

Phytochemical and Pharmacological potential of *Amaranthus viridis* L.

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Abstract

Medicinal plants are important in the traditional medicine and as well as modern pharmaceutical drugs. In traditional system of medicine various plant parts like leaves, flowers, stems, fruits, seeds, barks and even whole plants are used for the treatment. Traditionally the leaves, seeds, roots and entire plant of *Amaranthus viridis* Linn is used in the treatment of many diseases. Its uses include diuretic, analgesic, antipyretic, vermifuge, antiulcer antidiabetic, anti-cholesterolemic, laxative, asthma and venereal diseases. This review encompasses the available literature on *Amaranthus viridis* with respect to its pharmacognostic characters, physicochemical parameters, synopsis of pharmacological activities and traditional uses. This attempt provides a direction towards further research.

Keywords: *Amaranthus viridis*, physicochemical parameters, pharmacological activities

Introduction

Amaranthus viridis Linn (Amaranthaceae) is an annual herb, commonly called "chilaka thotakura" in Telugu [1]. Traditionally it is eaten as a leafy vegetable in South India. The leaves and seeds are highly nutritious. The nutrients present in the leaves include protein, fiber content, vitamin A, vitamin C, riboflavin (Vit B₂), thiamin (Vit B₁), minerals like calcium, phosphorus, iron, amino acids (arginine, histidine, lysine, methionine, cystine, phenylalanine, leucine, isoleucine, threonine, tryptophan, tyrosine, valine). The seeds possess protein and fat. Therefore the *A. viridis* received considerable attention because of the high nutritional value.

In Nepal the plant seeds have been used to reduce labour pain and to treat stomach problems [2]. Negritos of the Philippines apply the bruised leaves to treat eczema, psoriasis and rashes. Poultice of leaves are used to treat inflammations, boils and abscesses [3]. In India it is used as antidote for snake bites and scorpion stings. Other traditional uses are diuretic, anti-rheumatic, anti-ulcer, laxative, anti-leprotic and also used to treat respiratory problems. The entire plant decoction is used to treat dysentery and inflammation [4]. The root juice of *A. viridis* is used to treat inflammation during constipation and urination [5]. The plant is used as emollient and vermifuge [6].



Figure:1 *Amaranthus viridis* L



Synonyms

Amaranthus viridis L. is also known by various synonyms such as [7,8]

Viride Pyxidium Moench

Glomeraria viridis Cav

Amaranthus ascendens Loisel

Euxolus viridis Moq.

Amaranthus emarginatus Salzm

Amaranthus gracilis Desf

Taxonomical Classification

Kingdom : Plantae
 Unranked : Angiosperms
 Unranked : Eudicots
 Order : Caryophyllales
 Family : Amaranthaceae
 Genus : Amaranthus
 Species : Viridis
 Binominal name : *Amaranthus viridis* L.

Common names

Different vernacular names of *A. viridis* have been reported in table:1

Table:1 Vernacular names of *Amaranthus viridis* L.

Languages	Common Names
English	Slender amaranth
Hindi	Jungali Chaulayi
Konkani	Ranbhaji
Malayalam	Kuppakeera, Kuppacheera, Kuppacheera
Marathi	Math
Sanskrit	Tanduliya
Tamil	Kuppai-k-kirai
Telugu	Chilaka-thotakoora

Origin and Geographical Distribution

Amaranthus viridis is probably native to South America [9] and also Asia and Africa [7]. It is also distributed in Mexico and has been recorded in Northern Baja California, Chiapas, Chihuahua, Mexico, Tabasco and Veracruz. It is distributed throughout the World especially in tropical countries.

Ecology

It requires well-drained fertile soil in a sunny position. It should not be provided with inorganic fertilizers. It is cultivated as a food in tropical countries. It photosynthesizes by C₄ carbon-fixation pathway which effects at high temperatures.

