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E-Newsletter of the Department of Botany, Dudhnoi College and
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Nature Trails, a quarterly e-newsletter of the Department of Botany, Dudhnoi College and Alumni Association of Botany Department, Dudhnoi College
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Cover page: a few indigenous seasonal fruits – Indian red pear (*Protium serratum*), Jamun (*Syzygium cumini*), Mulberry (*Morus alba*), Burmese grape (*Baccaurea sapida*), Jackfruit (*Artocarpus heterophyllus*), Pineapple (*Ananas comosus*)

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Editor's Page

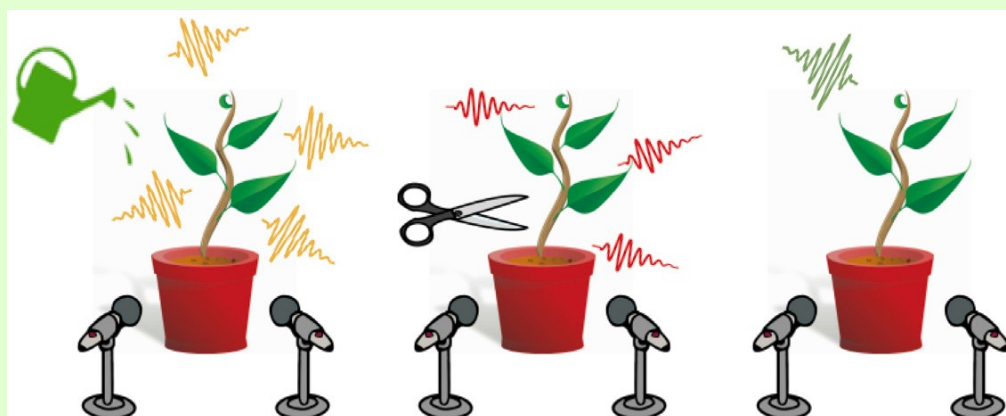
~Dr Shahadev Rabha

The ability to communicate by emitting sound is one of the most important characteristics of animals. They can share their feelings and emotions with others using different types of sounds. Some animals such as bats use ultrasonic sound to find their food. What if plants can express their emotions by emitting sound energy like animals?

As we all know, plants are living being and have senses like sense of light (phototropism), sense of gravity (geotropism), and sense of touch. These make them able to sense and respond to the environment by adjusting their morphology and physiology. A recent study shows that plants emit airborne sounds. Yes, plants emit airborne ultrasonic sounds. A research article recently published in Cell journal revealed that plants at different environmental conditions emit different sounds which can be recorded from a distance and identified.

A study on stressed tomato and tobacco plants inside an acoustic chamber in a greenhouse revealed emission of ultrasonic sounds that are recordable, and the sounds are stress- and species-specific. Interestingly, these informative sounds may also be detectable by other organisms.

In the emerging era of artificial intelligence, the emission of detectable and informative sounds by plants may have a significant impact on agrotechnology and agriculture.



Stressed plants emit remotely detectable ultrasounds

Remembrance of the Visit to Damas, Meghalaya: the Coffee Plantation Village

Dr Dipali Deka

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Field study is an essential part of Life Science and especially of Botany. The plant world in their natural habitat is one of the most interesting angles, which is very much necessary to be studied by the students of Botany. Field study in Botany includes direct observation and collection of plant materials, through a survey of a particular area and face-to-face interview with a particular person related to plants.

The main aim of the field study is to analyze a special phenomenon, collect plant samples and observe vegetation in a particular area. The analyzed theories and observations are used to identify solutions for a specific project or case report.

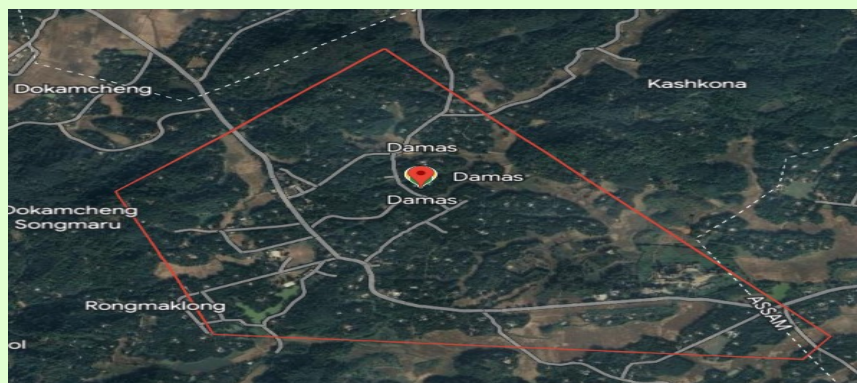
Fieldwork help to break down barriers between students and teachers and it gives an opportunity to develop soft skills among students such as leadership, teamwork, curiosity and communication skills. It contributes to students' personal and social development.

Considering all these facts, the Department of Botany, Dudhnoi College has been conducting field trips for honours students every year in different places for the last 35 years.

A field trip was arranged by the faculty members of the Department of Botany, Dudhnoi College for the honours students of the 1st, 3rd and 5th semester of the department to the coffee plantation site of Damas, a village of North Garo Hills district in Meghalaya on 23 December 2020.

Damas village is located in the Resubelpara subdivision of the East Garo Hills district in Meghalaya which is 17 km. away from sub-district headquarter Resubelpara (Tehsildar office) and 70 km away from district headquarter Williamnagar. The extension of this village is about 25°56'04'' N latitude to 25°56'58'' N latitude and 90°43'20'' E longitude to 90°43'50'' E longitude. The altitude of this village is 93.03 m. According to the census report of 2011, the location code or village code of Damas village is 274695. The total population of the village is 1606 out of which the male population is 799 and the female population is 807. The literacy rate is 78.39%. For all major economic activities, Resubelpara is the nearest town to Damas village.

A total of 40 families in Damas have been growing coffee where a total amount of 20,000 kg coffee beans are produced annually. The word 'Coffee' is derived from the word 'Kaffa', the name of a district in Shoa of South-West Abyssinia wherefrom the coffee plant was discovered. Commercial coffee is prepared from the roasted and powdered beans of different species of coffee plants.



Location of the village (Source: Google Earth)

There are 25 species of coffee distributed all over the world, out of which commercially important species are *Coffea arabica* L. (Arabian coffee), *Coffea liberica* Bull ex. Hiern (Liberian coffee), *Coffea robusta* Linden (Congo coffee) and *Coffea stenophylla* G. Don (Sierra Leone coffee).

C. arabica and *C. robusta* are the two economically important species, which are extensively cultivated in India. The characteristics of these two species may be mentioned as follows.

