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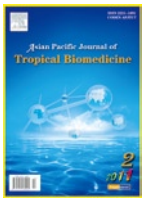

Document heading

Pharmacognosy of *Coccinia grandis*: a review

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ABSTRACT

Traditional system of medicine consists of large number of plants with various medicinal and pharmacological importances and hence represents a priceless tank of new bioactive molecules. *Coccinia grandis* belongs to the family Cucurbitaceae. It is a rapidly growing, perennial climber or trailing vine. Traditionally different parts of this plant namely the roots, leaves and fruits are used in folklore medicine for several purposes like jaundice, diabetes, wound healing, ulcers, stomach ache, skin disease, fever, asthma, cough. The leaf and its constituents have been reported to possess hypoglycaemic, hypolipidemic and antioxidant properties. This review provides adequate information to develop suitable therapeutics out of these plant parts.

1. Introduction

In India use of the different parts of several medicinal plants to cure specific ailments has been in vogue from ancient times. The indigenous system of medicine, namely, Ayurvedic, Siddha, and Unani, has been in existence for several centuries. Some drugs from Ayurveda approaching modern diseases, have already reached the market place[1]. It is estimated that around 70 000 plant species have been used for medicinal purposes. India recognizes more than 2 500 plant species having medicinal value, Srilanka around 1 400 and Nepal around 700[2]. About 40% doctors especially in India and in China have reverted to increasing use of indigenous drugs and natural medicines[3,4]. The World Health Organization (WHO) estimates that about 80% of the population living in the developing countries rely almost exclusively on traditional medicine for their primary health care needs. *Coccinia grandis* (*C. grandis*) (L) Voigt plays a major role in the medicinal properties. The plant parts of *C. grandis* such as roots, leaves and fruits are used for numerous medicinal purposes like wound healing, ulcers, jaundice, diabetes and antipyretic. The leaf possesses hypoglycemic, antihyperglycemic, antioxidant properties and is also used to treat infective hepatitis[5-8]. This review provides the botany, morphological character, geographical distribution, medicinal values, physiochemical characters, phytochemical characters and pharmacological activity of the *C. grandis*.

2. Folklore medicinal value of *C. grandis*

C. grandis 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. It is used internally in the treatment of gonorrhea. Aqueous and ethanolic extracts of the plant have shown hypoglycaemic principles. It helps to regulate blood sugar levels. Compounds in the plant inhibit the enzyme glucose-6-phosphate which supports the body's own regulatory system and promotes a more balanced and healthy body and therefore it is recommended for diabetic patients.

2.1. Taxonomy

Kingdom: Plantae; Order: Cucurbitales; Family: Cucurbitaceae; Genus: *Coccinia*; Species: *C. grandis*; Binomial name: *C. grandis* (L) J. Voigt; Common name: Ivy gourd, scarlet fruited gourd; Nomenclature: The name is derived from the latin coccineus, meaning scarlet, in reference to the fruit colour[9].

2.2. Vernacular name

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Marathi: Tindora (Tindori, Tindora); Oriya: Parwal, Kundru, Tondi; Malayalam: Tendli (Konkani), Ghiloda, Kundri, Kowai, Kovai, Kovakkai; Tamil: Kovakka; Telugu: Dondakaya; Kannada: Tondekayi.

2.3. Botany of C. grandis

From botanical description of *C. grandis*, it is a dioecious perennial herbaceous vine. Stems are mostly glabrous, produced annually from a tuberous rootstock, tendrils simple, axillary. Leaves are alternate, simple, blade broadly ovate, 5-lobed, [(5-9)×(4-9)] cm, acute and mucronate at the apex, cordate with a broad sinus at the base. Surfaces are glabrous or scaly, with 3-8 glands near the base, margins denticulate, petiole (1-5 cm) long. Inflorescence is usually of solitary, axillary flowers. Calyx is of 5 subulate, recurved lobes (2-5 mm) long on the hypanthium. Peduncle is (1-5 cm) long. Corolla is campanulate, white, (3-4.5 cm) long, deeply divided into 5 ovate lobes. Stamens are 3, present as staminodes in female flowers. Ovary is inferior. Fruit is a smooth, bright red, ovoid to ellipsoid berry (2.5-6 cm) long[10]. Synonym of botanical name is "cephalandra indica" (ivy gourd).

2.4. Geographical distribution of C. grandis

The native range of *C. grandis* extends from Africa to Asia including India, Philippines, China, Indonesia, Malaysia, Thailand, Vietnam, Eastern Papua, New Guinea and Northern Territories (Australia)[11].

2.5. Macroscopic/morphological characters

Its perennial herbs with tuberous root stock produce annual stems up to several meters long, which is found spreading on ground and twining around the tress and supports around it. Leaves are triangular or pentagonal in shape. Margin is dentate, upper surface glabrous and attachment of petiole and major vein branching occurs. Apex obtuse, petioles (1-3 cm) long and tendrils are unbranched. Flowers are monsecious, solitary, rarely in axillary clusters of 2-3, pedicels (10-15 mm) long. Fruits are slimy in touch, pulpy and ovoid to ellipsoid shape. It is green in colour when young and it turns scarlet red when it ripes (2.5-5 cm) long and (1.3-2.5 cm) in diameter, glabrous, purple red. The fruit possesses numerous seeds which are ablong (6-7 mm), margins thickened[9,12].

