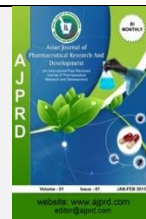


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Review Article

A Review on Macroscopy, Microscopy and Pharmacological Activity of *Cayratia trifolia* Linn.Kapil Sharma^{*1}, Lavish Salvi¹, Ravi Gupta¹, Monika Meghani¹, Pradhuman Kumar Nagar¹, Chetan Kumar Dubey², Jagdish Chandra Nagar³¹Kota College of Pharmacy, Kota, Rajasthan, India – 324003²Department of Pharmacology - Kota College of Pharmacy, Kota³Department of Pharmacognosy - Kota College of Pharmacy, Kota

ABSTRACT

Cayratia trifolia (Linn.) Domin is a perennial climber, family Vitaceae, found in India, Asia and Australia. The plant is found in hilly regions as well as the hotter part of India from Jammu and Rajasthan to Assam. It is commonly known as fox grape in English, Amalbel, Ramchana in Hindi and Amlavetash in Sanskrit. The plant has trifoliate leaves with (2-3cm) long petioles and ovate to oblong-ovate leaflets. Flowers are small greenish white and brown in colour. Fruits are fleshy, juicy, spherical, about 1 cm in diameter of dark purple or black colour. The stem composed of cork cells on the outer side and composed of small size sclerenchymatous cells. The cortex is wide and has parenchymatous cells. Numbers of sclereids are widely distributed in the cortex region. Cortex also shows the presence of calcium oxalate crystals. The leaf surface shows the stomata covered with guard cells followed by epidermis layer (Figure 2A). Epidermal cells are rectangular, thin and straight walled cells. Stomata are anisocytic or unequal celled stomata, three subsidiary cells, one is smaller than other two. Leaf surface analysis also shows the presence of veins, vein islet and vein termination (Figure 2B). Transverse section of leaf shows the epidermis layer followed by cuticle layer and vascular bundles (xylem and phloem). The leaf powder is pale green in color, with a characteristic odour and bitter taste. This plant also contains kaempferol, myricetin, quercetin, triterpenes and epifriedelanol. Whole plant of *Cayratia trifolia* has been reported to contain yellow waxy oil, steroids/terpenoids, flavonoids, tannins. Plant shows the antioxidant, antidiabetic, antibacterial, antiviral and anticancer activity.

Key words: -*Cayratia trifolia*, chemicals, macro and microscopy and pharmacological activity.**ARTICLE INFO:** Received 11 Jan. 2020; Review Completed 06 March 2020; Accepted 28 March 2020; Available online 15 April 2020

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INTRODUCTION: -

Cayratia trifolia (Linn.) Domin is a perennial climber, family Vitaceae, found in India, Asia and Australia. The plant is found in hilly regions as well as the hotter part of India from Jammu and Rajasthan to Assam. It is commonly known as fox grape in English, Amalbel, Ramchana in Hindi and Amlavetash in Sanskrit. The plant has trifoliate leaves with (2-3cm) long petioles and ovate to oblong-ovate leaflets. Flowers are small greenish white and brown in colour. Fruits are fleshy, juicy, spherical, about 1 cm in diameter of dark purple or black colour. The roots of the plant are used as poultice on boils. Infusion of seeds along with extract of tubers is traditionally given orally to diabetic patients to check sugar level of blood. Whole plant is used as diuretic, in tumours, neuralgia and splenopathy. The paste of tubers is

applied on the affected part in the treatment of snake bite. It is reported to possess antiviral, antibacterial, antiprotozoal, hypoglycaemic, anticancer and diuretic activity etc.¹

Synonyms: -*Cayratia trifolia* is also known by various synonyms²⁻⁶ such as:

Vitistrifolia Linn.

Cissuscarnosa Lamk.

Viticarnosa (Lamk.) Wall. ex M.

Lawson Cissustrifolia (Linn.) K.

Schaum Cayratia carnosa (Lamk.) Gagnep

Botanical distribution: -

Cayratia trifolia is a weak herbaceous climber, woody at base, stem is more or less succulent, compressed and densely. Leaves are trifoliate with petioles 2-3-cm long.

