

Bridging tradition and science: A review on medicinal potential of *Dregea volubilis* (L.F.) Benth. ex Hook.F.

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Abstract

The Indian traditional system of medicine is one of the oldest and most comprehensive systems of healthcare in the world. Medicinal plants form the foundation of India's rich traditional medical systems. Systems like Ayurveda, Siddha, Unani, and Folk medicine have used plants for thousands of years due to their natural and holistic healing property. However, their safe and effective use requires scientific validation, regulation, and awareness of limitations. Integrating traditional wisdom with modern research is the key to maximizing the benefits and minimizing the risks. *Dregea volubilis* (L.f.) Benth.ex Hook.f. is one such important medicinal plant. This comprehensive review explores the medicinal properties of this plant, aiming to bridge the gap between its traditional uses and the scientific validation. The botanical description, traditional uses, phytopharmacological investigations, biosynthesized nanoparticles and toxicological studies of this plant are discussed in this review based on an extensive survey of the existing literature.

Keywords: Phytopharmacology, biosynthesized nanoparticles, toxicology

Introduction

Dregea volubilis (L.f.) Benth.ex Hook.f. is a member of Apocynaceae. It is commonly called as cotton milk plant, sneeze wort, and green wax flower. The vernacular name of this plant in Malayalam is “vattakakkodi” and ‘kakkalankodi’. According to the data available in the Plants of the World Online, Royal Botanic Gardens, Kew, this name was first published in Fl. Brit. India 4: 46 (1883). Data available in the website of State Medicinal Plant Board, Kerala, indicates that *Dregea volubilis* is a native plant of India and its distribution ranges Indo-Malaysia and China.

Synonyms

1. *Wattakaka volubilis* (L.f.) Stapf
2. *Asclepias volubilis* L.f.
3. *Marsdenia volubilis* (L.f.) Cooke
4. *Stephanotis volubilis* (L.f.). S. Reuss, Liede & Meve

Botanical Description

Dregea volubilis is a liana reaching up to about 12 m height. Branches are pale grey in colour and lenticellate. Branchlets are green and smooth. Leaves are ovate or somewhat rounded, base cordate, apex acuminate and glabrous. Flowers green or yellowish green, fragrant, produced in umbel like axillary cymes. Fruit is a follicle, long, turgid, longitudinally ribbed, velvety until mature. Seeds are yellowish brown, broadly or broad elliptic, winged and comose. Flowering usually occurs between March and April (Das *et al.*, 2019).

Traditional Uses

Dregea volubilis has a fairly good history of medicinal use in the traditional medicinal system of India. The whole plant is considered as medicinal. According to the data available in the website of State Medicinal Plants Board, Kerala (SMPB), the young leaves are used as vegetables and are

also used in the treatment of fever in children. Leaf salad and soup are used to increase the milk production in lactating mother and also used for the detoxification and blood purification (Farzana & Tarique, 2022). It is also used to get relief from constipation. Crushed leaves used to apply on boils and abscesses (Athuraliya *et al.*, 2019). Ground roots and young stalk are used as emetic and expectorant (Sukanya Vijayan, 2022) [36]. In Ayurveda this plant is considered as a rejuvenating herb. The oil prepared from this plant is found as effective as ‘murivena’ and a preliminary clinical study conducted with the ointment prepared from this plant found as effective in pyoderma, tinea pedis, scabies, cuts, wounds and plantar psoriasis (Moni Thomas *et al.*, 1995). *Dregea volubilis* is also reported as extensively used to treat inflammation, piles, leucoderma, asthma, urinary discharge, tumors, etc (Hossain *et al.*, 2010) [9]. This plant is used for snake bite, eye diseases, fever, etc. and reported as it has anthelmintic and aphrodisiac properties. (Shivani *et al.*, 2023) [6]. Administration of a decoction of 3 gm powdered bark of *D. volubilis* and 21 black peppers in one cup of lukewarm water for 21 consecutive days used for the treatment of gout and rheumatism (Maurya & Anand Kumar, 2018).

