



# REVIEW ON: ANTIBACTERIAL ACTIVITIES OF CLOVE ESSENTIAL OIL AND CINNAMON ESSENTIAL OIL

Name:

Mr. Priyanshu Gokul Dhumal

College Name:

Dharmaraj Shaikshanik Pratishthan's College of Pharmacy, Walki, Ahmednagar(5462)

(Under Dr. Babasaheb Ambedkar Technological University)

Principal Name:

Dr. Urmilesh Jha

Guide Teacher:

Prof. Manali Joshi

## ABSTRACT

Herbal products containing essential oils as an antimicrobial agent are undoubtedly growing in popularity. Clove oil is reported to have antimicrobial activity against *Staphylococcus aureus*, *Escherichia coli*, *Streptococcus pyogenes*, *Propionibacterium acne*, *Staphylococcus epidermidis* and *Candida albicans*. One of the most widely available cinnamon extract, essential oil is antibacterial activity against gram-positive and gram-negative bacteria that are responsible for human infections. Cinnamon oil can increase blood flow to the affected area and eliminate blemishes, helping to lighten the skin. Increase in antibiotic-resistant strains has become a major threat to human health and needs to be explored in other ways to fight germs. Medicinal plants have great phytochemical properties that make them suitable as a competitive alternative. Cinnamon bark is a popular tropical spice from *Cinnamomum* spp. Rich in phytochemical bioactive molecules. It has great medicinal uses and is one of the most important antimicrobial plants studied. *Syzigium aromaticum* L. (clove) is a sweet-smelling spice, belonging to the Myrtaceae family. The main ingredients of cloves are essential oils. Cloves are used in traditional and modern medicine. Contains anti-helminthic, anti-inflammatory, anti-spasmodic, anti-pyretic, anti-allergic, anti-fungal, anti-carcinogenic, anti-allergic, anti-viral, antioxidant, anti-mutagenic, anti-arthritis, anti-parasite structures. This review demonstrates the antibacterial properties of cinnamon and cloves as a promising source of new antibacterial agents, which can be used in pharmaceutical preparations to fight multidrug-resistant germs.

**Key Words:** Clove, Cinnamon, Antimicrobial, Essential oil.

### Abbreviations:

- 1) EO- Essential oil
- 2) S.aureus - Staphylococcus aureus
- 3) S.epidermis- Staphylococcus epidermis
- 4) E.coli- Escherichia coli

## 1. INTRODUCTION

The antimicrobial property of essential oil has been known for many centuries. In recent years large number of essential oil and their constituent has been noted for their antimicrobial property against some bacteria and fungi. It is reported that essential oil provides a gentle inexpensive way of treating acne, clearing infection, healing acne scarring and skin lightening. India has a rich heritage of traditional remedies. In India, spice and cinnamon are used extensively adding aroma and taste to the food. They are used widely in the ayurvedic preparation flavor and perfume industry. From natural and synthetic sources various antimicrobial agents are used in cosmetic preparation. Normally synthetic materials are used because of their low cost and strong antimicrobial activity but synthetic material may give adverse effects on humans and the environment, also the faith of consumers on the herbal product is growing fast. Hence there is a need to find out an effective natural antimicrobial agent. Clove oil and cinnamon oil are mainly investigated for their strong antimicrobial property against some species of bacteria which cause the minor to serious infections to the skin. Cinnamon oil has an additional property to lightening the skin. The preparation of combination of clove oil and cinnamon oil helps to reduce the microbial infection that occurs on skin surfaces.

