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Study on diversity and therapeutic potential of aquatic macrophytes in the freshwater bodies of Canchipur, Manipur (India)

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Abstract

The state of Manipur in North-east India is endowed with a rich repository of medicinal and aromatic plants and more over well-known for its diverse culture of human races. This could be due to its climatic condition, perennial rivers, fertile soil and dense forests. Despite of such wide availability of aquatic vegetation, the literature pertaining to the therapeutic utility of these plants is meagre because of their unproductive and impractical nature. Hence, keeping these facts in mind, the present investigation was formulated to study the diversity of aquatic macrophytes of some freshwater bodies of Canchipur and to document their therapeutic potential prevailing among the local community. In the present investigation, thirty two macrophytes were found to have medicinal value, whereas twenty one species were found to be crop related wild species, nine species belonged to wild edible leafy vegetables, three species were wild edible tubers, two species were wild edible seeds and one species belonged to wild edible fruit. The study also revealed the presence of fourteen invasive species, seven species were identified as exotic plants, nineteen species were found to be perennial herbs, fifteen annual herbs, ten perennial aquatic herbs, four aquatic ferns, one semi-aquatic herb and one aquatic bryophyte. The present work will be of immense help to future researchers in evaluating the therapeutic effectiveness or isolated components of these aquatic macrophytes by applying in the field of medicine.

Keywords: Aquatic macrophytes, therapeutic, freshwater, medicine, eutrophication

Introduction

Since time immemorial, human beings have utilised the plant parts like rhizome, stem, roots, fruits, leaves, in various ways for the treatment of different kinds of ailments. Medicinal plants have proved to be an effective protagonist in the health care system, especially in most of the developing nations of the world (Dar *et al.*, 2017) ^[1]. It has also been proved that natural products are better options for their therapeutic effectiveness even comparable to synthetic molecules (Imtiaz *et al.*, 2020; Subramaniyan *et al.*, 2019) ^[2, 3]. The use of medicinal plants can be traced back as early as the Rig-Veda period (4590 BC – 1600 BC) which is perhaps the oldest depository of human knowledge. Over the centuries, the use of medicinal herbs has become an important part of day to day life. According to the WHO more than 80 percent of the world's population relies on traditional herbal medicine for their primary healthcare (Singh *et al.*, 2015; Vijayan *et al.*, 2007) ^[4, 5].

In North-East India, particularly the state of Manipur, since pre-historic days, there are herbal physicians locally known as *Amaiba* (male vaid) who have prescribed and habitually used plants as folk medicine with their mystic invocation. In fact, the art of healing and the knowledge of healing herbs are as old as man. But its progress is far behind as compared to other modern systems of treatment; however, the system of home treatment is accurate with no side effects or after effects like antibiotics of the modern allopathic medicine (Singh, 2013) ^[6]. There have been many reports by different researchers in recent years on folkloric treatment with herbal medicine that are being used to treat different diseases by the people of Manipur *viz.* Yumnam & Tripathi (2012) ^[7]; Yumnam *et al.* (2012) ^[8]; Devi *et al.* (2011) ^[9] and Devi and Singh (2008) ^[10].

Many impressive works done on the aquatic plants of India have been reported by Khusboo *et al* (2021) ^[11]; Pandey and Pandey (2009) ^[12]; Hogeweg and Brenkert (1969a, b) ^[13, 14]; and Kaul and Zutshi (1967) ^[15]. Sporadic mention on the wetland flora of Manipur were made by; Sharma, H.M (2014) ^[16]; Devi, Ch. N (2002) ^[17], Sharma *et al.*, (2002) ^[18] Devi, Ch. U (2000) ^[19]; Sharma *et al.*, 2002 ^[20] and Sharma *et al* (1997, 1998a, b) ^[20, 21, 22]. Aquatic plants are generally considered as menace, but a large number of these plants have medicinal properties which are worth mentioning. Keeping these facts in mind, the present investigation was formulated to study aquatic macrophytes of Canchipur, Manipur and to document their therapeutic potential and remedies which is prevalent among the local community.

