INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: https://www.ijpsjournal.com

OPEN ACCESS

Review Article

Phytochemistry And Pharmacological Prospects of Flueggea Virosa: A Holistic Review

Rutuja Dhormare*, Apurva Belhekar, Yogita Bodhane, Mugdha Joshi

Indrayani Vidya Mandir's Krishnarao Bhegade Institute of Pharmaceutical Education and Research, Talegaon Dabhade, Tal. Maval, Dist. Pune.

ARTICLE INFO

Published: 17 April. 2025
Keywords:
Flueggea virosa, Medicinal plants, Phytochemistry, Ethnomedicine, Bioactive compounds, Alkaloids, Polyphenols, Terpenoids, Flavonoids, Bergenin, Traditional medicine.
DOI:
10.5281/zenodo.15233563

ABSTRACT

Integrative medicine is seeing increased adoption of herbal plants, especially in traditional Indian medicine, where medicinal plants, like Flueggea virosa or white berry bush, play a central role. F. virosa is well known for its therapeutic importance. Traditionally used in Africa, India, and China, this plant has been utilized to treat stomach disorders, liver ailments, urinary tract infections, and even diabetes. Tremendous polyphenolic and bioactive constituents such as flavonoids, alkaloids, bergenin, terpenoids, and virosecurinine with important pharmacological properties make F. virosa impactful. Its possible antimicrobial, antiparasitic, antidiabetic, anticancer, and analgesic functions have been studied. This paper aims to compile the available information on the plant's morphology and phytochemistry along with its medicinal uses, with particular attention paid to its bioactive compounds. Reevaluation of the plant needs to be done to get the health benefits from its alkaloid constituents whilst preventing mild toxic side effects. This review also calls for more pharmacological research on the plant to assess its putative value to modern medicine.

INTRODUCTION

***Corresponding Author:** Rutuja Dhormare
Address: Indrayani Vidya Mandir's Krishnarao Bhegade Institute of Pharmaceutical Education and Research, Talegaon Dabhade, Tal. Maval, Dist. Pune.
Email ✉: rutujadhormare8@gmail.com
Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Figure No1:Fruits of Plant

India is home to a wide variety of plants used in daily life for treating from common ailments to serious diseases. Flueggea virosa is a versatile plant known for its numerous medicinal, ethnomedical, and horticultural applications. Its popularity is growing due to the identification of various bioactive compounds and its range of biological and pharmacological effects. This review aims to expand on and enhance the knowledge of the phytochemical constituents and pharmacological activities reported in recent years. Known as the white berry bush, Flueggea virosa is a medicinal plant found in tropical regions and has been traditionally utilized in Africa, India, and China. Decoctions made from its roots are used to alleviate stomach pains, while extracts from its above-ground parts address liver and urinary issues, as well as diabetes and other conditions. Extracts from this plant have shown antiparasitic, antimicrobial, antiepileptic, antidiabetic, anticancer, and pain-relieving effects. Three main categories of phytochemicals have been isolated from Flueggea virosa: polyphenols, particularly bergenin; terpenoids, which include flueggenoids and related podocarpane-type diterpenoids; and several alkaloids derived from securinine and norsecurinine.[1] Analgesic consequences three essential categories of phytochemicals had been isolated from Flueggea virosa: polyphenols, with the lead product bergenin; terpenoids, consisting of the flueggenoids and associated podocarpane-kind diterpenoids; and plenty of alkaloids derived from securinine and norsecurinine. Alkaloid within the circle of relatives is the dimeric indolizidine flogging B, which is diagnosed as a capability binder to α or β-tubulin dimer, which is a known target for securinine. This assessment highlights the range of phytochemicals recognized from Securinega Virosa and the ability healing advantages of dimeric alkaloids. Studies are encouraged to further inspect the therapeutic houses of the lead compounds however additionally outline and fitnesse the dietary profile of the fit to be eaten fruit. Flueggea Virosa is referred to as the white berry bush or the Chinese water berry in English.[28] The given common names range considerably from one. Securing to another, with more than 50 trivial names recognized in more than 35 countries. The range of names displays the unusual use of the plant in conventional medication. The complete plastome of the plant is thought, it consist of one hundred thirty genes (for a total of 154,961 base pairs) with 80 specific protein genes. Phylogenetically, Flueggea virosa is nearly the same as another medicinal plants, particularly, Phyllanthus emblica Linn. (amla).[1] Flueggea Virosa is a dioecious, multi-stemmed, speedy-developing, medicinal plant, namely, Phyllanthus emblica Linn.[1] Virosa is a dioecious (male and woman plants on separate vegetation), multi-stemmed, rapid-growing, furry shrub or small tree with

small, rounded leaves and tiny, greenish plants, in conjunction with greenish-white fruit.[1]

Morphology:

Table No.1: Morphology Of Plant [1]