Leaflets are ovate to oblong-ovate, 2-8-cm long, 1.5-5-cm wide, pointed at the tip. Flowers are small greenish white 2.5mm, and brown on solitary cymes in leaf axils.¹⁰⁻¹² Fruits are fleshy, juicy, dark purple or black, nearly spherical and about 1 cm in diameter. Seeds are triangular, apex rounded, ventral holes and ribs obtuse along margin, slightly raised.¹³

Geographical distribution: -

Cayratia trifolia is known as kalitkalit in Philippines where it is found at low altitudes. It is also found from India to southern China, through the Malaya to the Moluccas and the Caroline Islands. It also found throughout the hilly regions in India.^{13,14} This perennial climber also grows wild in Jammu, Rajasthan, Assam, Tripura and West Bengal extending into peninsular India up to 600 m.⁷ This plant is also distributed in Bangladesh, Burma, Ceylon, Cambodia, Indonesia, Laos, Malaysia, Malacca, Pakistan, Thailand and Vietnam.^{15,16} It is found in tropical and subtropical areas of Asia, Africa, Australia and Island of the Pacific Ocean.¹⁷

Macroscopical Characters: -

Stem: -

The stems of Cayratia trifolia were green when fresh and dark brown in colour when dried. It was slightly scaly and curved in shape. The average stem size was 10-20 cm, with characteristic taste and odour. Outer surface was rough.¹

Leaves: -

Leaves are trifoliate with petioles (2-3 cm) long. Leaflets are ovate to oblong-ovate, (2-8 cm) long, (1.5-5 cm) wide, pointed at the tip. Leaves are green in colour with agreeable odour and bitter taste.¹⁸

Microscopical Characters: -

Stems: -

The stem composed of cork cells on the outer side and composed of small size sclerenchymatous cells. The cortex is wide and has parenchymatous cells. Numbers of sclereids are widely distributed in the cortex region. Cortex also shows the presence of calcium oxalate crystals.

Local names: -Different vernacular names of *Cayratia trifolia* have been reported⁷ in Table 1.

Table no.1: - Vernacular names of Cayratia trifolia.

Language	Vernacular names
Assam	Ghepeta-lat, Chepetalota
Bengali	Amla-lata
English	Fox-grape
Gujrati	Khat-khatumbo
Hindi	Amal-bel, Ramchana, Teen panyakand, Amar chatiao, Khata-limba, Tamnaya, Gidardrak
Karnataka	Heggoli
Malayalam	Sorivalli
Marathi	Ambat-vel
Punjabi	Armal-bel
Sanskrit	Amlavetash, Atyamlapami, Gandiran.

Taxonomical classification: -The taxonomical classification of *Cayratia trifolia* has been mentioned in Table 2.^{8,9}

Table 2: - Taxonomical classification of Cayratia trifolia.

Taxonomical hierarchy	Names
Domain	Eukaryota
Subkingdom	Viridiplantae
Kingdom	Plantae
Phylum	Tracheophyta
Subphylum	Euphyllophytina
Infraphylum	Radiatopses
Class	Magnoliopsida
Subclass	Rosidae
Suborder	Vitanae
Order	Vitales
Family	Vitaceae
Subfamily	Vitaceae
Genus	<i>Cayratia</i>
Species	<i>trifolia</i>

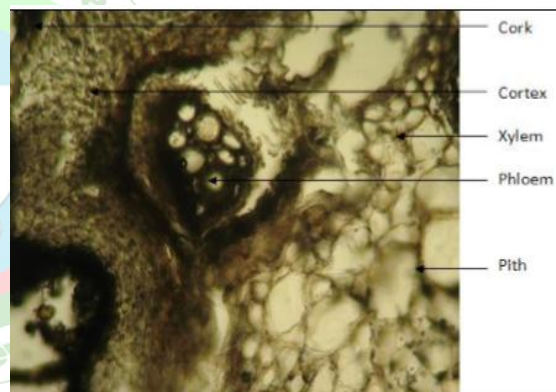


Figure1: - Microscopic Characteristics of Cayratia trifolia Stem.¹

Leaves: -

The leaf surface shows the stomata covered with guard cells followed by epidermis layer (Figure2A). Epidermal cells are rectangular, thin and straight walled cells. Stomata are anisocytic or unequal celled stomata, three subsidiary cells, one is smaller than other two. Leaf surface analysis also shows the presence of veins, vein islet and vein termination (Figure2B). Transverse section of leaf shows the epidermis layer followed by cuticle layer and vascular bundles (xylem and phloem). Upper epidermis consists of rectangular cells and the outer wall which contains abundant covering trichomes and anisocytic stomata. Trichomes are uniseriate and multicellular. The mesophyll is differentiated into palisade and spongy parenchyma. Spongy parenchyma is two to three layered, compactly arranged. Strips of collenchyma are present below upper and above lower layer of epidermis. Collenchyma is thick walled with cellulose cells. Collenchyma tissue consists of thick walled rounded parenchymatous cells. Xylem are lignified whereas phloem is non-lignified. Lower epidermis is similar to upper epidermis (Figure2C).

