

MEDICAL AND PHARMACOLOGICAL PROPERTIES OF *OCIMUM GRATISSIMUM* (SCENT LEAF): A REVIEW

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Abstract

Ocimum gratissimum is a well-known plant used in the Indian system of medicine. Folklore medicine claims its use in headache, fever, diarrhoea, pneumonia etc. Research carried out using different *in vitro* and *in vivo* techniques of biological evaluation supports most of the claims. The ethanolic extract of the leaves of *Ocimum gratissimum* L. (Lamiaceae), used in traditional medicine for the treatment of several ailments such as urinary tract, wound, skin and gastrointestinal infections, was evaluated for its antibacterial properties against four clinical bacteria isolates namely: *Escherichia coli*, *Proteus*

Introduction

Ocimum gratissimum, also known as clove basil, African basil, and in Hawaii as wild basil, is a species of *Ocimum*. It is native to Africa, Madagascar, southern Asia, and the Bismarck Archipelago, and naturalized in Polynesia, Hawaii, Mexico, Panama, West Indies, Brazil, and Bolivia (Mann *et al.*, 2019). *Ocimum gratissimum* is an aromatic herb that been

mirabilis, *Staphylococcus aureus* and *Pseudomonas aeruginosa* and the antifungal properties using a clinical isolate of *Candida albicans*. This review paper presents the ethnobotanical, natural product chemistry, pharmacological, clinical information of the plant.

Key words: *Ocimum gratissimum* Pharmacological Extract Plant

Introduced extensively across tropical and subtropical regions of the world. It has escaped cultivation and can be found growing as a weed in disturbed sites, waste areas, pastures and along roadsides, but also invading disturbed natural vegetation, savannas, coastal thickets and riparian areas. In this species, seeds are small and numerous and easily dispersed by gravity, animals, human activities and as a contaminant in soil and garden debris (Aziba *et al.*, 2019). Once established, *O. gratissimum* has the potential to grow forming dense monospecific thickets that outcompete native vegetation and reduce native biodiversity (Okwu *et al.*, 2018).

Ocimum gratissimum L. is a medicinal plant widely grown in tropical and subtropical regions with the leaf decoction usually taken in folk medicine to enhance erectile performance in men although the probable mechanism of actions remains undetermined (Kalita *et al.*, 2019).

Origin of *Ocimum gratissimum*

Ocimum gratissimum, also known as clove basil, African basil, and in Hawaii as wild basil, is a species of *Ocimum*. It is native to Africa, Madagascar, southern Asia, and the Bismarck Archipelago, and naturalized in Polynesia, Hawaii, Mexico, Panama, West Indies, Brazil, and Bolivia. *O. gratissimum* is found throughout the

tropics and subtropics, both wild and cultivated. Its greatest variability occurs in tropical Africa (from where it possibly originates) and India. In South-East Asia it is cultivated mainly as a home garden crop, only in Vietnam is it grown on a commercial scale as well.

Morphology of *Ocimum gratissimum*

Aromatic, perennial herb, 1-3 m tall; stem erect, round-quadrangular, much branched, glabrous or pubescent, woody at the base, often with epidermis peeling in strips. Leaves opposite; petiole 2-4.5 cm long, slender, pubescent; blade elliptical to ovate, 1.5-16 cm × 1-8.5 cm, membranaceous, sometimes glandular punctate, base cuneate, entire, margin elsewhere coarsely crenate-serrate, apex acute, puberulent or pubescent. Inflorescence a verticillaster, arranged in a terminal, simple or branched raceme 5-30 cm long; rachis lax, softly pubescent; bracts sessile, ovate, 3-12 mm × 1-7 mm, acuminate, caducous; pedicel 1-4 mm long, spreading or ascending, slightly curved. Flowers in 6-10-flowered verticillasters, small, hermaphrodite; calyx 2-lipped, 2-3 mm long, in fruit 5-6 mm, pubescent, upper lip rounded and recurved, reflexed in fruit, lower lip with 4, narrow, pointed teeth, central pair of teeth minute and much shorter than the upper lip; corolla campanulate, 3.5-5 mm long, 2-lipped, greenish-white, pubescent outside, upper lip truncate, 4-fid, lower lip longer, declinate, flat, entire; stamens 4, declinate, in 2 pairs, inserted on the corolla tube, filaments distinctly exserted, upper pair with a bearded tooth at the base; ovary superior, consisting of 2 carpels, each 2-celled, style 2-fid. Fruit consisting of 4, dry, 1-seeded nutlets enclosed in the persistent calyx (the lower lip closing the mouth of the fruiting calyx); nutlet subglobose, 1.5 mm long, rugose, brown; outer pericarp not becoming mucilaginous in water.