Material and methods

The present study was conducted at Canchipur, which is about 7 km from Imphal City and located between 24.75°N Latitude and 93.93°E Longitude. The climate of the study area is sub-tropical, monsoonal with moderate temperature, rainfall and relative humidity and lies at an elevation of 782 m above sea level. Extensive field tours were conducted on monthly basis from January 2021 to January 2022 at randomly selected sites and the macrophytes were identified using standard literature and flora as well as online data resources (www.worldflora.online.org; and www.kew.org) ^[23, 24]. Botanical names, common names, properties, parts and their curative uses were recorded. Data, both oral (Non-

codified) and written form which has relevant findings of aquatic medicinal plants were also consulted.

Results

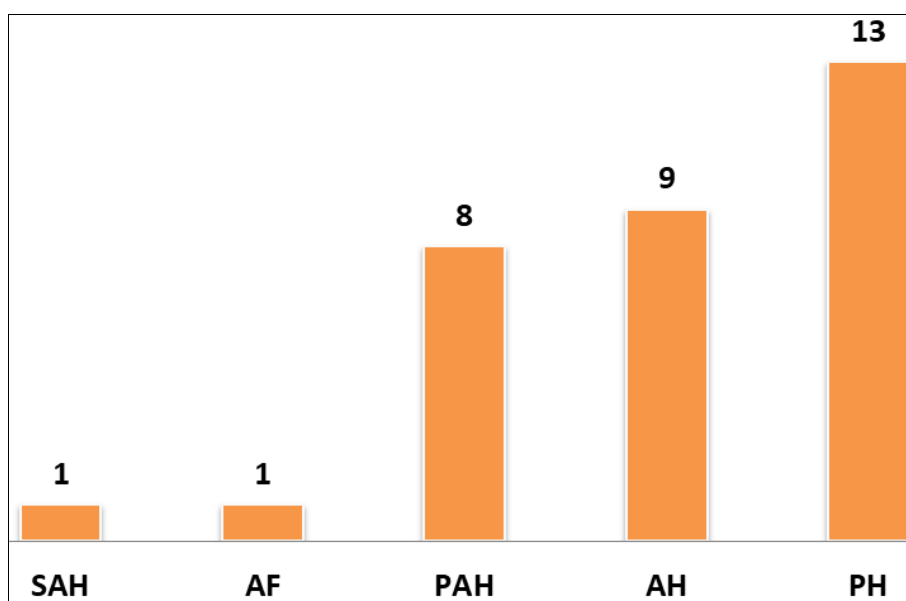
Result of the present investigation is enumerated in Table. A total of 32 aquatic macrophytes of medicinal importance have been recorded from the freshwater bodies of Canchipur. The recorded aquatic plants belonged to 23 families. The families, Apiaceae and Commelinaceae contributed 3 species each, Amaranthaceae, Araceae, Hydrocharitaceae, Nymphaeaceae and Onagraceae contributed 2 species each. Other remaining families were restricted to 1 species only. Again, among the 32 aquatic macrophytes, 5 species were found to be exotic *viz.* *Alternanthera sessiles*, *Aponogeton crispus*, *Alternanthera philoxeroides*, *Enhydra fluctuans* and *Marsilea quadrifolia*. There were 18 Dicots among the aquatic plants followed by 13 Monocots and 1 Pteridophyte. Altogether, there were 13 perennial herbs (PH), 9 annual herbs (AH), 8 perennial aquatic herbs (PAH), 1 semi-aquatic herb (SAH) and 1 aquatic fern (AF). (Fig. 1)

In the present investigation, 11 aquatic plants were found to have anticancer properties, 6 (Antidiabetic), 3 (Diuretic), 3 (Antiviral), 3 (Antidote) and 1 aquatic plant was found to have astringent property. The usage of whole plant for medicinal purposes was found to be 50%, leaves, shoot, stalk, stem and rhizome contributed 41% while fruit, tuber, seed, corm and flower comprised of 9% (Fig. 2).

Table 1: Enumeration of medicinal aquatic macrophytes found in Canchipur, Manipur.

