



Note on *Ocimum africanum* Lour.: New distributional record of wild basil for Odisha and central India

R.C. MISRA^{1*}, A.P. RAINA² AND S.P. AHLAWAT³

^{1*}ICAR – National Bureau of Plant Genetic Resources, Regional Station, Cuttack-753006, Odisha, India

^{2,3}ICAR – National Bureau of Plant Genetic Resources, Pusa Campus, New Delhi-110012, India

*rcmisranbpgr@gmail.com

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ABSTRACT

Ocimum Linn. (Lamiaceae) is a large and diversified genus of economically useful and medicinal and aromatic importance and associated with Indian cultural traditions. It is highly valued for its therapeutic properties in indigenous as well as modern pharmacological system. During the exploration mission for germplasm collection in parts of Odisha and Northeast India, the natural occurrence of *Ocimum africanum* (syn. *O. citriodorum* Vis.), a natural hybrid and alien to the Indian flora, was explored from parts of Odisha, Tripura and Manipur. After critical assessment of published literature on distribution, its natural occurrence is found to be a new species record for the flora of Odisha extending to central India. The present report deals with its taxonomic description, ecology, ethno-botany and information on biochemical analysis of essential oil for easy identification and further economic utilization.

Key words: Basil, central India, germplasm collection, new species record, *Ocimum africanum*, Odisha

INTRODUCTION

The genus *Ocimum* of family Lamiaceae, collectively called as basil, is a large and diversified plant group of high medicinal and aromatic importance and associated with manifold Indian cultural traditions. Most of the members are annual, biannual or perennial herbs or shrubs and distributed in the tropics and subtropics of the old and new worlds, with few species cultivated in temperate areas (Paton, 1992). The main centre of diversity of *Ocimum* appears to be Africa (Hedge, 1992; Paton, 1992) with secondary centre in South America: Brazil and Asia: India (Sobti and Pushpagandan, 1982; Vieira and Simon, 2000). A high degree of polymorphism along with inter-specific hybridization and polyploidy (Harley and Heywood, 1992) has created taxonomic confusion in the genus which designates a large number of subspecies and varieties. Hence the nomenclature of *Ocimum* species and varieties is still complicated and various workers have reported the content of species not in

exact numbers but approximately ranging from 30 to 160 (Mabberly, 1997; Charles and Simon, 1990; Pushpagandan and Bradu, 1995; Gill et al., 2012; Bhasin, 2012). However, *Ocimum* has 66 accepted species names and the rest were placed as synonyms and unassessed (Anonymous, 2014). India is represented by 9 species of *Ocimum* (including 3 exotics) mainly confined to tropical and peninsular region (Anonymous, 1966). It is highly valued for its therapeutic properties in traditional as well as modern pharmacological system. The species are good source of essential oils and aromatic compounds, culinary herbs, food preservatives and attractive fragrant/perfumery ornamentals, aromatherapy and to inhibit growth of microorganism (Simon et al., 1984; 1990). Extracts of plant are used in traditional medicines and have been shown to contain biological active constituents of insecticidal, nematocidal, fungistatic and antimicrobial importance.

Ocimum africanum Lour. (syn. *Ocimum citriodorum* Vis.); commonly known as lemon

basil, hoary basil or Lao basil, is a hybrid between *Ocimum basilicum* (sweet basil) and *Ocimum americanum* (American basil). It is a native of northeastern Africa and South Asia and further recorded as an invasive species in many countries including India and Ecuador. It was recorded earlier in the country in southern peninsula and Northeast India. However, the wild occurrence of *Ocimum africanum* as natural hybrid in different phyto-geographical zones of Odisha forms a new distributional record for the flora of Odisha and Central India.

