Review Article

A Review on *Digera Muricata* (l.) Mart. - A Great Versatile Medicinal Plant

Neha Sharma*, Rekha Vijayvergia
Plant Pathology and Plant Biochemistry Laboratory, Department of Botany, University of Rajasthan, Jaipur, India.
***Corresponding author's E-mail:** siya28@gmail.com

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ABSTRACT

Digera muricata (L.) Mart. is an annual herb, growing to 20-70 cm tall. It is an important medicinal herb belongs to the Amaranthaceae family, found as a weed throughout India. Though almost all of its parts are used in traditional systems of medicines, leaves, roots and shoots are the most important parts which are used medicinally. The present article gives an account of updated information on its phytochemical and pharmacological properties. The review reveals that wide numbers of phytochemical constituents have been isolated from the plant which possesses activities like antibacterial, antifungal, diuretic, laxative, Free radical scavengic activity, anthelmintic, and various other important medicinal properties. The crushed plant is used as mild astringent in bowel complaints. The Leaves and spikes are used as a vegetable. Flowers and seeds used in the treatment of urinary discharges. For the last few decades or so, extensive research work has been done to prove its biological activities and pharmacology of its extracts. Analysis of various fractions of the *D. muricata* indicated the presence of flavonoids, alkaloids, terpenoids, saponins, coumarins, tannins, cardiac glycosides and anthraquinones.

Keywords: *Digera muricata*, Amaranthaceae, pharmacological activities, medicinal properties, phytochemical.

INTRODUCTION

From the time immemorial, plants have been widely used as curative agents for variety of ailments. Any plant which possesses curative elements or properties in one or more of its organs may be termed as medicinal plant. Plants based medicaments have been employed since the dawn of civilization for prolonging the life of man and for combating various ailments.

Medicinal herbs are moving from fringe to mainstream use with a greater number of people seeking remedies and health approaches free from side effects caused by synthetic chemicals. India officially recognizes over 3000 plants for their medicinal value. It is generally estimated that over 6000 plants in India are in use in traditional, folk and herbal medicine.

Indian traditional medicine is based on various systems including Ayurveda, Siddha, Unani and Homoeopathy. The evaluation of these drugs is primarily based on phytochemical, pharmacological and allied approaches including various instrumental techniques such chromatography, microscopy and others. With the emerging worldwide interest in adopting and studying traditional systems and exploiting their potential based on different health care systems, the evaluation of the rich heritage of traditional medicine is essential[2]. In this regard, one such plant is *Digera muricata*.

Digera is a genus having one species only *Digera muricata* (L.) Mart. (Syn *Digera arvensis* Forssk ; *Achyranthes muricata* L.) belongs to the family amaranthaceace. This is an annual herb, growing to 20-70cm tall. It is widespread in eastern tropical Africa and subtropical Asia. In India, It is widely distributed in Rajasthan, Maharashtra and Andhrapradesh. The root, leaf, stem, seeds and flowers of this plant have medicinal properties and traditionally used as medicinal plant. All parts of the plant have been used as crude drug for the treatment of kidney stone and urinary tract disorders.

D. muricata ethnopharmacologically has been used in renal disorders, aperients, refrigerant[3]. This plant is also used as an alternative for secondary infertility[4]. Antioxidant properties of *D. muricata* against the CCl4-induced toxicity for kidneys and testis had been documented. The Leaves and young shoots of this plant are locally used as a vegetable and given to relieve constipation[5]. *D. muricata* is used internally against digestive system disorders and in India seeds and flowers are used to treat urinary disorders. Leaf paste is applied locally to prevent pus formation[6]. This article aims to provide a comprehensive review on the phytochemical and pharmacological aspects of *Digera muricata* (L.) Mart.

TAXONOMY

Kingdom	: Plantae (plants)
Subkingdom	: Tracheobionta (Vascular plants)
Superdivision	: Spermatophyta (Seed plants)
Division	: Magnoliophyta (flowering plants)
Class	: Magnoliopsida (Dicotyledons)
Subclass	: Caryophyllidae
Family	: Amaranthaceae (Amaranth)
Order	: Caryophyllales
Genus	: Digera Forssk
Species	: Muricata (False amaranth)
Subspecies	: Digera muricata muricata
Subspecies	: Digera muricata trinervis
Variety	: Digera muricata macroptera

Variety : Digera muricata muricata
Variety : Digera muricata patentipilosa

Botanical Name

Digera muricata (L.) Mart.

Synonyms

Achyranthes alternifolia L., *Achyranthes muricata* L., *Digera alternifolia* (L.) Aschers., *Digera arvensis* Forssk.