3. Phytochemical characters

Petroleum ether, chloroform, methanolic and aqueous extract of the leaves were tested for phytochemical analysis[13]. The results were showed in Table 1. Methanolic extract of *C. grandis* fruits were also tested[14]. Results were presented in Table 2.

Table 1
Qualitative analysis of phytochemicals of *C. grandis* in leaf extract[13].

Phytochemicals	Solvents			
	Petroleumether	Chloroform	Ethanol	Aqueous
Sterols	+	−	−	−
Tannins	−	+	+	−
Flavonoids	−	−	+	+
Proteins & amino acids	−	+	+	+
Glycosides	−	+	+	+
Phenols	−	−	+	+
Acidic compound	−	−	−	−
Carbohydrates	−	−	+	+
Saponins	−	+	+	−
Alkaloids	−	+	+	+

+: Positive; −: negative.

Table 2
Qualitative analysis of phytochemicals in *C. grandis* fruit[14].

Phytochemicals	Methanolic extract
Alkaloids	+
Steroids	+
Tannins	+
Saponins	+
Ellagic acid	+
Phenols	+
Glycosides	+
Lignans	−
Triterpenoid	+
Flavonoids	+

+: positive; −: negative.

4. Physiochemical characters

The physiochemical characters of the powdered leaves of *C. grandis* were evaluated[13]. The values were expressed in w/w (Table 3).

Table 3
Physiochemical parameters of leaves of *C. grandis*[13].

Quantitative parameters	Values obtained (%) w/w
Alcohol soluble extractive	8.420
Water soluble extractive	24.600
Total ash	15.330
Acid-insoluble ash	1.683
Water soluble ash	8.830
Swelling index	2.000
Loss on drying	10.270
Foreign matter content	1.200

5. Pharmacological activities of *C. grandis*

5.1. Antibacterial activity

Antibacterial activity of aqueous, hexane extracts of leaves and aqueous, hexane, ethyl acetate, ethanol extracts of stem of *C. grandis* was tested against four gram positive bacteria (*Bacillus cereus*, *Corynebacterium diphtheria*, *Staphylococcus aureus* and *Staphylococcus pyogenes*) and six gram negative bacteria (*Salmonella typhi*, *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Proteus mirabilis* and

Shigella boydii). Ethanol and ethyl acetate extracts of stem are more effective in both gram positive and gram negative bacteria as compared with hexane and water extracts. Leaf hexane extract is more effective than water extract against gram positive and gram negative bacteria. Ethanol extract of stem is more effective against *Pseudomonas aeruginosa* (9 mm zone of inhibition) whereas ethyl acetate extract and hexane extract of stem is more effective against *Salmonella typhi* and *Pseudomonas aeruginosa* (7 mm zone of inhibition), *Staphylococcus pyogenes*, *Salmonella typhi* and *Pseudomonas aeruginosa* (7 mm zone of inhibition). Leaf ethanol extract is more effective against *Salmonella typhi* and *Pseudomonas aeruginosa* (8 mm zone of inhibition) whereas water extract is more effective against *Shigella boydii* (11 mm zone of inhibition). Petroleum ether, diethyl ether, chloroform, ethyl acetate, acetone, methanol, ethanol and aqueous extracts of the fruits of *C. grandis* were also tested[14].

5.2. Hepatoprotective activity

Diethyl ether extract of leaves of *C. grandis* was evaluated in CCl_4 induced hepatotoxicity in rats. The elevated levels of SGOT and SGPT were significantly reduced in the group of animals administered with 400 mg/kg diethyl ether extract. Sylimarin (125 mg/kg) were used as positive control. Reduction in SGOT and SGPT level was higher in diethyl ether extract treatment (89.39) compared with the sylimarin treatment (84.39)[15-18].

5.3. Anti-ulcer activity

Methanol extract (2 g/kg), aqueous extract (2 g/kg) and powder (0.5-2 g/kg) of leaves of *C. grandis* were tested for antiulcer activity in Wistar albino rats. Aspirin (200 mg/kg bw) in 1% sodium was used as control, famotidine (20 mg/kg bw) in 1% sodium was used as standard drug. Powder of leaf and methanol extract showed significant decrease of ulcer, aqueous extract showed no significant decrease[19]. In another study ethanolic, aqueous, total aqueous extracts (200 and 400 mg/kg) of leaves of *C. grandis* (Linn.) were used for anti-ulcer activity. Anti-ulcer activity of the three extracts was studied in rats by using pylorus ligated ulcer model. Omeprazole (2 mg/kg) was used as the standard drug. The ethanolic extract 400 mg/kg showed comparable anti-ulcer activity as that of standard omeprazole[20].

