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ETHNOBOTANICAL RELEVANCE AND SUSTAINABLE UTILIZATION OF HYGROPHILA AURICULATA

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ABSTRACT

Hygrophila auriculata also known as Aster acantha longifolia, a member of the acanthae family. is common Plant Found growing in marshy and waterlogged place it is also called Neermulli, Talmakhana, kokilaksha! and I ksura". il is an important herbalplant, broadly Spread in srilanka, india and wed to treat various disecue the aerial part of the plant are used to treat blood disorder. it has various medicinal properties such as anticancer, Hypoglycemia, aphrodiast, aphrodisiac antimicrobial, antioxidant, lipid peroxidation. hepato-prolective and hemalopioeticadivity it consist of lupeol, stigmasterol, bulletin, Fatly aud and alkaloid.

KEYWORD: Hygrophila auriculata, Antidiabetic.

1. INTRODUCTION

Hygrophila or Marsh Barbel (English) it is commonly used to call in Tamil as a Neermulli. An annual herbal plant grows up to 60cms altitude. The plant stem is tetragonal, hairy and stiffened at the nodes. The bark is dark brown, although the leaves are elliptic-lanceolate and hispid. The flowers are violet and somewhat purple-blue. The fruit looks like a four-sided figure, linear, glabrous and about contains 1cm long seeds which are orbicular hairy and brown in color.

2. PLANT PROFILE

- **Synonyms:** Asteracantha longifolia, Asteracantha auriculata, Hygrophilaschulli
- **Biological source:** Hygrophila auriculata is a Semi-woody, herbaceous plant
- **Family:** Acanthaceae

2.1 Taxonomic Position

- **Kingdom:** Plantae-plantes, planta, vegetal, plants
- **Subkingdom:** iridiplanta Infrakingdom Streptophyta-land plants
- **Superdivision:** Embryophyta
- **Division:** Tracheophyta - vascular plants, tracheophytes
- **Subdivision:** Spermatophytina – spermatophytes, seed plants, Phanerogames
- **Class:** Magnoliopsida
- **Superorder:** Asteranae
- **Order:** Lamiales
- **Family:** Acanthaceae - acanthacees
- **Genus:** Hygrophila R. Br.- Swampweed
- **Species:** auriculata

Figure:1 Whole Plant Of H.Auriculata

Figure:2 Flower Of H.Auriculata

2.2 Vernacular Names:

Table: 1 Vernacular Names.

Tamil	Golmidi, Nirguvireru, Nerugobbi
Telugu	Kuilirakha, Nirguvireru
English	Long leaved barleria
Hindi	Talmakhanna, Kantakaliya, Gokulakanta
Kannada	Kolavali, Kolarind, Kolavankal
Marathi	Talikhana, Kalsunda

Gujarati	Ekharo, Gokhru
Malayalam	Yayalculli, Culli, Nirmulli
Urdu	Talmakhana
Bengali	Kuliyakhara, kantakalika

2.3 Distribution

Around the world found in Sri Lanka, Myanmar, Indonesia, Malaysia and throughout the plains of India, in moist habitats such as marshy margins of canals, also found in tropical Himalaya.

2.4 Description

A spiny, semi-woody herbaceous plant in the Acanthaceae family. Herbs, 40-100 cm tall with unbranched, sub-quadrangular stems with numerous fasciculate, swollen node, hispid with long hairs. Leaves sub-sessile, lanceolate, 6-15×1.5-3 cm, acute, hairy, in whorls of 6 at each node, the two outer ones much larger than the four inner ones. Thorns from the axils of leaves sharp, 2-3 cm long, yellowish-brown. Flowers in axillary clusters of eight at each node in 4 pairs. Bracts lanceolate, hairy and ciliate, like the leaves; bracteoles linear-lanceolate, 1.5-2cm long, with hyaline margins in the lower part, hairy and ciliate with long white hairs. Calyx 4 partite; upper sepals broader unequal, longer than the other three, all linear lanceolate, 1.2-2 cm long, with hairy on the back and hyaline ciliate margin. Corolla purple-blue, 2-3 cm long, bilipped; tube 11-13 mm long, swollen at top.

