

MEDICO-BIOWEALTH OF INDIA

Vol. X

Rajesh Kumar Verma
Brajesh Kumar Sahu
Chanchal Malhotra
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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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ABOUT THE BOOK

There are several plant species that are locally available and have food, medicinal, ecological, and economic values. Due to the impact of modernization and urbanisation, we are going to forget about them in our day-to-day lives. The book **Medico-Bio-Wealth of India-X** brings attention to common plants and their associates. The book has eight chapters on *Ficus virens*, *Lawsonia inermis*, orchids, *Cassia fistula*, *Plantago asiatica*, mushrooms, and the medicinal plants of the Santal community. It also has a chapter on birds and their importance for the balance of the ecosystem. Hopefully, this book will be useful for students, researchers, and intellectuals.

BACKGROUND

The COVID-19 pandemic brought attention to the locally available food and medicinal plants, along with their associated faunal species. After the pandemic, people started believing in herbs for day-to-day food and health problems. They started restoring the biowealth in their locality, which led to success in fighting common food and health problems. In this aspect, books like the series *Medico Bio-Wealth of India* play an important role in creating awareness about local bioresources. Keeping this in mind, the book *Medico Bio-wealth of India-X* has been designed, and information is gathered about the plants and their associated faunal wealth. The book will also be fruitful for making conservation plans and strategies against different types of day-to-day health problems.

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Ficus virens Aiton: an unexplored leafy vegetable

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Abstract: Wild plants and their products have made significant contributions to the human diet since ancient times. Among them, wild leafy vegetables play a major role in meeting the nutritional requirements of the tribal and local populations. Leafy vegetables not only provide food quantity but also make a significant contribution to the population's nutrition throughout the year. *Ficus virens* is one such species that is used as traditional food and medicine by tribal communities as a wild leafy vegetable. There is less documentation available on it. Therefore, keeping this in mind, an attempt has been made to gather information about *F. virens* in various aspects from field and literature surveys. The survey revealed that the tender leaves or new foliage of *F. virens* are used in food, medicinal, and economic aspects. It needs proper documentation in a scientific way for value addition.

Keywords: *Ficus*, leafy vegetables, nutraceuticals, traditional knowledge

Introduction: Throughout the world, accelerated growth of the population has resulted in scarcity of food accessibility and availability. Taking this problem in consideration, exploration, identification, and utilization of lesser-known leafy vegetables is important as it could play a prominent role

in satiating the hunger of the world's expanding population (Sheela et al. 2004; Noor and Satapathy 2023). Wild plants and their products make significant contributions to the human and animal food web. They are often a means of survival for millions of poor rural households. Wild leafy vegetables are an important constituent of the traditional diets of tribal communities (Raghuvanshi et al. 2001). These leaves are high in nutrients and medicinal values. It plays a crucial role in ensuring food security during times of famine and poor harvest (Jana 2007; Mallick et al. 2020). The tribal people collect various species of edible leaves from their agricultural fields, non-agricultural fields, and forest areas (Parida and Mahalik 2020). These edible wild plants are an important source of food and medicine in their routine lives and ensures food security for them. Often, they also earn their livelihood by selling those leafy vegetables in the local market, boosting their socio-economic standard (Horo and Topno 2015). There are still many unexplored leafy vegetables in their natural habitat with hidden nutritional and medicinal values exist that need identification and commercialization to solve the menace of food problems (Noor and Satapathy 2023). For the reasons, genus *Ficus* plays an important role in the ecosystem and providing food & medicines for humans since long. *Ficus* L. (commonly known as Fig) is the largest genus in Moraceae, with about 870 species of trees, shrubs, climbers, and creepers occurring in the tropical and subtropical ecosystems of the world as keystone species. Its fruits are eaten by insects, birds, and animals throughout the year (Dubey et al. 2019; Kumar et al. 2022). *Ficus virens* from this family is one such species that not only provides fodder for animals, but also used as a vegetable by many tribal communities, which is an unexplored food plant. The authors have presented here its food, medicinal, and pharmacological values, along with future aspects.

Morphology: *F. virens* or White fig belongs to the family Moraceae. Commonly it is known as Pilkhan, Pakad, or Pakhad tree, and in Odisha it is known as Putkal saag (Plate 1). It is a medium-sized tree that grows to the height of 24-27 meters. It has a very large and spread canopy. The leaves are 8-9 cm long and 3-6 cm wide. New leaves appear in the month of March with purple, red, and bronze hues which give mesmerizing look to the whole trees. The leaves of this deciduous species are spiral-arranged, hairless, and have entire laminae that can be egg-shaped oblong, or elliptical (Saxena and Brahman 1995; Patel et al. 2023). Sometimes, it grows as a hemi-epiphyte that can germinate on the host plant and later establishes its root in soil.



Plate 1: Vegetative parts of Putkal Sag (*F. virens*)

F. virens is found in coastal, monsoon, or savannah forests, on cliffs, and in secondary rainforests (Berg and Corner 2005). It is normally found in India, Southeast Asia, Malaysia, and Northern Australia.

Food Values: The new foliage of *F. virens* is collected by the tribal communities during the winter season since the mature leaves are not appropriate for human consumption. They prepare side dishes like curry or chutney from the leaves and eat it with rice. In Thai culture, it is consumed as a cuisine called Phak Lueat. It also eaten by boiling as vegetable (https://en.wikipedia.org/wiki/Thai_cuisine). The fruits of *Ficus virens* are edible and can be consumed in ripened or dried form. The ripened fruits are also eaten in the form of jam (Mahapatra and Panda 2012; Patel et al. 2023).



Plate 2: A tribal woman selling Putkal Sag in Odisha state, India

Economic Values: Nowadays economic aspects of all single essential things link with sustainability. Therefore, the study of wild edible plant and nutraceuticals gets focused and are in high demand in global market. In rural communities, these wild edible plants are not only the food source but also boosts the financial stability of the family. Nonetheless, this wild leafy vegetable is still unexplored and is limited to the tribal market only. The new foliage is sold in the local market for a value of 20 rupees per leaf bowl and 80 to 100 rupees per Kg ([Present study](#); [Plate 2](#)).

Ethnomedicinal Value: *F. virens* is used in treating various diseases and provides many health benefits. For instance, ripened fruit is helpful for indigestion ([Mon et al. 2020](#)). Soup made with the fruits of *F. virens* gives relief in urinary disease, and reduces excess sweating. Grounded tender leaves and fruits and the juice is taken against diabetes ([Devi et al. 2022](#)). It is also used as poultice, and has estrogenic, hepaprotective, intrinsic, anti-haemorrhage, anti-erysipelas, and wound healing properties. The white latex of the tree when applied on sore sites reduces inflammation. The ripened fruits can be eaten in the form of jam mixed with jaggery or sugar to cure heart-related diseases. The dried fruits are called figs which have many medicinal properties. The ripe fig or the cluster fig can be roasted over fire and taken with salt to treat fever. The bark has astringent properties. An infusion of bark is used as mouth wash in spongy gum condition ([Murugan et al. 2013](#); [Ramadevi et al. 2014](#)). Decoction of bark is used in blood diseases, menstrual disorders, leucorrhoea, and diabetes. Paste from the bark is used in burning sensation, rheumatism and in bone fracture. Bark is also useful in treating diarrhoea, menorrhoea, nervous disorder, vaginal diseases, hyperlipidaemia, hallucination, dysentery etc. ([Khan et al. 2011](#); [Kumar et al. 2012](#)).

Pharmacological Values: Very limited research has been done on the pharmacological activities of *F. virens*. It has been found that in *F. virens* exhibits a wide range of biological actions including antioxidant, anti-inflammatory, antibacterial, anti-diabetic, and anticancer characteristics. Its leaf shows antioxidant, anti-inflammatory, antidiabetic, and hepatoprotective properties ([Orabi and Orabi 2016](#); [Ramadevi et al. 2014](#)). It has also been found that the extract of *F. virens* improves insulin sensitivity ([Nugraha et al. 2018](#)). The bark extract showed antifungal, antibacterial, anti-inflammatory, and anticancer properties ([Figure 1](#)).