Propagation

Amaranthus viridis is propagated by sowing seeds in spring. Germination is rapid if the soil is warm. A drop in temperature overnight will assist the germination. Apart from seeds the cuttings of growing plants are also used for propagation which roots easily [10].

Morphological Characteristics

It is an annual herb, erect, 10-75 (-100) cm stem, slender, branched, angular [11].

Leaves

Leaves are glabrous, dark green at upper surface and light green at lower surface. They are alternate, simple with reticulate and unicostate venation. The margin is entire, obtuse at apex and shape is cordate.

Flowers

The flowers are unisexual and small with green or reddish tinge colour. They are slender axillary and often paniculate spikes. The male flowers are with 3 tepals 1-2 mm long, narrowly elliptic to linear-spatulate, usually mucronate apex, stamens 3, filaments 0.7 to 1.2 mm long, anthers 0.4 to 0.5 mm long. The female flowers are with 3 tepals equal from 1.2 to 1.7 mm long, narrowly elliptic, obovate-elliptic or spatulate, apex rounded or almost acute sometimes mucronate, with a single locule with a single ovule, style short, stigma 3 branches.

Fruits

The fruits are sub-globose, less than 1 mm long. The sepals are indehiscent or rupturing irregularly at maturity and wrinkled. The seeds are dark brown to black, shiny and 1 mm long.

Stem

The stem is light green in colour, cylindrical in shape with irritating odour. It is herbaceous and grows upward. It has smooth texture and fibrous fracture.

Root

Root whitish in colour, cylindrical in shape with pungent odour. It possesses rootlets and grows horizontally downwards. It has smooth texture with fibrous fracture.

Nutritional Composition

The leaves and seeds are highly nutritious. The seeds possess 14-16% protein and 4.7 to 7% fat. The leaves are rich source of protein, fiber, amino acids and vitamin A, riboflavin, vitamin C,



niacin [6]. The nutritional composition of leaves are reported in table:2.

Table:2 Nutritional composition of 100g of leaves

Constituents	Quantity per 100 g of leaves powder
Water	81.8
Protein	34.2 g
Fibre	6.6
Fat	5.3
Carbohydrates	44.1
Ash	16.4
Calcium	2243 mg
Phosphorous	500 mg
Iron	27 mg
Sodium	336 mg
Potassium	2910 mg
Vitamin A	50 mg
Riboflavin	2.43 mg
Thiamine	0.07 mg
Niacin	11.8 mg
Vitamin C	790 mg
Calories	283 kcal

Phytochemistry

Amaranthus viridis have several active constituents like tannins, resins, reducing sugars and aminoacids. The methanolic leaves extract was reported for the presence of rutin and quercetin [12]. It also possess spinosterol (24-ethyl-22-dehydrolathosterol) as major component along with 24-methylathosterol 24-ethylathosterol, 24-methyl-22-dehydrolathosterol, 24-ethyl cholesterol and 24-ethyl-22-dehydrocholesterol as minor components in sterol fraction. The roots of *A. viridis* possess a steroidal component, amasterol (24-methylene-20-hydroxycholesta-5,7-dien-3 β -ol).

Pharmacological Activities

Antioxidant & Antimicrobial Activities

The methanolic and aqueous methanolic leaf and seed extracts were evaluated for total phenolic content, antioxidant and antimicrobial activities. The extract yields of active components of leaves using 100% methanol and 80% methanol were ranged from 5.4 to 6.0% and for seeds 2.4 to 3.7%.

The extracts possess appreciable levels of total phenolic contents 1.03 to 3.64 Gallic acid equivalent (GAE), g/100g and total flavonoid contents 18.4 to 5.42 Quercetin equivalent, g/100g in leaves and seed respectively. They also exhibited good 1,1-diphenyl-2-picryl hydrazyl (DPPH) radical scavenging activity as revealed by IC₅₀ (14.25 to 83.43 μ g/ml). Besides, the tested extracts showed considerable antimicrobial activity against selected bacterial and fungal strains with MIC ranging from 179-

645 μ g/ml. among the parts tested, the seed extracts exhibited superior antioxidant and antimicrobial activities.