2.5 Morphology

- **Spines:** A distinguishing feature is thepresence of two to six straight, sharp yellow spines, up to 4 cm long, in the axil of each leaf whorl.
- **Flowers:** The plant produces strikingpurplish-blue or violet flowers, which are about 2.5-3 cm long and appear in dense, whorled clusters at the nodes. The flowers are two-lipped, with the lower lip often having a yellow spot.
- **Fruit and Seeds:** The fruit is an oblong,linear capsule, approximately 1 cm long, whichis typically hairless and contains 4 to 8 seeds. The seeds are dark brown, nearly spherical, and develop a notable mucilaginous coating when soaked in water.
- **Habitat:** Hygrophila auriculata thrives in moist and wet environments such as swamps,
- ditches, and along the banks of rivers and streams.

2.6 Chemical Constituents

The pharmacological effects of H. auriculata are largely attributed to its rich phytochemical profile, which includes various bioactive constituents like alkaloids, flavonoids, tannins, steroids, and triterpenoids. Recent research into the plant's phytochemistry has provided detailed insights into the specific compounds responsible for its medicinal properties.

- **Alkaloids:** H. auriculata contains alkaloids like asteracanthine and asteracanthinine, which are primarily responsible for the plant's aphrodisiac and neuroprotective effects . These alkaloids have been shown to modulate neurotransmitter levels and enhance sexual behaviour in experimental models.

- **Flavonoids:** Flavonoids like quercetin, kaempferol, and luteolin are abundant in H. auriculata. These compounds are well-known for their antioxidant, anti-inflammatory, and anti-cancer properties. Quercetin, in particular, has been linked to the plant's anti-inflammatory and hepatoprotective activities . The antioxidant potential of flavonoids helps in scavenging free radicals, thereby preventing oxidative damage to cells and tissues.

- **Steroids and Triterpenoids:** The presence of steroids such as stigmasterol and ß-sitosterol, along with triterpenoids like lupeol, contributes to the plant's anti-inflammatory, hepatoprotective, and diuretic effects. These compounds modulate the immune response, reduce inflammation, and protect the liver from toxin-induced damage

- **Phenolic Compounds:** The phenolic content of H. auriculata includes compounds like caffeic acid and ferulic acid, which exhibit strong antioxidant activity. Phenolic compounds play a vital role in reducing oxidative stress and inflammation, thereby supporting the plant's therapeutic applications in liver protection, cardiovascular health, and cancer prevention.

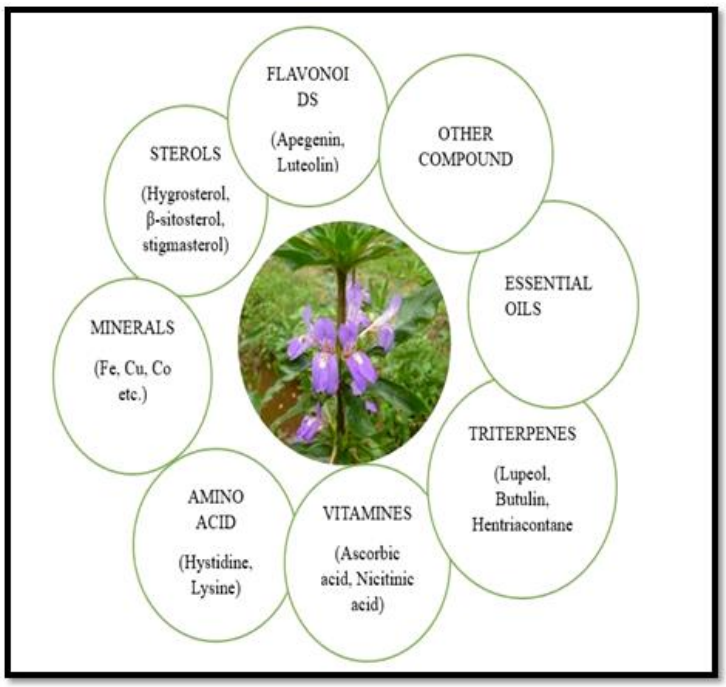

Figure 3: Chemical Constituents.

