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A review on phytochemical and pharmacological activities of selected *Ocimum* species

Dr. S Radha**Abstract**

Ocimum species (*O. americanum*, *O. basilicum*, *O. gratissimum*, and *O. tenuiflorum*) belongs to family Lamiaceae. It is also known as Tulsi. It is currently used as a traditional medicinal plant in India, Africa and other countries in the world. It is used in Ayurveda and in traditional Chinese medicine for treating different diseases and disorders like digestive system disorders such as stomach ache and diarrhea, kidney complaints, and infections, etc. Many researchers have investigated the anti-inflammatory potential of various *Ocimum* species and reported various activities like anti-viral, anti-bacterial, anti-hemolytic and also different phytoconstituents like essential oil, saponins, phenols, phlobatannins, and anthraquinones etc. Exploration of the chemical constituents of the plants and pharmacological activities may provide us the basis for developing new life-saving drugs hence this review may help the traditional healers, practitioners, researchers and students who were involved in the field of ethno pharmacology.

Keywords: *Ocimum* species, therapeutic uses, biological activity, phytoconstituents

Introduction

The name "basil" comes from Latin word 'Basilius'. In Greek, basil was named as "royal plant", because the plant was believed to be used in production of royal perfumes. The genus *Ocimum* consists of above 150 species and is a member of the Lamiaceae family. Basil is originally native of India and other tropical regions of Asia. It is well grown in temperate regions. It has been cultivated for more than 5,000 years. Numerous species are found in Africa regions. Among them the well-known species are *Ocimum basilicum*-Thai basil; *Ocimum americanum*-hoary basil; *Ocimum gratissimum*-African basil; *Ocimum sanctum*-Holy basil. Along with the above species there are also many varieties, as well as several related species or hybrids which are also called as basil. The type used commonly is typically called sweet basil. Basil is most commonly used fresh in recipes and is added at the last moment of cooking. Different parts including the leaves, stems, flowers, roots can be used. The seeds are edible, and when soaked in water become mucilaginous and the leaves can be eaten as a salad. Basil is used in traditional Ayurvedic medicine and Chinese medicine for digestive system disorders, diarrhea and kidney infections. In African traditional medicine, it is used for cough and various types of fever [1]. Many researchers have been investigated the anti-inflammatory and anti-nociceptive potential of various *Ocimum* species, including *O. gratissimum*, *O. basilicum*, *O. sanctum*, *O. americanum*, *O. suave*

Table 1: Botanical description of selected *Ocimum* species

<i>Ocimum americanum</i>	<i>Ocimum basilicum</i>	<i>Ocimum gratissimum</i>	<i>Ocimum tenuiflorum</i>
Botanical names [2-5]			
<i>O. americanum</i> L. <i>O. americanum</i> var. <i>americanum</i>	<i>O. basilicum</i> (L) <i>O. basilicum</i> var. album (L.)	<i>O. gratissimum</i> L <i>O. gratissimum</i> var. macrophyllum	<i>O. tenuiflorum</i> L. <i>O. sanctum</i> L.
Botanical synonyms [6-9]			
<i>O. album</i> Roxb <i>O. brachiata</i> Blume <i>O. canum</i> Sim	<i>O. album</i> <i>O. var. basilicum</i> <i>O. caryophyllatum</i>	<i>O. arborescens</i> GO. Lebanonese <i>O. febrifugum</i> Lindl	<i>O. anisodorum</i> F. muell <i>O. caryophyllum</i> F. muell <i>O. hirsutum</i> Benth
Vernacular names [10-13]			
English: Hoary basil, Lemon basil Hindi: Ban-tulsi, Rantulsi, Vantulsi Sanskrit: Ajaka, Kathinjara, Kshudraparna	English: Basil, Common basil, Sweet basil Hindi: Babuitulsi, Barbar, Tulsi Sanskrit: Krishnamula,	Hindi: Banjari, Banjiri, Malatulsi Sanskrit: Ajakatalasi, Vanabarbarika Telugu: Nimmatulasi	English: Holy basil, Thai basil Hindi: Baranda, kala tulasi Sanskrit: Ajaka, Vishnu-priya
Taxonomy [14-17]			
Kingdom: Plantae Class: Magnoliopsida Family: Lamiaceae Genus: <i>Ocimum</i> Species: <i>O. americanum</i>	Kingdom: Plantae Class: Magnoliopsida Family: Lamiaceae Genus: <i>Ocimum</i> Species: <i>O. basilicum</i>	Kingdom: Plantae Class: Magnoliopsida Family: Lamiaceae Genus: <i>Ocimum</i> Species: <i>O. gratissimum</i>	Kingdom: Plantae Class: Magnoliopsida Family: Lamiaceae Genus: <i>Ocimum</i> Species: <i>O. tenuiflorum</i>

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Morphological Description



Fig 1: *Ocimum americanum*



Fig 2: *Common basilicum*



Fig 3: *Ocimum gratissimum*



Fig 4: *Ocimum tennis forum*

Ocimum americanum [18].

