

MEDICO-BIOWEALTH OF INDIA

VOL-IX

ASHISH PATEL
SANJEET KUMAR



**APRF
PUBLISHERS**



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Vol. IX

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Title: Medico-Biowealth of India Vol. IX

Published By:

APRF Publisher

Cuttack, Odisha

Pin: 753014, Odisha,

India

www.aprf.co.in

Medico-Biowealth of India Vol. IX

First Edition: 2023

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Cover Page: *Pentanema indicum*, *Ipomea vitifolia*

Back Page: *Polygala crotalarioides*

ISBN: 978-81-962761-8-8



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Dedicated to

*All nature lovers, botanists, academicians, or
anyone who seeks to learn the bioresources of
India with medicinal values*

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BACKGROUND

Medico-Biowealth of India is a series of edited books published by APRF Publishers under the Ambika Prasad Research Foundation, India. The aim of the publication is to document the traditional knowledge of India for the preservation of Indigenous Traditional Knowledge (ITK) and create awareness about it. Medicinal plants play an important role in primary health care systems. They also provide nutraceuticals, which are highly demanded in contemporary situations throughout the world. Therefore, documentation of such bio-wealth is an important task for us, and we are doing the same for sustainable development and utilization. The series also brings together the different researchers in the country. In this book, seven chapters are published by 27 researchers from different states of India. The authors have documented the implications of *Phlogacanthus thyrsoformis* for ethnobotanical use by the Karbi tribe of Karbi Block in Biswanath Chariali, Sonitpur district, Assam, India; Less known ethnomedicinal plants of India; climbing plants with special reference to their ecological and medicinal importance; Plants used against fungal infections: sources of future drugs; *Houttuynia cordata* Thunb.: A potential nutraceutical herb; *Alocasia indica* (Lour.) Spach: A potential nutraceutical wetland flora; Pollination in the Cucurbitaceae family and medicinal uses of selected cucurbits. The documentation will be helpful in designing the experimental works and value addition.

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Implications of *Phlogacanthus thyrsiformis* for Ethnobotanical use by Karbi tribe of Karbi Block in Biswanath Chariali, Sonitpur district, Assam, India

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DOI: <https://doi.org/10.5281/zenodo.8246544>

Abstract: A survey of plants consumed as vegetables by the Karbi tribe of Karbi Block in Biswanath Chariali, Sonitpur, Assam, India, was carried out during November 2022–February 2023. A wide variety of vegetables were identified. Out of the identified vegetables, *Phlogacanthus thyrsiformis* (Roxb. ex Hardw.) Mabb. was among the ones with great ethnobotanical value. In the present study, emphasis was given to investigating the local name, plant part consumed, mode of consumption, and ethnobotanical use of *P. thyrsiformis* by Karbis of Karbi Block, Biswanath Chariali, and Sonitpur district in Assam.

Keywords: North-East, Assam, Vegetable, Karbi, Tribe, Ethnobotany

Introduction: The need for proper nutrition or adequate diet and medications is of utmost necessity for mankind because of the rise in diseases and disorders in the present-day world. Vegetable, being a principal component of the human diet is enriched with high nutrients as they constitute a dynamic composition of proteins, minerals, vitamins, dietary fibres, and some significant bioactive markers. Hence, vegetables play a crucial role in maintenance of our good health. A healthy diet must include an intake of at least 400 g (five servings) of fruit and vegetables each day, omitting potatoes, sweet potatoes, cassava, and starchy roots (World Health Organization, 2003). When a healthy diet is maintained, it prevents occurrence of a number of non-communicable diseases (NCDs) and illnesses, as well as malnutrition (World Health Organization, 2003). When choosing food, taste is crucial. Since taste is one of the basic senses, it helps in our assessment of food and enables us to distinguish between foods that are safe for our consumption and those that are not. Every human being is born with a universal preference for sweetness and dislike for bitterness (Liem & Russell 2019). However, not everyone dislikes the bitter taste of food. There is a common belief that vegetables which have bitter-tasting compounds are often associated with more positive health benefits. Alkaloids, terpenoids and their glycosides (saponins) as well as some amino acids and peptides are responsible for bitter taste in vegetables (Izawa et. al., 2010). It is believed that the bitter compounds of vegetables have some level of toxicity, yet consuming them in a right proportion have so many beneficial effects to the human body (Izawa et. al., 2010). Assam located in North-Eastern part of India and being situated within Indo-Burma biodiversity hotspot (Myers et. al., 2000), houses a rich diversity of tropical fruits and vegetables. There are many plants that are native to the region. The state is inhabited by diverse group of tribes like Bodo, Rabha, Mising, Deori, Tiwa, Karbi, Sonowal, Dimasa etc. (Bhattacharyya & Bhattacharyya 2016). There always has been a strong relationship between tribals and rural people with “Ethnobotany” or with plant wealth. The tribal communities illustrate

distinct food habits. They consume plants as vegetable that grow in wild habitat and this forms a part of their regular diet. The Karbi inhabitants of Karbi Block in Biswanath Chariali, Sonitpur district, Assam consume a wide array of vegetables that have ethnobotanical uses. *Phlogacanthus thyrsiformis* (Roxb. ex Hardw.) Mabb., known as “Tita bahek”/ “Tita phool” in Assamese language and “Jok-aan” in Karbi language is one among the plants that has both medicinal as well as food value and well known for its bitter taste. It is also reported to have anti-microbial properties (Singh & Singh, 2010), analgesic activities (Mukherjee et. al., 2009) and anti-hyperglycaemic activity (Chakravarty & Kalita, 2012). Although the plant is not usually cultivated in large scale like other vegetables viz. potato, brinjal, tomato etc., but it is consumed as vegetable by tribal as well as non-tribal communities in Assam because of its medicinal value. This species' native range extends from the Indian Subcontinent to Indo-China (POWO, 2023). There are about 49 species in the genus *Phlogacanthus* (Dutta et. al., 2016; Mabberley et. al., 2008; Scotland, 1992; Scotland and Vollesen, 2000). The genus is represented in India by 10 number of species, and all of them are concentrated in the North-east region of the country (Clarke, 1884). Of these 10 species, Assam has records for 8 of them (Kanjilal et. al., 1939). A lot of work has been done on the genus *Phlogacanthus*, but before this, the ethnobotanical study of *P. thyrsiformis* by Karbis of Karbi Block in Biswanath Chariali was not done. So, in this study, an attempt was made to provide a baseline information, consumption mode as vegetable and ethnobotanical use of *P. thyrsiformis* by Karbis of Karbi Block in Biswanath Chariali.

Methodology: The present survey was carried out in Karbi Block village, situated in Biswanath Chariali by the side of the river Pothai Langsou in Sonitpur district, Assam, India. A field survey was done from November 2022 to February 2023 with the help of local elderly people who have knowledge of wild vegetables and ethnobotany (Das et al., 2022). Various information was collected by speaking with local people about the plant, like the local name, what part of the plant is consumed, mode of consumption as a vegetable, ethnobotanical uses, etc.

Results and discussion: As vegetables make up an important portion of our daily meals, their role in keeping us healthy is apparent. There are so many vegetables that are of medicinal importance. Use of plants to heal diseases is an age-old practice in India. Indigenous vegetables grown in wild/natural habitat have enormous potential to contribute to food as well as nutritional security among the tribal communities. The tribal communities are continuing to use plants as natural healers for a number of ailments. Karbi tribe residing in Karbi Block of Biswanath Chariali are also known to use a good number of plants that comprise ample of ethnomedicinal properties and our study was based entirely by speaking to the elderly people of the village who have knowledge about the ethno-botanical uses of plants. Plate 1 represent pictures of habit of *P. thyrsiformis* and inflorescence respectively. Table 1 compiles information providing updated name, family name, vernacular names in Assamese (official language of Assam) and Karbi language of Karbi tribe, habit, occurrence, and a brief description about the plant. Table 2 provides information on the taste of the vegetable, consumption mode as vegetable, the part of the plant used as ethnomedicine and ethnobotanical use of the plant. The study conducted justifies the use of this plant as ethnomedicine by Karbi tribe of Karbi Block,

Biswanath Chariali in treatment of many ailments. Hence, despite the fact that it is not cultivated in large scale and has an unpleasant bitter taste, *P. thyrsiformis* proves to be an important vegetable that should be included in our diet to promote health. Extensive research may pave a way for the discovery of many natural treatments or promising herbal drugs, as because modern medicines are usually claimed to have numerous side effects to mankind.



Plate 1: *Phlogacanthus thyrsiformis*, a) Habit & habitat; b) Flowers

Table 1: Information providing updated name, family name, vernacular names in Assamese and Karbi language, habit, occurrence, and a brief description about the plant

Plant species	Family	Vernacular names	Habit	Occurrence	Brief description
<i>Phlogacanthus thyrsiformis</i> (Roxb. ex Hardw.) Mabb.	Acanthaceae	Assamese: Titaphool, Tita bahek Karbi: Jok-aan	Evergreen shrub	Usually found in dry areas, grown along the roadside as well as in forest.	An evergreen shrub growing upto a height of approx. 2-4 m with oblong-lanceolate leaves, apex is entire and acuminate. Flowers are elongated, grown terminally and thyrse type, orange to brick red in colour.

Table 2: Information providing mode of consumption as vegetable, taste, consumption mode as vegetable, plant part that is consumed as ethnomedicine and ethnomedicinal uses of the plant

Plant species	Mode of consumption as vegetable	Taste	Plant part consumed as ethnomedicine	Ethnomedicinal use
<i>Phlogacanthus thyrsiformis</i> (Roxb. ex Hardw.) Mabb.	Flowers are cooked in oil or boiled along with daal to make curry and eaten with rice; Inflorescences are cooked with fish and meat; Flowers are also sun-dried and cooked with dried fish or chutney is prepared.	Bitter	Flower, leaf, inflorescence	Flower: Flower cooked in low oil is used in treating malaria, jaundice, fever, cough, stomach ache and gastric problem. Leaf: Decoction of leaf is used in small pox and skin problems; leaf juice is used in cough. Inflorescence: Cooked forms are used in treating malaria and cough.

Conclusion: The ethnobotanical knowledge of the plant species used by the Karbi tribe of Karbi Block, Biswanath Chariali, in Sonitpur district of Assam, was previously not recorded, and hence, the current study is crucial. From our study, it can be summed up that *P. thyrsiformis* is vital to the rural people of the mentioned tribal community as it contributes to promoting their health. However, there is still a long way to go until the complete list of plant species used by the Karbi tribe of Karbi Block is complete, and more thorough scientific investigations and studies are required to fully understand the ethnobotanical uses of *P. thyrsiformis* by the Karbi tribe residing in Karbi Block, Biswanath Chariali, Sonitpur district, Assam.

Acknowledgement: The author is grateful to the informants of Karbi Block, Biswanath Chariali, Sonitpur district, Assam for their humble cooperation to carry out the study.

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Less known ethnomedicinal plants of India

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Abstract: The tribals in remote areas completely depend on the traditional medicines to cure various diseases. In recent times, the use of traditional herbal medicines in healthcare has declined, particularly amongst the rural population. Due to rapid urbanization and easy availability of allopathic facilities, the interest in traditional medicines is gradually diminishing. This implies a risk of losing vital information from previous generations regarding plants and their uses in traditional medicine. As a result, the knowledge of ethnomedicinal plants became lesser day by day in upcoming generations. Thus, the documentation of less known ethnomedicinal plants to cure various health disorder naturally is highly essential for future which will be helpful to all. Therefore, an attempt has been made to document traditional knowledge of the ethnomedicinal plants from the traditional healers from field and literature survey. In the present study, 15 common plant species belonging to 10 families used in folk medicine are documented. Due to poor condition of modern healthcare facilities and poverty, indigenous people of the country fully or partially depend on local medicinal plants. For each less known medicinal flora, botanical name, vernacular name, part(s) used, popular medicinal use, forms of preparation and applications of the herbal remedies are provided. The collected information could help to discover new drugs for the pharmaceutical industry. The present study provides baseline information to discover new drug extraction in the future for further studies.

