



Review Article

COCCINIA INDICA (KUNDRU): A MAGICAL HERB WITH ANTIDIABETIC POTENTIAL

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ABSTRACT

Many traditional medicines are obtained mainly from medicinal plants, minerals and organic matter. During the past many years, there has been increasing interest among the uses of various medicinal plants from the traditional system of medicine for the treatment of different ailments. *Coccinia indica* is one such important medicinal plant which belongs to the family Cucurbitaceae. It is extensively used as a vegetable and grown widely throughout the Indian Subcontinent. It is commonly called 'Kundra' in India. Traditionally different parts of this plant namely the roots, leaves and fruits are utilized in folklore medicine for several purposes, especially for hypoglycemia and skin diseases. There are many patented formulations derived from *Coccinia indica* plant. This plant is a primary source from where we get different phytochemicals which are utilized as the main constituent in numerous formulations endorsed for several ailments. *Coccinia indica* plant possesses many therapeutic activities like antidiabetic, hypolipidemic, hepatoprotective, larvicidal, anti-inflammatory, analgesic and antipyretic activities. The present review provides adequate information, photochemistry and various medicinal uses of *Coccinia indica* plant.

KEYWORDS: *Coccinia indica*, Antidiabetic, Flavonoid, *Bimbi*, *Kundru*.

INTRODUCTION

In India, there is wide use of the different parts of medicinal plants to cure various ailments from past times. Traditional system of medicine consists of a large number of plants with much medicinal and therapeutic importance. The indigenous system of medicine, namely Ayurveda, Siddha, Unani and Chinese traditional has been in existence for several centuries. According to the stats around 70000 plant species have been used for medicinal purposes. India recognizes more than 2500 plant species having therapeutic value, Sri Lanka around 1400 and Nepal around 700^[1]. About 40% of doctors especially in India and China have prescribed to increase the use of indigenous drugs and natural medicines^[2,3]. According to the World Health Organization (WHO), 80% of the population living in developing countries relies on traditional medicines for their primary health care needs. Plants have played a significant role in maintaining human health and improving the quality of human life^[4]. The present review highlights the details about *Coccinia indica* plant. *Coccinia indica* is commonly called as Little gourd. It is a native plant to India, Asia and Africa. It is a climbing perennial herb which spread vegetative or by seed. This plant has also been used extensively in Ayurvedic and Unani practice in the

Indian Subcontinent^[5]. *Coccinia indica* is used to treat the highly prevalent disorder diabetes mellitus^[6]. Many reported studies clear that this plant is widely used for its hypoglycemic and antidiabetic potential^[7-9]. Each part of this plant is valuable in medicine and various preparations. According to Ayurveda, *Coccinia indica* has been well documented in *Vamanopaga dashemani* and *Urdhvabhagahara varga*^[10]. The plant stem is an herbaceous climber with occasional adventitious roots forming where the stem runs along the ground. This plant is found to have many other pharmacological activities like hypolipidemic^[11], antimutagenic^[12], anti-inflammatory^[13] and antiglycemic^[14]. It is also used in various skin disorders, bronchitis, smallpox, ringworm, scabies and ulcers^[15,16]. In present review, the authors explained the detailed description of the plant, its phytochemicals, and its numerous therapeutic uses from an Ayurvedic and modern perspective. The taxonomical classification^[17] and vernacular names^[18-20] of *Coccinia indica* plant are given in table no. 1 and 2 respectively.

Table 1: Taxonomical classification of *Coccinia indica*

Taxonomical Rank	Taxon
Kingdom	Plantae
Division	Magnoliophyta
Class	Manoliophyta
Order	Cucurbitales
Family	Cucurbitaceae
Genus	Coccinia
Species	Indica
Common Name	Ivy- Gourd

Table 2: Vernacular names of *Coccinia indica*

English	Ivy-Gourd, Scarlet-fruited gourd, Tindora, Kovai fruit
Hindi	Kundaruki-Bel
Arabian	Kabare
Persian	Kabare
Canarian	Goraph-phla-lata
Burmese	Kenbh-oun-bin
Sanskrit	Bimbi
Punjabi	Kanduri
Assam	Kawabhaturi
Bengali	Bimbu, Telakucha
Gujarati	Kadavinghilodi, Ghilodi
Kannada	Tonde-Balli
Malayalam	Kova, Nallakova
Marathi	Tondale
Oriya	Pitakundii, Kainchikakudi
Tamil	Kovai
Telugu	Donda Tiga
Urdu	Kunduru
Chinese	Hong gua
Danish	Slariagenagurk