Common name:

Hindi : Latmahuria, Lesua
Sanskrit : Aranya, Aranyavastuka, kunanjara, kuranjara
English : False amaranth
Telugu : Chnchali Koora
Tamil : Toya Keeri, kaatu Keerai
Kannada: Chenchali soppu, Goraji playa, Kankali soppu
Marathi : Gitana, Getna
Bangali : Lata mouri Ful, Gun gutiya

Distributional Range

This weed flower is known as false amaranth. It is widespread in eastern tropical Africa (from Sudan and Ethiopia south to Tanzania)[7], Madagascar[8] and tropical and subtropical Asia (from Yemen to Afghanistan, Pakistan, India, Malaysia and Indonesia). In India it is widely distributed in Rajasthan, Maharashtra and Andhrapradesh.

Native

- **Africa**
  Northeast Tropical Africa: Ethiopia; Somalia; Yemen - Socotra
  East Tropical Africa: Kenya; Tanzania; Uganda
- Western Indian Ocean: Madagascar
- **Asia-temperate**
  Arabian Peninsula: Oman; Saudi Arabia; Yemen
  Western Asia: Afghanistan; Iran
- **Asia-tropical**
  Indian Subcontinent: India; Pakistan
  Malaysia: Indonesia -Celebes, Java, oluccas; Malaysia

Cultivated:

- **AFRICA**
  Northeast Tropical Africa: Ethiopia
- **ASIA-TROPICAL**
  Indian Subcontinent: India

Ecology

D. muricata is most common on disturbed and waste ground, but occurs in many kinds of habitat, from dry savanna and semi-desert to moist localities on deep clay and mud soils, from sea-level up to 1500 m altitude. It also occurs as a weed in fields, sometimes being troublesome. Its cultivation occurs in northeast tropical Africa (Ethiopia) and in Indian subcontinent (India)[9].

Nutritive Value

D. muricata is considered as an edible GLV (Green leafy vegetable)[10]. Fifty six percent edible portions are present in this weed[11]. This plant is a rich source of calcium, iron, phosphorus, potassium, magnesium etc. Various parameters are listed in table.

Table 1: Nutrient levels of *Digera muricata*

Parameter	Concentration (g/100g)
Edible portion	56
Ash value	3.54
Moisture	83.8
Protein	4.3
Mineral contents	mg/100g
Calcium	506
Potassium	604
Magnesium	232
Sodium	-
Phosphorus	63
Trace mineral contents (mg/100g)	
Iron	17.72
Zinc	0.57
Copper	0.16
Chromium	0.243
Manganese	0.23
Vitamin content (mg/100g)	
Ascorbic acid	49
Thimine	0.10
Total-Carotene	17.93
B-carotene	3.36

BOTANICAL DESCRIPTION

This is an annual herb up to 70 cm tall; stem simple or branched, subglabrous, ridged. Leaves alternate, simple; petiole up to 5 cm long; blade linear to ovate, 1–9 cm × 0.2–5 cm, base narrowed, apex acuminate, margin entire, subglabrous. Inflorescence a long-pedunculate (up to 14 cm long), axillary, spike-like bracteate raceme up to 30 cm long, each bract subtending a subsessile partial inflorescence with a central fertile flower and 2 sterile lateral flowers. Flowers are borne on slender spike-like racemes, which can be as large as 30 cm long. Flowers are hairless, white mixed with pink to carmine or red, usually becoming greenish-white in fruit. Flowering occurs in month of August and September. Fertile flower with 2 firm, boat-shaped outer perianth segments 3–5 mm long and 2–3 inner, slightly shorter, hyaline segments; stamens usually 5, free or slightly connate at base; ovary superior, 1 -celled, style filiform, up to 4 mm long, stigmas 2, divergent; lateral flowers consisting of accrescent antler-shaped scales. Fruit is subglobose, hard, 2 mm in

diameter, ridged, enclosed by the persistent perianth and falling together with the sterile flowers and bracteoles.

Digera comprises only 1 species. Based on the venation of the outer tepals 2 subspecies of *Digera muricata* have been distinguished: subsp. *muricata* with outer tepals 7–12-veined, mainly occurring in Asia, but also in eastern Africa and Madagascar, and subsp. *trinervis* C.C.Towns. with outer tepals 3–5-veined, mainly occurring in Africa. Based on hairiness of leaves and on form of scales in sterile flowers, several varieties have been distinguished in subsp. trinervis, of which var. *patentipilosa* C.C.Towns. It seems most suitable as a leafy vegetable because it has large leaves [12].