Botanical Name/ Common Name	Nativity	Growth Form	Family	Local Name	Properties	Parts Used	Mode of Use	Uses
<i>Alocasia cucullata</i> (L) Schott (Chinese Taro)	Native	PH	Araceae	Hong-ngoo kakla	Antimicrobial Antioxidant	Leaves & Rhizome	Fresh	Plant juice is used externally for detoxifying viper bite and for treating abscesses, rheumatism & arthritis.
<i>Alternanthera philoxeroides</i> (Mart) Griseb. (Alligator Weed)	Exotic	AH	Amaranthaceae	Kabonapi	Anticancer Antibacterial Antiviral	Leaves	Fresh	Leavers are locally used to remove warts and corns. Poultice of leaves is applied to boils.
<i>Alternanthera sessiles</i> (L) (Brazilian spinach)	Exotic	AH	Amaranthaceae	Phakchet	Anticancer Anthelmintic	Whole plant	Fresh	Fresh young shoots are eaten for night blindness. Paste of the plant is used in snakebite.
<i>Aponogeton crispus</i> Thunb. (Ruffled sword plant)	Exotic	PAH	Aponogetonaceae		Antidiabetic	Whole plant & tubers	Fresh	Decoction of the plant is used to treat burning sensation of the body. Soup of boiled tubers is given to increase urine flow.
<i>Centella asiatica</i> (L) Urban (Indian Pennywort)	Native	PH	Apiaceae	Peruk	Antiepileptic Antidepressant	Whole plant	Fresh	Plant extract is used as an anti-ulcer. It is also used to cure inflammation and irritation of throat as well as diarrhoea.
<i>Colocasia esculenta</i> (L) Schott (Edible Taro)	Native	PH	Araceae	Pallukabi/ Singjupaan	Antihepatotoxic Anticancer Laxative	Leaves & Corn	Fresh	Juice of the leaves is used for the treatment of diarrhoea. Paste of corm is applied on skin disorders.
<i>Commelina benghalensis</i> L. (Tropical spiderwort)	Native	PH	Commelinaceae	Wangdenkhoibi	Carminative Laxative Refrigerant	Whole plant	Fresh	Plant extract along with little honey is effective in cough. Leaf decoction is applied on boils and burns.
<i>Commelina longifolia</i> Lam. (Longleaved Dayflower)	Native	PH	Commelinaceae	Wangdenkhoibi	Antibacterial Antifungal Diuretic	Stem & Leaves	Fresh	The paste of stem and leaves is used in bone fracture.
<i>Cyperus rotundus</i> L. (Nutgrass, Nutsedge)	Native	PH	Cyperaceae	Sembang Kouthum	Anticancer Antiviral	Rhizome	Fresh	The juice of the rhizome is a good remedy for indigestion, skin diseases and insect bites.
<i>Enhydra fluctuans</i> Lour. (Water spinach)	Exotic	AH	Asteraceae	Komprek Tujombi	Analgesic Antimicrobial	Leaves & Shoot	Fresh	Boiled leaf extract is taken twice a day to cure calculus and diarrhoea. Shoot extract is given as antidote to flood poisoning.
<i>Euryale ferox</i> Salisb. ex K.D. Koenig & Sims (Foxnut or Gorgon Fruit)	Native	PH	Nymphaeaceae	Thangjing	Astringent Antidiabetic Antioxidant	Leaf Petiole & Fruit	Fresh	Leaf paste is applied on burns and boils. Fruits help in keeping the blood pressure in control.
<i>Hydrilla verticillata</i> (L.f.) Royle (Water thyme)	Native	PAH	Hydrocharitaceae	Charang	Antimicrobial Antioxidant Antitumour	Whole plant	Fresh	Plant aqueous extract is used as antidepressant and immune booster.
<i>Hydrocotyle javanica</i> Thunb. (Water pennywort)	Native	AH	Apiaceae	Awaperuk	Anti-inflammatory Anticancer	Whole plant	Fresh	Plant extract is used to cure sore throat, gastritis and constipation.
<i>Hygroryza aristata</i> (Retz) Nees. ex. Wight & Arn (Asian water grass)	Native	PH	Poaceae		Anthelmintic Galactagogue	Whole Plant	Fresh	Decoction of the plant is used in diarrhoea and general weakness
<i>Ipomoea aquatica</i> Forsk. (Water spinach)	Native	SAH	Convolvulaceae	Kankong	Anthelmintic Antidiabetic	Leaves & Floral bud	Fresh	Poultice of floral buds are used in skin diseases. Boiled leaf extract is used in constipation.
<i>Limnophila sessiliflora</i> (Vahl) Blume (Asian marsh weed)	Native	AH	Plantaginaceae		Antioxidant Antimicrobial	Leaves	Fresh	Fresh juice of the leaves is given in dysentery & dyspepsia.