Sr. No.	Part of plant	colour	shape	texture	Chemical constituents
1	Root	White	Irregular i.e. depends on soil conditions	• Deep or restricted i.e. depending on the soil condition	8% tannins, 0.4–0.6% alkaloids
2	Leaves	Green	Obovate	• narrowly based, thin • length:1.2-9 cm • wide:1.2-5cm	virosecurinine, viroallosecurinine, norsecurinine, dihydronorsecurinine (tyrosine), other alkaloids include hordenine and N-methyl tetrahydro-β-carbon
3	Seed	Yellowish brown	Ovoid	• 2-3mm long, shiny.	virosecurinine, viroallosecurinine, norsecurinine, dihydronorsecurinine
4	Fruit	White	Round	• Fleshy, juicy, • globose • Size: small • Taste: sweet • diameter:5mm	water 84 g, soluble carbohydrate 12 g, protein 0.5 g and fat 0.3g
5	Flower	Creamy green		• Unisexual, regular pentamerous • sepals: Slightly • unequal • petals; absent	Flavonoids, β- sitosterol
	A.Male Flower		Sepals:ovate-elliptic anthers: ellipsoid to suborbicular	• pedicels 1.5-5 mm long, filiform • sepals 5,0.8-1.5 X 0.5-1mm long • disc glands: 5 • stamens: 5 • filaments:1-2 mm long • anthers:0.3-0.5 mm long • pistillode 1-1.5 mm long	Flavonoids, β- sitosterol, phenolic compounds terpenoids
	B.Female Flower		Sepals oval triangular	• pedicels: 2-3mm long	Flavonoids, β- sitosterol, phenolic compounds terpenoids

			or elliptic ovary subglobose or depressed	• sepals: 5,0.5-1 X 0.4-0.8 mm • disc annular: 1 mm across • ovary: 0.5 mm in Diameter • styles:0.7-1.5 mm long	
6	Bark	Reddish brown	Cylindrical	• Smooth,fissured, or rough, lower • branches: thorny end.	triterpenes friedelin and friedelinol
7	Wood	Reddish yellow	Cylindrical	• Very strong, elastic, durable.	triterpenes friedelin and friedelinol

Taxonomic Classification:[3]

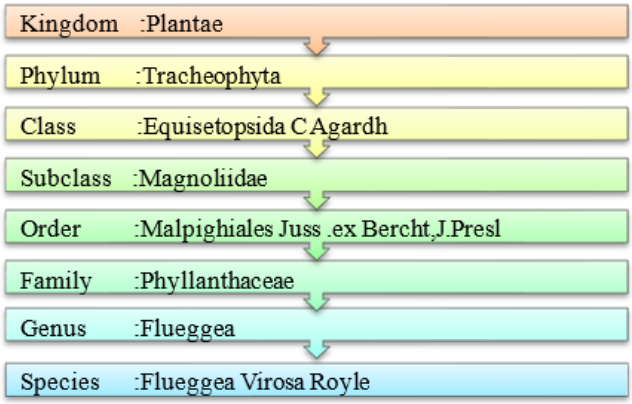

Figure No 2: Taxanomic classification

Scientific names

1. Acidoton virus(Roxb.ex Willd)Kuntze
2. Flueggea virosa(Roxb.ex Willd)Royle
3. Phyllanthus virus(Roxb.ex Willd)
4. Securinega virosa(Roxb.exWilld) Baill

Common names

1. Chinese Waterbury
2. Common bush weed
3. Simple leaf bush weed
4. Snowberry tree
5. White berry bush

Figure No 3: Vernacular Names According to Country.[1]

Distribution: The distribution area is drier parts of the mainland Africa, parts of the Arabian Peninsula, Indian Archipelago, China, South East Asia, Northern Australia, and the Indian sub-continent including India, Africa, Yemen, Pakistan, Nepal, Bhutan, Bangladesh, Myanmar, Thailand, China, Taiwan, Japan, Malaysia, Philippines, Indonesia, Australia, and the Pacific Islands.

Given hazards: This plant has vibrant alkaloids. The virosecurinin alkaloid constitutes a mild threat to mice with an LD50 of 73 mg per kg bodyweight. Death occurs because of alcoholic tempestuous storms and motor paralysis like those seen in strychnine poisoning. Its bark is tangy and occasionally utilized as a fish poisoning bait although the toxicity to fish is Low.

Phytochemistry

The network of chemical compounds of the plant revealed the same alkaloids, triterpenes, tannins, flavonoids and saponins, resins, steroids, cardiac glycosides and anthraquinones, 11- O-acetylbergenin, virosecurinine, entphyllanthidin, 11- O-acetyl borgenin, virosecurinine, and entphyllanthidine, kaempferol, quercitrin, tannic acid, daucosterin, and beta-sitosterol. Corridors of all plants contain indolizidine heavier alkaloids and their substantial isomers and derivatives of the highly poisonous securinine. The alkaloids are grouped into five major groups, surviving type alkaloids (virosecurinine, viroallosecur..

Table No. 2: Chemical Constituents Present In Flueggea Virosa[17]

Compound Name	Compound Class
(−)-securinine	Alkaloid
Virosecurinine	Alkaloid
(+)-norsecurinine	Alkaloid
(−)-virosine B	Alkaloid
(+)-virosine B	Alkaloid
Flueggine A	Alkaloid
Flueggine B	Alkaloid
Flueggether A	Alkaloid
Flueggether B	Alkaloid
Flueggether C	Alkaloid
Rutin	Flavonoid
Isoquercitrin	Flavonoid
Kaempferol	Flavonoid
Quercetin	Flavonoid
Gallocatechin	Flavonoid
Epi-gallocatechin	Flavonoid
(+)-catechin	Flavonoid
p-hydroxybenzoic acid	Phenolic acid
Vanillic acid	Phenolic acid
Bergenin	Polyphenol
Glucogallin	Polyphenol
Corilagin	Polyphenol

