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Review Article

A Current Pharmacological Impacts and Perspective of *Hybanthus enneaspermus* (Linn.) F. Muell

Ananthapalpu Krishnan Nadar Ramya[1], Rengasamy Devika[2]

ABSTRACT

Medicine relies heavily on the use of medicinal plants. In terms of their pharmacology, they showed a broad spectrum of traits. All but a few of the medicinal plants in India are naturally rich in chemicals. An infinite number of potent phytochemicals can be synthesised by these plants. It is a tropical and subtropical shrub of the *Hybanthus enneaspermus* (*L*) famuell family. Asthma, cough, and epilepsy are all treated with the herb in ayurvedic literature as side effects of its usage. For steroids, sugars, alkaloids, polyphenols, catechins, tannins, anthraquinones, and amino acids, phytochemical analysis of *Hybanthus enneaspermus* achieved good quality. Alkaloids, terpenoids, tannins and glycosides are only some of the many phytochemical elements found in the plant. We examined the plant's phytopharmacological properties, including as anti-microbial and antioxidant properties as well as its effects on diabetes and arthritic conditions. We also looked at its anti-allergic and anti-convulsant properties. The active chemicals extracted from this valued herb have the potential to be used in drug development research because of the plant's wide range of pharmacological activity.

Keywords: *Hybanthus enneaspermus*, Anti-microbial, Antioxidant, Anti-diabetic, Anti-arthritic, Anti-allergic, Anti-convulsant, Anti-fertility.

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INTRODUCTION

Medicinal plant life are an essential part of natural wealth, serve as crucial therapeutic sellers as well as valuable raw materials for production numerous conventional and cutting-edge medicines. Phytomedicine applies medical studies and the highest gifted requirements to the practice of herbal medication. Plant based tablets continue to be an crucial source of therapeutic marketers because of the availability, fantastically less expensive cost and non-poisonous nature whilst in comparison to contemporary medicinal drug and they have received great interest in recent years because of their numerous pharmacological residences. The medicinal drug flowers contained a wide range of chemical materials (called as phytochemicals) that may be used to deal with continual as well as infectious illnesses. Phytochemicals are chemicals that arise naturally in plants. They are labeled into organizations along with number one metabolites and secondary metabolites. Plants are a rich source of secondary metabolites with exciting organic activities. In trendy, these secondary metabolites are an crucial supply with a variety of structural preparations and homes. Secondary metabolites are chemicals produced with the aid of plant life; and their feature in growth, photosynthesis, duplicate and other number one techniques are no longer recognized yet. Secondary chemical compounds are important in plant use with the aid of extensively used especially in Asia.[1] *Hybanthus* popularly referred to as Ratanpurus (Hindi) which belongs to the own family *violaceae*. It is also called "humpback flower". It is a herb or a shrub distributed in the tropical and subtropical vicinity of the arena. It is an critical clinical herb used from historic times.[2] This herb is taken into consideration to be extremely useful to guys, used as a diuretic, demulcent and tonic. The genus encompasses a hundred and fifty species located in one-of-a-kind areas of the world, frequently visible in mountainous regions, *Hybanthus* is used to deal with diverse ailments in ayurveda, siddha and different diverse conventional structure.[3]

The plant's major uses in ayurvedic literature are to treat "kapha" and "pitta" problems. Urinary calculi, strangulation, severe diarrhoea, vomiting, burning feeling, mental wandering, urethral discharge, blood issue, bronchial asthma, epilepsy, and breast tone are all treated with it.[4] Flavonoids, stilbenes, and hydrolysable and condensed tannins are only a few of the plant phenolics that may be found. phenolics may also serve as phyto-alexins, anti-feedants, attractants for pollinators, individuals to

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the plant's pigmentation, antioxidants, and defences against Ultraviolet light, among other functions in plants. Aside from its fitness-protective properties, phenolics in their normal form contribute to a variety of product attributes such as bitterness, astringency, colour, taste, fragrance, and the overall oxidative balance. A wide range of biochemical and pharmacological motions, such as anti-inflammatory, antioxidant, anti-allergic, hepatoprotective, anti-thrombic, antiviral, and anti-carcinogenic activities, may be shown in the activity of flavonoids.

These chemicals seem to serve a crucial role in defence against viruses and predators and contribute to physiological aspects such as seed development and dormancy. They are thus important. In the adjuvant-induced arithmetic model in rats, the alcoholic and aqueous extract was shown to be quite effective at reducing inflammation.[5] Extracts of *Hybanthus enneaspermus* were employed in GC-MS analyses to determine the bioactive components. Over 10 chemicals were found to be present including D-mannitol, 2-piperidinone, cedarn-2-dioxol, 2-methylsilyl glycerol trimethyl ether and silane.[6-8] Synonyms for the plant include *Ionidium suffruticosum*, *Viola suffruticosa*, *Ionidium enneasperumum*, and *Viola enneasperumum*.

