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In-depth review on Taxonomy, Phytochemistry, Traditional uses and Pharmacological activities of *Curcuma caesia* Roxb

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Abstract

Traditional healers employ the Curcuma genus for a variety of diseases in ethno medical traditions, Although *Curcuma caesia* (*C. caesia*) Roxb. is a relatively unknown and unexplored drug. *C. caesia*, often called as black turmeric, belong from *Zingiberaceae* family. The herbaceous plant can be found in the north-east, central India, east-west Godavari, and Andhra Pradesh. *C. caesia* rhizomes have anti-asthmatic, smooth muscle relaxant, antifungal, antibacterial, analgesic, anticonvulsant, antioxidant actions as well as anti-inflammatory properties. (Z)-ocimene, bornyl acetate, ar-turmerone, camphor, ar-curcumene, elemene, 1,8- cineole, curcumene and borneol are said to be the main constituent of the plant. It is also regarded as a useful source of natural ingredients for the progression of drugs to treat a different types of ailments. In this review the medicinal uses, phytochemistry, isolation methods, analytical methods and pharmacological actions of the plant are mainly considered.

Keywords: *Curcuma caesia*, Kali haldi, Rhizomes, *Zingiberaceae*

Introduction

The utilization of herbal substances is not only restricted to nutritious purposes, such as nutrition, food etc., but also a potent role in the treatment of numerous severe health concerns. The herbal medicine, also termed as phytomedicine which employs the various plant parts for medicinal purposes [1].

Herbal medicine is the key subdivision of supportive and substitute medicinal treatments (Complementary and Alternative Medicine). The various drawbacks of the traditional treatments viz., high treatment costs, and high risk of side effects have increased the significance of CAM over traditional medicine. Consequently, the medicinal plants active ingredients are directed to their specific use in the diseased state, or can be explored employing complex mixtures of one or more plants. When compared to allopathic therapy in general, the use of traditional medicines is very concerned with patient conceptualization and less paternalistic [2].

However, there are numerous problems which are selected for treatment by traditional

medicines; like cancer, liver diseases, memory diseases, peptic ulcers and various gastrointestinal diseases, inflammatory disorders, cardiovascular diseases, diabetes, tuberculosis and central nervous system [3].

Curcuma Linn. is the key genus of the family; *Zingiberaceae*. It is commonly distributed in Southeast Asia and contains over 70 species of rhizome herbivores as a wild and cultivated plant. Turmeric is denoted as economically important genus and has been exploited for many purposes. Previously, it is extensively exploited as spices, flavorings agent, food preservatives, dyes, cosmetics, medicines, starch, and ornamental plants [4]. Moreover, the underground rhizome is major source of yellow color [5]. The word "karakuma" comes from Arabic word "kurkum" which specify the yellow color [6].

In past few decayed, they have been utilized for the cure of various diseases viz., stomach ulcers, cough, liver, diabetes, spleen, chest pain, blood purifiers, dermatitis, liver disorders, boils, and arthritis [7]. One of the species of Curcuma i.e. *C. caesia* contains flavonoids, oil content, curcuminoids, phenols and also presence of secondary bioactive metabolites is related to the therapeutic use of *C. caesia* as flavoring, aroma and in numerous useful medicines [8]. Moreover, the rhizomes have been used to treat hemorrhoids, cancer, leprosy, menstrual disorders, fever, asthma, vomiting, epilepsy, wounds, edema,, anthelmintic, gonorrhea etc. [9] and Figure 1 summarises the entire knowledge regarding *C. caesia*.