2.7 Chemical Structure

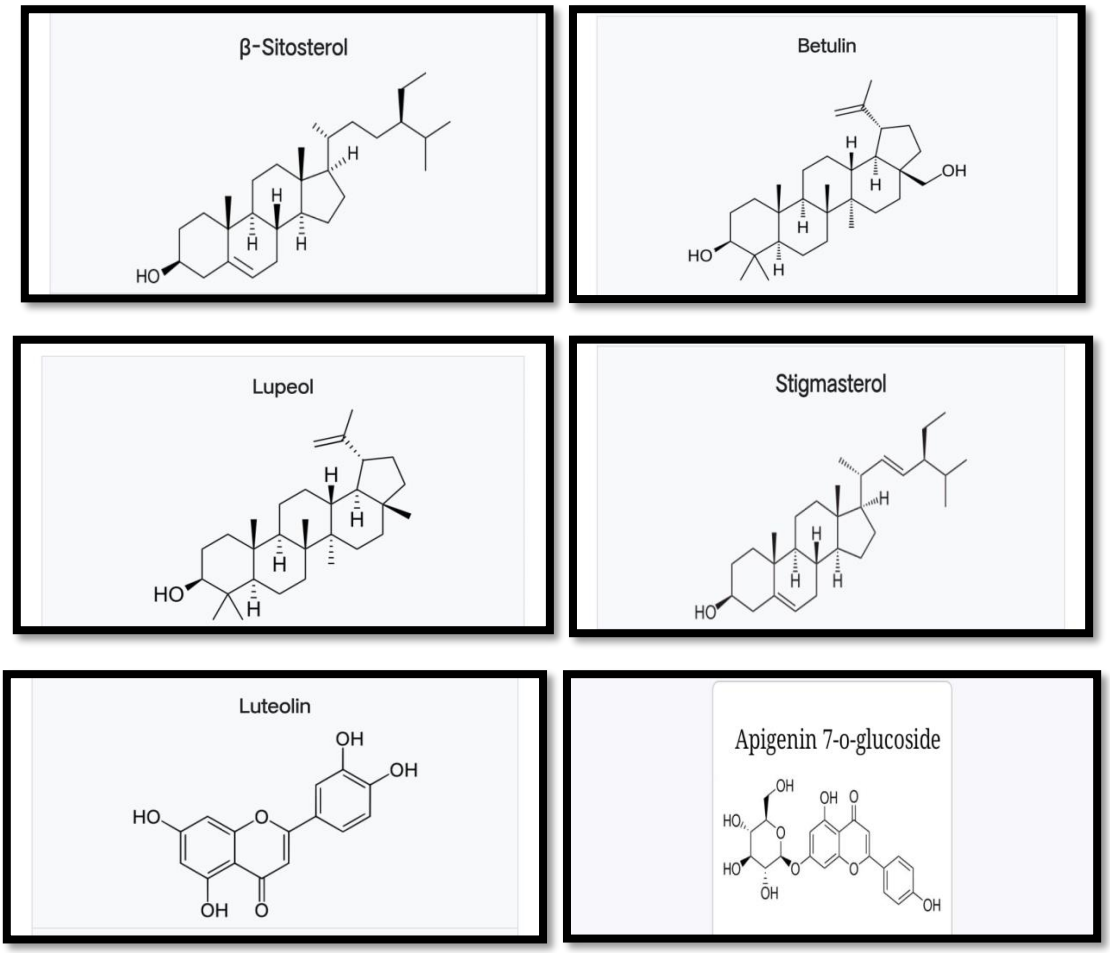

Figure 4: Chemical Structure Of Chemical Constituents.

2.8 Medicinal Uses

Hypoglycemic activity: Fernando et al., (1991) carried out preliminary investigations of the hypoglycaemic activity of aqueous extracts of the whole plant of Asteracantha longifolia and found that the extract significantly lowers the fasting blood glucose level and markedly improves the glucose tolerance of rats at a therapeutic dose equivalent to 5 g/kg of the starting material.

An ethanolic extract of the aerial parts of Hygrophila auriculata, at a dose of 100 and 250 mg/kg body weight for 3 weeks, produced a significant reduction in blood glucose, thiobarbituric acid reactive substances (TBARS) and hydroperoxide in both liver and kidney in streptozotocin-induced diabetic rats. Treatment with an ethanolic extract of the aerial parts of Hygrophila auriculata significantly increased glutathione (GSH), glutathione peroxidase (GPx), glutathione S-transferase (GST) and catalase (CAT) levels compared with the control group. An ethanolic extract of Hygrophila auriculata given to glibenclamide-treated rats also produced a decrease in lipid peroxidation associated with increased activity of superoxide dismutase (SOD) and catalase. The result of this study showed that an ethanolic extract of the aerial parts of Hygrophila auriculata possesses significant antidiabetic activity along with a potent antioxidant activity in models of diabetes.