Classification of *Ocimum gratissimum*

Kingdom: Plantae

Order: Lamiales

Family: Lamiaceae

Genus: *Ocimum*

Species: *O. gratissimum*

Binomial name *Ocimum gratissimum*

O. gratissimum is a common culinary herb in West Africa and is used by some in the Caribbean, going by many local names.

- **Ebe-amwonkho** in Edo
- **Efirin** in Yoruba
- **Daidoya** in Hausa
- **Nchuanwu** also **Arimu** in Igbo
- **Ntong** in Ibibio, Efik
- **Scent leaves** in Nigeria and in the African diaspora



Fig 1: Feuilles et inflorescences de *Ocimum gratissimum* Linn.

The essential oil of *Ocimum gratissimum* contains eugenol and shows some evidence of antibacterial activity. The essential oil has potential for use as a food preservative, and is toxic to *Leishmania*.

The use of plant materials as spices, condiments and for medicinal purposes dates back to the history of mankind. Recently, the exploitation of wild plants for medicinal purposes has gained more acceptances in many countries of the world Aziba *et al.*, 2019). To further underscore the importance of herbal medicine, most national governments have established the traditional medicine regulatory council under the supervision of their various health ministries to tap the numerous potentials of herbs (Offia *et al.*, 2019). This may be because traditional medicine has long been practiced even before the orthodox medical practice appeared. *Ocimum gratissimum* belongs to the group of plants known as spices. The plant is an erect small plumb with many barnacles usually not more than 1 m high. It is of the family Labiatea, genus *Ocimum* and species *gratissimum*. The plant is found throughout the tropics and subtropics and its greatest variability occurs in tropical Africa and India. In South East Asia, it is cultivated as a home garden crop but it is grown on a commercial scale in Vietnam (Mann *et al.*, 2019). It is used for a variety of reasons. In culinary, it is used in salads, soups, pastas, vinegars and jellies in many parts of the world. The Thai people are popularly known to use it in food flavouring. In traditional medicine, the leaves have been used as a general tonic and anti-diarrhea agent and for the treatment of conjunctivitis by instilling directly into the eyes; the leaf oil when mixed with alcohol is applied as a lotion for skin infections, and taken internally for bronchitis (Okwu *et al.*, 2018). The dried leaves are snuffed to alleviate headaches and fever among other uses. Although, conventional antibiotics have been very useful in orthodox medicine, it has been argued by many that its concomitant use with herbal extracts is not desirable as one normally antagonizes the activity of the other. Considering the fact that *Ocimum*

gratissimum is used in most local dishes/foods to achieve a variety of purposes, there is need to ascertain if its extract antagonizes or acts as a synergy when used together with conventional antibiotics (Njoku *et al.*, 2018).

