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## Clove: A Champion Spice and Its Multiple Uses



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### ABSTRACT

Clove (*Syzygium aromaticum*) is one of the most important spices that have been used traditionally as a food preservative and for many therapeutic uses. Clove is a native of Indonesia but it is also been cultured in several parts of the world including Pakistan. This plant shows one of the important sources of phenolic constituents as eugenol and eugenol acetate and possesses the potential for pharmaceutical, cosmetic, food, and agricultural applications. The antioxidant activity and antimicrobial activity of cloves are much more than many fruits, vegetables, and other spices. Most parts of the world use clove as a spice in home kitchens. However, commercial use of the clove is for the production of clove oil that contains active constituents, which possess antioxidant, anti-fungal, anti-viral, anti-microbial, anti-diabetic, anti-inflammatory, anti-thrombotic, anesthetic, pain-relieving, and insect repellent properties. The clove oil is used as a dental analgesic.



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## INTRODUCTION:

The names of cloves such as lavang *Caryophyllum*, Clove buds, and many more. Cloves are the aromatic flower buds belonging to the family *Myrtaceae Syzygium aromaticum*. Cloves contain significant amounts of volatile oil used for flavoring foods and pharmaceuticals. Clove buds possess a good fragrance and burning taste. They have a deep brown color and a more powerful fragrant odor which is warm, pungent, and strongly sweet as well as slightly astringent. Cloves are available throughout the year due to different harvest seasons in different countries Clove is a-utilized as a food preservative and medicine because of its antimicrobial and antioxidant properties. *Syzygium* is the largest genus of the *Myrtaceae* family comprised of about 1200 to 1800 species of flowering plants, which are all over distributed in tropical and subtropical areas. In India, it is used in most spicy rich dishes. Clove oil is also used as a dental analgesic for tooth pain.

Clove trees grow well in rich loamy soils of the humid tropics and can be grown successfully in red soils of the Midlands of Kerala as well as in the hilly terrain of the Western Ghats in Tamil Nadu and Karnataka. A cool climate with good rainfall is best for flowering. The site and place are selected for the cultivation of clove according to good drainage since the crop cannot withstand waterlogging.

## HISTORY:

Clove is an ancient spice, which is believed to be originated in the first century, before Christ. The ancient Chinese Han dynasty lasting from 207 B.C. to 220 A.D. gives us our first sign of the use of fragrant clove. Chinese physician of In the third century, Chinese emperors Han Dynasty required those who addressed them to chew the clove for fresh breath. They hold cloves in their mouth to prevent the emperor from visitor's bad breath. The use of clove as a spice reached Europe around the 4th century A.D. when commercial trading 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. In that century, when a child was born parents planted a clove tree, believing if the tree flourished, so will the child. In the 17th century A.D., cloves were introduced to Sri Lanka. In the 18th century A.D., cloves were established in India by the East India Company. Until modern times, cloves grew only on a

few islands in the Molucca it is also called spice Island. Tourists are told that seedlings from State capital Poivre this terribly were taken by a French person named in 1770, transferred to the Island American state France (Mauritius), and so later to island that was once the world's largest producer of cloves. In the republic of India Malay archipelago company introduced clove. Some European countries create pomanders (studding of a huffy orange with clove buds) that square measure decorated round the house. This helps to unfold a pleasant scent throughout the house and is pageant decoration.

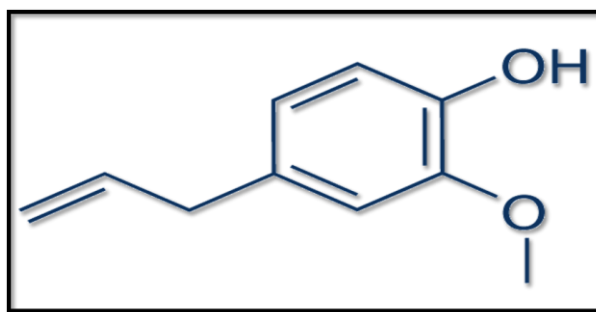
#### **CLIMATE AND SOIL:**

Clove is strictly a tropical plant and needs a hot wet climate having a temperature of 20-30°C wet climate condition and well-distributed annual precipitation of 150 to 250 cm square measure is essential. It thrives well all told things starting from water level up to associate degree altitude of 1500 meters and additionally in places proximal to and removed from the ocean. Deep black soil with high humus content found in the forest within the forest region is best fitted for clove cultivation. It grows satisfactorily on dirt soils, clay loams, and made black soils having smart drainage. Sandy soil is not suitable. Clove requires damp tropical and sub-tropical environments for growth. It has been cultivated in the following countries: following countries: Indonesia, Sri Lanka, India Tanzania, Malaysia, Madagascar, and Pakistan.

