Future Natural Products
doi: 10.34172/fnp.169 2024;10(1):39-43 https://fnp.skums.ac.ir

Review Article

Ethnomedicinal uses and pharmacological activities of scarlet gourd

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Abstract

Background and aims: Scarlet gourd, a common name for *Coccinia grandis*, is an essential plant due to its immense medicinal properties. It is traditionally used to treat bronchitis, cough, skin diseases, epilepsy, psoriasis, wound healing, smallpox, leprosy, gonorrhea, malaria, and jaundice.

Methods: The scientific information on *C. grandis* was obtained from various sources, including Scopus, Google Scholar, PubMed, Science Direct, and other scientific databases, covering 2005 to 2022.

Results: The bioactive components of *C. grandis* include taraxerone, lycopene, heptacosane, cephalandrine, lupenol, vitamins, triterpenoids, and saponins. The pharmacological activities of the scarlet gourd are antidiabetic, antipyretic, antimalarial, antihistamine, antihypertensive, antioxidant, hepatoprotective, antitussive, anticancer, antimicrobial, and antifungal effects.

Conclusion: Due to its bioactive components, scarlet gourd (*C. grandis*) exhibits diverse pharmacological activities, including antidiabetic and anticancer effects. However, many traditional uses remain scientifically unverified, warranting further research.

Keywords: *Coccinia grandis*, Ethnomedicine, Pharmacological activities, Bioactive components, Antidiabetic, Anticancer, Traditional uses

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Received: April 25, 2024
Accepted: September 18, 2024
ePublished: December 31, 2024

Introduction

The scarlet gourd, known scientifically as *Coccinia grandis*, is a member of the Cucurbitaceae family, which is highly regarded in various traditional medicinal systems, including Ayurveda, Unani, and Chinese medicine. The Cucurbitaceae family, the pumpkin, gourd, and melon family, comprises approximately 960 species predominantly distributed across tropical regions (1). These plants are typically annual vines and have been widely recognized for their medicinal properties.

Coccinia grandis, commonly called kundru or gentleman's toes, is found in various parts of India, including Karnataka, Andhra Pradesh, and Madhya Pradesh (2). Traditionally, different parts of *C. grandis* have been used to treat a range of ailments such as bronchitis, cough, skin diseases, epilepsy, psoriasis, wound healing, smallpox, leprosy, gonorrhea, malaria, and jaundice (3). In addition, *C. grandis* has been reported to possess antidiabetic, anti-obesity, antihypertensive, antitussive, anticancer, antimicrobial, and antifungal activities (4-7).

Necessity and objectives of the study

Despite the extensive traditional use of *C. grandis* and the initial evidence of its pharmacological potential, there remains a significant gap in scientifically validated data, particularly in understanding the bioactive components responsible for its medicinal effects. Therefore, this study must systematically review and compile the ethnomedicinal uses, phytochemistry, and pharmacological activities of *C. grandis*.

The primary objectives of this study are:

1. To consolidate the traditional medicinal uses of *C. grandis* across different cultures.
2. To identify and analyze the bioactive compounds present in *C. grandis*.
3. To evaluate the pharmacological activities of these compounds through a review of existing scientific literature.
4. It is crucial to underscore the areas where further research is needed to validate traditional claims and explore potential therapeutic applications. This will not only validate the traditional uses of *C. grandis* but also open up new avenues for therapeutic applications.

This study aims to bridge the gap between traditional knowledge and modern scientific validation, providing a comprehensive understanding of *C. grandis* and its potential as a source of novel therapeutic agents.

Materials and Methods

Vernacular Names of Coccinia grandis

English: Ivy gourd, Kannada: Tonde-balli, Hindi: Kundaruki bel, Marati: Tondale, Sanskrit: Bimbi, Telugu: Donda Kaya, Tamil: Kovai (8).

Taxonomical Classification of Coccinia grandis

Kingdom: Plantae, Phyllum: Tracheophyta, Class: Magnoliopsida, Order: Cucurbitales, Family: Cucurbitaceae, Genus: *Coccinia*, Species: *grandis* (8) (Figure 1).

Phytochemical constituents present in *Coccinia grandis*

Coccinia grandis was found to contain various phytochemicals, such as flavonoids, glycosides, alkaloids, anthraquinones, phytosterols, saponins, vitamins (like thiamine, riboflavin, and niacin), and tannins (9) (Table 1).

