Phytochemistry and biological evidence on clove

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Abstract

Clove scientifically known as Syzygium aromaticum (S. aromaticum), is a tree of median size (8-12 m) that is indigenous to the east Indonesian Maluku islands and belongs to the Mirtaceae family. The commerce and hunt for cloves fueled this Asiatic region's economic growth for a number of years. Many researchers research for several years and find that cloves have many medicinal properties such as anti- inflammatory properties.

Clove oil is extracted for use in pharmaceutical, culinary, and cosmetic formulations. Clove oil contains several phytoconstituents, including eugenol, a phenolic component.

Clove, a native of Indonesia, is planted in coastal locations and at higher altitudes worldwide. Clove has been used for ages to treat a variety of maladies and diseases. Clove exhibits antibacterial, antiviral, antiinflammatory, hepatoprotective, anti-stress, antinoceptive, and anesthetic properties. Clove has been shown to have larval-killing efficacy in dengue, a novel application.

In this article, we will discuss about the uses, pharmacological activity, phytochemistry and it's toxicological studies based on many researches and the data collected.

Keywords:- Syzygium aromaticum, Mirtaceae, Phytoconstituents, Eugenol, Hepatoprotective, Anesthetic, Antinoceptive, Culinary

Introduction :-

Myrtaceae family, produces aromatic flower buds known as cloves. They are native to Indonesia's Maluku Islands, sometimes known as the Moluccas, and are widely used as a spice, flavouring, or aroma in consumer products such as toothpaste, soaps, and cosmetics. Cloves are available throughout the year due to varying harvest seasons in different nations.

The cloves are a fragrant spice derived from dried blossoms of the clove tree. Historically, spices, including cloves, were highly valued. Cloves are still a popular spice, adding a subtle sweetness to many foods. Clove oil contains 400 times more antioxidants than blueberries or wolfberries. Cloves have high levels of manganese, which aids in bone healing and hormone production. Manganese can also work as an antioxidant, shielding your body from damaging free radicals. Cloves are a fragrant, thick spice that may be used in both savory and sweet recipes. They include potent nutrients that help protect your cells from injury. Some natural chemicals found in cloves can conflict with medications or create potentially fatal side effects. As a result, it is best to only cook or

bake with cloves in order to get the beneficial health effects of this spice. Clove is used in cosmetics, health, gastronomy, and agriculture because of its abundance of bioactive components such as gallic acid and flavonoids.

Clove is used to treat and cure a wide range of illnesses. One of its novel applications is as a larval killer agent to combat dengue, one of the most critical health concerns in tropical countries. Clove is also used to treat digestive issues such as loose stool, nausea, gas, and indigestion. It works as an antibacterial agent by strengthening the body's defensive mechanism against invading germs. It is also used to treat athlete's foot disease, onchomysosis, and respiratory disorders such as cough, cold, asthma, bronchitis, and sinusitis. Clove has been demonstrated to be effective in lung and skin cancers, as well as diabetes by controlling blood glucose levels.



Taxonomical Classification:-

Kingdom	Plantae
Phylum	Tracheophyta
Class	Magnoliopsida
Order	Myrtales
Family	Myrtale (Myratales family)
Sub family	Myrtoideae
Genus	Syzygium
Species	S. aromaticum (Clove)
Binomial Name	Syzygium aromaticum.

Different names of cloves over Indian States/ Region:-

Hindi	Laung
Malyalam	Grambu
Tamil	Kirambu, Lavangam
Kannada	Lavanga
Telugu	Lavangalu
Bengali	Lawang
Marathi	Luvang
Oriya	Labang
Punjabi	Laung
Sanskrit	Lavanga
Urdu	Laung
Gujarati	Lavang



Methods of usage, part used and taste:-

Clove and its compounds have been used as an excellent pain reliever for millennia. The flavour is strong, pungent, and aromatic, with a mild bitterness. When used in food, it tastes similar to cardamom. It is used in meals to add a gentler or complementing flavour and odour, similar to its application in medicinal treatments.

It is utilized in a variety of ways, including topical application of clove oil and oral ingestion of clove, either raw or as part of a preparation. Pressing a clove bud between the jaws can help relieve dental pain.

Cloves have mainly two parts a bud and a stalk used as main portion. They can be consumed raw or prepared. In Pharmaceutical industry the cloves oil is also very useful and it is obtained from its raw material when it is boiled and filtered.