#### **CHEMICAL CONSTITUENTS:**

Clove is a vital source of phenolic compounds such as flavonoids, hydroxycinnamic acids, hydroxybenzoic acids, and hydroxyphenyl propenes. Eugenol is the main bioactive constituent of clove, which is present in concentrations ranging from 9 381.70 to 14 650.00 mg/100 g of fresh plant weight Eugenol contain 75-90% of the essential oil are extracted from cloves, and it is most responsible for clove aroma. Good quality clove bud contains volatile oil (15 to 20%). Along with eugenol also contains eugenyl acetate (10 to 15%), and beta-caryophyllene (5 to 12%).

Other minor constituents including methyl amyl ketone, kaempferol, gallotannic acid,  $\alpha$ -humulene,  $\beta$ -humulene, methyl salicylate, cratogenic acid, and Benzaldehyde are responsible for the pleasant fragrance of clove.



**Fig.1. Structure of chemical constituents of clove: Eugenol**

## **PHARMACOLOGICAL ACTIVITY:**

### **1.Anti-microbial activity:**

Cloves show one of Mother Nature's premier antiseptics. Clove oil was found to be more useful than sodium propionate (standard food preservative) against some food-borne microbes. Clove oil is very effective against *Staphylococcus* species. Amongst the fungi, *Aspergillus Niger* was found to be highly sensitive to clove oil. Essential oil of clove, mixed 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*. It has been found the 0.05% solution of eugenol is used to kill bacillus tuberculosis. Clove shows antimicrobial activity against some human pathogenic bacteria.

### **2.Antiviral activity:**

clove is a potent antiviral agent. Eugenol isolated from clove buds showed antiviral activity against the Herpes Simplex virus at a concentration of 10 µg /ml.

### **3.Antioxidant activity:**

High antioxidant activity was shown by the clove oil due to the presence of phenolic compounds like eugenol, thymol, and eugenol acetate. Clove has the capacity to give off hydrogen and reduce lipid peroxidation. With respect to lipid peroxidation, the inhibiting activity of clove oil is determined by using a linolenic acid emulsion system indicated a higher antioxidant activity than the standard BHT (Butylated hydroxyl toluene).

#### **4. Anti-inflammatory activity:**

Eugenol, the primary component of clove's volatile oils, shows as an anti-inflammatory agent. Clove also contains a variety of flavonoids, including kaempferol, rhamnetin, and  $\beta$ -caryophyllene which also contributed to clove's anti-inflammatory and antioxidant activity.

#### **5. Analgesic activity:**

Eugenol was administered intravenously and intragastrically to rabbits to examine its analgesic effect. Paracetamol was a standard drug. Eugenol showed greater fever-reducing potential than Paracetamol.

#### **6. Anti-diabetic activity:**

Clove extract acts as a hypoglycaemic agent in hepatocytes and hepatoma cells by reducing phosphoenolpyruvate carboxykinase (PEPCK) and aldohexose 6-phosphatase (G6Pase). Organic Phenomenon additional world analysis of organic phenomenon by deoxyribo-nucleic acid microarray analysis unconcealed that clove and hypoglycaemic agent regulated the expression of the many identical genes in an exceedingly similar manner.

#### **Nutritional information:**

Cloves are a preferred spice in preparation. According to the U. S. Department of Agriculture National Nutrient info, 2.1 grams (g) or one teaspoon of ground cloves contains:

6 kilocalories (kcal)

0.13 grams (g) of macromolecule

0.27 g total fat

1.38 g saccharide

0.7 g fiber

The same quantity of ground cloves additionally provides one.263 milligrams (mg) of metallic element, that is sixty-three p.c of the Daily price (DV) for metallic element.

### **Mechanism of action:**

The chief constituent present in clove oil is the phenol "eugenol" which is present in amounts up to 85%. Clove oil acts as a germicide 9 to *Escherichia coli*, *Staphylococcus aureus*, and *Pseudomonas aeruginosa*. Clove oil is thought to inhibit prostaglandin synthesis, thereby reducing painful symptoms.