Hepatoprotective activity: A methanolic extract of the seeds of Hygrophila auriculata at a dose of 200 mg/kg/p.o exhibited potent hepatoprotective activity against paracetamol- and thioacetamide-induced liver damage in rats.

Shanmugasundram et al., (2005) showed that an aqueous extract of the roots of Hygrophila auriculata (K.Schum) Heine at a dose of 150 mg/kg/p.o exhibited potent hepatoprotective activity against carbon tetrachloride-induced liver damage in rats.

Hewawasam et al., (2003) tested the aqueous extract of Asteracantha longifolia for hepatoprotective activity against carbon tetrachloride- and paracetamol-induced acute hepatotoxicity in mice. The plant exhibited significant hepatoprotective activity by reducing carbon tetrachloride- and paracetamol-induced changes in liver enzymes. The plant extract may interfere with free radical formation, which may account for the hepatoprotective action. Asteracantha longifolia showed significant hepatoprotective activity against carbon tetrachloride and paracetamol, comparable with standard drugs used for this purpose.

The Asteracantha longifolia whole plant slurry was tested against carbon tetrachloride-induced liver dysfunction in rats. The plant exhibited significant hepatoprotective activity by reducing carbon tetrachloride-induced changes in biochemical parameters of hepatic enzyme activity. The whole plant slurry of Asteracantha longifolia exhibited significant hepatoprotective efficacy against carbon tetrachloride, comparable with a known hepatoprotectant, silymarin.

Aphrodisiac activity: The ethanol derived of aerial parts indicates androgenic along with an improvement of sexual behavior in the rat by reliant on dose, improve the histo-architecture of the testis, increase the concentration of sperm count in the epididymis and increase testosterone level. The effect of aerial parts proliferated sexual behavior of male albino rats. The ethanolic extract of Hygrophila auriculata was directed as 100, 150 and 200 mg kg^{-1} doses to rats for a period of 28 days, and the action associated with control rats. The alterations are a weight of organ, sexual behavior, histo-architecture and fructose level of seminal vesicles were observed in a body. The erotic behavior was considered by determining of parameters in aphrodisiac. The ethanolic extract of Hygrophila auriculata showed that evident of anabolic effects in treated animals, by gains weight in the body and reproductive organ. Hygrophila auriculata extracts were showed that ability to raise the development of mature spermatozoa and witnessed in transverse section.

Hematopoietic action: Petroleum ether extraction from Hygrophilaauriculata increases WBC count significantly. The mixture of Petroleum: ether: chloroform extracts of leaf showed significantly increases erythrocyte count, leukocyte count, and hemoglobin count.

Anti-nociceptive property: Using both chemical and thermal methods of nociception in mice, the antinociceptive properties of the aqueous extract of the aerial portions (haa) and root (har) were evaluated. The acetic acid writhing test was conducted chemically, and the hot plate and tail flick tests were conducted thermally. Hygrophila auriculata powdered aerial parts and roots were macerated in separate batches with distilled water for a whole day. The extracts were then dried, evaporated, and filtered. The root and aerial portions produced a brownish residue that was extracted. Six groups of six animals each were formed out of the animals.

Group i served as the normal control group and was given distilled water (1 ml/kg. p.o.). Group ii served as the reference group and received aspirin (100 mg/kg/p.o.). Groups iii-vi

served as the treatment groups, where groups v & vi received har and group iii &iv received haa at doses of 100 and 200 mg/kg/p.o., respectively.

Mosquitocidal activity: In the current study, the egg hatchability and larvicidal qualities of the plant extract of h. Auriculata against a. Stephens, a malarial vector that is medically significant, were assessed. To assess mosquitocidal activity, larvicidal assays and ovicidal bioassays were carried out.

Anxiolytic activity: The current study set out to assess the anxiolytic activity of seeds from the hygrophila auriculata plant. The powdered seeds of hygrophila auriculata were extracted using two distinct solvents: ethanol and water. The standard utilized was diazepam, and the extracts were given orally at a dose of 300-600 mg/kg of body weight. The elevated plus maze, light-dark model, open field test for examine anxiolytic behavior, rotarod for motor coordination testing, and photo-actinometer for locomotor activity was utilized the total amount of time that each mouse spent in the maze's open and closed arms was recorded for five to seven minutes in the elevated plus maze model. Both extracts demonstrated a significant increase in the number of entries and percentage of time spent in the open arm. The duration of time spent in the compartments,the frequency of crossings between compartments, the avoidance and latency to entering the light area, and other factors are interpreted as anxiety-like behaviors in the light-dark model. Time spent in the light area increased significantly as a result of the extracts.