Phytochemicals present: Phytochemicals found in *F. virens* include phenolics, flavonoids, tannins, terpenoids, alkaloids, and glycosides. These chemicals have been demonstrated to exhibit a wide range of biological actions, including antioxidant, anti-inflammatory, antibacterial, anti-diarrhoeal, anti-diabetic, and anticancer characteristics. Quercetin, kaempferol, luteolin, myricetin, catechin, epicatechin, rutin, gallic acid, ellagic acid, betulinic acid, sitosterol, stigmasterol, and lupeol are some of the phytochemical elements found in *F. virens* (Chandira et al. 2010; Shi et al. 2011). These compounds have been researched for their potential therapeutic uses and are known to exhibit a wide spectrum of biological functions (Patel et al. 2023).



Figure 1: Pharmacological values of Putkal Sag

Future Aspect: As per the reports indicate, *F. virens* has several ethnomedicinal, ayurvedic, pharmacological as well as food values. However, the reports need to be validated and detailed investigations on the

composition and pharmacological significance of this wild leafy vegetable must be conducted. This leafy vegetable is in dire need of commercialization so that the urban people can also get benefited from this wild edible plant species. Based on the dietary bioactivities, this evaluation additionally highlights the capacity utilization of this leafy vegetable. Multidisciplinary research interventions have facilitated the conversion of underutilized leafy vegetable into healthy ingredients in the food sector. Different parts of the plant are also rich in several phytochemicals such as quercetin, kaempferol, luteolin, myricetin, catechin, epicatechin, rutin, and gallic acid. Further exploration these phytochemicals can lead to discovery of new drugs in coming future. Advanced analytical techniques must be used to authenticate the secondary metabolites found in this plant species to validate its quality and biological potential. Additional scientific studies on *F. virens* or other unexplored plants can contribute effectively to G20 goal of sustainable development.

Conclusion: Modern civilization and industrialization have become biggest threat to the biodiversity. Uncontrolled increase in the population is further aggravating the world's food accessibility and availability issues. Young and tender leaves of *F. virens* has significant good amino acid profile, a significant amount of minerals and vitamins, and has richness in phytoconstituents. It could be a better option for our dietary system and for economic purposes as well. To encourage this crop there is a need to enlighten the local inhabitants on its food, clinical and commercial importance, and uses. This *Ficus* species also provides food and habitat to many birds or other organisms. It also has ecological aspects that contribute for healthy and fresh environment. Proper knowledge and conservation practices are required to conserve this native species.

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Medicinal and socio-cultural values of *Lawsonia inermis* L.

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Abstract: *Lawsonia inermis* L., popularly known as Henna or Mehndi, is an evergreen medium-sized shrub of the family Lythraceae. The use of *L. inermis* for medicinal, mythological, and cosmetic purposes is intricately linked to the ancient and modern cultures of India. The present article describes the medicinal properties as well as the traditional uses made by different communities in the various regions of India. The information collected is based on literature survey, field studies and personal interviews with local and rural communities. The present study highlights the importance of plants having various uses and being linked with Indian culture.

Keywords: Cultural, Mythological, Medicinal, Mehndi

Introduction: *Lawsonia inermis* belonging to the family Lythraceae, is commonly known as "Henna" or Mehndi (Plate 1). The name is derived from the Sanskrit name Mehaghni," which is synonymous with turmeric. The use of Mehndi is described in the earliest Vedic ritual books as a symbolic representation of the outer and inner sun in Vedic customs meant to awaken the "inner light," as the gold of the inner sun has an important symbolic function. The traditional mehndi design with the drawn palm represents the mind (Singh et al. 2009). At the time of the reign of Augustus, Emperor of Rome (27 B.C.–A.D. 14), Egypt became an important trade source for the commerce of Mehndi between Rome and India. There are ancient rituals in

the Ajanta-Ellora caves near Mumbai dated before A.D. 350 that remarkably show a prince of Patliputra reclining under a tree, half asleep, having her hands and feet painted with flowery henna designs. Historians mention that henna may have been brought to India along with Persian horses around A.D. 712 and has been in cultivation in Rajasthan since around 1476. The cultivation practises and medicinal properties of henna have also been studied (Lodha, 2003). Henna is cultivated in India, the Middle East, and parts of tropical America and is planted in home gardens as living hedges and as an ornamental plant. It is a perennial shrub, branching profusely and reaching a height of up to 6 m. The plant grows rapidly and resembles a bush. The leaves are rather small, about 2-3 cm long and 1-2 cm wide, lanceolate, dark-green, glabrous, opposite, and with very short petioles. Flowers are numerous, small, white, or pale pink-coloured, and fragrant. The fruits (capsules) are borne in clusters and are green in colour, turning red to brown upon ripening (Singh et al. 2009; Plate 1). An attempt has, therefore, been made by the present authors to explore the traditional uses of mehndi and assess its value to the people.

Material and methods: The course of the present investigation includes the exploration of various regions of India to find out the medicinal and traditional usages of mehndi. The data presented here are based on first-hand information and related published literature (Singh et al. 2009).

Results and discussion: Henna's auspicious reddish colour merits its use during all ceremonies related to marriage (Vivaha) and married women. It denotes the prosperity that a bride is expected to bring to her new house. A day before the wedding, all the friends and relatives of the bride get together, and the dark green paste of henna leaves is applied to the hands with decorative designs (Singh et al. 2009). *L. inermis* played an important holistic role in the daily lives of some ancient cultures, providing psychological and personal adornment as well as being used for medicinal benefits. When the sole of the human foot is hot and there is a burning sensation in the sole, applying a paste of mehndi leaves soothes the sole and makes us feel sleepy. When there are cracks in the heel of the human foot, applying a paste of mehndi leaves for 12 hours makes the skin soft, and applying it for seven days continuously heals up the cracks. If there is a headache due to tension, then applying a paste of henna powder to the head reduces the pain as well as the tension. If there are pimples on the face, then applying a paste of

multani miti, sandalwood powder, and henna powder mixed in equal quantities for 21 days continuously makes the pimples disappear. If there are rashes and boils on the skin or head, then apply a paste of either henna powder or a paste of the bark of mehndi. Due to excessive sun exposure and high temperatures, when the skin is sunburnt, applying a paste of multani miti and henna powder in equal quantities with 5 ml of rose water soothes the skin if used regularly for 15 days. Applying a paste of henna powder in Nisode's oil to burnt skin soothes it, and on continuous use, it does not leave any scars on the skin (Singh et al. 2009).



Plate 1: *L. inermis* (a) flowers, (b) fruits, (c) leaves, and (d) whole plant

Mythological values: On several Hindu festivals, ladies and girls apply mehndi paste to their hands. The religious festival of Karva Chauth is considered incomplete without the use of mehndi. Married women decorate their hands and keep fast for the long life of their husbands (Singh et al. 2009). During offering prayers to the goddess, the mehndi is applied to her hands as well as to our hands. During keeping fast to please the goddess, the mehndi is applied to the hands (Singh et al. 2009).