Ethnomedicinal uses of *Coccinia grandis*

This plant's different parts were traditionally used to treat diseases such as skin diseases (like skin eruptions and burns), cough, leprosy, jaundice, asthma, bronchitis, tongue sores, eye infections, earache, insect bites, and fever. The fruits and leaves of this plant were used to treat diabetes. In the Unani medicinal system, *C. grandis* is used for ringworm, psoriasis, smallpox, and scabies (10).

Figure 1. *Coccinia Grandis*

Pharmacological actions of *Coccinia grandis*

Antidiabetic activity

Meenatchi et al evaluated the antidiabetic activity of mature fruit extract from C. grandis, focusing on its effects on antioxidant activity and antiglycation in a BSA-fructose and insulin section model. They concluded that the possible mechanisms of action include: stimulation of insulin secretion, regeneration of β-cells, restoration of antioxidant enzymes, enhancement of glucose uptake, regulation of metabolic enzymes, improvement of lipid profiles, and inhibition of digestive enzymes (11).

Antioxidant activity

The alcoholic extracts of *C. grandis* were evaluated for DPPH radical scavenging, hydrogen peroxide, and superoxide radical scavenging methods. *C. grandis* showed dose-dependent radical scavenging activities due to the presence of flavonoids and total phenolics. These findings suggest that *C. grandis* has the potential to protect against oxidative damage, which is associated with the development of chronic diseases such as cirrhosis, diabetes, cancer, and arthritis (12).

Anti-inflammatory, antipyretic, and analgesic properties

The aqueous extract of *C. grandis* fresh leaves was evaluated for anti-inflammatory activity using the carrageenan-induced paw edema method, antipyretic activity by yeast-induced hyperpyrexia, and analgesic properties using the tail flick model and yeast-induced hyperpyrexia. *C. grandis* extract showed a significant reduction in inflammation, pain, and hyperpyrexia when compared with morphine and paracetamol as standards (13).

Antihyperlipidemic activity

The ethanolic fruit extract was evaluated for antihyperlipidemic properties using the dexamethasone-induced hyperlipidemia model. At doses of 200 mg/kg, the fruit extract significantly reduced elevated levels of low-density lipoprotein (LDL) and triglycerides while increasing high-density lipoprotein (HDL) levels. This effect was comparable to that of the standard drug atorvastatin (14).

Table 1. Phytochemical constituents of various parts of *Coccinia grandis*

Plant Parts	Phytochemical Constituents Reported
Roots	Lupeol, triterpenoid, taraxero, β-amyrin, β-sitosterol, coccinioside-k, stigmast-7-en-3-one, flavonoid glycoside ombuin, and 3-O-β- (α-l-arabinopyranosyl) -(1→2)–β-d-glucopyranosyl-(1→3)- β-hydroxylup–20(29)-en-28-oic.
Fruits	Taraxerone, 2-methoxy-4-vinylphenol, tocopherol, stigmatosterol, phenol-2-methoxy-5(1-propenyl), undecanol, 2(3h)-furanone, phenol, 3,7,11,15-tetramethyl-2- hexadecen-1-ol, 2.4-bis(1,1-dimethylethyl), ethisteron, β-sitosterol acetate, benzofuranone, 2-methyl-z,z-3, 13-octadecadienol 9,12-octadecadienoic acid, hexadecanoic acid methyl ester, campoesterol, and campesterol.
Aerial parts	Heptacosane, cephalandrol, $C_{29}H_{58}O$ tritriacontane $C_{33}H_{68}$ B-sitosterol alkaloids, kaempferol-3-O-rutinoside, kaempferol-3-O-glucoside, cephalandrine A and B, quercetin-3-O-neohesperidoside.
Whole plant	Asparagines, triterpenoid, aspartic acid, β-sitosterol, threonine, arginine, glutamic acid, tyrosine, histidine, phenylalanine, valine, cephalandrol, and triacontane.

Anticancer activity

The ethanolic extract of *C. grandis* leaves decreases the viable cell count, increases the nonviable cell count, and also causes an increase in ascites volume. *The extract of C. grandis leaves* normalizes hematological parameters like RBC, Lymphocyte, and WBC counts, including eosinophile and neutrophil counts. The aqueous extract of *C. grandis* was also evaluated for anticancer activity. From the studies, it has been concluded that *C. grandis* possesses a dose-dependent anticancer property when compared with vinblastine as a standard (15,16).

Alpha amylase inhibition

Alpha amylase inhibitory activity in an aqueous methanolic extract of *C. grandis* leaves was evaluated at a dose of 10 mL/g. *The C. grandis* leaf extract showed significant alpha-amylase inhibitory activity (81.2%). This study provides scientific proof for the traditional claim of *C. grandis* for the treatment of diabetics (17).