Coccinia indica (Figure 1) is a tropical plant of the pumpkin family. It is an aggressive climbing vine that can spread quickly over trees, shrubs, fences and

other supports. Being a perennial plant, it can spread vegetative or by seed. Leaves are 5-10cm, long and broad, bright green above, paler beneath, studded and sometimes rough with papillae, palmate 5-nerved from a cordate base, often with circular glands between the nerves. Lobes are broad, obtuse or acute, apiculate more or less sinuate toothed, petioles 2-3.2cm long. In male flowers peduncles are 2-3.8cm long and sub-filiform. Calyx-tube is glabrous, broadly campanulate and 4-5mm. Corolla is 2.5cm long, veined pubescent inside and glabrous outside. In female flowers peduncles are 1.3-2.5cm long. The ovary is fusiform, glabrous and slightly ribbed. Fruits are fusiform-ellipsoid, slightly beaked, 1.3-2.5cm sized, marked when immature with white streaks, bright scarlet when fully ripe. Seeds are ovoid and rounded at the apex, slightly papillose, much compressed and yellowish-grey. The root is thick, tuberous, long tapering, more or less tortuous with a few fibrous rootlets attached to it. Roots are soft, flexible and break with a fibrous fracture. A transaction of the root shows a circular outline. Parenchyma with vascular elements is observed. The cork is composed of rows of cells.^[21]

Geographical Distribution of *Coccinia indica*

All species of *Coccinia* occur in sub-Saharan Africa, from semi-arid Savannas to a rain forest. It is also found rarely in mountain forests. *Coccinia indica* is widely distributed throughout India, tropical Africa, Australia, Fiji and other oriental countries. It is native to Bengal and other parts of India^[22].

Phytochemical Constituents of *Coccinia indica*

The phytochemical studies of the plant *Coccinia indica* are focused mainly on the roots and fruits of the plant. Scientific studies discovered that *Coccinia indica* contains saponins, flavonoids, sterols and alkaloids. Saponin and flavonoid are found to be responsible for antidiabetic activity. The phytochemical constituents of *Coccinia indica* are summarized in table no. 3.

Table 3: Phytochemical constituents of *Coccinia indica*

Plant Part	Phytochemical Constituents Reported
Roots [23-26]	Triterpenoid, saponin coccinioside – C ₄₁ H ₆₆ O ₁₂
	Flavonoid Glycoside ombuin 3-o- arabinofuranoside
	3-o-β- (α-1- arabinopyranosyl)-(1-2) - β-d- glucopyranosyl- (1-3)- β-hydroxylup- 20(29)- en-28- oic acid
	Lupeol, β-amyrin and β- sitosterol
	Stigmast – 7-en-3-one
Fruits [27-30]	Taraxerone, taraxerol, and (24R)-24- ethycholest-5-en- 3β-ol glucoside
	B- carotene, lycopene, cryptoxanthin, and apo-6- lycopenal

	B- sitosterol and taraxerol
Aerial Parts [31-32]	Heptacosane
	Cephalandrol, C ₂₉ H ₅₈ O tritriacontane C ₃₃ H ₆₈ B- sitosterol alkaloids Cephalandrine a and Cephalandrine b
Whole Plant [33]	Aspartic acid, Glutamic Acid, Asparagine, Tyrosine, Histidine, Phenylalanine and Threonine Valine Arginine



Botanical Description of *Coccinia indica*

Traditional and Modern View

Ayurvedic View: *Coccinia indica* is known in Ayurveda as *Bimbi*. This is an eatable vegetable plant popular for the treatment of intestinal worms, skin diseases and diabetes problems. It is also used for inducing emesis and purgation in *Panchakarma* therapy. This plant is classically categorized by many popular Ayurvedic physicians. According to Charaka Samhita, it is categorized as *Moolini* that means herbs with root as used part. In Sushruta Samhita, it is categorized as *Urdhwabagahara* (a group of herbs that are used for inducing vomiting). This plant reduces the vitiate *Kapha* (Earth+Water elements) and *Pitta* (Fire+water) *Dosha*^[34-35]. *Rasa panchak*^[36] of the *Kundru* as per Ayurveda is shown in table no. 4.

