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PHARMACOLOGICAL STUDIES OF *OCIMUM BASILICUM* L.

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Abstract:

Ocimum basilicum (O. basilicum) L. belongs to family Lamiaceae which comprises the most employed medicinal plants as a worldwide source of spices and also as a consolidated source of extracts. The phytochemical constituents of sweet basil essential oil have been investigated for several therapeutic importance from many regions of the world. They include terpenoids, alkaloids, flavonoids, tannins, saponin glycosides and ascorbic acid. These compounds have been reported to exhibit antibacterial and antifungal, antidyspepsia, anti-inflammatory, antioxidant, antiulcer, antiviral, insecticidal, wound-healing etc. activities. The plant parts of O. basilicum have been widely used in preparation traditional medicine. The plants also been used as a folk remedy to treat various ailments such as feverish illness, poor digestion, nausea, abdominal cramps, gastro-enteritis, migraine, insomnia, depression, gonorrhea, dysentery etc. Externally, they have been applied for the treatment of acne, loss of smell, insect stings, snake bites and skin infections. The present review is aimed to cover the pharmacological investigations on this important medicinal herb.

Key Words: *Ocimum basilicum, phytochemical constituents, antiinflammatory, antioxidant, antiviral, insecticidal.*

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I. INTRODUCTION:

Plant kingdom presents the richest source of remedies to diverse human ailments. The WHO survey shows that 80% of the populations in the developing countries use herbal medicine for their health needs. Realizing the importance of plants in the discovery of new and safer therapeutic agents, screening of herbs for pharmacological activities and phytochemical constituents is one of the active fields of research round the world today. *Ocimum basilicum*L. commonly known as Sweet Basil, belongs to the genus *Ocimum* of the family Lamiaceae. *Ocimum* (from Greek ozo for smell) is appropriate for the genus since its various species are known for their peculiar strong odors. *Ocimum basilicum* is sensitive to cold, with best growth in hot, dry conditions. It behaves as an annual if there is any chance of a frost. However, due to its popularity, basil is cultivated in many countries around the world. Production areas include countries in the Mediterranean area, in the temperate zone, and others in subtropical climates.

1.1 Taxonomical Classification:

Kingdom: Plantae,
Phylum: Magnoliophyta,
Class: Magnoliopsida,
Order: Lamiales,
Family: Lamiacaeae,
Genus: *Ocimum*,
Species: *basilicum*

English: Basil, Sweet Basil,

Hindi: Bawaribawai, Mumari

1.2 Morphology of Plant Parts:

Type of inflorescence: Verticellaster

Flowering month: October-December

Plant **parts used:** Leaves, flowering tops, essential oil, whole plant.

Ocimum basilicum (Sweet basil) is a herb of medium size, strong scent with smooth having leaves of the herb are opposite, simple, entire and ovate. They are toothed often, 3-5 cm long and petiole is slender. Its flowers are 8-12 mm long in cluster-like circles of 6-10 flowers. Glandular as well as non-glandular hairs are found on both sides of the leaves of the herb. *Ocimum basilicum* that is considered to have originated in the warmer parts of the Indo-Malayan regions, is abundantly found in tropical and hotter parts of the Indian subcontinent (fig. 1).

Fig.1: Plants of *Ocimum basilicum* (Sweet Basil)

It grows in habitats like wastelands and on hills and due to its ornamental and therapeutic significance it is also grown as pot plant. The pollination is through the aid of insects. Nitrogen fertilization has effect in different stages of development of the herb on the leaves of *O. basilicum*. Mass, chlorophyll and essential oil yield significantly increases with nitrogen fertilization. If its leaves have wilted from lack of water, it will recover if watered thoroughly and placed in a sunny location. The plants can also be propagated reliably from cuttings with the stems of short cuttings suspended for two weeks or so in water until roots develop. Once the plant is allowed to flower, it may produce seed pods containing small black seeds, which can be saved and planted the following year.