It is a pubescent erect much branched herb having 15 to 60 cms high with a sub-quadrangular striate branches. Leaves are elliptic- lanceolate, entire or faintly toothed, glabrous and gland dotted. Flowers are white, pink or purplish in elongate racemes with more or less closely set whorls. Fruits are small,

notelets pitted, mucilaginous when wetted found in open fields and waste lands. (Fig.1)

Ocimum basilicum [19].

Ocimum basilicum is an annual plant found widely in the tropical, subtropical and temperate regions of the world. Grow about two feet long. Leaves are opposite, narrow at the tips. Flowers are verticillaster and they are often white, labiate (like lips) and are six in numbers, pedicel is almost sessile, calyx is five lobed, bilabiate. It reaches a mature height of 15-18 inches with white flower spikes. Dwarf Bush Basil grows in the form of a globe and normally doesn't exceed 8-10 inches in height. The leaves are small and the flavor is mild. (Fig.2)

Ocimum gratissimum [20].

Ocimum gratissimum is an 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. (Fig.3)

Ocimum tenuiflorum [21].

Holy basil is an erect many branched having 30-60cm tall with hairy stems. Leaves are green or purple they are simple with an ovate up to 5cm (2.0in) long blade which usually has a slightly toothed margin they are strongly scented and have a desiccate

phyllotaxy. The purplish flowers are placed in close whorls on elongate racemes. The two main morphotypes cultivated in India and Nepal are green leaves (Sri or Lakshmi Tulasi) and purple leaved (Krishna Tulasi). (Fig.4)

Therapeutic activities

Ocimum Americanum [22].

- Aqueous decoction of Tulsi leaves is given to patients suffering from gastric and hepatic disorders.
- Herbal preparations containing *Ocimum* have been suggested to shorten the course of illness, clinical symptoms and biochemical parameters in patients suffering from viral hepatitis.
- The leaf juice of *Ocimum americanum* along with Triphala is used in Ayurvedic eye drop preparations recommended for glaucoma, cataract, chronic conjunctivitis and other painful eye diseases.
- The juice of fresh leaves is also given to patients to treat chronic fever, dysentery, hemorrhage and dyspepsia.
- A decoction of Tulsi leaves is a popular remedy for cold.
- Tulsi leaves also check vomiting and has been as anthelmintic.

Ocimum basilicum [23].

- Demulcent, Antiperiodics, Emmenagogue.
- Leaves are aromatic and used as expectorant.
- Decoction of the leaves, given in gastric and hepatic disorders and is useful in catarrh, bronchitis, in cough (due to heat).
- Acts as diuretic, tonic for stomach.
- Its leaves are brushed into paste and applied over the inflammations.
- Its seeds are mucilaginous and demulcent, used for heat, as a household remedy, Urino-genital complaints, such as gonorrhoea.
- Oil of seeds is employed in syphilis, otitis and otorrhoea, whereas the fragrant oil of basil leaves and seeds

(obtained after steam distillation) are used in perfumes and toiletries.

- Decoction of roots is useful in malarial fever as antiperiodics.
- Extract of leaves are useful in earache (as drops).
- The flowering tops are used to flavour foods, in dental and oral products and in fragrances.
- These are used frequently in soups, desserts, pickles, pizza, spaghetti sauce, egg, cheese dishes, tomato juice, dressings, confectionery, salads, meat products etc.
- Basil is well known as a plant of a folk medicinal value.
- Basil tea taken hot is good for treating nausea, flatulence and dysentery.
- It is immune stimulant, sedative, hypnotic, anticonvulsant, diuretic, carminative, galactagogue, stomachic, spasmodic and vermifuge purposes.
- Basil is used in pharmacy for diuretic and stimulating properties, in perfumes and cosmetics for its smell; in fact, it is a part of many fragrance compositions.
- Its oil has been found to be beneficial for the alleviation of mental fatigue, colds, spasms, rhinitis, and as a first aid treatment for wasp stings and snake bites.
- The essential oil has antifungal, physiochemical and insect-repelling activity.
- Aerial part shows antispasmodic, aromatic, carminative, digestive, stomachic, and tonic agents, they are also used externally for the treatment of acne, insect stings, snake bites, and skin infections.

