

Curcuma caesia Valuable Source for Developing Therapeutic Activities

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Abstract: *Curcuma caesia* Roxb Zingiberaceae caesia plant, known Caesia black turmeric or borneol turmeric, is part of the Zingiberaceae family. This plant is characterized by dark green underground stems. This plant is native to northeastern and central India, especially the states of Madhya Pradesh and Maharashtra, and has an unlimited lifespan. It is widely used due to its immense medicinal benefits. Essential oils and hydrosols are produced from caesia by hydro distillation. The main ingredient of C is essential oil. The main chemical constituents of Caesia are camphor, ar-turmerone, (Z)-ocimine, 1-ar-curcumene, 1,8-cineole, elemene, borneol and turcumem. The rhizome of black turmeric is prized for its famous medicinal properties, making it economically important. In the West Bengal region, the roots of a certain plant are used in a religious ceremony called Kali Puja. Accordingly, this special plant is often called Kali Haldi. Its ability to fight bacteria may play a role in its ability to promote healthy skin. Other properties of the drug include being a stimulant, treating diarrhea, preventing vomiting, reducing inflammation, acting as a diuretic, cleaning wounds, relieving pain, acting as an antioxidant and has anti-cancer effects.

Keywords: *Curcuma caesia*, Black turmeric, Black zedoary, Kali Haldi, Antifungal.

1. Introduction

Turmeric also known as Indian saffron in old age Indian system of medicine 'Ayurveda'. Black turmeric it has origin from India and south East Asia [1]. In West Bengal, the rhizome of the plant is used in Kali Puja, and hence the plant is called Kali haldi. By etymology, Kali is the feminine form of Kala, which means black color and hence the plant is termed as black turmeric in English. This species has been regarded as endangered by the central forest department of India due to biopiracy. It is a perennial herb, grows to a height of 3-5 feet. It has deep violet patch on the leaf which runs throughout the lamina. Usually, the upper side of the leaf is rough, velvety but this character may vary. Flowering bracts are green with a ferruginous tinge. Flower petals may be deep pink or red in colour. The rhizomes of the plant are aromatic in nature. It has bitter, hot taste with pungent smell. The inner part of the rhizome is bluish-black in colour and emits a characteristic sweet smell, due to presence of essential oil [2]. Black turmeric is used by numerous ethnical communities in the state of Madhya Pradesh, Maharashtra. The condiment is vended fresh or dried in requests across India and Southeast Asia. As of 2016,

Black turmeric has been listed as an exposed species by the Indian Agricultural Department. Sweats are being made to cover and conserve Black turmeric in Odisha, on the central eastern seacoast, along the Bay of Bengal [3]. Traditionally, the rhizomes of *Curcuma caesia* Roxb. are used in treating leukoderma, asthma, tumours, piles, bronchitis etc. The paste is applied on bruises, bruises and rheumatic pains in Manipur (Sarangthem and Haokip, 2010). In Arunachal Pradesh, Adi lines use decoction of fresh rhizome as anti-diarrhoeic. The Khamti lineage of Lohit quarter applied the paste of fresh rhizome in case of snake and scorpion bite (Kagyung et al., 2010 Label et al. 2007) [4].

Plant Profile:

- Kingdom - Plantae
- Subkingdom - Viridiplantae
- Phylum - Tracheophyta Sinnott
- Subphylum - Euphyllophytina
- Class - Magnoliopsida monocotyledons commelinids
- Order - Zingiberales
- Family - Zingiberaceae
- Subfamily - Zingiberoideae Tribe Hedychieae
- Genus - *Curcuma*
- Species - *C. caesia* Roxb [5]

Vernacular Names:

Curcuma caesia is known by different names in different corridor of India.

- Hindi - Kali Haldi
- Marathi - Kali halad
- Manipuri - Yaingang Amuba or 3 Yaimu
- Telugu - Nalla Pasupu
- Kannada- Kariarishina, Naru Kachora
- Bengali - Kala Haldi Mizo Aihang, Ailaihng
- Assamese - Kola Halodhi [6]

Morphological Characteristics:

Black turmeric is a standing, rhizomatous condiment, about 1.015 m high.