In the open field test, the animals were put in the middle of the field 30 minutes after the treatment, and the number of squares crossed in 5 minutes was recorded. The extract revealed a notable rise in the quantity of squares crossed, all of which are indications of anxiolytic behavior. The animals were positioned with all four paws on the bar in the rotarod model, and the fall-down latency was measured. As the mice's time spent on the revolving rod decreased, the extracts generated showed a significant decline in motor coordination scores, suggesting that they had anxiolytic-like effects. When an animal blocks one or more light beams in a photo actinometer, its locomotive activity is recorded. As compared to the diazepam-treated standard group, the extract-treated animals showed lower cut-off numbers in locomotor activity as measured by a photo actinometer. The outcome was an ethanolic extract of hygrophila auriculata with high anxiolytic action at a dose of 600 mg/kg.

Antimotility activity: The goal of this work was to investigate the antimotility properties of several h. Spinosa leaf extracts. With atropine sulfate as the standard medication, antimotility action was investigated using the charcoal meal feeding method at a dose of 0.1 mg/kg (i.p.). Soxhlet apparatus was used to extract the powdered plant material using petroleum ether, chloroform, and alcohol in succession. The process of decoction was used to create the aqueous extract. The extracts were filtered, and the resulting filtrates were evaporated using a rotating vacuum evaporator to produce various extracts. The study used albino mice, 20-25 grams in weight, of either sex.

The gastrointestinal motility of charcoal meal was used to investigate antimotility activity. The extracts were administered to the animals at doses of 200 and 400 mg/kg of body weight after they had been separated into separate groups. The positive control group had atropine sulfate intraperitoneally at a dose of 0.1 mg/kg of body weight, while the control group received 1% v/v tween 80 in water at a dose of 10 ml/kg of body weight. Each animal received 0.3 ml of charcoal meal, which included 10% charcoal and 5% gum acacia, orally after receiving the medication for 30 minutes. After thirty minutes, the animals were slaughtered, and the movement of charcoal meal that had moved from the pylorus to the caecum was measured. Hygrophilaspinosa's alcoholic extract has the highest level of antimotility activity.

Renal stone: The incidence of kidney stone formation in pediatric patients is increasing at a rate of about 5-10% every year. Kidney stones are linked with higher risk of heart disease, hypertension, chronic kidney disease, and reduced amount of minerals in the bones. Many young patients being diagnosed with kidney stones is a matter of great concern (Jeyashree Sundaram,2018). A stone that develops from crystals that form in urine and build up on the inner surfaces of the kidney, in the renal pelvis, or in the ureters. Kidney stones include calcium oxalate stones, cystine stones, struvite stones, and uric acid stones (Source: NIH National Institute of Diabetes and Digestive and Kidney Diseases)

Oedema: Swelling caused by the build-up of excess fluids in the body is called oedema. It is an accumulation of excessive amount of watery fluid in cellular tissues. Oedema may be generalized or local. Generalized edema result in dysfunction of the heart, liver, kidney and endocrine dysfunctions. Localized edema, which is more prevalent among those who do not exercise at all and stand or sit still for a long time, may be limited to specific area such as the ankles or leg resulting in venous or lymphatic or inflammation (Wen-ping zhang et al, 2017). This causes an increase in weight and swelling at places where the tissue is lax and fluid accumulation is possible, e.g. puffiness of face, around ankle, bipedel oedema etc (Yashpal Munjal). Modern treatment of oedema depends on underlying cause, reversal of the underlying condition is the basis of treatment, dietary sodium restriction and diuretic therapy in pitting edema.

Anti-cancer activity, anti-tumor activity, and cytotoxicity of H. schulli: According to the global cancer statistics in 2020, it is estimated that there were 19.3 million new cancer cases and 10.0 million cancer deaths in 2020. Sung et al. in 2021 revealed female breast (11.7%), lung (11.4%), prostate (7.3%), non-melanoma of skin (6.2%), colon (6.0%), stomach (5.6%), liver (74.7%), rectum (3.8%), and cervix uteri (3.1%) as the commonest sites for the development of malignancies.