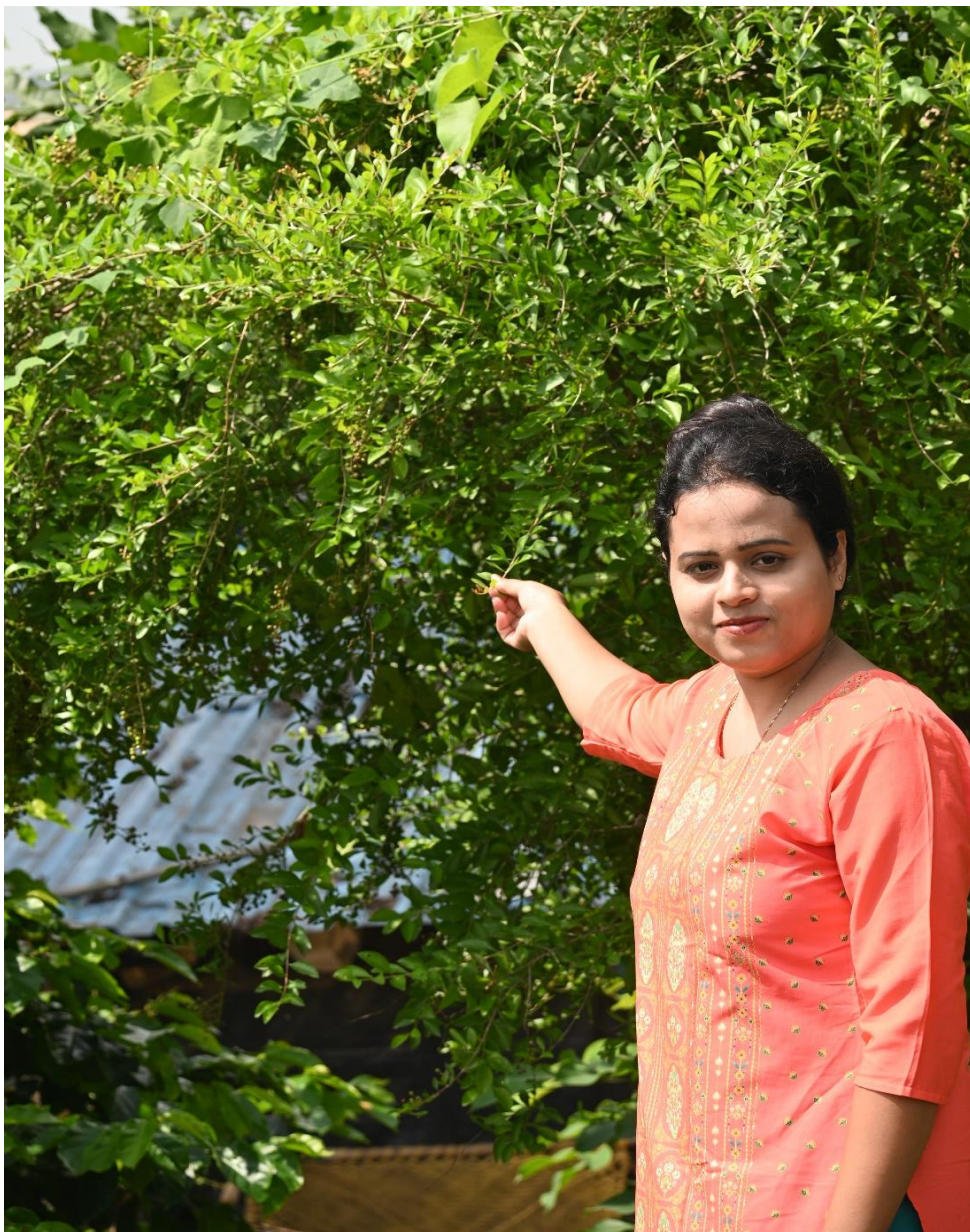


Figure 1: Collection of plant parts and information on Mehndi from Mahanadi River areas, Cuttack, India

Cultural values: Mehndi is used for making rangolis, i.e., decorative paintings on the floor using dry colour, on different festivals. When a newlywed lady enters her husband's house for the first time, in Indian culture,

her hands are dipped in mehndi paste and then applied on the side of the main door for good luck. When a person shifts into his own new house, the lady of the house dips her hands in mehndi paste and applies it to the sides of the main door for good luck ([Figure 1](#)). The family gets together, and hands are dipped in mehndi paste and applied to the sides of the door for good luck ([Singh et al. 2009](#)). While making a drumet, a layer of mehndi paste is applied to its skin to provide strength and smoothness.

Cosmetic values: Cosmetically, mehndi is used vividly in Indian society, viz., to decorate tattoos on hands as well as on other parts of the body, to provide natural hair colour, and to condition hair.



Figure 2: Gorgeous fruits of Mehndi near Mahanadi River areas, India

The present observations clearly indicate that the traditional uses of mehndi started ([Figure 2](#)) with the birth of Indian culture. At that time, there was no

knowledge of the chemical composition of henna, yet the men used henna for their welfare. However, at this time, biochemical and other estimations proved that henna has several properties for human welfare (Singh et al. 2009). Hanke and Tallat (1961) have also studied some traditional uses of henna. According to them, henna is used in hair cleaning, conditioning, and occasionally as a temporary dye to colour fabrics and textiles. Henna is also used as a medicinal plant because of its attributed antibacterial, antifungal, astringent, antihemorrhagic, hypotensive, and sedative effects. It has also been used as a folk remedy against headaches, jaundice, and leprosy in many cultures around the world. Scientific studies also proved that henna is a better hair conditioner than other commercial conditioners (Cajkovac et al. 1996). Henna is being investigated for its antimicrobial, antibacterial, and antifungal properties (Malekzadeh and Shabestari 1989; Rosenberg 1999). The henna fruits are antiviral (Khan et al. 1991), and the bark extracts are protective for the liver, preventing oxidative stress (Ahmad et al. 2000; Anand et al. 1992). Pratibha and Korwat (1999) have studied that Lawsone (2, 4-hydroxy-naphthoquinone) is responsible for colour development in henna. Natarajan and Mahendraj (2000) studied the anti-dermatophytic activities of *L. alba*. The antidermatophytic activities of ethanol, ethyl acetate, and hexane extracts of *L. alba* were tested on five strains each of *Tinea rubrum* and *T. mentagrophytes*, which showed significant antidermatophytic properties in vitro. The wound-healing activity of the leaves of *L. alba* has also been studied (Patil and Mandawgade 2003). *Lawsonia alba* Lam. ethanol leaf extract has significant wound healing properties. It can also be concluded that flavonoids may be responsible for wound healing activity.

Conclusion: The foregoing results and discussion proved that the medicinal properties and traditional uses of henna are very important in all aspects. The villagers recommend this plant for various traditions and against diseases without knowing its phytochemistry which indicate our rich traditional therapeutic knowledge of our country.

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Ecologically and medicinally important Orchids and their conservation strategies

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Abstract: Wild orchids are highly appreciated because of their sheer beauty and variety. It is also ecologically important as they are a climatic indicator and indicate a healthy forest, as well as having medicinal values. Due to their beneficial character, orchids are over-exploited for trading purposes and fall under different threatened categories. Keeping this in view, an attempt has been made to document the medicinally and ecologically important orchids. Literature and field surveys were carried out. Results revealed that *Vanda tessellata*, *Bulbophyllum careyanum*, *Vanda testacea*, *Acampe praemorsa*, etc. are used as medicinal agents that cure diseases like rheumatic pain, stomach disorders, fever, etc. It was noticed that most orchid populations are declining, which becomes a major concern. The authors present here the medicinal uses and ecological significance of wild orchids, along with their conservation strategies.

Keywords: Medicinal uses, climate indicator, over-exploitation, trading purpose, industrial uses

Introduction: Orchids have been attracting botanists, naturalists, and ecologists for a long time due to their incredible range of diversity and high economic value. Orchidaceae is a member of the Asparagales, an order of monocotyledonous flowering plants that also includes asparagus. In India, about 1300-1500 orchids are documented (Singh et al. 2019). In Odisha state, a total of 160 orchids are documented by Dr. Sanjeet Kumar (Kumar et al. 2021). Orchid flowers are mono-symmetrical. This means that both halves of

the flower are like mirror images. Orchids are important due to certain factors like ecological aspects, medicinal value, food value, economic value, ornamental value, and cultural value. They are mostly found in dry to moist deciduous forests. Three types of orchids are mainly identified that is epiphytic, terrestrial, and saprophytic ([Plate 2](#)). Orchids that are epiphytic possess aerial roots. These aerial roots contain a spongy tissue called velamen that provides water and nutrients from the atmosphere ([Plate 1](#)). Orchids are important for ecological aspects because they are somehow interlinked with mosses, ferns, tree mushrooms, and different types of pollinators. In some tribal areas, orchids are used for medicinal purposes, as *Bulbophyllum careyanum* is consumed to treat stomach diseases; *Vanda tessellata* leaf is used to treat cuts and wounds; and *Rhynchostylis retusa* is used to treat cuts and wounds.