2. PHARMACOLOGICAL ACTIVITIES

Phytochemical Compound extracted from plants have been used in medicine, either as they are or after chemical modification [1]. *O. basilicum* has immense ethnomedicinal applications. The essential oil of *O. basilicum* was tested against bacterial strains *S.aureus, E. faecalis, E. coli, P. aeruginosa* and *Candida albicans*. Among other *Ocimum* species the oil of *O. basilicum* showed best MIC against *C.albicans* means highest activity [2]. It has been reported to be antiviral, larvicidal, antinociceptive, antimicrobial by several researchers [3, 4] .It has been used since prehistoric time for the treatment of digestive and nervous disorders and has been found to be anthelmintic, antipyretic, stomachic, taste improving agent, cardioprotective and cure for blood diseases [5]. Like other medicinally important plants,it is also known for its use in different ailments such as muscle cramps, insecticidal, antimicrobial and superficial disorders[6]. It is active as an antioxidant, anti-inflammatory agent, feverish illness, nausea, migraine, abdominal cramps, gonorrhea, dysentery, headache, colic, dizziness, piles, cough, paralysis, nervous temperament and numbness [,7,8]. The essential oil is used for acne, snake bites and insect stings. It is known to be antitoxic and cure for kidney and respiratory ailments. Basil tea cures diarrhea, vomiting, constipation and for mental fatigue and hyssop for cough [9]. The chemical composition of the essential oil of *O. basilicum* has been under study since long timeand more than 200 chemical components have been identified till now.

2.1 Immunomodulatory Activity

For immunomodulatory effect, *O. basilicum*exhibited increase in body weight than the control animal [10]. Immunomodulatory activity of ethanolic and aqueous extracts of the leaves of *O. basilicum* in rats was reported. Both types of extracts were given orally at the level of 400 mg/kg/day body weight. Delayed type hypersensitivity (DTH), haemagglutination antibody (HA) titer, neutrophil adhesion test and carbon clearance test were used for checking immunomodulatory activity for both specific and non-specific immunity. Immuno stimulating agents used were cyclophosphamide (100 mg/kg/day, p.o.) A notable increase in circulating antibody titer production in comparison to sheep red blood cells (SRBC' s) was seen when given orally. In primary and secondary HA titer an increase was observed ($p< 0.05$) increases in serum levels of total cholesterol (HDL and LDL), was seen but significantly ($p < 0.05$) reduced the serum triacylglycerols. Significant prevention of HFD induced increases in serum total cholesterol and partial decrease of the HFD induced decrease in serum triacylglycerols was noticed by the administration of aqueous extract of *Osuave* or *O. basilicum*. Lipitor the standard hypolipidemic drug was used to compare the results (Umar et al., 2012). Anti-hyperglycemic and hypolipidemic effects of the aqueous extracts from *O. basilicum* in rats were reported. Aqueous extract of the whole plant was taken and both the effects were analysed in normal rats as well as streptozotocin (STZ) diabetic rats. Hence, basil proved to have CNS activity [11]. Anticonvulsant activity of the essential oil of *Ocimum basilicum* leaves was reported. *Ocimum basilicum* and many other herbs belonging to the genus Ocimum are used as treatment for the diseases related to the central nervous system. Varieties of experimental models have been used to analyze the CNS depressant and anticonvulsant activity of the essential oil obtained from leaves. Decrease of spontaneous activity, sedation, and ataxia was seen at all doses of the oil along with a considerable increase of sleep time and decrease in latency to sleep.

