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Variability in turmeric as sources of secondary metabolites

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Abstract
The biodiversity is boon to ensure natural sustainability of different plant species. The *Curcuma* is one of the important genera having medicinal importance. In the world nearly 100 different species of turmeric are observed out of which 40 are found in India. The species like *C. aeruginosa, C. amada, C. anguistifolia, C. aromatic (Wild turmeric), C. caesia (black turmeric), C. longa, C. vamana and C. zedoaria* are economically important. The different *Curcuma* species having important compounds which plays important roleas anti-inflammatory, wound healing, anti-melanogenic, antioxidant and free radical scavenging activity, anti-tumor, anti-cancer, anti-repellent, antitussive, anti-platelet activity and anti-nephrotoxic activity. Hence, there is wide scope for exploitation of secondary metabolites by preserving biodiversity of *Curcuma sp* in India.

Keywords: Variability, turmeric, secondary metabolites

Introduction
The biodiversity in the 21st century gaining importance in the universe due to its direct as well as indirect benefits provided by it. The biodiversity is mainly having importance in health care and secondary metabolites present in different species. The new genetic material and it's ingredients may help to fight against the different pandemic diseases like COVID -19. Hence it is becoming necessity of today's life and not a luxury. The term biodiversity is mostly used to describe the number, variety, and variability of living organisms.
The turmeric (*Curcuma* sp) is an important spice crop of India known as the golden spice. It is the fourth most important spice crop after cardamom, black pepper and ginger. India is the traditional producer consumer and exporter of the turmeric and holds major share in the world market. The turmeric contains yellow coloured natural phenol known as Curcumin which is having medicinal value as it contains almost no calories and zero cholesterol. It is mainly used in pharmaceutical and cosmetic industries. It is also used as colorant to food.
The turmeric is native to South East Asia, southern China, the Indian Subcontinent, New Guinea and northern Australia. Some species are reportedly naturalized in other warm parts of the world such as tropical Africa, Central America, Florida and various islands of the Pacific, Indian and Atlantic Oceans. In the world nearly 100 different species of turmeric are observed out of which 40 are found in India. It is cultivated mainly in South East Asia especially Pakistan, Bangladesh, Burma, China, Indonesia, Myanmar, Nigeria, Sri Lanka, Taiwan etc. In India it is grown in almost each state but in isolated areas. However, Telangana, Andhra Pradesh, Maharashtra, Orissa, Tamil Nadu, Karnataka, West Bengal and Assam as well as North East states of India are major stakeholders in India. Among these States Telangana contributes more than 20% in area and production in India. The area under turmeric is 2.30 lakh ha. with annual production of 11.89 lakh MT (Anonymous, 2019) [1].
Scientifically the *Curcuma sp* is classified as follows

Table 1: USDA National Resources Conservation Service

Kingdom	:	**Plantae**
Sub-kingdom	:	Tracheobionta
Superdivision	:	Spermatophyta
Division	:	Magnoliophyta
Class	:	Liliopsida
Subclass	:	Zingiberidae
Order	:	Zingiberales
Family	:	Zingiberaceae
Genus	:	*Curcuma*