MATERIALS AND METHODS

During the exploration mission for germplasm collection of medicinal and aromatic plants and other crops in parts of Odisha and Northeast India during the period 2011 to 2021, the first author observed the natural occurrence of one uncommon wild relative of *Ocimum* species in Odisha and Northeast India (Fig. 1-3). A total number of 14 germplasm accessions of this species were collected from different phyto-geographical zones of Odisha, Tripura and Manipur (Table 1). The seed germplasm bearing respective accession number were collected from the field and conserved in the National Gene Bank, NBPGR, New Delhi for long



Fig. 1. *O. africanum* in wild habitat in Dhenkanal district, Odisha

term storage. Further, the seeds were multiplied and live plants were characterized in experimental plots of NBPGR, Base Center, Cuttack for morphological and biochemical traits. The plant specimens bearing both vegetative and flowering parts were deposited in the herbarium of NBPGR base center, Cuttack, Odisha along with one set at the National Herbarium of Cultivated plants (NHCP), NBPGR New Delhi. The live plants and the herbarium specimens were critically studied and the morphological features of the plant were examined using the trinocular lens and dissection microscope and the distinctive characters were recorded. The collected specimens were also compared with the images of the authentic herbarium type specimens (K000911679, K000011682) deposited at the Royal Botanical Garden, Kew, London to confirm the identity of the plant. The photographs of the vegetative, flowering/ fruiting stage and seeds along with the associated species in the natural habitat were taken for reference and future use. Besides, information on biochemical analysis of essential oil of leaves and fatty acid composition of seed oil of this species was incorporated from the investigations made at the Division of Germplasm Evaluation, ICAR-NBPGR, New Delhi (Raina and Misra, 2018; Raina and Misra, 2020).



Fig. 2. Natural occurrence of *O. africanum* in Bishnupur district, Manipur



Fig. 3. Natural occurrence of *O. africanum* in Gomati district, Tripura

Table 1. Specimen examined and seed germplasm of *Ocimum africanum* (*syn. O. citriodorum*) collected and conserved

Site	Collection No.	IC No.	Date of collection	Source	Site of collection					
					Village	Block	District	State	Latitude	Longitude
1	RCM/GD/02	589183	28.03.2011	Disturbed wild	Gabapadar	Khallikote	Ganjam	Odisha	19° 44'	85° 12'
2	RCM/PM-MS/07	624514	30.11.2012	Disturbed wild	Nityabazar	Killa	Gomati	Tripura	23° 34'	91° 34'
3	RCM/GD/98	599313	14.03.2013	Disturbed wild	Kukuprasad	Dasapalla	Nayagarh	Odisha	20° 20'	84° 49'
4	RCM/GD/107	599322	15.03.2013	Natural wild	Sidhamula	Gania	Nayagarh	Odisha	20° 23'	85° 06'
5	RCM/GD/109	599324	5.03.2013	Natural wild	Ekdal	Gania	Nayagarh	Odisha	20° 25'	85° 07'
6	RCM/GD/125	599338	17.03.2013	Wasteland	Ghantapada	Narsinghpur	Cuttack	Odisha	20° 29'	85° 03'
7	RCM/GD/127	599340	7.03.2013	Wasteland	Champeswar	Narsinghpur	Cuttack	Odisha	20° 26'	85° 09'
8	RCM/GD/139	599352	20.03.2013	Disturbed wild	Dandimal	Odopada	Dhenkanal	Odisha	20° 42'	85° 31'
9	RCM/GD/141	599354	20.03.2013	Disturbed wild	Balaram prasad	Odopada	Dhenkanal	Odisha	20° 46'	85° 24'
10	RCM/GD/144	599357	20.03.2013	Wasteland	Gaudakatani	Hindol	Dhenkanal	Odisha	20° 47'	85° 22'
11	RCM/GD/147	599360	20.03.2013	Disturbed wild	Gahama	Kaniha	Angul	Odisha	21° 07'	85° 09'
12	RCM/GD/159	599372	22.03.2013	Disturbed wild	Bariapur	Parjang	Dhenkanal	Odisha	20° 56'	85° 21'
13	RCM/PM/MS/31	626384	14.11.2013	Wasteland	Maibam Chingning	Nambol	Bishnupur	Manipur	24° 42'	93° 49'
14	RCM/PK/19/83	635064	26.12.2019	Disturbed wild	Chakratirtha	Anandpur	Keonjhar	Odisha	21° 16'	86° 15'

RESULTS AND DISCUSSION

On critical examination of the vegetative and floral characters of live plants grown at the experimental plots of the center coupled with study on herbarium specimens and perusal of literature, the species was identified as *Ocimum africanum* Lour. The plants grow gregariously in disturbed areas such as waste lands, fallow, open scrub lands etc. in natural habitat and its occurrence was recorded at different locations of Odisha, Tripura and Manipur (Fig. 1- 3). However, some records were available in which it was reported to be cultivated or run wild in India in few states of southern peninsula and Assam without mentioning the specific locality of occurrence (Drury, 1866;