Phytochemical Investigations

Various phytochemical works done on *Dregea volubilis* has identified a variety of bioactive compounds like triterpenoids, glycosides, fatty acids and phenolics. A pentacyclic triterpenoid designated as taraxerol, characterized as D- friedoolean- 14- en, 3 ol was isolated from the petroleum ether extract of the fruits of *Dregea volubilis* (Biswas *et al.*, 2010) [17, 21, 22]. One study with the dried ethanol extract of the plant revealed the presence of different phytoconstituents like amino acids, protein, lipid, anthraquinones, flavonoids, coumarins, saponins, cyanogenetic & cardioactive glycosides, tannins, catechin,

phytosterols, alkaloids, gum and mucilage (Shankar *et al.*, 2010) ^[31]. Another study with liquid chromatography identified and quantified some compounds like gallic acid, ferulic acid, rutin, ellagic acid, quercetin and cinnamic acid (Das *et al.*, 2017). A comparative evaluation on the chemical composition of various solvent extracts of *Dregea volubilis* leaves identified and quantified 67 bioactive compounds from different parts of the plant by using different solvents (Amalraj *et al.*, 2021) ^[35]. A polyoxypregnane glycoside was isolated from the roots through the ethyl acetate extract and demonstrated chondroprotective effects in cartilage-explant models ((Sanyacharemkul *et al.*, 2009). In a study using GC-MS-identified hexadecenoic acid from the ethanolic leaf extract (Natarajan & Dhas, 2013) ^[39, 40, 42]. A study on the allelopathic effect of this plant identified two phytotoxic substances, and their structures were determined as dehydrovomifoliol and loliolide (Kyaw *et al.*, 2022) ^[7]. Three new pregnane glycosides namely volubilosides D-F (1-3) and three known dregoside Da1 (4), volubiloside A (5) and drevoluoside N (6) were isolated from the methanol extract of the leaves of *Dregea volubilis* using combined chromatographic methods (Kim Thuy *et al.*, 2020).

Pharmacological Studies

Dregea volubilis has been widely used in the Indian traditional medicine system since ancient times. Recent studies have isolated and characterized many bioactive compounds from this plant. As a result, many pharmacological studies have been carried out to explore its medicinal properties.

Antioxidant Activity

Different extracts from various parts of *Dregea volubilis* shown significant antioxidant activity. Antioxidant activity of the petroleum ether, chloroform, and methanol extracts of *D. volubilis* fruits were evaluated in a study. All the extracts exhibited dose - dependent antioxidant activity and was comparable to vitamin C in some assays (Biswas *et al.*, 2010) ^[17, 21, 22]. A study with the petroleum ether extract of fruits of this plant in streptozotocin induced diabetic rats revealed its antioxidant potential by reducing lipid peroxidation and restoring endogenous enzymes like catalase and SOD (Biswas *et al.*, 2011) ^[23]. A comparative evaluation of different solvent extracts of the leaves of this plant for antioxidant activity demonstrated that methanol extract showed highest DPPH, nitric oxide and superoxide radical activities and the ethanolic extract of the leaves of *D. volubilis* exhibited antioxidant potential (Natarajan & Dhas, 2013) ^[39, 40, 42]. Another study with the ethanolic extract of the leaves of this plant in a dose of 200 mg/Kg demonstrated significant improvement in the glutathione, SOD, catalase, peroxidase and transaminase enzyme levels comparable with the vitamin E ((Natarajan & Vishwanath, 2021) ^[41, 43]. Methanolic and hot water extracts of its stem bark showed superior antioxidant potential (Udhayasankar *et al.*, 2012). A study on the antioxidant activity of this plant indicates that the methanolic, polyphenolic and sapogenin mixture extracts possess both *in vitro* and *in vivo* antioxidant activity (Sathapathy *et al.*, 2016).

Anti-Diabetic Activity

A study with the petroleum ether extract of the fruits of *D. volubilis* in streptozotocin induced hyperglycemic Wistar

rats, reported remarkable antidiabetic activity (Biswas *et al.*, 2011) ^[23]. In another study, the hydroalcoholic flower extract of *D. volubilis* was evaluated for antioxidant activity *in vitro* and found as potent antioxidant due to high phenolics and flavonoids (Das *et al.*, 2017). Moreover, a study on the antidiabetic effect of the ethanolic extract of the leaves of this plant identified and isolated a bioactive compound with strong antidiabetic efficacy and provides a scientific rationale for the use as an anti-diabetic agent (Natarajan *et al.*, 2020). A comparative study with petroleum ether, ethyl acetate and ethanol extracts of the leaves *D. volubilis* on streptozotocin induced diabetic rats found out that the ethanol extract was more effective and could lower the fasting blood glucose level significantly (Natarajan & Dhas, 2013) ^[39, 40, 42]. Another comparative study with different solvent extractions of leaves of *D. volubilis* also revealed the antidiabetic effect of this plant (Amalraj *et al.*, 2021) ^[35]. An anti-diabetic herbal capsule made from the isolated compounds of ethanolic extract of *D. volubilis* and *Leptadenia reticulata* in 1:1 proportion shown active antidiabetic effect over the standard drug metformin in an experimental study (Natarajan *et al.*, 2021) ^[41, 43]. A molecular docking study of the flavonoids of this plant with HEX 6.3 software suggested that flavanones subcategory compound hesperidin can act as a potent insulin receptor activator (Priya & Caroline, 2014) ^[27].

