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# ETHNOMEDICINAL AND PHARMACOLOGICAL ACTIVITY OF CURCUMA CAESIA

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## ABSTRACT

*Curcuma caesia* Roxb. is a perennial, erect rhizomatous herb with large leaves. Fresh rhizomes are aromatic with intense camphoraceous odour, cultivated for its rhizomes, which are used in traditional medicine. The plant is reported to contain camphor, ar-turmerone, (*Z*)-ocimene, ar-curcumene, 1, 8-cineole, elemene, borneol, bornyl acetate and curcumene as the major constituents. The plant has been reported to have antifungal activity, anti-asthmatic, smooth muscle relaxant, antimicrobial activity, antioxidant activity, analgesic, locomotor depressant, anticonvulsant and muscle relaxant effects, anti-inflammatory properties. It is now considered as a valuable source of unique natural products for development of medicines against various diseases. This review gives a view mainly on the meditional uses, phytochemistry and pharmacological actions of the plant.

**KEYWORDS:** *Curcuma caesia*, Ethnomedicinal uses, Pharmacological activity.

## INTRODUCTION

Black turmeric (*Curcuma caesia* Roxb.) is an important medicinal plant belonging to zingiberaceae family. *Curcuma caesia*, black turmeric is a perennial herb with bluish-black rhizome. The rhizomes of *Curcuma caesia* have a high economical importance owing to its reputed medicinal properties. Rhizome of this plant is claimed to be useful in treating several disease like piles, leprosy, bronchitis, asthma, cancer, epilepsy, fever, wounds, impotency, fertility, tooth ache and vomiting etc.[1] The rhizome of black turmeric has a high economic importance owing to its medicinal properties. Black turmeric has been regarded as endangered by the central forest department of India due to bio piracy.[2] In the hilly areas of the country this endangered medicinal plant grows, thus needs to be conserved for future generations. *C.caesia* is a wonder herb and contains the highest content of curcumin and it is a chemical substance with many curative properties.[3] It is used for treatment of menstrual disorders, piles, impotency and epilepsy. Externally, this plant has been used in the treatment of wounds, white patches on the skin and leprosy sores.[4] It is also capable of enhancing fertility levels. It is also used for the treatment of enlargement of the spleen and certain types of tuberculosis. The rhizome as well as the leaves of the plant is used in medical formulations.[5]

## TAXONOMICAL HIERARCHY

Kingdom: Plantae
Subkingdom: Viridaeplantae
Phylum: Tracheophyta Sinnott
Subphylum: Euphyllophytina
Class: Magnoliopsida “monocotyledons” “commelinids”
Order: Zingiberales
Family: Zingiberaceae
Tribe: Hedychieae Genus: Curcuma
Species: C. caesia Roxb
Vernacular Names in different parts of India C. caesia is known by different names.[6]
Hindi: Kali Haldi, Nar Kachura Krishna Kedar
Manipuri: Yaingang Amuba or Yaimu
Marathi: Kala-haldi
Kannada: Kariarishina, Naru Kachora
Bengali: Kala Haldi
Telugu: Nalla Pasupu
Assamese: Kala Haladhi

**MORPHOLOGY OF *CURCUMA CAESIA* PLANT**

**Rhizome:** The rhizome is tuberous and has camphoraceous sweet odor and 2-6 cm in diameter, the shape and size is often variable. It is sessile, and covered with adventitious roots, root scars and warts and is laterally flattened. The nodal and inter nodal zones present due to its circular wrinkles on the surface. The surface of rhizome is dark brown, bluish black, or buff in color; a false impression of growth rings is the circular arrangements of remnants of scaly leaves. The branching is more or less sympodral.

**Root:** At the propagation stage the rhizome is not developed. Yellow brown long fibrous and tapering adventitious roots are found all over the surface of rhizome

**Leaves:** The leaves are found of 10-20 grouped. Leafs are broad oblong lanceolate and glabrous. In the middle region the lamina shows deep farraginous purple colored clouds. The petiole is ivory color and unsheathing the petioles encircles each other forming a pseudo axis. The variation is parallel, typical characteristic of monocots.