Gamble, 1925; Matthew, 1982; Henry et al., 1987; Pullaiah et al., 2011; Sasidharan, 2011; Suddee et al., 2005; Kumar, 2019). On verification of major published Indian literature, it was found that it has not been reported till date in wild condition from Central India including Odisha (Haines, 1922; Saxena and Brahman, 1995; Mudgal et al., 1997; Singh et al., 2001; Singh and Karthikeyan, 2000). Therefore, the present collection counts an addition of species to the flora of Odisha and forms a new distributional record for Central India. A detailed taxonomic description on morphology of different parts, field photographs and ethno-botanical uses were provided for easy identification and sustainable utilization (Fig. 4 - 8).



Fig. 4. *O. africanum* maintained in experimental plot, NBPGR Regional Station, Cuttack



Fig. 5. Flowering twig of *O. africanum*



Fig. 6. Leaves of *O. africanum*



Fig. 7. Flowers of *O. africanum*



Fig. 8. Seeds of *O. africanum*

Taxonomic account

Ocimum africanum Lour., Fl. Cochinch. 370. 1790. *O. americanum* var. *pilosum* (Willd.) A.J.Paton, Kew Bull. 47:426. 1992; *Ocimum basilicum* var. *anisatum* Benth. Labiat. Gen. Spec.: 4. 1832; *Ocimum citriodorum* Vis. Index Seminum (PAD, Patavium) 1840: 9. (1840); *Ocimum graveolens* A.Br. Flora 24: 265. 1841; *Ocimum petitianum* A.Rich. Tent. Fl. Abyss. 2:176. 1850; *Ocimum pilosum* Willd. Enum. Pl.: 629. 1809.

Perennial aromatic herb or under shrub up to 90 cm high; stem and branches erect, 4-angled, hairy, woody at base, sometimes grooved, primary branches 12-22; young shoot densely hairy, apical nodes and petioles pilose with long spreading and sometimes retrorse hairs. Leaves simple, opposite decussate, ovate or elliptic-lanceolate, 3.5 to 6.0 cm including petiole; lamina 2.5 to 5.0 × 1.5-3.0 cm; petiole 0.8 - 1.5 cm long, hairy; leaf base acute to decurrent, margin entire or distantly sparingly serrate, apex acute; lower surface glandular-punctate, hairy on nerves beneath with long spreading hairs on midrib and lateral veins, upper surface glabrous or puberulous; strongly lemon-scented. Inflorescence lax, verticels 5 - 15 mm apart, distance reduces towards apex, axis densely pubescent with sometimes retrorse hairs; bracts ovate to obovate, sessile, 3-5 mm long; apex acute to acuminate, base attenuate, margin pilose, glandular punctate; pedicels recurved, 1- 2.5 mm long, shorter than calyx, finely patent-pubescent;

spikes 10 - 25 cm long, flower whorls 10-18 per spike. Flowers small, verticillate, 6 in a whorl, in terminal, elongated 3- chotomous racemes. Calyx campanulate, 2-lipped, 1.5 - 3.0 mm long at anthesis, 4.0 - 6.0 mm long in fruit; anterior lip 4- toothed with two median teeth lanceolate, acuminate, move upwards slightly longer than posterior and laterals; lateral teeth more or less deltoid, acute, almost equal to posterior; posterior lip reflexed, broad, rounded, decurrent on calyx tube, apparently accrescent, sometimes apiculate at apex; calyx tube densely hairy, with a ring of dense villous hairs on throat; throat open, with or without sessile glands outside. Corolla campanulate, white, 2- lipped, 5- 8 mm long including corolla tube, truncate, upper lip truncate, 5-6 mm long, 4- lobed; lobes not equal, ovate- obovate; lower lip boat- shaped, elliptic-oblong, up to 8 mm long; tube straight, glabrous on both sides. Stamens -4, declinate, in two pairs, exserted, posterior pair with a glabrous transverse process near base; anther cells confluent, filaments free; style thinly 2- fid. Nutlets ovoid - oblong, minutely tuberculate, black, 1 - 1.5 mm long, produce mucilage when wet. Essential oil is light yellow with strong odour of lemon. Flowering and fruiting: December-January.