Eugenol, the main constituent of clove oil is purported to have anticancer action. In one study, eugenol-treated HL-60 cells showed features of apoptosis including DNA fragmentation and formation of DNA ladders in agarose gel electrophoresis. It was observed that eugenol transduced the apoptotic signal via reactive oxygen species (ROS) generation, inducing mitochondrial permeability transition (MPT), decreasing anti-apoptotic protein bcl-2 level, inducing cytochrome c release to the cytosol, and subsequent apoptotic cell death. When taken together, the study showed that ROS plays a critical role in eugenol-induced apoptosis in HL-60, and this is the first report on the mechanism of the anticancer effect of eugenol.

### **Absorption:**

Clove oil is quickly absorbed through the skin and is employed in proprietary systems for dermal drug delivery to boost drug uptake from pad delivery systems.

### **Metabolism:**

In the rat, 20-30% of eugenol is metabolized to homovanillic acid and 4-hydroxy-3-methoxymandelic acid.

In a pharmacokinetic study in man, ninety-fifth of the eaten eugenol dose was recovered within the excreta, most of that (greater than 99%) consisted of phenoplast conjugates; five-hundredths of the conjugated metabolites were eugenol-glucuronide and salt. alternative metabolic routes ascertained were the epoxide-diol pathway, synthesis of a thiophenol and a substituted carboxylic acid, group oxidization, and migration of the covalent bond.

### **Pharmacokinetics of eugenol and its effects on thermal hypersensitivity in rats:**

Neuropathic pain may be a sort of chronic pain following central or peripheral system lesions that cause allodynia (pain initiated by a non-painful stimulus) and hyperalgesia (increased pain sensation following a painful stimulus). the primary objective of the study was to judge

the pharmacokinetics of eugenol, the principal chemical constituent of volatile oil, following a gavage administration (40 mg/kg) in male Sprague-Dawley rats. The second objective was to gauge the effect of repeated oral administrations of eugenol on hyperalgesia and allodynia using an experimental model of neuropathic pain in rats. Thermal and mechanical sensitivity (Hargreave's test and von Frey filaments) were determined in nerve cuff-implanted rats. Sensitivities were assessed following repeated oral administrations of 40 mg/kg of eugenol or saline for five days (n=6 per group). Pharmacokinetic parameters were calculated using noncompartmental methods. Serial blood samples were collected over 24 h. Concentrations of eugenol in blood and plasma peaked rapidly following oral administration. Mean T(1/2) values of eugenol in plasma and blood were long (14.0 and 18.3 h, respectively), suggesting a possible accumulation of drugs following repeated administrations. Latency to thermal stimuli seemed to increase constantly following repeated administrations of eugenol. On the Judgment Day of treatment, eugenol treatments resulted in a very statistically significant prolongation of the latency to thermal stimuli in rats compared to the saline group (Mean $\pm$ S.E.M.: 11.4 $\pm$ 1.23 vs. 6.1 $\pm$ 0.53 s, P<0.01). These results support the hypothesis that eugenol may alleviate neuropathic pain which the cumulative effect of the drug is also partially answerable for this effect following repeated daily administrations.

Clove volatile oil is mostly recognized as a safe substance once consumed in concentrations under 1 500 mg/kg. On the opposite hand, the globe Health Organization (WHO) established that the daily amount acceptable of clove per day is two.5 mg/kg of weight in humans. The toxicity of essential oil was tested in 2 tank fish species, Danio rerio and Poecilia reticulata the medium fatal concentrations (LD50) at ninety-six h were (18.2 $\pm$ 5.52) mg/mL in Danio rerio and (21.7 $\pm$ 0.8) mg/mL in Poecilia reticulata. Eugenol is well absorbed once administrated by oral route reaching chop- chop plasma and blood with mean half-lives of fourteen.0 h and 18.3 h, severally. A cumulative result has been hypothesized and associated to alleviate neuropathic pain once continual daily administrations.

### **Toxicity effect of Eugenol:**

Eugenol is understood for its inhibitor, anti-inflammatory drug, antimicrobial, and growth activities; but, it should gift some toxicity counting on the kind of microscopic anatomy structure exposed to the current Thus, eugenol toxicity was determined in human dental pulp fibroblasts from deciduous teeth, with polymer injury at concentrations starting from

zero.06–5.1  $\mu\text{M}$ , which wasn't determined at higher interval concentrations of Eugenol was conjointly ready to induce genotoxicity by causation polymer injury of mouse serous membrane macrophages the of least bit concentrations tested (0.62, 1.24, and 2.48 mg/mL). However, its incontestable antigenotoxic potential counting on the treatment protocol, which can be interlinked with its impact on drug metabolism. Therefore, eugenol will modulate inflammatory and oxidizing processes.