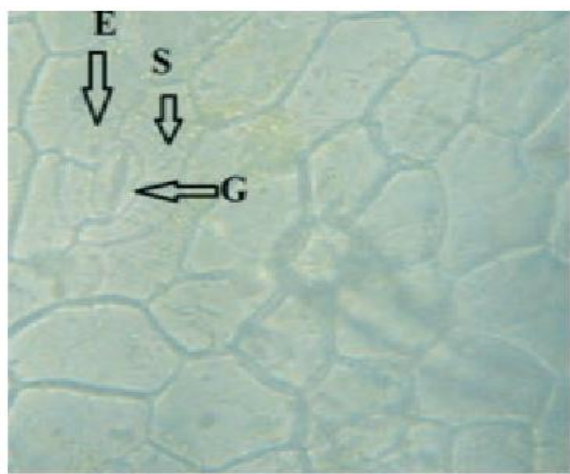


Fig. 2A

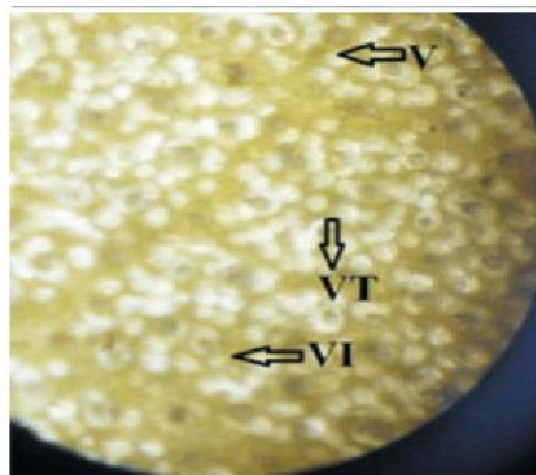


Fig. 2B

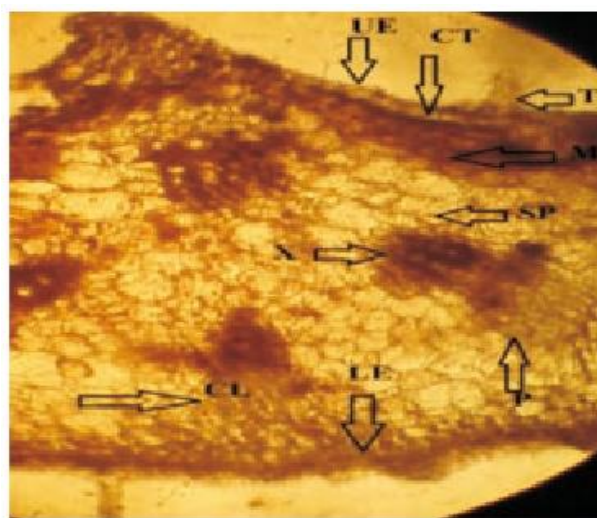


Fig. 2C

Figure 2 Microscopic characteristics of *C. trifolia* Leaf 2A: T.S of upper leaf surface; 2B: Leaf surface; 2C: T.S of leaf.³

Where:- S: Anisolytic stomata; E: Epidermis cell; G: Guard cell; V: Veins; VT: Vein termination; VI: Vein islet; UE: Upper epidermis; T: Covering trichomes; CU: Cuticle layer; M: Mesophyll; SP: Spongy parenchyma; X: Xylem; P: Phloem; CL: Collenchyma; LE: Lower epidermis.

Powder characteristic: -

The organoleptic evaluation of the leaf powder revealed the following characteristics. The leaf powder is pale green in color, with a characteristic odour and bitter taste. Fibers are elongated distributed (Figure 3A). Trichomes are unicellular, dagger shaped, warty (Figure 3B) and sometimes are in fragments or multicellular (Figure 3C).