Medical studies have shown that *Hybanthus enneasperum* has anti-hyperlipidemic and free radical scavenging characteristics as well as potential nephroprotective and antioxidant effects. It has also been shown to have efficacy against arrhythmia and allergies. Oxidative stress-related degenerative disorders may benefit from antioxidants found in this plant.[7]

Distribution

- Global Distribution: Asia: China, India, Taiwan, Africa, Australia.
- Local Distribution: Andhra Pradesh, Assam, Bihar, Chhattisgarh, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu, Uttarakhand, West Bengal.
- Habitat: Common in grassy places, road sides, railway tracks and close to cultivated fields.

Taxonomic Classification

Kingdom - *Plantae*

Phylum - *Tracheophyta*

Class - *Magnoliopsida*

Order - *Malpighiales*

Family - *Violaceae*

Genus - *Hybanthus*

Species - *enneaspermus*

Morphology

They are Annual or perennial herbs, that are approximately 10-60 cm long. The basis system of those plants have Slender faucet roots. The shoot system is straightforward or branched slightly woody within the bottom. Leaves are straightforward, alternate, variable, linear lancelike-elliptic to oblong-lanceolate, about 0.5-8.5 x 0.2-1.5 cm across, lateral veins regarding 4-7 on either facet of the vein affected on top of and outstanding at a lower place, higher leaves of additional linear, stalk subsessile or sessile, stipules little in pairs, linear lanceolate, margins ciliate, regarding 1-4 millimetre long. Inflorescence axillary cymes. Flowers ar bisexual, zygomorphic, red, orange or purple, pedicle articulate, slender, hairless or pubescent with 2, breacteoles below articulation, sepals 5, subequal, lanceolate, imbricate, free or slightly connate at the bottom, margins ciliate, apex acute, regarding 2-4 × zero.75-1 millimetre across, petals 5, unequal, posterior ones little and straight, elliptic, symmetric, acuminate, regarding 3-5 millimetre long, lateral triangular rectangular, regarding 4-6 millimetre long, apex wider and obtuse, lower ones suborbicular. Stamens 5, hypogynous, filament connate or free, connivent around gametoecium, regarding two millimetre long, anterior anthers two dorsal, gibbous or spurred, with distinct membranous curving connective appendage. Ovary superior, sessile, unilocular, globose, glabrous, three pistil, ovules 3-24, on three placentae, vogue clavate, slim close to the bottom and thick close to apex, stigma oblique. Fruit capsule, tri-valved elastically, subglobose, glabrous. Seeds many, ovoid-ellipsoid, surface swish, reticulate, with longitudinal ribs, embryo straight.

Isolation of Bio active Compounds

Flavonoids are present in the form of polyphenolic compounds which have robust antimicrobial, anti-inflammatory activities. They save you oxidative cellular harm and additionally have sturdy anti most cancers pastime. Terpenoids are the myriad compounds used by means of people in the meals and pharmaceuticals. Phenols are the biggest group of plant metabolites, which have many organic houses along with anti-apoptosis, anti-growing older, anti-carcinogenic, anti-inflammation and cell proliferating activities. Tannins have astringent properties, which accelerate the recovery of wounds and infected mucous membranes due to their physiological sports which include antioxidant, antimicrobial and anti-inflammatory residences. Saponins have traditionally been used as foaming and surface active sellers,which assist in controlling cardiovascular diseases and in controlling cholesterol in humans.

Numerous bioactive phytochemicals have been identified in the plant species. *Hybanthus enneaspermus* contains aurantiamide acetate (dipeptide), isoarborinol (triterpene), and –sitosterol.[8] A variety of solvent fractions from *Hybanthus enneaspermus* were tested for antioxidant activity *in vitro*, and the total amount of phenolic compounds was measured. The DPPH test, the total antioxidant assay, the decreasing electricity assay, the nitric oxide assay, and the hydrogen Peroxide scavenging assay were all carried out. out. Researchers found that the total antioxidant capacity and the higher phenolic content of the Ethyl Acetate fractions[9] were superior. Ethanol, acetone, and water were among the three solvents used to extract fractions. Excess phytochemical components, such as alkaloids, tannins, flavonoids, steroids, and phenolics were found in the ethanolic fraction of the plant *Hybanthus enneaspermus*.[10-11] Pharmacognostical testing of *Hybanthus enneaspermus* altered the phytochemical analysis of many solvent extracts. Extracts made from methanol are excellent sources of steroids, sugars, alkaloids, phenolics, flavones, catechins, tannins and amino acids. Water extracts phenols, flavones, tannins, anthraquinones, and amino acids,[10] whereas petroleum ether extracts indicated the presence of steroids and triterpenoids.