2.2 Antibacterial activity

The antibacterial activity of *O. basilicum*essential oil was studied against gram-negative and gram-positive bacteria including *Escherichia coli, Pseudomonas aeruginosa, Bacillus cereus, and Staphylococcus aureus*, respectively. Minimal Inhibition Concentration (MIC),and Minimum Bactericidal Concentration (MBC) were detected. For gram-positive bacteria the MICs were: *B. cereus* ranging 36-18 µg/mL, *S. aureus* 18 µg/mL, and for gram-negative bacteria the MICs were: *E. coli* and *P. aeruginosa* were 18-9 µg/Ml44. Alcoholic, hydroalcoholic and aqueous extracts from *O. basilicum*,*Saturejahortensis*and *Anethum graveolens* were tested against pathogenic microorganisms *Escherichia coli, Staphyloccocus aureus, Streptococcus cricetus* and inhibitory zone diameter was the evaluation indicator for antimicrobial activity. Except *Saturejahortensis* aqueous extract for *Streptococcus cricetus*, for all aqueous extracts *Staphylococcus aureus* and *Streptococcus cricetus*showed resistance. When *O. basilicum* aqueous extract was evaporated at 80^0C the largest inhibition zone diameter was noted for *Escherichia coli* and in case of alcoholic extracts for *Candida albicans*, the average inhibitory zone diameter for tested pathogenic microorganisms was noted for other extracts. The antimicrobial activity was evaluated by using agar diffusion and agar dilution methods for the volatile oils of *O. basilicum*and *O. gratissimum*.. At

a concentration of 0.51% in the agar, the volatile oils of both plants separately inhibited the growth of *Streptococcus viridian; Staphylococcusalbus*; and *Klebisiella pneumonia Pseudomonas aeruginosa* at 10.0%. *Proteus vulgaris* was inhibited at 0.67% by *O. basilicum* and 0.53% by *O. gratissimum*. By using volatile oil of both herbs separately in tooth pastes (2 and 5 %), antibacterial activities comparable to a commercial tooth paste were shown at a concentration of 0.5% in mouth washes, complete inhibition of the growth of organisms was observed46. By using disk-diffusion and minimal inhibition concentration (MIC) method ethanol, methanol, and hexane extracts from *O. basilicum* were tested for antimicrobial potential. The three extracts varied in terms of their antimicrobial potential. The hexane extract showed the strongest spectrum of antimicrobial activity (table 1.1).

2.3 Antifungal Activity

The phytochemical constituent of *O. basilicum* proved to have antifungal potential against *Fusarium oxysporum*, *F. proliferatum* (33.37 and 44.30%, respectively), *F. subglutinans* (24.74 and 29.27%, respectively), and *F. verticillioides*. At the concentration of 1.50% (v/v) the growth of *Fusarium* spp. was completely inhibited and at concentrations of 0.35 and 0.70% (v/v) aerial mycelium growth reduced over all. Hyphae deformations, thickenings, fragmentations and diminished sporulation were also observed. Antifungal activity of *O. basilicum* and *O. gratissimum*oil was tested against seven species of rice pathogenic fungi namely *Alternaria brassicicola*, *Aspergillus flavus*, *Bipolarisoryzae*, *Fusarium moniliforme*, *Fusarium proliferatum*, *Pyricularia grisea* and *Rhizoctonia solani*. The techniques used were mycelium growth and spore germination inhibition. The remaing oil was used as control and the efficiency of essential oils was recorded at 0.4, 0.6, 0.8, 1.0 and 2.0% v/v. In vitro study was carried out using potato dextrose agar (PDA) with 3 replications. The data of mycelium growth inhibition showed that sweet basil oil showed inhibition of *F. moniliforme* (100%), *F. proliferatum*(49.6%) and *P. grisea*(100%) at a concentration of 0.6% v/v. *B. oryzae*, *A. brassicicola* and *A. flavus* was inhibited up to 97.40%, 94.62% and 59.25% respectively at 2.0% v/v. The result showed for spore germination inhibition showed that *F. moniliforme*was inhibited up to 91.31% and *A. brassicicola*99.74% at 0.8% v/v. *F. proliferatum*, *P. grisea*, *B. oryzae*, *R. solani*and *A. flavus*were inhibited at 2.0% v/v. *O. gratissimum*also showed inhibition of fungi strains by both methods. Hence, the plants had antifungal activity which depended on evaluation conditions also (table 1.1)**2.4**