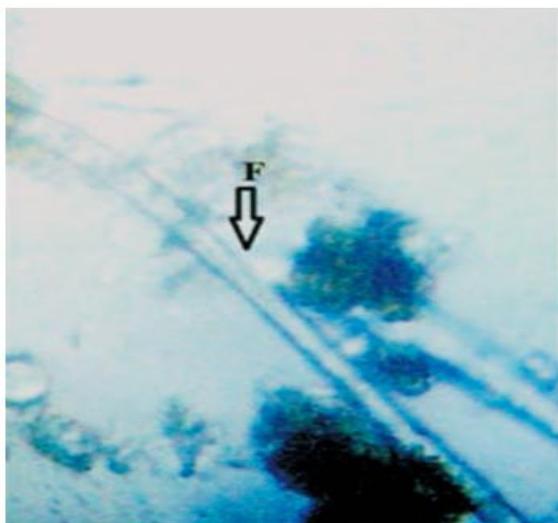


Fig. 3A

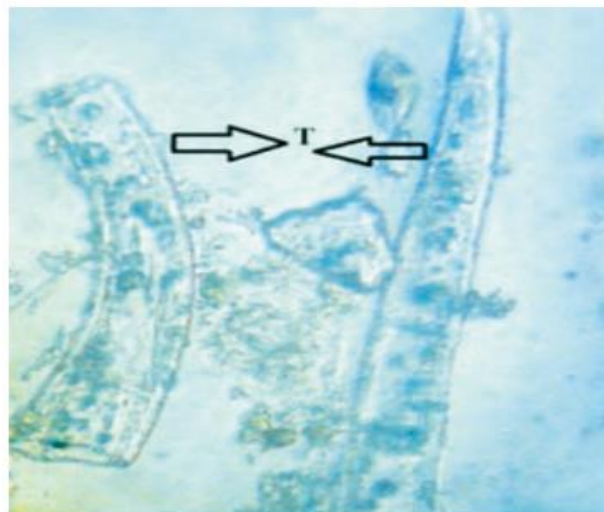


Fig. 3B

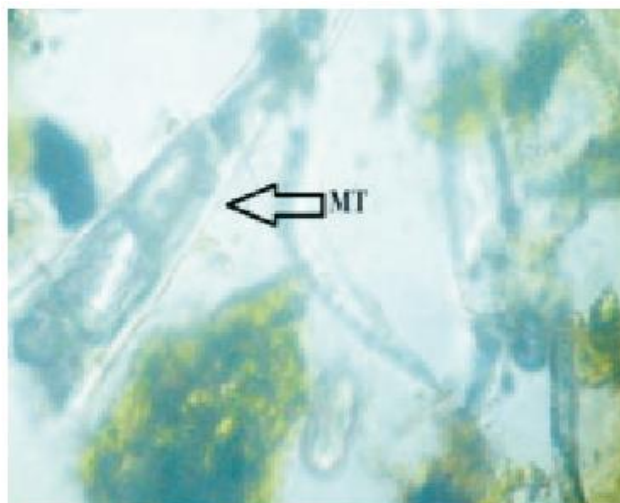


Fig. 3C

Figure 3: Powder characteristics of *C. trifolia*. 3A: Powder microscopy; 3B: Powder study; 3C: Powder study. Where: F: Fibers; T: Trichomes; MT: Multicellular trichomes.¹⁸

Chemical constituents: -

This plant also contains kaempferol, myricetin, quercetin, triterpenes and epifriedelanol.¹⁹ Whole plant of *Cayratia trifolia* has been reported to contain yellow waxy oil, steroids/terpenoids, flavonoids, tannins.⁷ Leaves contain stilbenes such as piceid, resveratrol, vaniferin and ampelopsin.²² Stem, leaves and roots are reported to possess hydrocyanic acid and delphinidin. Several flavonoids such as cyanidin are reported in the leaves. [20,21] Its seeds and fruits showed presence of cyanogenic compounds. Fruits also contain calcium oxalate responsible for severe irritation in the mouth.⁷

Ethnomedicinal uses: -

Whole plant is used as diuretic and is also useful in tumors, neuralgia and splenopathy, leucorrhea,^{7,23} astringent.²⁴ Leaves, root and seeds are used as poultice to ulcers and boils.^{3,11,23} Fermentation of hot decoction of leaves and root is used as diaphoretic³ and recommended in high fever.²³ Sap of stems and juice of leaves are used as aphrodisiac.²⁰ Root is used to reduce anemic condition, stomachic diseases, as an astringent²⁷ and paste as an antidote in snake bite, also in complained of carencules.^{7,25,26} Extract of tuber along with infusion of *Cayratia trifolia* seeds is given orally to diabetic patients to check sugar level of blood whereas powder of tuberous root is taken orally with the milk for the early recovery of fractured bone.^{25,26} Leaves are Rubifacient, used to stop bleeding of injuries.^{28,29} Root bark reduces the muscular pain.²⁴

