Therapeutic Potency of Ocimum Kilimandscharicum Guerke - A Review

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Abstract: This review paper involves Ethnomedicinal, Phytochemical and Pharmacological survey of Ocimum kilimandscharicum Guerke, a medicinal plant of genus Ocimum having immense therapeutic potential. Ocimum kilimandscharicum Guerke, a perennial evergreen shrub, native of East Africa have been used traditionally in Kenya against measles, abdominal pains, diarrhoea, particularly against mosquitoes (insect repellent), congested chest, cough and cold. In Indian system of medicine (Ayurveda) Ocimum kilimandscharicum (Kapur tulsi) have been used as an antiinflammatory, indigestion, insecticidal, mosquito repellent, aromatic. In this review an attempt has been made to depict the tremendous usefulness of Ocimum kilimandscharicum found in various regions of Asia, Africa, Central and Southern America. Various oxygenated monoterpenes have been reported in hydrodistilled essential oil of Ocimum kilimandscharicum Guerke, which were determined using capillary Gas Chromatography (GC), Gas Chromatography-Mass Spectrometry (GC-MS), Gas-Liquid Chromatography (GLC). Camphor has been reported as a chief essential oil component from Ocimum kilimandscharicum Guerke. Other important compounds found to be phenyl propane derivatives or terpenoids, including methyl eugenol, 1, 8-cineole, bornyl acetate, germacrene-D, E-myroxide, germacrene-B, caryophyllene oxide and p-cymene, 1,8-cineole, limonene, caryophyllene, camphene, 4-terpineol, α-terpinol, linalool which have been responsible for various pharmacological activities (insecticidal, mosquito repellent, antimicrobial, antioxidant, wound healing, antimelanoma, radioprotective). In such a way, this review makes us enable to explore more about the Ocimum kilimandscharicum Guerke, a therapeutic effective drug belonging to genus Ocimum.

Key words: Ocimum • Essential Oil • Insecticidal • Mosquito Repellent

INTRODUCTION

Ocimum Genus: The genus Ocimum, member of Lamiaceae family comprised of almost 200 species of herbs and shrubs[1] and is graded high among some of the astonishing herbs for having tremendous medicinal potentialities. There are large numbers of distinct species and varieties falls in this genus [2-4]. Genus Ocimum is widespread over Asia, Africa, Central and Southern America. The genus Ocimum is cultivated for its extraordinary essential oil which display many therapeutic usages such as in medicinal application, herbs, culinary, perfume for herbal toiletries, aromatherapy treatment and as flavouring agent. Due to the difficulties in identifying the species, it has concluded that identification can be optimized by combined analysis of morphological traits, essential oil composition and molecular markers as well as biological activity [3]. Leaf flavonoid glycoside (Luteolin 5-O-glucoside) considered as chemosystematic characters in O. americanum, O. basilicum, O. gratissimum, O. Kilimandscharicum, O. lamifolium, O. minimum, O. selloi, O. gratissimum, O. citriodorum. Essential oils are ambrosial, highly concentrated essences of plants which are considered to illuminate the vitality of the plant [5-7]. Quality and quantity of essential oil afforded by aromatic plants rely on heterogeneous factors such as seasonal variation, method of harvest, leaf development stages, climate and soil type [7-10].

Therapeutic Efficacy of Genus Ocimum: Genus Ocimum major molecular markers comprised of β-bisabolene, methyl chavicol, 1, 8-cineole, eugenol, (E)-α-bisabolene, α-terpineol, linalool, (Z)-cinnamic acid methyl ester, camphor exerting wide range of therapeutic effects like antimicrobial, antispasmodic, bactericide, carminative, anthelmintic, hepatoprotective, antiviral, larvicidal,
antinociceptive, anti-fungal, antipyretic, phototoxic activity, antiaflatoxigenic, anti-diarrheic, α-amylase inhibitory etc. which have been shown in Table 1 [11-45, 61-75].

**Plant Description:** It is perennial evergreen shrub having oblong, ovate green coloured leaves (0.5-5 m), oppositely arranged having pubescent leaf surface, narrow at the base and deeply serrated. One seeded fruits are indehiscent type found in clusters, hermaphrodite flowers are found in clusters, tap roots are deep and soft wooded. The leaves accommodate aromatic oils, which represents the essence of the plant. The essential oil is extracted using distillation, expression or solvent extraction methods. The oil constitutes liquid oil and white solid crystals, where the pure crystals possess a characteristic odour and taste of natural Camphor [46-47].

