

Ethnobotanical Plants of Phumdi, Loktak Lake, Manipur, India

Rajkumari Supriya Devi¹, Kunja Bihari Satapathy¹, Sanjeet Kumar^{2*}

ABSTRACT

Loktak is the largest natural freshwater lake in the North-Eastern region of India playing an important role in the ecological and economic security of the region. It is also known for "Phumdi," a heterogeneous mass of soil, vegetation and organic matter at various stages of decomposition. For the fishing purposes, local communities make a ring with "Phumdi" mass called "Athaphum" measuring 500 ft in diameter, a traditional practice popular since last 200 years. It is further interesting to report that these also harbor a rich flora of medicinal herbs. Keeping the importance of its medicinal wealth, an attempt was made to survey 20 different "Athaphum" of the lake to explore and document the diversity of medicinal plants of the fresh water lake. Extensive floristic survey in the study area revealed the occurrence of over 89 plant species in and around "Athaphum" and "Phumdis." Among them, five plants (*Blumea mollis*, *Ludwigia repens*, *Rumex nepalensis*, *Oenanthe javanica*, and *Carex riparia*) were selected for phytochemical screening to validate their therapeutic claims. All the selected plants were found to be enriched with phenolic compounds. On the basis of their ethnobotanical claims and results of phytochemical analysis, *R. nepalensis* and *O. javanica* could be recommended as potential nutraceutical for being a popular food plant among the local inhabitants.

Keywords: Nutraceutical, Secondary metabolites, Traditional therapeutic values, Wetlands
Asian Pac. J. Health Sci., (2022); DOI: 10.21276/apjhs.2022.9.4.16

INTRODUCTION

Loktak lake is the largest natural freshwater lake in the north-eastern region of India and plays an important role in the ecological and economic security of the region. People of Manipur are socially, economically, culturally and ecologically connected with the lake.^[1-4] The lake has been the source of water for domestic generation of hydro-electric power, irrigation, habitat for several plants used as food, fishing ground for local people, fodder, fuel, medicines, recreation etc. Hence, it has been referred to as the "Lifeline of Manipur." It is also known for its floating island "Phumdi" which is mainly made up of plant biomass. The main plants grown in "Phumdi" are *Phragmites* and paragrass, besides sparsely developed other plants such as *Mikania* and *Colocasia*.^[4] Indigenous people make use of the hard matured "Phumdi" to make an artificial ring locally known as "Athaphum" [Figure 1] which is mainly constructed for the purpose of fishing and one athaphum is owned by a particular family at a time or shared among two or three families. The matured phumdi of thickness 1.5 ft is cut with 5ft wide and joined to form a ring structure of 500 ft in diameter.^[5] The ringed masses of Phumdi (Plate 1.5) are the home of many floral wealth.^[6-9] The local communities use them for different purposes for which the present attempt has been made to enumerate the floral wealth available in and around Athaphum and phytochemical analysis of selected plants. The present study highlights the medicinal plant wealth available in and around Athaphum for their further application in drug discovery.

MATERIALS AND METHODS

Floristic survey was carried out in different seasons during 2017–2019 in Loktak lake [Figure 2], Manipur. The collected plant specimens were identified in consultation with available literature and recent publications.^[6-9] For ethnobotanical information, Passport Data Form (PDF) was used, developed by Biodiversity and

¹School of Applied Sciences, Centurion University of Technology and Management, Bhubaneswar, Odisha, India

²Biodiversity and Conservation Lab., Ambika Prasad Research Foundation, Bhubaneswar, Odisha, India

Corresponding Author: Sanjeet Kumar, Biodiversity and Conservation Lab., Ambika Prasad Research Foundation, Bhubaneswar, Odisha, India. Email: sanjeet.biotech@gmail.com

How to cite this article: Devi RS, Satapathy KB, Kumar S. Ethnobotanical Plants of Phumdi, Loktak Lake, Manipur, India. *Asian Pac. J. Health Sci.*, 2022;9(4):77-80.

