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Nutritional and therapeutic values of *Coccinea grandis*: A review

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Abstract

Coccinia grandis also known as Ivy Gourd is a nutrient rich fast growing perennial vine plant of Cucurbitaceae family. It is a dioecious, perennial and herbaceous climber or trailing vine with glabrous stems and tuberous roots. Traditionally it is known for its medicinal and nutritional qualities and its all plant parts like roots, leaves and fruits are used in local medicinal purposes like jaundice, diabetes, wound healing, ulcers, stomach ache, skin disease, fever, asthma, cough. It is a wonderful vegetable plant species having various pharmacological properties like analgesic, antipyretic, anti-inflammatory, antimicrobial, antiulcer, antidiabetic, antioxidant, hypoglycemic, hepatoprotective, antimalarial, antidyslipidemic, anticancer, antitussive, mutagenic.

Keywords: Analgesic, antioxidant, *Coccinia grandis*, cucurbitaceae, dioecious

Introduction

Coccinia grandis (Ivy gourd) is a member of Cucurbitaceae family. It is believed to origin of India (Nath, 1966) [46]. Ivy gourd is a perennial vine crop, grown in tropical and Sub-tropical region. Ivy gourd is grown for their immature tender fruits, test like a cucumber and are used as salad and preparation of various vegetable. In southern Asia, Ivy gourd is cultivated for its long slender edible young shoot and fruit (Linney, 1986) [34]. Ivy gourd has a many medicinal values. It is rich in vitamin C, which is straightening the bones. It also provided vitamin B1 and B2 and also small amount of vitamin A and tendril of Ivy gourd is also rich in mineral like potassium, calcium and iron. All part of plant are used for treating various disease, leaves extraction of *Coccinia grandis* for antibacterial activities (Bhattacharya 2010) [10, 11], root are used for antidiabetic, skin diseases, removes pain in joint, urinary tract infection (Pekamwar *et al*, 2013) [48, 49] and to help in controlling diabetes (Shibib *et al*. 1993, Deokate and Khadabadi 2011) [57, 17]. In India, the family Cucurbitaceae is represented by 36 genera and 100 species (Chakravarty, 1982) [15]. Cucurbitaceae are a major family among economically important domesticated species, particularly those with edible fruits including cucumber (*Cucumis sativus*), melon (*Cucumis melo*), watermelon (*Citrullus lanatus*), squash and pumpkin (*Cucurbita* spp.), bitter melon (*Momordica charantia*), chayote (*Sechium edule*), loofah (*Luffa* spp.), bottle gourd (*Lagenaria siceraria*), snake gourd (*Trichosanthes cucumerina* var. *anguina*) and wax gourd (*Benincasa hispida*). Some of these represent the earliest cultivated plants and known for their medicinal properties and so many other uses. Since ancient times, particularly *Lagenaria* spp., those have hard-shelled fruits, which have been used to manufacture musical instruments and so many containers. It is indigenous species to Bengal and other parts of India. *C. indica* grows abundantly all over India, Tropical Africa, Australia, Fiji and throughout the oriental countries. The plant has also been used extensively in Ayurvedic and Unani practice in the Indian subcontinent (Wealth of India, 1992) [70]. It has long tuberous fleshy roots, smooth and green fruits. Microscopy of root shows parenchyma, phelloderm, pericyclic fibers, stone cells, starch grains.

Some other Cucurbits are also used in the indigenous system of medicines they are: *Lagenaria siceraria*, *Trichosanthes dioica*, *T. cucumerina*, *T. cucumerina* var. *anguina*, and *Benincasa hispida* are rich in protein and vitamin C. Each and every part of pointed gourd has high nutritional value. The roots contain amorphous Saponin. Species of *Momordica* spp. are used in diabetes. *Citrullus lanatus* seeds are used as cooling medicine. *Coccinia grandis* roots, stems, and leaves has been used to curing the skin diseases.