Analysis of nephroprotective interest of the plant extract of *Hybanthus enneaspermus* has been carried out in an examination. Ordinary rats (control) and cisplatin brought about renal broken rats (check) were decided on[11] Antioxidant or the capability of the extract to scavenge loose radicals was studied to correlate its nephroprotective interest.

The observer found out that the root extract was nephroprotective and should be used in destiny to deal with neurotoxin induced renal harm.[12]

Cardioprotective interest of *Hybanthus enneaspermus* became studied on isoproterenol handled rats. *Hybanthus enneaspermus* became given at a dose of 500mg/Kg for 4 weeks and a look at discovered that the extract reduced the oxidative strain and normalized the stage of vital cardiac marker enzymes.[11]

Anti-fungal property of *Hybanthus enneaspermus* changed into examined in opposition to *Aspergillus flavus, Aspergillus fumigatus* and species of *Candida*. The inhibitory belongings studied the use of a nicely diffusion technique. The observer found out that the activity became higher against those fungal pathogens using methanol extracts. The Protective effect of alcoholic extract of *Hybanthus enneaspermus* on diabetic worry changed into an investigation. Streptozotocin prompted male rats to be selected for look at. The agent causes selective damage to the pancreatic β cell by means of releasing nitric oxide. Alcohol has vast antioxidant interest and reduces glucose level significantly in oral glucose tolerance tests (OGTT). The discount became depending on the dose of the extract and exhibited considerable hypoglycemic pastime.[13]

Aldose reductase is discovered in all cells however at excessive stages in cornea, lens, retina,kidney, myelin which are without difficulty laid low with diabetic complications. The protective effect of one-of-a-kind fractions of *Hybanthus enneaspermus* on diabetic complications such as aldose reductase inhibitory pastime (ADH) became studied.

Ethyl acetate fraction changed into located to have maximum ARI pastime of 49.26 µg / ml and may be because of excessive phenolic and flavonoid content.[14] Alcoholic and aqueous extracts of complete flowers of *Hybanthus enneaspermus* on Freund's adjuvant precipitated arthritis become evaluated in rat paw. Aqueous and alcoholic extract suppressed the swelling of the paws in each acute and chronic stage. Alcoholic extract showed extra reported impact of about 59.4% compared to aqueous extract of fifty-nine. 4%.[15] Cyclotides are plant defense peptides possessed by many individuals of the family *Violaceae*. They have antiviral, uterotonic and other biological activities. The cyclotide variant in diverse species of *Hybanthus* and *violaceae* plant circle of relatives discovered many novel cyclotides which might also facilitate protein engineering applications.[16] The lipid reducing activity of hydro alcoholic extracts of *Hybanthus enneaspermus* became investigated at the male winstar albino rats that have been fed on a high fat weight loss program for four weeks. Hydro alcoholic extract at a dose of 400 mg/Kg becomes observed to be greater effective in good sized reversal of overall cholesterol, TG, LDL and VLDL in the direction of normal values.[17]

Major Chemical Compounds Reported from *Hybanthus enneaspermus*

1,2,3-Propanetriol

For those unfamiliar, glycerol is the most basic of all the polyol compounds. Non-toxic and sweet-tasting, it is a colourless, odourless, viscous fluid. Glycerides are lipids that contain the glycerol spine. Antimicrobial and antiviral qualities make it a common ingredient in FDA-approved wound care and treatment. Using this as a marker for liver disease is also a good idea. Additionally, it is widely used in the food and pharmaceutical industries as a sugar and as a humectant. Glycerol is water-miscible and hygroscopic because to the proximity of three hydroxyl groupings.[18]

Octanoic Acid

Octanoic acid, usually known as caprylic acid, is a straight-chain unsaturated fat found in different vegetable and creature sources, for example, coconut oil, palm nut oil, and margarine fat. Caprylic acid has appeared to disturb the sodium internal current in separated neuroglioma cells, while not influencing the ionic outward current. The impact of caprylic acid on the plasma layer ATPase movement of one strain of *Saccharomyces cerevisiae* has been investigated. The impacts of different unsaturated fats, including caprylic acid, on insulin discharge from rodent and human islets of Langerhans have been acid. conventions for counter acting agent cleansing that utilization caprylic acid have been accounted. A strategy for DNA extraction that utilizes caprylic acid has been published. It is a middle of the road in the assembling of scent esters and of dyes.[19]

