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Black Turmeric (Kala Haldi) – Ethnomedicinal Plant

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SUMMARY

Curcuma caesia Roxb is a perennial, erect rhizomatous herb with large leaves, commonly known as kali haldi. It belongs to the family Zingiberaceae. It is a multipurpose medicinal plant widely used in the traditional system of medicine, mainly fresh and dried rhizomes, in treating leucoderma, asthma, tumours, piles, bronchitis, bruises, snack bites, etc. The plant is reported to contain camphor, ar-turmerone, (Z)-ocimene, ar-curcumene, 1, 8-cineole, elemene, borneol, bornyl acetate and curcumin as the major constituents. The plant has been scientifically reported to have antifungal, antimicrobial, antioxidant and anti-asthmatic activities. Other medicinal properties are muscle relaxant, analgesic, locomotor depressant, anticonvulsant and anti-inflammatory. It is now considered as one of the potential sources of unique natural products for the development of medicines. In the present review article various established facts related to the plant Curcuma caesia have been compiled so that proper scientific methods can be initiated to validate its traditional uses and open the door for a source of potential drugs in near future.

INTRODUCTION

The black turmeric (family Zingiberaceae; botanical name *Curcuma caesia* Roxb., English name black turmeric, Hindi name kali haldi, locally known by Kalahaldhi in Assamese, Yaingangamuba in Manipuri, Borangshagain Monpa, BeiAchombain Sherdukpen communities) is a perennial herb with bluish-black rhizome. It has its origin from India and South-East Asia and thrives well in moist deciduous forest areas in clayey soil. In India, it grows in North-East and Central India, and also found in some places of South India. 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 aerial shoot along the leaves. The leaves show deep violet patches that run throughout the lamina. The upper side of the leaves is rough, velvety and broad oblong lanceolate. The leaves are generally present in the group of 10-20. The flowering bracts are green with a ferruginous tinge. Flower petals may be deep pink or red in colour. The inner part of the rhizome is bluish-black in colour and emits a characteristic sweet smell, due to the presence of essential oil. It has bitter and hot taste with pungent smell (Pandey *et al*., 2003; Das *et al*., 2013).

***Curcuma caesia* plant**

Inflourescence

Black Turmeric Rhizomes

Therapeutic uses

Black turmeric has been an essential component in general healthcare, particularly in the rural areas. It has been used by many tribal communities worldwide from centuries as spice, medicine and in spiritual practices. With advancement in technology, the species is gaining importance as a potential source of new drugs (Chadalavada *et al*., 2017). The rhizomes are used as stimulants, anti-diarrheal, diuretic, anti-emetic, wound cleanser and in treating various skin disorders in India, Indonesia, Thailand and Malaysia (Vairappan *et al*., 2013). The paste of black turmeric rhizome is applied on wounds and in rheumatic pain in Manipur. In Arunachal Pradesh the fresh decoction of rhizome is used as anti-diarrheic while the fresh paste of rhizome is applied over snake and scorpion bite (Chadalavada *et al*., 2017).These rhizomes are traditionally used in treatment of stomachache, typhoid and wounds in tongue by Monpa community of Dirang (West Kameng) in Arunachal Pradesh.

Bioactive compounds

Black turmeric has been recognized as a medicinal herb containing mixtures of different bioactive compounds that may act individually, additively, or in synergy to improve health. The plant contains a good percentage of curcumin which possesses many curative properties, as usually reported from all the curcuma species. The multiple phtyoconstituents like curcumminoids, oil content, flavonoids, phenolics, amino acids, protein and high alkaloids, found in the rhizome, are responsible for the antimicrobial, antitumor, anxiolytic, antiinflammatory, antiulcer, CNS depressant and antioxidant activities (Karmakar *et al*., 2013; Devi *et al*., 2015; Vineela *et al*., 2017). The chemical structure of phenolic compounds having hydroxyl group attached to benzene ring in its structure provides the ability to act as free radical scavenger. Antioxidants have been reported to act as scavengers of singlet oxygen and free radicals in biological systems. Black turmeric, used in traditional and folk medicine, seems to be a promising source of active therapeutic agents. Further studies on isolation of active principle agents may play an important role in increasing its pharmaceutical and industrial significance. Being a species of the genus Curcuma, that has been known for its antimicrobial potential since ages, black turmeric should be seen as an important source of plant based antimicrobials. Such species are likely to provide safer alternates to the microbe-based antimicrobials which are increasingly reported for their side effects and drug resistance (Pandey *et al*., 2015). In a field and market based survey, conducted in Dirang area of Arunachal Pradesh, this medicinal herb was recorded with economic benefits in the local communities due to its high market

price (Approx. Rs. 3000-3500/kg).The local communities should be encouraged to generate income through cultivation of this plant species at commercial scale.

Pharmacological profiles

Traditionally, *Curcuma caesia* possesses a wide range of anti-inflammatory activities. Its pharmacological study shows, bioactive components of its rhizomes, such as curcuminoids are responsible for anti-oxidative and anti-inflammatory properties, wound healing, hypoglycemia, anti-coagulant, anti-microbial activities and it also exhibit free radical scavenging property. Phytochemicals of *Curcuma caesia* shows potent antitumor properties. Its chemopreventive potential has the potential of protecting endogenous enzymatic and non-enzymatic antioxidant activity.