Rhizome:

The rhizomes are elliptical in shape, acute at tip, but not so thick as in other species of *Curcuma*. It's a sessile, indirectly smoothed and covered with accidental roots, root scars and knobs. It shows longitudinal indirect wrinkles on the face

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giving the look of nodal and intermodal zones to the rhizomes. The face (cork) of rhizome is dark brown, bluish black, or buff in colour. The branching is more or less sympodial. There rhizome of black turmeric has high significance owing to its apparent medicinal properties.

Leaves:

Leaves are about 3060 cm long and over to 15 cm broad, astronomically lanceolate or oblong, rough, with a deep ferruginous grandiloquent pall down the middle, which penetrates to the lower surface. Leaves arise from the underground rhizome. Inflorescence is a shaft, about 15 cm long or altogether about 30 cm high on rudimentary peduncle.

Flowers:

Flowers are pale unheroic, sanguine at the external border and shorter than their bracts. Petiole and jacket are about as long as the blade. Harpoons appear before the leaves. Flowers appear in June and July, while fruits develop in September and October [7].



Fig. 1.

Chemical Constituents:

The end is to insulate chemical ingredients from *C. caesia* rhizomes through bioassay- guided separation. The excerpt, hexanes and chloroform fragments showed effect on MCF- 7 and MDA- MB- 231 cells in cell viability assay. The chromatographic separation swung germacrone zerumbone, furanodienone, curzerenone, curcumenol, zederone, curcumenone, dehydrocurdione from hexanes bit and curcuminol G, curcuzederone, (1S, 10S), (4S, 5S)- germacrone-1(10), 4- diepoxide, wenyujinin B, alismoxide, aerugidiol, zedoarolide B, zedoalactone B, zedoarondiol, isozedoarondiol from chloroform fraction. This is first report of composites 2, 9- 13, 15- 18 from *C. caesia*. The study demonstrated composites 1- 4 and 10 are the bioactive composites. The effect of curcuzederone on MDA- MB- 231 cell migration showed significant inhibition in scrape and trans well migration assays [8].

The exploration on the unpredictable oil painting of *C. caesia* rhizomes redounded in the identification of 30 factors, representing 97.48 of the oil painting, with 1. Camphor (28.3) 2. AR- turmerone (12.3) 3. (Z)- ocimene (8.2) 4. AR- curcumene (6.8), - cineole (5.3) 6. Elemene (4.8) 7. Borneol (4.4) 8. Bornyl acetate (3.3) 9. Curcumene (2.82) as the major ingredients [9].

A. Cultivation of Black Turmeric

1) Climate

Curcuma caesia generally grows in wettish evanescent regions. The stylish season to plant turmeric is spring or summer. It requires warm and sticky climate to grow. Keep the turmeric factory in partial sun in the warmer zones. Turmeric prefers warm direct or indirect sun.

2) Soil

Rich organic soil that's wettish and well- drained. It's grown on different types of soils from light black, cadaverous gault and red soils complexion gault. still, it grows stylish in a well- drained flaxen or complexion gault. Keep the soil wettish throughout the growing season from spring to fall and feeding with a liquid toxin in growing season is ideal [10].

3) Caring

Choose a large pot as this condiment can fluently exceed the height and spread. Place it about 2 elevation (5 cm) below the soil face, with the kids facing up. Water the land completely, avoid over watering. The crop is to be mulched incontinently after planting with green leaves at the rate of 12- 15 tonnes per hectare. It may be repeated for a alternate time after 50 days with the same volume of green leaves after weeding and operation of diseases or plastic mulching distance could be useful. Pruning isn't necessary, taking dried leaves off will be sufficient.

4) Nursing Techniques

Raising Propagules Rhizome pieces are directly planted in the field and no nursery stock is generally raised. Propagule rate and pre-treatment. Approximately, 1000 Kg of rhizomes shall be needed per acre for planting at distance of 30 cm 30 cm. No particular treatment is given to the propagules before planting.

5) Preparation of land

The land is ploughed, cursed, mixed with Vermicompost, Neem cutlet, Trichoderma and Gypsum@ 10 tonnes per acre together. However, lime@ 2 tonnes per hectare may be applied to reduce inordinate acidity in soils, at least one month before planting.