Source of support: Nil

Conflicts of interest: None

Received: 12/02/22 **Revised:** 18/03/22 **Accepted:** 20/04/22

Conservation Lab., Ambika Prasad Research Foundation, Odisha and methodological framework was followed as per standard technique of ethnobotanical approaches of Christian and Brigitte (2004).

Collection of Selected Plants for Experimental Work

The samples were collected from different Athaphum of Loktak lake (24° 48' 22.67" N; 93° 56' 53.5" E), Manipur and kept in poly bags tagged with the botanical name and sorted out as per standard sampling procedure and passport description.^[10]

Preparation of Extracts

Soxhlet method and percolation were adopted to obtain the different extracts.^[11-13] The collected experimental plant materials were dried at room temperature under shade and were powdered after drying using mechanical devices. The powdered material of the experimental plants was kept in thimble and extraction was carried out using the Soxhlet apparatus. The residues were

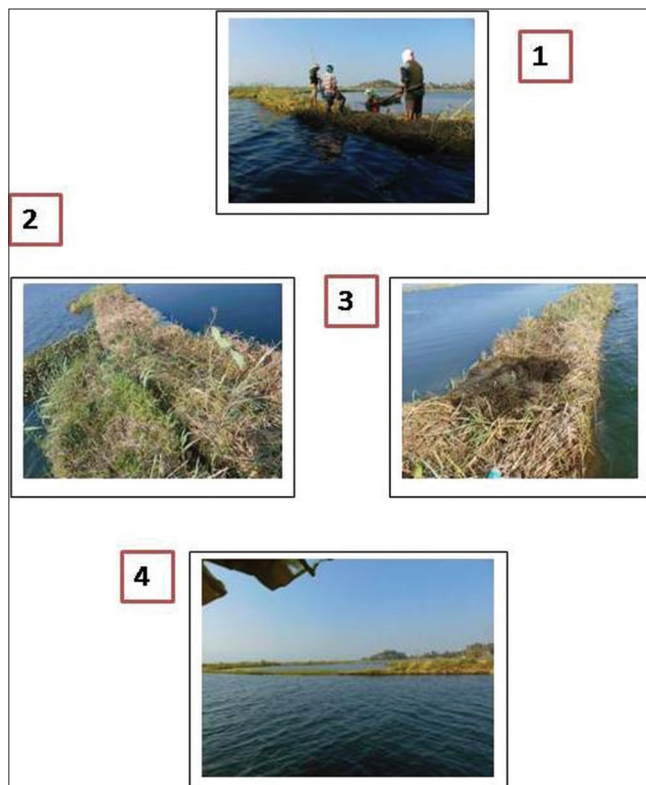


Figure 1: Formation of Athaphum, (1) Collection of Biomass; (2-3) Making ring; (4) Ringed biomass in the form of Athaphum