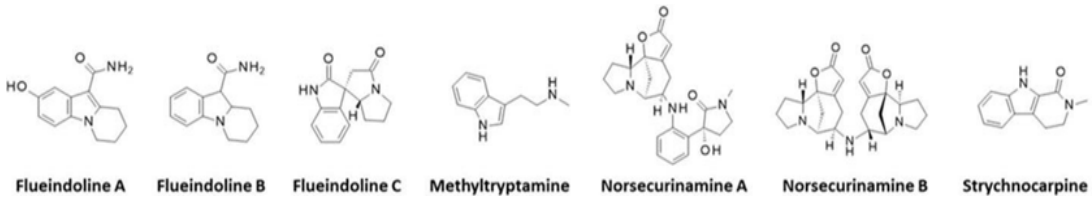

Figure No 4: Structure Of Chemical Constituents [17]

Table No 3: Microscopical Characters

Features	Description
Epidermal cells	Shape tetra hexagonal, anticlinal wall straight, cuticle present, smooth
Stomata	Type-anomocytic Frequency-numerous
Trichomes	Absent
Calcium oxalate crystals	Size –small Form-microcrystal Shape-spherical Frequency-frequent
T.S. through midrib	Dorsoventral

Table no 4: Physicochemical Constant [2]

Parameters	Value
Total ash	11.83 ±0.17
Acid insoluble ash	0,67 ±0.17
Moisture content	10.65±0.32
Water soluble extractives	18.13 ±0.46
Alcoholsoluble extractives	17.60 ± 0.36

Table No 5: Qualitative Phytochemical Analysis of Plant Flueggea Virosa

Sr.no	Chemical constituent	Test procedure	Conclusion	Result
1	Tannin	1 ml of filtrate of leaves extract 3 drops of 0.1% lead acetate solution.	The creamy gelatinous precipitate formed.	Tannins are present.
2	Saponin	1 ml of filtrate of leaves extract+1 ml distilled water then shake it vigorously.	Shaking provides persistent foam formation.	Saponins ar e present.
3	Flavonoids	1 ml of filtrate of leaves extract+2 ml 2% NaOH solution+3 drops dilute HCl.	The color initially turned an intense yellow color with NaOH solution and later became colorless.	Flavonoids are present.
4	Terpenoids	1 ml of filtrate of leaves extract+6drops$CHCl_3$ then placed in water bath for few minutes + 6 drops conc.H_2SO_4.	Reddish-brown interface.	Terpenoids are present.
5	Phenolic compounds	1 ml of filtrate of leaves extract+5% FeCl3.	Dark bluish-black color present.	Phenolic are compounds.
6	Reducing sugars	1 ml of filtrate of leaves extract+ Fehling's solution A Fehling's solution B then put in the water bath for some time.	Formation of red-orange precipitate.	Reducing sugars are present.
7	Steroids	1 ml of filtrate of leaves extract+ 1ml $CHCl_{3+}$ 1 ml of concentrated H_2SO_4.	Appearance of upper red and lower yellow with green fluorescence.	Steroids are present.
8	Alkaloids	1 ml of filtrate of leaves extract+3-4 drops of Dragendroff's reagent.	Formation of reddish brown precipitate.	Alkaloids are present.
9	Carbonyl compounds	1 ml of filtrate of leaves extract+3-4 drops of 2,4-dinitrophenylhydrazine reagent.	Formation of yellow crystal.	Carbonyl compounds are present.

Pharmacological Activities:

Studies showed that the plant has a variety of pharmacological activities including Analgesic, anti-inflammatory, aphrodisiac, sedative, anti-arrhythmic, antidiabetic, antimalarial, anti-HIV, anti-hepatitis C, antidiarrheal, cytotoxic, antimicrobial, antifungal, antioxidant, and laxative.[6]

Anti-inflammatory action: The methanolic extract of root bark and leaves has significant Analgesic and Anti-inflammatory activity in animal models. The acute inflammation was induced by the injection of carrageenan under the plantar fascia of the right hind paw of mice as described by Winter with slight modifications. Male mice were randomized into six groups of five animals. Groups I and II were treated orally with distilled water (20 ml/kg) used as a negative

control group and indomethacin (10 mg/kg) used as a reference drug respectively.[29] Groups III and IV received orally 20 ml/kg of 10% extemporaneous decoction from the leaves and stems of the plant respectively.[6] Groups V and VI were respectively treated orally with 250 mg/kg of dry 10% leaf decoction and 100 mg/kg of dry 10% stem decoction. One hour after the treatments 0.025 ml of a 1% carrageenan suspension in physiological saline was injected into the right hind paw of each animal to induce the oedema.[30] The paw thickness was measured using a digital caliper. The measurements were determined at 0 h or initial thickness (E0) before injection of the carrageenan) and after the injection of the carrageenan, the thickness of the paw was then measured every hour until the fifth hour (ET). The difference between ET (1, 2, 3, 4, and 5 h) and E0 was considered as the œdema value. The average paw thickness for each group was calculated and compared to the negative control group according to the following formula. [6]

$$\%Edema = (E_T - E_0) * 100 / E_0$$

Where,

E0=Initial thickness of the mouse paw;

Thickness of the paw after injection of carrageenan.Treatment the percentages of inhibition were then calculated using the following formula.

$$\%Inhibition = (P0-PT) * 100 / P0$$

Where,

P0=% increase of the paw in the negative control; PT=% increase of the paw in the treated batch.