6) Broadcasting and optimum spacing

Middle of April is the stylish time for raising the crop in North- East India, while in other regions, it's the pre-monsoon period. The crop is propagated vegetatively through rhizomes. The whole or corridor of rhizome, importing roughly 20 g, should be planted in rows directly in the field during April. Planting at a distance of 30 cm 30 cm is set up optimum, for which 4500 propagules (rhizome parts) are needed acre. The rhizomes sow in about 15-20 days.

7) Intercropping system

Kali haldi is grown as a single crop. But, it may be intercropped beneath extensively interrupted cover trees, like Amla, Mango etc.

8) Irrigation practices:

The crop is generally grown under rain- fed conditions in high downfall tracts of Assam and Kerala countries. Constant moisture is to be maintained in other areas through regular irrigation. Sprinkler irrigation is the most suitable system.

9) Disease and pest control

Leaf spot (*Tephriasp.*, *Coletotrichum* sp.) and splint blotch

(Corticiumsp.) are occasionally observed on the crop. They can be controlled by scattering of liquid organic supporter at a week intervals.

B. Gathering Management

1) Crop maturity and harvesting

The crop takes about nine months to mature. Harvesting is done in mid-January. Before digging the rhizomes, soil is bedewed through irrigation, so that the rhizomes aren't injured. Injury to the rhizomes may beget decay of the harvest.

2) Post-crop operation

Pilled, half cut or sliced rhizomes should be kept in roaster at 55 C or beneath well-voiced shade for drying. These dried rhizomes should be stored in suitable damp- proof containers.

3) Chemical ingredients

Dried rhizomes of *Curcuma caesia* are reported to contain 1.6 essential oil painting containing 76.6 d- camphor 48.2 camphene and bornylene and 10.5 sesquiterpenes, curcumine, ionone, and 5 turmerone.

4) Yield

Estimated yield of fresh rhizomes is 19-21 tonnes per acre while dry rhizome yield is about 3.5 to 5 tonnes per acre [11].

Material and methods

5) Plant Collection

The rhizome of *C. caesia* was collected from Western Ghats of Karnataka, India and the rhizome of *C. aeruginosa* was collected from different points of Kottayam sections (Kerala, India) during the month of March-April 2011 and linked by Department of Botany, St. Thomas College Pala, Kerala. Voucher instance was prepared and deposited in the herbarium of the council for reference.

C. Preparation of Plant Extract

The collected rhizomes were dried under the room temperature and pulverized with a mechanical grinder and stored in air tight vessel. The 50 g of dried pulverized was subordinated to soxhlet birth using hexane, chloroform, ethyl acetate, acetone, methanol and water consecutively. Before birth with the coming detergent, the greasepaint was air dried to remove the clinging detergent. The excerpt attained was filtered and concentrated in rotary vacuum evaporator. The concentrated excerpt was used for antibacterial assays.

1) Bacterial Strains

Three gram-negative, multidrug-resistant (MDR) bacterial strains (*Acinetobacter baumannii*, *Escherichia coli*, and *Klebsiella pneumoniae*) were insulated from the Department of Microbiology, Siksha O Anusandhan (Deemed to be the University), Bhubaneswar.

2) Essential Oil

Extraction 100 g of fresh splint and rhizome samples of *C. caesia* were diced and subordinated to hydro distillation using Clevenger outfit for 3 and 6 h, independently. The chance of oil painting yield was calculated on the base of fresh weight. The humidity trace present in essential canvases (EOs) was removed by treating it with anhydrous sodium sulfate (Na_2SO_4) and stored in amber glass vials at 4C until farther analysis [12].

D. Therapeutic Activities

1) Antifungal

(Antimicrobial) The antimicrobial activity of the ethanolic extract of *Curcuma caesia* against both Gram-positive and Gram-negative bacteria and on various fungal strains might be demonstrative of the presence of broad-spectrum antibiotic compounds in the extract. The ethanolic extract of rhizomes of *Curcuma caesia* was exceptionally successful towards the majority of the Gram-positive microbes, Gram-negative microscopic organisms, and fungal strains in agar well diffusion strategy [13].