Fruits of melons are eaten when ripe and are also used in chronic eczema. Bottle gourd (*Lagenaria siceraria*), ribbed gourd (*Luffa acutangula*), white gourd (*Benincasa hispida*), cucumber (*Cucumis sativus*), and pointed gourd (*Trichosanthes dioica*) are some of the most common vegetables (Kirtikar, 1975 [31]. The *Coccinia grandis* fruit is used as vegetable when green and eaten fresh when ripened into bright scarlet colour (Sastri, 1950) [50]. Every part of this plant is valuable and used in various diseases; bronchial catarrh, bronchitis and Unani systems of medicine for ring worm, psoriasis, small pox, scabies (Perry, 1980) [50] and other itchy skin eruptions and ulcers (Behl *et al.*, 1993) [8]. Oil of this plant is used as an injection into chronic sinuses. The plant is used in decoction for gonorrhoeae (Nadkarni, 1976) [43], diabetes and also useful in dropsical condition, pyelitis, cystitis, strangury, snake bite, urinary gravel and calculi (Jayaweera, 1980; Nadkarni, 1976) [29, 43]. It is also useful to induce perspiration in fever and cures sores in the tongue (Anon., 1992) [5]. It has antilithic (Jayaweera, 1980) [29], hypolipidemic (Presanna Kumar, *et al.*, 1997) [51], antimutagenic (Kusamran *et al.*, 1998) [33] and hypoglycemic activities (Chopra & Bose, 1925; Gupta, 1963; Brahmachari *et al.* 1963; Kumar *et al.* 1997; Nahar *et al.* 1998) [16, 27, 13, 51, 44]. Vegetables are considered to be protective foods and highly beneficial for the maintenance of good health and prevention of diseases. Medical nutrition and pharmaceutical applications of plant origin will be the new research mandate for healthy future. Ivy gourd fruits are rich in lycopene (5.68 mg / 100 g), β -carotene (2.24 mg / 100 g) and leaves contain protein (3.3-4.9g), vitamin A (8000-18000 IU). Fruits are antidiabetic and

having antioxidant property. In Ayurveda, it is used for skin eruption, tongue sores and earache. They are sources for nutrients such as carbohydrates, proteins, vitamins, fibre and minerals required for human health. According to some generous estimates, almost 80% of the present day medicines are directly or indirectly obtained from plants.

Nutritional Value of *Coccinea grandis*

Khatun *et al.*, 2012 evaluated the different nutrient Components of *Coccinia grandis* are carbohydrate-12.62%, total protein- 15%, water soluble protein-11.25%, lipid-4.0%, total phenol-61.92mg/100g, vitamin C-25.55 mg/100g, β -carotene-70.05mg/100g, potassium-3.3 mg/100g, phosphorous- 1.15 mg/100g, sodium-0.95mg/100g, iron-2.23 mg/100g and calcium-3.79 mg/100 g. Fruits of *Coccinia grandis* contains steroids, saponin, ellagic acid, terpenoids, lignin, other compound like alkaloids, tannins, flavonoids, glycosides, phenols, B-amyrin acetate, lupeol, taraxerol, β , B-carotene, lycopene, cryptoxanthin, xyloglucan, carotenoids and β -sitosterol.

Table 1: Nutritional value per 100g of edible portion (fruit) of *Coccinia Grandis*

Components	Amount
Energy	21 K.Cal
Protein	1.4g
Carbohydrate	3.4g
Fat	0.2g
Calcium	25mg
Iron	0.9mg

Table 2: Phytochemical properties of different parts of *Coccinea* Chemical constituent of different plant parts of *Coccinea* (Deokate *et al.*, 2011).