<i>Lindernia crustacea</i> (L.) F. Muell (Brittle Malay impernel)	Native	AH	Linderniaceae		Emetic Cathartic	Shoot & stem	Fresh	Fresh juice of the shoot and stem is used as an analgesic and antipyretic.
<i>Ludwigia adscendens</i> (L.) H. Hara (Water primrose)	Native	PH	Onagraceae	Ishing kundo	Febrifuge Anti-inflammatory	Whole plant	Fresh	Plant extract is used in skin and throat infections.
<i>Ludwigia octovalvis</i> (Jacq.) Raven (Yellow primrose)	Native	PH	Onagraceae	Ishing kundo	Antibacterial Anticancer Antidiabetic	Whole plant	Fresh	Poultice of leaves is used in headache. Boiled extract of the whole plant is used in diabetes.
<i>Marsilea quadrifolia</i> L. (Water clover)	Exotic	AF	Marsileaceae	Ishing Yenshang	Antidote Diuretic	Leaf & Stem	Fresh	Juice of leaf and stem is used in diarrhoea, applied on snake bite and abscesses.
<i>Monochoria hastata</i> (L.) Soms (Arrowleaf pondweed)	Native	PH	Pontederiaceae	Uren laba/ Kabokang laba	Antioxidant Anti-nephrotoxic	Leaf & Rhizome	Fresh	Juice of leaf is applied to boils. Rhizome is mixed with charcoal & applied to scurf.
<i>Murdannia nudiflora</i> (L.) Brenan (Dove weed, Naked stem dew flower)	Native	AH	Commelinaceae	Tandal pambi	Anticancer Analgesic	Whole plant and roots	Fresh	The plant paste is locally used to cure piles. Root paste with goat milk is taken orally to cure asthma.
<i>Nelumbo nucifera</i> Gaertn (Indian or sacred lotus)	Native	PAH	Nelumbonaceae	Thambal	Diuretic Anthelmintic Antidote	Leaf, stem, seed and flower	Fresh	Petiole is eaten as remedy for stomach ulcer. Flowers are useful in vertigo. Seek kernel is eaten raw to enhance eye vision.
<i>Nymphoides hydrophylla</i> (Loureiro) Kuntze (White water snowflake or crested floating heart)	Native	PAH	Menyanthaceae	Tharo angouba	Anthelmintic Hepatoprotective	Leaves & Stalk	Fresh	Fresh leaf & stalk extract is used to cure parasitic infection, fever and jaundice.
<i>Nymphaea stellata</i> Willd. (Water nymph)	Native	PAH	Nymphaeaceae	Thariktha	Dyspepsia Erysipelas	Whole plant	Fresh	Flower decoction is used in diarrhoea, piles. Stem and rhizome infusion is used in urinary tract infections.
<i>Oerantha javanica</i> (Blume) De (Water dropwort or water celery)	Native	PH	Apiaceae	Komprek	Anticancer Anticoagulant Antiviral	Leaf and Shoot	Fresh	Decoction of leaf & shoot is used as an antifatigue, appetizer and helps in digestion.
<i>Polygonum glabrum</i> Willd (Marsh Buckwheat)	Native	AH	Polygonaceae	Chaokhong	Antipyretic Anti-inflammatory	Whole plant & roots	Fresh	Juice of leaves is used in colic pain. Juice of whole plant along with rootstock is used in fever and jaundice.
<i>Potamogeton crispus</i> L. (Curly Pondweed)	Native	PAH	Potamogetonaceae	Charang	Anticancer Immuno-regulator	Leaves	Dried & Fresh	Infusion of dried leaves is taken to cure kidney problems. Fresh juice of leaves is given in jaundice.
<i>Rotala rosea</i> (Poir) C.D.K. Cook (Rosy Rotala)	Native	AH	Lythraceae	Loubuk leiri	Antidiuretic Anthelmintic Antipyretic	Whole plant	Fresh	Decoction of the whole plant is found to be effective in renal or urinary calculi. Leaf extract is used to cure herpetic eruptions.
<i>Sagittaria sagittifolia</i> L. (Arrowhead)	Native	PH	Alismataceae	Koukha	Anticancer Antiviral Antioxidant	Leaf & Roots	Fresh	Poultice of leaves is applied in itching. Fresh root paste is taken along with honey to cure sore throat.
<i>Trapa natans</i> L. (Water chestnut)	Native	PAH	Trapaceae	Heikak	Antidiabetic Antifungal Analgesic	Leaves, stalk & fruit	Fresh	Plant extract is used to enhance blood circulation and to cure leucorrhoea. Fruits act as an appetiser and help to cure constipation.
<i>Vallisneria spiralis</i> L. (Eel graas)	Native	PAH	Hydrocharitaceae	Ishing Yensum/ Lairenchak	Antidiabetic Anticancer	Whole Plant	Fresh	The whole plant is boiled with sugar candy and about 20 ml is taken daily to cure diabetes.



