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Promising *Curcuma* species suitable for hill regions towards maintaining biodiversity

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Abstract

Biodiversity refers to the variability among living organisms and diversity within species, between species and of their ecosystem. Turmeric, considered as the Golden Spice of the world has considerable biodiversity including innumerable medicinal values. India occupies the first position in area and production of turmeric. Several species of *Curcuma* which are mostly grown in high elevations include *Curcuma caesia*, *Curcuma rubescens*, *Curcuma amada*, *Curcuma leucorrhiza*, *Curcuma montana*, *Curcuma aromatica*, *Curcuma zedoaria*, *Curcuma angustifolia*, *Curcuma pseudomontana*, *Curcuma longa* etc. Turmeric contains protein, fat, minerals, carbohydrates and moisture. The essential oil obtained by steam distillation of rhizomes Curcumin is responsible for the yellow colour, and comprises curcumin I (94%), curcumin II (6%) and curcumin III (0.3%). Turmeric has attracted much attention due to its significant medicinal potential. It is used in the cure for leprosy, 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. The *Curcuma* sp. which are grown in temperature ranging from 11-40°C which are also suitable from the hilly area for their growth and development as the region receives a well distributed rainfall during the growing season and also the sloppy well drained land with good organic matter content. Hence, there is a suitability of *Curcuma* species for their biodiversity and conservation in the hilly regions for the exploitation of yield and also used for various medicinal purpose.

Keywords: *Curcuma* sp, biodiversity, medicinal properties, hilly regions

Introduction

Biodiversity or Biological diversity refers to the variability among living organisms which includes diversity within species, between species and of their ecosystem (Biodiversity Convention, Rio de Janeiro June 1992). Most of the world's biodiversity is concentrated in the tropical and subtropical forests. The warm temperatures and high humidity levels in the tropics are conducive to greater survival rates than are the harsh temperatures in the winter in the temperate regions. Special features such as dormancy, hibernation, or migration are required to survive or escape the harsh winter conditions. Such adaptations are normally difficult to achieve. This led to a decrease in the overall number of species in the temperate regions, as compared to the tropical regions. Of the 18 biodiversity hot spots of the world 2 of them belongs to India. Western Ghat and Eastern Himalayas are the hot spots of biodiversity in India. Conservation of biodiversity is the planning and management of biological resources in a way so as to secure their wide use and continuous supply, maintaining their quality, value and diversity. Human race cannot exist without biodiversity whereas the biodiversity can exist without human race. Therefore, biodiversity has to be conserved for the long term benefit and well-being of the biosphere, including the human race.

India is popularly known as the "Spice Bowl of the World" as a wide variety of spices with premium quality is grown in the country since ancient times. But among all those ancient spices, one which is virtually associated and intertwined with all individuals in issues related to food as well as life, so far as aroma, taste, flavor, colour, society, religion, economy, ecology and emotion is concerned, is turmeric. Turmeric (*Curcuma* sp) is a plant of the family Zingiberaceae which comprises of about 70 species (Smart & Simmonds, 1992) [1]. It not only adds golden grace but also considered as the Golden Spice and grown almost all over the world especially in India, Bangladesh, Burma, China, Indonesia, Myanmar, Nigeria, Pakistan, Sri Lanka, Taiwan, etc. Among these countries, India occupies the first position in area (2, 22, 000 ha) and in production (11, 32, 000 MT) (Anonymous 2017a) [2]. Several species of *Curcuma* growing in various altitudes ranging from sea level to very high elevations (Dymock *et al.* 1980, Gamble 1935) [3, 4]. Many species of the genus *Curcuma* viz.,

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Curcuma caesia, *Curcuma rubescens* *Curcuma amada*, *Curcuma leucorrhiza*, *Curcuma Montana*, *Curcuma aromatica*, *Curcuma zedoaria*, *Curcuma angustifolia*, *Curcuma pseudomontana*, *Curcuma longa* etc are there with huge diversity and enormous medicinal usage. They are principally tropical in nature, requiring hot and moist climate with a temperature ranging from 11°C to 40°C for proper growth and development. Most of them are very much sensitive to low temperature, grown as unirrigated crop in heavy rainfall area and as irrigated crop in moderate rainfall area. The crop requires well drained, loose and friable loamy or alluvial soil. Heavy black or clayey soils are unsuitable as rhizome development is not proper. It cannot stand in water logged or alkaline soil.