Figure 1: a. A complete plant of *Digera muricata* (L.) Mart. b. Leaves c. Inflorescence

MEDICINAL PROPERTIES

The *Digera muricata* (L.) Mart. is a wild edible herb used by village people. It is popularly known for herbal remedy for various ailments. In Ayurveda this herb is considered as cooling, astringent of bowels and also used as a laxative[13]. The leaves are used for treatment of diabetic[14]. But the scientific basis for its medicinal use especially for boiled root infusion given to mother after child birth to increase lactation purpose is to be evaluated. The flower and seeds are used to treat urinary discharges[15]. Ethyl alcohol extract of plant is diuretic. The whole plant is used in digestive system disorders. The leaves and young shoots of this plant are locally used as a vegetable and given to relieve constipation[11]. The whole plant is used in urinary disorders[16]. The decoction of leaves gives once in a day for kidney stone treatment[17,18]. The extract of this plant used in biliousness and in urinary discharges[19]. Leaf paste is applied locally to prevent pus formation. The crushed plant is used as mild astringent in bowel complaints and antibilious[20]. Antioxidant properties of *D. muricata* against the CCl4-induced toxicity for kidneys and testis had been documented[21]. This plant is used as an alternative for secondary infertility. Secondary infertility is found to be associated with hepatic disorders. The models created by the use of CCl4 to induce liver injuries can be best suited to study the hypogonadism in rat. The whole plant extract improves blood content and also works as expectorant[22]. This is antiperiodic, coolent and stomachin[23].

Other uses

D. muricata is considered as a famine food[24] because of rich source of nutrients[25]. In Kenya they are particularly popular as a cooked vegetable amongst coastal tribes. In India the leaves are made into curries or the entire plant is boiled in water and seasoned with salt and chilli. The whole plant is also commonly grazed as forage, particularly by sheep and goats. The flowers are rich in nectar which is sometimes sucked by children in Kenya[26].

CHEMICAL CONSTITUENTS

The primary metabolites like carbohydrates, proteins, lipids, phenols, chlorophylls, amino acids etc. of this plant in different solvent extracts have been investigated[27,28]. The plant contains α- and β- spinasterol[29]. Analysis of various fractions of the *D. muricata* indicated the presence of flavonoids, alkaloids, terpenoids, saponins, coumarins, tannins, cardiac glycosides and anthraquinones. Rutin and Hyperoside flavonoids have been identified in hexane extract of this plant[30].

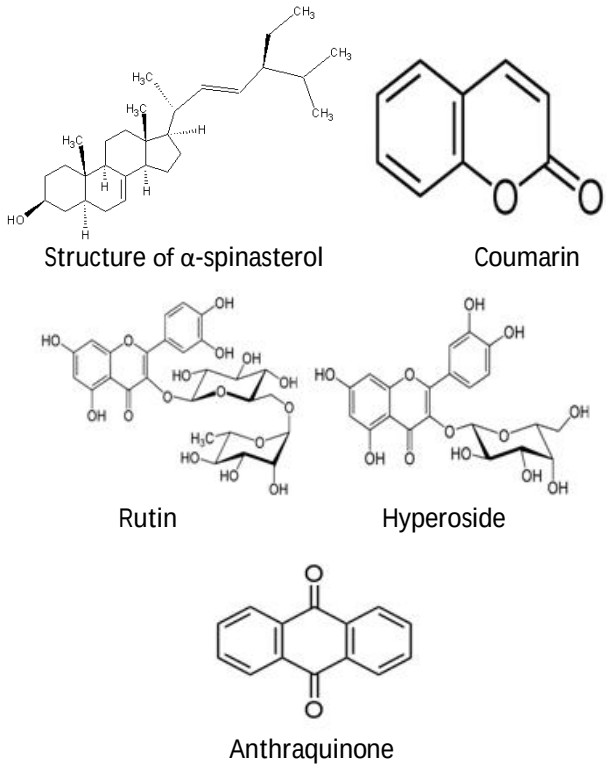

Figure 2: Structure of some phytoconstituents isolated from *Digera muricata*

PHARMACOLOGICAL ACTIVITIES

Hepatoprotective activity

The methanolic extract of *D. muricata* shows hepatoprotective effect against acryl amide-induced hepatocellular injuries. Acryl amide (AA) is a water-soluble vinyl monomer used in the production and synthesis of polyacrylamides[31,32]. It has been documented that AA is formed during the cooking of starchy foods at high temperature[33]. Daily exposure to AA might present a risk factor for neurotoxicity and reproductive toxicity as well as carcinogenicity in humans[34,35]. AA can also cause glutathione depletion, resulting in intracellular oxidative stress[36]. The methanolic extract of *D. muricata* was given to acryl amide induced Sprague-Dawley rats and found that Hepatic lesions induced with AA were reduced with DME treatment. The results suggest that the hepatoprotective effects of DME against AA-induced oxidative injuries could be attributed to the phenolics and flavonoids.

