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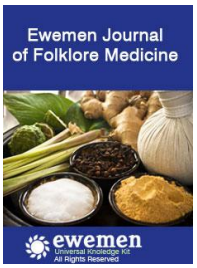

Review

CURATIVE EFFECTS OF CLOVE IN MEDICINE AND DENTISTRY: A REVIEW

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ABSTRACT

Nature has bestowed on us a very rich botanical wealth and a large number of assorted types of plants grow in different parts of the country. Clove is a medicinally powerful herb with a solid traditional heritage. Clove possesses anti-oxidant, anti-viral, anti-microbial, anti-inflammatory, anesthetic, pain reliving properties. Eugenol is the main constituent responsible for the medicinal properties of the clove bud. Clove is the most important spice of the world. This review gives a bird's eyeview mainly on the biological activities of clove and plausible medicinal and dental applications.

Keywords: Alternative therapy, Dentistry, Clove, *Eugenia caryophyllus*, *Syzygium aromaticum*

INTRODUCTION

Name of the Medicinal Plant is *Eugenia caryophyllus,* Synonyms is *Syzygium aromaticum.* Belong to the Family - Myrtaceae. Common names are Cloves, Carophyllus, Clovos, Caryophyllus. Names in Indian languages like in Sanskrit - Bhadrasriya, Devakusuma, Devapuspa, Haricandana, Karampu, Lavanga, Lavangaka, Lavangam, Varala. In Hindi -Laung, Laumg, Lavang. In Malayalam - Grampu, Karampu, Karayampu. In Marathi -Luvang. In Kannada - Lavanga, Daevakusuma, Krambu. In Tamil - Kirampu, Ilavankam, Kiraambu, Kirambu, Grambu. In Telgu - Devakusumamu, Lavangamu, Lavangalu, Kaaravallu. In Bengali - Lavanga. In Gujarati - Lavang. In Punjabi - Laung. In Oriya - Labanga. In Urdu - Laung, Loung (Parle and Khanna, 2011).

"Clove" stands as the symbol of dignity. It is a precious and valuable spice of the world. It is an unopened flower bud growing on a tree. Cloves are the aromatic dried flower buds, which are commonly used in biryanis, pickles, salads and garam masala. The tree that creates the miracle of nature originated from the Moluccas Islands, actually known as Spice Island. It is the common product found in the spice rack around the world. Clove buds possess intense fragrance and burning taste. They have deep brown color, powerful fragrant odour which is warm, pungent, strongly sweet and slightly astringent. In India it is used in almost all spicy rich dishes. Indonesia uses half the world production of cloves (Parle and Khanna, 2011).

Clove is native to Indonesia and used as a spice in virtually all of the world's cuisine. The name derives from French *clou*, a nail, as the buds vaguely resemble small irregular nails in shape. Cloves are harvested primarily in Indonesia and Madagascar; it is also grown in Zanzibar, India, Sri Lanka, and the "Spice Islands" (Moluccas, Indonesia known as the Bandas Islands). Cloves can be used in cooking, either whole or in a ground form, but as they are extremely strong, they are

used sparingly. The spice is used throughout Europe and Asia and is smoked in cigarettes (also known as kreteks) in Indonesia and in occasional coffee bars in the West, mixed with marijuana to create marijuana spliffs.

The clove tree is an evergreen which grows to a height ranging from 10-20 m, having large oval leaves and crimson flowers in numerous groups of terminal clusters. The flower buds are at first of a pale color and gradually become green, after which they develop into a bright red, when they are ready for collecting. Cloves are harvested when 1.5-2 cm long, and consist of a long calyx, terminating in four spreading sepals, and four unopened petals which form a small ball in the centre (Kim *et al.*, 1998).

MATERIALS AND METHODS

This review was conducted on the basis of articles search from university library and also from electronic database such as pubmed and google scholar.

RESULTS AND DISCUSSION

We have reviewed about 20 publications from different journals among them we have selected 15 publications to prepare a scientifically robust and technically sound review on clove.