**Taxonomic classification of Ocimum kilimandscharicum Guerke** [48]

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Plantae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subkingdom</td>
<td>Tracheobionta</td>
</tr>
<tr>
<td>Division</td>
<td>Magnoliophyta</td>
</tr>
<tr>
<td>Class</td>
<td>Magnoliopsida</td>
</tr>
<tr>
<td>Subclass</td>
<td>Asteridae</td>
</tr>
<tr>
<td>Order</td>
<td>Lamiales</td>
</tr>
<tr>
<td>Family</td>
<td>Lamiaceae</td>
</tr>
<tr>
<td>Genus</td>
<td>Ocimum L.</td>
</tr>
<tr>
<td>Species</td>
<td>Kilimandscharicum Guerke.</td>
</tr>
</tbody>
</table>

**Vernacular Names**

- **English:** Camphor basil
- **Hindi:** Kapur tulsi
- **Ayurvedic:** Karpura tulasi
- **Common name:** Kilimanjaro basil, Camphor basil

**Geographical Source:** Ocimum kilimandscharicum Guerke is native of East Africa (Kilimanjaro, Kenya) and was introduced and cultivated in India and some parts of Turkey. Cultivated in India (West Bengal, Assam, Tamil Nadu, Karnataka, Kerala, Dehradun, North India) [49-50].

**Ethnomedicinal Uses:** Traditionally, extracts of Ocimum kilimandscharicum Guerke were used to mitigate many disorders in East Africa comprising remedy of coughs, colds, measles, abdominal pains, diarrhoea, insect repellent, particularly against mosquitoes and storage pest control [51-52]. The essential oils obtained from this plant as repellent against nuisance biting insects and malaria vector have been practised in North-Eastern Tanzania for centuries [53]. Ocimum kilimandscharicum is an important aromatic medicinal plant in Kenyan communities as mentioned in Table 2 [54].

**Karpura Tulasi in Ayurveda:** Ayurvedic benefits of Kapura Tulsi well understood by this Sloka in Sanskrit

“Para Tulasi na bhavadvardhate karpuravrinda karpura”

“In Indian system of medicine (Ayurveda) Ocimum kilimandscharicum (Kapur tulsi) have been used as an antiinflammatory, indigestion, insecticidal, mosquito repellent, aromatic [55].

**Other Uses** [50]: Whole plant of Ocimum kilimandscharicum used as spasmylytic, antibacterial and the decamphorized oil obtained from leaves have been employed as insecticidal, mosquito repellent. Ocimum kilimandscharicum (Kapur tulsi) essential oil used in preparation of portable liquid disinfection. [56]

**Chemistry of Ocimum Kilimandscharicum Guerke:**

The hydrodistilled essential oil of Ocimum kilimandscharicum Guerke (Northern India region) studied by capillary gas chromatography (GC) and gas chromatography-mass spectrometry (GC-MS) and have been reported to accommodate oxygenated monoterpenes (95.8%), represented by camphor (1) (64.9%), limonene (2) (8.7%), camphene (3) (6.4%) and (E)-β-ocimene (4) (3.0%) [57]. The essential oil of Ocimum kilimandscharicum Guerke, grown wild in Rwanda region of Africa, investigated by LSC, GLC and GC-MS and its essential oil found to contain 62% 1,8-cineole (5), 16 oxygen-containing compounds and 14 monoterpenic hydrocarbons including limonene (6) and β-pinene (7). The essential oil of Ocimum kilimandscharicum Guerke, grown in Indiana region of USA have been analyzed by GC and GC/MS and seventeen constituents have been identified in oil. The essential oil content varied...
Table 1: Therapeutic efficacy of Genus Ocimum