Key words: Ethnomedicinal, urbanization, indigenous people, traditional healers, diminishing, pharmaceutical

Introduction: India has a rich tradition of plant-based knowledge (Das et al., 2022) distributed amongst a huge number of ethnic groups (Kumar et al., 2012). India is very rich in floristic diversity as well as ancient folk literature. Humans have always used plants to enhance physical and spiritual wellbeing. Traditionally used medicinal plants have a long history of use as they are often considered safe and non-toxic to human beings (Kumar et al., 2021). In rural areas, most of the people residing depend on subsistence agriculture for their survival and have a great cultural knowledge of curing diseases by the utilization of forest resources (Uniyal, 2003). However, lack of documentation of traditional practice by the healers leads to the unclear effect of herbal medicine among the present generation (Chakraborty et al., 2016). In past, several attempts have been made to study the medico-ethnobotanical aspects from various regions of India (Kumar, 2015; Kumar et al., 2017; Kumar and Kumar, 2020). As the rural Indian tribal villagers are deprived of modern health care system, they are highly dependent on traditional therapeutic methods of medicinal plants for meeting their health care needs (Mohapatra and Sahoo, 2008). The tribes found in the survey area are traditionally a nomadic community. They reside in remote and inaccessible forest areas and practice indigenous

phytotherapy to treat common ailments (Dash and Satapathy, 2016). During the exploration of ethnomedicinal plants, the informations have been gathered from the healers found in forest areas, who depend mostly on forests for their need and have sound knowledge of herbal remedies (Behera et al., 2006). For many centuries, the tribal community has a traditionally self-managed system of folk medicine and primary health care mainly based on herbal remedies (Anuradha et al., 1986). The tribals in remote areas completely depend on the traditional medicines to cure their diseases (Patro, 2016). But due to rapid urbanization and easy availability of allopathic facilities, the interest in traditional medicines is gradually diminishing (Das and Misra, 1988). The objective of this study was to interact with local traditional healers and document their knowledge on some of the unreported medicinal plants, their usage, and the types of diseases they treat and gather information from literature (Ayyanar and Ignacimuthu, 2009).

Methodology: Realizing the fact that tribal rich forest pockets of several states of India were not adequately worked out from the ethnobotanical point of view, field survey were conducted at regular interval in different season. Tribal uses of plants were studied in situ by establishing close intimacy with the tribal healers. Folk lore claims were documented and the detailed information about plants, plant parts, dosages, duration, method of preparation, mode of administration, precautions to taken etc. was recorded. An effort was made to cross check the folk lore claims. This study involved field (Odisha, Uttarakhand and Jharkhand State) and literature survey (Ayyanar and Ignacimuthu, 2009; Sahoo et al., 2021; Kumar et al., 2022; Swain et al., 2022). Plants were identified by Dr, Sanjeet Kumar, Ambika Prasad Research Foundation, India.

Results: A total of 15 plant species are belonging to 10 different families as unreported in several states of India to treat skin diseases, stomach problems, piles, heel cracks, rheumatism, to reduce heat and to strengthen the body.

***Acalypha indica* (L.)**

Family: Euphorbiaceae (Plate 1a)

Indra Marisha is used to treat bronchial asthma.

***Ageratum conyzoids* (L.)**

Family: Asteraceae (Plate 1c)

It is used to treat fever, rheumatism, headache, colic, wounds caused by burns, dyspepsia, eye problem, uterine disorders and pneumonia (Kotta et al. 2020).

***Conyza bonariensis* (L.) Cronq.**

Family: Asteraceae

Decoction of leaves is boiled with the stem bark of *Sphaeranthus indicus* and bath is taken with the decoction to treat skin diseases.

***Curculigo orchoides* Gaertn.**

Family: Asteraceae

It is used to treat piles, appetizer, blood related disorders, bronchitis, ophthalmia, indigestion, vomiting, lumbago, hydrophobia, and joint pains.

Dimorphocalyx lawianus (Muell. -Arg.) Hook. f.

Family: Euphorbiaceae

Paste of leaves is applied topically on affected places along with the leaves of *Lawsonia inermis*, *Aloe vera*, bulb of *Scilla indica*, fruit juice of *Citrus limon*, rhizome of *Curcuma longa* to treat felon (wound on nail).

Diotacanthus albiflorus (Bedd) Benth.

Family: Acanthaceae

Paste of leaves is applied topically on affected places to treat wounds and heel cracks.

Dorstenia indica Wall. ex

Family: Moraceae

Decoction of whole plant is taken internally along with the leaves of *Vitex altissima* and *Naravelia zeylanica* to treat rheumatism.

Eugenia singampattiana Bedd.

Family: Myrtaceae

Leaves of this plant, fruit, and leaves of *Trichopus zeylanicus*, leaves of *Tinospora cardifolia*, rhizome of *Theriophonum minutum*, stem juice of *Sansevieria roxburghiana* and *Alstonia scholaris* are pounded separately and made into fine powder. The powder is taken orally with honey or cow's milk to treat constipation and to strengthening the body.

Leea indica (Burm. f.) Merr.

Family: Vitaceae (Plate 1c)

Whole plant parts are crushed, made into paste, and applied externally on body to increase disease resistance power in children.

Meiogyne pannosa (Dalzell) Sinclair

Family: Annonaceae

Leaves are dried with the leaves of *Trichopus zeylanicus*, *Begonia malabarica* and rhizome of *Curculigo orchoides* and pounded. The powder obtained is taken orally with honey for strengthening the body.

Murdannia montanum (C. B. Clarke) G. Bruckn

Family: Commelinaceae

Paste of leaves is crushed along with the leaves of *Aristolochia indica* and rhizome of *Asparagus racemosus* and made into paste and taken orally to treat stomach-ache.

Murdania spirata (L.) Brueck.

Family: Commelinaceae (Plate 1c)

Leaves are crushed along with the root bark of *Senna auriculata*, stem bark of *Achyranthes aspera* and seeds of *Pongamia pinnata*, made into paste and applied externally to treat piles.

Orophea thomsonii Bedd.

Family: Annonaceae

Leaf, stem bark and root bark are crushed along with the leaves and fruits of *Trichopus zeylanicus*, rhizome of *Alpinia galanga*, unripen fruits of *Phyllanthus emblica* and made into a paste and taken orally for strengthening the body.

Psychotria connata L.

Family: Rubiaceae

Juice extracted from the leaves is mixed with the juice of leaves of *sida acuta*, *Cocculus hirsutus* and *Tridax procumbens* and the mixture is stored for three days and applied externally to reduce the body heat.

Syzygium zeylanicum DC. Var. lineare (Duthie) Alston.

Family: Myrtaceae

Leaves are dried and grounded with the dried leaves of *Alternanthera sessilis* and *Cryptolepis buechanani* and applied externally on whole body to reduce heat in the body. Fruits are dried, grounded, powdered and made into paste with milk and taken orally along with the fruits of *Ficus racemosa*, leaves and rhizome of *Curculigo orchioides* and *Caryota urens* to strengthening the body.

Tylophora tenuis Blume

Family: Asclepiadaceae

Paste of leaves is crushed with the stem bark of *Melia azedarach*, leaves of *Naravelia zeylanica* and whole plant of *Elephantopus scaber* and applied topically on affected places to treat rheumatism.

Conclusion: The local as well as tribal communities in different states of India have their traditional knowledge of plant medicine-based system of curing many health disorders. An appropriate dosage to prepare drug from different parts of the plant body are prescribed as a remedy to treat different kinds of health disorders. Unfortunately, information on the use of plants for medicine from some regions is completely lacking. At the same time the traditional knowledge is rapidly degrading due to modernization of that area and the younger generation is not interested to learn from older generation. Thus, the documentation of less known ethnomedicinal plants to cure various health disorder naturally is highly essential for future which will help both tribal and local people. Ethno-medicinal plants and remedies documented have need photochemical and pharmacological screening for active principles and clinical trials for therapeutic action (Plate 2).



Plate 1: Less known ethno-medicinal plants e.g., (a) *Acalypha indica*, (b) *Leea indica*, (c) *Ageratum conyzoids*, and (d) *Murdannia spirata*

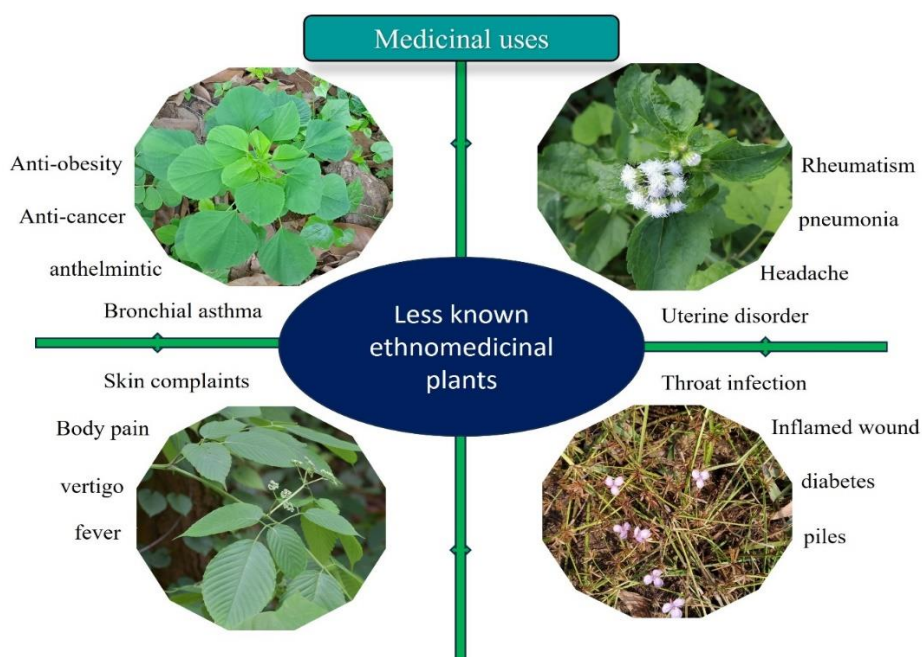


Plate 2: Less known ethnomedicinal plants showing different medicinal uses to cure various health problems

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Climbing plants with special reference to their ecological and medicinal importance

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DOI: <https://doi.org/10.5281/zenodo.8356010>

Abstract: Climbing plants are groups of plants that often have unique horticultural uses because of their beauty-imparting features. They are plants that develop upright and depend on other plants or structures for growth and development. Several families, such as Cucurbitaceae, Convolvulaceae, Dioscoreaceae, etc., are exclusively climbers. The prevalence of diseases and the high cost of modern medicine, coupled with the increasing human population across the globe, have resulted in the overexploitation of climbing plants with annihilation possibilities. Therefore, an estimated approach is needed to raise awareness of the ecological and medicinal importance of climbers in order to preserve them for sustainable future uses. The work was started on the climbing plants to determine their ecological and medicinal importance from December 2022 to August 2023 through literature and field surveys. The field survey was carried out in selected areas of Odisha and Himachal Pradesh. Though the climatic variations are not remarkable, the regions sustain a good number of plant species, among which climbers occupy a unique position. Our investigation revealed that the whole plant—leaves, bark, roots, flowers, fruits, or seeds—has medicinal value separately or in combination. It was observed that they are very useful in providing food and shelter materials for many faunal species. The information regarding medicinal values was collected from local people and verified with literature findings. A total of 40 different climbing plant species were studied, along with their botanical names, ecological significance, and medicinal uses.