5.4. Anti-tissue activity

Methanol extract of fruits of *C. grandis* with two different concentrations (2.5% and 5% w/v) was tested for anti-tissue activity by counting number cough of bouts produced due to aerosols of citric acid and sulfur dioxide with the experimental animal guinea pig. The extract showed significant inhibition of cough, like the standard drug (codeine phosphate) in dose-dependent manner. Thus the extract might be acting via the central nervous system, but the exact mechanism of action cannot be withdrawn from the study. From this investigation, it can be concluded that on preliminary screening the extract of *C. grandis* produced a significant anti-tissue effect and thus the claim of using the plant as an anti-cough agent in ancient folklore medicine was established[21].

5.5. Antioxidant activity

Methanolic extract, aqueous extract and powder of the leaves of *C. grandis* were tested for antioxidant activity. Powder form and methanolic extract showed good antioxidant property whereas aqueous extract did not showed any significant activity[22].

5.6. Hypoglycemic activity

Hypoglycemic activities of leaves of *C. grandis* were tested with 90% alcoholic extract. Diabetes was induced by a single intraperitoneal injection of a freshly prepared of streptozotocin 55 mg/kg bw of rats in 0.1 M citrate buffer (pH 4.5). Alcoholic extract 600 mg/kg bw was injected orally to mice. Oral administration of alcoholic extract of leaves of *C. grandis* showed significant hypoglycemic effect on blood glucose level in normal fasted rats[23].

5.7. Antihelminthic activity

Antihelminthic activity of *C. grandis* (fruits) using petroleum ether, ethyl acetate, methanol and aqueous extracts was studied. Different concentrations of extracts were used for antihelminthic activity (25 and 50 mg/mL). *Pheretima posthuma* worms were used for antihelminthic activity. Anthelmintic activity of *C. indica* is confirmed by examining the time taken for paralysis (P) and death (D) for *Pheretima posthuma* worms. Time taken was measured in minutes. Methanolic extract of *C. indica* exhibited antihelminthic activity in dose dependent manner taking shortest time for paralysis (P) [(4.500±0.645) min] and death (D) [(6.500±0.646) min] with 50 mg/ml concentration, next to this ethyl acetate [P= (3.5±1.84 min) and D= (28.25±5.266 min)] showed more activity compared with that of chloroform extract [P= (22.25±2.175 min) and D= (23.25±2.562 min)] with 50 mg/mL concentration, least activity showed by the aqueous extract [P= (46.5±1.705 min) and D= (62.25±2.016 min)] with 50 mg/mL concentration[24].

5.8. Antidyslipidemic activity

Ethanol extract of *C. grandis* (L.) Voigt showed significant triglyceride and cholesterol-lowering effects in dyslipidemic hamster model. Ethanolic extract was fractionated into chloroform, n-butanol and water-soluble fractions (250 mg/kg bw) which were used to evaluate the antidyslipidemic activity. Standard drug fenofibrate at the dose of 108 mg/kg was used. Golden Syrian hamsters (*Mesocricetus auratus*), male, 12-week-old, (110-120 g) body weight were used. Chloroform fraction was found to possess significant lipid-lowering activity followed by increase in high-density lipoprotein-cholesterol and total cholesterol ratio. Chloroform soluble fraction which acts as active component was subjected to repeated column chromatography for the isolation of a polyprenol compound and characterized as C60-polyprenol. Polypernol was the first compound isolated from this plant. The polyprenols, which were isolated from chloroform fraction, showed antidyslipidemic activity[25,26].

5.9. Anti-inflammatory, analgesic and antipyretic activity

Anti-inflammatory activity of the aqueous extract of fresh leaves of *C. grandis* was studied in rats using the carrageenan-induced paw edema method at various dose levels. Analgesic and antipyretic properties were evaluated using tail flick model and yeast-induced hyperpyrexia, respectively. Ceiling effect of the extract was observed at 50 mg/kg in pre-treatment carrageenan test. In post-treatment

studies, a dose-dependent anti-inflammatory effect was observed in the dose range of (25-300 mg/kg). The effect was equivalent to diclofenac (20 mg/kg) at a dose of 50 mg/kg but it was significantly pronounced at higher doses. A significant reduction in hyperpyrexia in rats was also produced by all doses of extract with maximum effect at 300 mg/kg comparable to paracetamol. In conclusion, this study has established the anti-inflammatory activity, analgesic and antipyretic activity of *C. grandis* and, thus the ethnic uses of the plant were justified[27].

5.10. Alpha amylase inhibition

50% aqueous methanolic extract (10 mL/g bw) of *C. grandis* leaves was used for the alpha amylase inhibitory activity. Dried methanolic extract were re-dissolved in 50% DMSO (10 mL/g bw) and subjected to alpha amylase activity. Methanolic extract of *C. grandis* showed 81.13% of inhibitory activity of alpha amylase. The present study provides the support to *C. grandis* to inhibit alpha amylase and this helps in reduction of diabetic risk[28,29].

The plant shows the presence of many chemical constituents which are responsible for varied pharmacological and medicinal property. Various bioactivity studies of *C. grandis* plant derivatives are at the preliminary level requiring further studies to delineate the mechanism of actions. This review provides an outlook on various aspects that need to be done to carry forward the available information in developing suitable clinical therapeutics out of *C. grandis* plant.

Conflict of interest statement

We declare that we have no conflict of interest.

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