Determination of acute toxin:

The acute oral toxin test was performed according to the guidelines of the Organization for Economic Cooperation and Development (OECD). The mice were dieted for 18 hours with free access to water[31]. With a weight varying between 19 and 25 g, they were divided arbitrarily into five groups of three womanish mice and treated orally with a single cure of dry waterless excerpt from the leaves or stems of F. virosa(2000 mg/ kg), 20% unconsidered extract of each plant organ(20 ml/ kg) or distilled water(20 ml/ kg) used as a negative control.[31] After administration, the animals were observed for the first 2 hours before feeding them and also observed for another two hours to record cases of immediate deaths or cases of behavioral change relating to the skin, hair, eyes, mucous membranes, respiration, etc, and formerly a day on 14 days to record late deaths. [31]

Analgesic Activity: The analgesic effect was measured with thirty male mice that weighed between 22 to 34 grams. Researchers divided the mice into six groups with each group containing five animals.[32] The researchers administered distilled water at a dose of 20 ml/kg orally to Groups I and II as negative controls while independently giving Group II Paracetamol at 100 mg/kg as a reference medicine. Groups III and IV orally received a dosage of 20 ml/kg from ten decoctions prepared from leaves and stems without consideration. 250 mg/kg of dry leaf 10 decoction extract and 100 mg/kg of dry stem 10 decoction extract were given orally to groups V and VI respectively. After one hour of treatment they administered 0.6 acetic acid intraperitoneally which cured 10 µl per gram of body weight. Immediately following their injection researchers placed the mice in plastic coops and monitored each mouse for twisting behavior during the subsequent 25 minutes after receiving the acetic acid intra-peritoneal injection. Researchers

tracked the time until the first twist appeared and counted the total twitches for each mouse.][32]The percentages of inhibition were calculated using the following formula:[5]

$$\%Inhibiton = (W_C - W_T) * 100 / W_C$$

Where

Wc =represents the mean of the number of contortions of the mice in the negative control group;

Wt = mean of the number of contortions of the mice in the groups treated with extracts and Paracetamol.

Analgesic action: The results of the analgesic exertion of the 10 unconsidered and dry waterless extracts of the leaves and stems of Flueggea virosa on the pain caused by acetic acid are reported.[32] Overall, all the excerpts tested showed the analgesic exertion. Still, it was the dry extract of the stems that led to the accurate exertion with 64.82% inhibition of pain.[5]

Antidiabetic: Methanol extract of leaves possesses anti-diabetic portions. The extract might be promoting glucose uptake and metabolism or inhibiting hepatic gluconeogenesis.[33]

Opiate, Behavioral Goods, and sleep-converting action: Bergenin insulated from the root has shown sleepconverting parcels and is also responsible for the dreamy eventuality of the root. The methanol splint excerpt shows the presence of alkaloids, tannins, saponins, flavonoids, cardiac glycosides, cyanogenic glycosides, resins, steroids, terpenoids, and carbohydrates.[1] The saponins and flavonoids are responsible for dreamy exertion in mice.[29]

Anti-arrhythmic action: Berginin showed significant anti-arrhythmic exertion in rats and has good eventuality for treating cardiac arrhythmias.{23] It also shows an inhibitory effect on the growth of the bloodstream form of Trypanosoma brucei with an IC50 (the half minimal inhibitory attention) value of 1µ M.[3]

Antimalarial action: Methanol and water extracts of the leaves have shown strong antimalarial exertion, significantly inhibiting the growth of Plasmodium falciparum in vitro in a cure-dependent manner. [7]

Anti-HIV action: Flueggether A and Virosinine A were insulated from the root bark and both alkaloids showed anti-HIV exertion. [11]

Anti-Hepatitis C action: The nonalkaloid dinorditerpenoides extract from the roots displayed anti-hepatitis c infection exertion. Two trinorditerpenes, flueggrenes A and B, have been separated from the roots which shows the Hepatitis C infection exertion.

Antidiarrheal action: Methanolic extracts of leaves, stem bark and root bark of plant on a castor oil convinced diarrheal model showed the leaves and root bark extract to retain pharmacological Aexertion against diarrhea.

Cytotoxic action: A study of hexane and ethyl acetate bit of outgrowths and leaves of Flueggea virosa yielded friedelin, epifriedelanol, stigmasterol, heptanolide, and betulinic acids. The betulinic acid of the insulated composites is considered a high-implicit source of cytotoxic exertion. Alcoholic splint excerpts showed significant cytotoxicity in different excrescence cell lines in vitro.[5] Virosecurinine was primarily responsible for the cytotoxicity; viroallosecurinine was only cytotoxic to one of the cell lines.[5] The

outgrowths and leaves yielded leggings A and B, two dimeric indolizidine alkaloids. Flueggine B displayed growth inhibitory exertion against MCF- 7(Michigan Cancer Foundation- 7) and MDA- MB- 231(M. D. Anderson and MB stands for Metastasis bone cancer) mortal bone cancer cells.[9]

Antimicrobial and antifungal action: Petroleum spirit, chloroform, and ethanol excerpts of the root bark were tested for antimicrobial exertion against a range of organisms in vitro antimicrobial exertion.[10] Ethanol and chloroform extracts of the plant have shown significant antimicrobial conditioning, and moderate antioxidant and free-radical scavenging conditioning.[14] A methanol extract of the dried fruit pulp and the ethanolic root excerpt has shown significant antifungal conditioning against Trichytum mentagrophytes and Candida albicans. [14] **Antioxidant activity:** From the leaves of Flueggea virosa one new flavonoid glycoside, 3-O-kaempferol 4-O(galloyl)-beta-Dglucoside, one new bergenin derivative, 11-0- caffeoylbergenin, along with other known flavonoids and phenolic derivatives, were isolated. The isolated compounds showed that they were able to quench DPPH (2, 2-Diphenyl-1-Picrylhydrazyl) radicals and had a direct scavenging activity on superoxide anion. Kaempferol 3-O-(4-galloyl)-beta-D-glucopyranoside, 11- 0-caffeoylbergenin, and glucogallin exhibited the highest antioxidant capacity (Sanogo et al., 2009). In a study of South African plants for antioxidative activity using the DPPH radical scavenging assay, the acetone extract of the plant showed the highest antioxidant activity with IC50 of 30µg/ml closely matching ascorbic acid.[4]

Laxative activity: The leaves are considered laxative.[4]

Traditional Uses:

The plant is used as an ornamental hedge because of its attractive foliage, white waxy berries, and bushy nature. All parts of the plant are used but the roots are considered the most active part. Different parts of this plant, such as leaves, barks, stems and roots, are used in different forms of preparation (infusion, decoction, and maceration).

