

USE OF SPICES IN TREATMENT OF DENTAL INFECTIONS**Kirti Dahigaonkar*, Chetna Sanjay Yelpure, Nagma Farook Syed and FarhaNaaz****Abdul Wajid**

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Corresponding Author*Kirti Dahigaonkar**Abeda Inamdar Senior
College, Pune.**ABSTRACT**

A dental infection or tooth infection is the infection that forms inside the teeth or gums. Bacteria exist in plaque, a by-product of food, saliva, and bacteria in the mouth, which sticks to the teeth and damages them and the gums, if infection continues the enamel is weakened and destroyed, forming a cavity. Pathogens that cause primary infections are *Provotella*, *Fusobacterium*, *Treponema*, *Enterococcus faecalis*, *Streptococcus mutants* *Candidia albicans*. Antibiotics have been used for the treatment of dental infection, but because of increased

resistance of bacteria to antibiotics, spices have been used. This review aims at the potential use of *Syzygium aromaticum* (clove), *Elettaria cardamom* (cardamom), *Piper nigrum* (black pepper), *Cinnamomum verum* (cinnamon), *Curcuma longa* (turmeric), *Zingiber officinale* (ginger), *Myristica fragrans* (nutmeg), *Trigonella foenum graecum* (fenugreek), *Amomum subulatum* (black cardamom), *Citrus limon* (lemon), sesame and alum as dental remedies.

KEYWORDS: Dental infection, pathogens, spices and antimicrobial activity.**INTRODUCTION**

Oral diseases play a major role in health problem worldwide. Periodontal diseases and dental caries are essential oral health problems, prevalence of dental caries in children is up to 90% and the majority of adults are also affected. Oral health is related to quality of life that extends beyond the functions of craniofacial complex. There might be risk of pregnancy complications if one suffers from periodontal diseases for example: low birth weight, premature death. Impact of oral diseases is up to 10% of public health expenditure in developed countries generally restricted to emergency dental care or pain relief.

EITOLGY OF DENTAL INFECTIONS

TOOTHACHE

Teeth are packed with nerves and thus irritation in nerves can result in a toothache, which is of great issue though only a small area of mouth is affected. A toothache is a pain in or around a tooth that may be caused by tooth decay, tooth fracture, damaged filling, infected gums, etc. This toothache can be of great extent and can result into soreness, sensitivity or sharp pains in mouth. Signs and symptoms include swelling in cheek, throbbing pain in tooth, sensitivity to hot or cold, fever, etc.

DENTAL CARIES

Dental caries (Tooth decay) is caused by the action of acids on the enamel surface and the layer under it, dentin, thus destroying them. Enamel is the hardest and highly mineralized substance in the body. The acid is produced when sugars in foods or drinks react with bacteria present in the dental biofilm (plaque), a clear, sticky substance which forms on the tooth surface. If left untreated, the disease can lead to pain, tooth loss and infection. Bacteria causing dental caries mostly include *Streptococcus mutans* and *Lactobacillus*.^[1] *Streptococcus mutans*, facultative anaerobic Gram positive cocci commonly found in human oral cavity combines with sugars and complex carbohydrates in food forming acid that causes breakdown of enamel resulting in cavities. *Lactobacillus acidophilus* combines with proteins that are found in saliva and food debris forming plaque. In this shallow hole, *L.acidophilus* positions itself on the groove and begins the process of tooth decay

DENTAL ABSCESS

A dental abscess is a state where pus collects inside the teeth, in gums or in the bone that holds the teeth in place. Abscess at the end of the tooth, commencing in the soft pulp of tooth is periapical abscess, abscess only in the gums and does not affect tooth is gingival abscess and abscess starting in the supporting bone tissue structures in the teeth is periodontal abscess. Bacteria exist in plaque which sticks to teeth and damages them and the gums. If the plaque is not removed by brushing and flossing, bacteria may spread inside soft tissue and result in an abscess. Symptoms include pain, bad taste in mouth, fever, swallowing difficulties, sensitivity to cold or hot food. Bacteria causing abscess include Gram-negativerods, fusiforms, filaments, spirilla and spirochetes *Fusobacterium nucleatum* subspecies *polymorphum*, *Lachnospiraceae*[G-2] species HOT100, *Lautropia* species

HOTA94, and *Prevotella oulorum*, *Rothiadentocariosa* was associated with periodontal health.^[2]

ORAL THRUSH

Oral thrush is a yeast infection in which *Candida albicans* accumulates on the lining of the mouth. Oral thrush causes white, curd-like plaques appear on the tongue, inner cheeks. Sometimes, it may be spread to the roof of mouth, gums or tonsils, or back of throat. This fungus usually resides in mouth without causing any harm but infection develops when fungus grows uncontrollably. Symptoms include creamy white lesions on tongue; redness, burning or soreness; difficulty in swallowing; slight bleeding if lesions are rubbed; loss of taste; irritation and pain under dentures.