<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>Pharmacological activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>O. basilicum</td>
<td>Common basil</td>
<td>Antiviral, larvicidal, antinociceptive, antimicrobial</td>
</tr>
<tr>
<td>O. citriodorum</td>
<td>Lemon basil</td>
<td>Antioxidant</td>
</tr>
<tr>
<td>O. sanctum</td>
<td>Holy basil</td>
<td>Antifungal, anticandidal, antioxidant, activity, lipid-lowering effect, antifungal, antiaflatoxigenic, anthelmintic, hepatoprotective</td>
</tr>
<tr>
<td>O. gratissimum</td>
<td>African basil</td>
<td>Against convulsions, antimicrobial, phototoxic activity, cancer-fighting, anti-trypanosomal, anti-nociceptive, antifungal</td>
</tr>
<tr>
<td>O. tenuiflorum</td>
<td>Thai basil</td>
<td>Potent (\alpha)-amylace inhibitory</td>
</tr>
<tr>
<td>O. lamifolium</td>
<td>Basil</td>
<td>Antiinflammatory</td>
</tr>
<tr>
<td>O. suave</td>
<td>Mtule basil</td>
<td>Antimicrobial</td>
</tr>
<tr>
<td>O. canum</td>
<td>Kali tulasi</td>
<td>Acaricidal activity</td>
</tr>
<tr>
<td>O. americanum</td>
<td>American basil</td>
<td>Antimicrobial</td>
</tr>
<tr>
<td>O. suave</td>
<td>Mtule basil</td>
<td>Antimicrobial</td>
</tr>
<tr>
<td>O. kenyense</td>
<td>Kenya basil</td>
<td>Insecticidal</td>
</tr>
<tr>
<td>O. selloi</td>
<td>Pepper Basil</td>
<td>Anti-diarrheic, antispasmodic and anti-inflammatory</td>
</tr>
<tr>
<td>O. micranthum</td>
<td>Peru basil</td>
<td>Radical scavenging activity, antibacterial</td>
</tr>
<tr>
<td>O. forskolei</td>
<td>Basilikum</td>
<td>Mosquito repellent</td>
</tr>
<tr>
<td>O. minimum</td>
<td>Bush basil</td>
<td>Phytotherapeutic effect</td>
</tr>
<tr>
<td>O. campechianum</td>
<td>Least basil</td>
<td>Antidiabetic</td>
</tr>
<tr>
<td>O. Kilimandscharicum</td>
<td>Camphor basil</td>
<td>Wound healing, insecticidal, mosquito repellent, acaricidal action, antimelanoma, radioprotective, antioxidant, antimicrobial, antibacterial</td>
</tr>
</tbody>
</table>

Table 2: Vernacular names and ethnomedicinal uses of Ocimum kilimandscharicum in Kenya

<table>
<thead>
<tr>
<th>Kenya regions</th>
<th>Location</th>
<th>Vernacular names</th>
<th>Ethnomedicinal use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meru</td>
<td>Central Kenya</td>
<td>Gethereti/Makori</td>
<td>The strong camphor-scented leaves treat congested chest, cough and cold, by sniffing crushed leaves or inhaling vapour of boiling leaves.</td>
</tr>
<tr>
<td>Luhya</td>
<td>Western Kenya</td>
<td>lisuranza/Mwonyi</td>
<td></td>
</tr>
<tr>
<td>Marakwet</td>
<td>Eastern Kenya</td>
<td>Mbirirwa</td>
<td>Infusion is a cure for measles. It is also used to repel insects</td>
</tr>
<tr>
<td>Kikuyu</td>
<td>Central province of Kenya</td>
<td>Mutei</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Pharmacology of Ocimum kilimandscharicum [66-73,65,74-75]

<table>
<thead>
<tr>
<th>Extract/Plants</th>
<th>Secondary metabolite</th>
<th>Biological activity</th>
<th>In vivo/ in vitro screening model</th>
<th>Result of study</th>
</tr>
</thead>
<tbody>
<tr>
<td>O. kilimandscharicum (aqueous extract)</td>
<td>Essential oil</td>
<td>Wound healing</td>
<td>Excision, incision and dead space</td>
<td>Significant increase in skin breaking strength, granuloma breaking strength, wound contraction, dry granuloma weight and decreased in epithelisation period was observed in animals of both the treated groups compared to control</td>
</tr>
</tbody>
</table>