Table 4: Rasa Panchak (Properties and Action) of Kundri (*Coccinia indica*)

Sanskrit/ English	Sanskrit/English
<i>Rasa/taste</i>	<i>Tikta/ bitter</i>
<i>Guna/physical properties</i>	<i>Laghu, Ruksha, Teekshna/ light, dry, strong</i>
<i>Virya/potency</i>	<i>Ushna/hot</i>
<i>Vipaka/metabolic properties</i>	<i>Katu/pungent</i>

As per the *Bhajana Kutuhalam* literature, the leaves of *Bimbi* are sweet in taste, cold in potency. It is also helpful in the treatment of *Vata-pitta dosha*, bleeding disorders, *Kamala* (jaundice), *Pandu* (anemia disorders) and thirst. It also increases *Medhodathu* (fats in the body), semen and aggravates *Kapha Dosha*.

Each part of the plant possesses different therapeutic action. Various Ayurvedic uses^[37,38] of *Kundri* is mentioned below:

Vamani- Excess usage may induce vomiting.

Ashleshmala- Balances down *Kapha dosha*.

Raktapitta- Indicated in bleeding disorders such as nasal bleeding, heavy periods etc.

Shwasa- Indicated in asthma and chronic respiratory disorders.

Pandu- Prescribed in anemia.

Shvayathu- Reduces swelling and inflammation.

Kamala- Prescribed in jaundice and liver disorders.

Stambhana- Used for blocking the external channel that may useful in diarrhea, bleeding disorders.

Vatadhmanakrut- May cause bloating, gaseous distension of the abdomen.

Daha- Indicated in burning sensation, as in gastritis, neuropathy, burning sensation in eyes, etc.

Folk View: The literature indicates that the medicinal use of *Coccinia indica* is as old as 5000-6000 BC. Each part of the plant is used in ethnomedicine. The fruits of *Coccinia indica* have an astringent effect on the bowels. It is also employed in the purification of blood and the treatment of leprosy. The seeds were used in the treatment of sore chests, fever, hemoptysis and bronchitis by the locals of India. It was also reported that they have applied seeds in the case of benign prostatic hyperplasia which possesses anti-ulcer property^[39-40]. In the past times, there was confusion regarding the plant's origin. Some early literature states that it might have been introduced by humans before Europeans settlement of Australia, along Indonesian fishing routes to the isolated coastal regions of the Northern Territory, where it now occupies remnant vine forests. The Queensland Herbarium currently lists this species as 'naturalized' (not native). This herb is recorded as an invasive weed in Saipan, Fiji, Guam, Hawaii, Solomon Island and Tongatapu Island. In Hawaii, PIER commented that it is 'naturalized and rapidly spreading plant'^[41-42]. According to folklore, *Coccinia indica* is rich in beta-carotene. The juice of the roots and leaves is used in the treatment of diabetes. The leaves are used as a poultice in treating skin eruptions. The plant is used as a laxative^[43].

Modern View: From the early times *Coccinia indica* has been popularly used as an Ayurvedic drug for diabetic mellitus. People prefer herbal medicines over allopathic medicines due to their fewer side

effects and are considered as safest medicines^[44,45]. To meet the demand of people, adulteration rises in the herbal drug industries which ultimately affect the health of people. All the herbal plants contain several phytochemicals which possess numerous therapeutic activities. Modern medication systems used herbal plants for drug formulation but alter their natural effect whereas Ayurvedic medicines work on a holistic approach^[46,47]. Many clinical trials reveal that *Coccinia indica* is of limited value in controlling diabetes as compared to exogenous insulin or the synthetic drug. It is similar to a drug which stimulates the production of gastric juice and the flow of intestinal hormones. It is helpful in the release of insulin. From the reported studies, it was found that the inhabitants who use this plant as a drug are convinced of their efficacy of scarlet gourd in curing many ailments^[48].