Plate 1: Velamen in epiphytic orchid

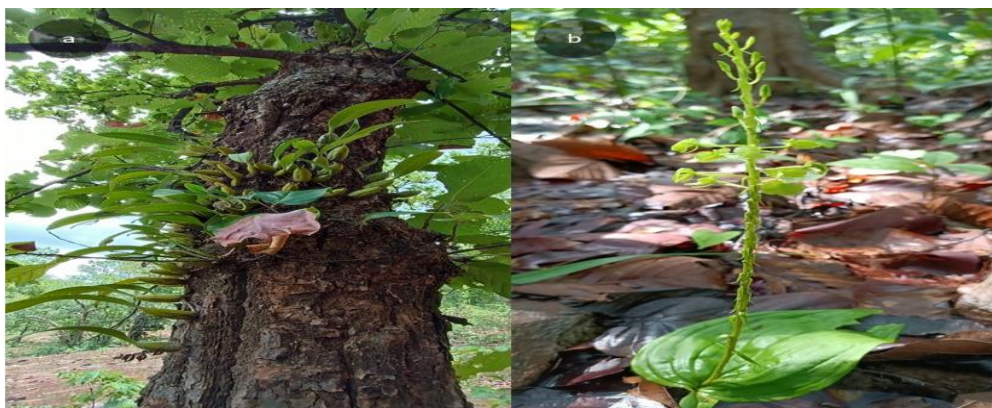


Plate 2: Habit and habitat of Orchids (a) Epiphytic orchid, (b) Terrestrial orchid

Orchids are also used for economic purposes, as in many wedding areas, orchids are used for decorative purposes, like in bouquets for reception centrepieces and home decoration. Ecologically, it is important because in terrestrial orchids, without the nutrients from the mother plant, orchid seeds need help from the environment in the form of special fungi. In order to germinate in epiphytic orchids, they take nutrients and water from the air without harming their host plant. Some orchids have a symbiosis with these fungi, and as soon as the orchid fully develops leaves, it gives back nutrients to the fungus, rewarding it for its initial help. Nowadays, orchids are diminishing due to certain specific factors, which are habitat loss, land clearance for urbanisation, overexploitation of medicinal orchids, and illegal trading. These have been the major threats for most of the habitat. Therefore, an attempt has been made to document the ecological importance & medicinal value of orchids. Authors have also discussed here on the conservation strategies to restore such species before they go extinct.

Methodology: The literature and field survey were carried out in 2022–2023 in selected areas of India (Odisha and Jharkhand). The semi-structured questionnaire with a passport data form was carried out. For further verification, a cross-question was conducted on the mode of use of medicinal orchids ([Plate 3](#)). The presented species was identified by the authors.



Plate 3: Field survey in Odisha state

Results and discussion: The results revealed that, commonly, about 34 orchids have medicinal uses. Out of 34, 21 epiphytic orchids and 13 terrestrial orchids are noticed (Plates 4 and 5). The recorded mode of use was by paste, decoction, juice, and eating raw, especially the pseudobulb or bulb (Table 1). Specifically, the plant part is used, like the root, leaf, pseudobulb, or whole plant. Orchids are indicators of a healthy ecosystem. From the survey, it is revealed that, ecologically, orchids are important due to certain factors such as mosses, lichen, tree mushrooms, and ferns for food and nutrition (Plate 6). Orchids and trees are referred to as commensalism. Orchids and mycorrhizal fungi have symbiotic associations where orchid stage is dependent on specific fungi. It is also important for some faunal and insect species like spiders, mantises, insects, the Indian giant squirrel, bees, and moths (Figure 1; Plate 7). Apart from its ecological value, it holds enormous medicinal value for curing many diseases. As per a survey, it was concluded that in Odisha state, the tribal communities use *Vanda tessellata* as a medicinal plant to cure cuts and wounds (Figure 2). Some researchers reported on medicinal values in 2021. Kumar et al. reported the diversity of orchids in Odisha. In 2015, De et al. reported a medicinal and aromatic orchid. In 2019, Swain et al. reported about the orchids in Odisha. In 2020, Kumar and Kumar reported on the medicinal orchids of Jharkhand. In 2022, Chakraborty reported some medicinal uses of orchids in India. In 2023, Choudhary et al. reported the medicinal orchids available in India.

Table 1: Medicinally important orchids

Botanical name	Common name	Flowering & fruiting period	Medicinal Uses
<i>Acampe praemorsa</i> (E)	Brittle tiger orchid	May- January	Arthritis
<i>Aerides multiflora</i> (E)	The multiflowered Aerides	June- September	Cuts and wounds
<i>Aerides odorata</i> (E)	The fragrant Aerides	June- November	Joint pain
<i>Bulbophyllum careyanum</i> (E)	Carey's Bulbophyllum	October- March	Constipation

<i>Cymbidium aloifolium</i> (E)	Aloe leafed Cymbidium	April – July	Fever
<i>Cymbidium macrorhizon</i> (T)	The long Rhizome Cymbidium	June - August	Boils
<i>Dendrobium aphyllum</i> (E)	Hooded orchid	February–October	Sore throat
<i>Dendrobium crepidium</i> (E)	The shoe lip Dendrobium	March- November	Bones
<i>Dendrobium formosum</i> (E)	Giant flowered Dendrobium	May– October	Antitumor activity
<i>Dendrobium macrostachyum</i> (E)	Fringed tree orchid	April- July	Earache
<i>Dendrobium moschatum</i> (E)	Musky smelling Dendrobium	May- July	Immunity booster
<i>Dendrobium regium</i> (E)	The Royal Dendrobium	April- March	Anemia
<i>Dendrobium transparens</i> (E)	The translucent Dendrobium	April - August	Dislocated bones
<i>Geodorum densiflorum</i> (T)	Pink nodding orchid	April – July	Diabetes
<i>Geodorum laxiflorum</i> (T)	Shepherds' crooks	June – July	Menstrual cycle
<i>Habenaria commelinifolia</i> (T)	The Commelina like leafed Habenaria	August- October	Immunity
<i>Habenaria furcifera</i> (T)	The fork carrying Habenaria, green Habenaria	August- September	Insect bites
<i>Habenaria marginata</i> (T)	Golden yellow Habenaria	September- October	Ulcer
<i>Habenaria plantaginea</i> (T)	Plantain Habenaria	August- October	Immunity

<i>Liparis odorata</i> (T)	Lish twin - bulb lip	May - August	Ulcer
<i>Luisia zeylanica</i> (E)	Suta rasna	March- August	Food poisoning
<i>Nervilia concolor</i> (T)	Tall shield orchid	May - July	Pneumonia
<i>Nervilia crociformis</i> (T)	Trembling nervilia	May - June	Asthma
<i>Nervilia plicata</i> (T)	Velvet shield orchid	March - June	Diabetes
<i>Oberonia falconeri</i> (E)	Falconer's Oberonia	August - October	Bone fractures
<i>Papilionanthe teres</i> (E)	Terete leaf vanda	February - June	High fever
<i>Pelatantheria insectifera</i> (E)	The insect bearing Pelatanthera	August - October	Inflammation
<i>Peristylus constrictus</i> (T)	The Constricted Peristylus	July - August	Malaria
<i>Peristylus lawii</i> (T)	Law's Peristylus	July - August	Insect bites
<i>Pholidota imbricata</i> (E)	Rattlesnake orchid/ Bada patra rasna	March - August	Arthritis
<i>Rhynchostylis retusa</i> (E)	Fox tail orchid / Ponari	May – July	Gastric problem
<i>Smitinandia micrantha</i> (E)	The small flowered Smitinandia	June - August	Food poisoning
<i>Vanda tessellata</i> (E)	The lattice like patterned flower Vanda	June - July	Cuts and wounds
<i>Vanda Testacea</i> (E)	The brick red Vanda	June - July	Asthma

(E: Epiphyte; T: Terrestrial)

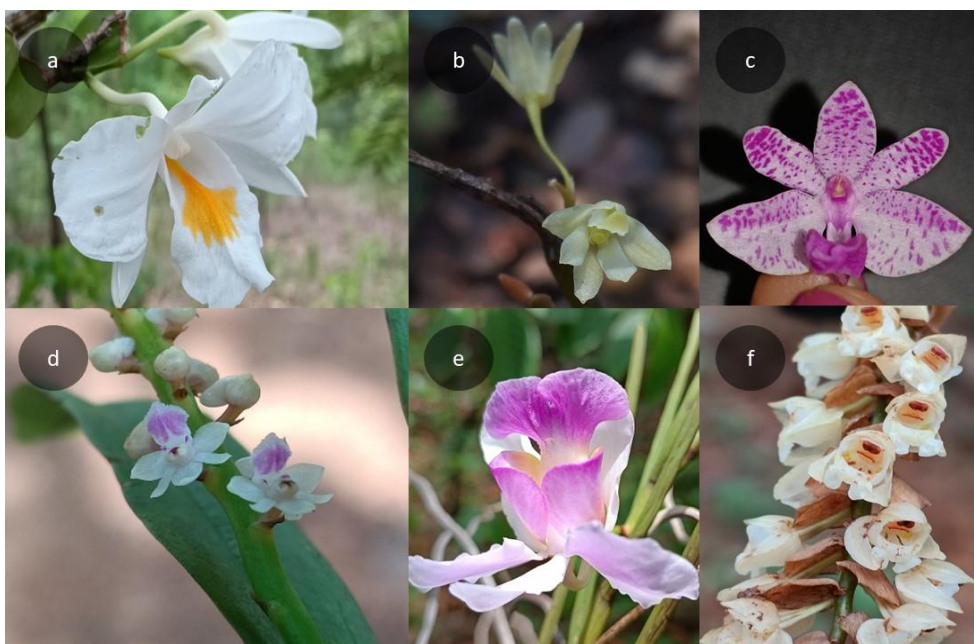


Plate 4: Some epiphytic orchids a) *Dendrobium formosum*, b) *Dendrobium herbaceum*, c) *Rhynchosstylis retusa*, d) *Smitinandia micrantha*, e) *Papilionanthe teres*, f) *Pholidota imbricata*



