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## An updated review on *Cissus vitiginea* L. (Family: Vitaceae) - An important medicinal climber

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### ABSTRACT

*Cissus vitiginea* L. is a perennial climber with potent medicinal values and used in Indian traditional systems of medicines to cure wounds, diabetes, cardiovascular illness, cancers, particularly bone diseases and arthritis. This plant is kept under rare category in certain parts of India due to its imprudent harvesting from the wild. Assortment of literature on phytochemical studies of this plant shows the presence of alkaloids, flavonoids, triterpenoids, steroids, glycosides, coumarin, tannins, sugar, proteins etc. The reported secondary metabolites have been reviewed to possess immense biological activities in living systems. In the present review, we have summarized the information concerning the botanical description, phytochemistry, toxicology, pharmacology and the traditional medicinal uses of *C. vitiginea*. It has been concluded that this plant has not been well explored for its various biological activities and the alternate methods of propagation to increase its natural population in the wild.

**Keywords:** *Cissus vitiginea*, Climber, Medicinal plant, Traditional uses, Pharmacology

### 1. INTRODUCTION

The family Vitaceae comprised of 14 genera and 850 species and represented by the woody climbers with leaf opposed tendrils, some of them are shrubs and succulents too. Genus *Cissus* belongs to the family Vitaceae consists of about 350 species, among these a number of species used globally in traditional medicine to treat various ailments [1].

*Cissus* species are pantropical in distribution and explored for their splendid phytochemical constituents and biological activities.

The medicinal applications of *Cissus* species growing in recent years are reviewed by Fernandes and Banu [1]. Sudmoon et al. [2] investigated the genetic relationship and chemical contents of eight *Cissus* species available in Thailand. Medicinal uses and biological properties of *Cissus quadrangularis* was well explored in India [3]. But *Cissus vitiginea* is one of the less explored medicinal climbers of the genus *Cissus*. It is a woody climber (Liana) distributed throughout the south India and Sri Lanka [4].

It has natural distribution in deciduous forests of Deccan, Carnatic and Tamil Nadu in India [5]. Recently, the extended distribution of this species is recorded in Karnataka, Maharashtra [6, 7], Bastar district of Chhatisgarh [8] and Madhya Pradesh states of India [9].

### Synonym [10]

*Cissus angulata* Lam.

*Cissus vitifolia* Salisb.

*Cissus vitiginea* var. *cochinchinensis* DC.

*Vitis vitiginea* (L.) W. Theob.

*Vitis vitiginea* var. *cochinchinensis* (DC.) Kuntze.

### Vernacular names

English	- South Indian Treebine
Tamil	- Cempirandai, Kundupirandai
Telugu	- Adavi Drksha, Nelagummudu
Malayalam	- Kattumunthiri, Pannikuthi, Nerinnampuli
Sanskrit	- Amlavetasah

### Taxonomy of *Cissus vitiginea* L.

Kingdom	:	Plantae
Subkingdom	:	Tracheobionta
Super division:		Spermatophyta
Division	:	Magnoliophyta
Class	:	Magnoliopsida
Subclass	:	Rosidae
Order	:	Vitales
Family	:	Vitaceae
Genus	:	<i>Cissus</i>
Species	:	<i>vitiginea</i>

## **2. BOTANICAL DESCRIPTION OF *CISSUS VITIGINEA***

*Cissus vitiginea* L. is a woody foetid straggler when young and become a liana at mature stage. The aerial parts are densely covered with grey hairs (pubescent), stem swollen at the nodes and the tendrils are simple, stout and grows up to the length of 30-50 cm. Leaves are simple, 3-5 angled, broadly cordate at the base, lobed, pubescent, margins dentate and acuminate and ranges from 2-4 inch in length. Petioles are long, stipules triangular and pubescent. Stem bark is blackish to reddish. Flowers are pale yellow colored and arranged in dichotomous cymes. Calyx is cup-shaped, petals-4, triangular-ovate and recurved. Stamens are 4, filaments slender and oblong anthers. Ovary two celled and each cell consists of 2 ovules. Fruits are berry, pendulous, ovoid, 1/3 inch in length, bluish black when ripe and single seeded but occasionally two seeds were reported. Flowering and fruiting observed during May-December. It prefers to grow in dry and moist deciduous forests, and also in the plains [11].