- (i) *C. arabica* L. (n = 22): This species prefers cool and dry climates and mountainous regions. Its growth is average and fruiting is normal. It is susceptible to climate and disease. The beans of this species are long and wide. Caffeine content is 1-1.2% and contributes about 90% of the world's production. *C. arabica* yields high-quality coffee.
- (ii) *C. robusta* Linden (n = 11): This species prefers warm, humid climates and lowlands. Its growth is vigorous, fruiting prolific and resistant to diseases. Its beans are broad and oval and its caffeine content is 1.5 - 2.5%. It contributes about 9% of world production.

Coffee plantations in India

In India, coffee production is dominated in the hill tracts of South Indian states with Karnataka (71%), Kerala (21%) and Tamil Nadu (5%). Indian coffee is said to be the finest coffee and 98% of them are cultivated by small growers. 80% of Indian coffee is exported.

Some new areas are found to be developed in the non-traditional areas of Andhra Pradesh and Odisha on the Eastern coast of the country and with a third region comprising the states of Assam, Manipur, Meghalaya, Mizoram, Tripura, Nagaland and Arunachal Pradesh of N.E. India.

Meghalaya has been producing high-quality coffee in the country. Commercial plantation of coffee is relatively new and limited in Meghalaya. In Meghalaya, coffee gardens were first established in 1954 by Soil and Water Conservation Department at Umling (Ri-Bhioi district), Lumsnong (East Jayantia Hills district) and Tura (West Garo Hills district). At present, it is grown in 6 districts across the state and yields 200 metric tonnes (as per a Govt. report of 2016-17) of coffee.

Damas is a Garo community-dominated village at Meghalaya and near the border of Assam (mainly Goalpara district), which is popularly known as a 'Coffee plantation village' in recent days. Mr. Minathson M. Marak, a coffee grower at Damas is a retired teacher of Govt. L.P. School. He started a coffee plantation in 1985. Beans (seeds) of *C. robusta* for cultivation were supplied by 'The Coffee Board' of Tura, which was free of cost. The climatic condition of Damas is favourable only for the cultivation of *C. robusta* and not of *C. arabica*. A negligible amount of funds was allotted by the Coffee Board for cleaning the jungle and maintaining the plantation. He alone planted 600 saplings of *Coffea robusta* in 4 bighas of land and produced around 300 kg (after drying) of beans. The dried beans were sold by him at the rate of 90 rupees per kg. As there was no nearby market for selling those materials so, he had to supply those dried beans to the Coffee Board of Tura at his own cost. So, due to high transportation charges, he had to face a great loss. Again, after purchasing, the Coffee Board credited the due amount to the bank account in the instalment system, which took a minimum of 4-6 months.

It is well known to all that coffee is a costly beverage. In recent days, dried beans of *C. arabica* are sold in the markets of Delhi, Chennai, etc. at the rate of 670 rupees per kg. Green beans of *C. arabica* are sold at the rate of 453 rupees per kg.

Nowadays dried beans of *C. robusta* are sold in the markets of Karnataka, Tamil Nadu etc. at the rate of 285 rupees per kg.

In comparison to this value, the price received from the Coffee Board of Tura by Mr Minathson Marak was discouraging.

Mr Minathson claimed that he would have made greater profits if he had grown some other crops on his 4 bighas of land instead of coffee.

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On the campus of Mr Minathson, there are 800 betel nut plants. As of the year 2020, out of 40 families around 20 families in Damas continued coffee cultivation. In the current year, i.e. 2023, it is observed that only 10 families have been maintaining coffee gardens on their campus.

Mr Minathson M. Marak reported that after delivering beans nobody from the Coffee Board of Tura visited Damas to observe their cultivation.



C. robusta bearing ripened beans



Moments of interactions with the local coffee growers

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On the campus of another coffee grower in Damas namely Sanjive Sangma, we had an opportunity to observe almost 500 coffee plants, planted in 3.5 bighas of land.

Gladwin Momin, another coffee grower of Damas has been maintaining about 400 coffee plants on his campus.

The climatic condition in all parts of the state of Meghalaya is favourable for coffee cultivation. But it has been observed that despite ample scope, cultivation of coffee in this state is almost a neglected subject. People in the state as well as the state government have not taken much initiative to encourage the coffee growers to increase cultivation of coffee.

Only the Coffee Board of the government of India encourages people to go for coffee cultivation. But it is observed that due to some technical problems both the coffee board and the growers have not achieved their goal.

If the state government of Meghalaya takes an effort to assist the interested farmers, coffee is the best crop from which farmers may earn a lot.



Honours students of 1st, 3rd & 5th semesters, teacher guides and employees of the department

The ‘Button Orchid’: An Orchid of Dicotyledons

Gitartha Saikia

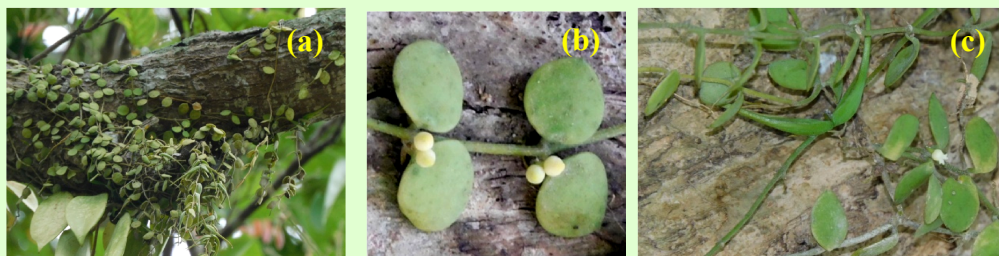
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Orchids, a distinct group of epiphytic monocotyledonous plants, are well known for their immense beauty with well-specialized floral synorganization such as pollinia, gynostegium, labellum and rostellum. Such unique synorganization is not very common among the other group of plant kingdom except the dicot members of the sub-family Asclepiadoideae of Apocynaceae *s.l.* Due to the presence of some orchid-like characters viz. pollinia in pollinarium with well-developed caudicle and corpusculum, gynostegium and epiphytic habit makes the group of these plants one of the evolutionary significant entity of plant Kingdom, can also be termed as the “Orchids of Dicotyledons”.

Dischidia nummularia R.Br., an epiphytic glabrous climbing herb belonging to the family Apocynaceae *s.l.* under the sub-family Asclepiadoideae, a native species of North East India to South East Asia and China. The plant is mostly found on the bark of mature trees or phorophytes viz. *Lagerostemia speciosa*, *Shorea robusta*, *Alstonia scholaris* etc. Leaves of this creeping herb are orbicular, opposite and shortly petiolate separated by an internode of 1–2 cm long. These orbicular leaves look like a button climbing or hanging on the tree trunk with some orchid-like features including well-developed pollinia, pollinarium and gynostegium makes the plant quite interesting, and hence it is commonly known as a ‘Button Orchid’.