[1]

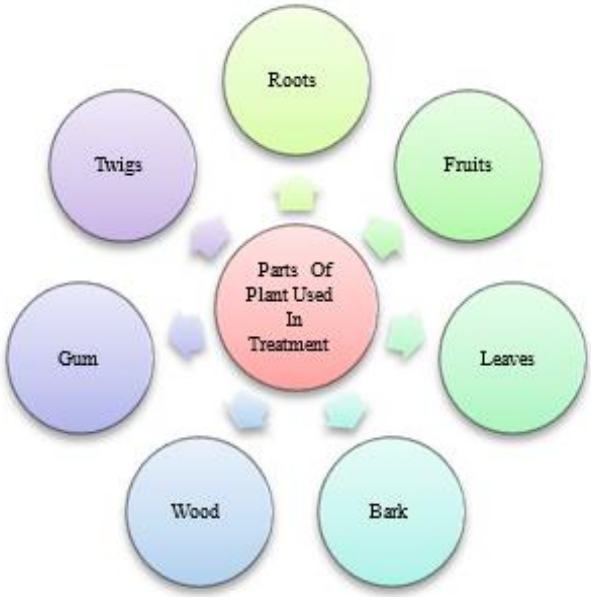

Figure No 5: Parts Of the Plant

Roots:

Root powder taken in water is used to treat liver, corrosiveness, order, Urinary, and venereal conditions, upper respiratory tract infections, ranging from cough to tuberculosis, and to treat abdominal complaints, including stomach pain, dysentery, intestinal worms, and schistosomiasis. Water in which the roots have been boiled is taken for collywobbles, and dysmenorrhoea, and is given to nursing maters whose milk is unsuited for the child, it's also used for treating infestation of intestinal worms and for infected cognizance.[1] Prize drunk as a pneumonia drug and drunk before sexual intercourse as a contraceptive; dried root grease paint was used as a snake cure and applied on injuries.[1] Used for treatment of internal conditions.

Fruits :

The fruits are comestible when mature. Pulped fruits are also rubbed on the skin to treat itch.[2] The fruit is masticated to treat snake mouthfuls.

Leaves:

A splint decoction is taken to treat lactation diseases and is also given to nursing maters whose babies are sickly at birth or to women with the threat of stillborn babies. The decoction of the leaves and roots is used for abdominal pain in Tanzania while the splint decoction is drunk for fever. The decoction of the splint with some other shops is used in northern Nigeria for the treatment of internal illness and painful lumps. Leaf grease paint is taken for revocation. Leaves retain anti-diabetic activity new leaves and roots are for coughs and malaria.[3] The leaves are used in the treatment of bellyache, rheumatism, diarrhea, epilepsy, diabetes, body pain, and ever.

A decoction of fresh splint latex:

It's used as nose drops to cure epilepsy and insanity.[4]

Leafy latex:

It's used in conjunctivitis, earache, and as a nose drop to treat headaches and migration. Leaves are used in dysentery, worms, and roots in venereal conditions.[12]

Leaves in decoction :

These are generally taken to treat malaria, fever, hostility, measles, edema, vertigo, sickle cell anemia, storms, puking, bellyache, intestinal worm, dysentery, and constipation.

Bark:

A black color is also attained from the dinghy in India used for dyeing matting.

The reddish-yellow wood :

It's fine-textured, close-granulated, hard, strong, and elastic and is said to be durable, and valued for use in house rafters, and tool handles.[10] The tough virgate stems are generally used to make beds, fishing stakes, wicker traps, for part of roof structures of hooches, to support granaries, etc. They're woven into shelves and also resolve for use in basketry. The dinghy is tangy. It's used in children's drugs.

Branches:

These are cut and used as toothbrushes.[1]

Gum:

A gum is attained from the stem which has been used for sealing envelopes. A red color is attained by pounding the fruit in a little hot water. The color can be used as a red essay. The wood is a good energy and is also used to make charcoal.[2]