2.4 Skin ErythmaActivity

Topical cream formulation with 3% concentrated extract of Basil against its base exhibited promising results for skin erythma and skin melanin. The test performed on the cheeks of 11 healthy human volunteers for a epoch of 12 weeks. After every two weeks time, pigment (melanin) and erythma was observed. The formulation showed statistically significant result whereas the base proved to be inconsequential ($p \geq 0.05$) against skin erythma. Similar results were noticed for skin pigmentation (melanin) thus proving the efficacy of new formulation [12].

2.5 Antitoxic Activity

For testing of antitoxic activity, albino rats delta methrin induced several histopathological alterations in the kidney like deterioration of epithelial lining cells, dilation and congestion of renal blood vessels, infiltration of intertubular spaces by inflammatory leucocytic cells and elevation in urea and serum creatinine. Superoxide dismutase (SOD) and catalase (CAT) in renal tissue became more or less inactive and the concentration of malondialdehyde (MDA) increased remarkably. The animals were then treated with aqueous extract of basil along with deltamethrin. It led to curing histopathological ailments. Activities of CAT and SOD were found to amplify and creatinine and urea level became normal whereas MDA level lessened [13].

2.6 Anti-dyspepsia

A double-blind placebo-controlled study showed *Ocimum basilicum* seems to relieve functional dyspepsia in female and young patients with dysmotility [14].

2.7 Anti-inflammatory

This crude methanolic extracts of *O. basilicum* exhibited anti-inflammatory action as evidenced by the inhibition of the key pro inflammatory cytokines and mediators [15].

2.8 Antioxidant activities

Polyphenols of *Ocium basilicum* were known for their antioxidant activity. In one study, polyphenols of *O. basilicum* were isolated from methanol extract and were examined for antioxidant activities, which exhibited best antioxidant activity as well as excellent synergistic effect against α-tocophero identified two phenolic compounds, rosmarinic and caffeic acids as strong antioxidant constituents of sweet basil [16, 17].

The antioxidant activity of the water and ethanol extracts of basil was investigated using different antioxidant methodologies: 1,1-diphenyl-2-picryl-hydrazyl (DPPH) free radical scavenging, scavenging of superoxide anion radical-generated non-enzymatic system, ferric thiocyanate method, reducing power, hydrogen peroxide scavenging and metal chelating activities. These experiments revealed that water and ethanol extracts of basil have betterantioxidant effects which are concentration-dependent. The total antioxidant activity was performed according to the ferric thiocyanate method. Additionally, these antioxidant activities were compared with BHA, BHT and α-tocopherol as reference antioxidants. Moreover,

the additional total phenolic content of these basil extracts was determined as the gallic acid equivalent and were found to be equivalent [18].

2.9 Insecticidal activity:

The essential oil of basil plantsand its three major active constituents (trans-anethole, estragole and linalool) were invetigatedon three tephritid fruit fly species, *Ceratitiscapitata, Bactroceradorsalis* and *B. cucurbitae* for insecticidal activity. All test chemicals acted fast and showed a steep dose-response association. The toxic action of basil oil in *C. capitata* generated significantly faster than in *B. cucurbitae* but slightly faster than in *B. dorsalis*. Estragole acted more rapidly in *B. dorsalis* than in *C. capitata* and *B. cucurbitae*. Linalool action was also faster in *B. dorsalis* and *C. capitata* than in *B. cucurbitae* trans-Anethole action was analogous to all three species. Apart from these Methyl eugenol worked rapidally in *C. capitata* and *B. cucurbitae* in comparison to*B. dorsalis*. When linalool was assorted with cuelure, its efficiencyto the three fly species decreased as the concentration of cuelure increased. This might be due to linalool hydrolysis catalyzed by acetic acid from cuelure degradation, which was confirmed by chemical analysis. Structural similarity between methyl eugenol and trans-anethole and estragole suggests that methyl eugenol might act at a site similar to that of trans-anethole and estragole and serve as an antagonist if an action site exists. Methyl eugenol also may play a physiological role on the toxicity reduction [19].