**Fig. 1.** *Cissus vitiginea* L. plant growing under natural conditions.

### **3. THE LEAVES**

#### **3. 1. Microscopic characters**

The transverse section of the leaf is bifacial in structure shows both upper and lower epidermis covered with thick cuticle. Short as well as elongated multicellular trichomes were reported from both abaxial and adaxial surfaces. The adaxial epidermal cells were rectangular, hypodermis is 2-3 layered collenchymatous and subsequently parenchymatous layers. The central vascular bundle is characterized by xylem and phloem in two separate bundles. Raphide sacs are reported to be abundant in parenchymatous regions of midrib and in palisade layers of mesophylls.

Hypostomatic, ranunculaceous or anomocytic stomata represented on the leaves [12]. Tannins are found to be predominant in the phloem region and also observed in the palisade cells. Presence of multicellular trichomes, mucilaginous cells in the midrib and laminar regions are reported to be peculiar foliar features of *C. vitiginea* [13].

#### **3. 2. Microscopic studies of powder leaves of *Cissus vitiginea***

The microscopic studies of leaf powder are characterized by green colour, coarse to touch, agreeable in smell, slightly sweetish and mucilaginous [5]. The chloral hydrate solution treatment revealed the occurrence of elongated, multicellular trichomes, elongated acicular crystals, thin walled parenchymatous cells with mucilage and numerous raphide bundles [12].

### **4. THE ROOT**

#### **4. 1. Macroscopic characters**

The organoleptic features of juvenile roots presented smooth and soft surface, pale brown colored and fragile, but mature roots are hard, fractured fibrous, agreeable in smell, tastes slightly sweet and mucilaginous [5, 12].

#### **4. 2. Microscopic characters**

Transverse section of the root is reported to be circular in outline represented by distinct outermost Phellum made up of many layered cells. Phellogen was characterized by thin walled, rectangular cells of 3-5 layers. Phelloderm consisted of many layers of thin walled, tangentially elongated parenchymatous cells filled with starch grains and abundant reddish tannin content. The stellar region is prominent. Raphide sacs are prominent in the cortex and well developed phloem reported with prominent cambium. Xylem vessels are well developed with tracheids. Uni to biseriate medullary rays are reported to fill with simple starch grains. Pith is absent and occupied by the secondary xylem elements in the centre [5, 12].

#### **4. 3. Maceration studies**

The maceration of roots are treated with Chromic acid and HNO<sub>3</sub> in 3:1 ratio for 5-6 hr revealed the presence of wider and short vessels ranging from 250 to 500 µm long and 25-30 µm wide simple, oblique perforation plates. The fibres are narrow and measured 650-950 µm in length and 5 -7 µm in width [5, 12].

## 5. PHYTOCHEMISTRY

Phytochemical analysis of *C. vitiginea* leaves and stem showed the presence of saponins (33 mg/gm), triterpenoids, terpenoids (52 mg/gm), steroids, glycosides, coumarin, tannins (43 mg/gm), sugar, proteins, alkaloids (0.8 % w/w), glucoside (15.6% w/w), total phenols (168 mg/gm), flavonoid (8.73 µgm/mg) etc. [13-15]. Fourier-transmission infrared spectroscopy (FTIR) Analysis of *C. vitiginea* leaves showed the presence of functional groups such as alcohols, phenols, alkanes, carboxylic acids, alkenes, aliphatic amines and aromatics [14]. Presence of phenolics and alkaloids were confirmed by the UV-Visible studies (absorbance peaks at 234-676 nm) the leaves extracts of *C. vitiginea* [14]. Similar spectra were reported for the presence of alkaloids, flavonoids and glycosides compounds in seeds and flowers of *C. vitiginea* [16].