**Inflorescence:** The inflorescence is 15-20 cm long dense spike, which arises much before the opening of leaf, the bracts are green, and the bracts of coma are deep red, when it is old it become crimson.

**Flowers:** The flower is smaller than bracts with pale yellow and reddish border. Calyx: 10-15 mm long, obtuse, 3 toothed, and Corolla: long tubular with pale yellow lip - 3 lobed semi-elliptic.[7]

**Figure 1: *Curcuma caesia*, rhizome, flower and leaves.**

**Figure 2: Dried rhizomes of Curcuma caesia.**

**Chemical Constituents of *Curcuma Caesia***

It contains: alkaloids, terpenes, amino acids, carbohydrates, tannins, flavones, flavonoids, steroids, reducing sugars, proteins, anthraquinones, glycosides, cardiac glycosides. The volatile rhizomes oil of *Curcuma caesia* contains of 30 components, representing 97.48% of the oil, with camphor (28.3%), ar-turmerone (12.3%),(Z) ocimene (8.2%), 1,8cineole (5.3%), elemene (4.8%), borneol(4.4%), bornylacetate (3.3%) and curcumene (2.82%), ar- curcumene (6.8%) as the major constituents.[8]

**Pharmacological Effects of *Curcuma Caesia***

Use of the rhizomes for medicinal purposes emerged from various bioactive compounds. Varying concentrations of essential oil has been used in the studies (ranging from 0.05 to 150 mg). IC50 values were calculated in order to determine the effectiveness of the essential oil used in the research studies. According to some previous reports due to the presence of some of the biological compounds in the plant such as phenolics and flavonoids[9] *C. caesia* have shown a number of pharmacological effects as mentioned below:

**Antimicrobial activity**

Since ancient times, people have used plant secondary metabolites as antimicrobial agents. In recent years, there has been a renewed interest in the use of plant parts as antimicrobial agents, as some of the synthetic antibiotics can become ineffective due to resistance by the human body.[10] A study conducted by Banerjee and Nigam (1976) reported that the rhizome essential oil of *C. caesia* could inhibit the growth of fungi, *Curvularia oryzae*, *Aspergillus niger*, and *A. flavus*. Rajamma et al. (2012) reported that the oleoresins present in *C. caesia*

rhizome essential oil is effective against *Staphylococcus aureus*, *Bacillus subtilis*, and *Escherichia coli*. The diameter of the zone of inhibition was measured and it was found that it is highly effective against *B. subtilis*. This can be related to the traditional use of the rhizome of *C. caesia* in healing infections and wounds. Borah et al. (2019) have found that the leaf essential oil inhibited the growth of the bacteria: *B .subtilis*, *B. cereus*, *S. aureus*, and *S. typhimurium*, and also prevented the growth of the fungi: *A. fumigatus*, *A.niger*, *Saccharomyces cerevisiae*, and *Candida albicans*. The assays were performed using disk diffusion method and the minimum inhibitory concentrations were determined, where *C. caesia* leaf essential oil showed maximum inhibition against *S. aureus* and *A. niger*. Previously, Hendry et al. (2009) reported that eucalyptol has antimicrobial properties against some microorganisms cultured in planktonic and biofilm cultures. Since eucalyptol is the major component and its synergetic effects may be inhibiting the growth of microbes resulting in good antimicrobial activity of *C. caesia* rhizome essential oil. Further studies by in vitro models as well as comparison to some positive control showing significant dose-dependent effect would be helpful in the use of *C. caesia* essential oil in pharmaceutical and aromatic products for curing various microbial infections.