The plant species harbors an inexhaustible source of active ingredients invaluable in the management of many microbial diseases. Traditional healing systems around the world that use herbal remedies are an important source for the discovery of new antibiotics. Spices contain antimicrobial activity due to the presence of Essential oil, alkaloids, glycosides, etc. that are present in most herbs and spices commonly used in Indian food preparation. The presence of these bioactive substances is responsible for antimicrobial properties. Clove (*Syzigium aromaticum* L.) is an aromatic spice, belongs to the family Myrtaceae. Cloves are used in Ayurveda, Chinese medicine and Western herbalism. It has been shown that some components of clove are useful in bacterial and fungal infections.[1]

Cinnamon is a widely known for traditionally used in medicine applications. The effect of cinnamon has been studied during pregnancy [2], for diabetes control [3], and gynecological problems [4]. Its anti-inflammatory, cardioprotective, antioxidative, and antimicrobial properties have also been researched [5]. Thus, cinnamon essential oil, cinnamon extracts, and pure compounds, due to their antibacterial, antifungal, and other properties, have potential uses in skin infection. According to botany, cinnamon is a tropical tree, the inner bark that is widely used as a spice, belongs to the Lauraceae family, with about 250 species, four of which they are commercially traded and sold worldwide, namely Ceylon cinnamon (*Cinnamomum verum* or *Cinnamomum zylanicum*) from India and Sri Lanka, Chinese cinnamon (*Cinnamomum cassia* or *Cinnamomum aromaticum*), Indonesian cinnamon (*Cinnamomum burmannii*) and Vietnamese cinnamon (*Cinnamomum loureiroi*)[6]

## 2. MICROBIAL INFECTION

Skin disease are caused by bacteria, fungi, viruses, rickettsia and parasite. This work focuses on the common bacterial disease of skin. Skin infection may be either primary or secondary. Primary infection have characteristic morphologies and courses, are initiated by single organism, and usually occur in normal skin. They are most frequently caused by *S.aureus*, *Streptococcus pyogenes* and *caryneform* bacteria. Secondary infection originate in disease skin as a superimposed condition. Most skin disease involves erythema, edema and other signs of inflammation. Focal accumulation of pus or fluid may form, but lesions may also be scaling without obvious inflammation.

Acne is a chronic inflammatory disease of the pilosebaceous unit. It is characterised by formation of comedones, papules, pustules, inflamed nodule, superficial pus, filled cyst and in extreme cases canalizing and deep scarring. Acne develops on those areas where subcutaneous glands are most numerous. The face, scalp, neck, chest, back, upper arms and shoulders. The bacteria *Propionibacterium acnes*, *Staphylococcus epidermis*, *S.aureus*, the fungus *Candida albicans* are most commonly present in the pustular contents of the acne. Acne is a common skin problem associated with microbial infection. For its treatment antimicrobial agents are required.

## 2.1. Classification of selected bacterial skin infection

1 Table: classification of selected bacterial skin infection

Disease	common agent
Primary	
Impetigo	- <i>S.aureus</i> , <i>streptococcus pyogenes</i> .
Cellulitis and erysipelas	- <i>Group A streptococci</i> .
Staphylococcal scaled skin syndrome	- <i>S.aureus</i>
Folliculitis	- <i>S.aureus</i>
Superficial folliculitis	
Staphylococcal folliculitis	- <i>S.aureus</i>
Gram negative folliculitis	- <i>Klebsiella pneumonia</i> , <i>Enterobacter</i> <i>Proteus vulgaris</i> .
Propionibacterium acne folliculitis	- <i>Propionibacterium acne</i>
Deep folliculitis	
Sycosis barbae	- <i>s.aureus</i>
Furuncles or Carbuncles	- <i>S.aureus</i>
Pitted keratolysis	- <i>Gram positive coryneforms</i>
Secondary	
Intertrigo	- Over growth of resident and transient bacteria
Eczematoid dermatitis	- <i>S.aureus</i>
Tinea web infection	- <i>Fungi, coryneform bacteria</i> .

## 3. DRUG PROFILE

### 3.1. Clove



1: clove plant



2: dried flower bud of clove

Kingdom: Plantae

Phylum: Angiosperm

Order: Myrtales

Family: Myrtaceae

Genus: Syzygium

Species: *S. aromaticum*

Binomial Name: *Syzygium aromaticum* (L.)