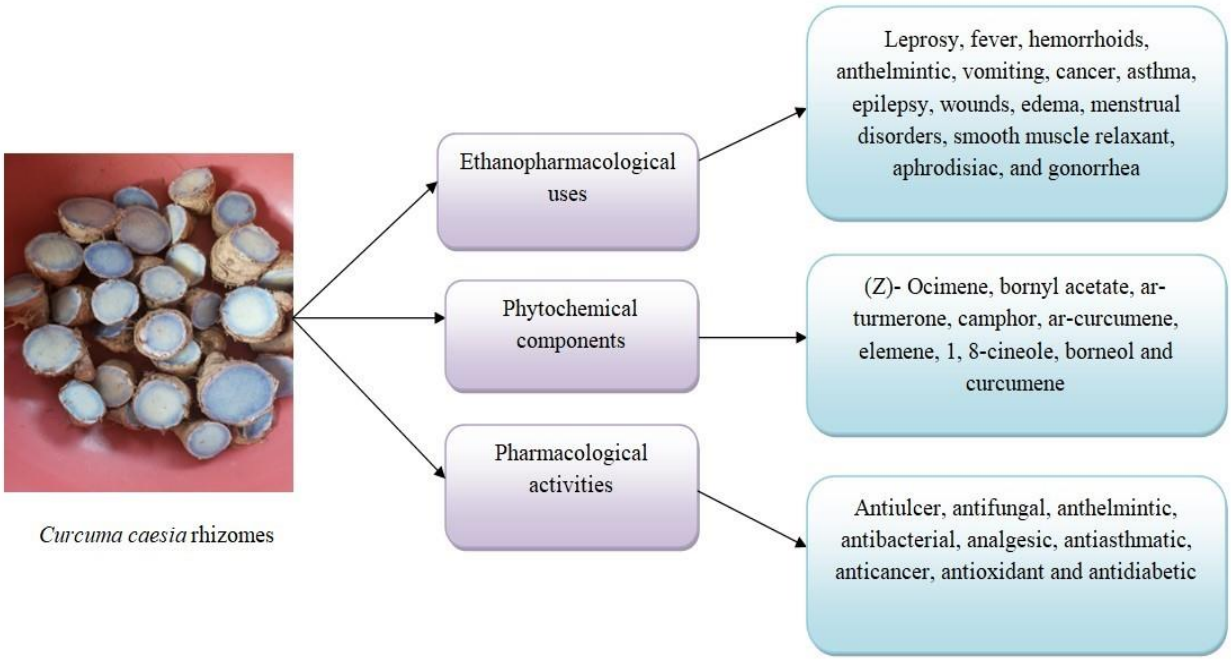

Figure 1: Graphical depiction of ethanopharmacological uses, phytochemical components and pharmacological properties of the *Curcuma caesia* Roxb

General Description

Plant profile

Botanical name: *Curcuma caesia* (Roxb.)

Synonym: *Curcuma kuchoor* Royle

Common name: Black turmeric, Kali haldi

Figure 2: Rhizomes of *Curcuma caesia*

Taxonomical classification
Kingdom: Plantae
Subkingdom: Viridae plantae
Phylum: Tracheophyta Sinnott
Subphylum: Euphyllophytina
Class: Magnoliopsida
Order: Zingiberales
Family: *Zingiberaceae*
Subfamily: Zingiberoideae
Tribe: Hedychieae
Genus: Curcuma
Species*:* *Curcuma caesia* Roxb
C. caesia is a blue black rhizome everlasting herb of northeast and central India. *C. caesia* usually called as black turmeric which is mainly distributed in East West Godavari, and Andhra Pradesh, India. *C. caesia* rhizomes are of considerable economic importance due to their perceived medicinal properties. Several reports have shown the use of rhizomes in the treatment of the relaxing activity of smoothmuscles, fever, leprosy, aphrodisiac, hemorrhoids, epilepsy, inflammatory discharge, asthma, menstrual disorders, cancer, wounds, vomiting, anthelmintic, and gonorrhea [10]. Rhizome plants are fragrant in diverse environment. The high abundance of essential oils into the interior of the rhizome gives blue black appearance and a distinctive sweet fragrance [11]. From the ancient time, rhizome of *C. caesia* are extensively utilized inside ailment of leukoderma, tumors, asthma, hemorrhoids and bronchitis. The paste is directly applied for the ailment of brews, contusions and arthritis. Fresh rhizomes are used as anti-diarrheals and for the relief of abdominal pain. Moreover, the fresh paste of rhizome of *C. caesia* is highly effective against the snake and scorpion venom [12].