Turmeric contains protein (6.3%), fat (5.1%), minerals (3.5%), carbohydrates (69.4%) and moisture (13.1%). The essential oil (5.8%) obtained by steam distillation of rhizomes (Kapoor, 1990) [5] Curcumin (diferuloylmethane) (3–4%) is responsible for the yellow colour, and comprises curcumin I (94%), curcumin II (6%) and curcumin III (0.3%) (Ruby *et al.*, 1995) [6]. Due to the lack of a comprehensive taxonomic revision, there is still little consensus on the number of species that should be recognized. Turmeric has attracted much attention due to its significant medicinal potential (Cousins *et al.*, 2007) [7]. It is used in the cure for leprosy, intermitted fever, infections of the liver, dropsy, purulent ophthalmia fevers, affections, wound healing, tumours, and indolent ulcers. It is known to, irreversibly inhibit HIV 1 protease (Mazumder *et al.*, 1995) [8] and enhance biological activity. (Khanna, 1999) [9]. It can be a potent anticancer agent. (Bhavani Shankar and Murthy, 1978) [10]. Turmeric oil is composed of several monoterpene and sesquiterpene compounds such as zingiberene, aromatic-turmerone and turmerone (10. Apisariyakul *et al.*, 1995) [11]. The main biological activities of the oil are carminative, antifatulence, antifungal and as an anti-platelet agent (Lee, 2006) [12]. Turmeric has been used in traditional medicine as a household remedy for various diseases, including biliary disorders, anorexia, cough, diabetic wounds, hepatic disorders, rheumatism and sinusitis (Ammon *et al.*, 1992) [13]. In old Hindu medicine, it is extensively used for the treatment of sprains and swelling caused by injury (Ammon and Wahl, 1991) [14]. In addition to helping cure some common diseases, turmeric also showed some medicinal properties for the treatment of snake bites (Ratanabanangkoon *et al.*, 1993) [15] and as antitumor (Baatout *et al.*, 2004) [16]. Turmeric also demonstrated antifungal properties (Afaq *et al.*, 2002) [17]. It has been reported to possess anti-inflammatory, hepatoprotective, antitumor, antiviral activities (Ammon and Wahl, 1991) [13] and anticancer activity (Polasa *et al.*, 1991) [18]. The World Health Organization has recommended the use of this spice (Vavilova, 1990) [19].

Curcuma caesia

Curcuma caesia (black turmeric) is a perennial herb with bluish-black rhizome (Syamkumar and Sasikumar, 2007) [20] native to North-East and Central India (Ravindran *et al.*, 2007) [21]. Black turmeric is also sparsely found in the Papi Hills of East Godavari, West Godavari, and the Khammam districts of Andhra Pradesh. The plant is normally erect with height ranging from 0.5 to 1.0 m. It is divided into underground large ovoid tuberous rhizome often called rootstock and an erect aerial shoot along with leaves and reproductive part. Rhizome is the major means of propagation for *Curcuma caesia*. The sessile rhizomes are

about 2–6 cm in diameter, of varied shape and size, tuberous, laterally flattened, covered with adventitious roots and with camphoraceous sweet odour. It shows longitudinal circular wrinkles on the surface giving the look of nodal and intermodal zones to the rhizomes. The surface (cork) of rhizome is dark brown, bluish black, or buff in colour. The branching is more or less sympodial. The leaves are usually present in the groups of 10–20; each leaf is broad oblong lanceolate and glabrous. A deep farruginous purple colour is present in the middle region of the lamina. The petiole is ivory in colour and ensheathing the petiole encircle each other forming pseudoxis. The variation is parallel in nature. Inflorescence is 15–20 cm long dense spike with green bracts. Flowers are pale yellow colour with reddish border. Calyx is 10–15 mm long, obtuse and three toothed. Corolla is long tubular, pale yellow three lobed semi-elliptic lobe.

