Coccinia indica: A Comprehensive Review of Pharmacology, Therapeutic Applications, Nutritional Potentials, and Future Prospects

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ABSTRACT

The pharmacognosy, phytochemistry, nutritional value, and ethnopharmacological activity of Coccinia indica (C. indica) are discussed in this review. Many patented compositions generated from C. indica are now widely available around the world. This has resulted in a rise in research on the phytochemical elements of C. indica as well as ethnopharmacological activities. This belongs to the Cucurbitaceae family. Indigenous peoples used several portions of the plant for food and medicine. When the fruit of C. indica is green in colour, it is used as a vegetable, and when it ripens into a beautiful scarlet hue, it is eaten fresh. C. indica's young leaves and branch tips are frequently utilised in traditional medical systems in Asia, including Ayurvedic, Siddha, and Unani. Traditionally, different parts of this plant used in folk medicine for many purposes, such as anti-diabetic, antimicrobial, anti-inflammatory, antioxidant, antimalarial, antidiyslipidemic, anticancer, analgesic, antipyretic, antinociceptive, hepatoprotective, ant obesity, and neuroprotective function. Many traditional medicines are made from medicinal plants, minerals, and organic materials, which is why this review is focused on that particular plant. The utilisation of numerous medicinal plants from the traditional medicine system for the treatment of various ailments has sparked increasing interest in recent years. Traditional medicine has employed C. indica as a home treatment for a variety of diseases.

Keywords: Coccinia indica; Pharmacognosy; Phytochemistry; Nutrition; Ethnopharmacology.

INTRODUCTION

Botanical Description of Coccinia indica

C. indica is in the Cucurbitaceae (pumpkin) family of tropical plants. C. indica is an aggressive vine that can spread rapidly across trees, shrubs, fences and other supports. It is an outdoor plant, but it is preferred to have a sunny sheltered location and a sandy earth. As a perennial plant, it may spread vegetation or seeds. The stem is a herbaceous climber with sometimes adventitious roots forming along the ground where the stem runs, or a perennial slender climber. The tendrils are long, elastic and have a springy, coil-like character that can curl up around the host for the entire length. With five lobes, the leaves are known as palmately plain, while the shape varies from the heart to the pentagon. The width and length of the leaves is approximately 5 to 10 cm. The flower is about 4 cm in diameter, wide and white, and contains five slender, tubular petals. The berry type belongs to the C. indica fruit: oval and flattened seeds [1,2]. The seeds are obovoid, slightly papillary, very compressed and yellowish-Gray, and rounded at the apex. The fresh root is dense, tuberous, tapering, with a few fibrous rootlets attached to it, more or less tortuous. Roots with a fibrous fracture are flexible, soft, and split. A root transaction displays a circular outline and is unique to the form of storage. Parenchyma is full of starch grains and it is observed to deeply permeate parenchyma with vascular elements. The cork is made of cell rows [3]. Indigenous peoples used several portions of the plant for food and medicine. When the fruit of C. indica is green in colour, it is used as a vegetable, and when it ripens into a beautiful scarlet hue, it is eaten fresh. In Asia, the young leaves and shoot tips of C. indica are used in cooking.

Nutritional Value of Coccinia indica

Aside from their delectable flavor, C. indica is a healthy source of vitamins, minerals, and nutrients. 100 grams of C. indica provide 1.4 milligrams of iron, 0/08 milligrams of Vitamin B2, 0.07 milligrams of Vitamin B1, 1.6 grams of total dietary fibre, and 40 milligrams of Calcium. Thiamine supports in the conversion of carbohydrates into glucose, which is the body's preferred source of energy for maintaining
metabolism running smoothly. It also supports in the digestion of proteins and fats. Thiamine is transported in the blood and plasma after consuming *C. indica* and then used by the cells to transform energy. Vitamin B1 is present in 0.07 milligrams in *C. indica*, which is 15.83 percent of the daily recommended dose. Thiamine, which is present in *C. indica*, is also essential for the production of red blood cells, which provide constant energy. Since thiamine and other B vitamins are naturally energy boosters and are necessary to create ATD from foods, B Vitamin Complex supplements are often categorized as energy boosters or healthy metabolism products. Patients are also given *C. indica* as a supplement to help correct metabolic disorders associated with genetic diseases [4].