Morphology

The plant usually stands with a height between 0.5 and 1.0 m. It is subdivided into large subterranean oviduct tuber rhizomes, often referred to as an aerial shoot with rootstocks and reproductive part and the leaves [13].

Root

As the plant spreads through the rhizome, the key roots are invisible; Although, the surface of the rhizome has all addictive, fibrous and slender yellow-brownroots [13].

Rhizome

The rhizome has a sweet smell of camphor with a length of about 2-6 cm and can have variable shapes. It is indistinguishable, subsequently flattened and covered with endangered roots, warts and scars of roots. They are longitudinal circular wrinkles on the surface that give the rhizomes the nodular and internodal zone. The surface of the rhizome is dark brown, blue-black or beige. The branches are high or low beautiful [13].

Leaves

The leaves are generally found in sets having 10 to 20 leaves in each group. Morphologically, every leaf is appearing tall, square, little bird and shiny. There is a deep pharyngeal purple color in the central region of the laminate. The petiole is elephant colored and the petioles form pseudoxides between them. The differences are similar in nature [13].

Inflorescence

It has a dense nail about 15-20 cm in length, which appears long before the leaf opens. Mainly, the cracks are of green color, but the crown cracks have a deep red coloration [13].

Flower

The flowers have a pale yellow appearance having a reddish color boundary. Calyx: 10-15 mm inlength, obese and 3 teeth. Collora: Long pale yellow tubular lip-3 semi elliptical lobes [13].

Isolation method of *Curcuma caesia*

Pakkirisamy Muthukumaran *et al*. (2017) used the Soxhlet apparatus to extract dried rhizomes with methanol for 8 hours. The extracts were then filtered, and the filtrates were thickened at 40°C utilizing a rotary flash evaporator under reduced pressure and kept at 4°C till use [14].

Chaturvedi Monika *et al*. (2019) used cold percolation methods to extract dried rhizomes with methanol, acetate and ethyl acetate. The maximum yield, 15.16 percent, was obtained in the methanol extract. Acetone and ethyl acetate, on the other hand, gives 10.86% and 9.24% yield respectively [15].

Donipati Prasanthi (2015) used soxhlet apparatus to extract dried rhizomes using chloroform, methanol and hexane for 8 hours. The extracts were filtered and filtrates were concentrated at 40°C utilizing a rota evaporator under decreased pressure, then stored at 4°C till further use [16].

Analytical method of *Curcuma caesia*

Pakkirisamy Muthukumaran *et al*. (2017) used GC-MS and FT-IR to assess bioactive components in the dried rhizomes of methanolic extract. The main constituents found in the *C. caesia* (Black turmeric) were Ar-tumerone, Alloaromadendrene, Retinal, α-Santalol , Benzene, Megastigma- 3,7(E),9-triene, methyl ester and various other components were identified as low level . The existence of N-H, O-H, C-H, CH3, C=C and C-O functional groups was confirmed by FTIR analysis [14].

Chaturvedi Monika *et al*. (2019) used GC-MS and FT-IR to identify bioactive metabolites in acetone, ethyl acetate and methanol extracts. They discovered 44 bioactive componentsin the methanolic extract of *C. caesia*, with six high peak components. *C. caesia* extracts of acetone and ethyl acetate yielded only 33 and 31 components, respectively [15].

Literature Review

Ethnopharmacological Review

Rhizome have been exploited for the treatment of leprosy, fever, anthelmintic, hemorrhoids, vomiting, asthma, cancer, epilepsy, edema, wounds, menstrual disorders, smooth muscle relaxant, aphrodisiac, and gonorrhea [17].