Anti-cancer activity

In phytochemical screening of MECC found the steroids, tannins, saponins, volatile oil, proteins alkaloids and flavonoids, which possess potent antitumor properties. This is presumably potentiated by its direct cytotoxic effect and antioxidant property. It was assumed that attenuation of oxidative stress in different tissues in Ehrlich ascites Carcinoma (EAC) bearing mice decreased the viability of EAC cells. Phytochemical findings suggest that the MECC exhibits potential antitumor and antioxidant activities which enlighten a novel source of phytomedicines in free radical and tumour biology.

Antifungal activity

Rhizomes of *Curcuma caesia* possessed antifungal activity. Essential oils extracted from the rhizomes were tested for antifungal activity against several human and plant pathogenic fungi. Dilutions of the oil in ethylene glycol were tested by an agar diffusion procedure on plates seeded with the test isolates. Some antifungal effect was noted[25]. The antimicrobial activity of ethanolic extract of CC was due to the presence of various type of curcumoid like substrate, which is confirmed by the TLC[26]. "(Z)-7-methoxy-1, 5-dihydrobenzo[c] oxepine" is a terpenoid, isolated from CC shows antifungal as well as antibacterial activities against some major plant pathogenic microbes[27].

Antibacterial activity

Antibacterial activity was determined against *Bacillus subtilis*, *Staphylococcus aureus* and *E. coli*. The results showed that total phenolic content in the oils ranged from 4 – 83 µg gallic acid equivalents (GAE)/µL oil. Oils from *C. caesia* exhibited maximum antibacterial activity against *B. Subtilis*. The methanol root extracts exhibited significant antibacterial activity against gram positive and chloroform root extracts against gram negative bacterial species except for *P. aeruginosa*. These findings reveal that the plant based antimicrobials have enormous therapeutic potentials and can serve the purpose with lesser side effects that are often associated with synthetic antimicrobials. Most of the *Curcuma* species are used in traditional medicine for their bactericidal and anti-inflammatory properties. Many are underutilized and among them CC have a tremendous scope for utilization of their essential oils as pharmaceutical and food additives.

Antioxidant activity

An antioxidant is a molecule stable enough to donate an electron to a rampaging free radical and neutralize it, thus reducing its capacity to damage. These antioxidants delay or inhibit cellular damage mainly through their free radical scavenging property. The body can not manufacture these micronutrient antioxidants, so they must be supplied in the diet. When CC was evaluated for their antioxidant properties through sulphur free radical activity with curcumin as reference indicator, it shows significantly decreases the depletion of pure curcumin sample, which indicates that this crude extracts possessed antioxidant properties[31]. The extract showed significant antioxidant activities in a dose dependent manner. The IC_{50} values for scavenging of free radicals were 94.03±0.67 µg/mL, 155.59±3.03 µg/mL, 68.10±1.24 µg/mL, 21.07±1.78 µg/mL, 260.56±12.65µg/mL and 33.33±0.52 µg/mL for DPPH, nitric oxide, superoxide, hydroxyl, peroxynitrite and hypochlorous acid, respectively. Therefore, it is concluded that the methanol extract of CC rhizome is a potential source of natural antioxidant. Presence of potent antioxidant activity in CC, probably derived from compounds such as flavonoids, phenols and sterols.

Antiulcer activity

The treatment of rats with ethanolic extract of *Curcuma caesia* produce a significant reduction of ulcer index, gastric acid volume, pepsin, free and total acidity along with increased production of gastric mucus. The LD50 value of the ethanolic extract of CC was found to be more than 2000 mg/kg. It shows the ethanolic extract of the plant exhibited anti-ulcer activity.

Neuropharmacological activity

The neuropharmacological effect of CC has been examined through experimental demonstration in rodent model. It possessed promising analgesic, locomotor depressant, anticonvulsant and muscle relaxant effects. In rodent model demonstration, the MECC showed significant ($p < 0.001$) inhibition of writhes, at both test doses as compared with control group in a dose dependent manner. The mean writhing score during 30 min observation period in the control group was 59.68 ± 4.63. MECC at the both doses exhibited significant ($p < 0.001$, after 30 and 60 min) increase in reaction time of mice but the effects were not dose dependent. Peak analgesic effect was observed at 60 min indicating maximum increase in reaction times. In locomotor activity study, it was found that MECC significantly ($p < 0.001$) depressed the locomotor activity in mice in a dose dependent fashion. The MECC pre-treatment exhibited significant ($p < 0.001$) and dose dependent protection from PTZ-induced convulsions in mice by delaying the onset of convulsions and recovering the animals leading to survival. In muscle relaxant study, the MECC significantly ($p < 0.001$) and dose dependently decreased the fall off time in mice demonstrating its muscle relaxant property. This study corroborates the traditional uses of CC rhizome in the management of pain, fever and epilepsy.

CONCLUSION

C. caesia is widely distributed throughout India. The plant appears to have a broad spectrum of activity on several ailments. Rhizomes of the plant have been explored for antifungal activity, smooth muscle relaxant and anti-asthmatic activity, antioxidant activity, analgesic activity, locomotor depressant, anticonvulsant and muscle relaxant effects, anxiolytic and CNS depressant activity, anti-bacterial activity, antiulcer activity, anticancer activity and many other miscellaneous activities. The rhizomes of the plant have enough bioactive properties as shown in the different animal model. The phytoconstituents are also proved to be identified. This data may signify the investigations of different bio-active compounds from the plant *Curcuma caesia* Roxb. and the requisite level of activity. The pharmacological studies reported through various investigations confirm the therapeutic value of *C. caesia*. Its possibility of *in vitro* regeneration through tissue culture and micropropagation will increase its use in pharmaceutical and cosmetic industries.

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