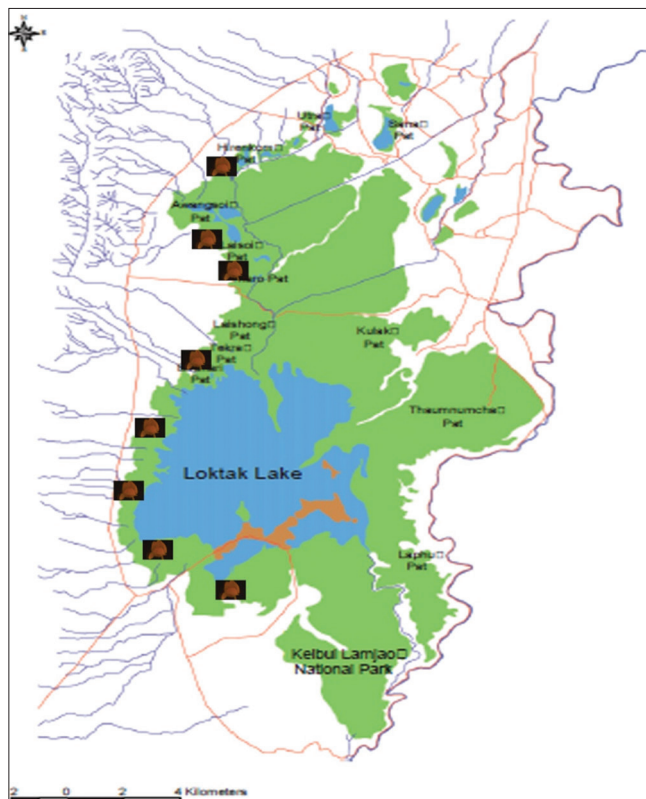


Figure 2: Geographical location of study areas and collection sites

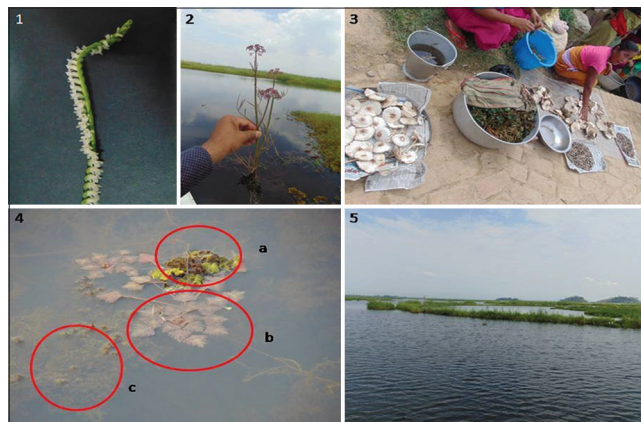


Plate 1: Survey for floral diversity and ethnobotanical data collection in Loktak lake: (1) *Spiranthes spiralis*, (2) *Oenanthe javanica*, (3) Local community selling vegetative parts of *Trapa natans*, (4) a: *Salvinia cucullata*; b: *Trapa natans*; c: *Hydrilla verticillata*, 5) Athaphum in Loktak lake, Manipur

collected and left for air drying and dried crude extracts were stored in refrigerator for further phytochemical analysis and antibacterial activities.

Phytochemical Analysis

Phytochemical analyses were carried using standard procedure to identify the bioactive compounds^[14] as per polarity index.

RESULTS AND DISCUSSION

Loktak lake being the life line of Manipur provides all life stuffs to the populace of the state and maintain the ecological balance of Indo-Burma Biodiversity hotspot of the country. The survey and experimental works unwind the diverse things.

Floral Diversity

The data collected during the floristic survey revealed that about 89 plant species naturally occur that belong to 67 genera and 28 families [Table 1]. Among them, 47 species were herbs, 14 grass species, four floating herb, seven shrubs, and one parasitic plant. Further, it is reported that a rich population of one aquatic orchid (*Spiranthes spiralis*: Plate 1.1) and two carnivorous plants [*Utricularia aurea* & *U. exoleta*: Table 1] are also found. Tuboi and co-workers in 2012.^[15] Also reported 185 plant species from Keibul Lamjao National Park, Manipur.

Ethnomedicinal Practices

The questionnaire with local people using PDF revealed that different plant species found in “Phumdis” and “Athaphum” were used as food as well as medicine. The data on ethnobotanical survey revealed (Plate 1.3) that *Centella asiatica*, *O. javanica* (Plate 1.2), *Euryale ferox*, *Alpinia galanga*, *Alternanthera philoxeroides*, *Alternanthera sessilis*, *Commelina benghalensis*, *Hedychium coronarium*, *Ipomoea aquatica*, *Rumex nepalensis*, and *Trapa natans* (Plate 1.4b) were used as food. It was observed that leaves of *C. asiatica*, *C. benghalensis*, *I. aquatica* and *R. nepalensis*

Table 1: Diversity of plant species in and around "Phumdi" and "Athaphum"