2) Anti-inflammatory

The result of anti-inflammatory studies showed that inhibition of albumin denaturation, membrane stabilization and Proteinase inhibitor at the highest concentration of 800 g/ml confirms the rhizome of *Curcuma caesia* are a potent inhibitor of acute and chronic inflammation [14].

3) Antibacterial

The research findings have shown that the rhizome of *C. caesia* is extensively rich in secondary metabolites. The extracts were assessed for their potential antibacterial activity against Gram positive and Gram-negative bacteria viz., *Bacillus cereus*, *Bacillus subtilis*, *Streptococcus agalactiae*, *Escherichia coli*, *Pseudomonas aeruginosa* and *shigella flexneri*. The rhizome extracts of black turmeric genotypes exhibit positive results against the Gram-positive bacteria [15].

4) Antioxidant

Curcuma caesia possesses strong antioxidant activity as evidenced by the free radical scavenging property, can be a very effective antioxidant and can protect biological systems against the oxidative stress that is found to be an important pathophysiological event in a variety of diseases including aging, cancer, diabetes, cardiovascular disorders, and rheumatoid arthritis. This may be due to the presence of phenolic components in the *Curcuma caesia*. Overall, *Curcuma caesia* is a source of natural antioxidant that can be important in disease prevention and health preservation [16].

5) Anti-Asthmatic Activity

Ethanolic extract of *Curcuma caesia* rhizomes offers mast cell protection against degranulation as compared to petroleum ether and water extracts. It leads to conclusion that CCEE may be useful in the management of asthma. *Curcuma caesia* shows significant role in mast cell protection against clonidine induced degranulation, while petroleum ether and water extract of *Curcuma caesia* rhizomes was nonsignificant. [17]

6) Anthelmintic Activity

Gill Randeep et al. (2011) studies two most popular species of genus *Curcuma*, one of which is *Curcuma caesia* were proved for their Anthelmintic activity. Extract were studied which included the determination of paralysis time and time of death of earthworms. All the extracts of both the plants exhibited dose dependent activity. The results indicated that ethanol extract of *Curcuma caesia* was most effective in causing paralysis of earthworms [18].

7) Smooth Muscle Relaxant Activity

Arulmozhi et al (2006) evaluated anti-asthmatic property of *Curcuma caesia*. The hydroalcoholic extract of *Curcuma caesia*

was tested for its relaxant effect in guinea pig trachea and also in the presence of various receptor antagonists and enzyme inhibitors.[19]

8) *Antiulcer*

An ulcer is defined as disruption of the mucosal integrity of the stomach and or duodenum leading to a local defect or excavation due to active inflammation. Ulcers occur within the stomach and or duodenum and are often chronic in nature. The etiology of peptic ulcer is not clearly known. The present study suggests that the ethanolic extracts of *Curcuma caesia* has significant ulcer protective effect against gastric ulcer, which is comparable to standard drug ranitidine [20].

9) *Anticancer*

C. caesia showed cytotoxic effect against EAC in vitro and anti tumour activity in Ehrlich's ascites carcinoma (EAC)-treated mice. *C. caesia* methanol extract significantly decreased the tumour volume, tumour weight, viable tumour cell and increased the non-viable tumour cell and lifespan of the EAC bearing control mice. The potential anti tumour activity is presumably by its direct cytotoxic effect and antioxidant property. The anti-proliferative activity of *C. caesia* was reported against three human cancer cell lines- (MCF-7) human breast cancer, (HCT-116) human colon cancer and (PA-1) ovarian cancer using the SRB (sulforhodamine B) assay.[21]

10) *Antidiabetic*

The antidiabetic effect of ethanolic and aqueous extracts of *C. cassia* Roxb revealed the presence of alkaloids, glycosides, steroids and many more. Diabetes Mellitus is a group of metabolic diseases characterized by hyperglycemia resulting from defects insulin secretion, insulin action or both. Diabetic nephropathy is a degenerative kidney vascular disorder that has a relationship with impaired carbohydrate metabolism or sugar intolerance (Diabetes Mellitus). Black turmeric (*Curcuma Caesia* Roxb.) is widely used by the community as a traditional medicine and has potential as an antidiabetic [22].