Antibacterial Activity

Ethanolic leaf extract of *D. volubilis* was tested for the antibacterial activity and found strong inhibitory effect on *Staphylococcus aureus*, *Pseudomonas aeruginosa* which causes carbuncles and dermatitis (Prabhu *et al.*, 2012) ^[28]. Another study with hydroalcoholic, ethyl acetate and aqueous extracts of the leaves of this plant showed significant antibacterial activity at higher concentrations against *Proteus vulgaris*, *Bacillus subtilis* and *E. coli* (Amalraj *et al.*, 2021) ^[35]. One study with the ethanolic extract of *Dregea volubilis* exhibited antimicrobial activity same as that compared with the standard drugs ciprofloxacin and amphotericin. (Natarajan & Dhas *et al.*, 2013) ^[39, 40, 42]. A comparative study on the antibacterial effect of different parts of this plant in aqueous and methanolic extracts, grown in Sri Lanka showed significant antibacterial effect against *Staphylococcus aureus* and *Escherichia coli* and among the different plant parts tested, flowers exhibited higher activity (Nerenja *et al.*, 2019) ^[3]. Antibacterial activity of the ethanolic extract of the leaves of this plant against these bacteria also reported in another study (Sangavi, & Anuradha, 2017) ^[34]. Another comparative study with the ethanol and aqueous leaf extracts for the antibacterial screening by disc diffusion method against three gram positive and six-gram negative bacteria gave a result as ethanol leaf extract was found to be active and the latter found as inactive (Shankar *et al.*, 2010) ^[31].

Anti-inflammatory Activity

All parts of *D. volubilis* found as possessing anti-inflammatory effect in an animal experiment study (Ravi *et al.*, 2014) ^[32]. Methanolic extract of *D. volubilis*, 100, 200 and 400 mg/Kg body weight significantly reduced carrageenan induced paw edema in mice (Hossain *et al.*, 2010) ^[9]. Taraxerone isolated from *D. volubilis* exhibited significant analgesic and anti-inflammatory properties (Biswas *et al.*, 2010) ^[71, 21, 22]. The dried root ethanolic

extract of this plant significantly reduced arachidonic acid induced paw oedema in rats (Shukla *et al.*, 2011) ^[1].

Anti Leishmanial and Antitumour Activity

A pentacyclic triterpenoid taraxerone isolated from the fruit extract exhibited potent anti-leishmanial activity against *Leishmania donovani* promastigotes and anti-tumor activity against K562 leukemia cells (Biswas *et al.*, 2009) ^[5]. A study with *Dregea volubilis* fruit exhibited remarkable antitumor activity against Ehrlich ascites carcinoma (EAC) in Swiss mice (Biswas Mahua *et al.*; 2010) ^[17, 21, 22]. Antitumor activity of the petroleum ether extract *D. volubilis* fruits were observed in the prevention of tumour formation by potato crown gall method (Thin Ni & Ngwe.,2018) ^[24].

Hepatoprotective Effect

The petroleum ether extract of *D. volubilis* fruit showed remarkable hepatoprotective effect against paracetamol induced hepatic damage in rats (Halder *et al.*, 2012). Methanolic extract of the *D. volubilis* powder also exhibited hepatoprotective effect in rats exposed to aluminium sulphate toxicity (Usha Rani *et al.*, 2014). Kaempferol, a bioflavonoid isolated from the methanolic extract of the leaves of *D. volubilis* showed better protection against aluminium induced hepatotoxicity in male albino rats (Saminathan *et al.*,2025) ^[37]. Ethanol extract of the stem parts of this plant inhibited cell proliferation and induced apoptosis in selective concanavalin A activated lymph node cells in mice (Gong *et al.*, 2008) ^[13].

Neuroprotective Effect

A study focused to explore the cognition-enhancing and neuroprotective functions of chloroform extract of *Dregea volubilis* in young and old mice in interoceptive and exteroceptive models revealed that it has significant potential as a nootropic and antioxidant with neuroprotective properties (Sharma & Gill, 2022) ^[2]. A study with daily administration of the alcoholic extract of the leaves of *Dregea volubilis* at doses of 300 and 500 mg/kg, enhanced cognition in dose dependent manner in normal rats and this study justifies scientific support for the protective effect of *Dregea volubilis* against stress induced amnesia & useful in combating the stress induced CNS disorders (Sandhya *et al.*, 2013) ^[33]. Sapogenenin glycosides mixture and Polyhydroxy Pregnane glycoside isolated from this plant exhibited neuroprotective effect through its anti-oxidative action in the rat I/R model induced by Middle Cerebral Artery Occlusion (Jadhav *et al.*, 2013) ^[30].