Singaravadiel and Santhanaraj [17] isolated twenty compounds from the leaves of *C. vitiginea* using Gas Chromatography and Mass Spectroscopic analysis. The GC-MS analysis revealed the presence of various compounds like diethyl phthalate, tetradecanoic acid, 2(4H)-benzofuranone, phytol, oleic acid, octadecanoic acid, hexadecanoic acid, 5,6,7,7 α-tetrahydro-6-hydroxy-4,4,7-α-trimethyl-(6S-CIS), neophytadiene, 2-hexadecen-1-ol, 3,7,11,15-tetramethyl, dibutyl phthalate, squalene and bis(2-ethylhexyl) phthalate.

GC-MS analysis of methanolic leaf extract of *C. vitiginea* confirmed the presence of Diethyl phthalate, tetradecanoic acid, 2,6,10-trimethyl, 14-ethylene-14-pentadecene, 2-hexadecene, 3,7,11,15-tetramethyl, 3,7,11,15-tetramethyl-2-hexadecen-1-ol, hexadecanoic acid, methyl ester, oleic acid, nonanedioic acid, dibutyl ester, 1-(+)-ascorbic acid 2,6-dihexadecanoate, dibutyl phthalate, 9-octadecenoic acid (Z)-, andrographolide, heptadecanoic acid, 2-hexadecen-1-ol, 3,7,11,15-tetramethyl, 1H-cyclopropan-α-aphthalene, 9,12-octadecadienoic acid (Z,Z)-, onnadecanoic acid, hexadecanoic acid, 2-hydroxy-1,3-propanediyl ESTER, 22-tricosenoic acid, icosanoic acid, octadecanoic acid, 2,3-dihydroxyprpyl ester, glycidol stearate, Bis(2-ethylhexyl) phthalate [18].

Rosy and Rosakutty [19] analyzed the chemical composition of methanolic extracts of wild plants and callus extracts of *C. xavierensis*, *C. quadrangularis* Var. *rotundus* and *C. vitiginea* using GC-MS. Subramani et al. [20] investigated the concentrations of trace elements in leaves and reported Cd (0.05 mg/Kg), Cu (018 mg/Kg), Fe (0.38 mg/Kg), Zn (0.48 mg/Kg), Cr, Ni and Pb below detectable limit with help of the 797 VA Computrace voltammetric analysis.

In general, the reported phytochemicals are said to possess antipyretic, analgesic, anti-inflammatory, antioxidant, anticancer and antibacterial activities [21, 22, 15].

## 6. PHARMACOLOGICAL ACTIVITIES

### 6. 1. Antimicrobial activity

Methanolic and acetone root extracts of *C. vitiginea* are reported to inhibit the Gram positive bacteria causing skin infections (*Staphylococcus aureus* and *Micrococcus* species) [23]. Gel prepared from the leaves of *C. vitiginea* (1.0 g) along with Carbopol 934 (0.5 g), Sodium Edetate (0.005 g), Tiethanolamine (1.0 ml), Propylene glycol (2.5 ml) are exhibited significant antibacterial activity [10]. Methanolic extracts of *C. vitiginea* was reported to inhibit the fungal and bacterial strains such as *Klebsiella pneumonia* NCIM 2883, *Shigella flexneri*

MTCC 1457, *Pseudomonas aeruginosa* NCIM 5029, *Candida albicans* MTCC 1637, *Cryptococcus* sp. MTCC 7076 and *Microsporum canis* MTCC 3270 [20].

## 6. 2. Antioxidant activities

Silver nanoparticles produced using *C. vitiginea* leaf extracts at 80 µg/ml is reported to have maximum inhibition (73.18%) on DPPH radical scavenging activity. Further the antioxidant potential was confirmed by the ferrous ion chelating and superoxide scavenging activity [24]. Ethanolic extracts of stem and leaves possess antioxidant activity *in vitro*. Protein denaturation is observed at 122.89 µg/ml and 233.383 µg/ml by IC<sub>50</sub> of stem and leaf extracts respectively. Proteinase inhibition in stem and leaf extract is found to be 53.7085 µg/ml and 267.84 µg/ml respectively [15]. Selvan and Velavan [25] also investigated the *in vitro* antioxidant activity of methanolic leaf extract of *C. vitiginea*. The leaf extract exhibited significant percentage of dose dependent DPPH radical scavenging, superoxide scavenging and ferrous ion chelating activities. The methanolic extract of *C. vitiginea* exhibited dose dependent antioxidant action in the superoxide and nitric oxide method using ascorbic acid as standard. The maximum percentage (66.5%) of inhibition is reported at the dose of 20 µgm/ml and IC<sub>50</sub> value was reported at 15.1 µgm/mg [26].