Reported Therapeutic Uses of *Coccinia indica*

There are several reports on the use of natural materials sources like plants, bacteria, fungi, yeast and honey. *Coccinia indica* is also considered as a wide source for modern or herbal formulation. Various studies (like *in-vivo*, *in-vitro*) have been done for the therapeutic uses of *Coccinia indica*. Those reported studies are shown below:

Anti-diabetic Activity

Ajay et al., studied the anti-diabetic activity of alcoholic extract of leaves of *Coccinia indica* in diabetic rats. Diabetes was artificially induced by a single intraperitoneal injection in the models. The result showed that 600mg/kg alcoholic extract of leaves possess a significant hypoglycemic effect on blood glucose level in rats^[49]. Mallick et al., reported anti-diabetic activity of aqueous extract of *Musa paradisiaca* and *Coccinia indica* leaves in streptozotocin-induced diabetes rats. Result showed a potent effect after composite extract treatment on blood glucose level in diabetic rats^[50]. Gunjan et al., reported that the chronic administration of 200mg/kg fruit extract for 14 days reduces the blood glucose level in alloxan-induced diabetic rat^[51]. Doss et al., reported that the aqueous extract of *Coccinia indica* reduces the blood glucose level in diabetic rats. The extract was also reported for the reduction of cholesterol protein and urea in the models^[52]. Manjula et al., examined the hypoglycemic activity of leaves extract of *Coccinia indica* in alloxan-induced diabetic rats^[53]. Ramakrishnan et al., reported hypoglycemic activity of *Coccinia indica* fruit by using alloxan-induced diabetic rat. Ethanolic extract showed a decreased blood glucose level. Pectin from fruit reduces blood glucose by decreasing the absorption of glucose from the intestine and increasing liver glycogen and decreasing glycogen

phosphorylase^[54]. Saklanil et al., reported hypoglycemic activity of combined methanolic extract of leaves of *Coccinia indica* and *Salvadora oleoids* in alloxan-induced diabetic rats^[55]. Ariful et al., reported triterpenes, alkaloid, flavonoid, B-carotene in ethyl acetate extract and petroleum ether extract of *Coccinia indica*. These reported constituents are responsible for hypoglycemic activity.

Antibacterial Activity

Syed et al., reported the antibacterial activity of aqueous, hexane extract of leaves and aqueous, hexane, ethyl acetate extract of stem of *Coccinia indica* against four Gram-positive bacteria i.e., *Bacillus cereus*, *Corynebacterium diphtheriae*, *Staphylococcus aureus* and *staphylococcus pyogenes* and six gram-negative bacteria (*Salmonella typhi*, *Escherichia coli*, *Klebsiella pneumonia*, *Pseudomonas aeruginosa*, *Proteus mirabilis* and *Shigella boydii*). Ethanol and ethyl acetate extracts of stem were found to be more effective in both gram-positive and gram-negative bacteria as compared to aqueous and hexane extract of leaves of *Coccinia indica*^[56]. Bhattacharya et al., reported antibacterial activity of aqueous extract of leaves of *Coccinia indica* against *Shigella choleraesuis*, *Shigella dysenteries* and *Shigella flexneri*. It was found that aqueous extract of *Coccinia indica* have significant antibacterial activity in comparison to ethanol extract^[57]. Sivaraj et al., evaluated the *Coccinia indica* leaf extract with solvents such as acetone, ethanol, methanol, aqueous and hexane for antibacterial activity against five bacterial species. Ethanol leaf extract was found to have antibacterial activity against *S. pigeons*, *E. coli*, *B. cereus*, *K. pneumonia* and *S. aurens*^[58]. Farukhh et al., evaluated antibacterial activity of *Coccinia indica* extracts against six gram-positive and gram-negative bacteria. The ethanol extract was found to possess active antibacterial activity against all except *Klebsiella p* and *Prosteus mirabilis*. Hexane extract was found to be moderately antibacterial against all gram-positive and gram-negative bacteria except *Proteus mirabilis*. Ethyl acetate extracts moderately active against all stains except *Proteus mirabilis* and *staphylococcus aeruginosa*^[59,60].

Antifungal Activity

Bhattacharya also examined the *Coccinia indica* leaves extract for antifungal activity against the *Candida albicans-II*, *Candida tropicalis*, *Aspergillus Niger*, *Saccharomyces cerevisiae*, *Candida tropicalis II*, *Cryptococcus neoformans* and *Candida albicans ATCC*. Result showed that ethanol extract is more significant in producing antifungal activity as compared to aqueous and ethanolic extract^[57].