Clove buds can be chewed to treat poor breath, hyperacidity, and pharyngitis, and when combined with salt, they alleviate coughing. As an expectorant, make a decoction of 5-6 cloves in 30ml of water with honey and take three times a day. Clove oil can treat stomach problems when combined with sugar and can also be administered to the location of mouth cavities to reduce pain. Clove paste, combined with salt and milk, can alleviate headaches and act as an antiemetic, particularly for pregnant women. Clove can be consumed with betel leaves to treat catarrh. Clove oil can be used to repel insects when sprinkled in water.

Phytochemistry:-

Clove (Syzygium aromaticum) is rich in phytochemicals, including eugenol, eugenyl acetate, and ßcaryophyllene. These compounds contribute to clove's various biological actions, which include antibacterial, anti-inflammatory, and antioxidant effects. Here are the details:-

Major phytochemicals:

- Eugenol:-
 - 1. It is a phenylpropanoid chemical. Eugenol, a main component of clove oil, is known to have analgesic, antimicrobial, and antioxidant activities.
 - 2. It is also found in some other plants such as cinnamon, nutmeg etc.
 - 3. It's appearance should be Colourless to pale yellow oily liquid with smell pleasant, spicy, the odour be clove like.
 - 4. It's Solubility is Slightly water-soluble, but easily soluble in organic solvents.
 - 5. The Chemical formula of Eugenol is $C_{10}H_{12}O_2$ with properties Weakly acidic in nature.

Uses:

- 1. Used as cosmetics such as in perfumes.
- 2. Used as medicines as a topical antiseptic, anesthetic and to treat toothaches.
- 3. It is also used as flavouring in food items to enhance its taste and smell. Used as flavouring substance jn tea and also used in toothpaste for smell and reduce toothaches.
- 4. Used in Pharmaceutical companies to make drugs with antibacterial, anti-inflammatory and anti-oxidant properties.
- Eugenyl acetate:-
 - 1. It is a chemical found in clove oil, is an ester of eugenol. It's also known as acetyleugenol. Odour is same as cloves used in perfumes and flavouring.
 - 2. It should be in yellowish liquid or crystalline solid, insoluble in water but soluble in alcohol.
 - 3. Also found in small quantity in other essential oil such as cinnamon, in its leaf.
 - 4. Chemical formula is $C_{12}H_{14}O_3$.

Uses:

- 1. It is used in perfumes in enhancing cloves smell.
- 2. Used as flavouring agent in preparation of mixed spice flavours.
- 3. Used as deodorant for clove, and other flavour.
- **B-Caryophyllene:-**
 - 1. It s a sesquiter pene, Beta Caryophyllene, another important component of clove oil, is renowned for its anti-inflammatory and anti-carcinogenic effects.

- 2. It is also known for its neuroprotective properties.
- 3. It is a common component in essential oil from various plants such as spices and medicinal plants.

Uses:

- 1. Used as flavouring in food to enhance its taste.
- 2. Used for fragrance in cosmetics.
- 3. It is used for it's therapeutic effects in inflammation, pain and neural problems.

Other phytochemicals:

• Flavonoids:

Clove contains flavonoids like quercetin and kaempferol.

- Phenolic Acids: Clove contains phenolic acids such as ferulic and ellagic.
- **Triterpenes** It has anti-inflammatory, anti-cancer, anti-viral, and immuno modulatory effects which can improve health benefits.
- Carbohydrates
- Lipids
- Alkaloids
- Tannins and Sterols.

Pharmacological Activities:-

• Antimicrobial Properties:-

Clove oil is effective against both Gram-positive and Gram-negative bacteria, including common infections such as Staphylococcus aureus, Pseudomonas aeruginosa, and Escherichia coli. The clove have antibacterial properties which help in fighting from gum infections and periodontal infections.

It also has high antifungal characteristics against vulnerable fungal pathogens such as Candida albicans. Dispensing clove oil in a concentrated sugar solution shown germicidal activity against S. aureus, pseudomonas aeruginosa, and Klebseilla pneumonia. E. coli was utilized to investigate clove oil's antibacterial properties. The modified hot synthesis ultrasonication process was used to create solid lipid nanoparticles containing eugenol from acrylic triglyceride, stearic acid, and poloxamer 188. These nanoparticles were described and tested for in-vivo antifungal activity in an oral candidiasis model. After administering nanoparticles, the therapeutic efficacy of eugenol increased, and there was an alteration in the drug release behavior.