### 3.1.1. Active constituent of clove oil:

Approximately, 72-90% of the essential oil extracted from cloves has Eugenol. Other essential oil ingredients of clove oil are,

Acetyl eugenol, Beta-caryophyllene, vanillin, Crategolic acid, tannins, gallotannic acid, methyl salicylate (painkiller), Flavonoids eugenin, kaempferol, rhamnetin, and eugenitin, Triterpenoids like oleanolic acid.

### 3.1.2. Pharmacological Activities

#### a. Anti-microbial activity

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 albican*. Clove is also included in Dr Huda Clark's protocol for elimination of parasites from the digestive system. It has been found that a 0.05% solution of eugenol is sufficient to kill *Bacillus tuberculosis*. Clove oil showed antimicrobial activity against some human pathogenic bacteria resistant to certain antibiotics. 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. [7]

#### b. 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<sup>16</sup>. [8]

#### c. Anti-inflammatory activity

Eugenol, the primary component of clove's volatile oils, functions as an anti-inflammatory agent. In animal 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. The essential oil of *Eugenia caryophyllata* had an anti-inflammatory effect matching to that of etodolac at 0.025 and 0.1 ml/kg and to that of indomethacin at 0.05 and 0.2 ml/kg doses. [9]

#### d. 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. [10]



## 3.2. Cinnamon



3:Cinnamon plant



4:cinnamon dried inner bark

Kingdom: Plantae

Phylum: True cinnamon tree

Order: Laurales

Family: Lauraceae

Genus: Cinnamomum

Species: C.verum

Binomial name: Cinnamomum verum

Cinnamon consist of died bark, freed from the outer cork and from the underlying parenchyma, from the shoots growing on the cut stumps of *Cinnamomum Zeylanicum Nees*. Belonging to family *Lauraceae*.

### 3.2.1. Chemical constituents:

The main aromatic compound in cinnamon EO is cinnamaldehyde, with a content of 80-94.8%. others are

Cinnamic acid, Cinnamal acetate [11], Terpeniol, Eugenol [12], Caumarin, Thujen [13]

### 3.2.2. Antibacterial properties:

**a. Combat hard-to-treat bacterial organism:** A study which used bacterial culture and lab test, found that compounds in cinnamon oil had an antimicrobial effect against a potentially life-threatening, drug resistant bacteria that effect plants, people and other animals.

**b. Support oral health:** Cinnamons antibacterial and antifungal properties have been found to be effective against *Streptococcus mutants* and on *Candida ssp* Biofilm, two agents which cause oral infection and cavities in teeth.

**c. Disinfectant:** Cinnamon bark oil's antibacterial properties make it a safe, effective and non-chemical additive alternative that can be used to reserve products and increase their shelf life. One study found that cinnamon oil could be effectively used as a preservatives in cosmetics, and hospital setting disinfectant.

## 4. ANTIMICROBIAL ACTIVITY OF ESSENTIAL OIL

### 4.1. Antimicrobial effect of Clove Oil :

The antimicrobial activity of clove showed good inhibitory action against test bacterial strains. Clove essential oil is indicate antibacterial activity against all test bacteria with zone of inhibition 6mm-16mm. Large area inhibited against gram negative Staphylococcus aureus bacteria (16mm) as well Bacillus subtilis (12mm), than gram positive bacteria Pseudomonas aeruginosa (7mm) and Escherichia coli (6mm). Maximum bacterial inhibition was 100µl in all bacterial culture. Indicates that with increasing concentration of essential oil zone of inhibition also increases.[14]

Table 2: effect of essential oil of clove on growth in bacteria in vitro [14]

Sr no.	Name of bacteria	Concentration (micro ml)	Zone of inhibition (mm)
1	Staphylococcus aureus	25	3
		50	5
		75	6
2	Bacillus subtilis	25	4
		50	6
		75	7
3	Pseudomonas aeruginosa	25	1
		50	2
		75	3
4	Escherichia coli	25	-
		50	3
		75	6

