

Azadirachta indica: A herbal panacea in dentistry – An update

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ABSTRACT

Azadirachta indica commonly known as *Neem*, is an evergreen tree. Since time immemorial it has been used by Indian people for treatment of various diseases due to its medicinal properties. It possesses anti-bacterial, anti-cariogenic, anti-helminthic, anti-diabetic, anti-oxidant, astringent, anti-viral, cytotoxic, and anti-inflammatory activity. Nimbidin, Azadirachtin and nimbinin are active compounds present in *Neem* which are responsible for antibacterial activity. *Neem* bark is used as an active ingredient in a number of toothpastes and toothpowders. *Neem* bark has anti-bacterial properties, it is quite useful in dentistry for curing gingival problems and maintaining oral health in a natural way. *Neem* twigs are used as oral deodorant, toothache reliever and for cleaning of teeth. The objective of this article is to focus on the various aspects of *Azadirachta indica* in dentistry in order to provide a tool for future research.

Key words: *Azadirachta indica*, anti-bacterial, anti-cariogenic, oral health

INTRODUCTION

Neem has been extensively used in Ayurveda, Unani and Homoeopathic medicine and has become a wonder tree of modern medicine.^[1] It has been used traditionally for the treatment of inflammation, infections, fever, skin diseases and dental problems.

It is effective in several epidermal dysfunctions such as acne, psoriasis, eczema. *Neem* leaves have been reported to also possess antihyperglycemic,^[2] immunomodulatory,^[3] anti-inflammatory,^[4] antimalarial,^[5] antioxidant,^[6] antiviral,^[7] antimutagenic^[8] and anticarcinogenic^[9] properties. *Neem* also exhibits antibacterial,^[10] antifungal,^[11] hepatoprotective,^[12] anti-ulcer,^[13] anti-fertility and anti-nociceptive activity.^[14,15]

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Neem twigs are used as oral deodorant, toothache reliever and for cleaning of teeth. *Neem* bark possesses antibacterial and deodorant activity. The phytochemical constituents present in *neem* are nimbidin, nimbin, nimbolide, Azadirachtin, gallic acid, epicatechin, catechin, and margolone. All these exhibit potent antibacterial activity. The chief active constituent of *neem* is azadirachtin, which is an effective antimicrobial agent.^[15,16] *Neem* has also been traditionally used as a skin moisturizer.^[17]

Objective of the literature review

Azadirachta indica is an evergreen tree having potential medicinal values. It has been found to be active against many dreadful disorders like hepatitis, viral infections, malaria and cancer. It is also effective against periodontal pathogens, and oral acidogenic bacteria responsible for dental caries and dental plaque. The aim of the present review is to focus on the dental aspects of various parts of *Neem* extract with their chemical constituents and biological activities. Several traditional uses of the miraculous tree have also been briefly discussed. This information may give a bird's eye view for the dentist, and consequently this database might play a major role in future research in the field of dentistry [Figure 1].

Therapeutic role of *Azadirachta indica* in dentistry

Nimbidin, a major active principle isolated from seed kernels of *A. indica* exhibits several biological actions. From nimbidin other active constituents like nimbin, nimbinin, nimbidinin, nimbolide and nimbidic acid have been isolated which are responsible for its biological activities.^[16]



Figure 1: *Azadirachta indica*

Neem dental care products contains *Neem* leaf or bark extract. *Neem* leaf is rich in antioxidants and helps to boost the immune response in gum and tissues of the mouth.^[18,19] *Neem* offers a good remedy for curing mouth ulcers, tooth decay and acts as a pain reliever in toothache problems.

Dental applications of *Neem*

Antibacterial activity

Neem is a natural antibacterial agent. Various scientific studies have revealed its antibacterial activity.^[20] The antimicrobial effects of *Neem* have been reported against *S. mutans* and *S. faecalis*.^[21] Ethanolic extract of *Neem* leaves and sticks and bark exhibited significant antibacterial activity.^[22,23] Dried chewing sticks of *Neem* showed maximum antibacterial activity against *S. mutans* compared to other dental caries-causing organisms, *S. salivarius*, *S. mitis*, and *S. sanguis*.^[24]

Anti-candidial activity

Ethanolic and aqueous extract of *Neem* leaf showed significant anti-candidial effect against *C. albicans*.^[25] A clinical study demonstrated the effects of the leaf aqueous extract from *Azadirachta indica* (*Neem*) on adhesion, cell surface hydrophobicity and biofilm formation, which may affect the colonization by *Candida albicans*. The results suggest that *Neem* leaves have a potential anti-adhesive effect on the sample studied *in vitro*.^[26]

Anti-cariogenic activity

Mango and *Neem* extract showed antimicrobial activity against *S. mutans*, *S. salivarius*, *S. sanguis* and *S. mitis*. A combination of chewing sticks is found to be beneficial in eradicating the dental caries-causing organism.^[27] Chloroform extract of *Neem* leaf inhibited *Streptococcus mutans* and *Streptococcus salivarius* and provides an aid for treating dental caries.^[28] Antimicrobial activity of commercially available Himalaya herbal dental cream containing neem and fluoride-containing cheerio gel toothpaste has been assessed in school children. The study reported both the toothpastes showed a good antimicrobial effect on caries producing salivary *streptococcus mutans*.^[29] The toothpaste containing *Neem* as well as fluoridated toothpaste were equally

efficacious against caries-producing bacteria. Acetone extract from the bark of *Neem* is bactericidal against *S. sobrinus* hence indicates its anti-cariogenic activity.^[30]