**Antioxidant activity**

The antioxidant properties of *C. caesia* have been determined by studying its free radical scavenging activities. The antioxidant property of the free radical scavenging properties of the rhizome extracts of *C. caesia* was studied by Liu et al. (2013) using DPPH assay and it was reported that the methanolic extracts of *C. caesia* showed good antioxidant ability, as compared to *C. aeruginosa* and *C. zedoaria*. Mangla et al. (2010) also studied the antioxidant activity of *C. caesia* rhizome extracts and found similar results, with IC50 value of 862.35 µg for 2 mL of 500 µM concentration of DPPH. However, recent reports showed a high level of total antioxidant ability of *C. caesia* from the hexane rhizome extracts (1200 mg ascorbic acid equivalent/100g) as compared to the methanolic extracts.[11] The total phenolic content was found to be proportional to the antioxidant activity. Krishnaraj et al. (2010) reported that the phenol content and antioxidant activity of *C. caesia* rhizome extract is greater than *C. amada*. Rajamma et al. (2012) reported the antioxidant activity of the oleoresin isolated from *C. caesia* with IC50 value of 0.32 mg and a significant correlation of the total phenolic content and the antioxidant properties was noted.

Another study on the antioxidant potential of essential oil of *C. caesia* leaf reported that the free radical scavenging activity and the reducing power activity of the leaf essential oil increases with the increasing concentration. The leaf essential oil is rich in flavonoids and phenol, which can render it the antioxidant properties. The studies reviewed here showing in silico antioxidant assays are of less pharmacological relevance. The nonspecificity and potential susceptibility of the chemical assays make the outcomes untrustworthy. In vivo assays are needed to determine the clinical application of this plant. Moreover, the antioxidants derived from natural products are gaining importance in the last few years. Certain industries are trying to focus on replacing the synthetic antioxidants with the natural ones, as people prefer to use products that are environmentally friendly and safe to use. Thus, such plants like *C. caesia* can be the source of natural antioxidants; which can be used in various cosmetics as well as pharmaceutical products.[12]

**Anticancer properties**

Cancer is a major disease affecting millions of people globally. There is a constant need for new drugs and therapies for treating this life-threatening disease. Nowadays, scientists are drawing attention towards producing naturally derived products for the treatment of cancer.[13] These natural products are less toxic and have fewer side-effects. Medicinal plants are a major source for such kind of compounds. Hadem et al. (2014) analyzed the chemopreventive effects of *C. caesia* using a mouse model. The BALB/c mice were exposed to an established carcinogen diethylnitrosamine, which is widely used as an inducer of hepatocarcinogenesis, and it was observed that the methanolic extract of the rhizome of *C. caesia* can revert the structural abnormalities induced by diethylnitrosamine exposure. Moreover, the hexane rhizome extracts of *C. caesia* have been reported for their ability to inhibit proliferation of carcinoma cell line, human liver adenocarcinoma cells (HepG2) in a dose-dependent manner. Various apoptotic modifications like membrane zeosis and formation of apoptotic bodies were observed with hexane extract-treated cancer cells and the western blot analysis provides substantial evidence that hexane rhizome extracts induce apoptosis via activated mitochondrial pathway as expression of proapoptotic proteins. These studies have reported the ability of *C. caesia* to inhibit the cancer cell proliferation, so future studies on the mechanism and the type of cell death caused by its compounds are suggested. The cytotoxicity of the compounds also needs to be studied further to establish the molecular mechanism involved in the anticancer properties of this important medicinal plant.

**Neuropharmacological activities**

Different neuropharmacological activities of *C. caesia* was studied by Karmakar et al. (2011), and it was reported that the rhizome has analgesic, anticonvulsant, muscle relaxant, and locomotor depressant, which shows antidepressant activity of the central nervous system. The study was conducted on mouse models. The toxicity of the plant was also checked, and it showed negative results, meaning that the plant is safe for commercial use. This data can be further scrutinized to develop potential drug molecule by isolating the compounds responsible for these activities. This study is a preliminary base

indicating the neuropharmacological potency of this plant. It is estimated that 1 in 10 adults takes prescribed antidepressants, but those come with major side effects.