Due to the adverse effects arising with the use of common anti-cancer drugs, traditional medicinal plants have been investigated as an alternative source of therapeutic agents which potentially had lesser adverse side effects. H. schulli is one such plant where a crude extract of the plant exhibited extensive anti-cancer and anti-tumor activities against different types of cancers and different experimental models. According to Uddin et al. in 2011, SK-BR-3, MCF7, HCT 116, SGC-7901, and Hs605T are some cell lines affected by the anticancer activity of H. schulli plant extract.

The use of natural medicinal plants as therapeutic agents is becoming more popular in the modern world. Toxicological assessment of a natural product is an important aspect that should be concerned before the clinical application (19). Modern scientists conduct studies on the cytotoxic effects of H. schulli to ensure the safe use of this important phytochemical agent.

Several toxicological studies have proved that at a dose of 2000 mg/kg body weight (BW), H. schulli plant extracts had not expressed any significant changes in the biochemistry parameters, weight of the internal organs, body weight, and food and water consumption of experimental animal models (53). Although H. schulli plant extracts were foundto have no cytotoxic effect against normal cells, they produced selective cytotoxic activity towards tumor cells at a range of IC50 0.22-1.6 mg/ml (1, 13). Importantly, some controversial findings were reported by various scientists on the toxicological characteristics of H. schulli extracts. The extraction method, solvents used, geography and botanical properties of the plant, and environmental factors can influence such discrepancies.

Anti-oxidant Activity by DPPH Method: Free radical scavenging activity of extracts was determined based on the DPPH spectrophotometric method of Mensor et al. with slight modifications. 1 ml of 0.3mM DPPH methanol solution was added to 2.5 ml solution of the extract (25, 50, 75 and 100 µg/ml) and allowed to react at room temperature for 30 minutes in the dark. The absorbance (Abs) of the resulting mixture was measured at 518 nm and converted to percentage antioxidant activity (AA %), using the formula:

$$\mathbf{AA\% = [100-((Abs_{sample}AbS_{blank})\times 100)]/AbS_{blank}}$$

Methanol (1.0ml) plus extract solution (2.5 ml) was used as blank. 1 ml of 0.3mM DPPH plus methanol (2.5ml) was used as a negative control to set the spectrophotometer to zero. Ascorbic acid was used a positive control.

3. LITERATURE REVIEW

Table 2: Literature Review.

S. NO	PLANT NAME	SOLVENT	ACTIVITY	CONCLUSION	REFERENCE
1.	Hygrophila auriculata	Methanol	Anti diabetic	Theantioxidant efficacy of MEHA modulated oxidative in standard senstizied diabetic rat &corrected neuropathic pain by alternating hyperglycemia	B.Jadhav (2024)
2.	Hygrophila auriculata	Methanol	Anti-oxidant	The present study proves that the methanolic extract of H.auriculata is potent antioxidant and antidiabetic it can prove to be valuable source of drug targeting these disease	Archit Rastog (2014)
3.	Hygrophila auriculata	Aqueous extract	Anti nociceptive	The aqueous extract af aerial part and root were screened for	P.Shanmuga -sundaram

				it's anti nociceptive property using both chemical and thermal method for nociceptive in mice	(2005)
4.	Hygrophila auriculata	Ethanol	Aphrodisiac	The Ethanolic extract of H.auriculata showed that evident of anabolic effect is treated animal by gain weight in the body and reproductive organ	(Amaldharma -priya) (Sarvanandaletc human) (2019)
5.	Hygrophila auriculata	Aqueous extract	Antioxidant & Hepato protective	The root extract was also studied for it's in vitroantioxidant activity using ferric thiocyanate and thiobarbituric acid method. The extract exhibit significant hepatoprotective and anti antioxidant	P.Shanmuga -sundaram (2006)
6.	Hygrophila auriculata	Petroleum ether extract	Hematopoi -etic effect	Petroleum ether extraction from H.auriculata increase WBC count significantly. The mixture petroleum: ether: chloroform extract of leaf showed significantly increase erythrocyte count leukocyte count, and hemoglobin count.	L.Sarvanada (2018)
7.	Hygrophila auriculata	Methanol	Cardio protective	The study examine The ability of leaves of H.auriculata to protect against cardiotoxicity caused by using doxorubicin by using methanolic extract of dried powder of leaves	(Vishnu neharkar) (Dr.Girendra -gautam) (2016)
8.	Hygrophila auriculata	Hydro alcoholic extract	Anti cancer	The effect is significant of Hydro - alcoholic extract decrease the size of tumor induced by the carcinogen	SP. Pattanyak, P.Sunita (2008)
9.	Hygrophila auriculata	Methanol	Anti mosquitocidal	These result suggest that a methanol leaf extract has the potential to be used an ideal eco friendly approach for the control of mosquito vector. Therefore this study provide on mosquito egg,l arvae pupae activities of plant methanolic extract against A.stephensi	Balusubash (2019)
10.	Hygrophila auriculata	Ethanol	Analgesic	The Ethanolic extract of H.auriculata show notable analgesic properties in acetic acid induced writhing test a commonly used method for	SM.Faysal -bellahetal, J.Basic clin physiolpharmac ol