Nonanoic Acid

An unsaturated lipid containing nine carbon atoms, Nonanoic Acid, is a naturally occurring substance. Nonanoic acid's ammonium salt form is used as a herbicide. By removing the plant's waxy fingernail skin, this method disrupts cells, causes leaking from the cells, and causes the plant to dry out. C9 straight-chain saturated unsaturated fat nonanoic acid is found in the oil of pelargonium. Used in the same way as plasticizers and enamels are put together, it has antifungal qualities. To name a few of its functions: antifeedant; plant; algal; and Daphnia magna. It's a medium-chain unsaturated lipid with a straight chain. It's a non-anoate conjugate acid. It's derived from a nonane hydride. Oil from pelargonium contains an unsaturated lipid called pelargonic acid or nonanoic acid, which generally occurs as esters. Flavorings like methyl nonanoate, a manufactured ester, are made from man-made esters. It's a carboxylic acid, a nine-carbon chain, and pelargonic acid is a natural substance. It's a slick fluid with a noxious odour. Almost insoluble in water, it is soluble in chloroform and ether, but not in water at all. A fixer in certain pepper showers is 4-nonanoyl morpholine.[20]

Hexadecanoic Acid, 2-Hydroxy-1-hydroxymethyl) ethyl

2-palmitoylglycerol is a 2-monoglyceride where the acyl branch is hexadecanoyl (palmitoyl). It has the role of an algal metabolite. It gets from a hexadecanoic acid. MG(0:0/16:0/0:0) is a monoacylglycerol. A monoglyceride, all the more effectively known as a monoacylglycerol, is a glyceride consisting of one unsaturated fatty acid chain covalently attached to a glycerol atom through an ester linkage. Monoacylglycerol can be extensively partitioned into two gatherings; 1-monoacylglycerols (or 3-monoacylglycerols) and 2-monoacylglycerols, contingent upon the situation of the ester bond on the glycerol moiety. Ordinarily the 1-/3-isomers are not recognized from one another and are named 'alpha-monoacylglycerols', while the 2-isomers are beta-monoacylglycerols. Monoacylglycerols are shaped biochemically by means of arrival of an unsaturated fat from diacylglycerol by diacylglycerol lipase or hormone touchy lipase. Monoacylglycerols are separated by monoacylglycerol lipase. They will in general be minor segments just of most plant and creature tissues, and without a doubt would not be relied upon to amass in light of the fact that their solid cleanser properties would disruptively affect layers. 2-Monoacylglycerols are a significant finished result of the intestinal absorption of dietary fats in creatures by means of the protein pancreatic lipase. They are taken up legitimately by the intestinal cells and changed over to triacylglycerols by means of the monoacylglycerol pathway before being moved in lymph to the liver. Mono-and di-glycerides are normally added to business food items in little amounts. They go about as emulsifiers, assisting with blending fixings, for example, oil and water that would not in any case mix well.[21] some other important phytochemical compound and structure reported in *Hybanthus enneaspermus* (Table 1) and in (Table 2)we have listed compound and their medicinal perspective given.

Table 1: Other Phytochemical constituents reported from *Hybanthus enneaspermus*.[17]

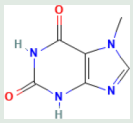
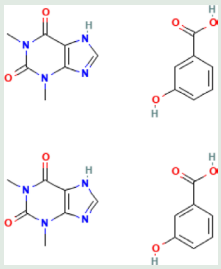
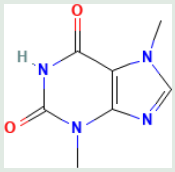
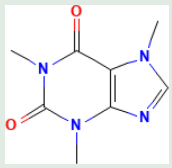
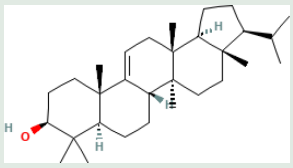
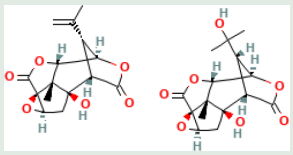
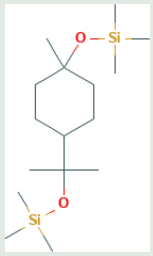
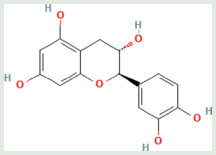
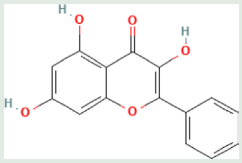
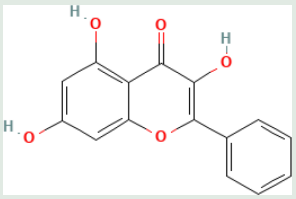
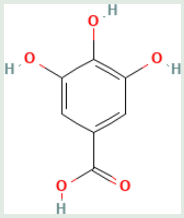
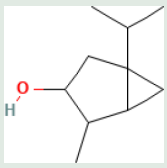
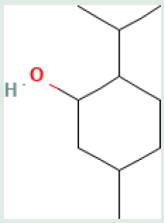
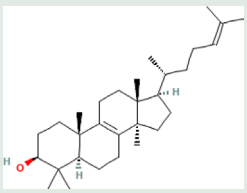
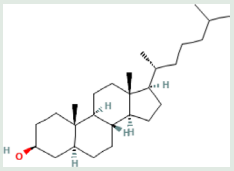
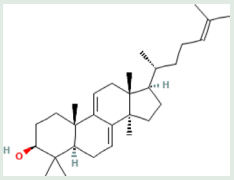
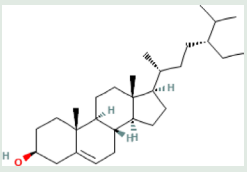
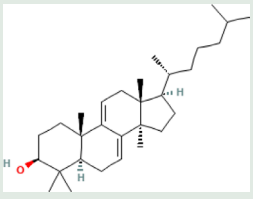
Sl. No.	Phytocompounds	Molecular Structure
1	Heteroxanthine	
2	Theophylline	
3	Theobromine	
4	Caffeine	
5	Isoarborinol	
6	Sesquiterpene	
7	Terpinol	
8	Catechin	
9	Galangin	
10	Kaempferol	
11	Gallic acid	
12	Thujyl alcohol	
13	Menthol	
14	Lanosterol	
15	Cholestanol	
16	Agnosterol	
17	Beta sitosterol	
18	Dihydroagnosterol	