Besides the floral beauty and advanced synorganization, the plant is traditionally used in various ethnomedicinal practices such as dermatological disorders (Deb, *et al.* 2012), cuts and wounds, cardiovascular diseases, pains and cancer (Silasahi, *et al.* 2015) by the traditional healers of Southeast Asia (Thailand, Indonesia and Tripura). While the phytochemical studies revealed the plant is enriched with cytotoxicity and anti-proliferative activities (Rehman *et al.* 2019).



Dischidia nummularia

(a) Habit of the plant, (b) Leaves with Flower, (c) Habit with flower and fruit.

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Traditional Knowledge and Intellectual Property Rights

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Traditional knowledge refers to the knowledge, innovations & practice of indigenous & local communities around the globe gathered through day-to-day walks of life. Traditional knowledge represents information knowledge, skill & technology along with standard management practices of agricultural knowledge, and medicinal knowledge which are being circulated from community to community and generation to generation. It tends to be collectively owned and takes the form of stories, songs, folklore, religious rituals, community laws etc. From its area of application and assortment management approaches, Traditional knowledge can be categorized into the following types.

- i. Traditional Ecological Knowledge
- ii. Traditional Medicinal Knowledge
- iii. Traditional Agricultural Knowledge and
- iv. Traditional Technical Knowledge.

Traditional ecological knowledge

This knowledge is specific to a place and it shows the relation between plants, animals, natural phenomena and the landscape that are used for livelihood and to sustain life, such resources are gathered through farming, agriculture, hunting, fishing etc. There are practices for weather forecasting also. E.g. in 2020, I got an opportunity to enrol myself in a one-month course on “Peoples Biodiversity Register (PBR)” which was conducted by the Ministry of Environment, Forest & Climate Change (MoEFCC) in collaboration with Assam Science Technology and Environment Council (ASTEC). During the course, I along with other participants visited a village named “DIKSHAK” which is a ‘Karbi Village’ located in Sonapur, Assam. There I came to know about traditional weather forecasting methods. The People of Karbi Hills of Assam have their traditional calendar system, which they use for agricultural planning. They use a phrase called “Thang Thang, Rit Lang” where “Thang Thang” represents the month of February” Rit” means ‘Jhum’(shifting cultivation), and “Lang” means ‘Land’ which they look for new Jhum cultivation. Their new year starts in February month. There are other phrases for the remaining months.

Traditional medicinal knowledge

Traditional medicinal knowledge is an important aspect of most local cultures & identities. Traditional medicinal knowledge is widely available in Indians’ daily life. Traditional knowledge is a vulnerable asset to indigenous & local communities. The preliminary healthcare needs of the population and livelihood of people in India depend on traditional medicine. It plays an important role in every Indian's daily life. It describes a group of healthcare practices and products with a long history of use. For Example, again I would like to mention here the spiritual rituals of the Karbi Tribes. During their Dehal/Deoxal Puja they make a garland using the Tulsi plant (*Ocimum sp.*). After the completion of Puja, they preserve the garland and use it for medicinal purposes to treat diseases like nose bleeding, headache etc. Some applications of traditional knowledge in our locality (i.e. Krishnai Paikan) regarding the treatment of different diseases of humans as well as animals may be mentioned as follows:

Plants used to maintain immunity and to prevent diseases like sugar, blood pressure, etc.

| S. No. | Plants | Scientific name |
|--------|----------|-------------------------------|
| 1. | Tulsi | <i>Ocimum sanctum</i> L. |
| 2. | Aamlokhi | <i>Emblia officinallis</i> L. |

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| | | |
|-----|-------------|---------------------------------------|
| 3. | Arjun | <i>Terminalia arjuna</i> (Robx.) |
| 4. | Posotiya | <i>Vitex negando</i> L. |
| 5. | Miskiri | <i>Morus aulba</i> L. |
| 6. | Ashwagandha | <i>Withania somnifera</i> L. |
| 7. | Holfoli | <i>Phyllanthus acidus</i> (L.) |
| 8. | Halodhi | <i>Curcuma longa</i> L. |
| 9. | Sarpagandha | <i>Rauwolfia serpantina</i> (L.)Benth |
| 10. | Nayantara | <i>Catharanthus roseus</i> (L.)G.Don |

Plants used for hair treatment:

| | | |
|-----|-----------|-----------------------------|
| 11. | Jetuka | <i>Lawsonia inermis</i> L. |
| 12. | Joba Ful | <i>Hibiscus</i> sp. L. |
| 13. | Vringoraj | <i>Wedelia chinensis</i> L. |
| 14. | Kehraj | <i>Eclipta prostrate</i> L. |

Plants used for bone fracture & swelling:

| | | |
|-----|-----------|---------------------------------|
| 15. | Haar Jora | <i>Cissus quadrangularis</i> L. |
| 16. | Gopakhi | <i>Drynaria quarcifolia</i> L. |
| 17. | Jaluk | <i>Piper nigrum</i> L. |

Plants used to treat animals (diseases like bloating, worms, ringworm etc):

| | | |
|-----|--------------|-------------------------------|
| 18. | Tita Bhekuri | <i>Solanum indicum</i> L. |
| 19. | Bhetai Tita | <i>Clerodendrum</i> sp. |
| 20. | Aada | <i>Zingiber officinale</i> L. |

Traditional agricultural knowledge

Traditional agricultural knowledge can be defined as an old-fashioned style of farming before the fall of modern techniques. Traditional agricultural knowledge involves the use of indigenous knowledge, traditional tools, organic fertilizer and cultural beliefs etc. This knowledge is gradually vanishing due to the increase in population and globalization. Modern agricultural practices and equipment are the major contributors to which traditional agricultural knowledge and traditional crops are becoming extinct day by day. Furthermore, climate change has a huge impact on the statistical distribution of weather patterns. India is vulnerable to climate change since the majority of its population depends on agriculture.

The Indian Council of Agricultural Research (ICAR) implemented a mission mode project on “Collection, Documentation and Validation of Indigenous Technical Knowledge” under National Agricultural Technology Project (NATP) in 2002. It will help sustain: farming practices preventing plant genetic erosion and environmental deterioration. It will also contribute to sustainable food security and variability of animals, plants and soil properties. Based on simple technology and defined management principles, some traditional agricultural practices are shown below.