SAH=Semi-Aquatic Herb; AF=Aquatic Fern; PAH=Perennial Aquatic Herb, AH=Annual Herb; PH=Perennial Herb

Fig 1: Growth form of the medicinal aquatic macrophytes

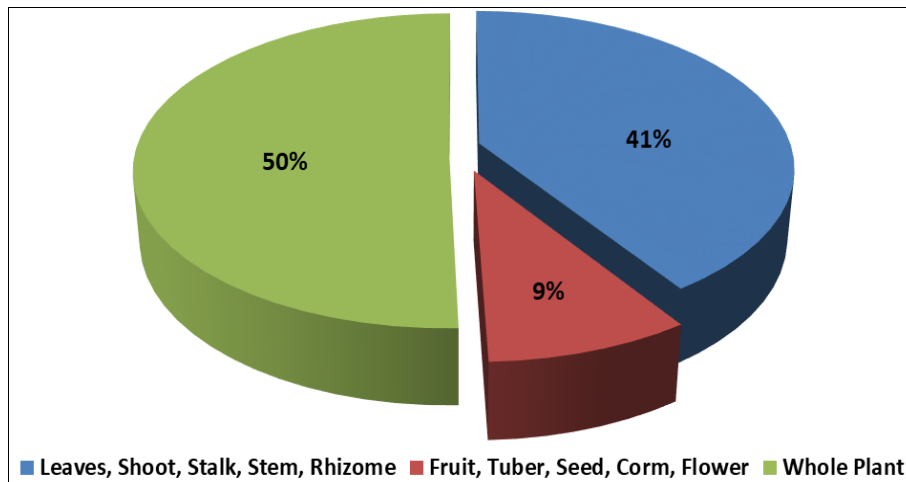


Fig 2: Percentage use of different plant parts

Discussion

It is a well-known fact that freshwater bodies around the globe is shrinking rapidly and hence their resources both plants and animals are depleting in the same pace (Jain *et al.*, 2007) [25]. Needless to say, it is also a matter of grave concern that land use pattern in Canchipur is changing fast and water bodies are soft target of this change. The survival of aquatic plant diversity is threatened both species wise and population wise. Almost same concern has been expressed by other workers, *viz.* Devi, AR, *et al.* (2019) [26], Devi, O.A. *et al.* (2021) [27] and Yadav, T (2021) [28], Bhumia and Mandal (2009) [29].

Freshwater bodies not only provide useful resources for maintaining the ecology and climate of the region, but they also harbour many medicinal aquatic plants used in the treatment of common diseases by the local people like cold, fever, sore throat, jaundice, insect bite, indigestion, stomach ache, etc. Therefore, conservation of these freshwater bodies needs to be addressed urgently so that highly useful aquatic plants can be saved and protected. It is also noteworthy to mention that most of the traditional uses of aquatic plants are novel and they need popularization, preservation and documentation.

Several freshwater ecosystems are drying due to climatic condition and transmute into other landforms such as paddy fields, human settlements, a land modification for developmental purposes, and indirectly by rainfall shifting patterns. It is suggested that a strenuously participatory approach is very much essential for the sustainable management of freshwater bodies. To accomplish the said objective, there needs to be a well-thought-out protocol for community linkages so that necessary training can be imparted for them.

Conclusion

The present investigation would provide a scope for future researchers and pharmacologists to discover plant based novel drugs with minimal side effects and maximal therapeutic values. These aquatic medicinal plants also need a proper evaluation on chemical, pharmacological properties through elaborate studies and clinical trials for the validation of their therapeutic efficacy. The interactions between researchers and local community have brought a sense of understanding as well as their orally handling down traditional practices for the cure and management of various diseases and ailments. A joint holistic approach between the

researchers and local community is very much necessary for the conservation and protection of such invaluable resources to enhance the population of the threatened aquatic medicinal plants in their natural habitat for the wellbeing of future generation

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