Therapeutic uses: -

Paste of *Cayratia trifolia* is applied locally by the tribal's for early cure of wounds and edema.^{4,25} Roots are grounded with black pepper and applied as poultice on boils.^{12,28,24} Root paste is mixed with coconut oil and applied as decoction for 3 days.²⁸ Leaf paste of *Gymnema sylvestris* and *Cayratia trifolia* is applied locally in eczema.³⁰

Pharmacological uses: -

The 50% ethanolic extract of the plant (excluding root) in a preliminary biological screening showed gross behavioral effect and hypothermia. The bark extract showed 40-59.9% inhibition of potato virus. The plant is

reported to have antibacterial, antifungal, antiprotozoal, hypoglycemic, anticancer and diuretic actions.⁷

Veterinary uses: -

Poultice of leaves are used for yoke sores of bullock and also used to cure swelling, injury and infection.^{23,28,24} Climbers are wrapped around the neck of a frantic bullock.^{13,24}

Non-medicinal uses: -

Fruits are edible, pleasantly acidic in taste. [3] Stem bark is used to make net and ropes.^{31,32}

PHARMACOLOGICAL ACTIVITY: -

Antioxidant Activity: -

The parameter used for antioxidant activity is IC_{50} which was defined as the concentration of antioxidant that caused loss of 50% of DPPH activity by comparison to ascorbic acid. The IC_{50} of the extract was 61,52 mg/L which indicated that the extract had strong antioxidant activity. The range strong antioxidant activity was ranging 50-100 mg/L.

The IC_{50} of ascorbic acid was 3.97 mg/L which indicated that it has very strong of antioxidant activity category because of its IC_{50} values less than 50 mg/L. The strong category as an antioxidant of *C. trifolia* Domin, most likely due to high levels of flavonoids. It contains kaempferol, myricetin, and quercetin which is included in the group of flavonoids. 11 Flavonoids can act as an antioxidant by reacting with free radicals which it is essential for maintaining the balance of oxidants and antioxidants in bodies.

Thus, the ethanol extract of galing stem contained the secondary metabolites which are alkaloid, flavonoid, saponin, tannin, and triterpene. It is potential as an antioxidant with the IC_{50} 61,52 mg/L which indicated that the extract had strong antioxidant.³³

Antidiabetic Activity: -

The antidiabetic activity showed that the effect of extract 400 and 500 mg/kg BW are not different significantly with glibenclamide in reducing blood glucose levels subset of the statistics ANOVA ($p > 0.05$).³³

Antimitotic Activity: -

The ethanol extract of stems and leaves of *C. trifolia* had moderate antimitotic activity against cell division of *T. gratilla*, with the IC_{50} value of 169.82 μ g/ml and 208.92 μ g/ml, respectively.³⁴

Anti-inflammatory Activity: -

Inflammation is a local reaction from living tissue or cells to an excitatory or injury. This study aims to determine the anti-inflammatory activity of ethyl acetate fraction of galling plant extract (*Cayratiatrifolia*) on one of the inflammatory parameters, namely swelling in the legs of rat with 1% carrageenan induction. In addition, this study also aims to determine the effective dose of ethyl acetate fraction of galling plant extract (*Cayratiatrifolia*) as anti-inflammatory. This study used 25 male wistar rats divided into 5 groups. Group 1 (negative control) Na CMC 0.5%, group 2 (positive control) diclofenac sodium 0.0065 mg/gBW rats, and group 3, 4 and 5 suspension ethyl acetate fractions of galling plant extract 0.0065; 0.013 and 0.026 mg /gBB rats. Inflammation in rats by inducing 1% carrageenan as much as 0.10 ml. The volume of edema every hour is known from the difference in foot volume at certain hours with normal foot volume. The AUC value of the edema volume was calculated by trapezoid method every one hour and calculated for anti-inflammatory power (IP). The results showed that ethyl acetate fraction of galling plant extract (*Cayratiatrifolia*) could reduce the volume of edema in the legs of male white wistar rats which was induced by caragenine with an effective dose of 0.0065 mg/gBW.