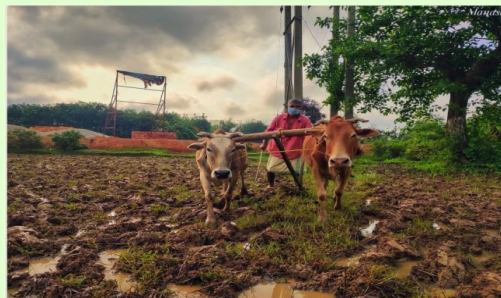
The traditional way of showing seeds



Soil aligning using banana stem



Traditional water dripping



Tilling using cow and wood plough

Traditional technical knowledge

It plays a significant role in our day-to-day walk of life. From the techniques leads to the discovery of fire to the development of human civilization, we are still connected with some traditionally known techniques. It includes the method of making houses to the method of different household equipment to survive. Some pictorial demonstrations of traditional technical knowledge which are being used for a long time are shown below.



The traditional way of making house



Basket making using water hyacinth



Traditional equipment for fishing



Traditional smithy



Stream water harvesting using bamboo

Intellectual Property Rights (IPR)

Intellectual property rights are the rights that are associated with the properties owned by persons, communities, countries, and companies and are protected against use without consent. IPRs aim to protect intellectual property by allowing the creators of trademarks, patents and copyright works to benefit from their creations. The property could be inventions, designs, symbols etc. There is mainly four recognized forms of intellectual property Patents, Trademarks, and Industrial Design & Trade secrets. It clearly shows that traditional knowledge does not find a place in the ambit of Intellectual Property. Since its conception, IPR has been mainly focused on the needs of the technologically advanced society.

Protection of traditional knowledge

There was never any provision for the protection of traditional knowledge. Currently, little attention is being paid to protecting traditional knowledge. But there is still no international mechanism in place for the protection of traditional knowledge. Traditional knowledge becomes an open treasure for misappropriation since this knowledge exists in the local language and its format is not understandable to patent examiners, few companies have seen taking advantage of this, they obtain a patent based on some of this traditional knowledge, but the role and contribution of Traditional knowledge holders has not been recognized.

In the era of biotechnological inventions, the basic genetic material derived from plants or animals is found in the biodiversity hot spot of developing countries. These resources are not adequately documented. These genetic materials are acquired by big multinational companies for their research & development work. Many of them contain traditional knowledge. Products like drugs, industrial enzymes, food flavours, fragrances, cosmetics & also genes are used for improving crops and livestock through genetic intervention are developed from such resources.

These research and development outputs are later patented, without sharing any kind of benefit with the original traditional knowledge holders & communities. This unauthorized extraction of biological resources and associated traditional knowledge is known as “Biopiracy”. If the Traditional knowledge is well documented then the prior art in the case of invention base such as biological material/Traditional knowledge will be readily available to the patent examiners.

To preserve and prevent the unlawful practice of traditional knowledge, India has created a digital database of prior art related to medicinal plants used in the Indian System of medicines like Ayurveda, Unnai, and Siddha. In 2001, Govt. of India set up the Traditional Knowledge Digital Library (TKDL) as a repository of 1200 formulations of various systems of Indian Medicine and 1500 yoga postures and translated into five international languages-English, German, French, Spanish and Japanese.

An interesting case study related to a patent for turmeric

In 1995, two persons of Indian origin at the University of Mississippi Medical Centre were granted a U.S. patent on the use of Turmeric in wound healing. The claim covered “A method of promoting healing of a wound by administering turmeric to a patient afflicted with wound”. This patent also granted them the exclusive rights to sell and distribute turmeric.

As we all know healing wounds by turmeric has been a “classic remedy” in India. In 1996 The Council of Scientific & Industrial Research (CSIR) India, New Delhi requested the U.S Patent & Trademark Office (USPTO) to revoke the patent on grounds of existing prior art. India provided documentary evidence of traditional knowledge including ancient Sanskrit text and a paper published in 1953 in the journal of the Indian Medical Association. The patent was then revoked in 1997.

Upendra Rice, an acknowledged black rice variety from Goalpara, Assam. Upendra Rabha after whom this rice is named is a progressive farmer who belongs to a village called Amguripara located near Dudhnoi in Goalpara district, Assam. He is the pioneer of black rice

cultivation in Assam. He has been associated with farming since 1985. He started black rice cultivation back in 2011 under the guidance of Krishi Vigyan Kendra, Dudhnoi Goalpara. It was an experimental cultivation and at that time only one paddy grew from one kg seeds, which later turned out to be a huge success. He exhibited his cultivated Black rice at an international exhibition held in Khanapara, Guwahati and this rice variety got recognition as "Upendra rice" from the Agriculture Department of Assam. His success encouraged many other farmers to cultivate black rice. At present, over 200 farmers are growing black rice in Dudhnoi, Goalpara and they are also exporting black rice to neighbouring states.

Acknowledgement

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Future Aspects of Fungi in Bioremediation

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Heavy metal pollution refers to the presence of metal elements, such as Hg, Zn, Cd, Pb, Cu, Cr, As, Mn, and Ni, that are released into the environment by various human activities like mining, smelting, processing, and commercial manufacturing and are considered significantly toxic to humans as well as to the natural ecosystem. Heavy metals negatively impact biological chains and cause ecological safety issues when they are ingested by people, animals, and plants. For example, excessive accumulation of heavy metals in water bodies can cause oxidative damage to aquatic plants, reduce nutrient absorption, and affect the development of aquatic animals. In terrestrial animals, the accumulation of heavy metals can reduce their competitiveness and viability and the size of their populations, consequently resulting in an ecological imbalance. In humans, exposure to heavy metals may lead to the development of a series of diseases, such as neurological and dermatological diseases, kidney damage, tumours, and cancers. Due to this, there has been a lot of research interest in investigating extremely effective methods to reduce environmental heavy metal pollution.

Physical, chemical, and biological methods can be used in heavy metal pollution cleanup. While physical and chemical treatments can typically remove a wide range of contaminants, their drawbacks include greater energy consumption, the need for additional chemicals, and secondary pollution. Biological remediation of heavy metal pollution, on the other hand, has attracted great attention because of its advantages, including high efficiency, low-cost and environmental friendliness, especially at low metal concentrations. Thus, the introduction of bioremediation agents, including microbes, is currently being researched thoroughly.

