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A Comprehensive review of Clove (Syzygium aromaticum) with special references of Ayurvedic and Modern Sciences.

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ABSTRACT-
Herbal medicinal products have been documented as a significant source for discovering new pharmaceutical molecules that have been used to treat serious diseases. Many plant species have been reported to have pharmacological activities attributable to their phytoconstituents such are glycosides, saponins, flavonoids, steroids, tannins, alkaloids, terpenes, etc. Syzygium aromaticum (clove) is a traditional spice that has been used for food preservation and possesses various pharmacological activities. S. aromaticum is rich in many phytochemicals as follows: sesquiterpenes, monoterpenes, hydrocarbon, and phenolic compounds. Eugenyl acetate, eugenol, and β-caryophyllene are the most significant phytochemicals in clove oil.
Key words- clove, antimicrobial, Origin, soil, anti-cancer.

I. INTRODUCTION-

Spices as clove, oregano, mint, thyme and cinnamon, have been employed for centuries as food preservatives and as medicinal plants mainly due to its antioxidant and antimicrobial activities. Nowadays, many reports confirm the antibacterial, antifungal, antiviral and anticarcinogenic properties of spice plants. Clove in particular has attracted the attention due to the potent antioxidant and antimicrobial activities standing out among the other spices[1]The traditional medicinal system based on the use of herbal remedies still plays an important rolein the health care system. In recent decades, medicinal plants have been gaining wider acceptancedue to the perception that these plants being natural products have lesser side effects and improvedefficacy than their synthetic counterparts[2,3]

Syzygium aromaticum (S. aromaticum) (synonym: Eugenia cariophylata) commonly known as clove, is a median size tree (8-12 m) from the Mirtaceae family native from the Maluku islands in east Indonesia. For centuries the trade of clove and the search of this valuable spice stimulated the economic development of this Asiatic region[4].Nowadays, the larger producer countries of clove are Indonesia, India, Malaysia, Sri Lanka, Madagascar and Tanzania specially the Zanzibar Island. In Brazil, clove is cultured in the northeast region, in the state of Bahia in the regions of Valença, Ituberá, Taperoá, Camamu and Nilo Peçanha, where approximately 8 000 hectares are cultivated, producing near 2 500 tons per year [5][6].

Synonyms-
Clovos, Caryophyllus, Lavang, Laung, Grambu, Grampus, Krambu.
Biological source- It consist of a dried flower bud of Eugenia caryophyllus.

Phylotoxy[7]

Rich loamy soil with a high humus quality is perfect for clove cultivation. In open sandyloam and laterite soil of southern kerala area and soil with good moisture, good drainage, it isalso found to grow favorably. The pH of soil should vary from 4.0-5.6. Soil water miningshould be prevented. These needs of higher moisture content, but also develops well close tothe sea. Rainy season it within ranges of 150-250 cm another cultivation and place factor thatranges from ocean level to 900 m. After 7-8 years, the plant starts to grow, andsatisfactoryyield per hectare of drugs is achieved only after 15-20 years of development. The clove isstrongly tropical and demands a dry, moist and wet. Humid climate and well distributedannually with an ideal requirement to cultivate the crop normally and commercially.

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MORPHOLOGY OF CLOVE[8,9]

Hpanthium is the upper crow or cap of clove. The lower portion is 10-13 mm in length and 4mm and 2 mm in thickness. Four spreading thick, squatted, cylindrical stem, sharp sepals areabout 3mm. Approximately 5-5,5 mm long and dome shaped corolla. Four petals in bowlshape. Color is a dark brown, odour is slightly aromatic, its taste is pungent. The top section iscreated of calyx, corolla, stamen and style, and shows bilocular ovaries and oil glands. Corolais a dome shaped in yellow with imbricated membranous petals. It is a conical myrtle tree,medium in size, with a straight trunk that grows in height from 10 to 12 m. Branches semistraight, and it occur greyish. Leaves are tall, elliptical and obovate, glabrous and have manyoil glands on the lower surface. The plant beings flowring in about seven years bloom formore than 80 years.The clove tree consists of leaves and buds (the company component of the crop) andflowering bud starts four years after planting. It is one of the most important drugs in Indianindigenous medicine, especially Unani. The clove is an herb. The dick is a tree. People mademedicine using their oils and drying flowers, leaves and stems.