Curcuma caesia resulted in the identification of 30 components, representing 97.48% of the oil, with camphor (28.3%), ar-turmerone (12.3%), (z) - cymene (8.2%), ar-curcumene (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. The rhizome of black turmeric has a high economic importance owing to its putative medicinal properties. The rhizome of the plant is used in Kali Puja in West Bengal, and hence the plant is called *Kali haldi*. By etymology, Kali is the feminine form of Kala, which means black color and hence it is so named. This species has been regarded as endangered by the central forest department of India due to biopiracy. The rhizomes are used as a rubeficient to rub the body after taking a Turkish bath and also used for treatment of smooth muscle relaxant activity (Arulmozhi *et al.*, 2006) [22], against haemorrhoids, leprosy, asthma, cancer, epilepsy, fever, wound, vomiting, menstrual disorder, gonorrhoeal discharges with various properties viz., anthelmintic, aphrodisiac, inflammatory, etc (Sasikumar, 2005) [23]. Crushed rhizome paste is applied against cur or injury to control bleeding and quick healing (Trivedi, 2003) [24]. The rhizome *Curcuma caesia* is administered during inflammation of tonsils (Mia *et al.*, 2009) [25]. The roots of the *Curcuma caesia* are grounded into powder and used water to treat gastric disorder (Idrisi *et al.*, 2010) [26]. In Lohit district of Arunachal Pradesh, Kanti tribes apply fresh rhizome paste on snake and scorpion bites (Tag *et al.*, 2007) [27].

Curcuma leucorrhiza

Curcuma leucorrhiza, also known as hidden lilly or palo, is naturally distributed through the hilly areas of Orissa, West Bengal, Jharkhand and Chhatisgarh. It has got numerous pendulous tubers, oblong, inwardly pearl white. Leaves are broad, lanceolate, uniformly green, about two feet long and height of the plant ranges from 3 to 4 feet. Palo starch is isolated from palo tuber. Its rhizomes are good source of starch. The natives prepare many herbal dishes using the starch extracted from the rhizomes. In tribal belts of Chattishgarh and Orissa people prefer palo dishes in hot summer. It is believed that the Palo removes extra heat from the body and develops resistance against common diseases. It is used specially during observing fast as a part of ritual. In different parts of the state, many similar methods with slight variations of preparing Palo laddu are adopted. The dry fruits may also be added to make the preparation more delicious and nutritive. The habitant of remote forest areas collect the root from the fields and make starch powder at home but in urban areas the Palo (*Curcuma leucorrhiza*) powder is easily available in shops. The rhizomes of this very species of

Curcuma have also been extensively used as traditional medicines in Manipur, northeast India (Sinha, 1996) [28]. It is used as an anti-inflammatory and anti-asthmatic in Ayurvedic medicine and rhizomes are used in curing for enlarged liver and spleen, and ulcer in stomach in Shingbhum, Bihar (Pal and Srivastava, 1976) [29]. The rhizomes are used for enlarged liver and spleen, and ulcer in stomach. The essential oils obtained by hydro distillation from the leaves and rhizomes of *Curcuma leucorrhiza* Roxb were germacrone (9.6–19.7%), curdione (19.1–19.5%), camphor (7.2–8.1%), 1,8-cineole (4.0–7.4%), curzerene (3.0– 5.7%), linalool (5.2–5.4%), neo-curdione (2.8–4.6%), isoborneol (2.0–3.8%) and showed antimicrobial activity (Devi *et al.*, 2012) [30]. The antioxidant and antimicrobial activities of different solvent extracts of the rhizome of this plant against four human pathogenic bacterial strains and four plant pathogenic fungal strains were reported (Linthoingambi *et al.*, 2013) [31].

Curcuma pseudomontana

Curcuma pseudomontana, an erect herb, is endemic to Karnataka, Kerala, and Andhra Pradesh of peninsular India especially in the Western and Eastern Ghats (Tyagi 2005, Prakash and Screeeramulu, 1985, Mangaly and Sabu, 1987, 1993; Ram Rao *et al.*, 2006) [32-36]. It is grown upto 75 cm tall, found on moist, shaded areas of wet forests and also in higher altitudes along the western side of the Western Ghats (Mangaly and Sabu, 1987) [34]. It has stout rootstock bearing small almond like sub-globose tubers at the ends of the fibrous roots. The tubers are fleshy and white inside, aromatic. Leaves 3-5, oblong-lanceolate, 20-30 x 6-9 cm, base acute, tip sharp, margin entire, hairless; shiny; leaf stalk and the leaf sheath up to 20 cm long. Flowering spikes seen in the center of the previously formed tuft of leaves, 10-25 cm long, bearing numerous compactly arranged flowers. Flowering bracts are conspicuous, inverted, egg-shaped to lanceolate, 3-5 x 1.5-2 cm, apex rounded to acute, hairless, and green with pinkish tip. Non-flowering bracts (coma) oblong-lanceolate, conspicuous, purple below and pinkish-purple above. Flowering occurs in June-September. Flowers 2-4 in each fertile bract, bright yellow, 3 cm long and 4 cm broad. Capsules spherical, 3-valved and smooth. Seeds ovoid or oblong, usually covered with arils. *Curcuma pseudomontana* and *C. montana* share many common floral and vegetative characters and occur in similar habitats. The inflorescence of *C. pseudomontana* is lateral in the early part of the rainy season and terminal later in the season. The colour of the coma is variable within the species (Mangaly and Sabu, 1987) [34]. This species was reported to be common and abundant in the Western Ghats in the 1950s, however, the population has shrunk (by around 30 % in 10 years) due to habitat loss at an alarming rate and over-harvesting for the medical trade (Molur *et al.*, 1997) [37]. The species has also been rated as Vulnerable in Eastern Ghats (Andhra Pradesh) (Jhadav *et al.*, 2006) [38].