- Also for treating nausea, dysentery, mental fatigue, cold, rhinitis, increased plasma lipid content, soothes the nerves.

Ocimum gratissimum [24].

- Clove basil is an aromatic, stimulant, antispasmodic, antiseptic herb that repels insects.
- Expels internal parasites and lowers fevers.
- The leaves and stems are used internally in the treatment of colds, especially chest colds; fevers, headache, impotence,
- diarrhea, dysentery, post-partum problems, and worms in children.
- Applied externally, the leaves are used to treat rheumatism and lumbago.
- An essential oil obtained from the leaf has shown marked antibacterial activity.

Ocimum tenuiflorum [25].

- Used in Ayurveda for the treatment of diseases.
- Traditionally taken as an herbal tea.
- Thai cuisine and insect repellent.
- Food and medicine.
- Treatment of Bronchitis, Bronchial asthma, Malaria, Diarrhea, Dysentery, Skin diseases, Arthritis, Painful eye diseases and chronic fever.
- To treat insect bites.

Chemical constituents of different species

Table 2: *Ocimum Americanum*

Part of the Plant	Chemical Constituents
Whole plant	Essential oil, terpenic hydrocarbons (myrcene, pinene, terpinene, limonene, p-cymene, α - and β - phellandrene) terpenoids (oxygen containing hydrocarbons) like acyclic monoterpene alcohols (geraniol, linalool), monocyclic alcohols (menthol, 4- carvomenthol, terpineol, carveol, borneol), aliphatic aldehydes (citral, citronellal, perillaldehyde), aromatic phenols (carvacrol, thymol, safrol, eugenol), bicyclic alcohol (verbenol), monocyclic ketones (menthone, pulegone, carvone), bicyclic monoterpene ketones (thujone, verbenone, fenchone), acids (citronellic acid, cinnamic acid) and esters (linalyl acetate). mono- and sesquiterpenoids [26]
Whole plant	Organic acids and Amino acids, Sugars [27]
Leaves	Dibutyl phthalate, 1,2-benzenedicarboxylic acid, butyl 2-methylpropyl ester, 1,2-benzenedicarboxylic acid, bis (2-methyl propyl ester, 1,2-benzene dicarboxylic acid butyl 2-ethyl hexyl ester; 1,2-benzenedicarboxylic acid butyl 2-methyl propyl ester; phthalic acid; butyl 2-pentyl ester; phthalic acid, butyl hept-4-yl ester, phthalic acid, butyl hex-3-yl ester phthalic acid; di(2-propyl pentyl) ester diisooctyl phthalate, bis(2-ethyl hexyl) phthalate; squalene; trans-geranyl geraniol ²⁸
Whole plant	Volatile oils, flavonoids, carbohydrates, phytosterols, tannins and fixed oils ²⁹