| O. kilimandscharicum, O. kenyense combined leaf extract | Essential oil | Insecticidal | Lethal toxicity determination against Sitophilus zeamais and Rhyzopertha dominica | Essential oil of O. kilimandscharicum was found to be largely responsible for the toxic action against R. dominica, the results with the other treatments indicated that the toxic action of the essential oils were due to the combined effects of different components, either with or without significant individual toxic action of their own against the insects |

| O. kilimandscharicum leaf extract | Camphor, 1, 8-cineole limonene carophylen, camphene-4-terpineol, \(\alpha\)-terpinol linalool | Mosquito repellent | Experimental huts and selected local houses against Anopheles gambiae | O. kilimandscharicum, revealed significant protective effect by reducing both the indoor resting mosquitoes and inhibiting mosquito blood-feeding |

| Combined plants | Essential oil | Mosquito repellent | Experimental huts under semi-field conditions inside a screen-walled greenhouse against Anopheles gambiae | O. kilimandscharicum, O. suave, Corymbia citriodora, Azadirachta indica, Tagetes minuta, Hptis suaveolens did not significantly repel mosquitoes for all treatments |
Table 2: Continue

<table>
<thead>
<tr>
<th>Kenya regions</th>
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<th>Vernacular names</th>
<th>Ethnomedicinal use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined plants</td>
<td>Essential oil</td>
<td>Mosquito repellent</td>
<td>Experimental huts and selected by burning of Ocimum and other plants</td>
</tr>
</tbody>
</table>

- Combined plants: *O. suave, O. kilimandscharicum* materials and their essential oils
- Combined plants: *Corymbia citriodora, leaves and seeds of O. kilimandscharicum, O. suave, C. citriodora*

- Combined plants: *Corymbia citriodora, leaves and seeds of O. kilimandscharicum, O. suave, C. citriodora*

- Hydro-distilled extracts of *Artemisia annua, A. vulgaris, O. kilimandscharicum, oil seeds of Pongamia glabra* kilimandscharicumexhibited

- Hydro-distilled extracts of *Artemisia annua, A. vulgaris, O. kilimandscharicum, oil seeds of Pongamia glabra* kilimandscharicumexhibited

- Hydro-distilled extracts of *Artemisia annua, A. vulgaris, O. kilimandscharicum, oil seeds of Pongamia glabra* kilimandscharicumexhibited

- *O. kilimandscharicum leaf extract 4- terpineol,*

- *O. kilimandscharicum leaf extract 4- terpineol,*

- *O. kilimandscharicum leaf extract 4- terpineol,*

- Aerial parts of *O. basilicum, O. kilimandscharicum, O. gratissimum*

The protective effect of essential oils from Ocimum plants were compared with N, N-diethly-3- methylbenzamide (DEET), a standard synthetic repellent. Study shows the potential of *O. suave, O. kilimandscharicum* crude extracts for use in protecting against human biting while the burning of plants reduces significantly the indoor resting mosquitoes.

All plant species also showed a residual effect against Anopheles gambiae with 36-44% repellency after a period of thermal expulsion.

Hydro-distilled extracts of three medicinal plants *Artemisia annua, A. vulgaris, O. kilimandscharicum* oil seeds of *Pongamia glabra* were tested for their in vitro efficacy against *Boophilus microplus.* O. highest efficacy (98.34%) followed by *P. glabra* (96.67%), *A. annua* (95.00%) and *A. vulgaris* (93.34%)

The 50% alcoholic aqueous extract of different species of *Ocimum* administered orally reduction in tumor volume, increase in *O.* average body weight and survival rate of mice. The various extracts showed modulatory influence against lethal irradiation doses of gamma radiation in terms of radiation-induced chromosomal damage, while at the same time induced an increase in reduced glutathione level and GST activity.

