

Biological Activity of Aromatic Compounds from Clove (*Syzygium aromaticum*)

Review Article

ABSTRACT

Clove (*Syzygium aromaticum*) is most vital spice which has been utilized for food preservative and also as a remedial plant over centuries. It is local plant of Indonesia however these days it is used in numerous parts of the world including Brazil in the province of Bahia. This plant is one of the plentiful sources of phenolic compounds and bears enormous capacity for pharmaceutical, makeup and foodstuff. This analysis includes studies coverage biological activity of eugenol and clove. The antimicrobial and antioxidant properties of clove are higher than numerous of the fruits and vegetables and it ought to have extraordinary consideration. The diverse studies mentioned in this review prove the long-established use of clove in food preservation and also as a remedial plant.

Keywords: Clove (*Syzygium aromaticum*); aromatic compound; volatile; antioxidant; dengue fever; biological activities.

1. INTRODUCTION

Clove (*Syzygium aromaticum*) also known as clove is a tree of Mirtaceae family. Clove tree is up to 8-10 meters in height [1]. It is evergreen tree and is often cultivated in coastal areas 200 meter above sea level. Tree bears large leaves and flowers of crimson color grouped in clusters [2]. Production of flower bud initiates after four years of plantation in commercialized plants. The flower buds are gathered before flowering in development stage. Gathering is done physically or chemically through usual phytohormones those secrete ethylene within vegetative tissues, producing maturation [3]. Cloves are harvested at the length of 1.5-2 meter, consisting extended calyx, splitting into four sepals and four decommissioned petals forming a little ball in the center [2]. Its bud possesses strong fragrance and a flame taste. These are dark brown in color and a prevailing aromatic odor which is balmy, strongly sweet and a little astringent [4]. Clove plant is also known as medicinal plant due to its antioxidant and antibacterial properties. It was first introduced in spice garden in Courtallam, Tamil Nadu by East India Company around 1800 AD. Due to the success of its introduction, clove cultivation was extended after 1850 AD [5]. Recent reports confirm that clove also have antiviral, antifungal, antibacterial and anticarcinogenic properties as well. It is a rich supply of phenolic compounds as eugenol,

eugenol acetate and Gallic acid. Cloves are utilized in long-established medicine as essential oil, which is utilized as an anodyne which is a painkiller and is used mostly for dental emergencies [6]. Recently discovered utilization of clove is as a larvicidal agent which is an eye-catching procedure to stop dengue which is a significant wellbeing issue in Brazil and numerous other tropical nations [7]. The plant is native of Maluku Island in east Indonesia. At present the larger producing counties of clove are India, Indonesia, Malaysia, Sri Lanka, Madagascar and Tanzania [1].

1.1 Phytoconstituents

Clove is important source of phenolic compounds i.e., flavonoids, hydroxybenzoic acid, hydroxy phenylpropenes and hydroxycinnamic acids. Eugenol is the main bioactive compound found in *Syzygium aromaticum* (clove). Concentration of Eugenol range from 9381.70 to 14650.00 mg per 100 g of new plant material [8]. Considering to the phenolic acids, gallic acid is found in high levels. Hydrolysable tannins are present in high concentration [9]. Some additional phenolic compounds in clove are caffeic, ferulic, elagic and salicylic acids. In clove flavonoids for example; quercetin and its derivative are as well present in lower concentrations. In flower buds of clove up to 18% of concentration of essential oils

are present. About 89% of essential oils are eugenol, eugenol acetate and β cariofileno [10]. A vital multipart found in essential oil of clove is α – Humulin found in 2.1% concentration. Other volatile compounds found in clove are β - pinene, limonene, farnesol, ethyl hexanoate and benzaldehyde.

1.2 Biological Activities

Syzygium aromaticum is a crucial medicinal plant as it has various pharmacological effects reinforced from traditional use by people of many countries and from various literatures. Following paragraphs are about biological behavior of clove and eugenol as reported in various scientific reports.