### 4.2 Antimicrobial activity of cinnamon oil

Table 3: antibacterial activity of cinnamon [15][16][17][18][19][20][21]

Cinnamon species	Extract	Gram positive	Gram negative
Cinnamomum casia	EO	S.aureus	E.coli, Pseudomonas aeruginosa
Cinnamomum zeylanicum	Cinnamaldehydes and euginol	Paenibacillum larvae	-
Cinnamomum zeylanicum	EO and cinnamaldehyde	Luctococcus garvieae	Photobacterium damsela
Cinnamomum verum	EO	S.aureus	E.coli

Cinnamomum burmannii	Ethanol extract	Staphylococcus mitis, streptococcus pneumonia	-
Cinnamomum burmannii	Crude extract	S.aureus, Listeria monocytogenes	Salmonella anatum, E.coli
Cinnamomum cassia	N-butane ethanol extract	Listeria monocytogenes, S.aureus	E.coli, salmonella anatum

## 5. CONCLUSION

Medicinal plants have been a major source of medicine since ancient times. At present, the availability of antibiotics especially from microorganisms (fungi and bacteria) and later the development of integrated antibiotics has led to neglect of herbal medicine. The misuse of this miraculous drug has resulted in a worldwide epidemic of antimicrobials germs. In the search for effective alternatives, scientists have rekindled interest in plants as a significant factor renewable drug source. Although, the separation of antibacterial molecules by the pure form of drugs industry and the diversity of phytochemical elements between species and varieties is a major challenge. Based on-In the current review, Cinnamon bark is a potent antibacterial agent with a wide spectrum called its phytochemical nutrients especially cinnamaldehyde. Therefore, in-depth chemical, biological and pharmacological studies are required to isolate antibacterial molecules and evaluate safety, dosage, and potential side effects. In conclusion, the present study has confirmed antimicrobial properties of essential oil of clove that showed significant growth inhibition for above test bacterial strains. The results indicate the essential oil of clove can also use as natural antibiotic for the treatment of several infectious diseases caused by several bacterial strains.

## 6. REFERENCE

- 1] Okpekon, et al. Antiseptic activities of medicinal plants used in Ivory Coast. J. Ethanopharmacol. 2004; 90:91-97.
- 2] John, L.J.;Shantakumari, N. Herbal medicines use during pregnancy: A review from the middle east. Oman Med.J. 2015; 30,229-236.
- 3] Wazaify, M.; Afifi, F.U.; EI-Khateeb, M.; Ajlouni, K. Complementary and alternative medicine use among Jordanian patients with diabetes. Complement. Ther. Clin. Pract. 2011; 17, 71-75.
- 4] Jaafarpour, M.; Hatefi, M.; Najafi, F.; Khajavikhan, J.; Khani, A. The effect of cinnamon on menstrual bleeding and systemic symptoms with primary dysmenorrhea. Iran. Red Crescent Med. J. 2015, 17, e27032.
- 5] Kawatra, P.; Rajagopalan, R. Cinnamon: Mystic powers of a minute ingredient. Pharmacogn. Res. 2015, 7 (Suppl. 1), S1–S6.
- 6] Ribeiro-Santos R, Andrade M, Madella D, Martinazzo AP, Moura LAG, Melo NR and Sanches-Silva A. Revisiting an ancient spice with medicinal purposes: Cinnamon. Trends in Food Science and Technology, 2007;62, 154-169.
- 7] Pinto E, Valer-Silva L, Cavaleiro C, Salgueiro E. Antifungal activity of clove essential oil from Syzygium aromaticum on candida aspergillus and dermatophyte species. 2009; 58:1454-1462.
- 8] Chaieb K, Hajlaoui H, Zmantar T Kahla-Nakbi, A.B., Rouabhia, M., Mahdouani, K. and Bakhrouf, A. The chemical composition and biological activity of essential oil, Eugenia Caryophyllata (Syzygium aromaticum L. Myrtaceae): a short review Phytotherapy Research. 2007; 21(6): 501-506.