**Preparation and Dosage**

*C. indica* supplements are available online as well as in several natural food retailers and dietary supplement stores. The majority of *C. indica* supplements come in tablet or capsule form, with doses ranging from 250 mg to 400 mg. *C. indica* tinctures are available in glass dropper bottles, as well as crude unfiltered extracts in larger (usually 32-ounce) bottles. There are no rules for using *C. indica* in a proper manner. Although some studies have used as little as 1 gram a day for 90 days [5], there is no proof that higher doses are more effective than lower doses. Most manufacturers recommend a daily dose of 400 mg to 500 mg, taken with or without food. Do not exceed the prescribed dose on the product label, regardless of the type our use. This does not mean that the product is safe or successful, but it can help you avoid unpleasant side effects. *C. indica* supplements should be kept in a cool, dry place. Never take a supplement until it has passed its expiration date.

**Table 1: Major Nutrients of Coccinia indica**

| Major Nutrients               | Quantity | Values in % per day |
|-------------------------------|----------|---------------------|
| Water                         | 93.5 ml  | Not Defined         |
| Energy                        | 75 kJ    |                     |
| Protein                       | 1,200 mg | 2.40 %              |
| Total Fat                     | 100 mg   | 0.29 %              |
| Carbohydrate                  | 3,100 mg | 2.38 %              |
| Dietary Fiber in Total        | 1,600 mg | 4.21 %              |
| Iron                          | 1.4 mg   | 17.50 %             |
| Calcium                       | 40 mg    | 4.00 %              |
| Potassium                     | 30 mg    | 0.64 %              |
| Vitamins B1                   | 70 µg    | 5.83 %              |
| Vitamins B2                   | 80 µg    | 6.15 %              |
| Vitamins B3                   | 70 µg    | 0.44 %              |
| Vitamins C                    | 1400 µg  | 1.56 %              |

*The values listed have been recommended by the United States Department of Agriculture. The calculations are based on a person who is 19 to 50 years old and weighs 88 kilograms [4].

**Phytochemical Constituents**

*C. indica* is high in β-carotene, complex carbohydrates, fibre, and a wide range of B vitamins and minerals. It's also a good nutrient source. Several important phytochemical elements have been found in various parts of the *C. indica* plant. The roots of *C. indica* are known to contain active constituents like “Flavonoid glycoside imbuing 3-oarabinofuranoside Triterpenoid, saponin locundioside – k (i). C41H66O12; Stigmast-7-en-3-one Lupeol, β-amyrin and β-sitosterol” [6-8]. Apart from alkaloids, carbohydrates, proteins and amino acids, tannin, saponins, flavonoids, phytosterol, and triterpenes, anthraquinones were found in the aqueous extract of fresh leaves of *C. indica*. Cephalandrol A and B, sigma-7-en-3-one, taraxerone, and taraxerol are some of the compounds found in Cephalandrol A and B [9]. The fruits of *C. indica* are known to contain active constituents like “Taraxerone, taraxerol, and (24R)-24- aholeholes- 5- en- 3β- ol glucoside. β- Carotene, lycopene, cryptoxanthin, and apo- 6'-lycopene, β- sitosterol and taraxerol” [10]. The study showed that whole plant of *C. indica* mainly contains “Aspartic acid, Glutamic Acid, Asparagine, Tyrosine, Histidine, Phenylalanine and Threonine Valine Arginine” [11].

![Figure1: Different parts of Coccinia indica](image)
Table 2: Major phytochemical compounds present in *Coccinia indica* [6-11]

| Name of the constituents | Chemical structure | Name of the constituents | Chemical structure |
|--------------------------|--------------------|--------------------------|--------------------|
| Aspartic acid            | ![Aspartic acid](image) | Taraxerol                | ![Taraxerol](image) |
| Glutamic Acid            | ![Glutamic Acid](image) | β-amyrin                 | ![β-amyrin](image) |
| Asparagine               | ![Asparagine](image) | β-sitosterol             | ![β-sitosterol](image) |
| Tyrosine                 | ![Tyrosine](image) | Cryptoxanthin            | ![Cryptoxanthin](image) |
| Taraxerone               | ![Taraxerone](image) | Palmitic acid            | ![Palmitic acid](image) |
| β-Carotene               | ![β-Carotene](image) | Lenoleic acid            | ![Lenoleic acid](image) |
| Lycopene                 | ![Lycopene](image) | Histidine                | ![Histidine](image) |