White rot fungi (WRF) is one of those agents that has been extensively studied for such purposes. These white-rot fungi are a heterogeneous group of fungi that belong to the Basidiomycota division. It is a famous degrader group in nature that has powerful biodegradability, thus demonstrating considerable potential for environmental applications. WRFs can degrade and transform complex lignin macromolecules and xenobiotics through the synergistic effects of enzymatic systems and free radicals. Owing to a broad substrate spectrum and the presence of environmentally friendly degradative enzymes, they are widely used for the degradation and remediation of organic pollutants such as pharmaceutically active compounds (PhACs), polycyclic aromatic hydrocarbons (PAHs), endocrine disruptor compounds (EDCs), herbicides, pesticides, and various other organic pollutants. With the development of knowledge and improvements in heavy metal pollution cleanup over the past few decades, the use of WRF for environmental applications has grown significantly, producing impressive results. For example, the use of polyethyleneimine (PEI)-modified *Phanerochaete chrysosporium* improves the efficiency of hexavalent chromium removal (Cr^{6+}) from wastewater. Approximately 344.48 mg/g of Cr^{6+} can be removed, of which ~32.5% can be converted to trivalent chromium (Cr^{3+}) under optimal conditions. Through intracellular accumulation and extracellular adsorption, *Phanerochaete chrysosporium* can also be employed to eliminate Pb. When the Pb content in a system is 50 mg/L, the maximum removal efficiency is 91.3%. Up to 205.1 mg/g Cu can be remedied by immobilising *Agaricus bitorquis* with Ca-alginate beads. *Phanerochaete chrysosporium* aids the remediation of Cd and Ni with adsorption efficiencies of 96.23% and 89.48% and corresponding adsorption capacities of 71.43 mg/g and 46.50 mg/g for Cd and Ni, respectively. *Schizophyllum commune* and *Pleurotus ostreatus* demonstrate removal capacities of uranium with removal rates up to $463.2 \pm 38.1 \mu\text{mol/g}$ and $441.8 \pm 79.4 \mu\text{mol/g}$, respectively.

From the information mentioned above, it is visible that heavy metal cleanup demands the application of various WRF strains and techniques.

Heavy metal pollution is a major environmental problem, and the rational selection of fungal resources for heavy metal remediation offers immense ecological and economic benefits. Although many researchers are working on bioremediation of heavy metal pollution by WRF, the capability and effectiveness of WRF for heavy metal remediation have not been systematically summarized so far. However, the use of WRF for heavy metal remediation and the progress achieved so far in this field has received tremendous attention from researchers and highlights future research prospects.

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Exploring the Rich Plant Habitat of Assam: A Biodiversity Hotspot

Aynul Haque

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Assam, a northeastern state of India, is a land of diverse natural beauty and abundant flora and fauna. The region's unique geographical location, coupled with its favourable climatic conditions, has fostered the development of a rich plant habitat. Assam's plant life showcases a remarkable array of species, from lush tropical rainforests to expansive grasslands, wetlands, and riverine ecosystems. This article delves into the captivating plant habitat of Assam, highlighting its significance as a biodiversity hotspot.

Tropical Rainforests: Assam boasts dense tropical rainforests, particularly in the southern and southeastern parts of the state. These rainforests receive substantial rainfall and are characterized by towering trees, thick undergrowth, and a multitude of epiphytes. Some notable tree species found here include the towering *Dipterocarpus macrocarpus*, the aromatic *Aquilaria malaccensis* (Agarwood), and the prized timber tree *Dipterocarpus turbinatus*. The rainforests of Assam are vital habitats for a wide range of animal species as well.

Wetlands and Marshes: The wetlands and marshes of Assam, such as the Kaziranga National Park and the Dibru-Saikhowa National Park, are home to a diverse array of plant species. These habitats are dominated by aquatic plants like the beautiful water lilies (*Nymphaea* sp.), floating hearts (*Nymphoides* sp.), and the majestic lotus (*Nelumbo nucifera*). The wetlands provide crucial breeding grounds for various aquatic animals and migratory birds.

Grasslands and Savannahs: The Brahmaputra Valley in Assam is adorned with expansive grasslands and savannahs, locally known as "beels." These grassy habitats, interspersed with scattered trees, support a distinct plant community. Species like *Saccharum ravennae* (Ravenna grass), *Imperata cylindrica* (Cogon grass), and *Arundo donax* (Giant reed) dominate the grasslands. These areas attract a variety of herbivores and provide valuable grazing grounds.

Riverine Ecosystems: The rivers that flow through Assam, including the mighty Brahmaputra and its tributaries, shape unique ecosystems along their banks. These riverine habitats harbour a plethora of plant species, including large trees like the *Bombax ceiba* (Red silk cotton), *Terminalia myriocarpa* (Black Myrobalan), and *Sterculia villosa* (Sterculia). The intricate interplay between the river's water levels and the soil's fertility nurtures a diverse assemblage of plant life.

Montane Forests: The hilly regions of Assam, especially in the north, are adorned with montane forests. These forests are characterized by a mix of evergreen and deciduous trees, including species like *Castanopsis indica*, *Lithocarpus fenestratus*, and *Alnus nepalensis*. The montane forests house a variety of ferns, orchids, and mosses, adding to their aesthetic appeal. They provide habitat to several unique bird and mammal species, including the elusive red panda.

Conservation and Challenges: The plant habitat of Assam faces several challenges, including deforestation, habitat fragmentation, and encroachment. Ensuring the conservation of these ecosystems is crucial to maintaining the rich biodiversity of the region. Efforts such as protected areas, wildlife sanctuaries, and community-based conservation initiatives have been instrumental in safeguarding Assam's plant habitat. Additionally, raising awareness among local communities and implementing sustainable land-use practices can contribute to the long term.

Herb of Grace

Rupathi Khakhalary

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One day, I noticed my mother bringing a plant from a neighbour's home. I asked her what it, what is the name of the plant is, does it bloom. She said it is called Brahmi and your neighbour Aunty said it is good for the brain as it improves brain functioning. I immediately refuse, how a mere small plant can boost brain functioning. Mother said it is a medicinal plant mostly used in Ayurvedic medicines and the herb not only boosts brain functioning but is also beneficial for various health issues. Let's know more about this plant.

Bacopa monnieri or Waterhyssob or locally known as **Brahmi** is a perennial herb that has been used for centuries for traditional Ayurvedic medicines. It is also known as thyme leaved gratiola and Herb of Grace, and mostly grows in wet and tropical environments native to India, Indonesia, Sri Lanka and Australia.

Bacopa monnieri is a succulent, glabrous, creeping herb with roots at nodes. The leaf blade is regular round to linear and the venation is pinnate. The flowers are produced from leaf axils, usually symmetrical with five petals and five sepals and are usually white to purple. The plant is easily recognized because of its spreading and fleshy leaves. The leaves of Brahmi are used for medicinal purposes and contain Bacosides compound. These compounds are believed to be responsible for all the benefits.

Benefits of consuming *Bacopa monnieri*

Antioxidant: Antioxidants are substances that protect cells against free radicals. This may play a role in heart disease, cancer and other diseases. *Bacopa monnieri* contains powerful compounds such as Bacosides that have antioxidant effects.