Ethnopharmacology

Traditional Uses *O. gratissimum* has been used extensively in the traditional system of medicine in many countries. In the North east of Brazil, it is used for medicinal, condiment and culinary purpose. The flowers and the leaves of this plant are rich in essential oils so it is used in preparation of teas and infusion (Ajiboye *et al.*, 2018). In the coastal areas of Nigeria, the plant is used in the treatment of epilepsy, high fever and diarrhoea. In the Savannah areas decoctions of the leaves are used to treat mental illness. *O. gratissimum* is used by the Ibos of South eastern Nigeria in the management of the baby's cord, to keep the wound surfaces sterile (Nwankwo *et al.*, 2019). It is also used in the treatment of fungal infections, fever, cold and catarrh. Brazilian tropical forest inhabitants use a decoction of *O. gratissimum* roots as a sedative for children [6]. People of Kenyan and sub Saharan African communities' use this plant for various purposes like viz., the leaves are rubbed between the palms and sniffed as a treatment for blocked nostrils, they are also used for abdominal pains, sore eyes, ear infections, coughs, barrenness, fever, convulsions, and tooth gargle, regulation of menstruation and as a cure for prolapse of the rectum. In India, the whole plant has been used for the treatment of sunstroke, headache, influenza, as a diaphoretic, antipyretic and for its anti-inflammatory activity (Kumar *et al.*, 2016). The tribals of Nigeria use the leaf extract in treatment of diarrhoea, while the cold leaf infusions are used for the

relief of stomach upset and haemorrhoids. The plant is commonly used in folk medicine to treat different diseases such as upper respiratory tract infections, diarrhoea, headache, diseases of the eye, skin diseases, pneumonia, cough, fever and conjunctivitis (Ayodele *et al.*, 2015). Alternative and Complementary Medicinal Uses Among the various species of *Ocimum*, *O. gratissimum* finds extensive use clinically throughout the world. Formulations of the leaf essential oil of *O. gratissimum* (*Ocimum* oil) have been incorporated in a variety of bases as topical antiseptics and for use in the treatment of minor wounds, boils and pimples. Ayodele *et al.*, 2015 reports that *O. gratissimum* and *Xylopia aethiopica* in combination are used in the preparation of potions and teas for women during peuperium.

Chemistry of *Ocimum gratissimum*

Similar to other members of the *Ocimum* genus, *O. gratissimum* contains an essential oil, alkaloids, glycosides, tannins, and other chemical constituents. Gas chromatography-mass spectrometry has been used to elucidate the constituents of the essential oil: eugenol and methyl eugenol, alpha and beta-caryophyllene, 1,8 cineole, methyl chavicol, carvacrol, linalool, thymol, limonene, gamma-terpinene, camphor, germacrene A, beta-ocimene, and cinnamyl acetate. Chemical composition varies with geographical location and environmental and genetic factors (Pandey *et al.*, 2017).

Traditional Uses of *Ocimum gratissimum*

The plant has a wide application in the traditional system of medicine to cure various ailments. The plant produces essential oil with antibiotic antioxidant, antimalarial , antifungal , antibacterial , antidiarrheal ,

antidiabetic , anti-carcinogenic , insecticidal, antimutagenic and antiurolithiatic properties. Studies have proved that dry leaves have better disease preventive properties in comparison to fresh leaves (Ayodele *et al.*, 2015).

In Africa, the plant has traditional importance as condiments and for treating various diseases such as pyorrhea, bronchitis and dysentery and dried leaves are used in treating headache and fever. Igala community of Kogi State, Nigeria uses leaves and root in treating diabetes, gastrointestinal problems and gonorrhea and in Abia State leaf juice are used to treat malaria fever (Okwu *et al.*, 2018).

In South-West Nigeria plant leaves are used in sexually transmitted infections whereas in some regions the water and ethanol extracts of the plant are used for several microbial and non-microbial associated diseases. In some other parts of Nigeria the plant is rare with strong antifungal potentiality and traditional medicine practitioners utilizes leaf extract in treating skin related diseases like Eczema . In Sao Tomé and Príncipe islands in central Africa the plant is used as traditional medicine as febrifuge and treating, respiratory disorders (Offiah *et al.*, 2019). In Nigeria the plant leaves macerates are used in treating diarrhea and respiratory disorders. In Brazil several species of the genus *Ocimum* including *O. gratissimum* have been used as a traditional medicine in treating coughs, bronchitis, sore throat, and also in food and flavoring agent and crop improvement programme (Singh *et al.*, 2019). In South Asia, the whole plant is used in treating sunstroke, headache, stomachache and influenza and seed are used against gonorrhea . In northwest Africa, the traditional practitioners use the plant as insect repellent (Aziba *et al.*, 2019). In South Africa, women use the plant to prevent dystocia and after childbirth to eliminate blood clots. Crushed