Thus, ethyl acetate fraction of Galing (*Cayratiatrifolia*) extract can have anti-inflammatory effects on male white rats induced by caragenine with an effective dose of 0.0065 mg / gBW.³⁵

Anti-ulcer Activity: -

Pyloric ligation induced gastric ulcer: -

In pyloric ligation induced ulcer model, oral administration of methanolic extract of *Cayratiatrifolia* in two different doses showed significant reduction in ulcer index, gastric volume, as compared to the control group. It was showing protection index of 74% and 82% at the doses of 250 and 500 mg/kg, respectively in comparison to control whereas omeprazole as reference standard drug showed reduction of ulcer 86%.

Ethanol-induced gastric ulcer: -

In control animal, oral administration of absolute ethanol produced characteristic lesions in the glandular portion of rat stomach which appeared as elongated bands of thick, black and dark red lesions. Methanolic extract of *Cayratiatrifolia* showed significant protection index of 54% and 68% with the doses of 250 and 500 mg/kg, respectively in comparison to control. Omeprazole as reference standard drug showed reduction of ulcer 72%.

Thus, the methanolic extract of *Cayratiatrifolia* possesses antiulcerogenic as well as ulcer healing properties, which might be due to its antisecretory activity.³⁶

Anti-implantation Activity: -

Among the two doses of Petroleum ether extract of *Cayratiatrifolia* (PEECT) leaves, a dose of 500 mg/kg was found to be significant ($P < 0.01$) and percentage inhibition

of implantations in rats, at doses of 250 and 500 mg/kg, were found to be in PEECT 37.1, 56.7 respectively when compared with control. The highest activity was observed with the 500 mg/kg dose when the implantation was calculated about 10th day after the administration of the test extracts. Thus, the Petroleum ether extract of *C. trifolia* Linn. leaves have potent anti-implantation activity.³⁷

Antibacterial Activity: -

The susceptibility test results of the 25%, 50%, 75%, 100% *Cayratiatrifolia* Linn leaves extract and the control drug yielded a mean zone of inhibition of 18.33 mm, 20.67 mm, 23.67 mm, 25.67 mm, and 25.33 mm, respectively. In reference to the 75% and 100%, *Cayratiatrifolia* Linn leaves extract there was no statistically significant difference ($P < .01$) between the treatments and the control drug. This implies that these 2 treatments were comparable with the control drug in terms of antibacterial property.

Thus, the *Cayratiatrifolia* L. leaves extract (75% and 100% treatments) exhibited antibacterial property against the boil-causing bacteria, *Staphylococcus aureus*.³⁸

Antiviral Activity: -

It inhibits herpes simplex virus types 1 and 2 replications by inhibition of an early step in virus replication cycle. In vivo studies in mice shows that resveratrol inhibits or reduce HSV replication in the vagina and limits extra-vaginal disease. Studies also show that resveratrol inhibits varicella-Zoster virus, certain influenza viruses, human cytomegalovirus. Furthermore, resveratrol synergistically enhances the anti-HIV-1 activity of several anti-HIV drugs.³⁹

Cardioprotective Effect: -

- It inhibits the vascular cell adhesion molecular expression.
- Inhibition of vascular smooth muscle cell proliferation.
- Stimulation of endothelial nitric oxide synthase activity.
- Inhibition of platelet aggregation.³²

Neuroprotective Effect: -

The dietary supplementation with resveratrol significantly reduced plaque formation in animal brains, a component of Alzheimer and other neurodegenerative disease.³⁹ In mice, oral resveratrol produced large reductions in brain plaque in the hypothalamus (-90%), Striatum (-89%) and radial cortex (-48%) section of the brain in humans. In humans it is theorized that oral doses of resveratrol may reduce β -amyloid plaque associated with aging changes in the brain.³²

CONCLUSION:-

Scientific studies conducted on a number of medicinal plants used by the folk medicinal healers of Vitaceae family validate their folkloric and medicinal uses. A considerable number of other medicinal plants need to be studied for their potential in obtaining newer drugs from those plants. At the same time, it must be pointed out that unselective collection of these medicinal plants from the wild is fast exhausting these natural resources.

Serious conservation efforts along with mass cultivation need to be done as soon as possible for preservation of these medicinal plant species. Otherwise, resources will

be lost that may never be replaced and with that will be lost the potential for effective and newer drugs.

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