for collagenase/gelatinase inhibition. However, long-term tetracycline therapy has certain disadvantages. Use of herbal product extract in treating periodontal disease does not produce side-effects of tetracycline compounds as well as other synthetic drugs. Triphala has strong inhibitory activity against PMN-type collagenase, especially matrix metalloproteinase 9 at a 1500 µg/ml concentration, which is well within the safety profile of toxicological studies.

Antimicrobial and antioxidant effect of Triphala

Antimicrobial and antioxidant effect of Triphala has been proven *in vitro* as it has been shown to inhibit *S. mutans* at concentrations as low as 50 µg/ml. This antiplaque effect probably may be due to the tannic acid in Triphala, which is adsorbed well to the groups on the surface of the bacterial cells, which result in protein denaturation and ultimately to bacterial cell death. The strong antioxidant activity of Triphala may be attributed to *T. bellirica*, which is the most active antioxidant followed by *E. officinalis* and *T. chebula*. The major ingredients of *T. bellirica* are ellagic and gallic-acid; *E. officinalis* has several gallic acid derivatives including epigallocatechin gallate and in *T. chebula*; gallic acid is the major ingredient. The presence of these active ingredients of phenolic nature may be responsible to scavenge the free radicals [3].

Triphala as a mouth rinse

Ayurvedic drugs have been used since ancient times. Oral rinses made from these are used in periodontal therapy. Triphala is one of these with a wide spectrum of activity. According to the Sushruta Samhita, Triphala can be used as a gargling agent in dental diseases. 0.6% Triphala mouthwash has shown to have significant anticaries activity, which is comparable to that of chlorhexidine without possessing disadvantages as staining of teeth and at much less cost although there was no evidence of remineralization of tooth structure [14].

Triphala mouth rinse, when combined with scaling and root planing, showed a significant reduction in the plaque, gingival, and oral hygiene indices without any evidence of staining of teeth at 7, 30, and 45 days, which was comparable to reduction obtained by chlorhexidine mouth rinse in combination with scaling and root planing [10].

Triphala mouthwash twice-daily combined with metronidazole 400 mg thrice-daily when compared with 0.2% chlorhexidine with metronidazole 400 mg thrice-daily and Triphala mouthwash with oral powder of Triphala in a 1 month study showed improvement in clinical indices in terms of reduction in tooth mobility, pocket depth, bleeding gums, sensitivity to hot and cold, and calculus formation with minimal recurrence in all the clinical parameters [15].

CONCLUSION

Triphala is a novel drug with an array of therapeutic activities gifted by Ayurveda to the world, having a wide spectrum of pharmacological and medicinal activities. This medicinal plant is the unique source of various types of compounds having diverse chemical structure. Though, it has a number of pharmacological activities due to the presence of various types of bioactive compounds. It has the potential to treat a variety of human ills with minimal or no side-effects. Dentistry is still in search of a drug for diseases affecting hard and soft tissues of the oral cavity. Triphala seems to fulfill most of these requirements without any adverse effect on oral tissues and at very minimal cost as compared to commercially available products today. Hence, further research exploring various therapeutic actions of Triphala should be encouraged in dentistry.

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