Table 3: *Ocimum basilicum*

Part of the Plant	Chemical Constituents
Whole plant	Linalool, methyl chavicol and 1, 8-cineole, camphor, thymol, cubenol, methyl cinnamate, eugenol, methyl eugenol, methyl isoeugenol, and elemicine, citral, eugenol [30]
Whole plant	Methyl eugenol, α -cubebene, nerol and geranyl acetate, terpinen-4-ol and octan-3-yl-acetate [31]
Whole plant	P-cymen, α -muurolene, 3,7-dimethyloct-1,5-dien-3,7-diol and β -cubebene, geranyl acetate, terpinen-4-ol, octan-3-yl-acetate, n-octanol, chavicol and eugenol, α -pinene, sabinene, β -pinene, myrcene, limonene and (z)- β -ocimene, limonen [32]
Whole plant	Polyphenols, triterpenic acids and phytosterols, essential oils like linalool, farnesen and guaiene, epibicycloses quiphellandrene, farnesene, cadinene [33]
Leaves and seeds	Phenylpropenes e.g Individual essential oils containing both terpenoids and phenylpropanoids of which methyl chavicol, citral and (z)- β -ocimene were major constituents. monoterpenes like β -myrcene, limonene, β -ocimene. Oxygenated monoterpenes like 1, 8-cineol, fenchone, linalool, camphor. sesquiterpenes like trans- α -bergamotene, α -bulnesene, γ -cadinene. Oxygenated sesquiterpenes like cubeno [34]
Leaves and seeds	α -Pinene, camphene, sabinene, β -pinene, myrcene, α -terpinene, 1,8-cineole, (z)- β -ocimene, (e)- β -ocimene, γ -terpinene, (z)-sabinene hydrate, fenchone, terpinolene, linal 3,7-dimethyl-1,6-octadien-3-ol, 1-methoxy-4-(2-propenyl) benzene, methyl cinnamate, 4-allyl-2-methoxyphenol and 1,8-cineole. the major aroma constituents of thyme were 2-isopropyl-5-methylphenol, 4-isopropyl-2-methyl phenol and 1,8-cineole, borneol, terpinene-4-ol, α -cubebene, eugenol, α -copaene, β -bourbonene, β - cubebene, β -elemene, α -cedrene, α -(z)-bergamotene, (e)-caryophyllene, α -guaiene, aromadendrene, (e)- β -farnesene, germacrene, camphor, limonene, β -selinene, α -zingiberene, bicyclogermacrene, α -bulnesene, γ -cadinene, δ -cadinene, (z)- nerolidol, α -cadinene, (z)-calamenene, spathulenol, caryophyllene oxide, alloaromadendrene, β -eudesmol, α -cadinol, α -bisabolol, phytol [35]

Whole plant	The main components in the essential oils found were linalol, methyl chavicol, citral and 1,8 cineole as well as camphor thymol, (e)-methyl cinnamate, eugenol, methyl eugenol, methyl isoeugenol and elemicin [36]
Flower and leaf tissues	Phenolic acid like rosemeric acid [37]

Table 4: *Ocimum gratissimum*

Part of the Plant	Chemical Constituents
Leaves	Sinapic acid, rosmarinic acid, luteolin, apigenin, nepetoidin A, xanthomicrol, nevadensin, hymenoxin, salvigenin, apigenin 7,4,-dimethyl ether, palmitic acid, basilimoside, 2- α , 3- β -dihydroxy olean-12-en-28-oic acid, methyl acetate and oleanolic Acid [38]
Leaves	Alkaloids, tannins, glycoside, saponins, resins, cardiac glycoside, steroidal terpenes and flavonoids [39]
Leaves	Saponins, phenols, phlobatannins, and anthraquinones [40]
Leaves	Tannins, terpenoids in the methanolic and ethanolic extracts; terpenoids in petroleum ether and chloroform extracts; carbohydrates in alcoholic extracts [41]
Aerial plant parts	Monoterpenes, sesquiterpenes, and aliphatic compounds, with p-cymene, γ -terpinene, α -thujene, and β -myrcene. p-cymene/thymol and p-cymene chemotype [42]
Aerial parts	Trans-methyl isoeugenol, cis-ocimene, germacrene-D, and β -caryophyllene [43]
Leaves	Volatile oils, methyleugenol, cis-ocimene, germacrene-D, transcaryophyllene and pinene [44]
Leaves	Four phenolic substances were identified: L-caftaric acid, L-chicoric acid, eugenyl- β -D-glucopyranoside and vicenin-2 [45]
Leaves	Eugenol, cis-ocimene, γ -muurolene, (Z,E)- α -farnesene, α -trans-bergamotene and β caryophyllene [46]
Leaves	Gamma-terpinene, beta-phellandrene, limonene and thymol [47]

Table 5: *Ocimum tenuiflorum*

Part of the Plant	Chemical Constituents
Whole plant	Methyleugenol and β -caryophyllene [48]
Whole plant	L-Asparaginase [49]
Whole plant	Bioactive polyketides and alkaloids [50]
Leaves	Essential oils: α - Thujene, octane, nonane, benzene, (z)-3-hexanol, ethyl 2- methyl butyrate, α -pinene, β -pinene, toluene, citronellal, camphene, sabinene, dimethyl benzene, myrcene, ethylbenzene, limocene, 1,8,-cineole, cis- β - ocimene, p-cymene,terpiniolene, allo-oc-imene, butyl-benzene, α -cubebene,linalool, eugenol, methyl eugenol, β - elemene, (e)-cinnamy, lactate, isocaryophyllene, β -caryophyllene, iso-eugenol, α -guaiene, α -amorphen, α -humulene, γ -umulene, 4,11-seinadiene, α -terpeneol, isoborneol, carvacrol, borneol, germacrene-d, α -selinene, β -selinene, myrtenylformat, α -murolene, cadinene, δ - cuparene, calamene, geraneol,nerolidol, caryophyllene oxide, humulene oxide, α - guaiol, τ - cadinol, α - bisbolol, (ez)-famesol, cissesquisainene hydrate, elemol, tetradecanal, selin-11-en-4- α -ol, 14-hydroxy- α -humulene. Alcoholic extract contains urosolic acid, apigenin, luteolin,apigenin-7-oglucuronide, luteolin-7-oglucuronide, isorientin, orientin, molludistin [51]