- 9] Ghelardini C, Galeotti N, Di Cesare Mannelli L, Mazzanti G, Bartolini A. Local anaesthetic activity of  $\beta$ -caryophyllene 11. *Farmaco*. 2001; 56: 387–389.
- 10] Feng J, Lipton JM. Eugenol: Antipyretic activity in rabbits. *Neuropharmacology*. 1987; 26: 1775–1778.
- 11] Ranasinghe P, Pigera S, Premakumara GS, Galappaththya P, Constantine GR and Prasad KP. Medicinal properties of ‘true’ cinnamon (*Cinnamomum zeylanicum*): a systematic review. *BMC Complementary and Alternative Medicine*, 2013; 13, 275.
- 12] Ribeiro-Santos R, Andrade M, Madella D, Martinazzo AP, Moura LAG, Melo NR and Sanches-Silva A. Revisiting an ancient spice with medicinal purposes: Cinnamon. *Trends in Food Science and Technology*, 2017; 62, 154-169.
- 13] Hajimonfarednejad M, Ostovar M, Raei MJ, Hashempour MH, Mayer JG and Heydari M. Cinnamon: A systematic review of adverse events. *Clinical Nutrition*, 2019; 38, 594-602.
- 14] D.Saikumari, S.Saxena, Antibacterial activity of *Syzigium Aromaticum* L., *International journal of current microbiology and applied science* 2016; vol 5: 484-489.
- 15] El Atki Y, Aouam I, El Kamari F, Taroq A, Nayme K, Timinouni M, Lyoussi B and Abdellaoui A. Antibacterial activity of cinnamon essential oils and their synergistic potential with antibiotics. *Journal of Advanced Pharmaceutical Technology and Research*, 2017;10(2), 63-67.
- 16] Gende LB, Floris I, Fritz R and Eguaras MJ. Antimicrobial activity of cinnamon (*Cinnamomum zeylanicum*) essential oil and its main components against *Paenibacillus* larvae from Argentina. *Bulletin of Insectology*, 2008;61 (1), 1-4.
- 17] Pathirana HNKS, Wimalasena SHMP, De Silva BCJ and Hossain S. Antibacterial activity of cinnamon (*Cinnamomum zeylanicum*) essential oil and cinnamaldehyde against fish pathogenic bacteria isolated from cultured olive flounder *Paralichthys olivaceus*. *Indian Journal of Fisheries*, 2019; 66(2), 86-92.
- 18] Vazirian M, Alehabib S, Jamalifar H, Fazeli MR, Toosi AN and Khanavi M. Antimicrobial effect of cinnamon (*Cinnamomum verum* J. Presl) bark essential oil in cream-filled cakes and pastries. *Research Journal of Pharmacognosy*, 2015; 2(4), 11-16.
- 19] Shan B, Cai Y, Brooks JD and Corke H. Antibacterial Properties and Major Bioactive Components of Cinnamon Stick (*Cinnamomum burmannii*): Activity against Foodborne Pathogenic Bacteria. *Journal of Agricultural and Food Chemistry*, 2007;55 (14), 5484-5490.
- 20] Liang Y, Li Y, Sun A and Liu X. Chemical compound identification and antibacterial activity evaluation of cinnamon extracts obtained by subcritical n-butane and ethanol extraction. *Food Science and Nutrition*. 2019; 00, 1-8.
- 21] Waty S, Suryanto D and Yurnaliza. Antibacterial activity of cinnamon ethanol extract (*Cinnamomum burmannii*) and its application as a mouthwash to inhibit streptococcus growth. *IOP Conference Series: Earth and Environmental Science*, 2018; 130, 012049.