The Evaluated clove oil's antifungal efficacy against fungi including [Mucor sp.>Microsporum gypseum>Fusarium monoliforme NCIM 1100> Trichophytum Rubrum> Aspergillus sp.> Fusarium oxysporum MTCC 284].

Mechanism of action:

Clove oil's antibacterial effect is mostly due to its major component, eugenol, which disrupts the membranes of bacteria and inhibits fungal development.

Clove oil, which contains eugenol, has significant antibacterial and antifungal effects. Unlike standard antibiotics, which frequently have permeability concerns within biofilms or are resistant owing to genetic mutations, clove oil may successfully enter biofilm matrix and disrupt the colonies of bacteria.

Anti-inflammatory Properties:-

Eugenol is an anti-inflammatory substance found in clove oil. Animal studies found an additive effect between clove oil extract and other anti-inflammatory substances. Flavonoids such as rhamnetin, kaempeferol, and β -caryophyllene boost the anti-inflammatory properties.

Eugenol is the main substance as it can be easily soluble in organic solvents so provide a fast relief from the inflammation.

• Anti-oxidant Properties:-

Clove oil has excellent antioxidant capabilities, primarily to its high eugenol content, which scavenges free radicals and protects cells from oxidative damage. Clove oil can effectively absorb free radicals, which are unstable chemicals that can harm cells and cause a variety of health problems. In addition to obtaining free radicals, clove oil has metal chelating properties, which serve to avoid the development of hazardous metal-related radicals.

Clove has strong antioxidant activity that is comparable to synthetic antioxidants such as BHA. Clove oil inhibits lipid peroxidation and decreases it because of its strong capacity to emit hydrogen, as evaluated by the linoleic acid emulsion technique. Clove oil, which neutralizes free radicals, can help protect the body from oxidative stress and the development of age-related disorders.

Antioxidants are molecules that are necessary for treating oxidative stress, which causes memory loss. Treatment with clove oil decreases oxidative stress caused by low glutathione levels and aids in memory recovery.

Antinoceptive and Hepatoprotective properties:-

Clove contains eugenol, which acts as an analgesic for toothaches, joint discomfort, and contractions. It works by activating calcium and chloride channels in ganglion cells. It also acts as a capsaicin agonist, providing analgesic effects. In the recent studies it is found that Ethanolic extracts of clove demonstrated liver-protective efficacy against paracetamol-induced damage. Hepatic toxicity is measured by elevated levels of cytoplasmic enzymes in blood circulation. The ethanolic extract improved liver function by controlling and maintaining enzyme levels.

It also help in reducing joint pain and stiffness caused by inflammation during the arthritis conditions.

• Anticancer Properties:-

In some recent studies, it is found that the cloves have some anti cancer properties in its compound such as eugenol. While there are many research done which promise to evaluate the potential benefits in humans.

Uses of clove:-

• Culinary uses:-

Cloves are used in many ways such as flavouring substance, in some savory dishes, in baked goods, in beverages, and also in pickles.

Flavouring substance:

Cloves are mainly used in several country as Cloves are a popular spice in many meals, providing a warm, aromatic, and somewhat sweet flavour to foods.

Savory dishes:

Savory foods include soups, stews, meats, sauces, and rice. This increase smell and taste of the foods. **Baked Goods:**

Cloves are an essential element in many baked items, including pumpkin pie, cookies, and cakes.

Beverages:

They are used to flavour hot drinks such as mulled wine, chai lattes, and clove tea. **Pickles:** Cloves can be added in pickling recipes to create spicy pickles. It is also believed that in pickles it acts as natural preservatives.

• Medical uses:-

Cloves and it's oil are used as many ways in field of medicine. As-

In oral medicine:

Cloves are used from several years traditionally to get relief from toothache pain. It also promotes oral hygiene and freshen breath.

In digestion:

Cloves are known to increase the synthesis of digestive enzymes in the mouth and stomach, allowing food to be broken down more efficiently.