To evaluate the antioxidant role of *A. viridis* Linn against isoproterenol induced oxidative damage in rats. The subcutaneous injection of isoproterenol to rats increases the level of lipid peroxidation products, decreased the activities of antioxidant enzymes, vitamic C, vitamin E & glutathione [13].

Antiphytopathogenic Activity

The leaves of *Amaranthus viridis* L. was evaluated for antiphytopathogenic property against microorganism resistant to pesticides and antibiotics. This study presents the antifungal activity on fusariosis by *Piper nigrum* and Anthracnose by *Musa* sp. The organic extracts of leaves were prepared using hexane, dichloromethane, ethyl acetate and ethanol. The extracts yields are 2.2, 2.4, 3.2 and 3.6% respectively. The minimum inhibitory concentration of these extracts was determined through microdilution technique using 96 well microplate. The dichloromethane, ethyl acetate and ethanol extracts exhibited MIC ranged from 15.6 – 250 μ g/ml against *Colletotrichum musae*. The hexane, ethyl acetate and ethanolic extracts showed activity against *fusarium solani* with MIC ranging from 31.2 – 250 μ g/ml. This study revealed the presence of antifungal constituents in extracts of *Amaranthus viridis* L [14].

Hepatoprotective Activity

The hepatoprotective and antioxidant activities of methanolic extract whole plant of *A. viridis* were evaluated against paracetamol induced hepatotoxicity in rats. The Wistar rats were administered for 15 days at a dose of 200 and 400 mg/kg. The hepatotoxicity showed significant increase in the levels of serum glutamate oxaloacetate transaminase (SGOT), serum glutamate pyruvate transaminase (SGPT), albumin and decrease in total protein and bilirubin.

The rats were treated with 200-400 mg/kg methanolic extract. The histopathological studies showed hepatoprotective activity. It also showed significantly decrease in the liver marker enzymes (SGOT, SGPT), bilirubin and restores albumin, total protein levels.

In vivo antioxidant studies in paracetamol administered rats showed significant increase in lipid peroxidation and decrease in glutathione, catalase and total thiol levels. The treatment with methanolic extract restored malondialdehyde, reduced glutathione, catalase and total thiols [15].

Anthelmintic Activity

Amaranthus spinosus, *Amaranthus caudatus* and *Amaranthus viridis* L. belong to *Amaranthaceae* family are traditionally used as vermicides. The methanolic extracts of these plants were investigated for anthelmintic activity using earthworms (*Pheretima posthuma*). The activity was evaluated at different concentration (10, 20, 40, 60, 80, 100 mg/ml) in dose dependent manner and compared with reference standard piperazine. The activity is due to



the presence of polyphenolic compounds. All the three plants methanol extracts were more effective in causing paralysis and death of the worms [16].

Antinociceptive and Antipyretic Activities

The methanolic extract of the whole plant of *A. viridis* was screened for antinociceptive and antipyretic activities. The antinociceptive activity was performed by acetic acid induce writhing test, hot plate and tail immersion methods. The oral administration of methanolic extract at a range of 200 – 400 mg/kg exerts significant prolongation in the response latency time to the heat stimulus. The activity was compared with morphine (5mg/kg). The antipyretic activity was evaluated using Brewer's yeast – induced pyrexia in the rats. The fever was induced by subcutaneous administration of 20 ml/kg of a 20% aqueous suspension of Brewer's yeast in normal saline. Rectal temperature was recorded. The administration of methanolic extract at 200 - 400 mg/kg shows an antipyretic activity. The activity was compared with oral administration of paracetamol (150 mg/kg [17].