Plant parts	Constituents
Roots	Triterpenoid, saponin, coccinoside – k(i). C ₄₁ H ₆₆ O ₁₂ Flavonoid glycoside ombuin 3-o- arabinofuranoside 3- o- β - (α -l- arabinopyranosyl)-(1 \rightarrow 2) – β -d-glucopyranosyl- (1 \rightarrow 3)- β -hydroxylup – 20(29)- en-28- oic acid. Lupeol, β -amyrin, and β - sitosterol. Stigmast -7- en-3-one,
Fruits	Taraxerone, taraxerol, and (24R)-24- ethylcholest- 5- en- 3 β - ol glucoside. B- carotene, lycopene, cryptoxanthin, and apo- 6'- lycopenal B- sitosterol and taraxerol
Aerial parts	Heptacosane Cephalandrol, C ₂₉ H ₅₈ O tritriacontane C ₃₃ H ₆₈ B- sitosterol alkaloids Cephalandrine a and Cephalandrine b.

Botanical description

Coccinia grandis is a fast-growing perennial vine crop that grows several meters long. It can form dense mats on lands that easily cover shrubs and small trees.

Leaves

Their leaves are arranged alternately along the stems; the shape of the leaves varies from heart to pentagon shaped. (Up to 10 cm wide and long). The upper surface of the leaf is hairless, whereas the lower is hairy and simple tendrils. There are 3-8 glands on the blade near the leaf stalk.

Flower

Flowers are star-shape, large and white in colour. The calyx has five subulate, recurved lobes, each 2-5 mm long on the hypanthium; peduncle 1-5 cm long. The corolla is white, campanulate, 3-4.5 cm long, deeply divided into five ovate lobes. Each flower has three stamens. The *Coccinia grandis* flower ovary is inferior. Staminate is solitary, rarely in axillary clusters of 2-3, pedicels 15-50 mm long, lobes of

calyx is subulate, recurved, 2-5 mm long, corolla lobes ovate, white, long about 15-20 mm; pistillate flowers solitary on stalks 10-30 mm long, hypanthium 10- 15 mm long (Starr *et al.*, 2003) [62].

Fruit

The fruit of *Coccinia grandis* is red colour, shape ovoid to elliptical, 25-60 mm long, 15-35 mm in diameter, glabrous, hairless on stalks. Seeds 6-7 mm long, tan-colored and thick margins.

Root

The roots and stems are succulent in nature, tuberous and most likely facilitate the plant to survive prolonged drought. Dispersal of *Coccinia grandis* are done by the humans and also spread by birds and other animals, pigs, moved unintentionally on equipment or on wood and germinate where they land. Hybridization and clonal selection are one of the viable methods to develop improved clone in ivy gourd (Maurice *et al.*, 2012; Ajmal Ali *et al.*, 2005-2006) [38, 3].

Table 3: Medicinal value of various parts of *Coccinea grandis* (Pekamwar *et al.*, May, 2013) [48, 49].

Leaf	Antidiabetic, oxidant, larvicidal, GI disturbances, Cooling effect to the eye, Gonorrhoea, hypolipidemic, skin diseases, urinary tract infection.
Fruit	Hypoglycemic, analgesic, antipyretic, Hepatoprotective, tuberculosis, eczema. anti-inflammatory
Stem	Expectorant, antispasmodic, asthma, bronchitis, GIT disturbances, urinary tract infection, skin diseases,
Root	Hypoglycemic, antidiabetic, skin diseases, removes pain in joint, urinary tract infection

Pharmacological Activities

Antibacterial

Bhattacharya *et al.*, (2010) [10, 11] analyzed the aqueous extract of leaves of *Coccinia grandis* for antibacterial activity against *Shigella flexneri* Niced, *Bacillus subtilis*, *Escherichia coli*, *Salmonella choleraesuis*, *Shigella dysenteries*, and *Shigella flexneri*. Aqueous extract of *Coccinia grandis* showed more significant antibacterial activity in comparison to ethanol extract. A polar moiety of the extract is more responsible for antibacterial properties. The chloroform extracts of *Coccinia cordifolia* moderately active against *Sarcina lutea*, *Bacillus subtilis*. Ethyl acetate extracts active against *staphylococcus aureus*. Hexane extract active against the *Sarcina lutea*, *Pseudomonas aeruginosa* (Bulbul *et al.*, 2011) [14].