Relief Gas and bloating:

Eugenol, a chemical found in cloves, has carminative qualities that can help reduce gas, bloating, and indigestion. Cloves are traditionally thought to improve digestion by stimulating digestive enzymes and possibly easing gas, bloating, and indigestion due to the eugenol chemical they contain.

In Diabetes:

Clove extract may help manage blood sugar levels and enhance insulin sensitivity, which could assist those who have diabetes or are at risk of acquiring it.

Boost immune system:

The remarkable component eugenol in clove is extremely efficient against a variety of dangerous bacteria, fungus and viruses. Clove's antiviral and blood purifying properties reduce blood toxicity while also increasing disease resistance by activating white blood cells.

Reduces Body Pain And Inflammation:

Clove oil can be used topically, and cloves can be consumed orally in raw or prepared form through a variety of methods. A clove bud pressed between the jaws might relieve pain at the toothache spot. You can chew clove buds to treat pharyngitis, hyperacidity, and foul breath. You can also use salt to help with coughing. Five to six cloves decocted in 30 ml of water with honey can be taken three times a day as an expectorant. If taken with sugar, clove oil can help with stomachaches. It can also be rubbed to the area where cavities are located to ease pain.

Prevent cancer:

Recent studies says it can also cure cancer by killing the newbie cancerous cells.

Good in bones and joints:

Hydro-alcoholic substances like eugenol and flavonoids, which are abundant in cloves, aid in boosting the mineral content and density of bones. Cloves are beneficial for those with osteoporosis and weak bones.

Toxicity of clove:-

Large quantities or concentrated forms, such as clove oil, can be poisonous, especially for youngsters, causing liver and kidney damage, convulsions, and other severe symptoms, even though tiny amounts of cloves are usually thought to be safe.

Eugenol: At large amounts, eugenol, the main active ingredient in cloves, can be harmful.

Organ Damage:

Acute hepatic necrosis and coagulopathy have been documented as side effects of overdoses that cause harm to the liver and kidneys.

Overdose: Symptoms such as agitation, reduced consciousness, coma, acidosis, respiratory depression, and severe hypoglycemia can occur when consuming high amounts of clove oil (10–30 mL). **Children:**

Children:

Because of their smaller bodies, children are especially susceptible to the harmful effects of clove oil. In addition to the aforementioned, symptoms of an overdose of clove oil may include convulsions, disorientation, diarrhea, and abdominal pain.

Precautions:-

Allergies: Some people may develop respiratory problems or skin irritation as a result of eugenol allergies.

Liver Disorders: People who have liver problems should not take this.

Children: Even tiny doses of clove oil can have serious adverse effects, making it probably dangerous to use orally.

Cigarette smoking: Avoid smoking clove cigarettes since they can damage your lungs.

Interactions: Cloves may interact with blood thinners, anti-inflammatory treatments and diabetes medications, among other medications.

Diabetes: Clove may lower the blood sugar levels, so any person with diabetes should monitor regularly. **Pregnancy and breastfeeding:** If any ladies is pregnant or breastfeeding then she should not take clove. **Surgery:** As in cloves eugenol are present which can thin the blood. So any person with any surgery do not use them.

Bleeding disorder: Any person with bleeding disorder, don't take clove in uses as it has blood thinner ability.

Clove oil: It can be harmful in high amounts, resulting in liver damage, convulsions, and fluid imbalances, particularly in youngsters.

Conclusion:-

A little yet potent spice, cloves have several health advantages, ranging from enhancing oral and digestive health to bolstering immunological and respiratory systems. They are a great natural treatment for a number of illnesses because of their anti-inflammatory and antioxidant qualities. You can improve your general health and well-being by including cloves into your everyday routine. Furthermore, you can be sure that you are covered for both immediate wellness and long-term medical requirements if your health insurance covers preventive care practices like using natural remedies.

Clove oil is a natural therapy for clearing respiratory airways and improving breathing during colds and flu. Clove has also proven to be an effective antioxidant. One drop of its oil is many times more potent and powerful than other antioxidants. Based on all the aforementioned evidence, it is considered to be a very useful plant with numerous proven advantages and the fewest detrimental effects.

As above mentioned, clove is very good in several aspects if taken in limited amount. If it's consumption is high and consumed in some situation where not to be taken as surgery aor bleeding then it can harm the person. Some reports says, if anyone should take surgery then 2 weeks earlier he should stop taking cloves.

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