| Botanical name | Family | Habitat |
|--|------------------|----------------------------|
| <i>Acmella paniculata</i> (Wall. ex DC.) R.K. Jansen | Asteraceae | Herb |
| <i>Acorus calamus</i> L. | Araceae | Herb |
| <i>Ageratum conyzoides</i> (L.) L. | Asteraceae | Herb |
| <i>Alocasia macrorrhiza</i> Schott | Araceae | Shrub |
| <i>Alpinia galanga</i> (L.) Willd. | Lythraceae | Herb |
| <i>Alternanthera philoxeroides</i> (Mart.) Griseb. | Amaranthaceae | Herb |
| <i>Alternanthera sessilis</i> (L.) R.Br. ex DC. | Amaranthaceae | Herb |
| <i>Amomum aromaticum</i> Roxb. | Zingiberaceae | Herb |
| <i>Garnotia stricta</i> Brongn | Poaceae | Grass |
| <i>Argyria nervosa</i> (Burm.f.) Bojer | Convolvulaceae | Grass |
| <i>Arundo donax</i> L. | Poaceae | Grass |
| <i>Azolla pinnata</i> R.Br. | Salviniaceae | Floating herb |
| <i>Blumea mollis</i> (D. Don). Merr. | Asteraceae | Herb |
| <i>Brachiaria mutica</i> (Forssk.) Stapf. | Poaceae | Grass |
| <i>Carex riparia</i> Curtis. | Cyperaceae | Herb |
| <i>Centella asiatica</i> (L.) Urb. | Apiaceae | Herb |
| <i>Ceratophyllum demersum</i> L. | Ceratophyllaceae | Herb |
| <i>Cissampelos pareira</i> L. | Menispermaceae | Climber |
| <i>Alocasia cucullata</i> (Lour.) G.Don. | Araceae | Herb |
| <i>Commelina benghalensis</i> L. | Commelinaceae | Herb |
| <i>Cuscuta reflexa</i> Roxb. | Convolvulaceae | Climber |
| <i>Cynodon dactylon</i> (L.) Pers. | Poaceae | Grass |
| <i>Cyperus difformis</i> L. | Cyperaceae | Herb |
| <i>Cyperus haspan</i> L. | Cyperaceae | Herb |
| <i>Cyperus iria</i> L. | Cyperaceae | Herb |
| <i>Cyperus rotundus</i> L. | Cyperaceae | Herb |
| <i>Dactyloctenium aegyptium</i> (L.) Willd. | Poaceae | Grass |
| <i>Euryale ferox</i> Salisb. | Nymphaeaceae | Aquatic herb |
| <i>Eclipta prostrata</i> (L.) L. | Asteraceae | Herb |
| <i>Eichhornia crassipes</i> (Mart.) Solms | Pontederiaceae | Herb |
| <i>Emilia sonchifolia</i> (L.) DC. ex DC. | Asteraceae | Herb |
| <i>Enhydra fluctuans</i> Lour. | Asteraceae | Herb |
| <i>Fagopyrum esculentum</i> Moench. | Polygonaceae | Climber |
| <i>Fuirena umbellata</i> Rottb. | Cyperaceae | Herb |
| <i>Gynura cusimbua</i> (D.Don) S.Moore. | Asteraceae | Herb |
| <i>Hedychium coronarium</i> J. Koenig | Zingiberaceae | Shrub |
| <i>Hydrilla verticillata</i> (L.f.) Royle. (Plate 1.4c) | Hydrocharitaceae | Submerged floating herb |
| <i>Imperata cylindrica</i> (L.) Raeusch. | Poaceae | Grass |
| <i>Ipomoea alba</i> L. | Convolvulaceae | Climber |
| <i>Ipomoea cairica</i> (L.) Sweet. | Convolvulaceae | Climber |
| <i>Ipomoea aquatica</i> Forssk. | Convolvulaceae | Climber |
| <i>Jussiaea repens</i> L. | Onagraceae | Herb |
| <i>Kyllinga brevifolia</i> Rottb. | Cyperaceae | Herb |
| <i>Lemna minor</i> L. | Lemnaceae | Herb |
| <i>Leersia hexandra</i> Sw. | Poaceae | Grass |
| <i>Limnophila aquatica</i> (Roxb.) Alston | Plantaginaceae | Herb |
| <i>Limnophila aromatica</i> (Lam.) Merr. | Plantaginaceae | Herb |
| <i>Limnophyton obtusifolium</i> (L.) Miq. | Alismataceae | Shrub |
| <i>Lindernia procumbens</i> (Krock.) Philcox. | Linderniaceae | Herb |
| <i>Ludwigia adscendens</i> (L.) H.Hara. | Onagraceae | Herb |
| <i>Ludwigia octovalvis</i> (Jacq.) P.H. Raven. | Onagraceae | Shrub |
| <i>Ludwigia repens</i> J.R. Forst. | Onagraceae | Herb |
| <i>Marsilea minuta</i> L. | Marsileaceae | Herb |
| <i>Melastoma malabathricum</i> L. | Melastomataceae | Shrub |
| <i>Merremia aegyptia</i> (L.) Urb. | Convolvulaceae | Climber |

(Contd...)