Sivaraj *et al.* (2011) [60] has been evaluated the antibacterial activity of *Coccinia grandis* leaf extract with solvents like acetone, ethanol, methanol, aqueous and hexane against five bacterial species. Ethanol leaf extract of *Coccinia grandis* showed high antibacterial activity against *S. pigeons*, *E. Coli*, *B. Ceres*, *K. pneumonia* and *S. aureus* (Sivaraj *et al.*, 2011) [60]. Antibacterial activity of *Coccinia grandis* extract tested against the six gram positive and gram negative bacteria, Hexane extract moderately active against all gram positive and gram negative bacteria except *Proteus mirabilis*. Ethyl acetate extracts moderately antibacterial against all except *Proteus mirabilis* and *staphylococcus aeruginosa* (Farukh *et al.*, 2008; Tamilselvan *et al.*, 2011) [24, 67].

Anthelmintic

Methanolic extract of *Coccinia grandis* posses the anthelmintic activity. Methanolic extract of *Coccinia grandis* acts through paralyzing the worm. (Tamilselvan *et al.* 2011) [67].

Antioxidant

Moideen (2011) [39] evaluated Ethanol extract of root of *Coccinia grandis* contain flavonoids, Methanol extracts of the fruit of *Coccinia grandis* posses the potent antioxidant activity. The methanol extract of *Coccinia grandis* contains glycoside and flavonoid. The antioxidant activity of *Coccinia grandis* is due to the reducing power ability, hydrogen peroxide scavenging potential (Deshpande *et al.*, 2011) [1]. Ethanol and methanol extract shows the antioxidant activity (Ashwini *et al.*, 2012) [6]. *Coccinia grandis* stem extract containing solvent petroleum, chloroform and ethyl acetate shows antioxidant activity. Ethyl acetate possess potent antioxidant activity than petroleum (Deshpande *et al.*, 2011) [1]. *Coccinia grandis* methanol extract and leaf powder contain the antioxidant principle (Mujumder *et al.*, 2008) [41].

Antiulcer

Aqueous extract of *Coccinia grandis* at doses of 250 and 500 mg/kg produced significant inhibition of the gastric lesions induced by pylorus ligation induced ulcer and ethanol induced gastric ulcer. The extract showed significant reduction in ulcer index, free acidity and gastric (Girish *et al.*, 2011) [25]. On the other hand; Manoharan (2010) [37] studied the Ethanol,

aqueous and total aqueous extract for antiulcer activity in pylorus ligation induced gastric ulcer.

Antimalarial

Extract of *Coccinia grandis* shows excellent antiplasmodial activity against the *Plasmodium falciparum* (Sundaram *et al.*, 2012) [63]. Aqueous leaf extract of *Coccinia grandis* decreases the SGPT, SGOT, ALP, total protein, blood urea nitrogen concentration. Hydrophilic moiety of *Coccinia grandis* extract is responsible for antimalarial activity. The extract significantly reduces the *Plasmodium berghei* parasite strength in mice (Samanta *et al.*, 2011) [54]. The methanolic extract from *Coccinia grandis* which is used for reducing the larvicidal activity (Rahumann., 2008) [52].

Antiinflammatory

Deshpande (2011) [1] evaluated the aqueous extracts of *Coccinia grandis* leaves and stem for the anti-inflammatory activity against formaldehyde induced paw edema in rats. The formaldehyde causes the cell damage and which provokes the production of histamine, prostaglandin bradykinin and serotonin. Aqueous extract of leaves showed more significant percentage inhibition of paw edema than the aqueous extract of the stem and standard, used as indomethacin. Formaldehyde induced inflammation results production of endogenous mediators, such as; histamine, serotonin, prostaglandins, and bradykinin treated with *Coccinia grandis* extract (Bernard *et al.*, 1998) [9].