**Thrombolytic activities**

Thrombolysis is the breakdown of blood clot; blood clots occur in the body when the body tries to repair the injured blood vessels.[14] Various synthetic thrombolytic drugs are available in the market. The thrombolytic activity of *C. caesia* was reported by.[15] They analyzed the percentage of clot lysis activity of the ethanolic extract of the rhizome and observed that the ethanolic rhizome extract showed 49.18% clot lysis. However, this report is not conclusive as the effect of various other extracts of *C. caesia* and comparison to positive controls was not studied. Future analysis using positive controls and comparison with other extracts could be helpful.

**Anthelmintic activity**

The anthelmintic activity of the widely used species of genus *Curcuma*, *C. amada*, and *C. caesia* was reported to have positive activity.[16] This study analyzed four extracts of C. amada and C. caesia prepared with petroleum ether, dichloromethane, ethanol, and water at three different concentrations. The results indicated that the ethanolic extact of C. caesia paralyzed the earthworm, while ethanolic extract of both the plants very effectively caused death of earthworms. Hence, further studies are warranted to establish the dosage and formulations along with mode of application.

**Antiulcer activity**

An ulcer is a common gastrointestinal disorder which is seen among many people. Several synthetic drugs are available to treat ulcers. However, these drugs are expensive and are likely to produce more side effects when compared to herbal medicines.[17] Das et al. (2012) studied the antiulcer activity of the ethanolic extract of the rhizome of *C. caesia* on experimental animal models and reported LD50 value of 2000 mg/kg of the extract and confirmed that the rhizome extract possesses antiulcer activity, as they could lower the ulcer index, gastric acid volume, pepsin, free and total acidity of the test animals. Furthermore, detailed bioactivity studies will be required for proper validation and evaluation of *C. caesia* rhizome to be used as an antiulcer drug.

**Toxicology**

There are several reports regarding the toxic nature of essential oil, which could be very harmful to human health; therefore, toxic nature of any compound should be tested before commercial uses. A study conducted on the genotoxicity of the leaf essential oil of *C. caesia* (0.05 mg) has shown that the essential oil has no toxic effect on the growth of *Allium cepa* L. roots and the mitotic index of the cells. The cells were also assessed for chromosomal aberrations and no such harmful changes were noted. In the chromosome aberration test chromosome breakage, bridge, multipolarity, chromosomal clump, and chromosomal stickiness were the characters taken into consideration, as they are the results of mutation in cellular level. The genotoxic effect of *C. caesia* rhizome essential oil was accessed, and it was found that the plant has negative impact on *A. cepa* roots and the mitotic index of the cells.[18] However, except that, no other report is available regarding the genotoxic effect of *C. caesia*. Therefore, further in vivo toxicology experiments can lead to the establishment of *C. caesia* in pharmaceutical industries as well as food industries.

**Bronchodilating activity**

Pritesh Paliwal et al. (2011) investigated the bronchodilating activity of extracts of C. caesia. Bronchodilator activity of the extract was studied on the histamine aerosol induced Bronchospasm and pre-convulsion dyspnoea in guinea pigs. Treatment with methanolic CC extract 500 mg/kg showed significant protection against histamine induced bronchospasm. In this study CC extract significantly prolonged the latent period of convulsions followed by exposure to histamine aerosol at the dose of 500 mg/kg and showed maximum protection of 34.84% at 4th h as compared to chlorpheniramine maleate (standard) 2 mg/kg, p.o. which indicating its H1 receptor antagonistic activity and supports the anti-asthmatic properties of the plant.[19]

**Analgesic Activity**

Different extracts obtained from C. caesia and C. amada rhizomes possess analgesic and antipyretic activity. Analgesic and antipyretic activities of the plant extracts was evaluated using chemical model of acute pain and brewer's yeast induced hyperthermia in rats. The writhing and pyrexia were observed at the doses of 250 and 500 mg/kg body weight of rats. Both the plants exerted analgesic and antipyretic activity. Where by C.amada showed better response in comparison to C. caesia.[20]