Curcuma is gaining importance world over as a potential source of new drugs to combat a variety of ailments as the species contain molecules credited with anti-inflammatory, hypocholesteremic, choleraic, antimicrobial, insect repellent, antirheumatic, antifibrotic, antivenomous, antiviral, antidiabetic, antihepatotoxic as well as anticancerous properties (Sasikumar, 2005) [23]. This species is used in arrowroot powder manufacturing and in local and tribal medicine (Ravindram *et al.*, 2007 [21], Sasikumar, 2005 [23]). The roots are boiled and eaten and said to be beneficial against leprosy, dysentery, cardiac diseases and general

debility (Tyagi, 2005) [32]. Behaviour analysis of rhizome powder showed the presence of steroid, tannin, alkaloid and flavonoid along with starch and protein (Hiremath and Kaliwal, 2014) [39]. The Savara tribes in the Eastern Ghats of Andhra Pradesh use tuber extracts to cure jaundice. Jatapu and Kaya tribes apply warm tuber paste to treat body swellings. Women of Jatapu and Savara tribes eat boiled tubers to increase lactation (Anonymous, 2017b) [40]. Khand tribes apply tuber paste on the head for cooling effect. The Kukus-Mukus eat fresh tubers for blood purification (Jagtap *et al.*, 2006) [41]. Warm tuber paste is applied on body swellings and leaves are used as meal plates (Ram Rao *et al.*, 2006) [36]. This species is also eaten as food during famines.

Curcuma zedoaria

Curcuma zedoaria is (known as white turmeric) is a perennial herb of Zingiberaceae. The plant is native to India and Indonesia but now naturalized in other places including the Florida, US. It grows abundantly in tropical and subtropical wet forest regions. The leaf shoots of the zedoary are long reaching upto one meter in height. The fragrant plant bears yellow flowers with red and green bracts with large and tuberous rhizome underground having numerous branches. The essential oil produced from the dried roots of *Curcuma zedoaria* is used in perfumery and soap fabrication, as well as an ingredient in bitter tonics. The curcuminoid 1, 7-bis (4-hydroxyphenyl)-1, 4, 6-heptatrien-3-one, and the sesquiterpenes pro-curcumenol and epiprocurcumenol can be found in *C. zedoaria* (Jang *et al.*, 2001) [42].

The rhizome of Zedoary is used extensively as a medicine. It is pungent and slightly aromatic with warming sensation. It improves blood circulation, acts as anti-contusion and improves menstrual flow. It helps in abdominal cramps, amenorrhea-abdominal pain and rheumatic pain. It also helps in pain and swelling associated with sprains. The bitter tincture of zedoary root is used to prevent disease recurrence and to treat ulcers. Aromatic, stimulant, useful in flatulent colic and debility of the digestive organs. It is active in dyspepsia, colic, vomiting, cough and menstrual disorders and also used as a restorative. The essential oil is an active ingredient in antibacterial preparations.

Curcuma angustifolia

Curcuma angustifolia is a perennial and flowering rhizomatous herb belonging to Zingiberaceae. It is popularly known as East Indian Arrowroot with many medicinal values. *Curcuma angustifolia* Roxb is endemic to India, found in North Western and Central Himalayas, Bihar, West Bengal and South India at a higher altitude. Leaves, also having smell and taste similar to turmeric (Bhavana *et al.*, 2011) [43], are simple, green, glabrous, and lanceolate, with entire margins. They appear in an opposite arrangement and are deciduous. They display fine parallel venation off of a central midrib. *C. angustifolia* is its strong rhizome, which can grow to be up to 1.5 m in length. The rhizome of this plant is the primary source of its nutritive and medicinal properties (Ravindran *et al.*, 2007) [21]. *C. angustifolia* uses its rhizome to reproduce asexually via vegetative propagation (Shukla *et al.*, 2007) [44]. Inflorescences are small, spiked, usually with 3-4, yellow, funnel-shaped flowers within tufts of pink terminal bracts (coma bracts). The bracts are boat-shaped and encase the entire perianth of the flower. The flowers of *C. angustifolia* have double anthers, a slender style, and a globular stigma. Flowers are usually seen at the