Table 1: (Continued)

| Botanical name | Family | Habitat |
|--|------------------|----------------------------|
| <i>Mikania cordata</i> (Burm.f.) B.L. Roxb. | Asteraceae | Climber |
| <i>Mikania micrantha</i> Kunth. | Asteraceae | Climber |
| <i>Mikania scandens</i> (L.) Willd. | Asteraceae | Climber |
| <i>Mimosa pudica</i> L. | Mimosaceae | Herb |
| <i>Oenanthe javanica</i> (Blume) DC. | Apiaceae | Herb |
| <i>Parthenium hysterophorus</i> L. | Asteraceae | Shrub |
| <i>Persicaria sagittata</i> (L.) H. Gross. | polygonaceae | Climber |
| <i>Phragmites karka</i> (Retz.) Trin ex. Steud. | Poaceae | Grass |
| <i>Pistia stratiotes</i> L. | Araceae | Herb |
| <i>Polygonum barbatum</i> L. | Polygonaceae | Herb |
| <i>Polygonum capitatum</i> Buch.-Ham. ex. D.Don. | Polygonaceae | Herb |
| <i>Polygonum hydropiper</i> L. | Polygonaceae | Herb |
| <i>Polygonum odoratum</i> Lour. | Polygonaceae | Herb |
| <i>Polygonum perfoliatum</i> L. | Polygonaceae | Herb |
| <i>Polygonum persicaria</i> L. | Polygonaceae | Herb |
| <i>Polypogon monspeliensis</i> (L.) Desf. | Poaceae | Grass |
| <i>Polystichum</i> sp. | Dryopteridaceae | Herb |
| <i>Ranunculus sceleratus</i> L. | Ranunculaceae | Shrub |
| <i>Rotala rotundifolia</i> (Buch.-Ham. ex Roxb.) Koehne | Lythraceae | Herb |
| <i>Rumex maritimus</i> L. | Polygonaceae | Herb |
| <i>Rumex nepalensis</i> Spreng. | Polygonaceae | Herb |
| <i>Saccharum spontaneum</i> L. | Poaceae | Grass |
| <i>Sacciolepis indica</i> (L.) Chase. | Poaceae | Grass |
| <i>Sagittaria sagittifolia</i> L. | Alismataceae | Herb |
| <i>Salvinia cucullata</i> Roxb. (Plate 1.4a) | Salvinaceae | Floating herb |
| <i>Salvinia natans</i> (L.) All. | Salvinaceae | Floating herb |
| <i>Setaria</i> sp. | Poaceae | Grass |
| <i>Spiranthes spiralis</i> (L.) Chevall. | Orchidaceae | Aquatic ground orchid |
| <i>Trapa natans</i> L. | Trapaceae | Floating herb |
| <i>Utricularia exoleta</i> R.Br. | Lentibulariaceae | Carnivorous herb |
| <i>Utricularia aurea</i> Lour. | Lentibulariaceae | Carnivorous herb |
| <i>Vallisneria spiralis</i> L. | Hydrocharitaceae | Submerged floating herb |
| <i>Zizania latifolia</i> (Griseb.) Turcz. ex Stapf. | Poaceae | Grass |