Table1.1: Summary table for major microbicidal activities of sweet basil

Microbicidal activities	Organism	Constituents	References
Antibacterial activities	*Staphylococcus aureus, Salmonella enteritidis, Escherichia coli, Bacillus cereus Pseudomonas aeruginosa, Listeria monocytogenes, Shigella sp., Escherichia coli,Haemophilusinfluenzae* and *Pneumococci Staphylococcus aureus, Staphylococcus, Enterococcus* and *Pseudomonas*	Essential oil	[20, 21, 22]
	Staphylococcus, Enterococcus and *Pseudomonas*	Linalool, methylchavikol,methyl	[23]
Antifungal activity	*Sclerotiniasclerotiorum* (Lib.), *Rhizopusstolonifer* (Ehrenb. exFr.) *Mucor sp.*	Linalool and eugenol	[24]
	Alternaria, Fulviafulva, Fusarium solani var. coeruleum, Glomerella cingulata, Fusarium oxysporum sp.vasinfectum and Rhizopusnigricans, Candidaalbicans, Penicilliumnotatum, Microsporum, Yeast and *mold. Aureobasidium pullulans, Debaryomyces hansenii, Penicillium simplicissimum, P. citrinum, P. expansum, P. aurantiogriseum*	Essential oil	[24, 25, 26]
Antiviral activity	Herpes viruses, Adenoviruses, hepatitis B virus and coxsackie virus B1 and enterovirus	Apigenin, linalool	[22]
Insecticidal activity	*Triboliumcastaneum, Sitophilusoryzae, Stagobiompaniceum, Bruchuschinensis*	Ocimene, cineole, linalool, methyl cinnamate, methyl chavicol	[26]
Mosquito Repellent activity	*Culexpipiens*	Essential oil	[27,28]

3. PRÉCIS OF BENEFITS OF BASIL

1. Basil leaves possess strong antiviral, antimicrobial and antioxidant properties in them due to the presence of compounds such as ethanol, vicenin.
2. Basil is used for treating stomach disorders such as intestinal gas, stomach spasms and loss of appetite.
3. Basil is used in ayurvedic medicine as a remedy for headaches, cough and common colds.
4. Basil is anti-bacterial in nature thus acts as an insect repellents.
5. Basil is anti-inflammatory in nature due to the presence of eugenol, limonene and citronellol in the leaf.
6. When raw basil is squeezed and applied on the body part bitten by venomous animals, the chemical content of the leaf is capable of extracting the poisonous venom from the body.
7. Basil seeds can be used to control blood sugar level sugar hence they are a great remedy for diabetes.
8. Decoction of basil seeds can be used for treating urinary infections. It also women to breast milk to flow as well as promote blood circulation.
9. When used as a mouth wash or gargle, basil water is capable of killing harmful bacteria in the mouth as well as helps to get rid of intestinal worms.
10. Basil is an excellent source of calcium magnesium, iron, Vitamin A, magnesium, copper, beta-carotene, potassium and manganese.
11. The presence of beta-caryophyllene in basil makes them ideal for treating inflammatory bowel diseases and arthritis.
12. Basil leaf contains anti-aging properties that is capable of preventing aging harmful effects

4. CONCLUSION:

The significance of medicinal plants has elevated with the passage of time because synthetic medicines and treatments have a number of side effects over benefits. These plants have recorded and known pharmacological applications which we have got in form our ancestors. Pharmacological studies along with botanical characteristics of sweet Basil havesummarized in the present review. The wide range of study on this herbal plant shows that it is very beneficial for the improvement of current drugs and more work can be done in future to take advantage of the potential remedial qualities of other medicinally important herbs also.

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