Table 2: Reported bioactive Phyto-compounds from *Hybanthus enneaspermus*.[22]

Sl. No.	Name of compound	Nature of compound	Biological activities
1	3-Amino-2-oxazolidinone	Metabolite of Furazolidone and Nitrofuran	Not intended for diagnostic or therapeutic use
2	Cyclopentene, 3-ethyl-	Cycloalkene	Antiallergic, anti-inflammatory, anti-tumour
3	1-Ethylcyclopentene	Cycloalkene	Antiallergic, anti-inflammatory, anti-tumour
4	1,3-Oxathiolane, 2,2-dimethyl-	---	Anticancer
5	2,4-Dimethylfuran	Furan derivative	Biofuel
6	4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl-	---	Antimicrobial, anti-inflammatory, Antiproliferative
7	Benzofuran, 2,3-dihydro-	Coumaran	Antilipidemic, Anti-inflammatory, anti-helminthics, antidiarrheal
8	Bicyclo[2.1.0]pentane, 1,4-dimethyl-	---	No activity reported
9	Phenol, 2-methyl-	Cresol (phenol derivative)	Anaesthetic, Analgesics Antiseptic, antipruritic (itch reliever), Antidotic, Antioxidant
10	Pyrazole, 4-aminomethyl-3,5-dimethyl-		Analgesic, Anti-inflammatory, Antipyretic
11	1,2,5-Trimethylpyrrole	Pyrrolizidine Alkaloid	Hepatoprotective, Antitumour
12	6,8-Dioxa-3-thiabicyclo(3,2,1)octane 3,3-dioxide	---	No activity reported
13	Urea, N,N'-dibutyl-N,N'-dimethyl-	Urea derivative	Not intended for diagnostic or therapeutic use
14	1-Butanol, 4-butoxy-	Alcohol	Volatile Biomarker for gastric cancer
15	Metformin	---	Antidiabetic
16	Dodecane, 1-chloro-	Chloroalkane	No activity reported
17	Chloroacetic acid, 2-tridecyl ester	Ester	Herbicide
18	Cyclododecane	Cyclic alkane	Non-toxic, No activity reported
19	Cyclotetradecane	Cyclic alkane	No activity reported
20	2,5-Difluorobenzoic acid, 4-dodecyl ester	Ester	Not intended for diagnostic or therapeutic use
21	2,6-Difluorobenzoic acid, 4-tridecyl ester	Ester	Not intended for diagnostic or therapeutic use
22	2,4-Difluorobenzoic acid, 6-dodecyl ester	Ester	Not intended for diagnostic or therapeutic use
23	Arginine	Amino acid	Anti-hepatatic, Anti-impotence, Anti-infertility, Aphrodisiac, Diuretic,
24	Dodecanoic acid	Fatty acid	Antibacterial, Antioxidant, Antiviral, Candidcide
25	Ethyl. alpha.-d-glucopyranoside	Glucoside	Anti-tuberculous Activity, Antioxidant, alpha amylase inhibitory activity, Hypolipemic activity, Anticonvulsant
26	1H-Indole, 3-methyl-	Skatole	Antituberculosis
27	Oxirane, [(dodecyloxy)methyl]-	Cyclic ether	No activity reported
28	1-Dodecanethiol	---	Not intended for therapeutic use
29	Cyclododecane	Cyclic alkane	Antidote, emergency treatment
30	Lactose	Sugar	Anti-cephalopathic, Anti-hepatotic, Sweetener
31	Tetradecanoic acid	Fatty acid	Antioxidant, Cancer preventive, Cosmetic, Hypercholesterolemic, Nematicide
32	beta.-D-Glucopyranose	Sugar (cyclic glucose)	Biofuel
33	D-Glucose, 6-O-. alpha.-D-galactopyranosyl-	Sugar moiety	No activity reported
34	1,2-Dihexylcyclopropene	Unsaturated hydrocarbon	No activity reported
35	(3-Fluorophenyl)(furan-2-yl)methanol	Alcohol	Antiepileptic
36	Bicyclo[3.1.1]heptane, 2,6,6-trimethyl-, (1. alpha.,2. beta.,5. alpha.)-	---	Antimicrobial
37	6-Octen-1-ol, 3,7-dimethyl-, propanoate	Ester	Fragrance, Flavour
38	n-Hexadecanoic acid	Fatty acid	Antioxidant, Hypocholesterolemic
39	1-(1-Hydroxybutyl)-2,5-dimethoxybenzene	Benzene derivative	No activity reported
40	Oxirane, tetradecyl-	Cyclic ether	No activity reported
41	9,12,15-Octadecatrienoic acid, methyl ester, (Z,Z,Z)-	Ester	Anti-inflammatory, Hypocholesterolemic, Cancer preventive, Hepatoprotective, Nematicide, Insectifuge Antihistaminic, Antiarthritic, Anti-coronary, Antieczemic Antiacne, Antiandrogenic
42	Methyl 8,11,14-heptadecatrienoate	Ester	Antibiotic
43	Phytol	Diterpene	Antimicrobial Anti-inflammatory Anti-cancer Diuretic
44	9,12,15-Octadecatrienoic acid, (Z,Z,Z)-	Fatty acid	Anti-inflammatory, Insectifuge, Hypocholesterolemic, Cancer preventive, Nematicide, Hepatoprotective, Insectifuge,