1.3 Antioxidant Activities

A short time ago, the United States Department of Agriculture in partnership with a few universities and individual companies created a record with the antioxidant activities of diverse type of foods. Mentioned in his record Pérez-Jiménez *et al* classified around 100 plentiful nutritional sources of polyphenols [11]. It indicates that spice plants are type of food which have more polyphenol substance which are followed by fruits, vegetables as well as seeds as well. In spices, clove has high concentration of antioxidant compounds. Antioxidants be very significant compound for the cure of memory loss due to oxidative stress [12]. Pretreatment with fundamental oil of clove decline the oxidative pressure with is surveyed by diminished levels of malondialdehyde and glutathione in mice's brain cells. The conclusion of this mentioned evaluation was that clove oil may possibly relapse memory which can be effectuated by scopolamine in petite as well as long-standing as a consequence of the reduction in oxidative pressure [13]. Concentrates from clove bud could equally be used as food cell reinforcement. The time span of accessibility and fricasseeing steadiness of exemplified and un-epitomized eugenol-wealthy clove separates were attempted in soybean oil [14]. Proscribed delivery of cell reinforcements possibly will be accomplished by exemplified clove fine particles acquired by shower aeration using Arabic gum as well as maltodextrin as a wall material.

1.4 Antimicrobial Activity

Clove have been proved of having antimicrobial activities against many fungal strains. Sofia *et al*. examined several Indian spices as cinnamon, garlic, mustard, mint, ginger and clove for their

antimicrobial properties [15]. The only taster which shows complete bactericidal impact in opposition to all the pathogens borne by food examined *Escherichia coli*, *Staphylococcus aureus* and *Bacillus cereus* was the aqueous extort of clove at 3%. Clove extract also show very remarkable inhibitory action at even 1% concentration. In effort available by Dorman and Deans [16], the sterile action of nutmeg, oregano, black pepper, thyme and clove has been tried in opposition to 25 strains of Gram-stained bacteria. The activities of clove oil are said to have maximum activity at 0.2mg/mL with effectiveness up to 60%, when tested against different dermatophytes [17]. In a vaginal candidiasis model, the antifungal work of eugenol and carvacrol was examined. The outcomes suggested eugenol and carvacrol perhaps is a capable antifungal specialist for the treatment and prophylaxis of vaginal candidiasis [18]. Beta – cyclodextrin consideration mixture constituting clove bud extracts and eugenol were tried in opposition to two normally occurring food born microbes, *Salmonella entericaserovar Typhimurium* LT2 and *Listeria innocua* [19]. Clove items contain an unbelievable potential as food added substances from the time when they are very effectual and are preferred for customers as they are natural products.

1.5 Anti-Nociceptive

The use of clove as pain relieving agent has been detailed in the last thirteenth century for toothache, joint agony and antispasmodic, eugenol being the primary compound used for its analgesic properties.

The impacts of clove subject to voltage, in sodium and calcium directs and in receptors conveyed in the trigeminal ganglions well added to the pain easing effects of clove [20]. Some outcome shows that clove has pain-relieving effect of capsaicin agonist [21].

1.6 Antiviral

Eugenol which is the main bioactive compound found in Clove can cause damage to viral envelopes of freshly formed virions and can cause inhibition of viral replication at the initial stage [22].

Antiviral action of eugenin, which is a compound isolated from clove was tried in opposition to herpes virus strain being viable at 5 μ g/mL, also is presumed that one of the huge focuses of eugenin is the viral DNA mix by hindrance of viral DNA polymerase [23].

1.7 Cytotoxicity of Eugenol

Past so many years of thorough researches, a variety of molecular targets have been identified for the avoidance and treatment of cancer. Eugenol is picked as a potential molecule which can impede with numerous cell- signaling pathways, mainly the atomic factor kappa B. This thing is results in the expression of genes which can induce cellular transformation, suppress apoptosis, induce proliferation, invasion and metastasis [24]. In other research, eugenol conquered the expansion of harmful melanoma WM 1205 Lu of anchorage independent and tie-up-based increase, diminishes mass of tumors and prevents melanoma intrusions furthermore, metastasis by the restraint of two progress factors of the E2F family [25].

2. CONCLUSION

In light of the data introduced, it very well may be inferred that Clove is a very useful spice. Aromatic compounds from Clove (*Syzygium aromaticum*) have biological activities as antioxidant, antiviral and antimicrobial activities. Its demonstrated natural activities recommend that the improvement of medicinal food stuffs for animals and as well as human use and verify the reason of this plant being used for fairly a long time.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Please mention ref. no. 23-25 after ref. no. 21 inside the references list.

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