Methods For Preparation of Plant Extract

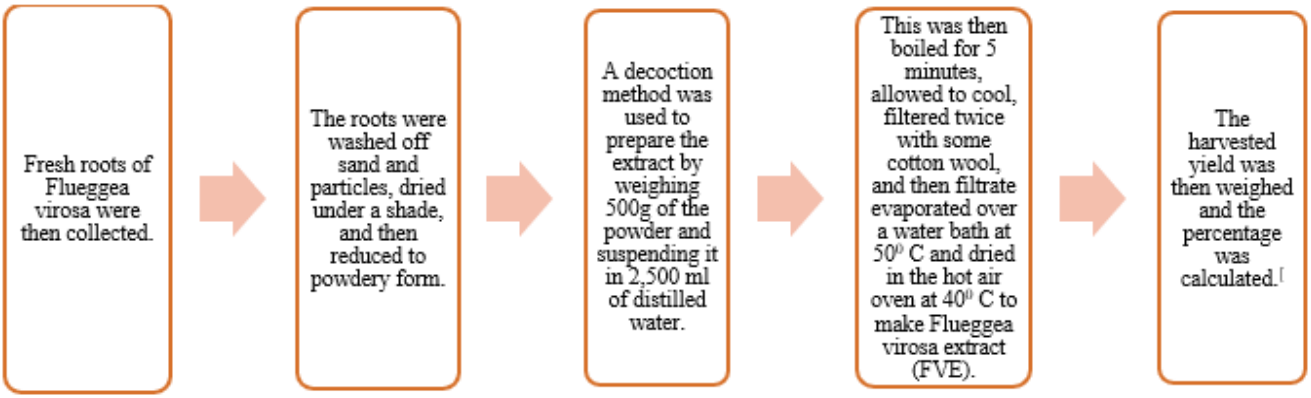

Figure No 6: Process Of Preparation of Plant Extraction [2]

Table No 6: Pharmacological Activity

Pharmacological Activity	Animal used	Plant material	Result
Anthelmintic activity[29]	For the anthelmintic activity of the plant, Haemonchus contortus parasite, obtained from the abomasum of a slaughtered goat, was used. The abomasum was washed	The shade-dried plant material (500 mg) was crushed, powdered, and soaked in 1 L solvents including petroleum ether, chloroform,	The qualitative phytochemical analysis of leaf and bark extracts of Flueggea virosa was performed to detect the presence of alkaloids, cardiac

	with 0.9 % NaCl, and the test organisms were placed in a solution of 0.9 % NaCl until further examination.	methanol, and distilled water for 15 days. The resulting extracts were filtered and concentrated under a rotary evaporator.	glycosides, flavonoids, anthraquinones, tannins, reducing sugars, saponins, and terpenoids. The reducing sugars, terpenoids, tannins, and saponins are found in all the extracts of leaf and bark. Flavonoids are present in chloroform, methanol, and aqueous extracts of leaf and bark. Alkaloids were present in methanol and distilled water. Extracts of leaf and bark. The cardiac glycosides are present only in chloroform extract of leaf and bark. Anthraquinones were present only in methanolic extracts of leaf and bark.
Analgesic activity and acute toxicity[5][15]	Wistar rats	The aqueous extract of the Flueggea virosa's root.	Standard methods did phytochemical screening. Acute toxicity was evaluated by the modified Lorke's method in one phase and analgesic activity was tested using Tail-Flick and Formalin models using rats.
Hyperplasia[6]	white mice male and female weighing between 18 and 35 g	aqueous extracts from the stems of Flueggea virosa	beneficial effect in the medical management of BPH.
Antiinflammatory activity [29]	white mice male and female weighing between 18 and 35 g	aqueous extracts from the leaves and stems of Flueggea virosa	The extract from the stems with 54.57% inhibition of inflammation
Anti-HIV Activity[30]	Infected MT4 cells	Stem and leaves 10kg	Flueggether A and VirosinineA Both alkaloid show mild in vitro anti HIV Activity.
Anti Hepatitis C Activity[]	Hepatitis C virus cell culture	roots	13-methyl-ent-podocarpanes is anti-HCV Agent .
Antimalarial activity[7][19]	Plasmodium falciparum strains injected into mice	Leaves are powdered and extracted with80% ethanol	Bergenin shows antimalarial activity.
Antibacterial and antifungal activity[17]	Gram positive bacteria: S.aureus,B.subtilis Gram-negative bacteria: E.coli,Pseudomonas aerogenosa,Proteus vulgaris Yeast like fungi:	Leaves are extracted with a chloroform filter and concentrated at 5859^{0}C.	The extract is effective against gram-negative bacteria and not against gram-positive bacteria.

	Candida albicans		
Antidiabetic activity[5]	Rat rendered diabetic by Streptozotocin	Hydro-ethanolic Extract of aerial parts of Flueggea virosa and metformin	Insulin-promoting activity.
Anti-sickle cell Activity [8]	Sickle cell	Aerial parts	Polyphenols, amino acids, and organic acids are responsible
Sedative and anxiolytic activity[6]	rats	Plant extract	Show better activity
Laxative activity [6]	Wistar rats	Ethanol leaf extract	Alkaloids and anthraquinones exert laxative action.

DISCUSSION

The plant is used as an ornamental hedge because of its attractive foliage, white waxy berries, and bushy nature. All parts of the plant are used (roots, leaves, wood, juice) but roots are considered the most active part.[1] Different parts of this plant, such as leaves, barks, stems and roots, are used in different forms of preparation (infusion, decoction, and maceration).[6] Root decoction is used to treat testicular inflammation, frigidity, sterility, heavy menstruation, rheumatism, and arthritis. Root powder taken in water is used to treat liver, bile, Kidney, Urinary, and venereal diseases, upper respiratory tract infections, ranging from cough to tuberculosis, and to treat abdominal complaints, including stomach-ache, dysentery, intestinal worms, and schistosomiasis.[2] Water in which the roots have been boiled is taken for stomachaches, and dysmenorrhoea, and is given to nursing mothers whose milk is unsuited for the child, it is also used for treating infestation of intestinal worms and for infected ears.[6] The root decoction is used to treat epilepsy, convulsions, and rectal and uterine prolapsed, and used to treat malaria. [9]Extract drunk as pneumonia medicine and drunk before sexual intercourse as a contraceptive; dried root powder used as snake antidote and applied on wounds .decoction used for the treatment of mental diseases. The fruits are edible when mature.[13] Pulped fruits are also rubbed on the skin to treat itch. The fruit is chewed to treat snake bites.[2] A leaf decoction is taken to treat lactation disorders and is also given to nursing mothers whose babies are sickly at birth or to women with the risk of stillborn babies.[9] The decoction of the leaves and roots is used for abdominal pain while the leaf decoction is drunk for fever.[19] The decoction of the leaf with some other plants is for the treatment of mental illness and painful swelling, leaf powder is taken for abortion. A decoction of leafy twigs or fresh leaf sap is used as nose drops to cure epilepsy and insanity.[23] Leafy sap is used in conjunctivitis, ear aches, and as nose drops to treat headaches and migration.[7] Leaves