Key words: Climbers, horticultural, upright, exploitation, medicinal values, ecological values

Introduction: Climbers are known to be aesthetic in gardens and are one of the most important sections of plant communities; still, they are less explored communities of plants in terms of ecological, medicinal and nutritional values (Shikha & Kumar, 2021). These plants with weak stems cannot stand upright but readily climb up the neighbouring mechanical support or a tree; that is why they are called climbers (Sharma & Shahzad, 2014). These are also called vines and lianas, with long, flexible, climbing stems that are rooted in the ground and usually have long dangling branches (Ali et al., 2015). This group of plants develops various climbing mechanisms, classified as tendrillers, twiners, scramblers, clinging, adhesive, and woody climbers (Deepa & Thomas, 2020). Although climbers are predominantly angiosperms, some are ferns, and one gymnosperm member, *Gnetum*, is included in this category. Climbers are a typical constituent of rain forests (Sarvalingam et al., 2011). The distribution and abundance of climbing plants in forests vary greatly with their geographic location. Climbing plants not only create important

structural components but also play a crucial ecological role in environmental dynamics (Agarwal, 2013). In addition to being a conspicuous structural component of the environment, vines play a vital role as food plants for insects as well as monkeys (Emmons & Gentry, 1983), especially when other food sources are scarce. Lianas are also used by local people in various villages or rural areas in many ways. They may be especially important in remote areas where regular modern and advanced western medicines and various other curative products are not easily available and accessible (Arnold & Perez, 2001). The most used medicinal climbers, viz., *Abrus precatorius* L., *Aristolochia indica* L., *Cissus quadrangularis* L., *Coccinia indica* (L.), *Gloriosa superba* L., *Tinospora cordifolia* (Thunb.) Miers, *Pergularia daemia* (Forssk.) Chiov., etc play an important role in the primary healthcare system of tribal communities residing in the study area (Srivastava et al., 2015). They are using these plants to cure diseases related to skin infections, fever, cough, headache, rheumatism, stomach ache, asthma, dysentery, and poison bites (Table 1; Kalam & Ahmad, 2015). Unfortunately, many of the climbing plants are under threat of extinction due to habitat depletion, overexploitation, and conservation efforts are required to ensure their long-term stability. This paper highlights the medicinal importance of climbers from diverse families, including Fabaceae, Rubiaceae, Convolvulaceae, Asparagaceae, Cuscutaceae, Dioscoreaceae, Aristolochiaceae, Vitaceae, Cucurbitaceae, Caesalpiniaceae, Asclepiadaceae, Menispermaceae, Apocyanaceae, Passifloraceae, Liliaceae, and Mimosaceae, which needs to be preserved mainly for future uses and ecological balance.

Methodology: The present study was carried out through literature survey and extensive field visits during December 2022 to August 2023 to collect information on the traditional or therapeutic uses of climbers used in the preparation of crude herbal drugs by the tribal people living in the selected areas of Odisha (Mayurbhanj, Keonjhar, Sundargarh and Cuttack) and Himachal Pradesh (Kangra and Hamirpur). The data were documented through interviews, discussions, and field observation with folk practitioners and knowledgeable people in the study area using standard field methods (Kumar et al., 2021). Plants are identified by Dr. Sanjeet Kumar, APRF, Odisha, India.

Results and discussion: The present study resulted in the documentation of the curative properties of 40 climbers belonging to 19 families. The plant species are listed with their correct botanical names, followed by family and their medicinal uses (Table 1; Plate 1). Fabaceae (5 species), Apocyanaceae, Dioscoreaceae, and Menispermaceae (2 species each), Cucurbitaceae (9 species), Asclepiadaceae (3 species), and Convolvulaceae (4 species). The rest of the families are represented by single species. The data enumerated through ethnobotanical surveys included plant species with their botanical names, distribution in families, and medicinal value. This paper highlights the medicinal properties of climbers (Plate 2).

Table 1: Some common climbers of study areas and their medicinal potential

Botanical name	Family	Medicinal uses	Sources
<i>Abrus precatorius</i> L.	Fabaceae	Treat worm infections	Present study
<i>Aganosma caryophyllata</i> G. Don	Apocyanaceae	Used in toothache	Present study

<i>Aristolochia indica</i> L.	Aristolochiaceae	Used in fever	Present study
<i>Artabotrys hexapetalus</i> (L.f.) Bhandari	Annonaceae	Used in cholera	Present study
<i>Asparagus racemosus</i> Willd.	Asparagaceae	Used in dysentery	Present study
<i>Caesalpinia bonduc</i> (L.) Roxb.	Caesalpiniaceae	Used in fever	Present study
<i>Cardiospermum halicacabum</i> L.	Sapindaceae	Used in menstrual pain	Present study
<i>Cissampelos pareira</i> L.	Menispermaceae	Used in urinary infections	Present study
<i>Cissus quadrangularis</i> L.	Vitaceae	Used in bone fracture	Present study
<i>Citrullus colocynthis</i> (L.) Schrad. ex Eckl & Zeyh	Cucurbitaceae	Used in constipation	Samanta and Biswas (2009)
<i>Clitoria ternatea</i> L.	Fabaceae	Used as memory enhancer agent	Present study
<i>Coccinia indica</i> Wt. & Arn.	Cucurbitaceae	Used in earache	Present study
<i>Cocculus hirsutus</i> (L.) Diels	Menispermaceae	Used in food poisoning	Present study
<i>Cucumis maderaspatanus</i> L.	Cucurbitaceae	Used in skin infections	Present study
<i>Cucumis sativus</i> L.	Cucurbitaceae	Used in throat ulcer	Present study
<i>Cucurbita maxima</i> Duch. ex Lam.	Cucurbitaceae	Used to kill the stomach worm	Present study
<i>Cuscuta reflexa</i> Roxb.	cuscutaceae	Used in paralysis	Present study
<i>Dioscorea alata</i> L.	Dioscoreaceae	Used to enhance the immunity.	Present study
<i>Dioscorea pentaphylla</i> L.	Dioscoreaceae	Used in skin infections	Present study
<i>Diplocyclos palmatus</i> (L.) Jeffrey	Cucurbitaceae	Used in skin infections	Present study
<i>Gloriosa superba</i> L.	Liliaceae	Used in piles	Present study
<i>Gymnema sylvestre</i> (Retz.) R. Br. ex Schult.	Apocyanaceae	Used in diabetes	Present study
<i>Hemidesmus indicus</i> (L.) R.Br.	Apocyanaceae	Used in kidney problems	Present study
<i>Ichnocarpus frutescens</i> (L.) W.T.Aiton	Apocyanaceae	Used to improve blood circulation	Present study
<i>Ipomoea aquatica</i> Forssk.	Convolvulaceae	Used in eye problems	Present study
<i>Ipomoea pes-tigridis</i> L.	Convolvulaceae	Used in insect bites	Present study
<i>Ipomoea quamoclit</i> L.	Convolvulaceae	Used in piles	Present study
<i>Lathyrus sativus</i> L.	Fabaceae	Used to improve body immunity	Present study
<i>Luffa acutangula</i> (L.) Roxb.	Cucurbitaceae	Used in stomach problems	Present study
<i>Luffa cylindrica</i> (L.) M. Roem.	Cucurbitaceae	Used in stomach problems	Present study
<i>Mikania micrantha</i> Kunth	Asteraceae	Used in skin infections	Present study

<i>Mimosa pudica</i> L.	Mimosaceae	Used in skin infections	Present study
<i>Momordica charantia</i> L.	Cucurbitaceae	Used in diabetes	Present study
<i>Mucuna pruriens</i> (L.) DC.	Fabaceae	Used in neurological problems	Present study
<i>Operculina turpethum</i> (L.) Silva Manso	Convolvulaceae	Used in constipation	Present study
<i>Paederia foetida</i> L.	Rubiaceae	Used in dysentery	Present study
<i>Passiflora foetida</i> L.	Passifloraceae	Used as tonic	Present study
<i>Pergularia daemia</i> (Forsk.) Chiov.	Asclepiadaceae	Used in skin infections	Present study
<i>Piper betle</i> L.	Piperaceae	Used in cough	Present study
<i>Pueraria tuberosa</i> (Roxb. ex Willd.) DC.	Fabaceae	Used to improve the immunity	Present study



Plate 1: Different climbers with their body parts like, flowers, fruits, & leaves are: (a) *Abrus precatorius*, (b) *Cissampelos pareira*, (c) *Aristolochia indica*, and (d) *Gloriosa superba*

Climbers are important because, due to their characteristic features, climbers on the wall will naturally reduce the temperature and keep the garden, backyard, balcony, or terrace areas cooler on summer days. In forest areas, climbers are one of the reasons for shade in the forest (Rahman et al., 2012). On summer days, the wild animal has a convenient place to rest beneath the climbers, like *Phanera vahlii*, *Butea superba*, and *Combretum roxburghii* (Sethi et al., 2023). The present investigation sheds light on the enormous availability of curative values of climbers all around us. Therefore, there is a need to create awareness among the local people about the importance and conservation of these climbers in their original habitat.