Fasciocidal Activity

A study reported the fasciocidal activity of the ethanol extract of *D. volubilis* leaves at different concentration. The liver fluke, *Fasciola gigantica* was found as killed in every concentration of the extract applied (Hossain, 2013) ^[10].

Mosquito Larvicidal Activity

The ethanol extracts of the powdered leaves of *D. volubilis* at different concentration was screened for the larvicidal effect against the first, second, third and fourth instar larval forms of *Culex quinquefasciatus*. This study recorded mortality rate after 24, 48 and 72 h of post-exposure of the extract (Hossain, 2011) ^[8].

Anthelmintic Activity

A study conducted to evaluate the anthelmintic activity of the methanol extract of *D. volubilis* against the live parasite, *Paramphistomum explanatum* collected from buffalo. The anthelmintic activity was found with all the doses through paralysis and death of the organisms. Maximum anthelmintic activity was found with a dose of 100 mg/ml (Hossain, 2012) ^[11].

Allelopathic Effect

Methanol extract of the leaves of *Dregea volubilis* exhibited significant inhibitory effect against the seedling growth of Italian Ryegrass, *Lolium multiflorum* Lam. and cress, *Lepidium sativum* L. (Kyaw *et al.*, 2022) ^[7]. This study also isolated and characterised two phytotoxic substances with allelopathic effect, dehydrovomifoliol and loliolide.

Biosynthesized Nanoparticles and Their Effect

Highly fluorescent ZnO composite of N-doped Carbon Dots prepared from the fruits of *Dregea volubilis* by following a green hydrothermal method, exhibited excellent characteristics such as good photostability, biocompatibility, low toxicity, and strong fluorescence, with a decent quantum yield of up to 59%. This study suggests the excellent sensing capabilities of the NCZ composite and the capacity to prevent nanoparticle aggregation, opening up new possibilities for the development of ecofriendly nanosensors (Sahu *et al.*, 2025) ^[45]. Another study with the bio fabricated AgNPs synthesised from the aqueous extract of the flowers of *D. volubilis* showed potential antioxidant activity and significant antibacterial activity ((Das, *et al.*, 2021). Three different metal oxides, copper oxide (CuO), nickel oxide (NiO) and zinc oxide (ZnO) nanoparticles, were green synthesized using *Dregea volubilis* leaf extract via a simple cost-effective co-precipitation method. All the three synthesized materials exhibited good antioxidant, antidiabetic and antibacterial properties and suggests as they are promising for biomedical applications (Neethidevan *et al.*, 2023) ^[14].

Toxicology Studies

Acute and sub-chronic toxicology study carried out with the administration of the petroleum extract of *D. volubilis* fruit at the single dose of 200 mg/Kg for 28 consecutive days in Swiss albino indicates that *D. volubilis* is safe in Swiss mice and there wasn't any noticeable toxicity. (Biswas *et al.*, 2010) ^[17, 21, 22]. Acute toxicity study of the Petroleum Ether, Ethyl acetate and Ethanol extracts of *D. volubilis* using OECD-423 guidelines never showed any mortality or morbidity in Albino mice throughout the 14-day period and didn't observe any changes in the general appearance of these animals. (Venkatesan & Vishwanath, 2017) ^[44]. Another acute toxicity study with various extracts of *D. volubilis* performed according to OECD-423 guidelines also didn't show any toxic symptoms in Wistar rats. This study suggests the lethal dose was of 2000 mg/kg body weight (Natarajan & Dhas, 2013) ^[39, 40, 42]. Acute toxicity study with 70% ethanol extract of the leaves of this plant in female albino mice showed no toxic effect and mortality up to the maximum dose level 5 g/kg b.w during the observation period of 14 days (Lwin *et al.*, 2023) ^[15]. All these studies indicate that the plant is safe and didn't show any symptoms related with toxicity.

Conclusion

At the end of the review survey of the plant *Dregea volubilis* it can be concluded that, this is a traditionally used medicinal plant with immense potential that extensively used for the treatment of various ailments such as fever in children, diabetes, rheumatism, jaundice, eye problem, skin diseases, wound healing, inflammation, piles, leucoderma, asthma, urinary discharge, tumours etc. Most of their traditional uses are found investigated scientifically and so many phytochemical compounds isolated and some are characterised also. Various pharmacological studies scientifically validated many of their traditional uses. Recent advances, such as the biosynthesis of nanoparticles using plant extracts, have shown improved medicinal potential. Toxicological studies have found no signs of toxicity, supporting the plant's safety. Overall, the studies reviewed here helps to bridge the traditional knowledge with modern scientific validation and also find that more systematic research is needed to validate the bioactive constituents responsible for the many traditional effects attributed to this plant.

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