continued...

Table 2: Cont'd.

Sl. No.	Name of compound	Nature of compound	Biological activities
45	2-Methyl-Z,Z-3,13-octadecadienol	Terpenoid	Pesticide, Herbicide, Insecticide, Pheromone
46	Octadecanoic acid	Fatty acid	Hypocholesterolemic, Cosmetic, Flavour, Lubricant
47	9,17-Octadecadienal, (Z)-	---	No activity reported
48	2-Nonadecanone	Ketone	Not intended for therapeutic use
49	L-Glutamic acid 5-ethyl ester	Ester	Antiepileptic; Anti-prostatitic; Anti0retardation; Anxiolytic; Neurotoxic;
50	Dodecahydropyrido[1,2-b]isoquinolin-6-one	Ester	No activity reported
51	Piperidine, 1-[(2,3,4,5-tetramethylphenyl)sulfonyl]-	Heterocyclic amine derivative	Anti-enzymatic, Diaphoretic, Pesticide
52	Bis(2-ethylhexyl) phthalate	---	Plastisizer
53	Diisooctyl phthalate	Ester	Antiandrogenic
54	Vitamin E/dl-alpha. Tocopherol	Vitamin	Anti-ageing, Analgesic, Anti-diabatic, Anti-inflammatory, Antioxidant, Antidermatitic, Antileukemic, Antitumor, Anticancer, Hepatoprotective, Hypocholesterolemic, Antiulcerogenic, Vasodilator, Antispasmodic, Anti-bronchitic, Anti-coronary, Anti-infertility
55	Adamantane, 1-isothiocyanato-3-methyl-	Cycloalkane derivative	Anticancer, Cocaine analogue
56	7-Hexadecenoic acid, methyl ester, (Z)-	Ester	Antioxidant, Flavor, Hypocholesterolemic Pesticide, Anti-inflammatory, hypocholesterolemic, nematicide, antiandrogenic
57	Ethanone, 2-(2-benzothiazolylthio)-1-(3,5-dimethylpyrazolyl)-	---	Antimicrobial
58	9-Octadecenoic acid (Z)-, methyl ester	Ester	Allergenic, Anemiagenic,Antialopecic, Antiandrogenic, Antiinflammatory, Antileukotriene-D4 (Anti-platelet activating factor),

Antimicrobial activity

P 0.001 revealed significant action of the ethanol extract against all pathogens tested, with E. faecalis showing the maximum inhibition (24 mm) and E. coli showing the least (17 mm). When compared to ethanolic and liquid extracts, chloroform and crude ether extracts were ineffective.[23] All investigated organisms, with the exception of E. coli, showed remarkable anti-bacterial activity in the look at extract. *S. aureus*, *S. epidermidis*, and *P. aeruginosa* were all killed by aqueous, chloroform, and methanol extracts, in that order. Liquid Extract is followed by chloroform Extract and Ethanolic extract for *E. coli* and *C. albicans* respectively. Antimicrobial activity of extracts was shown to be comparable to that of commonly used antibiotics against selected tract infections when they were tested at 300 micrograms per disc.

