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A review on *Diger arvensis* (Tandla)-A great versatile medicinal plant

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Abstract

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, antidiabetic, 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 arvensis* 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. arvensis* and phytochemical investigations and isolated principles from them, which can be investigated further to achieve lead molecules in the search of novel herbal drugs.

Key words: Zingiberaceae, Myrcene, Cosmetics, Essential oil, Anticancer

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1. Introduction

Tandla (*Digera arvensis*) is an annual herb belonging to the family Amaranthaceae. It has been used for thousands of years in many cooking traditions, locally used as a vegetable (Leaves and young shoots are cooked and use as a pot herb) [1] and less often used in folk medicine. It is widespread in eastern tropical Africa and subtropical Asia. In India, it is widely distributed in Rajasthan, Maharashtra and Andhrapradesh [2]. The stamens have lollipop hairs and therefore attract a variety of pollinators, especially flies, but the flowers are also capable of auto-pollination and the seeds are transported by the wind or rain. *Digera arnvensis* is known by different names depending where you are in the world. It is commonly known as false amaranth. In India, specifically in hindi or bengali is typically called chanchali, lahsuva or latmahuria, in Punjabi leswa or tandla, and in Marathi getan and kunjar, in Kannada language Chenchali soppu, Goraji playa, Kankali soppu or gorajepalle, in Telugu language chenchalicet, in Sanskrit language Aranya, Aranyavastuka, kunanjara, or kuranjara, in Chnchali Koora Tamil language Toya Keeri, in Marathi language Gitana or Getna and in Bangali Gun gutiya. The plants can be varied in size from 20cm to 70cm. Leaves entire deltoid-ovate, blade 3–7 cm long, 1.8–3.5 cm wide, acute or acuminate at apex, cuneate to subtruncate at base, glabrous or petiole.

2. History/Origin

Digera arvesis is native to Northeast Tropical Africa, Ethiopia and East Tropical Africa and Western Asia, and especially in the eastern and northern provinces of India. *Digera arvensis* herb is distributed throughout India and is commonly seen after rains especially in the eastern and northern provinces of India. 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 [3-4]. 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. In this regard, one such plant is *Digera Arvesis*.

D. arvensis ethno-pharmacologically has been used in renal disorders, aperients, and refrigerant. This plant is also used as an alternative for secondary infertility. Antioxidant properties of *D. arvensis* against the CCl_4-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. *D. arvensis* 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. This article aims to provide a comprehensive review on the phytochemical and pharmacological aspects of *Digera arvensis*.

3. Demography/Location

Digera arvensis is widespread in southern Asia from tropical Arabia and Yemen to Afghanistan, India, Malaysia, and Indonesia, as well as in northeastern and eastern tropical Africa and Madagascar. The occurrence of the species is usually relative to gram crop and human activity in Pakistan [5]. *D. arvensis* 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) [6]. *Digera arvensis* is grown widely in the following countries.

4. Botany, Morphology, Ecology

This is an Annual herb up to 20-70cm tall. *Digera arvensis* 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. The stem of plant is simple or with ascending branches from near base. The stem of *D. arvensis* is ridged and glabrous with alternate branches and leaves. The Leaves of *Digera arvensis* is alternate, simple and petiol up to 5 cm long and entire deltoid-ovate and blade linear to ovate 3–7 cm long and 1.8–3.5 cm its width, 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 antlershaped 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 arvensis* 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 [7]. Fruit a subglobose, hard, indehiscent nutlet enclosed by persistent perianth and falling together with sterile flowers and bracteoles, slightly compressed, 2–2.5 mm in diameter, bluntly keeled along each side, surmounted by a thick rim, firm processes furnished throughout with verrucae or ridges, style persistent [8].

5. Chemistry

Different parts of Tandla contain a profile of important minerals, and are a good source of protein, vitamins, beta-carotene, amino acids and various phenolics compounds, alkaloids and a terpenoid compounds. Greater quantities of all these allelochemicals were present in the roots followed by shoots.