are used in dysentery, worms, and roots in venereal diseases.[17] Leaves or leafy twigs in decoction or infusion are commonly taken to treat malaria, fever, jaundice, measles, edema, vertigo, sickle cell anemia, convulsions, vomiting, stomachache, intestinal worm, dysentery, and constipation.[27] The leaves are used in the treatment of stomachache, rheumatism, diarrhea, epilepsy, diabetes, and body pain. Future research for formulation can be possible.[1]

CONCLUSION

The whole plant can be considered an effective source of useful medicines for the treatment of colorful affections as indicated by the presence of alkaloids, steroids, saponins, cardiac glycosides, flavonoids, and numerous other secondary metabolites.[1] The phytochemicals in medicinal plants have been reported to be the active principles responsible for the pharmacological capabilities of plants.[14] Almost all of the composites insulated from the roots and leaves belong to alkaloids, glycosides, and terpenoids order which have a wide range of natural composites. The composites Flueggether A and Virosinin A, Viroseurinine, Flueggine B(alkaloids), Betulinic acid(Triterpene), Berginin(CGlycosides), Flueggrenes A and B(Trinorditerpens), enjoyingAnti-HIV, antiproliferative, cytotoxic, antiarrhythmic and Anti-Hepatitis C action which are veritably important in medicinal field. [2]The presence of these chemicals in the plant justifies the original uses of the plant for the treatment of various affections and suggests that traditional drugs still play an important part in meeting the introductory health care of original communities.[3] There are numerous other undisclosed operations of this plant, which remain uninvestigated and serve as the base for further studies.[7] This review will help the experimenters to know its different actions and give perceptivity for unborn exploration aimed at both ethnopharmacological confirmation of the popular use of plants and its disquisition as a new source of bioactive particles for herbal medicines and implicit operation in reciprocal and indispensable drugs.[10]

REFERENCES

1. Bailly C. Traditional uses, pharmacology and phytochemistry of the medicinal plant Flueggea virosa (Roxb. ex Willd.) Royle. Future Pharmacol. 2024;4(1):77-102. doi:10.3390/futurepharmacol4010007.
2. Ajaib M, Wahlau G. Phytochemical screening and anthelmintic activity of Flueggea virosa. Organic and Biochemistry. 2018;40:702–6.
3. Renu S, Rawat A. Taxonomy, phytochemistry, pharmacology, and traditional uses of Flueggea virosa: A review. Int J Life Sci. 2018;6:579–85.
4. Sanogo R, Vassallo A. New phenolic glycosides from S. virosa and their antioxidant activity. Nat Prod Commun. 2009;4:1645–50.
5. Matuki EK, Ajayi AM. Phytochemical screening, acute toxicity, and analgesic properties of aqueous extract of Flueggea virosa roots in rats. Ibnosina J Med BS. 2012;5:15–21.
6. Denou A, Mahamane H. Phytochemicals and biological activities of Flueggea virosa (Phyllanthaceae) used in the traditional treatment of benign prostatic hyperplasia in Mali. J Dis Med Plants. 2021;7(4):119-126. doi:10.11648/j.jdmp.20210704.14.
7. Singh SV, Manhas A, Kumar Y, Mishra S, Shanker K, Khan F, et al. Antimalarial activity and safety assessment of Flueggea virosa leaves and its major constituent with special

emphasis on their mode of action. Biomed Pharmacother. 2017;89:761–71.