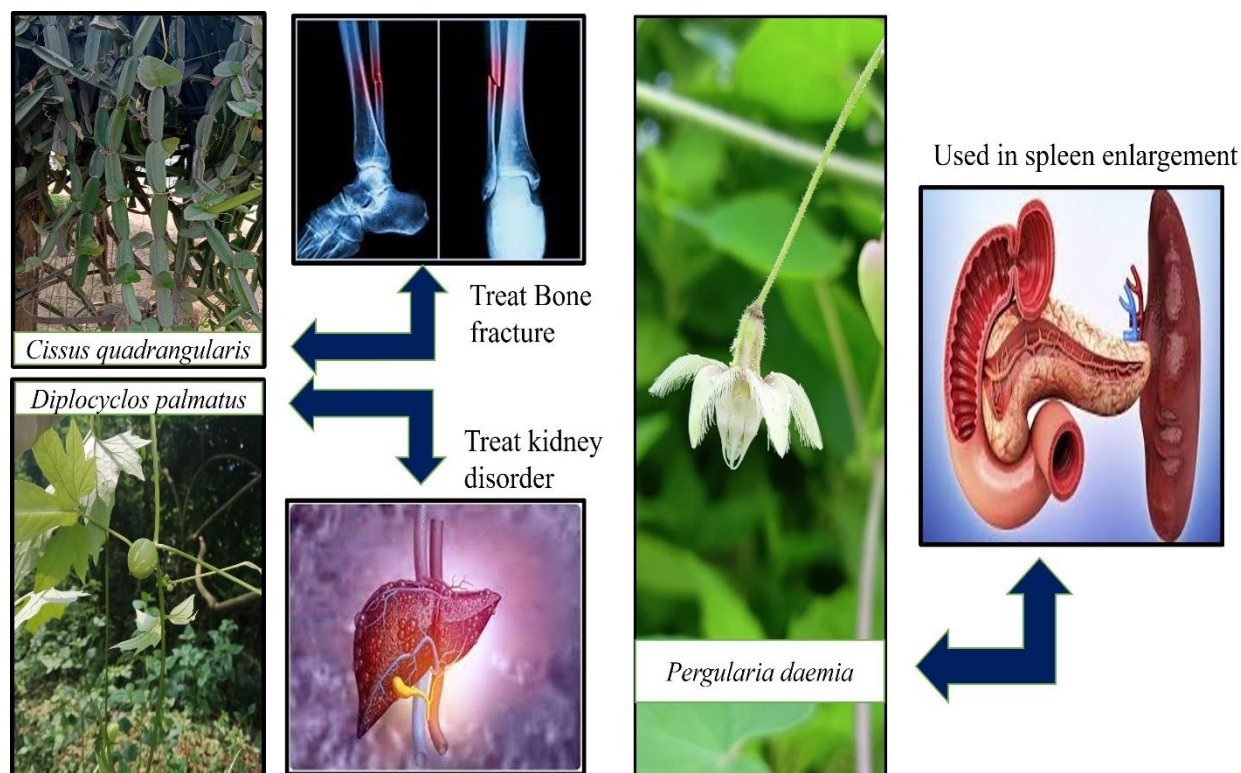


Plate 2: Medicinal values of some enumerated climber species

Conclusions: Medicinal plants play a major role in the medicinal and healthcare needs of people, especially among tribal communities. This preliminary study focused on documenting most of the curative climbers used by folk practitioners and older, knowledgeable people. These are one of the important groups of plants whose morphological support comes entirely from their own tissue and their original rooting position in the soil, and whose climbing efforts can take their foliage and reproductive organs into tree canopies. The present study revealed that about 40 climber species were documented from selected areas of Odisha and Himachal Pradesh states. However, destruction of habitat through deforestation and overexploitation for commercial purposes and changes in cultural altitude threaten to constrain many of these species to extinction. These are mostly considered obnoxious weeds to be eradicated. But, as a matter of fact, these species produce a good number of alkaloids or active principles as a gift of nature. As such, they need equal value as other medicinal plants and should be conserved as depleting taxa for sustainable utilization in the future.

Acknowledgement: Authors are thankful to the local communities of study areas and team Ambika Prasad Research Foundation, Odisha, India.

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Plants used against fungal infections: source of future drugs

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DOI: <https://doi.org/10.5281/zenodo.8388177>

Abstract: Plants synthesize a vast array of secondary metabolites that are gaining importance for their biotechnological applications. In the setting of other ailments, opportunistic fungal infections have become a common cause of morbidity and mortality. Thus, antifungal therapy is playing a major role in health care. Traditional plants are a valuable source of novel antifungals. The aim of this paper is to analyse the antifungal activities of medicinal plants. The increased use of antifungal agents has resulted in the development of resistance to the drugs. The spread of multidrug resistant strains of fungus and the reduced number of drugs available make it necessary to discover new classes of antifungals from natural products including medicinal plants. Keeping this in mind, an attempt has been made to document the plants used in fungal infections through field and literature survey during 2022-2023. Results are presented here to highlights the importance of plants against fungal infections and can be helpful to formulate new drugs from enumerated plants.

Key words: Synthesize, Biotechnological, Antifungal screening, Antibiotics, Antimicrobial

Introduction: Plants have been used by the human as medicinal remedies from the time immemorial (Misra et al., 2012; Kumar et al., 2018). The use of medicinal herbs in the treatment of infections is an age-old practice (Kariba et al., 2001). Several studies have described that the rural region's rich diversity of plants used for medicinal purposes, widely employed by the traditional communities until the present day (Amini et al., 2012; Kumar et al., 2013). Biologically active compounds found in plants appear to be more adaptable, acceptable, and safer than synthetic compounds and possess a wealthy source of potential pathogens control agents (Tripathi et al., 2008). In India infectious diseases accounts for apex proportion of health ailments & the observational data suggest that the incidence and prevalence of serious mycoses continues to be a public health threat (Bansod & Rai, 2008). Nearly a billion people are estimated to have skin, nail and hair fungal infections, many more people have mucosal candidiasis and serious fungal diseases, which have a major impact on their lives or are fatal (Bongomin et al., 2017). Fungal infections are common in tropical countries (Costa et al., 2010) and these are

ubiquitous in the environment, and infection due to fungal pathogens has become more frequent. Although the epidemiology of fungal diseases has greatly changed over the past few decades, *Aspergillus*, *Candida*, *Cryptococcus* species remain the main fungal pathogens responsible for the majority cases of serious diseases (Bongomin et al., 2017). Microorganisms have developed resistance to many antibiotics and as a result, immense clinical problem in the treatment of infectious diseases has been formed (Ferreira et al., 2013). The resistance of the organisms increased due to indiscriminate use of commercial antimicrobial drugs commonly used for the treatment of infectious diseases (Bhalla et al., 2009). The search for novel antifungal agents relies in great part on ethnobotanical information and ethnopharmacologic exploration (Webster et al., 2008). This situation forced the researchers to look for new antimicrobial substances from various sources including medicinal plants (Kumar & Jena 2014). The discovery of new antifungal agents remains an important challenge for the scientific community and traditional medicinal plants may furnish promising material for the development of antifungal drugs (Aqil et al., 2010). In several researches, extracts of various higher plants have been reported to exhibit antifungal properties under laboratory trials. Wild plants seem to be a promising source that can possess useful metabolites. For plants to protect them against pathogens, they produce secondary metabolites, which play important roles as defense mechanisms. The use of biological compounds extracted from plants is an alternative to conventionally used fungicides to control pathogenic fungi, due to their being bioactive chemicals such as flavonoids, phenols, tannins, alkaloids, quinones, saponins and sterols etc. (Salhi et al., 2017). Thus, this study aims to highlight the potential antifungal activities of some medicinal plants which are like *Schizogygia coffaeoides*, *Vitex negundo*, *Zantoxylum alatum*, *Ipomea carnea*, *Thuja orientalis*, *Cinnamomum camphora*, etc.

Methodology: To enumerate the plants used in fungal infections, literature and primary field survey (Figure 1) was carried out in the selected areas of Himachal Pradesh (Bilaspur) and Odisha (Mayurbhanj) states, India during 2022-2023 (Kumar et al., 2021). The collected information are tabulated in Table 1 and Plate 1. Plants are identified by Dr. Sanjeet Kumar, APRF, Odisha, India.

Results: Plants of high ethnomedicinal value were found to possess antifungal properties against numerous fungi. There are about 15 different medicinal plant species listed in the table with their botanical name, which parts are used against which pathogenic fungi. As per study, the result show that the leaf extract of *Balanites aegyptiaca*, seed oils of *Caesalpinia ferrea*, stem extract of *Cocculus hirsutus*, roots of *Crotalaria prostrata*, leaves of *Cinnamomum camphora*, and *Eugenia uniflora* are active against *Aspergillus flavus*, *Candida albicans*, *Rhizopus arrhizus*, *Microsporum gypseum*, *Choanephora cucurbitarum* and *Paracoccidioides brasiliensis* respectively (Table 1).



Figure 1: Discussion with local community on plants used in fungal infections (Skin infections) in Baripada, Odisha, India

Table 1: Some ethnomedicinal plants (specific parts) used against pathogenic fungi

Botanical name	Parts used	Effective microbes against	Sources
<i>Balanites aegyptiaca</i>	Leaves	<i>Aspergillus flavus</i>	Abdulhamid and Sani (2016)
<i>Caesalpinia ferrea</i> Mart.	Seeds	<i>Candida albicans</i>	Soares et al. (2018)
<i>Cocculus hirsutus</i>	Stem	<i>Rhizopus arrhizus</i>	Logesh et al. (2020)
<i>Crotalaria prostrata</i>	Root	<i>Microsporum gypseum</i>	Bhalla et al. (2009)
<i>Cinnamomum camphora</i> (L.) J. Presl	Leaves	<i>Choanephora cucurbitarum</i>	Pragadheesh et al. (2013)
<i>Eugenia uniflora</i> L.	Leaves	<i>Paracoccidioides brasiliensis</i>	Costa et al. (2010)
<i>Hymenaea stigonocarpa</i> Mart. ex Hayne	Fruit peel	<i>Colletotrichum truncatum</i>	Pimentel et al. (2023)
<i>Ipomoea carnea</i> Jacq.	Leaves (Leaves are used in fungal skin infections)	<i>Colletotrichum gloeosporioides</i>	Nidiry et al. (2011) Present study

<i>Mimosa tenuiflora</i> Poir.	wood	<i>Cryptococcus neoformans</i>	Araujo et al. (2018)
<i>Psidium guajava</i> var. minor Mattos	Leaves	<i>Candida albicans</i>	Andrade et al. (2020)
<i>Schinus terebinthifolia</i> Raddi	Leaves & stems	<i>Paracoccidioides brasiliensis</i>	Johann et al. (2010)
<i>Schizozygia coffaeoides</i> Baill.	Leaves & roots	<i>Cladosporium cladosporioides</i>	Kariba et al. (2002)
<i>Thuja orientalis</i> L.	Leaves	<i>Fusarium psidi</i>	Jain and Garg (1997)
<i>Vitex negundo</i> L.	Fruits Leaves (Leaf paste is used in fungal skin infections)	<i>Candida glabrata</i>	Mahmud et al. (2009) (Present study)
<i>Zanthoxylum alatum</i> Roxb.	Leaves	<i>Aspergillus flavus</i>	Li et al. (2021)



Plate 1: plants used against fungal infections are (a) *Psidium guajava*, (b) *Ipomoea carnea*, and (c) *Vitex negundo*

Conclusion

Throughout the globe, the plant kingdom has provided a variety of medicines. In modern times, plants with antimicrobial activity are also known to be numerous (Rios and Recio

2005). Fungi are ubiquitous in the environment, and infection due to fungal pathogens has become more frequent. As a result, antifungal therapy is playing a major role in health care and the screening of traditional plants in search of novel antifungals is now more frequently performed (Astal et al. 2005). The search for novel antifungal agents relies in great part on ethnobotanical information and ethnopharmacologic exploration. The study concluded about 15 different medicinal plants very much effective against numerous pathogenic fungi like *Aspergillus flavus*, *Colletotrichum truncatum*, *Colletotrichum gloeosporioides*, *Cryptococcus neoformans*, *Cladosporium cladosporioides*, and *Fusarium psidi* etc. (Plate 2).