Historical Background

Clove is one of the most ancient and valuable spices of the Orient, with its origin as old as the first century, before Christ. The ancient Chinese Han dynasty lasting from 207 B.C. to 220 A.D. gives us our first clue to the use of fragrant clove. Chinese physician of that era wrote that the court visitors to the Emperor were required to hold clove in their mouth. This was done to save the ruler from the bad breath of the visitors. The use of clove as a spice reached Europe around the 4th century A.D., when commercial trading really started with the Arabs, who in turn acquired these dried and fragrant buds from the cultures to the East in Asia. Its source and place of origin were shrouded in mystery until the Portuguese discovered the Moluccas Island or Indonesia in the 16th century. The islands of Zanzibar, which belong to present day Tanzania, in eastern Africa has been a major producer of cloves for many decades. This exported plant grows so well in Zanzibar that the moniker given to the island of Zanzibar is "Island of Cloves". Clove was established in Sri Lanka in 1796 A.D., before the arrival of the British. In Britain, cloves were worth at least their weight in gold, due to their high importing price in 17th and 18th centuries. In India East India Company introduced clove in 1800 A.D. (Parle and Khanna, 2011).

Constituents

Clove comprises of volatile as well as non-volatile constituents.

Volatile Constituents

Clove yields different types of volatile oil [oil extracted from i. leaves, ii. the stem, iii. the buds and iv. the fruit.] These oils differ considerably in yield and quality. The yield and composition of the oil obtained are influenced by its origin, season, variety and quality of raw material, maturity at harvest, pre- and post-distillation treatments and method of distillation. The chief component of all the types of oil is eugenol (Parle and Khanna, 2011).

a. Bud Oil

Good-quality clove buds contain 15–20% essential oil. The oil is dominated by Eugenol (70–85%), eugenyl acetate (15%) and β-caryophyllene (5–12%), which together make up 99% of the oil. The constituents of the oil also include methylamylketone, methyl salicylate, α- and β-humulene, benzaldehyde, β-ylangene and chavicol.

The minor constituents like methylamylketone, methylsalicylate etc., are responsible for the characteristic pleasant odour of cloves. The clove bud and stem oils from Madagascar were also dominated by eugenol, eugenyl acetate and β-caryophyllene. The stem oil contained a higher level of eugenol, whereas the eugenyl acetate content was higher in the bud oil.

The oil from clove bud contained 73.5–79.7% eugenol and 4.5– 10.7% eugenyl acetate, while the stem oil contained 76.4–84.8% eugenol and 1.5–8.0% eugenyl acetate. Both contained 7.3–12.4% β-caryophyllene and 1.0–1.4% α-humulene3. Pino et al. identified 36 compounds from the volatile oil of clove buds. Clove buds from India contained 12.9– 18.5% oil, of which 44–55% was eugenol, whereas the pedicels contained 3.0–7.7% oil with 60.0–72.4% eugenol (Pino *et al.*, 2001).

b. Leaf Oil

Clove leaves yield 3.0–4.8% essential oil. The essential oil content during the different stages of leaf growth revealed that the eugenol content in the leaves increased from 38.3 to 95.2% with maturity, while the contents of eugenyl acetate (51.2 to 1.5%) and caryophyllene (6.3 to 0.2%) decreased. Clove bud and leaf oil contain various classes of compounds, e.g. monoterpenes, sesquiterpenes, aldehydes and ketones (Parle and Khanna, 2011).

c. Clove Stem Oil

Clove stem yields 6% volatile oil. The oil is a pale to light yellow liquid containing 80.2% eugenol and 6.6% β- caryophyllene, besides several minor components (Parle and Khanna, 2011).

d. Fruit Oil

Ripe fruits yield 2% of oil, which is comprised of 50–55% eugenol. (Parle and Khanna, 2011)

Non-volatile Constituents

A few non-volatiles have been isolated from clove, which include tannins, sterols, triterpenes and flavonoids.