Plate 5: Some terrestrial orchids a) *Zeuxine gracilis*, b) *Zeuxine flava*, c) *Habenaria marginata*, d) *Habenaria commelinifolia*, e) *Habenaria furcifera*, f) *Epipogium roseum*

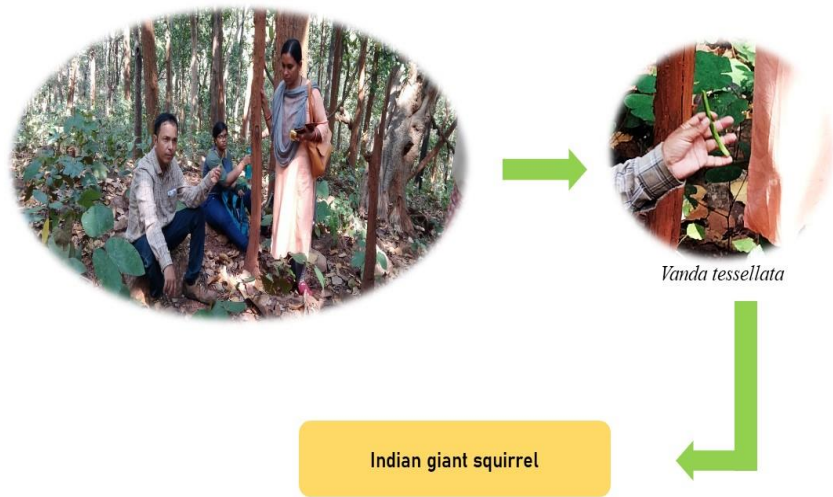


Figure 1: Indirect evidence of tender leaves of *Vanda tessellata* is consumed by Indian giant squirrel

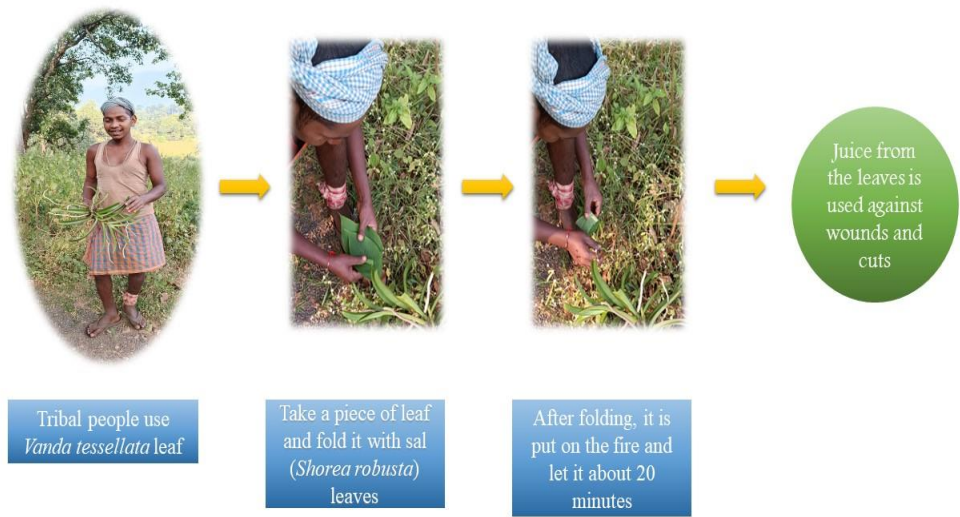


Figure 2: Tribal people use *Vanda tessellata* for medicinal uses



Plate 6: Ecological importance of orchids in association with other species a) Orchid relationship with lichen, b) Orchid relationship with mosses, c) Orchid relationship with tree mushroom, d) Orchid relationship with ferns



Plate 7: Orchid relationship with other insect species a) Insect takes water from velamen, b) Spiders web on orchids, c) Mantis on orchid

Authors have also restored many common orchid species for conservation purposes (Figure 3) which should be initiated in many places.

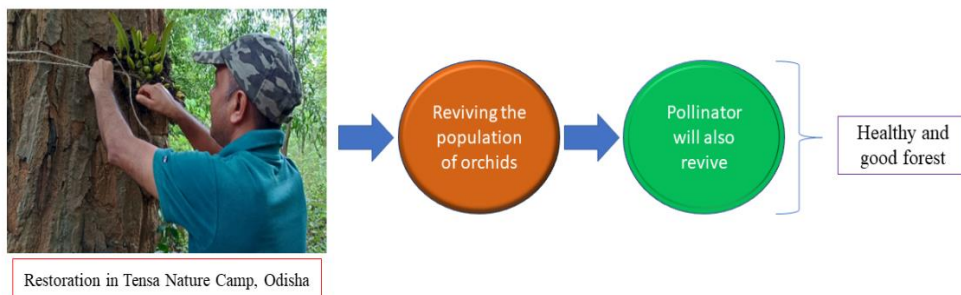


Figure 3: Conservation strategies by restoration process

Conclusion: Orchids are becoming threatened species due to overexploitation, habitat clearance for urbanisation, illegal trading, climatic change, pollution, mining activities, overgrazing, and overcollection. Several species that have been reported to have medicinal properties have not been collected or reported, thus indicating their possible disappearance due to habitat changes and many other factors. As most orchids are pollinated by insects, moths, and bees, the depletion of the population of pollinators may also lead to the depletion of the population of orchid species. Therefore, we need to document the medicinal and ecological values to conserve orchid species.

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Food, medicinal, pharmacological, and economic values of *Cassia fistula* L.

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Abstract: Several wild plants have been used for several purposes by indigenous people since time immemorial. Some of them are cultivated, and some are collected from the forest. These are commonly used in human nutrition, as medicines, and for economic purposes. They are known to be excellent sources of nutrients such as carbohydrates, proteins, fats, vitamins and minerals, dietary fibres, and diverse secondary metabolites. Among the wild plants, *Cassia fistula* is one of them. It is used as food (a flower), medicine (all plant parts), and has economic values. It is planted as an ornamental plant along the roadside due to its beautiful flowers. Medicinally, these plants have various pharmacological compounds that cure several ailments. Keeping this in view, an attempt has been made to gather the food, medicinal, and pharmacological values along with their role in upgrading the livelihood of local communities through field and literature surveys. The results revealed that all plant parts are used for various purposes, and their cultivation and conservation are needed for sustainable utilisation and development.

Keywords: Edible flower, indigenous people, medicinal uses, livelihood

Introduction: About 30,000 plants have been considered edible, but very few of them are used to fulfil human food requirements (Demasi et al. 2021).