Antipyretic

Aggarwal (2011) [1] was evaluate methanolic extract of *Coccinia grandis* for antipyretic activity at the doses of 100 and 200 mg/kg in yeast-induced fever. The extract showed antipyretic activity by influencing the prostaglandin biosynthesis. Prostaglandin is considered as a regulator of body temperature.

Analgesic

Analgesic action of the active compound(s) in the methanol extract of *Coccinia grandis* May be mediated through peripheral but not central mechanism. *Coccinia grandis* reduce the complications produced by acetic acid (Aggarwal *et al.*, 2011) [1].

Hypoglycemic

Mallick (2007) [35] studied the combined extracts of *Musa paradisiaca* and *Coccinia indica* aqueous extract of leaf for antidiabetic activity in streptozotocin induced diabetes rats. The ethanolic extract of the aerial part decreases blood glucose levels and lipid parameters in streptozotocin induced diabetic rats at 100 or 200 mg/kg. Chronic administration of fruit extract 200 mg/kg for 14 days reduces the blood glucose level in alloxan induced. diabetic rat (Gunjan *et al.*, 2010) [26]. The aqueous extract of *Coccinia indica* reduced the blood glucose level; also reduced the cholesterol, protein and urea with prolonged treatment. *Coccinia grandis* stimulated gluconeogenesis, or inhibited glycogenolysis in the diabetic

rat liver. Treatment with *Coccinia* extract increases the total protein, SGPT, SGOT (Doss *et al.*, 2008)^[20].

The *Coccinia indica* leaves extract exerts hypoglycemic activity on blood glucose and cholesterol, TG, LDL, VLDL level in alloxan induced diabetic rats (Manjula *et al.*, 2007)^[36]. The hypoglycemic activity of *Coccinia grandis* fruit evaluated by using alloxan induced diabetic rat. Ethanol extract shows the decreased blood glucose level.

Pectin from fruit reduces the blood glucose by decreasing the absorption of glucose from the intestine and increasing liver glycogen and decreasing glycogen phosphorylase. Combined Methanolic extract of leaves of *Coccinia indica* and *Salvadora oleoides* shows the hypoglycemic activity (Saklanil *et al.*, 2012). Alcoholic extract of *Coccinia grandis* leaves (Eliza Jose, 2010)^[23] and stem have the capacity to lower the blood glucose level in normal fasted rats (Doss *et al.*, 2008)^[20]. Ethyl acetate extract and petroleum ether extract of *Coccinia* contains triterpenes, alkaloid, flavonoid, β -carotene which is responsible for the hypoglycemic activity.

Antifungal

Bhattacharya (2010)^[10, 11] found the antifungal activity of the *Coccinia grandis* leaves extract against the *Candida albicans-II*, *Candida tropicalis*, *Aspergillus Niger*, *Saccharomyces cerevisiae*, *Candida tropicalis II*, *Cryptococcus neoformans* and *Candida albicans* ATCC. Aqueous extract is more sensitive for both strains of *Candida albicans* and Ethanol extract is more sensitive for *Aspergillus Niger* and both strains of *Candida albicans* (Bhattacharya *et al.*, 2010)^[10, 11].

Hepatoprotective

Vadivu (2008) revealed the alcoholic extract of the fruit of *Coccinia grandis* for Hepatoprotective activity against CCl₄-induced Hepatotoxicity in experimental rats, Treatment with 250 mg/kg ethanolic extract of fruit significantly reduced the SGPT, SGOT and bilirubin level. Hepatoprotective activity of the extract may be due to the antioxidant effects of flavonoid found to be present in the fruits. Flavonoids, triterpenes and tannin were antioxidant agent present in *Coccinia grandis* and may interfere with free radical formation confirmed that Hepatoprotective activities of certain flavonoids are known. (Vinothkumar *et al.*, 2009; Anil Kumar, 2012; DR. Krishnkumari *et al.* 2011; Sunilson., *et al.* 2009)^[29, 4, 21].