Inflammation: Inflammation is an essential part of the body's healing process. Chronic, low-level inflammation has been linked to many chronic conditions including cancer, diabetes, and heart and kidney diseases. A study showed that *Bacopa monnieri* releases pro-inflammatory cytokines which are molecules that stimulate an inflammatory immune response.

Boost brain function: Taking *Bacopa monnieri* daily may improve the speed of processing visual information, learning rate, and may improve memory, also cure Alzheimer's.

Anti-cancer property: Test tube studies found that *Bacopa monnieri* may have anti-cancer properties. Research suggested that high levels of antioxidants and compounds like Bacosides in *Bacopa monnieri* may be responsible for its cancer-fighting properties.

Reduce ADHD: ADHD also called Attention Deficit Hyperactivity Disorder is a chronic condition including attention difficulties, hyperactivity and impulsiveness. Research has shown that *Bacopa monnieri* help reduce ADHD symptoms like restlessness and self-control. However it has some side effects too, it may cause digestive symptoms including nausea, stomach cramps and diarrhoea. While *Bacopa monnieri* is generally considered safe for most people it may cause mild gastrointestinal discomfort in some individuals. Pregnant or breastfeeding women, as well as individuals with specific medical conditions or those taking certain medications, should exercise caution and seek professional advice before using *Bacopa monnieri* supplements.

In conclusion, *Bacopa monnieri* is a medicinal herb with a long history of use in traditional medicine. Its potential cognitive-enhancing effects, mood-stabilizing properties, and antioxidant activity make it a subject of interest in scientific research. As with any herbal supplement, it is important to approach its use with caution, seek professional advice, and adhere to recommended dosages.

Reference

(1) Ryan. R. (2019). *7 Emerging Benefits of Bacopa monnieri (Brahmi)*.

Utilization of Certain Aquatic Angiospermic Plants by the Rabha Tribe of Southern region of Goalpara District

Jyoti Rabha

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Aquatic angiospermic plants are plants that grow in water bodies. It is an important part of the aquatic ecosystem. They are the conspicuous plants that dominate wetlands, shallow lakes, rivers and streams.

Aquatic plants are plants that have adapted to living in aquatic environments. They are those plants which grow in water and spend at least a part of their life cycle in water.

Dudhnoi is a town and subdivision in the Goalpara district of Assam. It is located 31 km south of Goalpara Town. I had surveyed this area in connection with my 6th-semester project work session 2022-2023 and I came to know that there are many people of Rabha tribe here. This place is very resourceful for the survey and there are a lot of places to talk about that no one has ever known.

Enumeration:

| Scientific name/ family | Local name | Part used | Uses |
|--|-------------------------------------|-----------------------------------|---|
| <i>Monochoria hastata</i> (L.) Solms./ (Potentillaceae) | Nikunsuni (Rb/R), Bhat meteka (Ass) | Flowers and leaves | Flowers and young flowers with inflorescence are eaten cooked as vegetables. |
| <i>Hydrilla verticillata</i> (L.f.) Royle./ (Hydrocharitaceae) | Sial-bhobra (Rb/P), (Ass) | Stem | They are generally used for the photosynthetic experiment as they lack and used their entire body surface for the exchange of gases. Thus, oxygen released can easily be seen in the form of bubbles. |
| <i>Trapa bispinosa</i> Roxb./ (Trapaceae) | Singira kata (Rb/P) | Whole plant | The whole plant is used in gonorrhoea, menorrhagia, and other genital affections. It is useful in diarrhoea, dysentery etc. The seed present within this fruit is edible. |
| <i>Pistia stratiotes</i> Linn./ (Araceae) | Puni khar (Rb/R) | Leaves and roots | It is useful for fever and diseases of the blood. The root is laxative, emollient and diuretic. |
| <i>Eichornia crassipe</i> (Mart.) Solms./ (Pontederiaceae) | Pankhar (Rb/R), Meteka (Ass) | Young leaves and petioles | Young leaves and petioles cooked. It can be used as a hair fragrance, and snake bites. |
| <i>Nymphaea pubescens</i> Willd./ (Nymphaeaceae) | Vet phool (Ass), (Rb/P) | Roots, leaves, flowers and seeds. | Rootstock is used to treat piles, fevers, jaundice, etc. Roots and petioles are cooked. |
| <i>Jussiaea repens</i> L./ (Onagraceae) | Kesardam (Ass) | Leaves and stems | They are used as phytotherapeutics to cure peptic ulcers, dry cough, and skin protection. |
| <i>Cyperus rotundus</i> L./ (Cyperaceae) | Hokla sam (Rb/R) | Rhizomes | They are used as traditional folk medicine for the treatment of stomach and bowel disorders. |
| <i>Ottelia alismoides</i> (L.) Pers, | Panicola ful (Ass) | Petioles and leaves | The plants are used to improve the water quality in fish ponds by |

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|--|--------------------------------|--|---|
| (Hydrocharitaceae) | | | capturing floating mud particles. The petioles and leaves are eaten as a vegetable. The fruit is also edible. |
| <i>Ipomoea aquatica</i> Forssk./ (Convolvulaceae) | Kolmula (Rb/R) Kolmou (Ass) | Young shoots and leaves. | Young shoots and leaves are used as vegetables. Leaves are a good source of minerals and vitamins, especially carotene. |
| <i>Nymphoides indica</i> L./ (Menyanthaceae) | Sona puli (Rb/R) | Leaves and roots | It is used as a medicine and invertebrate food, has environmental uses and for food. |
| <i>Nelumbium speciosum</i> Willd./ (Nelumbonaceae) | Poddho phool (Rb/R) | The filaments, seeds, leaves, and roots. | When the lotus seeds inside the seed head are green, they can be eaten raw as they are sweet. The large leaves are used in high fever with much heat and burning of the skin. |
| <i>Sagittaria sagittifolia</i> L./ (Alismataceae) | Lakhor kui (Rb/R) | Leaves and roots | The leaf is used to treat a variety of skin problems. The root can be cooked and is excellent when roasted and likened to potatoes. |
| <i>Ipomoea carnea</i> Jacq./ (Convolvulaceae) | Asam pan (Rb/R) | Stem, fruit, leaf and seeds | Roots are boiled to use as a laxative and to provoke menstruation. Traditional healers for the treatment of skin diseases have used it, |

In this work, it is seen that a good number of plants have medicinal properties and are used as vegetables in this area. I surveyed beels, ponds, rivers and wetlands of this area. There are many species here, some of which I have shown in the table above. Aquatic plants are playing an important role to maintain the balance of the aquatic ecosystem.