Botanical Classification-
Kingdom- Plantae
Sub Kingdom- Tracheobionta
Super Division- Spermatophyta
Division-Magnoliphyta
Class- Magnoliopsida
Subclass- Rosidae
Order-Myrtales
Family- Myrtaceae
Genus- Syzgium
Species- aromaticum

History & Origin

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 Handynasty lasting from 207 B.C. to 220 A.D. gives us our first clue to theuse of fragrant clove. The use clove as a spice reached Europe around the 4th century A.D., whencommercial trading really started with the Arabs, who in turn acquired these dried and fragrant buds fromthe cultures to the East in Asia. For over 2,000 years, both Indian and Chinese traditional medicine madeextensive use of clove flowers and clove oil. Clove introduced in India around 1800AD by the East Indiacompany in its 'spice garden' in Courtallam, Tamil Nadu.Cloves are believed to be native to the MoluccaIslands of Indonesia. Although Indonesia is the largest producer of Cloves, Zanzibar and Madagascar are themajor exporters, where Clove trees cover thousands of acres of the islands. Historically, Clove originatingfrom Madagascar have been considered superior [10].

Chemical Composition

It consists of 82-88% eugenol, little amount of eugenyl acetate, and other minor constituents. Stem oils are evolvedfrom the twigs of Eugenia caryophyllus. It consists of 90-95% eugenol, and some other minor constituents. Amajor component of clove taste is imparted by the chemical eugeno l [11]. Eugenol is the main bioactive compoundof clove, which is found in concentrations ranging from 9 381.70 to 14 650.00 mg per 100 g of fresh plant material. With regard to the phenolic acids, gallicacid is the compound found in higher concentration (783.50 mg/100 gfresh weight) [12]. The chemical composition of the essential oil from the bud of clove (Syzygiumaromaticum). As canbe seen from this table, 18 compounds, representing about 99.95% of the essential oil from clove, were characterized.

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The major components are as follows: eugenol (87.00%), eugenyl acetate (8.01%) and β-Caryophyllene (3.56%).Thisessential oil comprises in total 23 identified constituents, among them eugenol (76.8%), followed by β-caryophyllene (17.4%), α-humulene (2.1%), and eugenyl acetate (1.2%) as the main components.[13]

Pharmacological Activities of Clove-

Antimicrobial activity-

Antimicrobial properties of Syzygium aromaticum and Rosmarinus officinal is essential oils were tested against multidrug resistant isolates including Pseudomonasaeruginosa, Enterococcus feacalis, Acinetobacterbaumannii, and Staphylococcus aureus, and two controlledstrains Pseudomonas aeruginosa-ATCC27853 and Staphylococcus aureus-ATCC29213, using agar welldiffusion model. Both oils exhibited significant inhibitionagainst tested strains, with minimum inhibitoryconcentrations ranging from 0.312-1.25% (v/v) for clove oil,and 0.312- 5% (v/v) for rosemary oil [14]. A comparativeanalysis was carried out to evaluate the antiseptic potentialof clove extract (ethanolic) and clove oil against some foodborne pathogens. Ten bacterial and seven fungal strainswere tested using agar well diffusion method. Sodiumpropionate was used as a standard food preservative. Resultsrevealed the greaterantimicrobial effect of clove oil, whencompared to extract and sodiumpropionate. In anotherstudy, clove oil was tested against five dermophytesincluding Trichophyton rubrum, Epidermophytonfloccosum, Microsporumcanis, Microsporumgypseum, andTrichophyton mentagrophytes. Maximum inhibitory effect (≈60%) against all fungal strains was shown at dose of0.2mg/ml [15].Antibacterial activity of six spices (clove,mint, cinnamon, ginger, mustard, and garlic) was evaluatedagainst Escherichia coli, Bacillus cereus, andStaphylococcus aureus, using dilution, cup, and paper discdiffusion assays. Results revealed the maximum inhibitoryaction of clove, mustard, and cinnamon at 1% concentration.Garlic showed good inhibitory action at 3% concentration.However, mint and ginger had negligible inhibition at sameconcentration [16]. Essential oils of Piper nigrum, Syzygiumaromaticum, Pelargonium graveolens, Myristica fragrans, Origanum vulgare, and Thymus vulgaris were evaluated forantimicrobial activity against twenty-five bacterial strains,including food borne, animal, and plantpathogens. considerableinhibitory action was observed bythe volatile oils in a dose dependent behavior.[17]