**Locomotor Depressant, Anti-convulsant and Muscle Relaxant Effects**

Indrajit Karmakar et al. (2011) evaluated the MECC for some neuro pharmacological activities like analgesic, Locomotor, Anticonvulsant property and muscle relaxant effect in experimental animal models. The results of acetic acid induced writhing showed significant inhibition of writhes, at both test doses as compared with control group in a dose dependent manner. In tail flick test MECC at the both doses exhibited significant increase in reaction time of mice. In locomotor activity study, it was found that MECC significantly depressed the locomotor activity in mice in a dose dependent fashion. In anticonvulsant evaluation methanolic extract of *Curcuma caesia* pre-treatment exhibit significant and dose dependent protection from PTZ-induced convulsions in mice. In muscle relaxant study, the MECC significantly and dose dependently decreased the fall off time in mice demonstrating its muscle relaxant property.[21]

**Anxiolytic and CNS Depressant Activity**
Indrajit Karmakar et al. (2011) evaluated the Methanolic extract of C. caesia rhizome for Central Nervous System (CNS) depressant activities. Methanolic extract of C. caesia was studied for Hypnotic activity, Forced swim test and Tail suspension test. Methanolic extract of C. caesia (50 and 100 mg/kg; i.p.) produced significant and dose dependent reduction in the onset and prolongation of sleep duration induced by pentobarbitone. Methanolic extract of *C.caesia* on immobility period in both FST and TST at the doses of 50 and 100 mg/kg, i.p for 7 successive days to mice reduce the immobility periods significantly in a dose dependent manner, denotes significant antidepressant activity.[22]

**Neuropharmacological assessment of *Curcuma caesia* Rhizome in experimental animal models**
The ethanol extracts of *Curcuma caesia* exhibited an important neuro pharmacological activity. The study was conducted in adult male Swiss albino mice in methanol extract of C. caesia rhizome for evaluating neuro pharmacological activities. Methanol extract *C.caesia* at 50 and 100 mg/kg body weight was evaluated for analgesic activity against acetic acid-induced writhing and tail flick tests. Using actophotometer locomotors activity was estimated. Anticonvulsant effect was assessed against pentylenetetrazol induced convulsion in mice and muscle relaxant effect was evaluated by using Rota-rod apparatus. The methanol extract of C. caesia showed significant inhibition of writhes in a dose dependent manner and also exhibited significant increase in tail flicking reaction time of mice, were not dose dependent, Peak analgesic effect was increase up to a maximum. In a dose dependent manner the methanol extract of *C.caesia* significantly depressed the locomotors activity in mice. The methanol extract of *Curcuma caesia* pre-treatment exhibited significant and dose dependent protection from PTZ-induced convulsions in mice by slowing the onset of convulsions. The methanol extracts of C. caesia significantly and dose dependently decreased the fall off time in mice demonstrating its muscle relaxant property.[23] Comparative anti-oxidant activity of nonenzymatic and enzymatic extracts of Curcuma zedoaria, Curcuma angustifolia and *Curcuma caesia* The non-enzymatic and enzymatic extracts of three important medicinal plants namely C. zedoary, *C.caesia* and C.angustifolia were used to compare the antioxidant activity. By using in-vitro systems both the enzymatic and non-enzymatic extracts of the rhizome and leaves of these plants were analyzed for their free radical-scavenging activity. DPPH scavenging activity of *C.caesia* was found to be 55.32±0.2 at a concentration of 200µg/ml of crude extract. The hydroxyl radical scavenging activity of *Curcuma caesia* was found to be 40.26± 0.01 of the crude extracts and it was compared to ascorbic acid (standard), which was found to be 52.33 ± 0.40 at the concentration of 50 µg/ml. In case of enzymatic extracts 2, 2-diphenyl-1-picrylhydrazyl (DPPH) scavenging activity of C. caesia was found to be 31.2± 0.8 at a concentration of 200µg/ml. The maximum antioxidant activity was found in catalase, superoxide dismutase and glutathione peroxidase enzyme.[24] A comparative study of phenol content and antioxidant activity between nonconventional *Curcuma caesia* Roxb. And Curcuma amada Roxb Krishnaraj et al .studied to investigate the phenol content and antioxidant activity of a nonconventional Curcuma sp. namely, *Curcuma caesia*in comparison with another species Curcuma amada. The reducing power and superoxide, ABTS and DPPH radical scavenging activities were determined to compare the antioxidant activity. The total phenol content of methanol extracts of rhizomes was found to be 37.64 and 44.33 mg TAE/g dry materials, respectively. These phenolic compounds are generally responsible for antioxidant activity. The reducing power of C. caesia was more than the C. amada, similarly superoxide, ABTS and DPPH scavenging ability of C. caesia rhizome was more than the C.amada.[25]