a. Tannins

Cloves contain 10–13% tannins, which have the same chemical composition as gallotannic acid. Eugenin and ellagitannin (Nonaka *et al.,* 1980) were isolated from cloves. Eugenol glucoside gallate, a chromone C-glycoside, galloyl and hexahydroxydiphenyl esters of 2,4,6-trihydroxyacetophenone-3-glucopyranoside (Figure 1) were isolated from clove leaves. Further, two ellagitannins, namely, syzyginin A (1, 2, 3-tri-O-galloyl–4, 6-(S) - tergalloyl-β- D-glucoside) (Figure 2) and syzyginin B, were also isolated from the leaves. (Parle and Khanna, 2011)

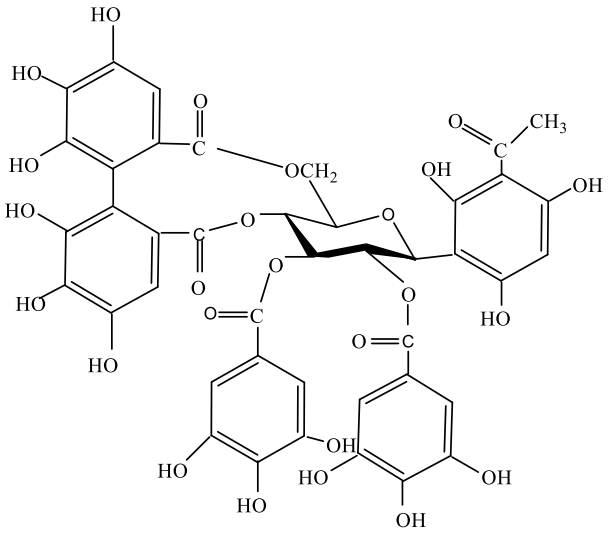

Figure 1**:** hexahydroxydiphenyl esters of 2,4,6-trihydroxyacetophenone-3-glucopyranoside

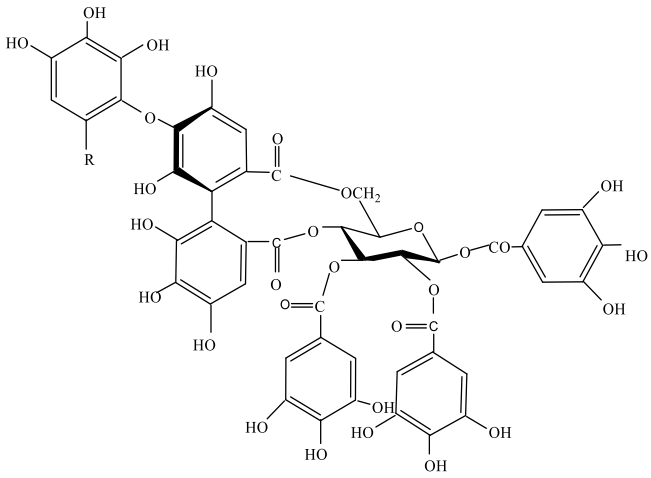

Figure 2: Syzyginin A (1, 2, 3-tri-O-galloyl–4, 6-(S) - tergalloyl-β- D-glucoside)

b. Triterpenes

Cloves contain about 2% of the triterpene (Figure 3), oleanolic acid (Figure 4). Narayanan and Natu (1974) isolated maslinic acid (Figure 5) from clove buds. From clove, 2α-hydroxyoleanolic acid was also isolated. (Parle and Khanna, 2011)