There are still many wild plants available in our forest that are underutilised and not explored. Among them, wild edible flowers have been highlighted among researchers, nutritionists, and chefs all around the world due to their high amounts of nutrition and minerals (Santos and Reis 2021; Garcia et al. 2021), along with medicinal, pharmaceutical, and economic values. Consuming flowers is a legacy of many cultures that have been using flowers in their food traditions for centuries. The use of flowers in natural medicine is also an ancient practise (Ceccanti et al. 2018; Santos and Reis 2021). Many tribal communities live near forests and depend on forest products for food and livelihood. WEF are one of the major non-timber forest products (NTFPs) collected by the tribal communities in different seasons, and they still play a vital role in the subsistence of many traditional communities, while they are receiving increasing recognition for tackling food security and nutrition (Leon-Lobos et al. 2022). WEF can provide consumers with a more diverse range of nutritionally high-quality compounds. They can be a source of energy, fibre, and micronutrients and offer a large spectrum of phytochemicals such as phenols, tannins, flavones, terpenoids, polysaccharides, steroids, saponins, and alkaloids (Camara et al. 2016; Datta et al. 2019). But with modernization and settled agriculture, this knowledge is becoming lost, a trend that may lead to decreased diversity of indigenous diets and poorer nutrition (Dwabe and Mearns 2011). Among the WEF, the flowers of *Cassia fistula* are widely used as an edible flower in many tribal communities. It is a deciduous tree that is widely spread all over India. It is common throughout the Gangetic Valley, Central India, and South India. It is planted as an ornamental plant along the roadside due to its beautiful flowers. Medicinally, these plants have various pharmacological compounds to cure disease. It is used as an infusion, decoction, or powder, either alone or in combination with other medicinal plants, to treat various diseases and disorders (Hanif et al. 2007; Chauhan et al. 2011). Keeping in mind the importance of *C. fistula* and the fact that its flowers are consumed as food by tribal communities, an attempt has been made to document its food, medicinal, pharmacological, and economic values.

Morphology: It is a tree of family Fabaceae and native to the Indian subcontinent. It is a deciduous plant found in tropical forests. It can grow up to 10 - 18 m tall. Leaves are compounded with oval-pointed leaflets. Flowers are yellow and hang in clusters about 40 cm. Due to its flowers, it is commonly known as an ornamental plant. Fruit is a legume that is dark brown

and 30-60cm long. Fruits are filled with a sticky pulp and 40-100 hard brown seeds. Pods are cylindric, deep brown or nearly black when ripe, smooth, and indehiscent (Danish et al. 2011; Kumar et al. 2017; Plate 1).

Vernacular names: *C. fistula* commonly known as Amaltas. It has many vernacular names. Details are listed in Table 1.

Table 1: Vernacular names of *C. fistula*

Language	Local Name
Bengali	Bundaralati, Sonalu, Soondali, Sondal
English	Golden Shower
Gujurati	Garmala
Hindi	Sonhali, Amaltas
Kannada	Kakkemara
Marathi	Bahasa
Odia	Sunaari
Punjabi	Girdnalee
Sanskrit	Nripadruma
Santali	Bandar Lati
Tamil	Shrakkonnai
Telugu	Kondrakayi
Urdu	Amaltaas

Food values: This medicinal plant has various nutritional values. Young leaves are edible. In India, some tribes of Odisha and Assam use flowers and flower buds as vegetable. The leaves are used to collect by the tribal communities during the month of February to June and cook as leafy vegetable. It is also food plants of wild animals like *Bos gaurus* (Haleem and Iyas 2018; Kumar and Kumar 2023).

Ethnomedicinal values: In India, many plants and their parts are used to formulate traditional medicine to treat various diseases. *C. fistula* is one of them that is very well known in Ayurvedic, Unani, and Chinese traditional medicines. Extract of *C. fistula* is used in different health relieving conditions like asthma, leprosy, ringworm, heart-related disorders, and fever (Sanjeet et al. 2012; Khobragade et al. 2023).



Plate 1: Vegetative parts of *Cassia fistula*

The fruits are also used to treat throat disorders, inflammation, liver complications, chest problems, asthma, and rheumatism. In traditional Thai medicine, ripened fruits are used as a highly effective moderate laxative medicine prepared by boiling them in water and filtering the extract using a sieve. The extracted part is converted into small pellets by evaporating the excess water from the filtrate (Agarwal and Paridhavi 2005). Leaves are used to relieve pain, skin irritation, and swelling. Seeds are insect repellents and are also used as medicine for treating gastritis, diarrhoea, and biliousness and improving appetite. Large doses of leaves and bark can cause vomiting, nausea, abdominal pain, and cramps (Pawar et al. 2017). Roots are treated for flu and colds and are also used in the treatment of skin disorders, syphilis, and tuberculosis. The stem, bark, and fruits of this plant help to eliminate toxins from the blood. Ashes from burnt pods mixed with a little salt are used with honey and taken 3–4 times to relieve cough (Gupta 2010). The juice of leaves is used to treat skin diseases. The heated pods are applied to swellings on the neck to cure colds (Nadkarni 2009). The root is used in cardiac disorders, biliousness, rheumatic conditions, haemorrhages, wounds, ulcers, boils, and various skin diseases (Agarwal and Paridhavi 2005).

Pharmacological values: It is a plant with numerous medicinal benefits. Around the world, various studies have reported that this plant provides different pharmacological properties like antioxidant, antimicrobial, anti-inflammatory, antidiabetic, CNS activities, leukotriene inhibition activity, antitumor, hepatoprotective, antitussive, antibacterial, antifungal, hepatoprotective activity, wound healing activity, laxative activity, antipyretic, larvicidal, and ovicidal activity (Danish et al. 2011; Mwangi et al. 2021; Figure 1).

Bioactive compounds: Extracts of this plant have been rich with their secondary metabolite composition. The seeds are rich in glycerides with linoleic, oleic, stearic, and palmitic acids as major fatty acids together with traces of caprylic and myristic acids. A major carbohydrate reported from the seeds is galactomannan (Srividhya et al. 2017). It has been reported that the stem bark of *C. fistula* is also a potential source of lupeol, β -sitosterol and hexacosanol (Sen and Shukla 1968). The flower's pollen showed a protein composition with appreciable amounts of free amino acids such as phenylalanine, methionine, glutamic acid and proline. Carbohydrate, lipid and free amino acid contents (Manonmani et al. 2005). Fruits are rich source

of potassium, calcium, iron and manganese and aspartic acid, glutamic acid and lysine in the pulp (Castro-Lopez et al. 2018; Bahorun et al. 2005; Sanoria et al. 2020).

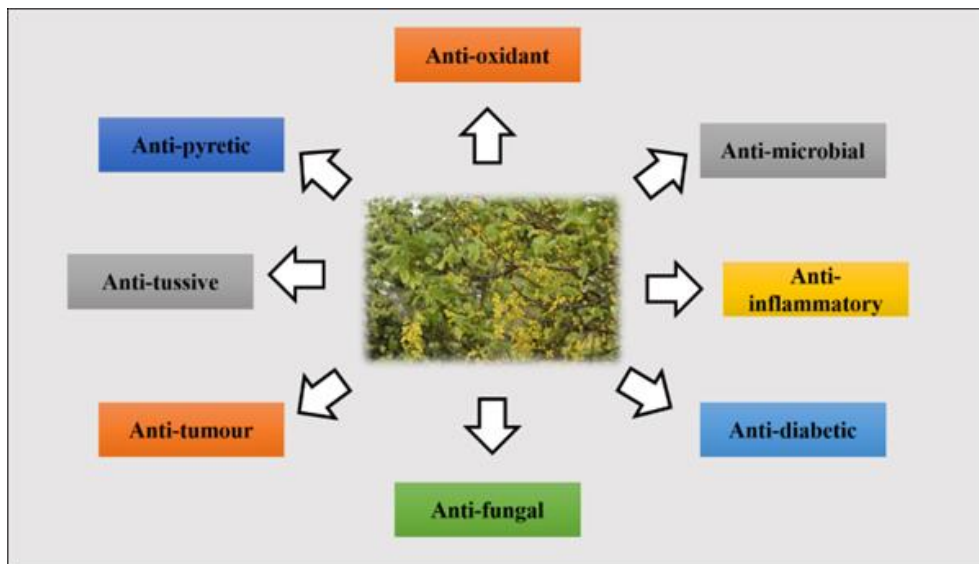


Figure 1: Pharmacological values of *Cassia fistula* L.

Economic values: The flower of *C. fistula* is not more commercialised; it is still underutilized. The flowers are commonly available for the tribal communities, as this plant is widely available in forests and cultivated in home gardens. The plant is also commonly available in rural areas as a revenue tree on road sides, but people have very little idea about its edibility. Some parts of this plant are used for commercial purposes in both local and international markets. This plant is used for ornamental purposes, and wood is used as fuel, so the seeds are available in the local market or online for the price up to Rs. 400. The extract of *C. fistula*, which is used in various medicines in Ayurveda, costs around Rs. 2200 in the online market. In the international market, qualitative fruits cost about 5000 rupees per 500 g. It is also used as a drug in homoeopathic medicine and costs under Rs. 100 per 30 ml.