**Study of the anti-ulcerogenic activity of the ethanolic extracts of rhizome of *Curcuma caesia* against gastric ulcers in experimental animals** *Curcuma caesia* has significant ant-ulcer activity. The ethanol extract of *Curcuma caesia* exhibited significant anti-ulcer activity in the experimental animal model studied by Swarnamoni et al. The albino rats of either sex were used to evaluate the anti-ulcer activity. The treatment of rats with ethanol extract of *Curcuma caesia* (EECC-500mg/kg) produced significant reduction of ulcer index, gastric acid volume, pepsin, free and total acidity along with increased production of gastric mucus in Aspirin induced ulcer animal model. Aspirin treatment caused a significant increase in the ulcer index, pepsin activity, free and total acidity, volume of gastric juice and decreased mucus production. *Curcuma caesia* extract decreased the gastric volume and gastric acid secretion significantly by pretreatment with aspirin.[26]

**Effect of *Curcuma caesia* leaves on rice seed germination and seedling establishment** *Curcuma caesia* Roxb leaves exhibited a significant effect on rice seed germination and secondary root formation. The maximum radical growth as well as the secondary root formation was shown by rice seed treated with the presence of C. caesia leaves placed above and below the seed in comparison to the distilled water treated, and leaves extract in water 5%(w/v) .The experimental plant did not exhibit such stimulation effect in rice seed treated with extract because during grinding and filtration, the essential oil get volatized and escaped. While that of cut leaves gradually escaped and spread inside the patridishes giving stimulation to the germination of the seeds. The result obtained in this study indicated that C. Caesia leaves have potential rice seed germination activity due to the presence of volatile oil.[27] Smooth Muscle Relaxant and Anti-asthmatic Activity Arulmozhi et al. (2006) evaluated anti-asthmatic property of C. caesia. The hydro alcoholic extract of *Curcuma caesia* (CC extract) was tested for its relaxant effect in guinea

pig trachea and also in the presence of various receptor antagonists and enzyme inhibitors. Furthermore, the possible role of hydro alcoholic extract in calcium channel modulation was investigated in depolarized rabbit aorta. The CC extract concentration dependently relaxed the carbachol (1 μM)-induced pre-contractions and the presence of an antagonist, such as propranalol, glibenclamide, 2′, 5′-dideoxyadenosine, a-chymotrypsin, L-NNA and methylene blue, did not affect the log concentration relaxing response curves of cumulative CC extract to carbachol (1 μM)-induced pre-contraction.[28]

## CONCLUSION

The present study emphasizes the knowledge on the plant *Curcuma caesia* Roxb. This study demonstrated that herbal product can be effective as modern medicine and also thought out to be safe in comparison to the synthetic product. The rhizomes of the plant have enough bioactive properties. It is prescribed for treatment of piles, impotency, menstrual disorders and epilepsy. *Curcuma caesia* have biological activities like smooth muscle relaxant, anti ulcerogenic, anthelmintic, anxiolytic and CNS depressant activity and many other miscellaneous activities. The phytoconstituents are also proved to be identified. The pharmacological studies reported in this review confirm the therapeutic value of *C. caesia*. This review supports the possible of *Curcuma caesia* as a medicinal plant.

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