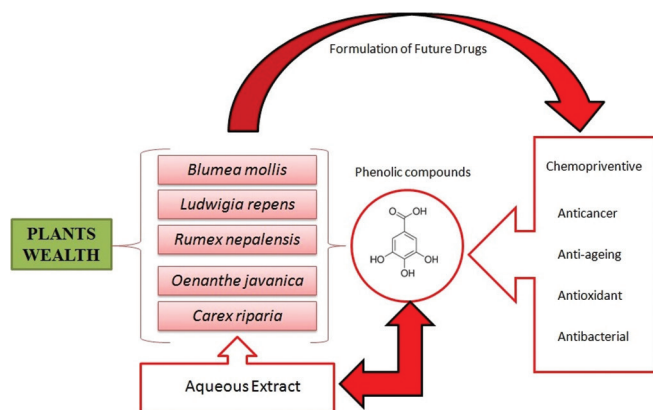
are cooked as leafy vegetables whereas whole plant of *O. javanica* is consumed as a salad, rhizome of *A. galanga* and *H. coronarium* is cooked as vegetables. The fruits of *T. natans* are consumed raw and stem is used to make pickle. *H. coronarium*, *Acorus calamus*, *Ageratum conyzoides*, *Argyria nervosa*, *Blumea mollis*, *Carex riparia*, *C. asiatica*, *Eclipta alba*, *Ludwigia adscendens*, *Mimosa pudica*, and *T. natans* were used for medicinal purposes. It was noted that the juice of rhizome of *H. coronarium* and *A. calamus* is used as tonic; the leaves paste of *A. conyzoides*, *A. nervosa*, *B. mollis*, *E. alba*, *M. pudica*, and *L. adscendens* are applied externally against skin infections. The whole plant of *C. riparia* and stem of *T. natans* are macerated with water and juice is used against gastric problems. *Arundo donax* and *Phragmites karka* are used as fuel while *Zizania latifolia*, *Polygonum barbatum*, *Limnophila aromatica* and *A. philoxeroides* are used as fodder.

Phytochemical Screening

Keeping in view the species richness and its ethnic claims, *B. mollis*, *Ludwigia repens*, *R. nepalensis*, *O. javanica*, and *C. riparia*

Table 2: Qualitative analysis of secondary metabolites present in selected ethnomedicinal plants of Loktak lake, Manipur

| Plant name | Solvent | Bioactive compounds detected |
|--------------------------|----------|---|
| <i>Blumea mollis</i> | n-hexane | Not detected |
| | Methanol | Tannin, Flavonoids, and Phenolic compounds |
| <i>Carex riparia</i> | Aqueous | Tannin, Flavonoids, Saponin, and Phenolic compounds |
| | n-hexane | Not detected |
| <i>Ludwigia repens</i> | Methanol | Phenolic compounds |
| | Aqueous | Tannin and Phenolic compounds |
| <i>Oenanthe javanica</i> | n-hexane | Not detected |
| | Methanol | Phenolic compounds |
| <i>Rumex nepalensis</i> | Aqueous | Flavonoids and Phenolic compounds |
| | n-hexane | Not detected |
| | Methanol | Tannin, Flavonoids, Saponin, and Phenolic compounds |
| | Aqueous | Tannin, Flavonoids, Saponin, and Phenolic compounds |

**Figure 3:** Plant wealth of Loktak lake: Source of bioactive compounds

were selected for qualitative analysis of bioactive compounds. The results of phytochemical analysis confirmed the presence of phenolic compounds in all the plants extracts [Table 2] indicating that the extracts might be having chemo preventive properties, antioxidant,^[16] anticancer, anti-inflammatory, organoleptic properties,^[17] molecular anti-cancer mechanisms, and anti-bacterial activity.^[18]

CONCLUSION

World's only floating lake, Loktak is considered as the lifeline of Manipur state of India. Phumdi, a heterogenous mass of biotic and abiotic components and Athaphum, a ringed mass of such bio-wealth is the heart of the lake and a good repository of many plant species. About 89 species of plants are available in and around of Athaphum which is used in different purposes by the local communities. The plants have medicinal values and possess diverse bioactive compounds such as saponin, tannin, and phenolic compounds. Due to presence of diverse secondary metabolites, they could be used to formulate new drugs to fight against lethal diseases as well as antimicrobial agents [Figure 3].

ACKNOWLEDGMENTS

The authors are thankful to the authorities of Centurion University of Technology and Management, Odisha and office-in-charge, Ambika Prasad Research Foundation, Regional Centre, Imphal, Manipur, for providing facilities to conduct the investigation.

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