5.1. Chemical composition

D. arvensis is considered as an edible Green leafy Vegetable [1]. Fifty six percent edible portions are present in this weed [9]. Phenolic compounds (Quercetin, sinapic and ferluic acid), alkaloids (cystine and berbine) and a terpenoid (limonene) were detected from roots and shoots of *D. arvensis*. This plant is a rich source of calcium, iron, phosphorus, potassium, magnesium etc. However, composition varies with different seasons [10]. *Digera arvensis* have different concentration of minerals they are Edible portion 56% and Ash value 3.54%. Moisture is 83.8% and amount of Protein is 4.3%. The Mineral contents mg/100g Calcium 506mg/100g, Potassium is 604mg/100g, Magnesium is 232mg/100g and Phosphorus is 63mg/100g. *D. arvensis* also have some trace mineral contents and there concentration are Iron is 17.72mg/100g, Zinc is 0.57mg/100g, Copper is 0.16mg/100g, Chromium is very least amount around about 0.243mg/100g, Manganese is 0.23mg/100g. Vitamin content also present in *Digera arvensis* they are Ascorbic acid is 49mg/100g, Thimine is 0.10mg/100g. Total-Carotene is 17.93mg/100g and B-carotene is 3.36mg/100g.

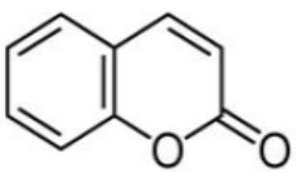

Figure 1. Structure of Coumarine

5.2. Phytochemistry

The primary metabolites like carbohydrates, proteins, lipids, phenols, chlorophylls, amino acids etc are present [11-12]. The plant also contains α- and β- spinasterol [12]. Analysis of various fractions of the *D. arvensis* indicated the presence of flavonoids, alkaloids, terpenoids, saponins, coumarins, tannins, cardiac glycosides and anthraquinones. Rutin and Hyperoside flavonoids have been identified in this plant [13].

6. Post-Harvest Technology

Conventionally, the best harvesting time of tandla is morning just after the evaporation of dew. However, many contrary finding reported that there is no contrast between fresh and dried *Digera arvensis* in relation to flavor contents. The fresh leaves have a flavor complexity and intensity that is greatly lost in the dried leaves. *D. arvensis* can be stored for a week or less when it is wrapped in several layers of paper and placed in an airtight bag and stored. The dry leaves of tandla are appropriately for long-term storing. These Lahsua (*Digera arvensis*) incorporated products was homogenized individually, dried at 60^0C and finely powdered. The dried powder was further used in the analysis of proximate and mineral analysis. Nutrients such as moisture, protein, fat, crude fibre, calcium, iron were analyzed as per AOAC methods. Energy and carbohydrate were calculated by difference method.

7. Processing

Digera arvensis, like other plants, is consumed in variety of ways and for various purposes. In addition to its fresh leaves, other common processed forms of *D. arvensis* include whole dry leaves, freezing, and extracted essential oils. Essential oils analysis is generally carried out by GC-MS analysis [14-16]. Alternative traditional methods for preserving tandla leaves include storage in salt and in the form of oil concentrates. *Digera arvensis* dried by hanging washed bundles inverted in a dry and shaded place or placing whole spread leaves between two sheets of papers to prevent oxidation and discoloration. *Digera arvensis* leaves should be dried immediately after harvest because they darken if exposed to open air for extended period of time.

8. Value addition

Digera arvensis will most probably remain a leaf vegetable of only local importance. *Digera arvensis* can be combined with variety of other herbs including juniper, oregano, paprika, mustard, sage and thyme and can be used in stuffings, stews, and as well as vegetable. Small leaves are good to be added to vegetarian dishes, salads and pasta. The Leaves and young shoots of *Digera arvensis* are cooked and Used as a pot herb. The plant is often used locally as a vegetable, and is particularly popular as a cooked vegetable amongst the coastal tribes of Kenya. In India the leaves are made into curries or the entire plant is boiled in water and seasoned with salt and chilli. Sometimes it is considered a famine food, and is only used when nothing else is available. The flowers are rich in nectar which is sometimes sucked by children in Kenya.

9. Uses

Many herbs and spices contribute to health despite the low amounts of consumption, as they are full of nutrients and certain mineral compounds. It is not clear that how much D. arvensis should be consumed to gain its health benefits. Researches do not have particular recommendation about the precise amount of use.