Traditional herbal medicines used in the treatment of some skin diseases in Dudhnoi circle

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Any plants which have medicinal properties or characteristics are called medicinal plants. Dudhnoi is an area of Goalpara district, Assam having rich biodiversity of medicinal plants. Since early ages, people have been using different kinds of herbs to cure different kinds of ailments. In Dudhnoi area also contains a huge number of tribes. Rabha and Bodo are two major tribes in the Dudhnoi area. The majority of these two communities still depend on traditional medicines for their primary health care and treatment of various ailments. The tribes of Rabha in Dudhnoi Circle have their indigenous medicines which have been traditionally used for the treatment of different ailments. Each tribe has its own concept and belief system regarding health, illness and disease. Most people use various plants as a source of medicine for healing some common illnesses.

In the Dudhnoi area, many people suffer from skin diseases caused by polluted water and different food habits. Skin diseases are conditions that affect the skin. I have enlisted 20 herbal remedies which provide curative properties against skin diseases.

Enumeration

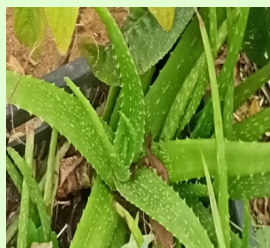
| Scientific name | Family | Local name | Part used | Medicinal uses |
|--|---------------|--------------------------------------|------------------|--|
| <i>Aloe barbadensis</i> Mill. | Liliaceae | Chal-kunwari (Ass), Salkumari (Rb/P) | Leaf | To cure burn, acne |
| <i>Andrographis paniculata</i> (Burm.f.) | Acanthaceae | Kalmegh (Ass), ChirataTita (Rb/P) | Leaf | It is improved skin hydration and against wrinkling. |
| <i>Azadirachata indica</i> A. Juss. | Meliaceae | Mahanim (Ass), Khakai pan (Rb/R) | Leaf | Prevent acne, dark circles wound |
| <i>Bombax ceiba</i> L. | Bombacaceae | Simalu (Ass), Pamsu phang (Rb/R) | Conical prickles | Paste prepared from conical prickles <i>Bombax ceiba</i> is applied to pimples, and acne to get a cure |
| <i>Carica papaya</i> L. | Caricaceae | Amita (Ass), Modu (Rb/P) | Fruits | To control acne, wrinkle, and dark spot. |
| <i>Cassia alata</i> L. | Fabaceae | Khorgach (Ass), Dadugach (Rb/P) | Leaf | To cure ringworm. |
| <i>Centella asiatica</i> (L.) | Apiaceae | Bor manimuni (Ass), Manamuni (Rb/P) | Whole plant | To brightening skin, helps to cure vanish red and dark spots |
| <i>Citrus limon</i> (L.) Burm. f. | Rutaceae | Nemu (Ass), Lebu (Rb/P) | Fruits | To control pimples, allergies and fungal infections. |
| <i>Corchorus capsularis</i> L. | Malvaceae | Morapat (Ass), Pata (Rb/P) | Leaf | Against chicken pox |
| <i>Cucumis sativus</i> | Cucurbitaceae | Tiyah (Ass), | Fruit | Against sunburn and |

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|---|----------------|---------------------------------------|-------------|--|
| L. | | Sengos (Rb/P) | | under-eye swelling. |
| <i>Curcuma domestica</i> Val. | Zingiberaceae | Halodhi (Ass), Haldi (Rb/P) | Rhizome | Reduces dark circles, acne, and fungal infection |
| <i>Eclipta prostrata</i> (L.) L. | Asteraceae | Kehraj (Ass), kalkehrati (Rb/P) | Leaf | To cure white spots and wounds. |
| <i>Houttuynia cordata</i> Thumb. | Saururaceae | Mochondari (Ass), Isali bun (Rb/P) | Leaf | It is effective for skin abscesses, glowing skin |
| <i>Lawsonia inermis</i> L. | Lythraceae | Jetuka (Ass), (Rb/P) | Leaf | Improving wound healing. |
| <i>Murraya koenigi</i> L. | Rutaceae | Narasingha (Ass, Rb/P)) | Leaf | To cure skin burn |
| <i>Ocimum sanctum</i> L. | Lamiaceae | Tulsi (Ass), (Rb/P) | Leaf | To control acne and white spot |
| <i>Piper nigrum</i> L. | Piperaceae | Gurmoris (Rb/P) | Fruit | Against skin cancer |
| <i>Pouzolzia zeylanica</i> (L.) Benn. | Uriticaceae | Borali vakua (Ass) | Whole plant | To cure herpes, burning skin. |
| <i>Tinospora cordifolia</i> (Wild.) Hook. | Menispermaceae | Sogunilota (Ass), Basanta lewa (Rb/p) | Stem | Against leprosy |
| <i>Zingiber officinale</i> Rosc. | Zingiberaceae | Ada (Ass), Chingku (Rb/P) | Rhizome | To cure all kinds of infection |



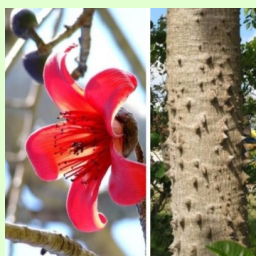
Houttuynia cordata



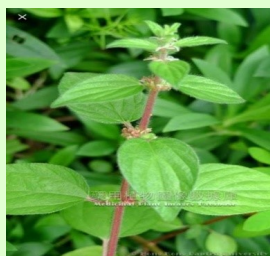
Aloe barbadensis



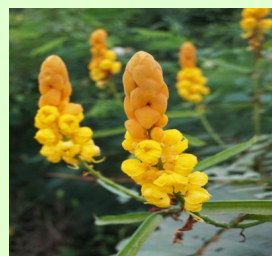
Centella asiatica



Bombax ceiba



Pouzolzia zeylanica



Cassia alata

It has been observed that the people of the Dudhnoi circle still depend upon the traditional healthcare system to cure different kinds of diseases. The present study highlights the rich medicinal knowledge of the Rabha people and their indigenous healthcare practice. The potential of this traditional knowledge needs careful evaluation in the field of modern scientific healthcare systems. It has been seen the medicine price of skin diseases is very costly. So there is a need to encourage people to preserve traditional knowledge for the betterment of future mankind in this area.

Some Wild Edible Fruits Available in Krishnai Area and Their Medicinal Properties

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Wild edible fruits have been a vital part of human diets since ancient times. These fruits, found in diverse ecosystems around the world, offer a bountiful array of flavours, nutritional benefits, and cultural significance. While the popularity of exotic fruits has grown in recent years, the importance of wild edible fruits remains deeply rooted in traditional and indigenous communities. Packed with essential vitamins, minerals, fibre, and antioxidants, these fruits contribute to overall health and well-being. Moreover, their availability in local ecosystems provides a sustainable and affordable source of nutrition, particularly in rural and remote areas. Exploring and preserving the rich diversity of wild edible fruits not only supports local livelihoods but also safeguards traditional knowledge and promotes a deeper connection with nature.