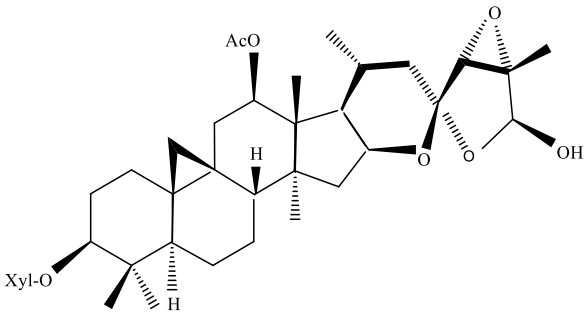

Figure 3: A triterpene

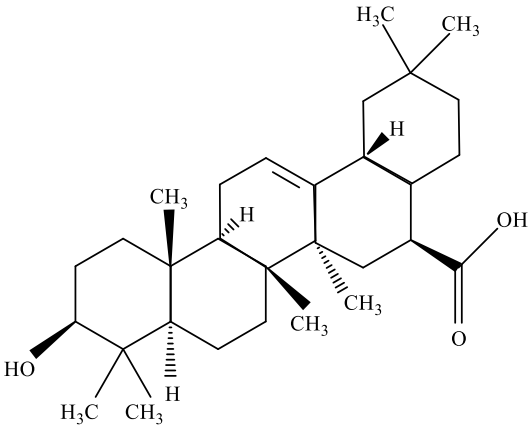

Figure 4: Oleanolic acid

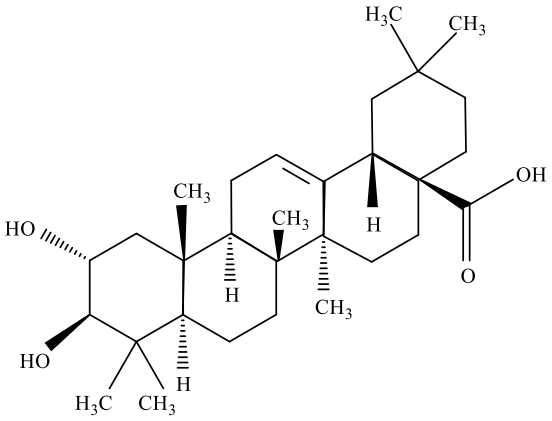

Figure 5: Maslinic acid

c. Sterols

Sterols isolated from clove include sitosterol, stigmasterol and campesterol. (Parle and Khanna, 2011)

d. Flavonoids

A chromone C-glucoside (Figure 6), isobiflorin (5, 7-dihydroxy-2-methoxychromone-8-C-β-D-glucopyranoside) (Figure 7) and biflorin were isolated from the ethanolic extract of cloves (Zhang and Chen, 1997). From the ethanol extract of the seeds, apigenin 6-C-[β-D-xylopyranosyl-(1→2)-β-D-galactopyranoside]-7-O-D-glucopyranoside and apigenin-6-C-[β-D-xylopyranosyl-(1→2)-D-galactopyranoside]-7-O-β-D-(6-O-p-coumarylglucopyranoside) (Figure 8) were reported (Nassar, 2006).

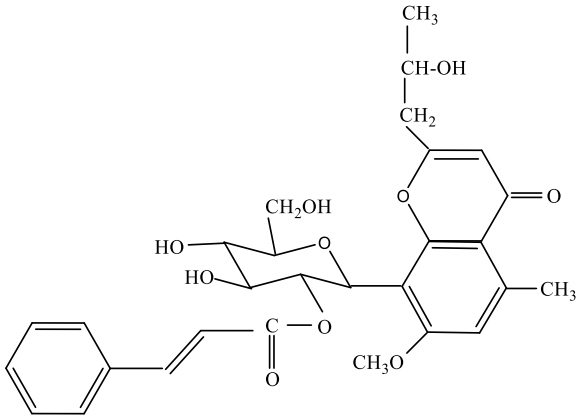

Figure 6: Chromone C-glucoside

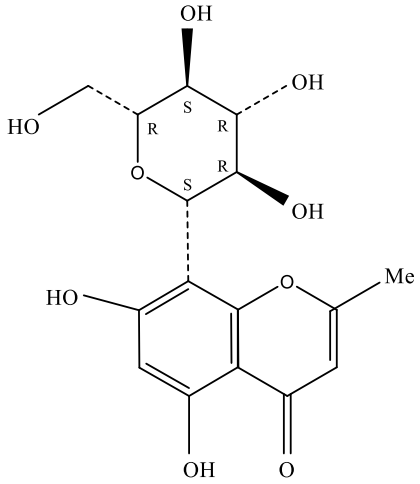

Figure 7: Isobiflorin (5, 7-dihydroxy-2- methoxychromone-8-C-β-D-glucopyranoside)