leaves are utilized to stop bleeding of fresh wounds and aqueous extract are hepatoprotective. The ethanolic extract of the leaves is used for the treatment of several ailments such as skin, urinary tract, and gastrointestinal infections. The plants are also used in treating dystocia, vomiting, dysmenorrhoea, mycoses, digestive troubles, cough, haemorrhoids, dysentery, abscess, typhoid fever (Mann *et al.*, 2019).

In India, the plant has a wide folklore medicinal importance and is used in treating diarrhea, headache, fever, pneumonia. In some regions in Maharashtra, the leaf juice is used as an antidote during snake bite (Akinmoladun *et al.*, 2017). In central India the seed extract mixed with sugar water is given during hot summer days as serve tonic and leaf extract are applied in cuts to stop bleedings. In northern India plant is grown for culinary, essential oil, perfume for herbal toiletries, flavouring agent and aromatherapy treatment (Mac Donald *et al.*, 2019). The essential oil obtained from the plant is used to treat ears or eye disorder, stomach, fever, diarrhea, throat inflammations, and skin diseases. In Central India, the local community of Bundelkhand region applies leaf decoction on cattle skin to treat ectoparasites (Iqbal *et al.*, 2016). In Barack valley, Assam the Manipuri community uses plant leaf with honey to treat fever. In Tripura, the plant leaf along with Zinger is utilized for the treatment of fever, headache, diarrhea, eye problems, upper respiratory tract disorders and skin diseases (Nwankwo *et al.*, 2019).

Fresh leaf juice is administered during indigestion and the decoction of boiled leaves of *O. gratissimum* and *Phaseolus lunatus* is used to treat stomach disorders in children in some eastern Imphal villages in Manipur (Njoku *et al.*, 2018). The Yanadi Tribe of Eastern Ghat in Andhra Pradesh uses the whole plant juice to treat cough and cold. The

Nancowry community of Nicobar Islands utilizes the plant orally in breathing disorders and in some parts of Odisha the plant leaves are used in treating rheumatism.

Botany of *Ocimum gratissimum*

O. gratissimum is an aromatic, perennial plant native to Africa, Madagascar, and southern Asia. It grows up to 1 m in height, with multiple branches arising from its base. It has elliptic-lanceolate leaves that taper at both ends, and long, pale, white to pinkish flower spikes. Recognized synonyms for African basil include *Ocimum suave* and *Ocimum viride* Willd ([Nwankwo *et al.*, 2019](#)).

Related plants include *Ocimum basilicum* (sweet basil), *Ocimum canum* (African mint), *Ocimum campechianum* (Amazonian basil), and *Ocimum tenuiflorum* or *Ocimum sanctum* (holy basil) [Okwu *et al.*, 2018](#)).

Pharmacological Properties of *Ocimum gratissimum*

Anti-inflammatory activity

In models of respiratory allergy (in vitro experiments evaluating effects on airway epithelial cells, in vivo studies in rodents), *O. gratissimum* demonstrated effects on markers of inflammation, including interleukins, protein kinases, and leukocytes/eosinophils ([Iqbal *et al.*, 2016](#)).

In mouse paw edema studies, ethanol and aqueous extracts of *O. suave* demonstrated anti-inflammatory activity. [Masresha 2012](#) Limited studies in rodents suggest antinociceptive activity of *O. gratissimum* extracts and essential oil, which may be mediated through the opioid and endocannabinoid systems ([Aziba *et al.*, 2019](#)).