**Reported Ethnopharmacological Activity of Coccinia indica**

**Anti-Diabetic Activity**

Plants from the *C. indica* genus, or extracts from them, may play a role in diabetes treatment. Bioactivity-driven fractionation was used to create quercetin, a bioflavonoid that was isolated for the first time from *C. indica* aerial parts. In the oral glucose tolerance test, Quercetin considerably reduced glucose levels in type 2 diabetic rats, whereas it had no hypoglycemic effects in normal rats. Quercetin enhanced HDL-cholesterol levels in insulin and serum, as well as β-cell function [12]. After 45 days of oral treatment of 200 mg/kg ethanol extract of *C. indica* leaves to diabetic animals, blood glucose, glycosylated hemoglobin, total hemoglobin, and plasma insulin levels all decreased significantly. Normal, diabetic, diabetic rats treated...
separately with *C. indica* and glipalamide leaves, and diabetic rats treated separately with *C. indica* and glipalamide leaves had their liver activity of hexokinase, glucose-6-phosphatase, fructose-1, 6-bisphosphatase, and glucose-6-phosphate dehydrogenase, a lipogenic enzyme, measured. The activity of the lipogenic enzyme and hexokinase in the diabetic liver was significantly reduced, whilst the activity of the gluconeogenic enzymes rose significantly. Glipalamide and *C. indica* leaves were both able to bring the altered enzyme activity back to near-control levels. *C. indica* leaves were more effective than glipalamide [13].

A double-blind, placebo-controlled, randomized experiment was carried out by Kurian *et al.* (2008) [3]. For 90 days, 60 type 2 diabetes participants were randomly assigned to either the placebo or experimental groups and given 1 g of alcoholic extract of *C. indica*. When compared to the placebo group, the experimental group had significantly lower fasting, postprandial blood glucose, and A1C levels. Gunasinghe et al. (2011) [14], performed a phase I clinical trial that was double-blind. For breakfast, 61 healthy volunteers were given a meal containing 20 g of *C. indica* leaves, scraped coconut, and table salt, whereas another 61 were given a placebo meal including scraped coconut and salt. Both groups underwent a blind glucose tolerance test. Blood sugar levels in the study group were likewise significantly lower than in the control group.

**Antimicrobial and Malarial Activity**

Antimicrobial efficacy of *C. indica* bioactive substances against pathogenic microorganisms was examined. The agar well diffusion method and the broth dilution method were used to evaluate the aqueous and organic solvent extracts from the leaves of *C. indica* against *Enterobacter aerogenes*, *Pseudomonas aeruginosa*, *Staphylococcus epidermidis*, *Bacillus subtilis*, and *Salmonella typhimurium*. In contrast to the other extracts, the findings showed that ethanol and aqueous extracts had a more potent inhibitory effect. This illustrates the ability of plant extracts for human treatment of different skin and gastrointestinal infections [15]. Sivaraj *et al.*, (2011) [16] studies have shown that ethanol leaf extract of *C. indica* high antibacterial activity against *S. aureus*, *B. cereus*, *E.coli*, *K. pneumoniae* and *S. pyogenes*. The antifungal activity of the extract of *C. indica* leaves against *Candida albicans-II, Candida tropicalis*, *Aspergillus Niger*, *Saccharomyces cerevisiae*, *Candida tropicalis-II*, *Cryptococcus neoformans* and *Candida albicans ATCC* was evaluated by Bhattacharya (2010) [17]. In the production of antifungal activities, ethanol extract is more important. The extract has a higher degree of antifungal properties in the nonpolar fractions. *C. indica* extract demonstrates excellent anti plasmodial activity against Plasmodium falciparum [18]. Plasmodium berghei parasite count in mice is significantly reduced by the extract [19].

**Activity against Inflammation**

The anti-inflammatory activity was observed in the 25-300 mg / kg dose range of *C. indica’s* aqueous leaf extract. The impact was 50 mg / kg diclofenac equivalent (20 mg / kg) but was greatly pronounced at higher doses. The effectiveness of the extract in the early stage of inflammation implies suppression of the release of histamine and serotonin [20]. The Aqueous extracts of *C. indica* leaves and stem were inhibited formaldehyde-induced paw edema in rats [21]. Recent research showed that the physical evaluation of ointment suggested that the *C. indica* formulation is more suitable than other formulations and that its efficacy should be further explored in harnessing the plant’s ability to treat skin inflammatory diseases [22].