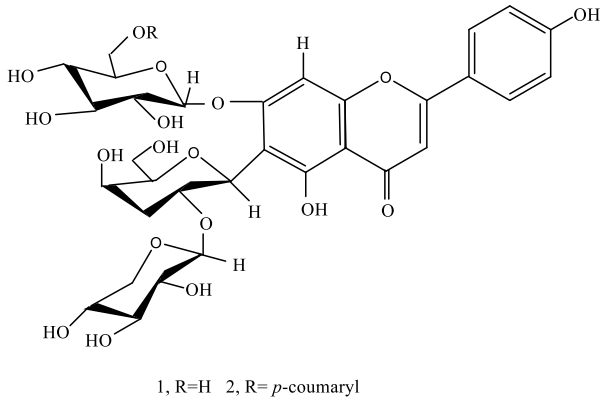

Figure 8 : Apigenin 6-C-[β-D-xylopyranosyl-(1→2)- β-D-galactopyranoside]-7-O-D-glucopyranoside (**1**) and apigenin 6-C-[β-D-xylopyranosyl-(1→2)-D-galactopyranoside]-7-O- β-D-(6-O-p-oumarylglucopyranoside) (**2**)

Commercially availability and Products

Clove is used as ingredient in

- Himalaya HiOra-K Toothpaste,
- Himalaya HiOra-K Mouthwash (For sensitive teeth and halitosis),
- Himalaya Active Fresh Gel,
- Himalaya Sparkling White Toothpaste.

Medical Implications

Anti- microbial

Cloves represent one of the Mother Nature's premier antiseptic. Clove oil was found to be more effective than sodium propionate (standard food preservative) against some food borne microbes. Clove oil was found to be very effective against Staphylococcus species. Amongst the fungi, *Aspergillus niger* was found to be highly sensitive to the clove oil. Essential oil of clove, dispersed (0.4% v/v) in a concentrated sugar solution, had a germicidal effect against various bacteria (*S. Aureus, Klebsiella Pneumoniae, Pseudomonas aeruginosa, Clostridium perfringens, E.coli*) and Candida albicans (Briozzor *et al.*, 1989). Clove oil and its main component eugenol show considerable antifungal activity against *Candida Aspergillus* and dermatophyte species. It also shows activity against clinically relevant fungi including fluconazole- resistant strains (Pinto *et al.,* 2009).

Anti -viral activity

Clove is a potent antiviral agent. Eugenin isolated from clove buds showed antiviral activity against Herpes Simplex virus at a concentration of 10 µg /mL (Parle and Khanna, 2011).

Chemo- preventive

Aqueous infusion of Clove effectively reduced benzo[a] pyrene (BP) (Figure 9) induced lung carcinogenesis in strain A mice. Incidence of hyperplasia, dysplasia and carcinoma were effectively reduced and there was significant reduction in the number of proliferating cells and increased number of apoptotic cells in BP induced lung lesions with the clove infusion. It also down regulates the expression of some growth promoting proteins, viz, COX-2, cMyc, Hras (Banerjee *et al.,* 2006). Aqueous infusion of cloves showed chemo preventive action on 9, 10-dimethyl benz (a) anthracene (DMBA) (Figure 10) and croton oil induced skin carcinogenesis in Swiss mice. Oral administration of aqueous infusions of clove at the dose of 100 µL /mouse /day not only delayed the formation of papilloma but also reduced the incidence of papilloma as well as the cumulative number of papillomas per mouse (Banerjee and Das, 2005).

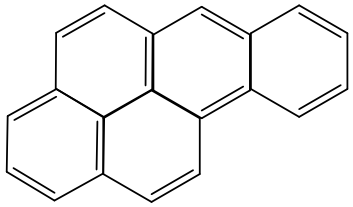

Figure 9: Benzo [a]pyrene

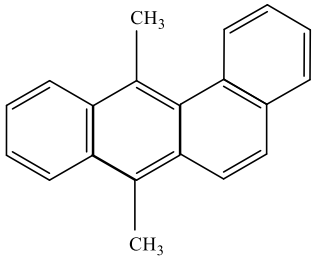

Figure 10: 9, 10-dimethyl benz (a) anthracene (DMBA)