Pharmacological/Biological Activities Selected Species of *Ocimum***Table 6: *Ocimum Americanum***

S. No	Part of the Plant	Pharmacological/Biological Activity
1	Whole plant	Hemolytic activity [52]
2	Whole plant	Antifungal activity [53]
3	Whole plant	Bactericidal activity [54]
4	Whole plant	Anti-microbial activity [55]
5	Whole plant	Anti-oxidant activity [56]
6	Leaves	Analgesic and Anti-inflammatory activity [57]
7	Leaves	Immuno modulatory activity [58]
8	Leaves	Anesthetic activity [59]
9	Whole plant	Hepato protective activity [60]

Table 7: *Ocimum bacilicum*

S. No	Part of the Plant	Pharmacological/Biological Activity
1	Whole plant	Antioxidant and Antimicrobial activity [61]
2	Leaves	Insecticidal activity [62]
3	Leaf extract	Antimicrobial [63]
4	Leaves	Antifungal activity and insect repelling activity [64]
5	Aerial parts	Anti convulsant and Hypnotic activity [65]
6	Whole plant	Anti-oxidant activity [66]
7	Aerial parts	Anti-convulsant [67]
8	Whole plant	Anti-viral activity [68]
9	Whole plant	Potent cytotoxicity [69]
10	Whole plant	Anti-gardial activity [70]
11	Whole plant	Antiseptic activity [71]
12	whole plant	Phytotoxicity and Haemagglutination [72]

Table 8: *Ocimum gratissimum*

S. No	Part of the Plant	Pharmacological/Biological Activity
1	Leaves	Inhibits the progression of human breast cancer ^[73]
2	Leaves	Hypoglycemic activity ^[74]
3	Leaves	Antibacterial activity ^[75]
4	Leaves	Antioxidant activity ^[76]
5	Whole plant	Antifungal activity ^[77]
6	Leaves	Anti-malarial activity ^[78]
7	Whole plant	Anti-helminthic activity ^[79]
8	Leaves	Anti-leishmanial activity ^[80]
9	Leaves	Antimicrobial activity ^[81]
10	Leaves	Anti-hepatic fibrosis ^[82]
11	Leaves	Inhibit prostate cancer cells ^[83]
12	Leaves	Apoptotic activity in human osteosarcoma cells ^[84]
13	Leaves	Cerebroprotective effect ^[85]
14	Leaves	Antidiarrhoeal activity ^[86]
15	Leaves	Hypotensive activity ^[87]
16	Leaves	Anti trypanosomal activity ^[88]

Table 9: *Ocimum tenuiflorum*

S. No	Part of the Plant	Pharmacological/Biological Activity
1	Whole plant	Hypoglycemic and anti-hyperglycemic activity ^[89]
2	Whole plant	Fibroblast and keratinocyte gene expression activity ^[90]
3	Whole plant	Standardization for increasing eugenol distribution activity ^[91]
4	Whole plant	Hyperglycemic activity ^[92]
5	Whole plant	Analgesic activity ^[93]
6	Whole plant	Anti-arthritis activity, Anticancer activity ^[94]
7	Whole plant	Anticoagulant activity Anticataract activity ^[95]
8	Whole plant	Antidiabetic ^[96]
9	Whole plant	Wound healing effect ^[97]
10	Whole plant	Anti-oxidant activity ^[98]
11	Whole plant	Anti-microbial activity ^[99]

Conclusion

The present article describes the review on medicinal importance, past pharmacological and phytochemical work done on *Ocimum species* (*O. americanum*, *O. basilicum*, *O. gratissimum* and *O. tenuiflorum*). These species are showing various pharmacological activities like anti-inflammatory, anti-viral, anti-bacterial, anti- haemolytic activities and used in the treatment of whooping cough, nausea, digestive disorders also having phytochemical constituents glycosides, tannins, flavonoids, phenolic compounds and essential oils.

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