Freeradical scavenging capacity antioxidant potential of *O. kilimandscharicum* cultivars were proved in vivo, using the TBARS assay. In liver and muscle assay systems of ovarian models results suggested that UV-B doses have modulated the antioxidative machinery of *Ocimum* plants. Differences in responses were closely related to the differences in the activities of antioxidants and overall growth responses.
Table 2: Continue

<table>
<thead>
<tr>
<th>Kenya regions</th>
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<th>Vernacular names</th>
<th>Ethnomedicinal use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerial parts of O. americanum, O. basilicum, O. campechianum, O. citriodorum, O. kilimandscharicum</td>
<td>Essential oil</td>
<td>Antibacterial</td>
<td>Preliminary screening of antibacterial activity was done against a number of common pathogens E. faecalis, E. faecium, Escherichia coli, Listeria monocytogenes, Listeria ivanovii, Proteus vulgaris, Staphylococcus aureus, S. epidermis. E. coli was inhibited by O. asilicum while O. americanum and O. citriodorum essential oil were the most effective against Enterococcus faecalis, Enterococcus faecium, P. vulgaris, S. aureus and S. epidermis. Broad variation in the antibacterial properties of investigated essential oils was observed.</td>
</tr>
</tbody>
</table>

Fig. 2: Essential oil components of Ocimum kilimandscharicum Guerke.
between the leaves (0.77-1.12% dry wt. basis) and the flowers (1.96-2.8% dry wt.). Oil composition was similar between the leaves and flowers with linalool (8) as the major constituent, leaves (41.94%), flowers (58.85%). Other major constituents included camphor, leaves (17.02%), flowers (15.82%) and 1, 8-cineole (5) leaves (10.18%), flowers (6.38).[60] Six samples of essential oils from four Ocimum species (O. basilicum, O. kilimandscharicum, O. lamifolium, O. suave) were analyzed by GC and GC-MS. Eighty-one compounds, corresponding to 81.1-98.2% of the chemical components of the oils, have been identified. Major compounds were phenyl propane derivatives or terpenoids, including methyl eugenol (9), 1, 8-cineole (5), camphor (1), bornyl acetate (10), germacrene-D (11), E- myroxide (12), germacrene-B (13), Caryophylene oxide (14) and-cymene (15). [61] Camphor (1) have also been reported as a chief essential oil component from Ocimum kilimandscharicum.[62-64] GC-MS analysis of Ocimum kilimandscharicum oil from Uttrakhand region of India showed camphor as the major component (1) (56.07%). Besides camphor, DL- limonene (2) (13.56%), camphene (3) (7.32%), 4-terpineol (16) (3.50%), ß- ocimene (4) (2.00%), linalool (8) (1.70%), ß- myrcene (17) (1.58%) and a-terpinolene (18) (1.33%) have also been reported. L- phellandrene (19) was found in least concentration of about 0.26%. Other components includes sabinene hydrate (20), Myrtenol (21), Ethyl amyl carbinol (22).[65] Major essential oil components of Ocimum kilimandscharicum have been shown in Figure 2.

**Pharmacology of Ocimum Kilimandscharicum Guerke:** Various extracts of Ocimum kilimandscharicum Guerke have been evaluated for screening in-vitro/ in-vivo pharmacological models. Essential oil isolated from the leaf extract exhibited significant wound healing [66], insecticidal [67], mosquito repellent [68] effects. Furthermore, essential oils isolated from hydro-distilled extracts of Artemisia annua, A. vulgaris, O. kilimandscharicum, oil seeds of Pongamia glabra showed significant acaricidal action [72]. 50% alcoholic aqueous leaf extract O. sanctum, O. canum O. gratissimum, O. basilicum, O. kilimandscharicum exhibited antimalanoma and radioprotective activity [73]. Phenolics and essential oil from O. kilimandscharicum leaf extract exhibited antioxidant activity estimated by TBARS assay (in vitro) and enzymatic antioxidant estimation (in vivo) [65]. Methyl chevicol, linalool, methyl eugenol and methyl cinnamate isolated from aerial part of O. basilicum, O. kilimandscharicum, O. gratissimum exerted antimicrobial activity evaluated by broth Dilution method [74]. O. americanum, O. basilicum, O. campechianum, O. citriodorum, O. kilimandscharicum leaf extract exerted antibacterial activity evaluated by filter paper disc agar diffusion technique [75]. Various pharmacological activities of O. kilimandscharicum Guerke. (Kapura Tulsi) has been mentioned in Table 3.

**CONCLUSION**

The experimental research on Ocimum kilimandscharicum Guerke, convey a huge pharmacological potential of this plant. It is firmly considered that detailed enlightenment on this plant as displayed in this review on the ethnomedicinal, phytochemical, pharmacological might dispense detailed evidence for the use of this plant in diverse medicines.

**REFERENCES**