Animals and plants are equally susceptible to disease caused mostly by microorganisms. Dealers of antimicrobials treat infections caused by microorganisms. The effectiveness of plant-based antibacterial tablets surpasses that of artificial capsules by a wide margin. Secondary metabolites generated by flora provide additional bioactive substances that may be effectively employed as antimicrobial agents. Secondary metabolites.

Anti-bacterial Activity

According to Sahoo *et al.*,[24] the antibacterial pastime of unique solvent extracts of *H. enneaspermus* against urinary tract infections was discovered by the researchers (*Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Proteus mirabilis*, *Enterococcus faecalis* and *Staphylococcus aureus*). When compared to chloroform and petroleum ether extracts, ethanol and aqueous extracts showed a wider range of inhibition in disc diffusion assays. *H. enneaspermus* aqueous herbal extract suppressed the most resistant root canal bacterium E. Faecalis at 50% concentration.

Antifungal Activity

Aspergillus niger, *Aspergillus flavus*, and *Aspergillus fumigatus* have all been shown to be sensitive to the antifungal compound found in various preparations of *H. enneaspermus*. Wet garment fungal spots were cultivated and disc diffusion assays were used to determine the quarter of inhibition. After the methanol extract, petroleum ether and chloroform extract, the majority of inhibitory effects became methanol extract. Aflatoxins-producing fungus (*A. Flavus* and A. Fumigatus) and pathogenic fungi (*Candida albicans* and *Candida tropicalis*) were shown to be inhibited by *H. enneaspermus* extracts in an *in vitro* study. Another study found that *H. enneaspermus*' ethanolic extract was very effective against *Candida albicans* and *Aspergillus niger*. The inclusion of physiologically active ingredients such alkaloids, flavonoids, and the like may explain the anti-microbial interest. *Aspergillus flavus*, *Aspergillus fumigatus*, and *Candida* species were tested against *Hybanthus enneaspermus* to see whether it had any anti-fungal properties. A well-diffusion approach was used to study the inhibitory characteristics. Using methanol extracts, the researcher discovered that the activity against these fungal infections increased.[24]

Antiviral activity

Antiviral properties of the plant are another well-known benefit of the herb. *Hybanthus enneaspermus* was tested for anti-HIV efficacy in a reverse transcriptase inhibition experiment, and the methanol and hexane extracts showed substantial inhibitory activity.[25] Infection with the HIV virus is a dangerous disease that is quickly spreading around the globe. HIV is a virus that attacks the immune system. No first-class curative medicine exists, thus plant-based products have received increased research attention. The anti-HIV activity of *H. enneaspermus* leaf extract is now being evaluated utilising an opposite transcriptase inhibition test. Extraction in methanol and hexane yielded excellent

results, whereas extraction in ethanol, chloroform, and petroleum ether yielded no inhibition at the conclusion of the process.

Anti-inflamatory

Researchers tested the anti-inflammatory effects of *H. enneaspermus* alcoholic and aqueous extracts against acute inflammation induced by carageenan, histamine, and five-HT at doses of 250 and 500 mgkg-1, p.o. in rats. The paw edoema of the animals studied was reduced by both extracts. Histamine and five-HT, two further inflammatory mediators, are also inhibited by the extracts.[26] Alcoholic extract had a more substantial influence than the aqueous extract.

Antioxidant Activity

The DPPH, reducing power, and hydrogen peroxide radical scavenging tests were used to measure the ethanol's antioxidant activity. A radical shift in DPPH action was found to be 24.32 percent, whereas the standard was 45.41 percent at 60 mg/ml of concentration.[27] The most severe absorbance was found at 60 mg/ml fixation, and in the hydrogen peroxide radical scavenging movement, there was a 35.11% degree of restraint. To counteract the growth of free radicals, *H. enneaspermus*' ethanolic leaf extract has been shown to have significant anticancer properties and may be used as a superior source of normal cell reinforcements.