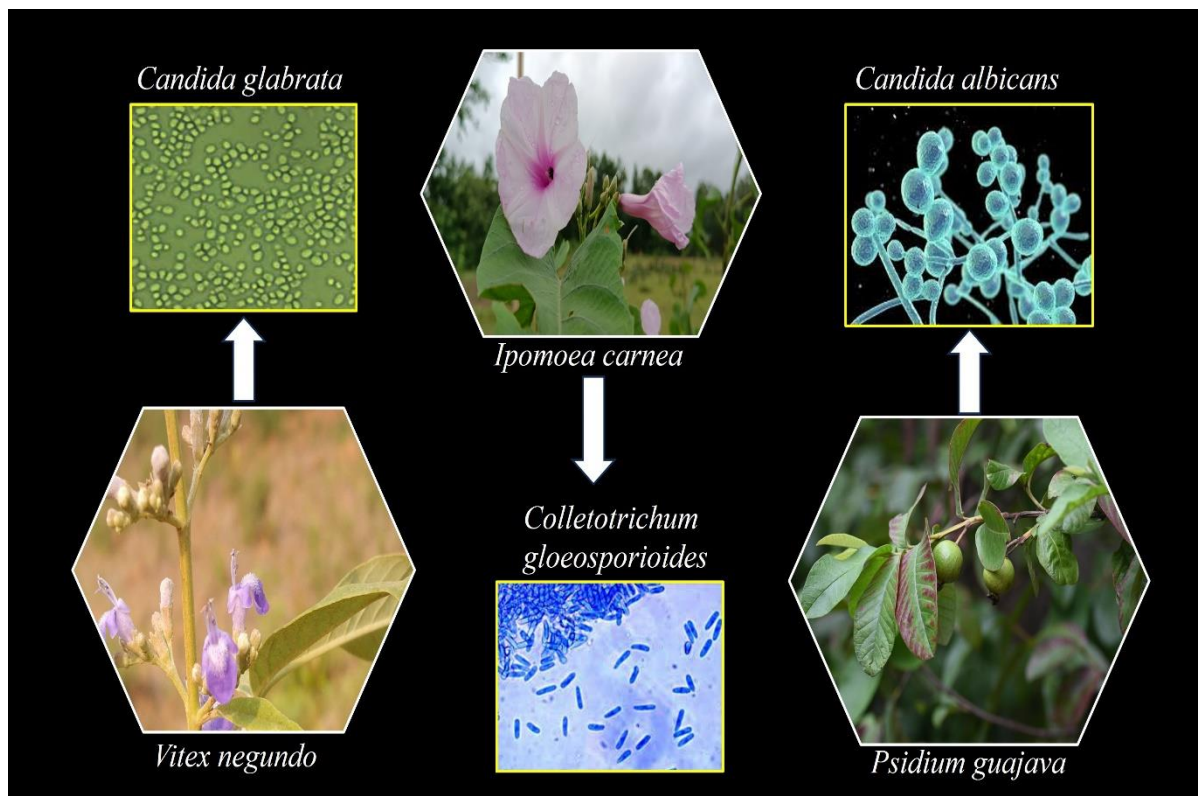


Plate 2: Showing three medicinal plants effective against 3 different pathogenic fungi

Acknowledgement: Authors are thankful to the local communities of study areas and team Ambika Prasad Research Foundation, Odisha, India.

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***Houttuynia cordata* Thunb.: A potential nutraceutical herb**

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DOI: <https://doi.org/10.5281/zenodo.8404557>

Abstract: *Houttuynia cordata* is an aromatic herb widely used in Northeastern states of India for various purposes, like spice and condiments, cooked as vegetables, or therapeutic purposes by the indigenous traditional healers for various ailments. Many of the tribal or indigenous people of these states are also aware of many of its therapeutic uses. Although they are old practices, many researchers and scientists have recently taken an interest in their varied medicinal values and therapeutic potential. Various phytochemical compounds have been detected and isolated that are responsible for their therapeutic purpose. Here, an attempt has been carried out to gather the ethnobotanical uses from different states of Northeast India reported and compare them with the present ethnobotanical study from Manipur. Morphological characters with photographs of the species are presented here for easy identification. Food prepared using *H. cordata* by the Meitei community of Manipur is shown here. The comparative account of food and medicine revealed that this species is a potential nutraceutical herb. Incorporating this species into a normal diet can be highly beneficial for people's health. Cultivation and value addition of such potential nutraceutical herbs could help people find more options for healthy, nutritious food at reasonable prices.

Keywords: Toningkok, spices, food, therapeutic values, Manipur

Introduction: *Houttuynia cordata*, locally known as Toningkok in Manipur State, Northeast India, is an aromatic herb used in all the states of Northeast India. It is native to many Asian countries like China, Korea, Japan, Thailand, Vietnam, India, Bangladesh, Bhutan, Nepal, etc. and has been introduced in many countries like Australia, New Zealand, North America, and the Pacific Islands (Fu et al., 2013; POWO). In India, it is entirely distributed in northeastern states, i.e., Manipur, Nagaland, Assam, Meghalaya, Mizoram, Tripura, Arunachal Pradesh, and Sikkim (Pradheep et al., 2016; Kumar et al.,

2014; [Rathi et al., 2013](#)). Traditional use of *H. cordata* as food and for therapeutic purposes is an old system, but many scientists and researchers have increasingly started working on the pharmacological aspect of the species over the past decade. In many Asian countries like China, Vietnam, Japan, Korea, Thailand, etc., the species is a well-known plant that is already part of their diet. In India, the different tribal and indigenous communities are aware of the plant and its edibility. Different communities have different ways of consuming food and for therapeutic purposes, although not many of the ways have been documented so far. Researchers and scientists in the last decade have worked on the phytochemical compounds responsible for therapeutic values; many have been isolated and identified over time. Reports have revealed the presence of alkaloids, flavonoids, polyphenols, and volatile oils ([Fu et al., 2013](#)). Many research activities have shown that the anti-inflammatory activity and antioxidant activity of *H. cordata* have contributed to various therapeutic properties. Some of the therapeutic values include protection of the lungs, intestinal flora, and other ailments like heart diseases, liver problems, kidney problems, diabetes, rheumatic arthritis, and antiviral and antibacterial diseases. Reports have shown that it works very well to treat the Corona virus (SAR-CoV-2). In Mizoram, India, many people were given treatment with *H. cordata* against SAR-CoV-2 during the COVID-19 pandemic ([Laldinsangi, 2022](#)). About 19 types of alkaloids have been identified, apart from the many flavonoids identified. Wild edible foods with nutritional and therapeutic value are of high concern in the present world. The availability of nutritional food has been affected by different factors, like high inflation on food prices, advanced agricultural practices for using fertilizers, pesticides, and fungicides, high productivity, adulteration of food, etc. The very fast urbanization has left very few to no spaces for home gardens and shrinking forest areas globally. The recent report of FAO 2023 revealed that worldwide hunger is prevalent at about 9.2 %. Again, the global population of 11.3 % has been severely affected by the food insecurity issue in the world, and 42 % of the global population is not able to get a healthy diet ([FAO, IFAD, UNICEF, WFP, WHO, 2023](#); [Devi et al., 2022](#)). The issue of food insecurity is a matter of concern, and an attempt has been made here to document the ethnobotanical use of *Houttuynia cordata* by the Meitei community of Manipur and show a comparative account of its uses with the different states of Northeast India ([Table 1](#)). The correlation of its food and therapeutic uses with respect to the large phytochemical compounds reported shows that

the species is a highly potential nutraceutical plant, and cultivation and value addition of the species could add the species to the diets of people at reasonable prices.

Methodology: *H. cordata* (Figure 1) is an important aromatic herb distributed and used for various purposes in all the states of Northeast India. The Meitei community of Manipur consumed the species, especially as condiments for the spicy salad, also called Singju. The traditional way of consuming the species is illustrated in Figure 2. The comparative account of the ethnobotanical uses of the species from different states reported is given hereunder. The morphological characters are described with photographs of the species in this document for easy identification. The various food and therapeutic potentials of the species make it a highly potent nutraceutical herb.

Results and discussion

Morphological description: It is a perennial aromatic creeping herb. Rhizomes creeping, thin, long, branching, pale yellow to white in colour, thin fibrous roots on internodes, glabrous at the nodes, aromatic; leaves simple, alternate, heart-shaped, cordate at the base and acuminate at the apex, abaxial surface green or sometimes line with purple lines along the margin and nerves, sheath at the lower part of petiole around the stem, glabrous, glandular, aromatic; inflorescence spikes, flower small, bracts four, white, appear like petals; fruits subglobose.

Ethnobotany of H. cordata: In Manipur, the aromatic herb *H. cordata* is mostly consumed by the Meitei community as a condiment to add flavour to spicy salads locally known as Singju or to a traditional delicacy known as Eromba. The preparation of Singju is illustrated with the mixture of spices and other less-known plants in the present study. However, it is also consumed as a cooked vegetable. The traditional local healers of Manipur, locally known as Maiba, used the species for therapeutic purposes in dysentery, stomach ulcers, muscular sprains, anaemia, gastritis, tuberculosis, stomach worms, etc. In Assam, people consume chutney and pickles, which are also used in the treatment of dysentery. In Sikkim and Nagaland, people used to treat helminths in the stomach. In Arunachal Pradesh, people use it for therapeutic purposes to add freshness to the body and treat sleep disorders and cardiovascular disorders (Rathi et al., 2013). In Meghalaya, the Khasi and Jaintia tribes consume salad and use it for ailments like reducing blood sugar (Kumar et al., 2014). In Nagaland, the Konyak tribe consumed cooked vegetables or added pickles as flavouring agents. They are also used to enhance appetite (Pradheep et al., 2016). The comparative ethnobotanical uses of *H. cordata* Reports of edibility from

other parts of the world revealed that in China and Vietnam, the rhizome and leaves are consumed as vegetables. In Japan, the whole plant is used in preparing beverages and deodorant. In Korea, the whole plant is used in carbonated drinks, pickles, and soy sauce. Again, in Thailand, the young leaves are cooked and consumed as vegetables.

Conclusion: The food and therapeutic values in Northeast India and the wide common use of *H. cordata* globally, especially in Asian countries, show that the species has high potential to be used as a nutraceutical plant. The very high increase in research activities regarding its pharmacological values also proved that the species is an exceptionally potential source of future drug development. Such plants, if incorporated into normal diets, could be highly beneficial and provide immunity and protection from many diseases. Cultivation and value addition of the species are recommended to provide a nutraceutical value at reasonable prices.

Table 1: Comparative account of ethnobotanical values of *H. cordata* from Northeastern states of India

State	<i>H. cordata</i> parts used	Ethnobotanical uses	Source
Manipur	Rhizomes and Leaves	Use as condiments	Present study
Manipur	Whole Plant	Cooked as vegetables	Present study
Manipur	Rhizomes	To treat dysentery, muscular sprain, stomach ulcer, anaemia, gastritis, tuberculosis, intestinal worms, etc.	Rathi et al. (2013)
Assam	Whole plant	Chutney & Pickles	Rathi et al. (2013)
Assam	Whole plant	Dysentery	Rathi et al. (2013)
Sikkim	Whole plant	Stomach worms	Rathi et al. (2013)
Nagaland	Whole plant	Cooked as vegetables & Pickles	Rathi et al. (2013)
Nagaland	Rhizome	Improve appetite	Pradheep et al. (2016)
Meghalaya	Whole plant	Salads	Kumar et al. (2014)
Meghalaya	Whole plant	Reduces blood sugar	Kumar et al. (2014)
Mizoram	Whole plant	Locally treated Sars-CoV ₂ virus	Laldinsangi (2022)
Arunachal Pradesh	Whole plant	Improves sleep, freshness and to treat cardiovascular disorders	Rathi et al. (2013)



Figure 1: *Houttuynia cordata* Thunb. in its habitat and depicting its leaves, flowers and roots