The possible mechanism of cytotoxicity and carcinogenicity could be due to the metabolic reaction of eugenol. Eugenol would undergo three metabolic reactions, hydroxylation epoxidation and O-demethylation. The reactive metabolite, 2,3-epoxyeugenol, and 10-hydroxyeugenol, after originating the quinone methide, can react with DNA, forming adducts that can contribute to the genotoxic activity (deleterious action on the genetic material) of eugenol.

#### **USES:**

Clove is also known for its antibacterial properties and is also used in various dental creams, toothpaste, mouthwashes, and throat sprays to kill and avoid bacteria.

It is also used to relieve pain from sore gums and improve good dental health.

Clove is used as an anti-inflammatory agent, because of its high content of flavonoids.

Pure clove oil is used in aromatherapists to cure the symptoms of rheumatism and arthritis.

Clove also acts as a carminative, improve peristalsis by increasing hydrochloric acid in the stomach.

Clove and clove oil also boosts the immune system by purifying the blood and help to kill and fight against various types of diseases. The clove oil, when inhaled can help soothe certain respiratory conditions like cold, cough, asthma, bronchitis, and sinusitis. It also helps in clearing the nasal tract.

Dried cloves are the more useful ingredient in Indian masala tea. Clove is often used to flavor meat products, pastries, cookies, candies, chewing gum, spiced fruits, hot spiced, chocolate drinks, wines and liqueurs, puddings, sandwiches, cakes, curries, and pickles. Clove is used to flavor Pharmaceuticals.



In Indonesia, the mixture of clove and tobacco in a ratio of 1:2 is used to make a special cigarette "Kretek". Clove is good for diabetic patients as it controls the blood level of glucose. Cloves are used as part of herbal formulations to cure animals. The clove oil has the potential of curing ear infections in dogs and cats.:

**Clove might play a therapeutic role within the following conditions:**

- Powerful disinfectant properties: Clove is employed extensively intending for relieving ache, sore gums, and oral ulcers. Gargling with essential oil can even aid in sore throat conditions and dangerous breathing.
- Anti-Bacterial: an efficient aid for food poisoning, essential oil effectively kills several forms of microorganism infections from contaminated foods.
- Antiseptic: essential oil may be accustomed cut back infections, wounds, insect bites, and stings.
- Anti-fungal: Clove is additionally effective in reducing fungus infections like athlete's foot.
- Skin: wonderful aid for skin disorders, such as acne.
- General Stress Reliever: essential oil stimulates the cardiovascular system, clearing the mind and reducing brain-fag and fatigue. it's conjointly been accustomed to aid sleep disorder, memory loss, anxiety, and depression.
- Anti-Inflammatory: essential oil clears the respiratory passages, acting as AN medication for treating several upper-respiratory conditions including colds, eye styes, bronchitis, sinus conditions, cough, and asthma attack.
- Blood Purifier: Not solely purifies the blood, but conjointly aids in stabilizing glucose levels, and may have advantages for diabetic individuals.
- General system Booster: Clove's antiviral and cleansing properties purify the body, augmenting our disease resistance.
- Premature Ejaculation: Some analysis has shown that clove could also be helpful as a aid for premature ejaculation.

□ Indigestion: essential oil offers a strong action against gas and bloating. It reduces gas pressure within the abdomen, aiding in the correct elimination of food and toxins. It conjointly relieves the discomfort of organic process ulcers. Effective for stomach connected conditions as well as nausea, hiccups, complaint, and unconditioned reflex.

□ Indigestion: essential oil offers a strong suggestion that essential oil might play a chemopreventive role, notably in cases of lung, skin, and organic process cancers.

□ Bar from harmful exposure: Studies show that essential oil will stop toxicity associated with exposure to environmental pollution.

## CONCLUSION:

Based on the information presented in this article, concluded that clove represents a very interesting plant with enormous potential as a food preservative and as a rich source of antioxidant compounds. It's proved biological activities suggest the development of medicinal products for human and animal uses and confirm why this plant has been employed for centuries.



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