Anti-plaque activity

Aqueous extract of *Neem* stick and the gallotannin-enriched extract from *Melaphis chinensis* inhibited insoluble glucan synthesis and results in bacterial aggregation. It reduces the ability of *streptococci* to colonize tooth surfaces.^[31] *Neem* oil shows significant antibacterial activity and has been suggested for use in treating dental plaque.^[32] Mucoadhesive dental gel containing *Azadirachta indica* is found to be beneficial in reducing the plaque index and salivary bacterial count comparatively better than chlorhexidine gluconate mouthwash.^[33]

Efficacy of *Neem* extract against acidogenic oral bacteria in fixed orthodontic appliance patients

The primary acid-tolerant bacteria associated with dental plaque including *Streptococcus mutans*, *Streptococcus oralis*, *Streptococcus sobrinus*, *Lactobacillus acidophilus*, *Streptococcus salivarius*, *Streptococcus mitis*, *Streptococcus sanguis*, *Streptococcus intermedius*, and *Streptococcus anginosus* that surround orthodontic appliances are a common problem in many patients undergoing orthodontic treatment. It has also been reported that presence of fixed orthodontic appliance greatly inhibits oral hygiene and creates new retentive areas for plaque and debris.

Ethanolic leaf extract of *Azadirachta indica* shows significant antibacterial activity against selected acidogenic oral bacteria causing dental plaque in fixed orthodontic appliance patients. The study conducted by us evaluated the anti-plaque activity of the extract against *S. mutans*, *S. sanguis*, and *S. mitis*. The extract did not inhibit *L. acidophilus* when tested.^[34]

Efficacy against periodontal pathogens

Brushing with *Neem* toothpaste after every meal and using a mouthwash with *Neem* extract is recommended treatment for preventing gingivitis. In a study, *Neem*-based mouth rinse was given to patients for assessing anti-plaque and anti-gingivitis activity. The findings conclude that *Neem* mouth rinse is as effective as chlorhexidine in reducing periodontal indices. *Neem* stick is found to be effective as a toothbrush in reducing dental plaque and gingival inflammation.^[35]

Studies indicate that leaf extract of *A. indica*-based mouth rinse is highly efficacious and that it may be used as an alternative therapy in the treatment of periodontal disease.^[36] Gingivitis has been prevented or even reversed with regular use of *Neem* toothpaste and mouthwash. Shefali sharma conducted a study on Soluneem (a water-soluble formulation from the *Neem* seed kernel from Shefali sharma conducted a study on Soluneem (a water-soluble formulation from the *Neem* seed kernel from *Azadirachta Indica* containing *Azadirachtin*) as an antimicrobial agent and the effective concentration of Soluneem required to inhibit periodontopathic bacteria and to compare it with a known antiplaque agent chlorhexidine (0.2%) *in vitro*. Study

revealed that solunee extract did not show activity against the organisms (*Bacteroids fragilis*, *B. distatonics*, *Prevotella corporis*, *Prevotella melagingogenica*, *Pepto streptococcus* species) tested.^[37]

Also Botelho *et al.*, and Behl *et al.*, in their experiments and trials concluded that *Azadirachta indica* is highly efficacious in the treatment of periodontal disease thus exhibiting its biocompatibility with human periodontal fibroblast.^[38]

Neem as root canal irrigant

Sodium hypochlorite has been used as root canal irrigant for decades; it causes potential weakening of the tooth structure by decreasing the hardness and structural integrity of the dentin within the root canal. To overcome this disadvantage herbal drugs are used effectively to inhibit *E. faecalis* that causes root canal failure in patients undergoing endodontic treatment.

Aqueous and ethanolic extract of *Neem* leaf inhibits *S. mutans* and *E. faecalis* which cause root canal failure in endodontic procedure. Its antioxidant and antimicrobial properties makes it a potential agent for root canal irrigation as an alternative to sodium hypochlorite.^[23] Literature suggested that the *Neem* (*Azadirachta indica*) leaf extract has significant antimicrobial effect against *E. faecalis* derived from infected root canal samples. The extract was found to be efficacious compared with 2% sodium hypochlorite.

Neem in dental care industry

Various parts of the *Neem* tree possess astringent and antiseptic activity. Leaf extracts have been widely used in both traditional and conventional times to manufacture toothpaste and mouthwash in the oral care dentistry. Its antibacterial properties due to the presence of nimbidin, Azadirachtin, and nimbinin help to remove many oral aerobic and anaerobic pathogens existing in the oral cavity.

Neem bark and leaf extract is most effectively used in preventing cavities and gum disease. Mouthwash containing *Neem* is a remedy for tooth decay, oral infections, prevents bleeding and sore gums. Twigs of *Neem* tree are used as chewing sticks by people all over India.

CONCLUSION

Regular brushing with *Neem*-containing toothpaste will reduce the deposition of plaque, prevents caries, and enhances the immune response for overall oral health. Frequent usage of mouthwash containing *Neem* extract will lessen gingival problems, and also treats halitosis.

In this modern, trendy world, we have done enough damage to nature. It is high time we start changing ways, to synchronize ourselves with nature, providing ample space for each other. Here we are trying to retrieve and learn the ancient Indian ways, which can still be infused into our fast-paced lives for a good effect, benefitting our future generations to come. This article hopes

to lay a good solid base for further uses of one of nature's best gift—*Neem* in many more day-to-day functions. If education can be provided in dental and dental hygiene schools about the use of *Neem*-based and also herbal oral care products, it would help our dentists treat patients more holistically.

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