The species like *C. aeruginosa, C. amada, C. anguistifolia, C. aromatic (Wild turmeric), C. caesia (black turmeric), C. longa, C. vamana and C. zedoaria*are economically important. However, the species like *C. coriacea, C. decipiens, C. ecalcarata, C. ferruginea, C. haritha, C. inodora, C. karnatakensis, C. kudagensis, C. longiflora, C. neilgherrensis, C. pseudomontana, C. purpurea, C. raktakanta, C. rubrobractata and C. thalakaveriensis*are mostly native to southern India. The other species *viz., C. albicoma, C. albiflora, C. alismatifolia (Siam tulip), (mango-ginger), C. amarissima, C. attenuata, C. aurantiaca, C. australasica, C. bakeriana, C. bicolor, C. bhatii,C. burtti, C. ceratotheca, C. chuanezhu, C. huanhuangjiang, C. chuanyujin, C. cochinchinensis, C. codonantha, C. coerulea, C. colorata, C. comosa, C. euchroma, C. ecomata, C. elata, C. exigua,, C. flaviflora, C. glans, C. gracillima, C. grandiflora, C. harmandii, C. heyneana,, C. kwangsiensis, C. lanceolata, C. larsenii, C. latifolia, C. leonidii, C. leucorrhiza, C. loerzingii, C. longispica, C. malabarica, C. meraukensis, C. mutabilis, C. nilamburensis, C. oligantha, C. ornata, C. parviflora, C. parvula, C. peethapushpa, C. petiolata, C. phaeocaulis, C. pierreana, C. plicata, C. porphyrotaenia, C. prakasha, C. purpurascens,, C. reclinata, C. rhabdota, C. rhomba, C. roscoeana, C. rubescens, C.saraburiensis, C. sattayasaii, C. sichuanensis, C. sattayasaii, C. sichuanensis, C. singularis, C. sparganiifolia, C. stenochila, C. strobilifera, C. sulcata, C. sumatrana, C. sylvatica,, C. thorelii, C. tongii, C. trichosantha, C. vellanikkarensis, C. wenyujin, C. wenchowensis, C. xanthella, C. yunnanensis,C. zanthorrhiz*having huge diversity and getting popularity due to use of these species inextraction of secondary metabolites. [Velayudhan *et al.* (1999) [15]; Shiva *et al.* (2003) [16]] The *Curcuma* is mainly tropical in nature which is cultivated in temeprature ranging from 11 to 40^{0}C with warm and humid climate for commerical growth and developemnt. The mainly species under commercial cultivation is *Curcuma longa*.

***Curcuma longa* L.**

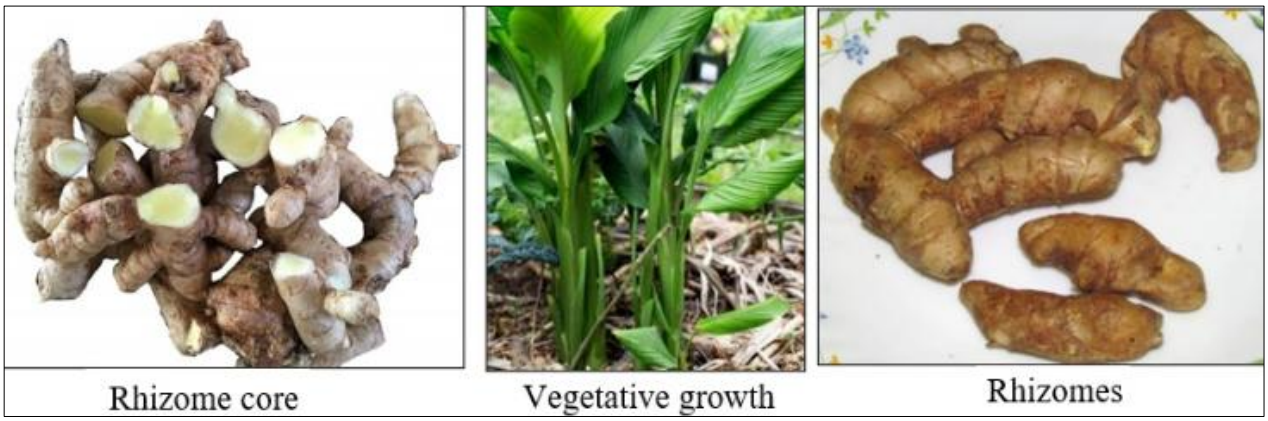
It is mainly grown for its curcumin as well as spice. It contains protein (6.3%), fat (5.1%), minerals (3.5%), carbohydrates (69.4%) and moisture (13.1%). The essential oil (5.8%) which is obtained by steam distillation of rhizomes (Kapoor, 1990) [8] Curcumin (diferuloylmethane) (3–4%) is responsible for the yellow colour to rhizomes, and comprises curcumin I (94%), curcumin II (6%) and curcumin III (0.3%) (Ruby *et al.*, 1995) [14]. It has significant medicinal potential. It is used in the cure for leoprosy, intermitted fever, infections of liver, dropsy, purulent ophthalmia fevers, affections, wound healing, tumours, and indolent ulcers. It is used for treatment of snake bites and as antitumor. Turmeric also demonstrated antifungal properties. It has been reported to possess anti-inflammatory, hepatoprotective, antitumor, antiviral activities and anticancer activity. (Bhutia and Sharangi, 2017) [3]. Several varieties of this *Curcuma longa* are evolved and under commercial cultivation.