Krishnai, a region located within the captivating landscapes under the revenue circle of Matia of Goalpara district in Assam, lies at a latitude of approximately 26.1344° N and a longitude of 90.4622° E. This picturesque area is blessed with abundant natural resources, including fertile soil, lush vegetation, and meandering rivers such as the Jinjiram, Krishnai, and The topography of Krishnai is characterized by rolling hills, verdant valleys, and dense forests, creating a diverse ecosystem that supports a rich biodiversity. Within this region, the combination of favourable geographical features and ample water resources creates an ideal habitat for numerous wild edible fruit-bearing trees. Krishnai provides an opportunity to delve into the local flora, document the various species of wild edible fruits, and gain insights into their nutritional value, traditional uses, and their significance in supporting sustainable livelihoods. This exploration of Krishnai's natural beauty and diverse resources contributes to our understanding of the wealth of wild edible fruits found within this captivating region of Goalpara.

Table: Some popular wild edible fruit in Krishnai, Goalpara, Assam

| Scientific Name | Family | Local Name | Edible part | Uses |
|----------------------------------|---------------|---------------------------|--------------|---|
| <i>Averrhoa carambola</i> L. | Oxalidaceae | Kordoi/Kordai | Entire fruit | Eaten raw, used for Fever, cough, diarrhoea, chronic headache, and inflammatory skin disorders. |
| <i>Baccaurea ramiflora</i> Lour. | Euphorbiaceae | Leteku/Letku | Pulp | Eat raw and Used to prepare jam, jelly and wine. |
| <i>Citrus maxima</i> Merr. | Rutaceae | Robab tenga/Jambura Tenga | Pulp | Eaten raw and have Used in Ulcers, febrifuge, dyspepsia, lumbago, fever, cardiotoxic, gastrointestinal disorders, diabetes, |
| <i>Dillenia pentagyna</i> Roxb. | Dilleniaceae | Baji-ou/Okhsi | Aril | Flower buds and ripe fruit are eaten raw and also have valued for their ornamental qualities in landscaping and gardens. |
| <i>Dillenia indica</i> L. | Dilleniaceae | Ou-Tenga | Calyx | Eat raw and cooked dishes, Used as both astringent and laxative. |

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|---------------------------------------|----------------|---------------------------|--------------------|---|
| <i>Eaeocarpus floribundus</i> Blume. | Elaeocarpaceae | Jolphai/Jolpai | Fleshy outer layer | Eaten raw, used in Anti-inflammatory, antibiotic, analgesic, and antihypertensive |
| <i>Flacourtia cataphracta</i> (Lour.) | Flacourtiaceae | Ponial/Poinal | Fleshy pulp | Are eaten raw or cooked as Jam. |
| <i>Mimusops elengi</i> L. | Sapotaceae | Bakul/Bokul | Fleshy Drupe | Benefits include treating coughs, sore throat, and dental issues. |
| <i>Morus alba</i> L. | Moraceae | Nooni/Meskuri | Multiple Drupe | Consumed fresh or used in jams, jellies, and desserts. |
| <i>Nymphaea nouchali</i> Burm.f. | Nymphaeaceae | Bhet phool | Seed | Seed can be eaten or cooked. |
| <i>Nelumbo nucifera</i> Gaertn. | Nelumbonaceae | Podum | Fruit | Seeds can be consumed as cooked, uncooked, ripened or raw. help in Bleeding, cough, and fever. |
| <i>Protium serratum</i> Engl. | Burseraceae | Niori-tenga | Aril | Used in traditional medicine for its various health benefits, including its anti-inflammatory and antioxidant properties. |
| <i>Phyllanthus acidus</i> (L.) | Euphorbiaceae | Por amlokhi/Holpholi | Fruit | Acidic fruits are eaten raw or as pickles. |
| <i>Phyllanthus emblica</i> L. | Euphorbiaceae | Amlokhi | Fleshy Mesocarp | Eaten raw and Used in Ayurveda as a potent rasayana and in traditional medicine for the treatment of diarrhoea, jaundice, and inflammation. |
| <i>Solanum indicum</i> L. | Solanaceae | Tita vhekuri/Berkuli teta | Berry,Pulp | It is typically cooked or processed. Cooking methods such as boiling, steaming. |
| <i>Syzygium cumini</i> (L.) | Myrtaceae | Kola jam/Kala jam | Fleshy Mesocarp | The ripe fruits are eaten raw. Jams and jellies |
| <i>Spondias pinnata</i> (L. f.) Kurz. | Anacardiaceae | Amora | Pulp | Eaten raw when ripped or as pickles or Chutneys |
| <i>Tamarindus indica</i> L. | Fabaceae | Teteli/Tetli | Pulp | Eat raw or dried. Jams and jellies |
| <i>Terminalia bellirica</i> Roxb. | Combretaceae | Bahera/Bohera | Seed | Traditional medicine for its various medicinal properties. |
| <i>Termenilia chebula</i> Retz. | Combretaceae | Xilikha | Pericarp | Bahera fruit is traditionally consumed in various processed forms rather than being eaten raw due to its astringent taste and fibrous texture |

In conclusion, Krishnai, nestled within the captivating landscapes of Goalpara district in Assam, stands as a remarkable region abundant in natural beauty and resources. Its fertile soil,

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rolling hills, meandering rivers, and diverse flora create an ideal ecosystem for the growth of a wide variety of wild edible fruits. Exploring the wild edible fruits of Krishnai unveils their nutritional value, traditional uses, and their significance in sustaining sustainable livelihoods. By recognizing the importance of conserving and promoting these natural treasures, we can ensure their preservation for future generations. The study of Krishnai as a rich source of wild edible fruits not only deepens our understanding of the region's biodiversity but also underscores the importance of valuing and harnessing the potential of these natural resources for the benefit of local communities and the preservation of cultural heritage. Krishnai, with its captivating beauty and abundant wild edible fruits, serves as a testament to the incredible gifts bestowed upon us by nature.



Dillenia pentagyna



Phyllanthus acidus



Syzygium cumini



Morus alba

Some Photographs of Felicitation Program Organized by the Department of Botany, Dudhnoi College on 19-06-2023



Felicitation to Dr Shahadev Rabha (editor of the current issue) for completing his PhD degree, he is the first student of the Botany Department, Dudhnoi College to be a Doctorate.