Anti-diabetic Properties

A dose-dependent reduction in OGTT glucose levels is possible with SHE's considerable antioxidant activity. Hypoglycemic effects are also notable, however they are dose-dependent. The glucose absorption in the rat hemidiaphragm was clearly seen in the investigation. AHE's anti-diabetic effect is well-supported, although further research is needed to confirm its mechanism of action. The ester fraction was shown to have the greatest ARI activity, which may be attributed to the high phenoplast and flavonoid content of this fraction. Diabetic cataracts may also be treated with the extract once more analysis.[27]

Anti-Allergy

Flavonoid has been shown to have anti-anaphylactic and anti-asthmatic properties in the literature. As a result, these chemical moieties may be responsible for the anti-allergic action shown by *Hybanthus enneaspermus* plants. Additionally, anti-allergic and analgesic properties of *Hybanthus enneaspermus* have been discovered. The analgesic efficacy of petroleum ether and ethanol extract was screened using the heated plate method, the tail immersion technique, and the tail flick technique. Milk-induced eosinophilia and leukocytosis were used to test the anti-allergy hobby. More analgesic and anti-allergic properties were found in the ethanolic extract.[28] This may be due to the presence of phytochemical components.

Anti-infertility

Male rats were given an ethanolic extract of *Hybanthus enneaspermus* to examine its anti-infertility effects on endosulfan-induced toxicity. MDA, GSH, -Tocopherol, and ascorbic acid were among the other variables examined. Testicular and serum MDA and GSH levels showed a greater drop.[11,29]

CONCLUSION

H. enneaspermus, a medicinal plant, is examined from a variety of angles, including its traditional applications, morphology, phytochemistry, and pharmacology. Consequently, this review will be useful to researchers who have an interest in examining and rationally approving the many usual circumstances of *H. enneaspermus*. A growing number of people throughout the globe are becoming interested in natural medicines because of the potent therapeutic potential of bioactive compounds. In the market, there are a variety of drugs derived from plant sources for the treatment of illness, which have been researched extensively using the information available in the traditional arrangement of the medication. Throughout the world, indigenous peoples have a wealth of knowledge on the use of plant materials to cure a wide range of diseases and illnesses. Conventional medications are growing in popularity among people of all socioeconomic backgrounds due to their affordability and efficacy.

Traditional ethnomedicines, such as *H. enneaspermus*, have been used to cure a wide range of ailments in India and other parts of the world. Aside from these issues, the clinical data on the appropriateness and safety of administration are still lacking. There are several phytoconstituents in *H. enneaspermus* that belong to a variety of chemical classes. *H. enneaspermus* and its phytoconstituents have not yet been studied for their natural healing properties or restorative properties. For its pharmacological activities, the plant is projected to become more useful in the treatment of a wide range of ailments. In spite of the fact that various arrangements and concentrates from various parts of *H. enneaspermus* have only recently been used and successfully demonstrated in the treatment of various types of illness in various frameworks of medication studies, for example, the examination of its bioactivity, pharmaco-therapeutics, poisonousness, normalisation, and clinical preliminaries should be attempted from a well-being perspective before utilision. As in modern medicine, the globe is shifting toward the use of plant resources to treat many forms of illness. For example, study into the science and pharmacological effect of *H. enneaspermus* has grown significantly.

All in all, the present analysis provides a comprehensive overview of *H. enneaspermus* data from a variety of perspectives, including pharmacognosy, phytochemistry, and pharmacology. Research on *H. enneaspermus* for human therapeutic purposes will benefit from the readily available data.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

GCMS: Gas chromatography–mass spectrometry; **DPPH:** 2,2-diphenyl-1-picrylhydrazyl; **OGTT:** Oral Glucose Tolerance Test; **HT:** Hydroxytyrosol; **MDA:** Malondialdehyde; **GSH:** Glutathione.

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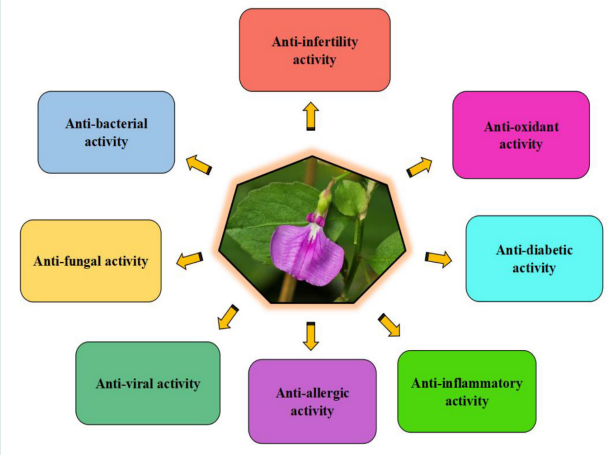
GRAPHICAL ABSTRACT



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