Phytochemical Review

Sarangathem *et al*. (2010) have conducted preliminary phytochemical research, reported the availability of steroids, alkaloids, tannins, and phenols as the main components in subsequent solvent extraction of rhizome with petroleum ether, n-hexane, chloroform, benzene, water, andethyl acetate [18]. The volatile oil constituent of C. caesia rhizome was analyzed using GC-MS revealed the presence of 30 components, indicating 97.48 % oil constituents, including (28.3 %) camphor,(12.3 %) ar-tumor, (8.2 %) (Z) -Ocimine, (6.8 %)1-R-curcumin, (5.3 %) 1,8 - cineole, (4.4%) borneol, (3.3 %) bornyl acetate and (2.82 %) curcumin as the major consituents [19]. Rastogi and co-worker have reported that linalool is the main constituents comprising 20.42%, whereas, ocimine, 1-ar curcumin, zingiberol, 1,8-cineole and borneol represents the 15.66, 14.84, 12.60, 9.06, 7.4 %, respectively [20].

Pharmacological Review

Antifungal activity

Earlier, Banerjee and Nigam have studied the antifungal activity of *C. caesia* rhizomes and reported that volatile oil of rhizomes of *C. caesia* Roxb are highly injurious against several fungal cultures [21.

Antiulcer activity

Das and his collegues (2012) have studied the *in-vivo* anti-ulcer activity of the *C. caesia* rhizomes on animal model. Four set of albino mice having the weight in the range of 150–200 g (n = 5) was selected for the study. The stomachs of the sacrificed mice were taken out. Significant reductionof pepsin activity, ulcer index, gastric juice content was seen in group III and IV compared to group II, While the amount of gastric mucus secreted increased [22].

Antibacterial activity

Rajamma and co-workers (2012) have performed the antibacterial and antioxidant properties of oleoresins separated from nine curcumin species. Oleoresins were isolated from the rhizomes of *Curcuma zedoaria* (*C. zedoaria*) and *C. caesia* utilizing dichloromethane and their antibacterial and antioxidant activity were revealed. Oleoresins of all species showed a high eliminationactivity of DPPH radicals and iron-reducing potency, which had a better relationship with phenolic content. Oleoresins inhibited Gram +ve and Gram-ve bacteria [23].

Anthelmintic activity

Previously, Gill and co-worker (2011) have reported that *C. caesia* and *C. zedoaria* have the high anthelmintic activity. Studies on extracts included determination of the time of paralysis and earthworm's death. The selected plants extract showed dose-dependent anthelmintic activity. The outcomes of the study revealed that the ethanolic extract of *C. caesia* plant was more effective and

caused paralysis to earthworms [24].

Analgesic activity

Kaur *et al*. (2011) compared various extracts obtained from rhizomes of *C. caesia* and *Curcuma amada* (*C. amada*) for analgesic and antipyretic activity. Then body weight was noticed at 250 and 500 mg / kg by Torsion and pyrexia. Both the plants had shown analgesic and antipyretic activity [25].

Antioxidant activity

Earlier, Chirangini and his colleagues (2004) have studied the antioxidant activities of different methanolic extracts of the rhizomes of different species, together with C. *caesia*, exploring the sulfur free radical reactivity with curcumin as a reference measure. The results indicate that *C. caesia* gives better radiation protection [26].

Rajamma *et al*. (2012) showed a noteworthy association between total phenolic content & antioxidant potential of isolated oleoresin from *C. caesia* [23].

Liu *et al*. (2013) reported the antioxidant potential of *C. caesia* by DPPH assay of methanolic extract of *C. caesia* which showed strong antioxidant potential [27].

Borah *et al*. (2019) described that antioxidant potential of *C. caesia* leaf essential oil is directly proportional to concentration. Furthermore, the antioxidants isolated from natural products are attaining significance in the last few decades [28].