9.1. General uses

Leaves and young shoots of *Digera arvensis* are locally used as a vegetable, e.g. in Africa (Ethiopia, Kenya) and in India. 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. Sometimes *Digera arvensis* is considered a famine food. The flowers are rich in nectar which is sometimes sucked by children in Kenya. The whole plant is also commonly grazed as forage, particularly by sheep and goats. In Senegal *Digera arvensis* is used internally against digestive system disorders and in India seeds and flowers are used to treat urinary disorders. *Digera arvensis* leaves were used for the incorporation into three products, namely, Paustic paratha, Sag and Dal in India. The *Digera Arvensis* 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. The leaves are used for treatment of diabetic. 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. 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. The whole plant is used in urinary disorders. The decoction of leaves gives once in a day for kidney stone treatment. The extract of this plant used in biliousness and in urinary discharges. Leaf paste is applied locally to prevent pus formation. The crushed plant is used as mild astringent in bowel complaints and antibilious. Antioxidant properties of *D. arvensis* against the CCl_4-induced toxicity for kidneys and testis had been documented. 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 CCl_4 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. This is antiperiodic, coolent and stomachin.

9.2. Pharmacological uses

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seeds are used to treat urinary discharges. 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. The whole plant is used in urinary disorders. The decoction of leaves gives once in a day for kidney stone treatment. The extract of this plant used in biliousness and in urinary discharges. Leaf paste is applied locally to prevent pus formation.

9.2.1. Hepatoprotective activity

The methanolic extract of D. arvensis shows hepatoprotective effect against acryl amide-induced hepatocellular injuries. Acryl amide (AA) is a watersoluble vinyl monomer used in the production and synthesis of polyacrylamides [17-18]. It has been documented that Acryl amide (AA) is formed during the cooking of starchy foods at high temperature [19]. Daily exposure to AA might present a risk factor for neurotoxicity and reproductive toxicity as well as carcinogenicity in humans [20-21]. AA can also cause glutathione depletion, resulting in intracellular oxidative stress36. The methanolic extract of *D. arvensis* 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.

9.2.2. Antimicrobial activity

The different solvent extracts of aromatic plants show antifungal and antibacterial activity against selected bacteria and fungi [14-22-23]. The organic successive Soxhlet extracts of *Digera arvensis* 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 [12]. It is also reported that the methanol extract shows maximum activity against test bacteria and fungi [11].

9.2.3. Antioxidant activity

Aromatic plants have shown antioxidant activity in different investigations [24]. Antixidant properties of plant are due to the presence of phenolic or flavonoid components [24-26]. The maximum activity recorded in methanol and least activity was recorded in hexane. The methanolic crude extracts of *D. arvensis* 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*. Antioxidant properties of *Digera arvensis* methanol extract against the CCl_4-induced toxicity in kidneys and testis had been well documented [27-28].

9.2.4. Anti-diabetic activity

The methanolic extract of D. arvensis (MEDA) 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 [29].

9.2.5. Anthelmintic activity

The crude extract from leaves was preliminary screened for anthelmintic activity when tested against earthworms (Pheretima posthuma) [30].

9.2.6. Anti-testicular toxicity

The study suggested the protective potential of hexane extract of *D. arvensis* against the CCl4-induced liver and testicular toxicity. CCl_4 can rapidly lead to both oxidative stress and acute liver injuries [31-32]. Liver cirrhosis causes Hypogonadism in male rats which are cured by Hexane extract of *D. arvensis*. 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 CCl_4 toxicity may be attributed due to the presence of various bioactive groups and specifically the rutin and hyperoside in DMH [33].

9.2.7. Renal disorders

D. arvensis used in renal disorders in folk medicine. The extract of this plant is administered daily in kidney stone treatment [34]. 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. arvensis* shows protective role against Carbon tetrachloride which is induced nephrotoxicity in rats [27].

9.2.8. Allelopathic effect

The aqueous extract of stem, root and leaf of *D. arvensis* 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.

9.2.9. Protective effect

The methanolic and hexane extract of *D. arvensis* shows protective effect against oxidative stress caused by ccl4 in rats. It is able to ameliorate oxidative stress in adrenal gland induced by CCl4 in rat. The protective potential may also involve the preventive effects of *D. arvensis* methanolic extract by the inhibition of CCl_4 metabolism. This study further supports the scientific evidence in favor of its pharmacological use in oxidative stress diseases.

9.3. Other uses

D. Arvensis is considered as a famine food because of rich source of nutrients. 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.

10. Summary

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, antidiabetic, 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 arvensis* 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. arvensis* 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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