## 6. 3. Anticancer and acute toxicity study

Phytochemicals such as flavonoids and terpenoids are reported to induce cytotoxic activity. Methanolic extract of *C. vitiginea* (200 µg/ml) were reported to have anticancer activity on MCF 7 (Breast cancer cells), HT 29 (Colon cancer cells), HT-29 and HeLa (Cervical carcinoma cell lines) and A549 (Lung adenocarcinoma cells) of Daltons Ascites Lymphoma *in vivo* model [26].

## 7. TOXICITY PROFILE OF *C. VITIGINEA*

Sub-chronic toxicity of alcoholic extract of *C. vitiginea* leaves are studied by Selvarani and Bai [27] in Male albino rats of Wistar strain. The oral administration did not illustrate any adverse behavioural effect. Haematological and serum biochemical evaluations resulted in RBC enhancement and serum glutamate oxaloacetate transaminase (SGOT), serum glutamate pyruvate transaminase (SGPT), serum alkaline phosphatase (ALP), and bilirubin, total protein, MDA (Malondialdehyde), urea and creatinine. They reported that the oral administration of ethanolic extract of *C. vitiginea* up to 2500 mg/kg is completely safe for animal and human use.

## 8. SYNTHESIS OF SILVER NANOPARTICLES FROM *C. VITIGINEA* LEAVES

*Cissus vitiginea* leaves are used as reducing agent to synthesize Silver nanoparticles. Fourier-transmission infrared spectroscopy and SEM analysis indicates that five millilitre aqueous extract of *C. vitiginea* leaves and 45 ml of 1mM silver nitrate were resulted in the formation of crystalline, spherical silver nanoparticles at the size of 10-40 nm. The UV Visible reaction mixtures exhibited absorption peaks at 422 nm after 5 hrs of incubation. Protein denaturation bioassay study of these nanoparticles proved to inhibit heat-induced protein

denaturation in Bovine serum albumin. It is concluded that *C. vitiginea* leaf mediated silver nanoparticles shows remarkable *in vitro* anti-inflammatory activity [28].

## 9. TRADITIONAL MEDICINAL USES

*Cissus vitiginea* is a partially explored ethnomedicinal plant, which is used in Ayurveda, Siddha and Indian folk medicines. Information from Irula tribals of Coimbatore (Tamil Nadu, India) states that, the whole plant paste applied all over the body to control excessive swellings [13]. Gritto et al. [29] reported that the plant paste is used to set bones by the tribal people of Pachamalai hills of Tamil Nadu, India. Yanadi, Chenchu and Nakkalas tribal of Andhra Pradesh reported that external application of *C. vitiginea* root powder heals the wounds. The leaf paste with Calcium carbonate ( $\text{CaCO}_3$ ) relieves swelling and sprains if applied on the affected area [23]. The tribes Chenchus and Sugalis inhabited in Nallamalais hills of Andhra Pradesh, India use the leaf paste to cure wounds [30]. Paste of stem bark is used to cure conjunctivitis by the tribals of West Vidarbha region in Maharashtra, India [31]. The fruit juice of *C. vitiginea* mixed with stem bark of *Chloroxylon swietenia* has been administered with goat milk once in a day to treat asthma [22]. Oral aphthous ulcers and rashes are cured by the sap of hollow stem of this plant. The fruits are reported to be edible and sold as wild grapes in some tribal hamlets. The roots are known as Cempirantai and Mutainari (Tamil) and eaten by the tribal people of Tamil Nadu, south India [5].

## 10. CONCLUSION

*Cissus vitiginea* has been claimed for a number of phytopharmacological activities and traditional medicinal uses. The phytoconstituents and biological properties presented in this review could help researchers to explore the plant at next extent. Development of transgenic plants and enhanced secondary metabolites production are untouched in this species. Emphasis should be laid on the novel methods of propagation of this plant and further exploration in drug research. By considering the medicinal values and other uses of *C. vitiginea* conservation of this plant is also recommended.

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