Irritant Activity

The antimicrobial and irritant activities of extracts of *Malva parviflora* L., *Malvastrum coromandelianum* L. and *Amaranthus viridis* L. were investigated. The hexane, chloroform and ethanol extracts of *Malva parviflora* L., *Malvastrum coromandelianum* L. were tested for their antibacterial, antifungal and irritant activities. Whereas the hexane, chloroform, ethanol and aqueous extracts of *Amaranthus viridis* was tested for the above mentioned activities.

The extracts of *Malva parviflora* L., *Malvastrum coromandelianum* L. exhibits similar antibacterial activities against *Escherichia coli* but slight variation against *Proteus vulgaris*, *Bacillus subtilis* and *Staphylococcus aureus*. The chloroform extracts of these plants showed prominent activity as compared to that of other extracts. The ethanolic extract of *Amaranthus viridis* L. exhibited prominent activity compared to that of other extracts.

The irritant activity was performed by injecting 10 µl of different extracts of all the three plants to inner surface of rabbit ear. The ear was observed for redness after 15 and then every 30 minutes up to 24 hours. The acute and chronic irritant activity was exhibited by *Malva parviflora* L., *Malvastrum coromandelianum* L [18].

Anti-inflammatory Activity

The anti-inflammatory property of petroleum ether, alcoholic and aqueous extracts of *Amaranthus viridis* L. was carried out using experimental animal models. The extracts were evaluated for anti-inflammatory activity by carrageenan-induced rat paw edema method. The extracts in dose levels of 50, 100 and 200 mg/kg were used for the study and it is compared with standard drug

indomethacin. The ethanol and aqueous extracts at 200 mg/kg were effectively reduced inflammation [19].

Antidiabetic and Antihyperlipidaemic Activities

The stem aqueous extract of *Amaranthus viridis* L. was investigated for anti-diabetic and anti-hyperlipidaemic activities. The diabetes was induced in rats by intraperitoneal injection of streptozocin (55mg/kg). The stem aqueous extract was prepared in 1% gum acacia, an emulsifying agent. Antidiabetic activity was evaluated in dose levels of 100, 200 and 400 mg/kg body weight for 30 days. Glibenclamide (50 µg/ml) was used as reference standard. Fasting blood glucose and lipid parameters, viz. triglycerides, total cholesterol, high density lipoprotein and low density lipoprotein levels were measured. In diabetic induced rats the repeated administration of stem aqueous extract decreased the blood glucose levels by the treatment for 30 days. Therefore, the study demonstrates the potential of *A. viridis* L. to treat diabetes mellitus and its complications [20].

The leaves methanolic extracts of *Amaranthus caudatus*, *Amaranthus spinosus* and *Amaranthus viridis* were also reported for anti-diabetic and anti-cholesterolemic activities [21]. The streptozocin induced diabetic rats were treated with leaves methanolic extracts at a dose of 200 mg/kg and 400 mg/kg daily for 21 days. Blood samples were collected and blood glucose levels were estimated. The lipid profiles serum cholesterol, serum triglycerides, high density lipoprotein, low density lipoprotein were also estimated. The rat treated with methanolic extract of *A. viridis* L. at 200 mg/kg showed significant decrease in blood glucose level.

Conclusion

The above presented information regarding *Amaranthus viridis* (L) is reviewed to congregate the ethano-botanical, phytochemical and pharmacological information. The plant was reported for various pharmacological activities, hence it has broad spectrum of activities in the treatment of numerous ailments. It was reported for the presence of few phytoconstituents responsible for few biological activities. Hence it is required to isolate the other phytoconstituents which can be used as lead molecules in synthesizing novel agents with good therapeutic activity.

The isolation and characterization of phytoconstituents, elucidation of mechanism of action of isolated compounds and clinical trials of compounds are much needed. In the present global scenario the interest towards the medicinal plants has been increased for primary health care. Therefore, the provided information may be helpful for further research to screen the compounds responsible for different bioactivities and to elucidate the molecular mechanism of action.



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