Antimicrobial activity

Antimicrobial activity against relevant human pathogens (including *Escherichia coli*, *Klebsiella pneumoniae*, *Staphylococcus aureus*, *Enterococcus faecalis*, *Pseudomonas aeruginosa*, *Enterobacter* spp., *Vibrio* spp., and periodontopathic organisms) has been demonstrated. (Ajiboye *et al.*, 2018). Antifungal activity of the essential oil has also been observed in vitro, (Pandey *et al.*, 2018). *O. gratissimum* extracts have been used in topical preparations as a mosquito repellent (Mac Donald *et al.*, 2019).

Cardiovascular effects

In a study in rats, *O. gratissimum* essential oil demonstrated endothelium-dependent, vasorelaxant effects and decreased perfusion pressure in isolated mesenteric vascular beds. An extract of *O. gratissimum* attenuated induced cardiac abnormalities associated with liver fibrosis in rats, possibly by influencing the interleukin-6 signaling pathway or by inducing antioxidant effects (Omobolanle *et al.*, 2018)..

Pharmacological Uses of *Ocimum gratissimum*

The *Ocimum gratissimum* potentiality as an antibacterial and antifungal agents has been provided in numerous studies (Offiah *et al.*, 2019). The pharmacological testing of aqueous extracts of the plant shows inhibition of the jejunum spontaneous pendular movement in rabbit, non-competitive stomach strip blocking in rat and non-toxic analgesic effects in mice (Kalita *et al.*, 2018). Plant oil possesses etiologic properties a potentiality to inhibit the virulent strains of *Shigella* isolates, the causal organism of diarrhea and also reduces extracellular

protease activity, o-lipopolysaccharide rhamnose content, and incidence of kerato conjunctivitis in guinea pigs (Singh *et al.*, 2019).

The methanolic leaf extracts can be a novel therapeutic agent against nicotine toxicity as it decreases lipid-protein damage, free radical generation, and antioxidant status in male mice in murine peritoneal macrophages in vitro (Ohadona *et al.*, 2018). The hexane fraction exhibited the highest antimicrobial activity against *Vibrio cholera* and *Klebsiella pneumonia* and also possesses the highest grain protectant activity (Akinmoladun *et al.*, 2017). The ethanolic leaves extract exhibits antimicrobial activity against *S. typhi*, *N. gonorrhoeae*, *K. pneumoniae*, *P. aeruginosa*, and *V. cholera* and along with ampicillin it becomes synergistic showing antibacterial properties against *Escherichia coli* and *Proteus mirabilis* and similarly synergistic with nystatin and ketoconazole showing antifungal properties against *Candida albicans* isolates

(Osuagwu *et al.*, 2018). The disc diffusion and tube dilution methods confirm the anti-diarrheal activities of leaf extracts against the bacteria *Escherichia coli*, *Salmonella typhi*, *Plesiomonas shigelloides*, *Aeromonas sobria* and *Shigella dysenteriae* (Ekwenchi *et al.*, 2018). The chloroform leaf extract shows better efficacy against filariasis causing mosquito vector *Culex quinquefasciatus*.

The researches on plant leaf flavonoid confirms broad-spectrum anti-bacterial activity against *Staphyococcus aureus*, *E. coli* and *Proteus mirabilis* (Pandey *et al.*, 2018). The aqueous leaf extract shows hypoglycaemic effects reducing lipid level malondialdehyde, triacylglycerol and LDL- cholesterol and the plasma glucose level in streptozotocin impelled diabetic rats and also inhibit CCl₄-impelled liver injuries in rats thus with a possibility to combat diseases in man.

The fresh aqueous leaf extracts inhibit chemotaxis, proliferation, 3D growth and morphogenesis and induction of COX-2 protein and reduce tumor size in breast cancer cells whereas dichloromethane leaf extract can inhibit myeloid leukemia in vitro, thus with a potential to combat cancer in human beings (Ajiboye *et al.*, 2018).