Antimicrobial activity

The different solvent extracts shows antifungal and antibacterial activity against selected bacteria and fungi. The organic successive Soxhlet extracts of D. muricata i.e., petroleum ether, chloroform, ethanol and distilled water, have shown significant zone of inhibition of bacterial growth at the concentrations of 200 and 400 µg/well against test pathogens[28]. It is also reported that the methanol extract shows maximum activity against test bacteria and fungi[27].

Antioxidant activity

The plant has shown antioxidant activity in different investigations. Mety et al., 2011 analysed free radical scavenging and antioxidant activity of different solvent extract like hexane, petroleum ether, chloroform, methanol, ethanol and aqueous[37]. The maximum activity recorded in methanol and least activity was recorded in hexane. The methanolic crude extracts of *D. muricata* was screened for their free radical scavenging properties by DPPH (1,1-diphenyl-2-picryl hydrazyl) radical scavenging assay. The maximum activity was observed in roots of *D. muricata*[38]. Antioxidant properties of *Digera muricata* methanol extract against the CCl4-induced toxicity in kidneys and testis had been well documented[39,21].

Anti-diabetic activity

The methanolic extract of *D. muricata* (MEDM) leaves exhibited antidiabetic activity in alloxan induced diabetic rats. These results suggest that MEDM (200mg/kg) showed antihyperglycemic activity in diabetic rats. The other parameters like blood glucose level, HDL level in serum decreases and body weight increases[14].

Anthelmintic activity

The crude extract from leaves was preliminary screened for anthelmintic activity when tested against earthworms (*Pheretima posthuma*) [40].

Anti-testicular toxicity

The study suggested the protective potential of hexane extract of *D. muricata* against the CCl_4-induced liver and testicular toxicity. CCl_4 can rapidly lead to both oxidative stress and acute liver injuries [41,42]. Liver cirrhosis causes Hypogonadism in male rats which are cured by Hexane extract of D. muricata. DMH treatment ameliorated the hepatic injuries with consequent increase in the antioxidant status of various enzymes and compounds. Level of testosterone was elevated with DMH in addition to the repairing of testis and accessory organs. These protective effects of DMH against the CCl4 toxicity may be attributed due to the presence of various bioactive groups and specifically the rutin and hyperoside in DMH[43].

Renal disorders

D. muricata is used in renal disorders in folk medicine. The extract of this plant is administered daily in kidney stone treatment[44]. Generation of reactive radicals has been implicated in carbon tetrachloride-induced nephrotoxicity, which are involved in lipid peroxidation, accumulation of dysfunctional proteins, leading to injuries in kidneys. Nephrotoxicity is a poisonous effect of some substances on kidneys. The n-hexane and methanolic extract of D. *muricata* shows protective role against Carbon tetrachloride which is induced nephrotoxicity in rats[39].

Allelopathic effect

The aqueous extract of stem, root and leaf of *D. muricata* shows allelopathic effect on in vitro seed germination of *Pennisetum typhoideum* (bajra). Different concentrations of various parts of weed showed inhibitory effects on shoot and root growth of *Pennisetum typhoideum*. The leaf extract proved inhibitory in nature than stem and root[44].

Protective effect

The methanolic and hexane extract of *D muricata* shows protective effect against oxidative stress caused by ccl4 in rats[45]. It is able to ameliorate oxidative stress in adrenal gland induced by CCl_4 in rat. The protective potential may also involve the preventive effects of *D. muricata* methanolic extract by the inhibition of CCl_4 metabolism[46]. This study further supports the scientific evidence in favor of its pharmacological use in oxidative stress diseases.

DISCUSSION

Before the introduction of modern medicines, disease treatment was entirely managed by herbal remedies. It is estimated that about 80% of the world population residing in the vast rural areas of the developing and under developed countries still rely mainly on medicinal

plants. Phytochemical and pharmacological investigations carried out in the plant reveals its multidisciplinary usage. It is quite obvious that the plant is widely used in traditional medicinal system of India and has been reported to possess anti-bacterial, antifungal, anti-diabetic, hepatoprotective, nephrotoxicity protective, anthelmintic, free radical scavenging properties. It is known as a rich source of phenols, tannins, terpenoids, flavonoids and glycosides present in *Digera muricata* might be medicinally important and/or nutritionally valuable. The plant is rich in carbohydrates, Calcium, potassium, ascorbic acid, iron, magnesium etc. The present review summarizes some important pharmacological studies on *D. muricata* and phytochemical investigations and isolated principles from them, which can be investigated further to achieve lead molecules in the search of novel herbal drugs.

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