beginning of the monsoon (rainy) season from July to August before leaf initiation and plants continue to flower even after the leaves have fully developed (Ravindran *et al.*, 2007)^[21]. The calyx of the flower is usually one centimetre long and very hairy, with 3 lobes that may appear to be triangular or obtuse. The corolla is white, and usually grows to be about 1.5–2 cm long with hairy as well as glabrous lobes. Seeds are reddish-brown in color (Babu, 1977)^[45]. East Indian Arrowroot is having with many medicinal values and used against certain chronic diseases. It is particularly used during convalescence from fevers, in irritations of the alimentary canal, pulmonary organs, or of the urinary apparatus. For infants, it is suppld as a temporary alternative to breast-milk. It may be given in the form of jelly, variously seasoned with sugar, lemon-juice, fruit jellies, essences, or aromatics.

Curcuma amada

Curcuma amada Roxb is a unique spice which essentially imparts a raw mango flavour but having morphological resemblance with ginger (*Zingiber officinale*). It is, therefore, commonly known as mango ginger. The crop is a perennial, rhizomatous, aromatic herb (Aminul, 2004)^[46]. *C. amada* is found as wild in parts of West Bengal and is cultivated in Gujarat, Uttar Pradesh, Kerala, Karnataka, Tamil Nadu and the North-Eastern states. The genus originated in the Indo-Malayan region, and is widely distributed in the tropics of Asia to Africa and Australia (Sasikumar, 2005)^[23]. The plant grows to a height of 1 m. The leaves are long, oblong, lanceolate, radical, sheathed, petiolate and in tufts. Mango ginger rhizomes are fleshy, buff coloured, 5–10 cm long, 2–5 cm in diameter and demarcated into nodes and internodes. At the rhizome nodes scaly leaves are arranged circularly giving the appearance of growth rings with scars on the surface. The rhizomes are branched, and the branching is sympodial. The rhizomes emulate a raw mango flavour and taste pungent. The mango ginger rhizome was found to be a rich source of fibres and starch (Lakshminarayana *et al.*, 1963)^[47]. Mango ginger rhizome is used for the manufacture of pickles and culinary preparations. The major chemical components include starch, phenolic acids, volatile oils, curcuminoids and terpenoids like difurocumenonol, amadannulen and amadaldehyde.

Ayurveda and Unani medicinal systems have given much importance to mango ginger as an appetizer, alexteric, antipyretic, aphrodisiac, diuretic, emollient, expectorant and laxative and to cure biliousness, itching, skin diseases, bronchitis, asthma, hiccough and inflammation due to injuries. The biological activities of mango ginger include antioxidant activity, antibacterial activity, antifungal activity, anti-inflammatory activity, platelet aggregation inhibitory activity, cytotoxicity, antiallergic activity, hypotriglyceridemic activity, brine-shrimp lethal activity, enterokinase inhibitory activity, CNS depressant and analgesic activity.

Curcuma longa

Curcuma longa, a perennial herb which grows to a height of three to five feet, is cultivated extensively in Asia, India, China, and other countries with a tropical climate. It has oblong, pointed leaves and funnel-shaped yellow flowers. The rhizome, the portion of the plant used medicinally, is usually boiled, cleaned, and dried, yielding a yellow powder. Dried *Curcuma longa* is the source of the spice turmeric, the ingredient that gives curry powder its characteristic yellow color. It is used extensively in foods for both its flavor and color, as well as having a long tradition of use in the Chinese

and Ayurvedic systems of medicine. It has many therapeutic applications particularly as anti-inflammatory and for the treatment of flatulence, jaundice, menstrual difficulties, hematuria, hemorrhage, and colic disorders. It can also be applied topically in poultices to relieve pain and inflammation (Leung, 1980)^[48].