8. Souleymane HD, Djibo AK, Seyni SH, Zakaria O, Botezatu AV, Dinica RM, et al. Phytochemical characterization and in vitro evaluation of the anti-sickle cell activity of aqueous and ethanolic extracts of two medicinal plants from Niger: Flueggea virosa (Roxb. ex Willd.) Royle and Kigelia africana (Lam.) Benth. Plants. 2023;12(20).
9. Soysa P, Silva ISD, Wijayabandara J. Evaluation of antioxidant and antiproliferative activity of Flueggea leucopyrus Willd (Katupila). BMC Complement Altern Med. 2014;14:274.
10. Swain J, Kumar S, Parida S, Jena PK. In-vitro screening of antibacterial activities of selected wild tuberous plants of Odisha, India. Asian J Biol Life Sci. 2020;9(1):79–87.
11. Zhang H, Zhu KK, Han YS, Luo C, Wainberg MA, Yue JM. Flueggether A and virosinine A, anti-HIV alkaloids from Flueggea virosa. Org Lett. 2015;17(24):6274–7.
12. Denou A, Koudouvo K, Togola A, Aziati KY, Esseh J, Ajavon CA, et al. Traditional knowledge of antimalarial plants having analgesic properties, used in the Togo Maritime region. J Ethnobiol Tradit Med. 2016;126:1160–70.
13. Devi RS, Bihari SK, Kumar S. Validation of tribal claims for the formulation of future drugs through evaluation of ethnopharmacological values of Ludwigia adscendens. Med Plants. 2023;15(4):691–7.
14. Ajaib M, Wahla SQ, Shafi F, Zahid MT, Siddiqui MF, Abbas T. Antimicrobial and antioxidant screening of Flueggea virosa. Biosci Res. 2021;17(4):2791–8.
15. Ezeonwumelu J, Matuki EK, Ajayi AM, Okoruwa AG, Tanayen JK, Adiukwu CP, et al. Phytochemical screening, acute toxicity, and analgesic properties of aqueous extract of Flueggea virosa's root in rats. Ibnosina J Med Biomed Sci. 2022;5(1):15–21.
16. Wang GC, Liang JP, Wang Y, Li Q, Ye WC. Chemical constituents from Flueggea virosa. Chin J Nat Med. 2008;6(4):251–3.
17. Kumar S, Behera SP, Jena PK. Validation of tribal claims on Dioscorea pentaphylla through phytochemical screening and evaluation of antibacterial activity. Plant Sci Res. 2013;35:55–61.
18. Kumar S, Mahanti P, Singh NR, Rath SK, Jena PK, Patra JK. Antioxidant activity, antibacterial potential, and characterization of active fraction of Dioscorea pentaphylla L. tuber extract collected from Similipal Biosphere Reserve, Odisha, India. Braz J Pharm Sci. 2017.
19. Tabuti JR. Herbal medicines used in the treatment of malaria in Budiope County, Uganda. J Ethnopharmacol. 2008;116:33–42.
20. Paris RR, Moyse H, Le Men J. Alkaloids from new Euphorbiaceae: Flueggea virosa. Ann Pharm Fr. 1955;13:245–50.
21. Magaji MG, Yaro AH, Musa AM, Anuka JA, Abdu-Aguye I, Hussaini IM. The central depressant activity of butanol fraction of Securinega virosa root bark in mice. J Ethnopharmacol. 2012;141:128–33.
22. Moshi MJ, Uiso FC, Mahunnah RL, Mbwanbo ZH, Kapingu MC. A survey of plants used by traditional healers to manage noninsulin-dependent diabetes mellitus. East Cent Afr J Pharm Sci. 2000;3:30–9.
23. Wang GC, Liang JP, Wang Y, Li Q, Ye WC. Chemical constituents from Flueggea virosa. Chin J Nat Med. 2008;6:251–3.
24. Wang XF, Liu FF, Zhu Z, Fang QQ, Qu SJ, Zhu W, et al. Flueggenoids A–E, new disorder

terpenoids from Flueggea virosa. Fitoterapia. 2019;133:96–101.

25. Aiyelero OM, Abdu-Aguye SN, Yaro AH, Magaji MG. Behavioural studies on the methanol leaf extract of Securinega virosa (Euphorbiaceae) in mice. J Pharmacogn Phytother. 2012;4(2):12–5.
26. Chao CH, Cheng JC, Shen DY, Wu TS. Anti-hepatitis C virus dinorditerpenes from the roots of Flueggea virosa. J Nat Prod. 2014;77(1):22–8.
27. Félix-Silva J, Giordani RB, Silva-Jr AA, Zucolotto SM, Fernandes-Pedrosa MF. Jatropha gossypiifolia L. (Euphorbiaceae): A review of traditional uses, phytochemistry, pharmacology, and toxicology of this medicinal plant. Evid Based Complement Alternat Med. 2014;2014:369204.
28. Modak M, Dixit P, Londhe J, Ghaskadbi S, Devasagayam TP. Indian herbs and herbal drugs used for the treatment of diabetes. J Clin Biochem Nutr. 2007;40(3):163–173. doi:10.3164/jcbn.40.163.
29. Yimer T, Birru EM, Adugna M, Geta M, Emiru YK. Evaluation of analgesic and anti-inflammatory activities of 80% methanol root extract of Echinops kebericho M. (Asteraceae). PMC7533268. PMID: 33061529.
30. Amdekar S, Roy P, Singh V, Kumar A, Singh R, Sharma P. Anti-inflammatory activity of Lactobacillus on carrageenan-induced paw edema in male Wistar rats. Int J Inflam. 2012;2012:752015. doi:10.1155/2012/752015. PMID: 22518342; PMCID: PMC3299308.
31. Lewis-Sanders D, Bullich S, Olvera MJ, Vo J, Hwang YS, Mizrachi E, Stern SA. Conditioned overconsumption is dependent on reinforcer type in lean, but not obese, mice. Appetite. 2024 Apr 15;198:107355. doi:10.1016/j.appet.2024.107355. PMID: 38621593; PMCID: PMC11308659.
32. Gaulton N, Wakelin G, Young LV, Twist2-expressing cells reside in human skeletal muscle and are responsive to aging and resistance exercise training. FASEB J. 2022;36:e22642. doi:10.1096/fj.202201349RR.
33. Ho GTT, Nguyen TKY, Kase ET, Tadesse M, Barsett H, Wangensteen H. Enhanced glucose uptake in human liver cells and inhibition of carbohydrate hydrolyzing enzymes by Nordic berry extracts. Molecules. 2017 Oct 24;22(10):1806.doi:10.3390/molecules22101806. PMID: 29064442; PMCID: PMC6151378

HOW TO CITE: Rutuja Dhormare*, Apurva Belhekar, Yogita Bodhane, Mugdha Joshi, Phytochemistry and Pharmacological Prospects of Flueggea Virosa: A Holistic Review, Int. J. of Pharm. Sci., 2025, Vol 3, Issue 4, 2064-2079 https://doi.org/10.5281/zenodo.15233563