Table 2: Variety Mean Yield fresh t/ha Duration (days) Dry recovery (%) Curcumin (%) Oleoresin (%)

Sr. No.	Variety	Mean Yield fresh t/ha	Duration (days)	Dry recovery (%)	Curcumin (%)	Oleoresin (%)	Essential oil (%)
1	Suvarna	17.4	200	20.0	4.3	13.5	7.0
2	Suguna	29.3	190	12.0	7.3	13.5	6.0
3	Sudarsana	28.8	190	12.0	5.3	15.0	7.0
4	IISR Prabha	37.5	195	19.5	6.5	15.0	6.5
5	IISR Prathibha	39.1	188	18.5	6.2	16.2	6.2
6	IISR Allepy Supreme	35.4	210	19.3	6.0	16.0	4.0
7	IISR Kedaram	34.5	210	18.9	5.5	13.6	3.0
8	CO-1	30.0	285	19.5	3.2	6.7	3.2
9	BSR-1	30.7	285	20.5	4.2	4.0	3.7
10	Krishna	29.2	240	16.4	2.8	3.8	2.0
11	PhuleSwarupa	37.5	240	22.0	5.14	-	-
12	Sugandham	15.0	210	23.3	3.1	11.0	2.7
13	Roma	20.7	250	31.0	9.3	13.2	4.2
14	Suroma	20.0	255	26.0	9.3	13.1	4.4
15	Ranga	29.0	250	24.8	6.3	13.5	4.4
16	Rasmi	31.3	240	23.0	6.4	13.4	4.4
17	Rajendra Sonia	42.0	225	18.0	8.4	-	5.0
18	IISR Pragati	38.0	180	15.95	5.02	15.29	6.3
19	Lakadong	25.36	240	20.0	7.5	14	7.8

***Curcuma amada* Roxb.**

It is cultivated for its edible rhizomes which flavors resemble to green mango. It is mainly used in the preparation of pickles, curries, chutneys etc. and in traditional as well as tribal medicines. It is used in external application, including rheumatism, sprains, and bruises (Watt, 1889) [18]. The extract from the rhizomes lowers the cholesterol level of experimentally induced hypercholesterolemic rabbits (Pachauri and Mukherjee, 1970) [10]. The extract from rhizomes is used against infectious skin diseases and control of *Aspergillus niger* (Gupta and Banerjee, 1972) [5].



***Curcuma caesia* Roxb.**

It is native to North East India, also observed in bastar region of Chhattisgarh. The rhizomes are dark blue in colour commonly called as black turmeric. The leaves have a deep red-violet patch along the midrib. The rhizome paste is used to cure blood dysentery and as poultice in rheumatic pain, the leaves are used as a packaging material and dry leaves as fuel in Bangladesh (Yusuf *et al.*, 2002) [19]. In this species 30 different components were identified representing 97.48% of the oil, with camphor (28.3%), ar-turmerone (12.3%), (z) - cymene (8.2%), arcurcumene (6.8%), 1-8 cineole (5.3%), elemene (4.8%), borneol (4.4%), bornyl acetate (3.3%) and curcumene (2.82%) as the major constituents. (Arulmozhi *et al.*, 2006) [2]

Curcuma caesia

***Curcuma aromatica* Salisb.**

It is mainly native to Tropical region of Asia. The rhizomes are having warm and aromatic taste. It is having an anti-inflamatory effect when the rhizome is applied to bruises and sprains (Jangde *et al.*, 1998) [7]. It is also used as stimulant, tonic and carminative, and is useful for curing leucoderma and blood diseases. It contains β-curcumene, arcurcumene, xanthorrhizol, germacrone, camphor, and curzerenone Kojima *et al.* (1998) [9]. Bordoloi *et al.* (1999) [4] reported camphor, curzerenone, α-turmerone, ar-turmerone and 1,8-cineole are the major components in this species.