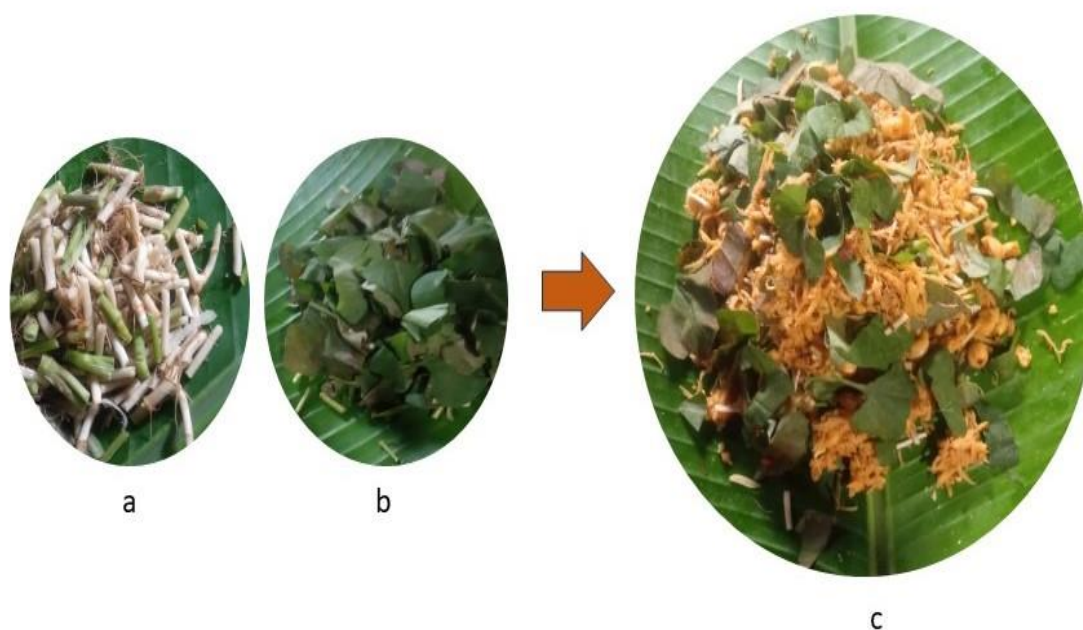


Figure 2: *H. cordata* used as condiments in a spicy salad locally known as Singju, a.) Rhizomes and b.) leaves of *H. cordata* c.) Singju

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Alocasia indica (Lour.) Spach: A potential nutraceutical wetland flora

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DOI: <https://doi.org/10.5281/zenodo.8417970>

Abstract: *Alocasia indica* is one of the wetland plant species distributed widely in Manipur, India. Although it is widely consumed as a vegetable, it has various health benefits too, therefore, this species is widely cultivated in home gardens. However, the species has been often confused with *Alocasia macrorrhizos* (L.) G.Don, and so the distribution in other parts of India is not clearly defined, and the ethnobotanical uses reported from Northeast India have often been misidentified, as the above confusion stated. Therefore, an attempt has been made to document the ethnobotanical uses of *A. indica* by the Meitei community of Manipur with proper photographs and descriptions of the plant species for easy identification. The therapeutic uses reported earlier have been also incorporated. As a result, such nutritional and highly beneficial therapeutic plants should be marked as nutraceutical plants and to create an awareness among the people all over the country about its nutraceutical values, so that the growing population of the country could face food insecurity issues, hunger, malnutrition, etc. through cultivation and value addition of this species of *Alocasia*.

Keywords: Ethnobotanical uses, medicinal, species confused, highly nutritive, food insecurity

Introduction: Manipur possesses one of the richest plant diversities in India due to the diverse hill and valley landscapes and as a part of the Purvanchal Mountains or the Eastern Mountains of the Himalayan Range bending sharply towards the south and spreading along the eastern boundary of India (Nandy et al., 2000). Most of the area are hills and the central area occupies the valley region. The valley lies in an elevation of about 790 m and most of the valley areas were initially wetlands but due to the rapid urbanization, many wetlands' areas are slowly disappearing. Among the various wetland plants, *Alocasia* and *Colocasia* are some of the genera of family Araceae that prefer wetland habitat (Devi et al., 2022). *Alocasia indica* is one among the most common plants

consumed as vegetable by maximum people of the state. This is because, the plant is considered highly nutritional and often cultivated in most home gardens. This species is native to Indian subcontinent and Indo-China ([IPNI 2023](#)) which is often misidentified as *Alocasia macrorrhizos* as a result many researchers are confused leading to the misinterpretation of the research works and distributional data. Thus, such misidentification of *Alocasia* species needs to be cleared for the future research works. This species of *Alocasia* needs to be of more concern as the people of Manipur especially the Meitei community considered it as a highly nutritional vegetable. As India is the second highest populated country in the world with a very high inequality of wealth distribution. International Labor Organization 2020 reported that many informal sector workers earn very less with minimum employment stability as compared to the official sector due to many factors like caste system, landownership patterns, colonial exploitation, economic policies, privatization, etc ([Sharma et al., 2023](#)). This led to the lower income groups to find difficulty to consume the healthy nutrition or in other words, they face the truth of food insecurity issues ([FAO 2023](#)). Considering the highly nutritional and therapeutic values of *A. indica*, along with the confusion in the identification of the species, an attempt has been made to find the ethnobotanical uses of *A. indica*, and to clear the confusion in identification of the species with photographs and illustrations to prove it as highly potential nutraceutical plant which could be consumed, marketed and cultivation in various parts of the similar habitat. So that, the people with lower income could get the nutrition accompanying its therapeutic values of *A. indica* with very less price.

Methodology: The ethnobotanical data has been collected on the food and therapeutic uses of *A. indica* from the Meitei community of Manipur using standard method ([Kumar et al. 2021](#)) Previous reports of the food and therapeutic uses of the species have also been incorporated. The confusion in misidentification of the species has also been cleared by the comparative account of the morphological characters and photographs procured from authenticated sources using the International Plant Name Index and Plants of the World Online, Royal Botanical Garden, Kew. The food and therapeutic values leading to a potential nutraceutical plant are also described hereunder.

Results and discussion: *Alocasia indica* is a highly nutritional plant species of the Araceae family of Manipur, India. It has high therapeutic values because of which, people

cultivate it in most of the home gardens. However, as mentioned earlier to carry out the research activities, people are confused in identification of the species. In the present study, proper description for identification with photographs is given along with the comparative morphology of the most misidentified species i.e., *Alocasia macrorrhizos* is given hereunder. The ethnobotany of the species collected from the Meitei community of Manipur is also presented here.

***Alocasia indica* (Lour.) Spach**

Habit: Moist areas or near waterbody like near drains, streams, wetlands, etc.

Morphological description: It is an herbaceous perennial, glabrous, tall herb. Leaves are broad, light green in colour, slightly cordate or heart shaped, margin entire and wavy, two ovoid lobes at the base, apex rounded and slightly acute, midrib primary and secondary veins marked with slightly whitish colour (not distinct), petiole long, fleshy, porous, overlap with one another, produce watery sap, sheathing at the lower part; inflorescence spadix, spadix surrounded by spathe and shorter than spathe, pale yellow; fruit fleshy berry, globose when mature ([Figure 1](#)).

Confusion with other species: *Alocasia indica* (Lour.) Spach was first reported in 1846 at the Naturelle des Vegetaux. Phanerogams in the volume 12 and issue 47 of the publication and *Alocasia macrorrhizos* (L.) G.Don was first reported in Sweet's Hortus Britannicus or a catalogue of cultivated plants in the gardens of Great Britain, third edition in 1839 ([IPNI 2023](#)). The two species are different species but often confused with its identification or wrongly treated as synonyms. *A. macrorrhizos* commonly known as Gaint Taro differentiates from *A. indica* with the dark green colour, ovato-sagittate, bluntly triangular in outline lamina, apex pointed upwards and more importantly its coriaceous or glossy green leathery surface with prominently distinct primary veined on the abaxial surface and glands in the axils of primary veins (Boyce 2008). This is supported by the photographs of *A. macrorrhizos* given in Kew Science Photographs (<https://powo.science.kew.org>; [Joshi et al., 2015](#); [Muller et al., 2023](#); [Nakhuru et al., 2021](#)). Many times, research activities have been published with *A. macrorrhizos* and wrongly identified as *A. indica* and vice versa. For example, antioxidant and hepatoprotective activity has been carried out of *A. indica* but the photographs illustrated shows the *A. macrorrhizos* ([Pal et al., 2014](#)). Sometimes, *A. macrorrhizos* has been wrongly

revealed as synonym of *A. indica* (Islam et al., 2013). In manipur, majority of the people locally refer *A. indica* as yendem and *A. macrorrhizos* as Hongoo. However, the confusion created due to misidentification has led to the wrong interpretation of the local names of the two species (Singh and Sharma 2018; Singh 2010; Sharma et al., 2015; Patil et al., 2012; Islam et al., 2013) The above quoted publication showed the misidentification. Some published documents like Srivastava et al., 2009; Singh 2010; Joshi et al., 2015; Sharma et al., 2015; Singh et al., 2018; Nakhuru et al., 2021 showed the right identification. This confusion needs to be cleared for the best possible outcome of the research activities.

Ethnobotany of *A. indica*: The present study shows that the leaf, petiole and corm are edible which are consumed in various ways of delicacies. The petiole along with the leaf is commonly cooked and consumed whereas the corm is commonly consumed as fresh in spicy salad known as Singju which can also be consumed as cooked vegetables. It is considered that this species is rich in iron content and so the cooked petiole is given during post-delivery of child birth which helps in the faster recovery. The leaf lamina is slightly roasted on fire directly and applied externally to reduce boils and swellings. Out of the various ways of consumption, the preparation of salad out of the corm of *A. indica* is illustrated in Figure 2. Reports have shown that the petiole is having blood purifying and good astringent properties and so it is used to cure cuts and wounds. The petiole tonic and the petiole paste is applied to forehead to reduce dizziness. The petiole is prescribed by the local healers to treat arthritis and rheumatic pains. The ash of the burnt petiole is mix with honey to treat dry cough. The corm is consumed to treat piles and constipation (Srivastav et al., 2009; Singh and Sharma 2018; Sharma et al., 2015). In other words, the whole plant is highly nutritional with good therapeutic properties. Other reports revealed that the high content of Vitamin C in this species recommended to consumed as it could help prevention of many diseases (Nakhuru et al., 2021). Although reports have shown the tuber or corm, leaves and roots possess antioxidant properties, tuber to have antibacterial, antidiabetic and antihyperlipidemic activity, the misidentification of species have created confusion and proper identification needs to be carried out before further research activities proceed (Ongpoy 2017; Mulla et al., 2009; Patil et al., 2012). There is a rich diversity of Araceae family flora in the state of Manipur but the local name Yendem refers to only one species *A. indica* and people of Manipur are well aware of this species as it is a very common vegetable and are cultivated in most home gardens. This indicates

that ethnobotany of Yendem given by Manipuri researchers is most likely that of *A. indica* even if it is misidentified as *A. macrorrhizos*.

Alocasia as nutraceutical plant: Each part of the plant *A. indica* is edible and has high nutritional value. The different parts of the species have its own importance in terms of food value and therapeutic values (Figure 3). The people of Manipur especially the Meitei community are aware of the importance of this species. Apart from the high content of Iron and Vitamin C, the corm is rich in carbohydrates too. The high nutritional and therapeutic values of the species makes the species *A. indica* as a highly potential nutraceutical plant. Keeping this point, the species could be marketed fresh or dried or cultivated in similar habitat i.e., moist terrestrial habitat or in flower pots to be consumed as vegetable. This could help to reduce the inability of the growing population in India to purchase high price nutritional diets or to find a solution towards food insecurity issues.