Paw *et al.* (2020) reported that *C. caesia* rhizome essential oil have higher antioxidant potential than ascorbic acid the standard with IC50= 48.08 ± 0.003 µg/mL and IC50=149.1 ± 0.0023 µg/mL, respectively, as smaller the IC50 value higher will be its antioxidant potential [29].

Anti-Asthmatic Activity

Arulmozhi *et al.* (2011) were studied the anti-asthmatic activity of *C. caesia*. In the presence of different receptor antagonists and enzyme inhibitors, the *C. caesia*'s hydroalcoholic extract was examined for relaxing activity in guinea pig trachea. In depolarized rabbit aorta, the probable role of hydroalcoholic extract in calcium channel regulation was also studied [30].

Pritesh Paliwal *et al.* (2017) apprasied the bronchodilating characterstics of *C. caesia* extracts. The extract's bronchodilator property was investigated in guinea pigs with histamine aerosol influence Pre-convulsion dyspnoea and Bronchospasm. In this investigation, when contrast to (standard) chlorpheniramine maleate 2 mg/kg, p.o., *C. caesia* extract considerably extended the latent time of convulsions aftermanifestation to histamine aerosol on 500 mg/kg dose and demonstrated maximum protection, confirming its H1 receptor antagonistic activity and supporting the plant's anti-asthmatic activities [31].

Neuropharmacological Activities

Karmakar *et al.* (2011) analyzed diverse neuropharmacological potential of *C. caesia*. They identified that *C. caesia* rhizome shows central nervous system antidepressant activity which was study on animal models. The plant showed nontoxicity effect and safe 17 for commercially use [32].

Caleja *et al.* (2017) reported that prescribed antidepressants are taken by 1 in 10 people, but some have significant side effects [33].

Anti-inflammatory Activity

Sawant *et al.* (2014) reported the anti-inflammatory nature of *C. caesia*. They analysed the anti- inflammatory potential of methanolic extract on Female Wistar rats by Carrageenan-induced paw edema assay and Cotton pellet-induced granuloma test. Three concentration of dose were giveni.e 100 mg/kg, 200 mg/kg and 400 mg/kg. They reported highest percentage of inhibition in Carrageenan induced paw edema assay after five hour as 23.33% (100 mg/kg), 57.86 % (200 mg/kg) and 82.28 % (400 mg/kg) where as standard showed the 92.49 % (10 mg/kg) inhibition after 5 hour in case of cotton pellet granuloma assay inhibition was directly dependent on dose [34].

Paw *et al*. (2020) reported that the essential oil of *C. caesia* possess strong antiinflammatory potential as it have IC50 value 121.7 ± 0.0013 as compare to sodium diclofenac which have IC50 value 129.5 ± 0.003 μg/mL. Also they demonstrate the antiinflammatory potential by protease inhibitory assay which reveal better antiinflammatory potential of essential oil of *C. caesia* [29].

Thrombolytic Activity

Fathima *et al.* (2015) repoted that *C. caesia* ethanolic rhizome extract have thrombolytic activity (49.18% clot lysis) [35].

Meanwhile, Bharathi *et al.* (2017) found that the hydroalcoholic extract of *C. caesia* has a thrombolytic activity of 38.75%, which is somewhat greater than that of *C. amada* at 34.74%. Furthermore, the silver nanoparticle derived from *C. caesia* shown significant efficacy in dissolving the blood clot [36].

Anticancer Activity

Mukunthan *et al.* (2014) described that hexane extracts of *C. caesia* rhizome have potential to induce apoptosis through triggering the mitochondrial pathway which is analysed by western blot confirming by the expression of proapoptotic proteins [37].

Anti-Diabetic Activity

Majumder Poulami *et al.* (2017) investigated *C. caesia'*s anti-diabetic properties. In *in-vivo* experiements, a methanolic extract of *C. caesia* (MECC) rhizome demonstrated antidiabetic property through reducing glucose of blood and controlling monosaccharides absorption by blocking alpha amylase and alpha glucosidase [38]. Various pharmacological properties of *C. caesia* are described in Figure 3.