CANKER SORES

Canker sores are small, painful ulcers on inside of mouth, tongue, lips or throat. The main causative agent of canker sores is *Helicobacter pylori*. Symptoms include fever, swallowing difficulty, crater like ulcers. Factors causing canker sores include injury to mouth, spicy foods, hormones, vitamin deficiencies, stress, etc. Usually, the sores heal in 10-14 days.

ORAL HERPES

An infection caused by Herpes simplex virus is oral herpes. The virus causes painful sores on lips, gums, tongue and inside cheeks. People contract this infection by touching infected saliva, mucous membranes or skin. There are three stages of the infection: primary infection, latency and recurrence. Herpes simplex virus are of two subtypes: - HSV type I and HSV type II. Symptoms include fever, tiredness, muscle aches, pain, burning, tingling at the infection site.

SUMMARY

TYPES	SYMPTOMS
Dental caries	Cause of tooth loss in children under 12
Gingivitis	Gums are affected and might start bleeding.
Periodontal disease	Pockets form around the teeth, giving way to inflammation and bone loss, at which point these teeth can loosen due to this bone structure.
Hand, foot and mouth disease	Painful blisters appear inside the cheeks and tongue as well as palms, soles and buttocks.
Herpangina	Tiny blisters at back of mouth.
Thrush	<i>Candida albicans</i> causes thrush where curd like plaques appears on the tongue, inner cheeks and back of mouth.
Canker sores	Lesion that form on the gums and other mouth tissues.
Oral Herpes	Ulcers on gums and tongue

There is a connecting link between micro-organisms and oral diseases that form part of microbiota of oral cavity. Some 750 species of bacteria have been identified which inhabit oral cavity (2). Dental caries is supragingival condition. Organisms involved in dental caries are acidogenic and aciduric Gram positive bacteria, such as *Streptococcus mutants* and *Streptococcus sobrinus*, *Lactobacilli* and Actinomycetes are also found which can metabolize sucrose to organic acids. Anaerobic Gram negative bacteria such as *Actinobacillus Sps*, *Fusobacterium Sps*, and *PrevotellaSps* also play role during supragingival condition.^[3] There is increased drug resistance due to prolonged over use of the synthetic drugs.

DRUG RESISTANCE

The ability of bacteria and other microorganisms to resist the effects of an antibiotic to which they were once sensitive is termed as drug resistance or antibiotic resistance. Such a resistance occurs when bacteria change in some way that reduces effectiveness of drugs designed to cure infections. An organism resistant to more than one drug is said to be multidrug resistant. The three important mechanisms of drug resistance in bacteria are as follows.

- Enzymatic degradation of antibacterial drugs
- Alteration of bacterial proteins that are antimicrobial targets
- Changes in membrane permeability to antibiotics

✓ Penicillins and cephalosporins

Penicillins are the first line agents in treatment of odontogenic infections. High rates of penicillin resistance have been observed in members of the genus *Bacteroides* and *Prevotella*. This resistance has been correlated with beta lactamase production. In a study, it was reported that patients with orofacial infections failed to respond to penicillin therapy due to beta lactamase producing *Bacteroides*.^[4] Imipenem is the most active molecule tested having a good activity against oral *Streptococcus*. Chinolones, glycopeptides and rifampicin also exhibited significant activity against oral *Streptococcus*.^[5]

✓ Macrolides

Macrolides resistance is mainly correlated to acquisition of one of a number of erm genes (erythromycin methylases resulting in reduced binding of macrolides to 50S ribosomal subunit). Such resistance is prevalent in viridians group *Streptococci*, anaerobic *Streptococci* and *Prevotella* species. Newer macrolides, clarithromycin and azithromycin offer improved

and better pharmacokinetics compared to erythromycin. Upto 50% of *Fusobacterium* are resistant to erythromycin.^[6]

✓ **Metronidazole**

It is a bactericidal agent active against most anaerobes, but lacks activity against aerobic bacteria. This drug has a moderate activity against microaerophilic Gram positive cocci. The development of resistance to this drug is rare. However, resistance may be caused by a combination of decreased antibiotic uptake, decreased nitroreductase activity, and decreased pyruvate:ferredoxinoxidoreductase activity accompanied by increased lactate dehydrogenase activity.^[3]

✓ **Vancomycin**

Vancomycin is a glycopeptide antibiotic active in treating Gram positive bacterial infections. Clinical isolates of methicillin resistant *Staphylococcus aureus*(MRSA) are observed with high level of vancomycin resistance. Another organism *Enterococcus faecalis* is found to be resistant to vancomycin as it alters cell wall structure and metabolism. *Lactobacillus* is also resistant to vancomycin as it prevents binding of vancomycin to the cell wall by causing changes in peptidoglycan structure.^[7]