Antidyslipidemic

Singha (2007)^[58] evaluated chloroform extract of *Coccinia grandis* leaves for antidyslipidemic activity by lowering the triglycerides and cholesterol level in hamsters. Chloroform extract of *Coccinia grandis* leaves containing polyphenol, lowers the plasma lipid profile then increasing high density lipid cholesterol and total cholesterol ratio. C60-polyphenol isolated first time from this plant. It drastically decreased serum triglycerides by 42%, total cholesterol 25% and glycerol 12%, in high fat diet feed dyslipidemic hamsters at the dose of 50 mg/kg body weight. Aqueous and ethanolic extracts of leaves can be used for control of obesity (Mishra *et al.*, 2012)^[59].

Anticancer

There have so many vegetables occurred to reduce the risk of cancer. The anticancer activity of the *Coccinia grandis* is due to its antioxidant nature. The antioxidant nature of *Coccinia grandis* reduces the ferrocynaide to ferrous and Hydrogen peroxide scavenged from *Coccinia grandis* neutralizes to water (Behera *et al.*, 2012)^[7].

Bhattacharya (2011)^[54] found the aqueous extract of leaves of *Coccinia grandis* for anticancer activity. Nitric oxide is a free radical which acting an important role in the pathogenesis of pain, inflammation. The antioxidant principle of *Coccinia grandis* decreases the nitrite generated by decomposition. Graded response produced by the cell is comparatively less. *Coccinia grandis* significantly reduced viable cell count and increased nonviable cell count suggesting comparable anticancer property with that of the reference drug (Vinblastine) (Nanasombat *et al.*, 2009; Bhattacharya *et al.*, 2011)^[45, 54].

Antitussive

Pattanayak (2009)^[47] analyzed the methanol extracts of the fruit of *Coccinia grandis* for analgesic activity and extensively used to get relief from asthma and cough by the indigenous people of India. The methanol extracts of the fruit of *Coccinia grandis* show the presence of alkaloid, tannin, steroid, triterpenoid, glycoside, carbohydrates and reducing sugar. The Antitussive activity of methanol extract has been compared with that of codeine (Antitussive drug). The methanol extract of *Coccinia grandis* fruit showed the significant decrease in cough induced by the chemical simulation similar to codeine phosphate in a dose dependant manner. The methanol extract produces maximum inhibition of cough at 90 min. The highest inhibition of cough (56.71%) was produced by the extract of the 400 mg/kg dose level at 90 min. The methanol extract act through the central nervous system.

Mutagenic effect

Aqueous extract of leaves of *Coccinia grandis* showed inhibition of growth and mutagenesis on *Neurospora crassa* by a gradual decrease of growth of mycelia. This result indicates that *Coccinia grandis* plant shows mutagenic effect on *Neurospora crassa*. (Bhuiyan *et al.*, 2009)^[12].

Alpha-amylase inhibition

Jaiboon (2011)^[28] evaluated the methanolic extract of *Coccinia grandis* for alpha amylase inhibitory activity. The dried plant material extracted with 50% aqueous methanol (10 ml/g drywt.) and redissolved in 50% aqueous DMSO (10 ml/g dry wt.) and subjected to alpha-amylase inhibitory activity. The *Coccinia grandis* showed the 81.13% of alpha amylase inhibitory activity.

Conclusion

Coccinia grandis is an important source of many pharmacological and medicinally important chemicals. In this review study *Coccinia grandis* medicinal plants play a fundamental role against various diseases. *Coccinia cordifolia* is a true miracle of nature because of the presence of effective chemical constituents responsible for diversified pharmacological applications. Also, it has been developed by some medicinal industries as a drug. The various parts of plant extracts have significant analgesic, antipyretic, anti-inflammatory, antimicrobial, Antiulcer, antidiabetic, antioxidant, anticancer, antitussive hypoglycemic, hepatoprotective, antimalarial, antidyslipidemic.

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