**Antioxidant Activity**

Using the DPPH (1, 1-Diphenyl, 2-picryl-hydradyl) free radical scavenging process, the antioxidant activity test of crude extracts was evaluated when ascorbic acid was used as normal with ICSO 43.22 μg / ml. With an ICSO value of 50.98 μg / ml, the ethyl acetate fraction of *C. indica* displayed the highest antioxidant activity [22]. In comparison with methanolic extract, the aqueous extract of *C. indica* fruits and leaves demonstrated important antioxidant activity by inhibiting DPPH and radical superoxide [24]. Study by Motiwala et al. (2015) [25], showed that *C. indica* crude mucilage (dietary fiber) indicates powerful antioxidant activity by scavenging DPPH and an excellent source of its growth as an excitant of nutraceutical / pharmaceutical and functional food in the prevention of various diseases.

**Anticancer Activity**

Cancer is a life-threatening disease that has a global impact. Curcubitacin B is responsible for some of *C. indica’s* anticancer properties. Curcubitacin B suppresses telomerase activity by suppressing hTERT gene expression, halting cell cycle progression in cancer cells at the G2/M phase. Apoptosis in cancer cells has also been described as a result of the chemical [26]. Hepatocellular carcinoma is the world’s fifth most frequent malignancy and the third leading cause of cancer-related death. Sampath Kumar *et al.*, (2008) [27], study have shown that protective effect of *C. indica* against benzidine induced hepatocellular carcinoma may be due to the presence of flavonoids and other Phyto constituents in the ethanolic extract of *C. indica*. Plant flavonoids were shown to have anticarcinogenic activity in certain experimental animals [28]. Curcubitacin-B, a tri-terpenoid present in the leaves of *C. indica* has also been shown to have anti-tumor activity. It inhibits the activation of JAK/STAT 3 pathways which can contribute to oncogenesis [29].

**Analgesic and Antipyretic Activity**

Niazi *et al.* (2009) [10], discovered that an aqueous extract of fresh *C. indica* leaves had analgesic efficacy comparable to morphine at 300 mg/kg, implying that the central mechanism is involved. In rats, extracts with a maximum impact of 300 mg/kg, comparable to paracetamol, were created, and hyperpyrexia was significantly reduced.

**Antitussive Activity**

*C. indica* has long been utilized by the indigenous people of India to treat asthma and cough. In comparison to the prototype antitussive drug codeine phosphate, Pattanayak (2009) [30], found that the number of coughs acquired in the presence of both methanol extract concentrations was significantly reduced. At 100, 200, and 400 mg/kg per oral, methanol extract showed significant antitussive effect, reducing cough by 20.57, 33.73, and 56.71 percent within 90 minutes of the experiment.

**Antinociceptive Activity**

Tests of antinociceptive activity in acetic acid-induced gastric pain writhing in a mouse model were performed. The number of writhing’s was decreased by 36.4 percent when the lowest dose of extract was measured (100 mg per kg body weight). The extract reduced the amount of writhing by 47.5 percent when a dosage of 400 mg per kg body weight was administered. When observed with a normal antinociceptive medicine, aspirin, the recorded result was significantly greater [31]. Major and dose-dependent antinociceptive activity was also shown by methanolic leaf extract.

**Hepatoprotective Activity**

The liver is the largest and one of the body’s most complicated internal organs. The liver is the largest and one of the body’s most complicated internal organs. It plays a key role in the detoxification of many endogenous and exogenous compounds and their excretion. Therefore, liver damage has been identified as a toxicological issue caused by toxic substances and some medications. In the worldwide health care scheme, herbal drugs play an important role and there is a revival of interest in herbal medicines for the treatment of various diseases, including hepatopathy [32]. The diethyl ether extract of *C. indica* leaves was tested in rats for hepatoprotective activity against...
liver toxicity caused by carbon tetrachloride. The findings showed that the hepatoprotective efficacy of *C. indica* leaf extract at a dosage of 400 mg / kg body weight was comparable to that of 125 mg / kg body weight of silymarin under standard care. We also observed the hepatoprotective role of *C. indica* leaf extract against toxic effects caused by enalapril in our previous research report. The results showed that *C. indica* leaf extract was hepatoprotective at a dose of 400 mg / kg body weight.