Mast cell stabilizing, anti-anaphylactic, and antihistaminic activity

Dnyaneshwar et al. studied mast cell stabilizing, antihistaminic, and anti-anaphylactic activity of ethanolic extract of *C. grandis* fruits at 100-150 mg/kg by intraperitoneal route using egg albumin-induced mast cell, clonidine induced degranulation, and cutaneous anaphylaxis in rats. Ethanolic extract showed significant inhibition of albumin, clonidine-induced degranulation, and anaphylaxis effect in rats. 150 mg/kg showed a potent effect on mast cell degradation and dose-dependent antihistaminic and anaphylactic potential. The studies concluded that *C. grandis* can be helpful to treat asthma (18).

Effect on Alzheimer's disease

Shalini *et al* carried out an *in-silico* evaluation of *C. grandis* fruits against Alzheimer's disease by using acetylcholine esterase as the receptor for this study. The reported phytochemicals in *C. grandis* and synthetic drug (rivastigmine) were taken as ligand molecules, and human acetylcholinesterase was retrieved from the PDB database. In silico studies were performed using glides (Schrodinger module). The phytochemicals in *C. grandis*, such as β-sitosterol, retinol, pectin, and taraxerone, had better glide scores than rivastigmine. Intake of *C. grandis* fruits can be used to reduce Alzheimer's disease (19).

Antimalarial activity

Green synthesis of gold nanoparticles using *C. grandis* leaves aqueous extract was evaluated for antimalarial activity against *Plasmodium berghei* in mice. Nanoparticles showed significant suppression compared to the aqueous extract of *C. grandis* (20).

Anthelminthic activity

The anthelminthic activity of petroleum ether, methanol, ethyl acetate, and aqueous extracts of *C. grandis* fruits was evaluated using *Pheretima posthuma*. Methanolic extract *C. grandis* shows dose-dependent anthelminthic activity by paralyzing and killing the worm. The remaining extracts are less effective than the methanolic extract (21).

Antibacterial and antifungal activity

The antibacterial activity of different extracts of *C. grandis* was tested against gram-positive and gram-negative bacteria. Ethanol and ethyl acetate extract of *C. grandis* stem showed a potent zone of inhibition compared with other extracts. Hexane leaf extract is more effective against gram-positive and negative bacteria (22).

Bhattacharya evaluated the antifungal activity of different leaf extracts of *C. grandis* against the *Candida albicans*, *Aspergillus niger*, *Candida tropicalis*, *Saccharomyces cerevisiae*, and *Cryptococcus neoformans*. Ethanol extract is a more significant inhibition zone than other extracts (23).

Hepatoprotective activity

Diethyl ether extract of *C. grandis* leaves was evaluated for hepatoprotective activity against CCl4-induced hepatotoxicity in rats. Diethyl ether extract significantly reduced elevated SGOT, SGPT, and bilirubin levels compared to silymarin (24).

Anti-tussive activity

Two different concentrations of methanol extract of fruits of *C. grandis* were evaluated for anti-tussive activity by counting the number of coughs of bouts produced by aerosols of citric acid and sulfur dioxide with the guinea pig. Methanolic extract showed significant inhibition of cough in a dose-dependent manner. It can be concluded from the studies that methanol extract of *C. grandis* produced a significant anti-tussive effect and the traditional claim of using *C. grandis* as an anti-cough agent was established (25).

Conclusion

Coccinia grandis offers numerous health benefits, including antidiabetic, hypolipidemic, antimalarial, antimicrobial, antipyretic, anti-inflammatory, anticancer, and analgesic properties, primarily due to its rich content of flavonoids, phenolics, and terpenoids. Despite these promising effects, further research is needed to elucidate the specific mechanisms of action of these phytochemicals responsible for their pharmacological activities.

Acknowledgments

The authors are thankful to Shantha College of Pharmacy, Peresandra, Chickballapur, for providing facilities for preparing this manuscript.

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Competing Interests
The authors declare no conflict of interest.

Ethical Approval
Not-applicable.

Funding
This research received no external funding.

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Cite this article as: Ramesh Sai Harshini S, Vijaykumar D, Sadali Venugopal V, Balakrishan T, Bhupalam Srinivas M, Thabassum R, et al. Ethnomedicinal uses and pharmacological activities of scarlet gourd. Future Nat Prod. 2024;10(1):39–43. doi: 10.34172/fnp.169.