Anti-Cancer Activity-

To stay protected from cancer eat more cloves, as the eugenol in clovepossess strong anticarcinogenic properties and helps control lung cancer,breast cancer, and ovariancancer at its early stages.Clove also reduced the abnormal crowding of cells in particular regions oflung tissue and checked the growth of pre-malignant cells by more than 85 per cent [19]. Inanother in vitrostudyTrusted Source, researchers found that clove oil stopped the growth of severalcancer cell lines, including but not limited to breast, cervical, and colon cancer. Clove extract alsoincreased cell death and disrupted cell division in a colon cancer cell line.[18]

Anti diabetic Activity-

Cloves also help keep your blood sugar levels in check and are knownto promote insulin production, further controlling diabetes. research shows that the compoundsfound in cloves may help keep blood sugar under control. As little as one teaspoon of the super-starspice is enough to reap benefits. [20]

Anti-viral activity-

The antiviral activity of eugeniin, a compound isolated from S. aromaticum and from Geum japonicum, was tested against herpes virus strains being effective at 5 µg/mL, and it was deductedthat one of the major targets ofeugeniin is the viral DNA synthesis by the inhibition of the viral DNApolymerase. Eugenol was virucidal and showed no cytotoxicity at the concentrations tested.[21]

Anti-fungal activity-

The present study indicates that clove oil and eugenol haveconsiderable antifungal activity against clinically relevant fungi, including fluconazoleresistantstrains, deserving further investigation for clinical application in the treatment of fungal infections.Studies have shown that clove essential oil is both fast and effective in killing fungal infections.[22]

Analgesic activity-

The results of the present study showed that aqueous extractof clove has analgesic effect in mice demonstrated by hot plate test which is reversible by naloxone. The role of opioid system in the analgesic effect of clove might be suggested.

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Clove oil containsthe active ingredient eugenol, which is a natural aesthetic. It helps numb and reduce pain to ease atoothache. Eugenol also has natural anti-inflammatory properties. It may reduce swelling andirritation in the affected area.[23]

Adulteration in Clove-

Cloves can be adulterated with cheaper substances that have similarphysical and chemical properties, which can affect the quality, safety, andefficacy of the product. Some examples of adulterants include:

Used cloves: Cloves from which the volatile oil has been extracted by distillation.
Benzyl alcohol: An adulterant of clove essential oil.
Vegetable oil: An adulterant of clove essential oil.
Clove stalks: An adulterant of clove buds.
Exhausted clove buds: An adulterant of clove buds.
Volatile substances such as clove leaf oils: An adulterant of clove buds.
Vaseline: A common adulterant of clove essential oil because it's low-cost and odorless.

Some ways to detect adulteration in cloves-

1.Water test-

Place the cloves in a glass of water. Unadulterated cloves will settle at the bottom, while adulterated cloves will float on the surface.

Raman spectroscopy-

Can be used to detect adulteration in clove essential oil.

2.Near IR diffuse reflectance spectroscopy-

Can be used to authenticate clove buds powders and oils.

3.Electronic nose with polymeric gas sensors-

Can be used to detect adulteration in clove essential oil.

4.FTIR with chemometrics-

Can be used to simultaneously discriminate and quantify the adulterants of B and E in COs.

Side Effects & Rick-

It is generally recommended not to ingest clove oil in large amounts, If swallowed, clove may cause a burning sensation. Applying it to the skin or using it as a wash is recommended instead.[24- 27]

1. Increases Bleeding.
2. Lowers sugar level in the blood.
3. Toxicity.
4. Causes Allergic Reaction.
5. Causes Seizures.
6. Makes the skin sensitive.
7. Causes Mouth Sensitivity.
8. Cause Respiratory problem.
9. Loss of sensation.
10. Erectile /Ejaculation Issues.
11. Itching, rash.
12. Mouth irritation, sore gums.

II. CONCLUSION-

Based on the information presented, it could be concluded that clove represents a very interesting plantwith an enormous potential as food preservative and as a rich source of antioxidant compounds. Cloveflower buds at flowering stage had the highest yield, eugenol content, and refractive index. The maincomponents of clove essential oils were eugenol, beta- cis-caryophyllene, & eugenol acetate. Further criticalstages, namely the development of a better distillation method to improve oil quality and the application ofclove essential oil as a natural antioxidant.

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