A Review on Macroscopy, Microscopy and Pharmacological Activity of Cayratia trifolia Linn.

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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 trifoliated leaves with (2-3 cm) 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 inlet 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

Cite this article as:
Sharma K, Salvi L, Gupta R, Meghani M, Nagar PK, Dubey CK, Nagar JC, A Review on Macroscopy, Microscopy and Pharmacological Activity of Cayratia trifolia Linn, Asian Journal of Pharmaceutical Research and Development. 2020; 8(2):90-95. DOI: http://dx.doi.org/10.22270/ajprd.v8i2.669

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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 trifoliated leaves with (2-3 cm) 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 synonyms 2-6 such as:
Vitistrifolia Linn.
Cissuscarnosula Lamk.
Vitiscarnosa (Lamk.) Wall. ex M. Lawson Cissustrifolia (Linn.) K. SchaeumCayratiacarnosa (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 trifoliolate with petioles 2-3-cm long.
Leaflets are ovate to oblong-ovate, 2.8-8 cm long, 1.5-5 cm wide, pointed at the tip. Flowers are small greenish white 2.5 mm, 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: -
Cayratiatrifolia is known as kalikital 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 wildly 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, Combodia, 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 Cayratiatrifolia 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 trifoliolate 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 Cayratiatrifolia have been reported 7 in Table 1.

Table no.1: - Vernacular names of Cayratiatrifolia.

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

Taxonomical classification: - The taxonomical classification of Cayratiatrifolia has been mentioned in Table 2. 8, 9

Table 2: - Taxonomical classification of Cayratiatrifolia.

| Taxonomical hierarchy | Names          |
|-----------------------|----------------|
| Domain                | Eukaryota      |
| Subkingdom            | Viridiplantae  |
| Kingdom               | Plantae        |
| Phylum                | Tracheophyta   |
| Subphylum             | Euphyllophyta  |
| Infra-phylum          | Raditopses     |
| Class                 | Magnolipsida   |
| Subclass              | Rosidae        |
| Suborder              | Vitanae        |
| Order                 | Vitales        |
| Family                | Vitaceae       |
| Subfamily             | Vitidae        |
| Genus                 | Cayratia       |
| Species               | trifolia       |

Figure 1: - Microscopic Characteristics of Cayratiatrifolia Stem. 1

Leaves: -
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). 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 (Figure 2C).
Figure 2 Microscopic characteristics of C. trifolia leaf. 2A: T.S of upper leaf surface; 2B: Leaf surface; 2C: T.S of leaf.  

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, dagged shaped, warty (Figure 3B) and sometimes are in fragments or multicellular (Figure 3C).
**Chemical constituents:**

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. Leaves contain stilbenes such as piceid, resveratrol, vanerferin and ameloposin. Stem, leaves and roots are reported to possess hydrocyanic acid and delphinidin. Several flavonoids such as cyanidin are reported in the leaves. Its seeds and fruits showed presence of cyanogenic compounds. Fruits also contain calcium oxide, responsible for severe irritation in the mouth.

**Ethnomedicinal uses:**

Whole plant is used as diuretic and is also useful in tumors, neuralgia, splenopathy, leucorrhea, and astringent. Leaves, root and seeds are used as poultice to ulcers and boils. Fermentation of hot decoction of leaves and root is used as diaphoretic and recommended in high fever. Sap of stems and juice of leaves are used as aphrodisiac. Root is used to reduce anemic condition, stomachic diseases, as an astringent and paste as an antidote in snake bite, also in complained of carencules. Leaves are Rubifacient, used to stop bleeding of injuries. Root bark reduces the muscular pain.

**Therapeutic uses:**

Paste of *Cayratia trifolia* is applied locally by the tribal’s for early cure of wounds and edema. Roots are grounded with black peeper and applied as poultice on boils. Root paste is mixed with coconut oil and applied as decoction for 3 days. Leaf paste of Gymnemasylvestris and *Cayratia trifolia* is applied locally in eczema.

**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.

**Veterinary uses:**

Poultice of leaves are used for yoke sores of bullock and also used to cure swelling, injury and infection. Climbers are wrapped around the neck of a frantic bullock.

**Non-medicinal uses:**

Fruits are edible, pleasantly acidic in taste. Stem bark is used to make net and ropes.

**PHARMACOLOGICAL ACTIVITY:**

**Antioxidant Activity:**

The parameter used for antioxidant activity is IC\textsubscript{50} Which was defined as the concentration of antioxidant that caused loss of 50% of DPPH activity by comparison to ascorbic acid. The IC\textsubscript{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\textsubscript{50} of ascorbic acid was 3.97 mg/L which indicated that it has very strong of antioxidant activity category because of its IC\textsubscript{50} values less than 50 mg/L. The strong category as an antioxidant of *C.trifolia* most likely due to high levels of flavonoids.

**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).
Antimitotic Activity: -
The ethanol extract of stems and leaves of C. trifolia had moderate antimitotic activity against cell division of T. grattia, with the IC50 value of 169.82 μg/ml and 208.92 μg/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 galing plant extract (Cayratia trifolia) 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 galing plant extract (Cayratia trifolia) 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 galing 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 trapezoidal method every one hour and calculated for anti-inflammatory power (IP). The results showed that ethyl acetate fraction of galing plant extract (Cayratia trifolia) 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 (Cayratia trifolia) extract can have anti-inflammatory effects on male white rats induced by caragenine with an effective dose of 0.0065 mg/gBB.35

Anti-ulcer Activity: -
Pyloric ligation induced gastric ulcer: -
In pyloric ligation induced ulcer model, oral administration of methanolic extract of Cayratia trifolilain 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 Cayratia trifolia 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 Cayratia trifoliapossesses 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 Cayratia trifoliap(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. trifoliain leaves have potent anti-implantation activity.37

Antibacterial Activity: -
The susceptibility test results of the 25%, 50%, 75%, 100% Cayratia trifoliain 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%, Cayratia trifoliain 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 Cayratia trifolia 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 extravaginal 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 redial 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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