				assessing pain reduction	(2017)
11.	Hygrophila auriculata	Ethanol	Cytotoxicity	Cytotoxicity of EEXHs was evaluated by brine Shrimp lethality bioassay widely used for screening of cytotoxic activity	Alireza (2016)

4. DISCUSSION

Hygrophila auriculata (Schumach.) Heine is an important medicinal plant with a long history of use in traditional systems of medicine such as Ayurveda, Siddha, and various indigenous healing practices across India and other parts of South and Southeast Asia. Ethnobotanical evidence highlights its extensive application in the treatment of ailments related to the urinary system, liver disorders, diabetes, inflammation, respiratory conditions, and general debility. The wide range of traditional uses reflects the plant's therapeutic versatility and underscores its cultural and medicinal significance.

Ethnobotanical documentation reveals that different parts of the plant—including seeds, roots, leaves, and the whole herb—are utilized in various formulations such as decoctions, powders, and infusions. This diversity in usage suggests a rich phytochemical profile and indicates that bioactive compounds are distributed throughout the plant. Modern pharmacological studies have increasingly validated many of these traditional claims, demonstrating activities such as antidiabetic, hepatoprotective, diuretic, antioxidant, anti-inflammatory, and antimicrobial effects. The convergence of traditional knowledge with experimental evidence strengthens the credibility of ethnomedicinal practices associated with H. auriculata.

Despite its recognized medicinal value, increasing demand for herbal medicines and raw plant materials poses a significant threat to the natural populations of H. auriculata. Unregulated harvesting, habitat destruction, and lack of cultivation practices have raised concerns regarding its long-term availability. Ethnobotanical surveys often indicate that the plant is predominantly collected from the wild, which may lead to overexploitation and genetic erosion if sustainable practices are not implemented.

Sustainable utilization of H. auriculata therefore becomes a critical aspect of its conservation. Strategies such as controlled harvesting, cultivation in agro-medicinal systems, and community-based conservation programs can help reduce pressure on wild populations. Additionally, promoting awareness among local communities regarding sustainable collection

methods and the ecological importance of the plant can play a vital role in its preservation. Scientific interventions, including micropropagation and phytochemical standardization, may further support sustainable use while ensuring consistent quality of medicinal preparations.

Overall, the integration of ethnobotanical knowledge with scientific research provides a holistic understanding of H. auriculata. However, gaps remain in translating traditional practices into standardized, evidence-based applications, particularly at the clinical level. Addressing these gaps requires interdisciplinary collaboration among ethnobotanists, pharmacologists, conservation biologists, and policymakers.

5. CONCLUSION

The ethnobotanical relevance of Hygrophila auriculata highlights its importance as a valuable medicinal plant with diverse traditional applications and proven pharmacological potential. Indigenous knowledge systems have played a crucial role in identifying its therapeutic uses, many of which are increasingly supported by modern scientific studies. This synergy between traditional wisdom and contemporary research emphasizes the plant's significance in both healthcare and cultural heritage.

However, the growing medicinal demand for H. auriculata necessitates urgent attention toward its sustainable utilization and conservation. Uncontrolled exploitation of natural populations may compromise its availability for future generations. Therefore, sustainable harvesting practices, cultivation initiatives, and community participation should be actively encouraged to ensure long-term conservation.

Future research should focus on standardizing ethnomedicinal formulations, elucidating molecular mechanisms of action, and conducting clinical studies to establish safety and efficacy. By combining ethnobotanical insights with scientific validation and sustainable management practices, Hygrophila auriculata can be effectively conserved and utilized as a promising natural resource for traditional and modern medicine.

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