Anti-obesity Activity

Bunkrongcheapet al. discovered that *C. indica* root has ant obesity properties. It worked directly on preadipocytes, preventing differentiation by inhibiting at least one primary adipogenicity transcription factor -PPARγ. In addition to having a blood sugar lowering effect, the presence of a potential antiadipogenic agent in this plant can make it suitable for treating metabolic diseases caused by obesity.

Neuroprotective agents

Vitamin B2 is a soluble vitamin in water. Since it cannot be stored in the body, it needs a regular dose. It is an important nutrient in our diet and plays a vital role in energy production. *C. indica* helps to strengthen the nervous system by providing calories, vitamins, and antioxidants. *C. indica* can help with a variety of nervous system issues, including Alzheimer's disease, epilepsy, numbness, multiple sclerosis, anxiety, and more. *C. indica*, when combined with vitamin B6, is thought to be beneficial in treating the debilitating symptoms of Carpal Tunnel Syndrome.

**Table 3: Summary of the most important reported pharmacological activities of *C. indica* species**

| Sr. No | Plant Part(s) Used | Pharmacological Properties | References |
|--------|-------------------|---------------------------|------------|
| 1      | Arial part and Leaves | Anti-Diabetic Activity | Kuriyan et al., 2008; Janwal & Kumar., 2019; Venkateswaran & Pari., 2002; Munasinghe et al., 2011 5, 12-14 |
| 2      | Leaves | Antimicrobial and Malarial Activity | Hussain et al., 2010; Sivaraj et al., 2011; Bhattacharya., 2010; Ravikumar et al., 2012; Amalesh et al., 2011 15-19 |
| 3      | Leaves and Stem | Anti-Inflammatory Activity | Deshpande et al., 2011; Nachimuthu., 2018 20-22 |
| 4      | Fruits, Leaves and Mucilage | Antioxidant Activity | Bubul et al., 2011; Sharma et al., 2011; Motiwala et al. 2015 23-25 |
| 5      | Leaves | Anticancer Activity | Kumari et al., 2016; Sampathkumar et al., 2008; Glusker& Rossi 1986; Sun et al., 2005 26-29 |
| 6      | Leaves | Analgesic and Antipyretic Activity | Niazi et al., 2009 20 |
| 7      | Leaves | Antitussive Activity | Pattanayak & Sunita., 2009 30 |
| 8      | Leaves | Antinociceptive Activity | Sutrpradhar et al., 2011 31 |
| 9      | Leaves | Hepatoprotective Activity | Rao et al., 2003; Kumar et al., 2010; Vinothkumar et al., 2019 32-34 |
| 10     | Root | Antioesity Activity | Rubatzky & Yamaguchi 35 |

**Conclusion and Future Prospects of *Coccinia indica***

This plant has definitely been a significant source of traditional remedies for decades, some of the ethnomedicinal uses of this plant have been scientifically validated and pharmacological activities such as anti-diabetic, antimicrobial, anti-inflammatory, antioxidant, antimalarial, antidiyslipidemic, anticancer, analgesic, antipyretic, antitussive, antinociceptive, hepatoprotective, ant obesity, and neuroprotective function have also been studied as discussed in this review. Every section of the plant contains several chemical components that are responsible for a wide range of pharmacological and therapeutic effects. *C. indica*’s nutritional characteristics were also discussed. The goal of this review is to reignite interest in this
important medicinal plant, with the ultimate goal of repositioning and expanding its uses beyond vegetable and diabetic management to evidence-based phototherapeutic uses through scientific studies aimed at validating its folkloric medicinal and therapeutic effectiveness for drug discovery and development. As a result, more scientific validation studies in the form of toxicological and pharmacological profile of C. indica in more in vitro and animal models are required as a prelude to human investigations via clinical trials.

**Highlights**

- The goal of the review is to explore the pharmacology activities, therapeutic uses, nutritional potentials of Coccinia indica.
- This belongs to the Cucurbitaceae family and is widely used in traditional medicinal systems, including Ayurvedic, Siddha and Unani.
- Traditionally, different parts of this plant, including the roots, leaves and fruits used in folk medicine.

**Conflict of Interest**

None declared.

**Financial Support**

None declared.

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**HOW TO CITE THIS ARTICLE**

Padma R, Kumar GV. Coccinia indica: A Comprehensive Review of Pharmacology, Therapeutic Applications, Nutritional Potentials, and Future Prospects. J Phytopharmacol 2022; 1(1):211-216. doi: 10.31254/phyto.2022.11313

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