Conclusion: *C. fistula* is an important medicinal plant with pharmacological properties and food values. This plant is commonly used in every part of the world in various ways. But the flowers are still unexplored as edible flowers. *C. fistula* is so rich in essential metabolites such as palmitic acid, linolenic

acid, oleic acid, phenols, flavonoids, arginine, phenylalanine, valine, lysine, isoleucine, and minerals such as K, Ca, Mg, and P, which have all proven to play different roles in the management of diseases. More information on the medicinal and nutritional values of the leaves and the detection of more bioactive compounds and isolating them could be a major step towards understanding this nutraceutical and could help in mitigating the food scarcity and health problems of the world.

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Common ethnomedicinal plants used by Santal tribes of Odisha, India

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Abstract: The Santals are one of the most populous tribal communities in India. In Odisha state, they are mainly found in the Mayurbhanj district. They have their own traditional practitioners who rely mostly on medicinal plants for treatment of a variety of ailments. Due to many factors, these practices are going extinct. Therefore, the present study was carried out in different villages of Mayurbhanj and the above-mentioned tribal areas to document the available ethno-medicinal plant consumption and traditional application by the Santal tribe. Field explorations were carried out from January to August 2023. The ethnomedicinal survey was conducted particularly with the Santal tribe in villages in Mayurbhanj district. Data were collected through structured questionnaires and observations during the field visits. According to the survey, the local population uses a total of 20 common plant species belonging to 17 families to cure a variety of diseases. Altogether, 20 plants were recorded that are used by the Santal tribe in the formulation of different ethnomedicinal preparations for curing 18 different types of diseases. Many of these ethnoveterinary medicinal preparations are new, as they have not been recorded earlier. Among the uses, some are administered in the form of single drugs to cure indigestion, reduced lactation, colic pain, colds, fevers, mouth diseases, eye problems, etc. In some cases, compound drug preparations are used for urinary troubles, diarrhoea, boils in the nose, etc. Lastly, the investigated plants have been enumerated with their botanical names and families, followed by tribal and local names, parts used, diseases, and modes of administration. The present study concluded that the Santal tribes of the study area possess rich knowledge of ethnomedicinal plants and their utilization. Thus, the present survey focuses on the documentation of the traditional knowledge of these valuable plant species, which could enhance the potential of these medicinal plants for other people or

communities as well. By understanding their importance, others can also be helpful in the conservation of these bioresources for further use.

Keywords: Santal tribes, ethnomedicinal, traditional application, formulation, conservation

Introduction: India, the home of the world's largest number of indigenous people, has a rich herbal heritage (Kumar et al. 2013; Satapathy et al. 2014). India is blessed with various climatic zones rich in flora and fauna. In India, Odisha is a state with mixed climatic conditions rich in medicinal plant diversity (Kumar et al. 2012; Vikal et al. 2023). In a society at various layers, everyone has his own personalised belief in practices concerned with health and diseases. It is well known that the tribal people are more dependent on plants than the other communities for their daily livelihood, especially herbal medicine (Kumar 2015; Mandal et al. 2020). Plant-based medicines are cost-effective and have no side effects (Kumar et al. 2018; Kumar et al. 2021). The Santals, one of the Adivasi, are the third largest tribal community in India after Bhil and Gond. They are mainly found in states like Jharkhand and West Bengal in terms of population and are also found in the states of Odisha, Bihar, and Assam (Rahmatullah et al. 2012). The Santals, partly because of their tradition and partly because they cannot afford allopathic doctors and allopathic medicines, still rely on their own traditional medicinal practitioners (some Santals call them ojhas) for treatment of their various ailments (Rahaman and Karmakar 2015). As they have lived on this land probably for thousands of years, they are a rich depository and guardians of indigenous traditional knowledge on medicinal plants (Jain and Tarafder 1970). The tribal people here use the plant resources in various ways, like curing diseases and ailments, for food, fibres, shelters, household implements, etc. (Mahanta and Pal 2012; Kumar 2022). In our country, studies in ethnobotany have now been conducted on various aspects, like ethnobotany of Santal tribes, of certain regions, of plant groups or diseases, and on many other miscellaneous sub- or interdisciplinary approaches (Rahaman et al. 2009; Behera et al. 2019). However, the knowledge of medicinal plants is rapidly dwindling due to the influence of western lifestyles, reducing the number of generations needed to carry on the use of plant species in traditional medicine, which has increased interest throughout the world (Rahman 2015). The present investigation highlights significant

information regarding the ethnomedicinal uses of plants by Santal tribes in their day-to-day lives in Mayurbhanj district, Odisha.

Methodology: The data presented here are based on frequent field trips conducted for the last 8 months ([January–August 2023](#)) in different regions of tribal areas in Mayurbhanj district, Odisha. The data on ethnomedicinal uses of plants were collected directly from various tribal medicine men and other knowledgeable people in the study areas. The tribal medicine men were taken individually to the forest to identify the plants that they used to cure the diseases. To confirm the authenticity of the collected data, it has always been cross-checked by interviewing other tribal medicine men from the same and different localities ([Kumar et al. 2021](#)).

Results: Altogether, 20 common plant species were recorded, with their scientific name and vernacular name, against which diseases they would be effective, the parts used, and the mode of administration by the Santal tribes of Odisha. Many of these ethnoveterinary medicinal preparations are new, as they have not been recorded earlier. Among the ethnomedicinal uses, some are administered in the form of single drugs to cure indigestion, reduced lactation, colic pain, fever, cold, mouth disease, ear sores, eye problems, dog bites, etc., while in some cases, compound drug preparations are used to treat bone fractures, urinary troubles, diarrhoea, earaches, etc. Details are listed in [Table 1](#) and illustrated in [Figure 1](#).

Table 1: Common ethnomedicinal plants used by Santal of Odisha, India

Plant Species	Vernacular name	Disease	Mode
<i>Acacia nilotica</i> (L.) Willd. Ex Delile	Babul	Colic pain & indigestion	The fruits are given twice a day for 7 days.
<i>Amaranthus spinosus</i> L.	Kanta Khira	Cold & fever	Root made into a paste and given 5 teaspoons thrice in a day for three days.
<i>Boerhavia diffusa</i> L. (Plate 1c)	Puruni	Dog bite	4.5” long twig made into paste and given for three days.

<i>Cajanus scarabaeoides</i> (L.) Thouars	Kulthia, Duma Hirma	Foot and mouth disease	Leaves made into paste along with 10 grains of <i>piper nigrum</i> and administered 5 teaspoon daily for three days.
<i>Cissus quadrangularis</i> L. (Plate 1b)	Hadobhanga, Hadasinkuda	Bone fracture	Stem of <i>C. quadrangularis</i> and leaves of <i>V. negundo</i> (Plate 1), one teaspoon of salts and 5 teaspoon of cow dung are made into paste and applied thickly as a plaster and bind with bamboo stick.
<i>Coccinia grandis</i> (L.) Voigt.	Bana Kunduri	Abscess, diabetes, lack of appetite, vomiting tendency due to poisoning	2-3 teaspoonful of juice obtained from crushed leaves and roots of <i>Coccinia grandis</i> is slightly warmed and taken for diabetes. For lack of appetite, especially due to fever or mucus, leaves are boiled and then fried in ghee and eaten. 5-6 tablespoon of the juice of leaves is administered to patients who are vomiting due to effects of poisoning. Macerated leaves are applied as poultice to abscess.