Curcuma aromatica

***Curcuma ecalcarata* L.**

It is endemic species found in southern ghats of India. Rameshkumar *et al.* (2015) identified diarylheptanoid trans, trans-1,7-diphenyl-5-hydroxy-4,6-heptadiene-3-one, steroid β-sitosterol, flavanone pinocembrin and monoterpenoidspiperitenone and 8-hydroxy piperitone. This species is rich source of the flavanone pinocembrin (0.37% dry wt.) and the volatile aroma compound piperitenone (62.5%).

***Curcuma ecalcarata* L.**

***Curcuma haritha* Mangaly and M. Sabu**

It is also endemic species found in southern ghats of India. It is more active against fungal and bacterial strains. The oil

obtained from leaves of the species contains forty one constituents representing the 97% analysed of oil. It contains Curdione (18.3%), 1,8-cineole (11.8%), camphor (11.8%), furanogermenone (8.6%) and furanodiene (8.9%) as the major constituents in C. haritha leaf oil (Raj *et al.*, 2013) [11].

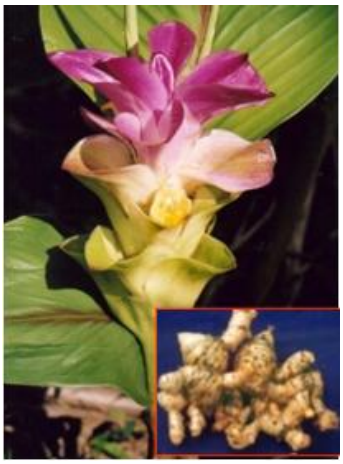
***Curcuma haritha* Mangaly**

***Curcuma pseudomontana* J. Graham**

It is endemic to Karnataka, Kerala, and Andra Pradesh of peninsular India especially in the Western and Eastern Ghats (Tyagi, 2005) [17]. It is occurred in the Maharashtra and mainly used during the *Ganesh* festival for worshiping the goddess *Gauri*. Hence it is also known as *Gauri'sphool*locally (Ravindran *et. al.*, 2007) [13]. It is a highly variable seed-setting species with attractive well-developed coma and deep yellow flowers.This species is having as potential of ornamental species. The plant develops big tuber which are boiled and eaten during famine in scarcity of grains. The powder is prepared from rhizomes and powder contains the steroid, tannin, alkaloid and flavonoid alongwith starch and protein (Hiremath and Kaliwal, 2014) [6]

***Curcuma zedoaria* Roscoe**

It is mainly observed in India and Bangladesh and cultivated in Asian countries. The oil produced from dried rhizomes is used in perfumery and soap industry, as well as an ingredient in bitter tonics. The curcuminoid 1, 7-bis (4-hydroxyphenyl)-1, 4, 6heptatrien-3-one, and sesquiterpenes pro-curcumenol and epiprocurcumenol can be found in *C. zedoaria* (Jang *et al.*, 2001). The fresh rhizomes useful against inflammation of intestines, purges the kidneys, cures gonorrhea, blood purifier and juice of leaves is use as laxative Rheede (1692).



Curcuma zedoaria

Conclusion and Future line of work

The different *Curcuma sp*. is having pharmacology potential as it contains several known and unknown secondary metabolites. These compounds are playing important role as anti-inflammatory, wound healing, anti-melanogenic, antioxidant and free radical scavenging activity, anti-tumor, anti-cancer, anti-repellent, antitussive, anti-platelet activity and anti-nephrotoxic activity. Hence, there is wide scope for exploitation of secondary metabolites by preserving biodiversity of *Curcuma sp* in India.

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