11) *Antiemetic activity*

The ethanol extract of *Curcuma caesia* rhizome showed significant antiemetic activity on chick emetic model and compared with domperidone. The highest % inhibition was shown by *Curcuma caesia* (89.97) [23].

12) *Depressant and hypnotic activity*

Curcuma caesia has potential therapeutic value for the management of depressive disorders. The methanol extract of *Curcuma caesia*. (MECC) rhizome was studied for CNS depressant activities and reported that the flavonoids, saponins and tannic acid are involved for the protecting brain function from CNS disturbance antidepressant. The analgesic activity of *Curcuma caesia* extract was evaluated by both acetic acid induced writhing method and tail flick method in mice to assess peripheral (non-narcotic) and central (narcotic) type of activities and revealed remarkable analgesic, locomotor depressant, anticonvulsant and hypnotic activity [24].

13) *Analgesic*

Satija Saurabha et al., (2011) compared the analgesic and antipyretic activity of different extracts obtained from *C. caesia* and *C. amada* rhizomes. Analgesic and antipyretic activities of the plant extracts was evaluated using chemical model of acute

pain and brewers 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* [25].

14) *Thrombolytic*

In the present study, thrombolytic activity analysis of *C. caesia* rhizome extract showed removal of clot by 38.75%, respectively, with that of positive control SK of 77.93% and negative control of 7.1% clot lysis. In the earlier work, we synthesized and characterized silver nanoparticle using hydroalcoholic extracts of and *C. caesia*. The silver nanoparticle synthesis was used for analyzing the thrombolytic potential along with the extracts. The comparative study reveals that the silver nanoparticle of *C. caesia* had high potential to lyse the clot. The available proof for the non-toxicity of silver nanoparticle will bring improvements in the treatment of thrombosis [15], [16]. Statistical analysis revealed that the rhizome extracts have a significant percentage of clot lysis when compared with positive and negative control. As the first-generation drugs (SK and UK), found to cause side effects, plant-based thrombolytic drugs will improve the treatment of thrombosis. Therefore, in-vivo *C. caesia* is further needed, to be recognized as a thrombolytic agent [26].

15) *Neuroprotective*

Results illustrated on antioxidant and anti AChE activities of the essential oil isolated from the rhizomes *C. caesia* indigenous to northeast India is the first report, which establishes the scientific fact that the essential oil of this plant has moderate antioxidant property and would be a valuable toxic free natural source for the management of neurodegenerative diseases. The major interactions of terpenoid al compounds with other compounds give a picture that terpenoids have a very significant role as antioxidants and cholinesterase inhibitors. Further analysis on in vivo models and the development of a formulation would facilitate to discern its mechanism and discover a novel, effective neuroprotective herbal drug [27].

16) *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. 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 food industry [28].

17) *Anticonvulsant*

The methanol extract of *Curcuma caesia* pre-treatment exhibited significant and dose dependent protection from PTZ-induced convulsions in mice by delaying the onset of convulsions. The methanol extracts of *Curcuma caesia* significantly and dose dependently decreased the fall off time in mice demonstrating its muscle relaxant property [29].

18) Scavenging Activity

The aim of present study was to evaluate antioxidant potential as well as the free radical scavenging activity of the methanolic extract of *Curcuma caesia*. The effect of extract on different ROS, RNS was studied and measured total phenol contains which is present in extract [30].

E. Marketed Preparation of Black Turmeric



Fig. 2. Black turmeric powder (Brand Name: Triphal)



Fig. 3. Black turmeric essential oil (Brand Name: Xetomos)



Fig. 4. Black turmeric capsules (Brand Name: Holy Natural)



Fig. 5. Black turmeric tablets (Brand Name: Neem & Black Turmeric)



Fig. 6. Black turmeric lip balm (Brand Name: Kali Haldi)

2. Conclusion

The genus *Curcuma* represents many species, most of them are fully explored but *C. caesia* Roxb. is not much studied. Traditional claims of this crude drug are yet to be pharmacologically explored to develop new compounds, which may be beneficial, for future studies. *Curcuma caesia* is widely distributed throughout India. The plant appears to have a broad spectrum of activity on several ailments. The pharmacological studies reported in this review confirm the therapeutic value of *Curcuma caesia*.

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