It is having antioxidant, hepatoprotective, anti-inflammatory, anticarcinogenic, and antimicrobial properties which is exploited to prevent cardiovascular disease and gastrointestinal disorders. It is one of the key ingredients in many Asian dishes. Indian traditional medicine, called Siddha, has recommended turmeric for medicine. Its use as a coloring agent is not of primary value in South Asian cuisine. Turmeric is mostly used in savory dishes, but is used in some sweet dishes, such as the cake *sfouf*. As the leaves impart a distinctive flavor, in many Southern states of India, they are used to cook many foods by covering with this leaf and also to prepare special sweet dishes, *patoleo*, by layering rice flour and coconut-jaggery mixture on the leaf, then closing and steaming it in a special copper steamer. It is used in canned beverages, baked products, dairy products, ice cream, yogurt, yellow cakes, orange juice, biscuits, popcorn color, cereals, sauces, gelatins, etc. Powdered rhizome is the most abundant form of use in almost every kitchen. Many Persian dishes use turmeric as a starter ingredient. In India and Nepal, turmeric is widely grown and extensively used in many vegetable and meat dishes for its color, and is also used for its supposed value in traditional medicine. Turmeric has been used as a remedy for stomach and liver ailments, as well as topically to heal sores, basically for its supposed antimicrobial property (Chaturvedi, 2009)^[49]. It is a medicine for a range of diseases and disorders, including those of the skin, pulmonary, and gastrointestinal systems, aches, pains, wounds, sprains, and liver problems. A fresh juice is commonly used in many skin conditions, including eczema, chicken pox, shingles, allergy, and scabies (Khalsa, 2013)^[50]. The active compound curcumin is believed to be used as anti-inflammatory, antioxidant, antitumour, antibacterial and antiviral, which indicates potential in clinical medicine (Aggarwal *et al.*, 2007)^[51].

Curcuma aromatica

Curcuma aromatica, commonly known as wild turmeric (*vana haridra*) or yellow zedoary, is a species that stands second among the widely used curcumin species next to common turmeric (*Curcuma longa* L.). The plant is distributed wild throughout India and mainly cultivated in Kerala and West Bengal (Shamim *et al.*, 2011)^[52] and also found in the eastern Himalayas and inhabits warm forest areas. Grows fast and vigorously during the summer monsoon months. Wild turmeric is an aromatic and pretty ginger with stout underground rhizomes. Foliage dies down in late in autumn and the rhizomes remain dormant in winter. The inflorescence appears in early spring from the base of the rhizome with pinkish white flowers having orange lips. The flowering stalks (about 20-25 cm) are crowned with enlarged, colored bracts tipped with pink. When in full growth the plants can reach a height of about 90cm tall. Leaves are broad and very decorative, elliptic, 1-1.2 m long, and 20 cm wide, leaf-stalk being as long as the blade. Rhizomes used to a limited extent in villages for flavouring curries. *Curcuma aromatica* contains alpha-curcumene (ar-curcumene), beta curcumene, d-camphor, alpha and beta-turmerone. Also other compounds like d-camphene, p-methoxycinnamic acid, curzerene, germacrone, alpha-and beta-pinenes, borneol,

alpha-terpeniol, myrcene, terpinolene, gamma-terpinene, limonine, beta-thujone, alpha-copaene, alpha-bergamotene, beta-bisabolene, cuminic aldehyde, cuminyl alcohol, hydroxyisogermafenolide, xanthorrhizol, curcuphenol, beta- α -elemene, zingiberene, isoborneol, linalool, beta- α -farnesene, 1, 8-cineole, curzerenone and curcumin.

It is used as an aromatic medicinal cosmetic and is also as a promising drug for therapeutic purpose. *Curcuma aromatica* is a common Chinese herb has been regarded as a potent anticancer herb. It is used in indigenous medicine for external applications on skin diseases, sprain, bruise, in snake poison and also to enhance complexion. The plant has been in traditional use and in Ayurvedic literature it is mentioned as a remedy for various diseases related to skin, cardiovascular and respiratory system. For the last few decades, research works have been done to establish the pharmacological potential of wild Turmeric and its extracts. Some of them include 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.

For the last few decades, research works have been done to establish the pharmacological potential of different turmeric species and their extracts. Some of them include anti-inflammatory, wound healing, anti-melanogenic, antioxidant and free radical scavenging activity, anti-tumor, anti-cancer, anti-repellent, antitussive, anti-platelet activity and antinephrotoxic activity. The curcuma sp. which are grown in temperature ranging from 11-40^oC are especially suitable for the hilly area for their growth and development as the region receives a well distributed rainfall during the growing season and also the sloppy well drained land with good organic matter content. Hence, there is a suitability of curcuma species for their biodiversity and conservation in the hilly regions for the exploitation of yield and also used for various medicinal purpose.

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