Distribution

It is primarily a native to tropical and subtropical old world, northeastern Africa and southern Asia such as Malaysia, Philippines, Indonesia, Papua New Guinea, Laos, Thailand, Vietnam, Madagascar, Ethiopia, Angola etc. and further spread as an invasive species in many countries including India and Ecuador. In India, it was recorded earlier in southern peninsula and Northeast India.

Habitat and ecology

The species was naturally growing in disturbed habitats on different landscapes among the weeds in wastelands, fallow and open scrublands interspersed with herbs, shrubs and grasses. A total of 14 acc were recorded from different locations of phyto-geographical zones of Odisha, Tripura and Manipur. The species is comparatively hardy, prefers direct sunlight and propagated through seeds and even from stem cuttings.

Specimens examined and germplasm collected and conserved

Fourteen germplasm accessions of *Ocimum africanum* were explored from different landscapes of Odisha, Tripura and Manipur and information on the sites of specimen collection and germplasm conservation were provided in Table 1.

Ethno-botanical uses

The local inhabitants of Kandha, Bhuyan and Gond tribes of Dasapalla and Gania blocks of Nayagarh district named this species as “*Lembu Tulasi*” and use the juice of fresh leaves along with honey in empty stomach for curing cold, cough and bronchial asthma, especially in children. The half-burnt leaves and the leaf-smoke is diffused in the huts/ cowsheds to ward-off insects and mosquitoes particularly during rainy season, as reported by tribes such as Shabar and Gonda of Parjang, Odopada and Kaniha blocks of Dhenkanal and Anugul districts. The Saura tribe of Ganjam and Kolha and Bathudi tribe of Anandpur, Keonjhar district use the leaf powder on hairs of body surface to remove the lice of dogs and cocks. Besides, the local inhabitants of Tripura and Manipur consume raw leaves with vegetable/ fruit salad and also in curry and fresh chili pickles. The leaves are also steeped in boiled water to make herbal lemon tea.

In Laos, the lemon basil is the key-ingredient in curries, stews and stir-fried dishes. In Indonesia, it is often eaten raw with salad or *lalap* (raw vegetables) and also to season certain dishes, such as curries, soup, stew and steamed dishes. In Cambodia and Thailand, the nutlets, which produce mucilage when wet, are used for making soup or sweet desserts. The fresh leaves are the main side dish for the traditional Thai rice noodle dish called ‘Khanom Chean’.

Biochemical analysis of essential oil

The essential oil profiling of leaves of *Ocimum africanum* exhibited a total of forty-four compounds constituting 95.2–99.9% of total oil (Raina and Misra, 2018). Among these, oxygenated monoterpenes (33.5–86.8%) were most predominant, followed by phenylpropanoids

(1.1–56.2%), sesquiterpene hydrocarbons (3.7–14.6%), oxygenated sesquiterpenes (0.8–2.3%) and monoterpene hydrocarbons (0.1–0.3%). Based on essential oil composition, this species showed two prominent chemotypes represented by geranial/neral and methyl chavicol-rich types. Geranial/neral-rich chemotype (IC-599354) showed substantially high content of geranial (42.2%) and neral (28.8%), which was detected only in *O. africanum*. Methyl chavicol-rich chemotypes were represented by IC-599325 with methyl chavicol content of 55.5%, followed by IC599357 (33.0%). Other common aroma compounds identified in both chemotypes were linalool (5.5–12.2%), nerol (1.8–3.5%), geraniol (1.6–2.0%), (*Z*)- α -bisabolene (1.7–8.2%), *trans*- α -bergamotene (0.7–2.0%) and caryophyllene oxide (0.3–1.6%). Earlier studies have also reported citral and methyl chavicol-rich chemotypes in *O. africanum* germplasm (Vieira and Simon, 2006). In addition, analysis of fatty acid composition of seed oil exhibits high linolenic acid content (66.82 - 72.95%) and chemotypes with highest content in *O. africanum* (Raina and Misra, 2020).

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