Anti-oxidant activity

Clove has the highest capacity to give off hydrogen and reduce lipid per-oxidation. With respect to the lipid peroxidation, the inhibitory activity of clove oil determined using a linolenic acid emulsion system indicated a higher antioxidant activity than the standard BHT (Butylated hydroxyl tolvene). It also

showed a significant inhibitory effect against hydroxyl radicals and act as an iron chelator (Gulcin *et al.,*2004). The antioxidant activity of clove bud extract and its major aroma components, eugenol and eugenol acetate were comparable to that of the natural antioxidant α-tocopherol (Lee and Shibamoto, 2001).

Anti-inflammatory activity

Eugenol, the primary component of clove's volatile oils, functions as an anti-inflammatory agent. In animal etodolac at 0.025 and 0.1 mL/kg and to that of indomethacin at 0.05 and 0.2 mL/kg doses (Parle and Khanna, 2011).

Anti-platelet activity

It was found that both eugenol and acetyl eugenol, (two active constituents of clove) were more potent than aspirin in inhibiting platelet aggregation induced by arachidonate, adrenaline and collagen. In arachidonate induced-aggregation eugenol was at par with indomethacin (Parle and Khanna, 2011).

Anti-stress activity

The clove extract reduced the development of cold restraint induced gastric ulcers and prevented the biochemical changes induced by sound stress such as elevated plasma levels of aspartate aminotransferase, alanine aminotransferase, alkaline phosphtase, glucose, cholesterol and corticosterone. Clove extract was also effective in increasing the latency of anoxic stress induced convulsions in mice (Parle and Khanna, 2011).

Anti-pyretic effect

Eugenol, the chief constituent of clove oil, showed marked antipyretic activity when given intravenously, intragastrically and centrally to rabbits made febrile by interleukin-1. Eugenol was more effective in reducing fever than acetaminophen. It reduced fever primarily through a central action similar to that of common antipyretic drugs, such as acetaminophen (Parle and Khanna, 2011).

Anaesthetic effect

Clove oil is found to be an alternative to Tricaine or MS-222 the only registered anaesthetic for several fish species. Exposure of channel catfish (*Ictalurus punctatus*) to clove oil at the concentration of 100mg/L induced anesthesia within 1min (Waterstrat, 1999). It was found to be useful as a crab anaesthetic. Clove oil studies, the addition of clove extract to diets already high in anti-inflammatory components (like cod liver oil, with its high ω-3 fatty acid content) brings a synergistic effect. Clove also contains a variety of flavonoids, including kaempferol, rhamnetin and β-caryophyllene which also contributed to clove's anti-inflammatory and antioxidant properties (Ghelardini *et al.*, 2001). The essential oil of Eugenia caryophyllata had an anti-inflammatory effect matching to that of

proved to be highly effective and easy to use on juvenile tropical marine fish (*Valamagugil cunnesius* and *Monodactylus argenteus*) at the dose of 0.05mL/L. This dose anaesthetized the fish in less than a minute (Parle and Khanna, 2011).

Dental Implications

Cloves are also an important incense material in Chinese and Japanese culture. Clove essential oil is used in aromatherapy, and oil of cloves is widely used to treat toothache in dental emergencies (Kim *et al.* 1998).

Clove is known to possess antibacterial properties and is used in various dental creams, tooth pastes, mouth washes, and throat sprays to cleanse bacteria. It is also used to relive pain from sore gums and improves overall dental health. In dentistry, eugenol in combination with zinc oxide is used for temporary filling of cavities. Clove is an anodyne (an agent that soothes or relives pain) for dental emergencies (Cai and Wu, 1996).

CONCLUSION

Clove is a medicinally powerful herb with a solid traditional heritage and history. Clove has physical, mental and emotional health benefits. Clove possesses antioxidant, anti-viral, anti-microbial, anti-inflammatory, anesthetic, pain reliving properties. Cloves represent one of the Mother Nature's premier antiseptic. Eugenol is the main constituent responsible for the medicinal properties of the clove bud.

CONFLICT OF INTEREST

None declared

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