Figure 1: *Alocasia indica* and its different plant parts: a) Whole plant in its habitat b) Watery sap from petiole c) Leaf lamina d) Corm e) Adventitious roots on corm f) Leaf petiole



Figure 2: Preparation of the spicy salad (Singju) out of the corm of *A. indica*

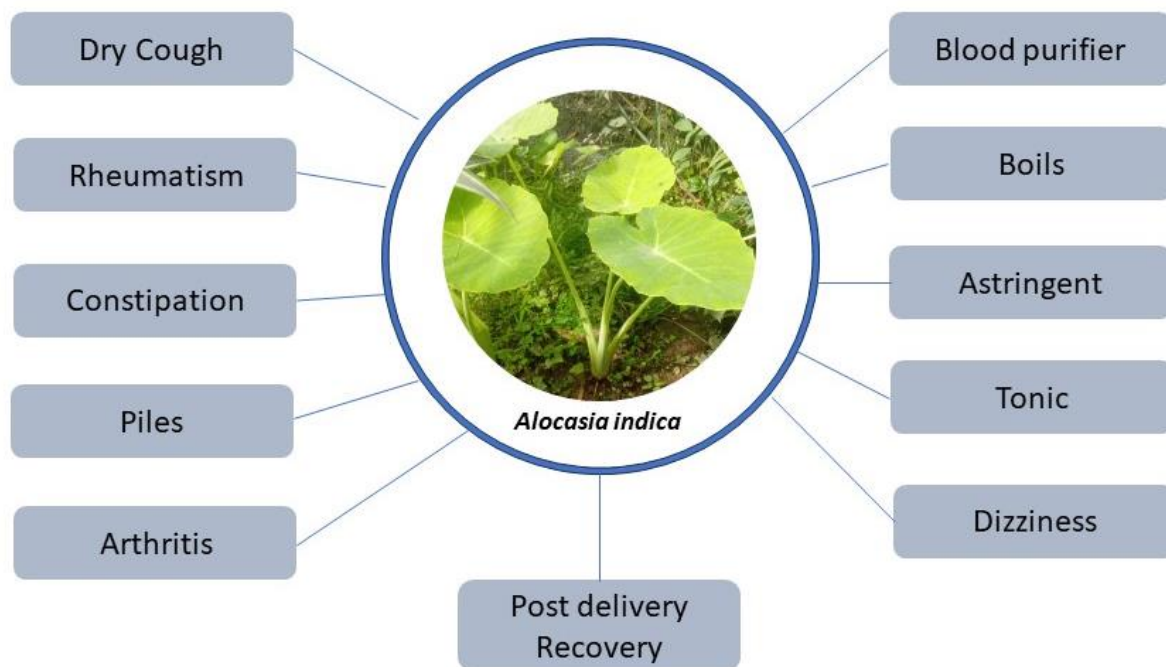


Figure 3: Ethnobotanical uses (therapeutic) of *A. indica* by the Meitei community of Manipur

Conclusion: As discussed above, *A. indica* is a highly nutritional plant, which also and possess a high therapeutic value. Each part of the plant has specific food and therapeutic uses which makes the species highly potential nutraceutical plant. Further, more research needs to be carried out to find out the nutritional components and to analyse the phytochemical compounds responsible for its therapeutic values after proper identification of the plant species.

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Pollination in Cucurbitaceae family

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DOI: 10.5281/zenodo.10029102

Abstract: Pollination is an important ecological phenomenon where life exists and grows. Insects are the most important pollinators of plants. From plants, people get food, medicines, and other life stuff, which are actual results of pollination. Among the plant species, the edible and medicinal plants of the Cucurbitaceae family are the most common and oldest. Keeping this in mind, an attempt has been made to document the common pollinators in the Cucurbitaceae family. The field survey was carried out at agricultural lands in 24 parganas, Nadia, Hooghly, and Midnapore of West Bengal, India, during 2021–2023, and enumerated the pollinators. Results revealed that about 36 pollinators pollinate 11 common cucurbits in the study areas. It was noticed that selected plants are used for food and medicinal purposes. The study highlights the need for pollinators for the existence of human beings.

Keywords: Pollinators, fertilization, edible plants, fruits

Introduction: Cucurbitaceae is a family of many plant species with food values (Rolnik and Olas 2020). The most common vegetable in our kitchen, from tribal to urban areas, belongs to the family Cucurbitaceae. Some plants have only medicinal values in this family, and some plants act as nutraceuticals. The most common genera of the family are *Cucurbita*, *Lagenaria*, *Citrullus*, *Cucumis*, *Momordica*, *Luffa*, etc. The plant species of these mentioned genera have food values and are mostly used as vegetables. The common vegetables of this family are *Cucurbita pepo*, *Cucurbita maxima*, *Cucurbita moschata*, *Lagenaria siceraria*, *Citrullus lanatus*, *Cucumis melo*, *Momordica charantia*, *Momordica cochinchinensis*, *Momordica dioica*, *Luffa acutangula*, *Luffa aegyptiaca*, etc.

The species are mainly pollinated by bees but also by birds, butterflies, bats, flies, moths, and ants. Pollination is very important for fruiting and producing seeds for the next generation, continuously increasing the population in the wild, and providing seeds

for sustainable cultivation. If pollinators do not exist in nature, humans will lose many foods from plants. Therefore, knowing about the relationship between food plants and pollinators is very important. Due to deforestation, anthropogenic activities, monocropping, and climatic changes, pollinators are going to go extinct, which will be a problematic issue in the future (Shivanna 2022). Hence, we need to maintain the ecological balance for sustainable ecoservices. Keeping this in view, an attempt has been made to enumerate some common pollinators of common plant species in the Cucurbitaceae family with food values.

Methodology: The field study will be carried out on the agricultural lands of 24 parganas, Nadia, Hooghly, and Midnapore in West Bengal, to explore the diversity of insects and other pollinators of the proposed plants. The pollinators on selected plants (Ridge gourd, Sponge gourd, Ash gourd, Bottle gourd, Snake gourd, Cucumber, Bitter gourd, Melon, Scarlet gourd, Sweet gourd, and *Cucurbita moschata*) of the Cucurbitaceae family are observed and noted.

Observed plant species were identified by my research guide. The visitors and significant pollinators were also determined by using previous researches and help by the identification department of Zoological Survey of India, Kolkata.

For observed species, floral traits of floral shapes, floral colours, floral rewards, landing platform, nectar guide present or absent, odour and floral symmetries were recorded. Total observation periods were 10 hours in field per day. Visitation rates of each visitor were watched and recorded. Visitation rates of all visitors and significant pollinators were calculated.

Results and discussion: The survey revealed that about 36 pollinators were observed on the flowers of Cucurbitaceae plants (Ridge gourd, Sponge gourd, Ash gourd, Bottle gourd, Snake gourd, Cucumber, Bitter gourd, Melon, Scarlet gourd, Sweet gourd, and *Cucurbita moschata*). It was noticed that they belong to seven orders. The highest pollinators were recorded in the order Lepidoptera (17), followed by Hymenoptera (8), Blattodea (4), Coleoptera (3), and each species from Diptera, Mantodea, and Orthoptera.

Details are listed in Table 1 and illustrated in Figure 1. Some common pollinators are shown in Figures 2–7. Morphological variations of selected plants are also studied and presented in Table 2.

Table 1: Common enumerated pollinators of Cucurbitaceae family

Scientific Name	Order	Family
<i>Amata cyssea</i> Stoll, 1782	Lepidoptera	Erebidae
<i>Apis dorsata</i> Fabricius, 1793	Hymenoptera	Apidae
<i>Apis florea</i> Fabricius, 1787	Hymenoptera	Apidae
<i>Aulacophora foveicollis</i> Lucas, 1849	Coleoptera	Chrysomelidae
<i>Aulacophora indica</i> Gmelin, 1790	Coleoptera	Chrysomelidae
<i>Aulacophora lewisii</i> Baly, 1886	Coleoptera	Chrysomelidae
<i>Blatta orientalis</i> Linnaeus, 1758	Blattodea	Blattidae
<i>Blattella germanica</i> Linnaeus, 1767	Blattodea	Ectobiidae
<i>Botyodes asialis</i> Guenée, 1854	Lepidoptera	Crambidae
<i>Camponotus compressus</i> Fabricius, 1787	Hymenoptera	Formicidae
<i>Chabula acamasalis</i> Walker, 1859	Lepidoptera	Crambidae
<i>Coccinella transversalis</i> Fabricius, 1781	Coleoptera	Coccinellidae
<i>Delias eucharis</i> Drury, 1773	Lepidoptera	Pieridae
<i>Diacamma rugosum</i> Le Guillou, 1842	Hymenoptera	Formicidae
<i>Diaphania hyalinata</i> Linnaeus, 1767	Lepidoptera	Crambidae
<i>Diaphania indica</i> Saunders, 1851	Lepidoptera	Crambidae
<i>Glyphodes bicolor</i> Swainson, 1821	Lepidoptera	Crambidae
<i>Glyphodes bivitalis</i> Guenée, 1854	Lepidoptera	Crambidae
<i>Hieroglyphus banian</i> Fabricius, 1798	Orthoptera	Acrididae
<i>Hippotion celerio</i> Linnaeus, 1758	Lepidoptera	Sphingidae
<i>Lerema accius</i> Smith, 1797	Lepidoptera	Hesperiidae
<i>Loboptera decipiens</i> Germar, 1817	Blattodea	Ectobiidae
<i>Mantis religiosa religiosa</i> Linnaeus, 1758	Mantodea	Mantidae
<i>Monomorium minimum</i> Buckley, 1866	Hymenoptera	Formicidae
<i>Oecophylla smaragdina</i> Fabricius, 1775	Hymenoptera	Formicidae
<i>Parapoynx villidalis</i> Walker, 1859	Lepidoptera	Crambidae
<i>Parotis marginata</i> Hampson, 1893	Lepidoptera	Crambidae
<i>Periplaneta americana</i> Linnaeus, 1758	Blattodea	Blattidae
<i>Pieris brassicae</i> Linnaeus, 1758	Lepidoptera	Pieridae
<i>Poliobotys ablactalis</i> Walker, 1859	Lepidoptera	Crambidae
<i>Pycnarmon cribrata</i> Fabricius, 1794	Lepidoptera	Crambidae
<i>Spoladea recurvalis</i> Fabricius, 1775	Lepidoptera	Crambidae
<i>Syrphus ribesii</i> Linnaeus, 1758	Diptera	Syrphidae
<i>Theretra silhetensis</i> Walker, 1856	Lepidoptera	Sphingidae
<i>Xylocopa aestuans</i> Linnaeus, 1758	Hymenoptera	Apidae
<i>Xylocopa latipes</i> Drury, 1773	Hymenoptera	Apidae

Table 2: Morphological variations of selected cucurbits

Scientific name of the selected cucurbit crops	Color of the Flower	Male and Female flower ratio	Flower anthesis	Floral resource
<i>Cucumis melo</i>	Yellow	12:1	Early morning until afternoon	Nectar and pollen
<i>Cucurbita maxima</i>	Yellow	31:11	Early Morning until noon	Nectar and pollen
<i>Cucurbita moschata</i>	Yellow	33:15	Early Morning until noon	Nectar and pollen
<i>Cucurbita pepo</i>	Yellow	32:10	Early Morning until noon	Nectar and pollen
<i>Lagenaria siceraria</i>	White	15:5	Early evening until afternoon of the next day	Nectar and pollen
<i>Luffa acutangula</i>	Yellow	47:9	Early evening until the late night	Nectar and pollen
<i>Luffa aegyptiaca</i>	Yellow	23:1	Before sunlight of the morning to noon	Nectar and pollen
<i>Momordica charantia</i>	Yellow	37:2	Early morning before sunlight to noon	Nectar and pollen
<i>Momordica cochinchinensis</i>	Yellow whitish	17:3	Early morning	Nectar and pollen
<i>Momordica dioica</i>	White	11:3	Early morning	Nectar and pollen
<i>Trichosanthes cucumerina</i>	White	17:1	Early evening to next day morning	Nectar and pollen

Some other researchers have also documented the pollinators of plants belonging to Cucurbitaceae family. Canto and Parra (2000) reported the pollinators of *Cucurbita moschata* whereas Rust et al. (2003) reported the pollinators of *Ecballium elaterium*, a mediterranean endemic. Andrews et al. (2007) reported the pollinators of Cucurbita family. Santos et al. (2008) also reported the pollinators of *Cucumis sativus*. Mitchell et al. (2015) reported the role of moth pollinators in Cucurbitaceae. The above reports revealed that, the works has been done but not in deep. During our observations, authors have also seen other pollinators like *Ceratina hieroglyphica*, *Ceratina smaragdula*, *Braunsapis picitarsis*, *Halictus taprobanae*, *Halictus timidus*, *Trigona spinipes*, *Macroglossum neotroglodytus*, *Cephonodes picus* etc.