✓ **Rifampicin**

Rifampicin resistance is usually observed in *Mycobacterium tuberculosis*. This resistance occurs due to genetic change in the beta subunit of bacterial RNA polymerase.^[8]

SPICES AS A THERAPEUTIC AGENT

As mentioned above, the oral microflora is quite essential for maintaining good health but overgrowth of any organism(s) (especially opportunistic pathogen) leads to several dental problems.^[9] Different antibiotics have been aimed at treating this disease but their prevalent overuse and antibiotic abuse has led to antibiotic resistant organisms, due to this there is a shift from use of synthetic drugs towards natural remedies.^[10] Use of plant or its parts as a therapeutic remedy dates back to the Vedic period.^[11] Spices are part of plants (seeds, bark, leaf, and flower) used in a small quantity as a culinary additive to give food the peculiar aroma and flavour. Phytochemical analysis performed has showed these spices to have medicinal value.^[12-14]

Spices can be used for the following purposes

- 1 As antimicrobials
- 2 Anti-inflammatory
- 3 Sedatives and anxiolytics
- 4 Endodontic medicaments/ irrigants and in retreatment.^[15]

This review aims at the potential use of *Syzygium aromaticum* (clove), *Elettaria cardamom* (cardamom), *Piper nigrum* (black pepper), *Cinnamomum verum* (cinnamon), *Curcuma longa* (turmeric), *Zingiber officinale* (ginger), *Myristica fragrans* (nutmeg), *Trigonella foenum graecum* (fenugreek), *Amomum subulatum* (black cardamom), *Citrus limon* (lemon), sesame and alum as dental remedies.

1: Clove (*Syzygium aromaticum*)

The phytochemicals present in cloves are essential oil- Eugenol, eugenylacetate, non-volatile ether, crude fibre carbohydrates, mineral matter, alkaloids flavonoids, tannins, saponins, phenols, steroids, glycosides and terpenoids.^[10, 13, and 14]

The essential oils present in clove have antibacterial properties and anodyne effects.^[15-16] Periodontal pathogens like *Porphyromonas gingivalis* and *Prevotella intermedia* were inhibited by clove extracted in methanol.^[17] Used as an endodontal medicament. It possesses antibacterial, anti-fungal, antiviral, local anaesthetic and anti-inflammatory action.^[18]

Soaked and boiled extracts inhibited growth of *S. mutans* and *C. albicans*.^[19] Eugenol is a potent anti-oxidant and also acts as an enzyme activator, hence used in toothaches.^[20] The oil shows a high degree of antibacterial activity against dental caries causing organisms; *S. mutans*, *S. aureus*, *Lactobacillus acidophilus* and antifungal activity against *Candida albicans* and *Saccharomyces cerevisiae* than the standard antibacterial ciprofloxacin and antifungal amphotericin-B.^[21] The mechanism is that clove destructs the cell wall and membrane and inhibits DNA and protein synthesis.^[22]

2: Cardamom (*Elettaria cardamom*)

Phytochemicals present in cardamom are flavonoids, glycosides, steroids, terpenoids, volatile oils and non-volatile ether.^[10,14]

It is used to treat infections of gums and teeth. It is used as a mouth freshener as it fights against bad breath causing organisms. Its oil is used to treat toothaches.^[22] It stops plaque formation

by inhibiting *S. mutans* and *C.albicans*. Invitro antimicrobial activity of the seed extract was done; the most susceptible were *S.aureus*, followed by *Candida albicans*, *Saccharomyces cerevisiae* and *S. mutans*.^[23]

3:Black pepper (*Piper nigrum*)

The phytochemical analysis revealed black pepper to have alkaloids flavonoids, tannins, steroids, glycosides and terpenoids. The essential oils present areLimonene, -3-carene, α -pinene, β -caryophyllene, β -pinene, sabinene, α -felandeno, myrcene, para-cymene, linalool, terpinolene, β -selinene, 1,8 cineole, α -terpinene, α -humulene, α -copaene, eugenol, terpinen-4-ol, camphene,safrole.^[10, 13, and 14]

Pepper is used in treatment of oral abscesses, tooth decay and aches. Shows in-vitro bactericidal action against *S.mutans*.^[24] Piperine is the main constituent due to which pepper exhibits antimicrobial property. It also exhibits antifungal property thus inhibiting the growth of fungi *Aspergillus* spp. Use of an herbal Toothpaste consisting of clove pepper and ginger as major constituents for 12 weeks had a positive effect on gingival bleeding, oral hygiene and reduced count of anaerobic bacteria of oral cavity.^[25]

4:Cinnamon (*Cinnamomum verum*).