Various researches conducted with an aqueous leaf extract on rat for hematological parameters show a distinct variation. In Central and West Africa the plant has been used in therapeutic and culinary applications and dose and time-related methanolic crude leaf extract shows haematinic and haemopoietic potentiality with a decrease in RBC and the increase in WBC count when tested for phenylhydrazine-induced anemia in Albino wistar rats (Kumar *et al.*, 2016). Some studies observed increase in the level of RBC, hemoglobin (Hb) packed cell volume (PCV), neutrophils and platelet count, along with platelet indices like mean platelet volume (MPV), platelet distribution width (PDW) and platelet-large cell ratio (P-LCR), whereas other studies observed decrease in these parameters (Njoku *et al.*, 2018). The study of the dose-and time-dependent effect of aqueous leaf extract on some biochemical parameters has shown significant impact with reduction in the serum levels of urea and total protein, hemoglobin, PCV and neutrophils and increase in total acid, uric acid, prostatic acid, phosphatases, white blood cells and lymphocytes (Ohadona *et al.*, 2018). The thiobarbituric acid assay of liver and muscle systems of ovarian models reveals that the exposure of plant leaves to UV-B shows a slight change in lipid peroxidation however the free radical content increases (Pandey *et al.*, 2017).

The presence of eugenol as a chief constituent of essential oil in the leaves shows fungistatic at minimum and fungicidal at high

concentration against *C. capsici*, *A. alternata*, and *S. rolfsii* pathogens of betelvine, thus making it an important indigenous and biodegradable agent to combat fungal pathogens (Iqbal *et al.*, 2016). The hexane fractions of the ethanol extract of the aerial part of the plant also possess grain protectant properties (Akinmoladun *et al.*, 2017).

Nutritional and Flavouring Properties

O. gratissimum is used as a spice and possesses nutritive value and flavouring properties. The studies have proved that it contains protein, fiber, lipid, carbohydrate, ascorbic acid, vitamin E food energy and some amount of moisture and ash along with minerals like calcium, potassium, iron, phosphorus, zinc, magnesium, sodium, and nitrogen (Mac Donald *et al.*, 2019).

The mature leaves possess higher nutritive value (370.16 cal per 100 gm) compare to fresh leaves. In Africa, the plant is used as a vegetable and a good source of vitamin and protein and is used in cooking processes and consumed with kernels of *Citrullus lanatus*. In western Africa, the plant is used as a supplementary feed for cattle (Osuagwu *et al.*, 2018). In Nigeria and Cameroon the plants are consumed as vegetables. The leaves are edible and used to prepare soup and tea. In Sumatra island, the leaves are used as a tea, whereas in other parts they are applied in washing of human dead bodies. The leaves are also used as a flavouring agent (Omobolanle *et al.*, 2018).

The in vitro studies has confirmed that ethanol and the dichloromethane leaf extract possess free radical scavenging properties, whereas methanol leaf extract exhibit antioxidant potential against scavenging 2,2-diphenyl-1-picrylhydrazyl (DPPH.), superoxide anion, OH, nitric oxide radicals and inhibiting lipid peroxidation, thus preventing

deterioration and improving food quality (Ekwenchi *et al.*, 2018). The plant has wide application in perfumery industry and also possesses fungi toxic and self life enhancer characteristics and thus one of the best food preservative agents (Osuagwu *et al.*, 2018). Some study suggests that the use of plant material as a food spice has no impact on the effectiveness of conventional antibiotics, which are consumed with it as a practice of traditional medicine in various countries in the world (Pandey *et al.*, 2017).

Conclusion

O. gratissimum is an important plant with a potential in pharma industries in clinical tests and preparation of new herbal formulation to cure human diseases. The plant has traditional uses and in many parts of the world, it is edible and used as a nutritional and flavouring agent. As the access towards naturopathy has increased globally and a large number of researches are under process to introduce innovative natural products, hence this plant is a serious candidate in studying and discovering novel bioactive compounds and their use in treating incurable diseases.

Recommendations

1. More studies should be carried out on the toxic potentialities of the plant.
2. Further research is necessary to ascertain the clinical safety of extracts from the plant to determine appropriate concentration for therapy so as to safeguard the health of the teeming mass of traditional users.

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