Medicinal values of selected cucurbits: During work on pollination of selected cucurbits (Ridge gourd, Sponge gourd, Ash gourd, Bottle gourd, Snake gourd, Cucumber, Bitter gourd, Melon, Scarlet gourd, Sweet gourd, and *Cucurbita moschata*), authors found that they have not only food values but they are used for medicinal purposes in study areas. The fruits of Bitter gourd are used in diabetes; Ridge & Sponge gourds are used against constipation; Cucumber is used to enhance the appetite; Bottle gourd is good for sound health.

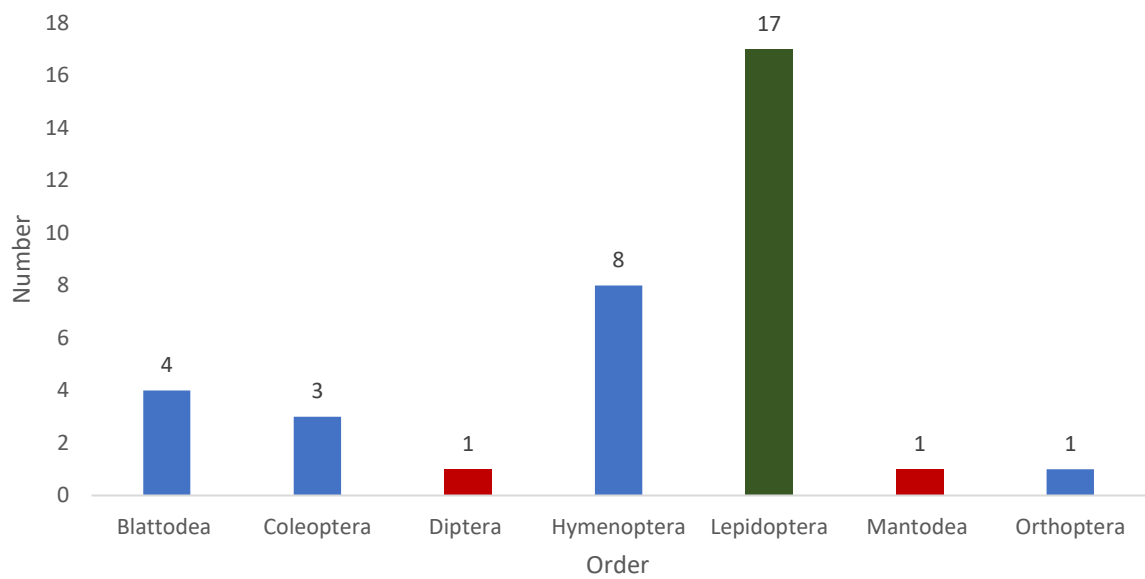


Figure 1: Pollinator diversity of Cucurbitaceae family in different orders



Figure 2: Pollination in *Luffa acutangula* flower by *Diaphania indica*

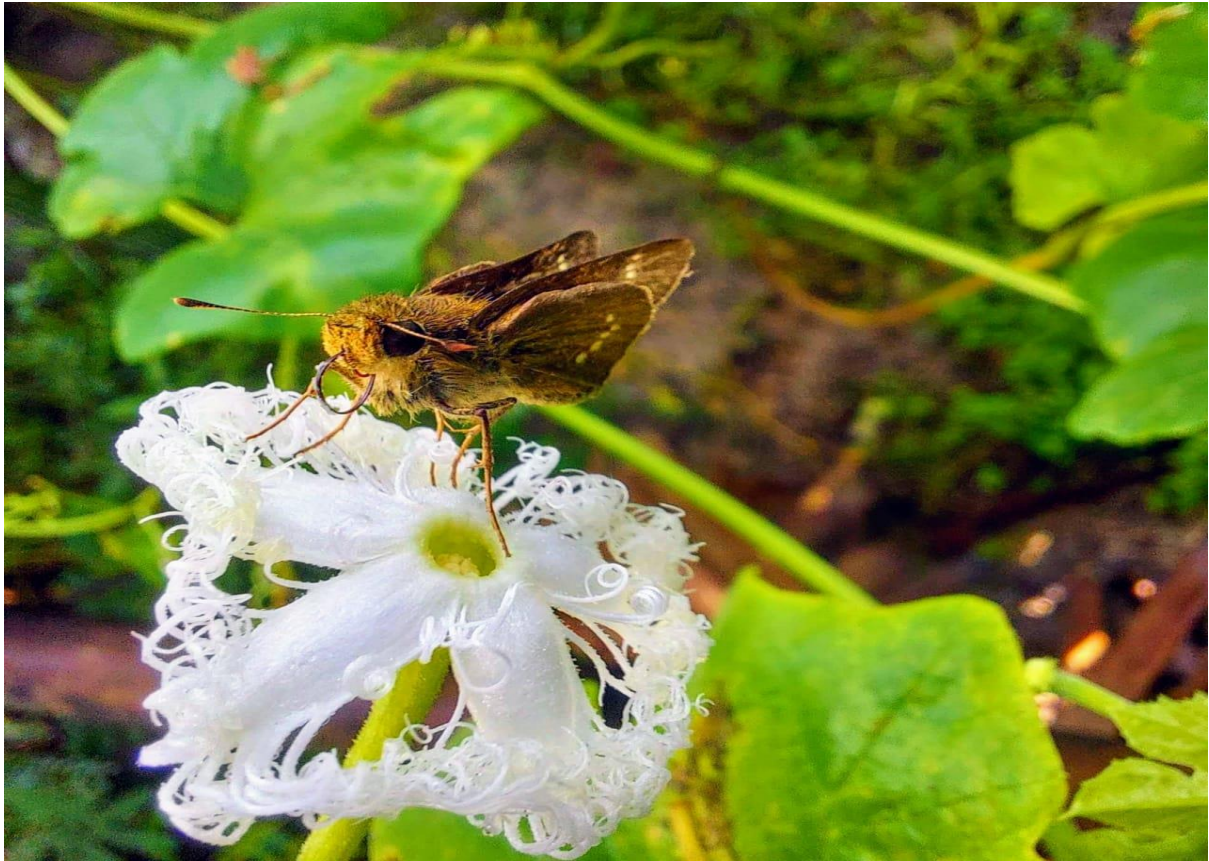


Figure 3: Nocturnal visitation, *Lerema accius* on the flower of *Trichosanthes cucumerina*



Figure 4: Pollination in *Luffa acutangula* flower by *Bastilla simillima*

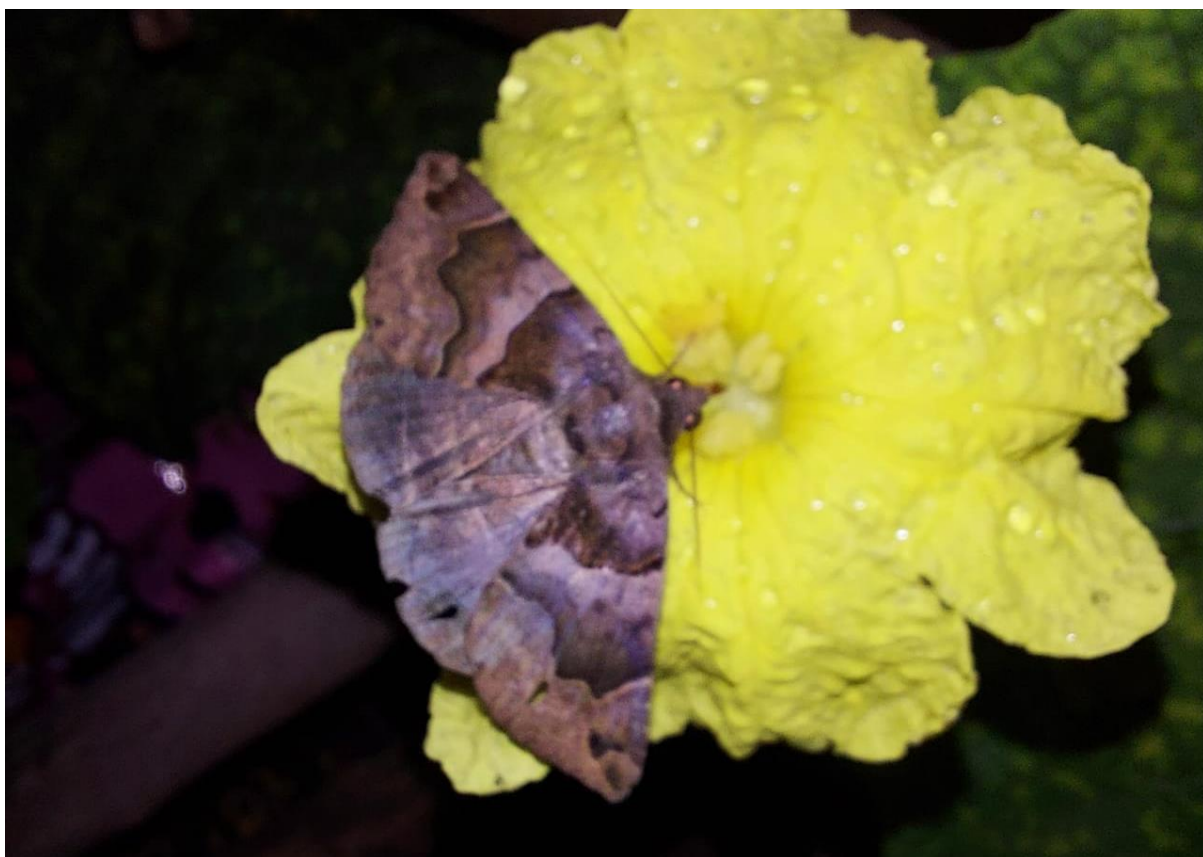


Figure 5: Pollination in *Luffa acutangula* flower by *Patania ruralis*



Figure 6: *Apis dorsata* on *Luffa acutangula*



Figure 7: *Xylocopa latipes* on Sponge gourd (*Luffa cylindrica*)

Conclusion: The present study highlights the importance of pollinators in the Cucurbitaceae family. Most species in this family are used as food and medicines. Therefore, the study concluded that there is an urgent need to document the pollinators in this family and also to develop their conservation strategies. It also suggests that there is a need for documentation of pollinators for other native crops.

Acknowledgement: The authors acknowledge the help of Dr. Sheela S. (Scientist- E & officer in-charge, CEL section), Zoological Survey of India for extending their help during identification of insects.

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The book consists of seven chapters related to different medicinal and nutraceutical plants. 27 researchers from different states of India have contributed and documented the medicinal uses and food values of many plant species of India.



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