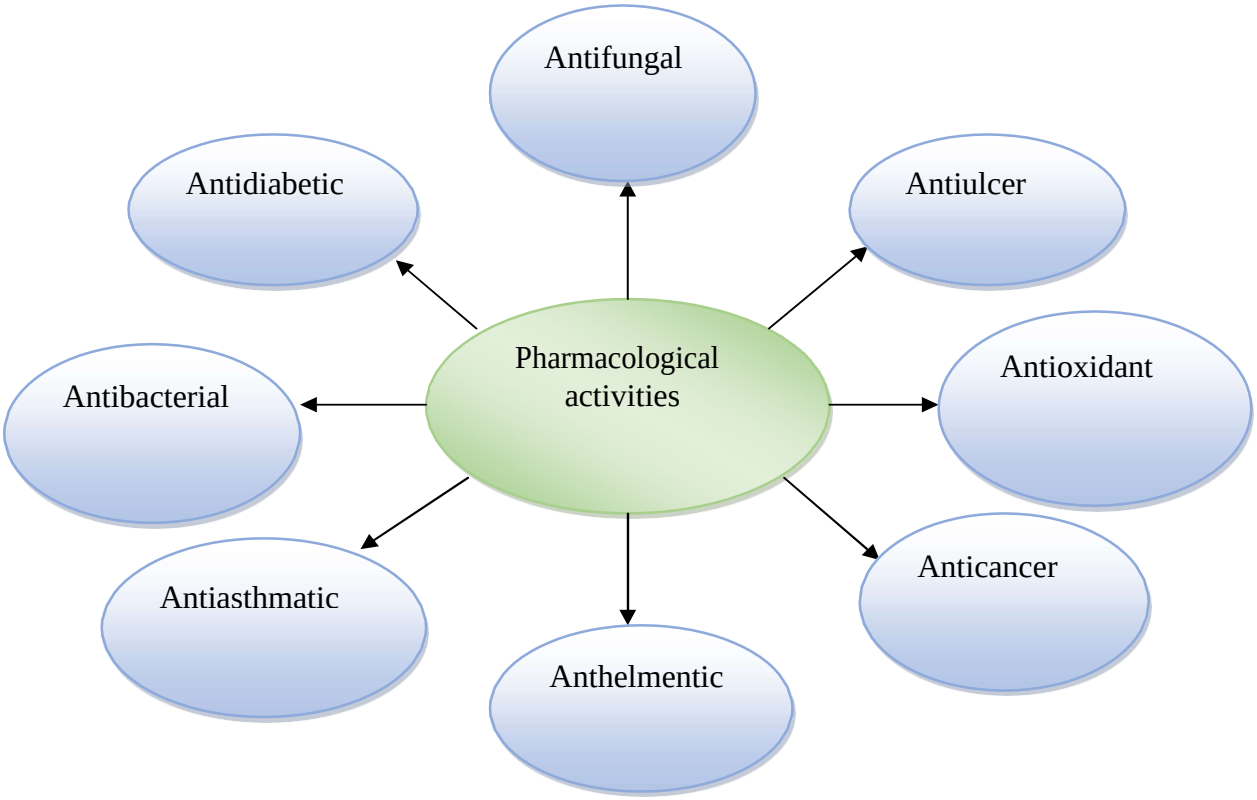

Figure 3: Various pharmacological activities of *C.caesia* Roxb.

Conclusion

In traditional medicinal practices, the conventional healers utilizes genus Curcuma for treating various types of diseases but *C. caesia* Roxb. is relatively unknown and unexplored medication.

C. caesia is a plant that may be found all throughout India. The plant seems to work well on a number of different illnesses. The pharmacological studies presented in this review support *C. caesia*'s medicinal value. However, there is limited information about this plant's clinical, toxicological and herbal formulation. Several phytochemical investigations have been published, but further research is needed.

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