Hepatoprotective Activity

Shyam et al., examined the hepatoprotective activity of diethyl ether extract of leaves of *Coccinia indica* in CCL₄ induced hepatotoxicity rats. The 400mg/kg diethyl ether extract was administered orally in the group of animals. Sylimarin was used as a positive control. The result showed a higher rate in reduction of SGOT and SGPT level when treated with diethyl ether extract as compared with sylimarin treatment^[61]. Vadiu et al., evaluated the hepatoprotective activity of alcoholic extract of fruit of *Coccinia indica* against CCL₄ induced rat hepatotoxicity rats. It was evaluated that treatment with 340mg/kg ethanolic extract of fruit significantly reduced the SGPT, SGOT and bilirubin level in rats^[62]. Another study reported flavonoids, triterpenes and tannins as an antioxidant agent present in *Coccinia indica* and may interfere with free radical formation. This may have confirmed that certain flavonoids possess hepatoprotective activities^[63-65].

Anthelmintic Activity

Tamilselvan et al., reported anthelmintic activity of methanolic extract of *Coccinia indica* against pheretime poshtuma. Result showed that methanolic extract of *Coccinia indica* was active for paralyzing the worm^[60].

Antilulcer Activity

Girish et al., examined antiulcer activity of aqueous extract of leaves of *Coccinia indica* in pylorus ligation and ethanol-induced ulcer in rats. Ulcer index was determined in both models. The aqueous extract showed a significant reduction in ulcer index, free acidity and gastric^[66]. Manoharan et al., evaluated antiulcer activity of ethanol, aqueous and total aqueous extract in pylorus ligation induced gastric ulcer. The three extracts were studies in rats. Result showed 400mg/kg ethanolic extract exhibited significant antiulcerogenic activity as that of omeprazole^[67].

Antioxidant Activity

Moideen et al., examined antioxidant activity of ethanol extract of root of *Coccinia indica* which contains flavonoids against paracetamol-induced hepatic oxidative stress in Wistar albino rats. These flavonoids are responsible for antioxidant activity^[68]. Deshpande et al., reported methanol extract of *Coccinia indica* also contains glycoside and flavonoid. Whereas, methanolic extract of the fruit of *Coccinia indica* possesses potent antioxidant activity^[69]. Another study also reported antioxidant activity of *Coccinia indica* plant^[70-71].

Antimalarial Activity

Sandaram et al., evaluated antimalarial activity of *Coccinia indica* extract against the

Plasmodium falciparum^[72]. Aqueous leaf extract was found effective to decrease SGPT, SGOT, ALP, total protein, blood urea nitrogen concentration. A hydrophilic moiety of *Coccinia indica* extract is responsible for antimalarial activity. The extract significantly reduced the plasmodium berghei parasite count in mice^[73].

Anti-inflammatory Activity

Deshpande et al., reported anti-inflammatory activity of aqueous extract of *Coccinia indica* leaves and stem against formaldehyde-induced paw edema in rats. Aqueous extract of leaves showed a more significant percentage inhibition of paw edema than the aqueous extract of stem^[69].

Antipyretic Activity

Aggarwal et al., reported antipyretic activity of methanolic extract of *Coccinia indica* in yeast-induced fever. 100 and 200mg/kg dose showed active antipyretic activity by influencing the prostaglandin biosynthesis. Prostaglandin is considered a regulator of human body temperature^[74].

Analgesic Activity

Aggarwal et al., also reported analgesic activity of methanolic extract of *Coccinia indica* against acetic acid-induced analgesia in rats. The result showed analgesic activity in the methanol extract of *Coccinia indica*^[74].

Anticancer Activity

Coccinia indica was reported to be having anticancerous activity due to antioxidants present in it. Bhattacharya et al., evaluated the aqueous extract of leaves of *Coccinia indica* for anticancer activity in Swiss albino rats. Nitric oxide is a free radical which acting an important role in the pathogenesis of pain inflammation^[75].

Mutagenic Effect

Bhuiyan et al., evaluated aqueous extract of leaves of *Coccinia indica* for mutagenic effect. Result showed inhibition of growth and mutagenesis on *Neurospora crassa* by a gradual decrease of growth of mycelia^[76].

CONCLUSION

Coccinia indica is one of the popular herbal plants utilized in various systems of medicine like Ayurveda, Siddha, Folk and Modern. This plant is associated with some significant therapeutic actions. It is utilized in the treatment of several diseases. As per the data of reported studies, each of its chemical constituents is associated with various pharmacological properties like antidiabetic, antiulcer, antibacterial, antimalarial, antioxidant, antifungal, anticancer, hepatoprotective, etc. It is also used in various Ayurvedic herbal formulations for

treating several disorders, especially in diabetic Mellitus. The literature revealed that this plant has been widely studied for therapeutic activities and regarded as universal Panacea in Ayurvedic medicines.

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