Active components of cinnamon are: flavonoids, tannins, phenols, steroids, glycosides and terpenoids .Cinnamaldehyde is an antimicrobial compound present in cinnamon. volatile oil, fixed oil, resin, proteins, cellulose, pentosans, mucilage, starch, calcium oxalate and mineral elements. The volatiles are monoterpenes, sesquiterpenes and phenylpropenes.^[10, 13, and 14]

Cinnamom extracts have a Invitro inhibitory effect on *S.mutans*, it also increases the salivary pH and increases its flowrate thereby not letting plaque buildup^[26]. It also has anti-candidalactivity.^[27]

5:Turmeric(*Curcuma longa*)

Turmeric is most widely used spice throughout the world and also known for its antimicrobial activity.The phytochemicals present in turmeric are curcuminoids, cyclocurcuminoids, tumerones, essential oils.^[10, 13, and 14]

It is anti-inflammatory, thus applied on swollen gums. Shows anti-bacterial action. Methanolic extracts show inhibitory action on virulence factors of *S.mutans* biofilms such as

adherence, acidogenecityand aciduricity.^[28] Can be used as a endodontal medicament or irrigant as it inhibits *Enterococcus faecalis* biofilm formation.^[29]

Used in plaque detection and as pits and fissure sealant.^[10]

6: Ginger(*Zingiber officinale*)

Active components: Volatile oils, Shogaols, Gingerols, Diarylheptanoids.^[10, 13, and 14]

Has an anti-inflammatory action. ginger is a potent antifungal plant and has an anticandidal action, therefore its extracts can be used in treatment of oral candidiasis.^[30] Combined extracts of honey and ginger have maximum inhibitory action against *S.mutans* isolated from carious teeth.^[31]

7: Nutmeg (*Myristica fragrans*)

Alkaloids flavonoids, tannins, steroids, glycosides, terpenoids fatty acids, phenolic acids, lignans, neolignans are the phytochemicals present in nutmeg.^[10, 13, and 14]

Brushing with nutmeg powder helps reduce gums problem. Nutmeg extract shows anti-microbial action against *S.aureus*. It can be used as a part of different formulations(floss, toothpaste, root canal irrigant)^[32]

8: Fenugreek (*Trigonella foenum graecum*).

Fenugreek contains alkaloids, including trigonelline, g]entianinecarpaine compounds. fiber, 4- hydroxyisoleucine and fenugreekine, a component that may have hypoglycemic activity. Also contain saponins such as yamogenin, tigogenin, gitogenin, neotigogens.^[10, 13, and 14]

Has antibacterial activity. Fenugreek seed infusion was used as a mouth wash. Before and after oral swabs were taken and checked for its action, the wash showed a drastic reduction in total viable count(unpublished data). Fenugreek leaf infusion is used as gargle for mouth ulcers.^[10]

9:Black cardamom(*Amomum subulatum*)

Flavonoids, tannins, saponins, phenols, steroids, glycosides and terpenoids are the phytochemicals present in black cardamom.

Aqueous extract of the spice has an inhibitory effect on *E.fecalis* proving it to be a potent irrigant(unpublished data).

10: Lemon(*Citrus limon*)

Lemon consist of citric acid with pH 3 and is potent antimicrobial.

Fresh lemon solution is used as a root canal medicament as it inhibits *E.fecalis*.^[33]

It is infused in many of dental products because of its antibacterial activity.

11: Alum aluminium potassium sulfate

Alum is used since ages in domestic water purification, but it is antibacterial.^[34]

Aqueous extract of the spice has an inhibitory effect on *E.fecalis* proving it to be a potent irrigant(unpublished data)

12: Sesame

Steroids alkaloids phenols and glycosides are the phytochemicals present in it.

Sesame oil inhibited the growth of *E.fecalis*Invitro, pointing out that it can be used as an alternative to sodium hypochlorite(unpublished data).

DISCUSSION

Many antimicrobials and other therapeutic agent are been used since ages in dental treatment. Their overuse and abuse have led to drug resistance in the microorganisms. Hence there is need to find alternatives to these agent and what better than natural products. Especially the plant and their products have been a topic of interest. Spices besides of giving aroma and flavour to food also have antimicrobial, anti-inflamatory, anti-oxidative and immune boosting properties and also have lesser side effects than chemicals.

Clove, cardamom, cinnamon, turmeric have good antibacterial activity against *S.mutans* and antifungal activity against *Candida albicans*, thus can be used in oral thrush, periodontal treatment. Fenugreek can be used for ulcers. Black cardamom, lemon, alum and sesame show inhibitory effect on *E.fecalis* and hence prove to be good medicament and irrigants in endodontics.

CONCLUSION

Benefits of using spices are they are cheap, easily available, have long life time as they are dried products and they are them selves preservatives. Spices have a wide variety of properties like antimicrobial, anti-inflammatory antioxidative, immune modulating property and microbes have not developed resistance to them.

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