<i>Crotalaria juncea</i> L.	Sanpat	Whitening of eyeball	2” long stem tied with thread on horn of the cattle
<i>Curculigo orchoides</i> Gaertn., & <i>Centratherum anthelminticum</i> (L.) Gamble	Talmuli & Somraaj	Helminthiasis, deafness due to old age	For helminthiasis, seeds of <i>Centratherum anthelminticum</i> (L.) are slightly powdered and taken. For deafness, powdered seeds of <i>C. anthelminticum</i> are taken with leaves of <i>Curculigo orchoides</i> in the morning on an empty stomach.
<i>Euphorbia antiquorum</i> Wall.	Vajrakantakah	Throat swelling	Milky latex applied on the swollen parts once daily for seven days.
<i>Helianthus annuus</i> L. & <i>Marsilea quadrifolia</i> L.	Surya Mukhi & Sunsunia	Bone fracture	Grind together these two species and applied thickly on the broken part as a plaster and bind with bamboo stick.
<i>Holarrhena pubescens</i> Wall.	Kurchi, Kurei	Helminthiasis, piles	For helminthiasis. 62.5g of powdered seeds of <i>H. pubescens</i> is taken with cold water every morning. For piles, 2/3 (1anna=62.5g) amount of powdered bark is mixed with honey and taken.
<i>Oldenlandia corymbosa</i> L.	Gharpodia, Jarjati	Burning sensation in hands or legs, dysentery	Whole plants are soaked in water; the plants are then boiled in 4 cups of water:

		symptoms including black stool, blood with stool & stomach pain.	when the volume is reduced to 2 cups the water is strained through a piece of cloth and divided into 2 equal portions. One portion is to be taken in the morning, the other in the evening.
<i>Premna integrifolia</i> L.	Agnimanth	snakebite	Orally administrated macerated leaves of <i>Premna integrifolia</i> L. along with black peppers. At the same time macerated roots of the plant are applied to the bitten area.
<i>Rauvolfia serpentina</i> (L.) Benth. ex Kurz	Patal Garuda	Ear sore and earache	Squeeze the juice of the leaves and drop into the ears.
<i>Solanum virginianum</i> L.	Ankranti	Fever, redness & watering of eyes	Roots of the plant and 21 grains of <i>piper nigrum</i> are made into paste and given three teaspoons twice in a day for seven days.
<i>Spondias pinnata</i> (L. f.) Kurz	Aamrataka	Painful joints	The bark of <i>S. pinnata</i> is used as a rubefacient for the treatment of painful joints.
<i>Stephania japonica</i> (Thunb.) Miers (Plate 1d)	Sondhimali	Low density of semen, abscess, infections of skin	For low density of semen, leaves of <i>Stephania japonica</i> are squeezed in water. As a result, a dense gum like juice comes out which is taken. Leaves are rubbed on

			abscesses or skin infections.
<i>Streblus asper</i> Lour.	Sahada	Abscess, dysentery	Roots of <i>Streblus aspera</i> are macerated in a small amount of water and applied to abscess. 3 teaspoonfuls of juice obtained from macerated bark is taken thrice daily for dysentery.
<i>Tinospora cordifolia</i> Miers.	Guluchi	Passing of semen with urine, leucorrhoea, helminthiasis, gonorrhoea, respiratory difficulties	Stems of <i>Tinospora cordifolia</i> is mixed with boiled cow milk or with cold water and taken in the morning, afternoon & evening. For respiratory difficulties, juice obtained from fresh stems of <i>T. cordifolia</i> Miers. is mixed with juice obtained from leaves of <i>Justicia adhatoda</i> L. and <i>Ocimum tenuiflorum</i> L. and taken
<i>Withania somnifera</i> (L.) Dunal	Ashwagandha	Tuberculosis, underweight in children	6g powdered root of <i>Withania somnifera</i> (L.) is taken daily with honey for tuberculosis. 5g powdered root is fed to underweight children with milk or ghee for 1 month.

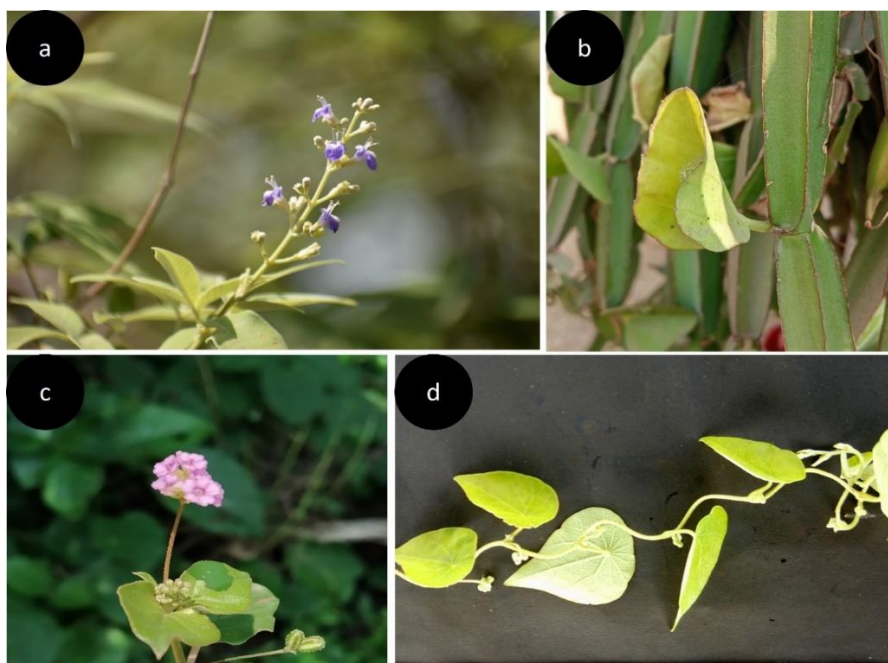


Plate 1: Some common ethnomedicinal plants are (a) *Vitex negundo*, (b) *Cissus quadrangularis*, (c) *Boerhavia diffusa*, and (d) *Stephania japonica*

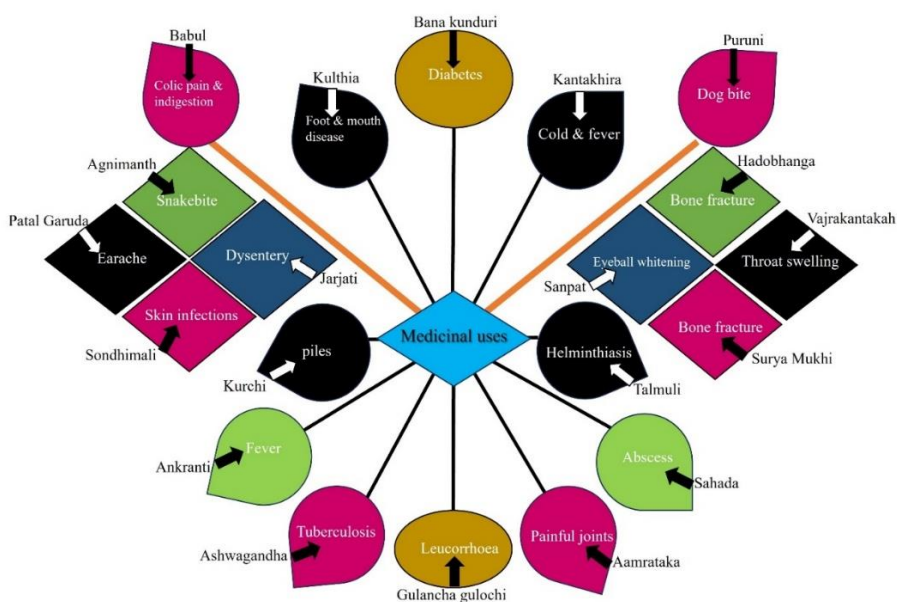


Plate 2: Common ethnomedicinal plants used by Santal community and their medicinal uses

Conclusion: The present findings in this documentation of ethno-medicinal information will not only support the preservation of age-old herbal knowledge but also promote the scope of drug development by the pharmaceutical industry based on traditional knowledge.

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Nectarivorous birds, threats, and conservation aspects

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Abstract: Birds play a vital role in the flowering and fruiting of all plant species worldwide. Birds are free-living beings and need adequate food to survive. Birds assist in flower pollination when they collect nectar from flowers. Nectar in flowers is food for birds, as it provides some energy to do their daily active routines like making nests, feeding their offspring to fly far distances, etc. Some major threats that birds are facing nowadays are habitat clearance, urbanization in their home areas, cutting down trees, and destruction of water bodies. Therefore, we need to pay attention to this global burning issue to document the threats and conservation strategies. For conservation strategies, the first step is to list out the food, nectar, and shelter plants that help the birds thrive again by maintaining the ecosystem. Since the birds pollinate the plants, the decline of any of the species will be a major issue. In this survey, about 20 bird species were recorded from different locations in India and their associated nectar plants. Keeping this in view, a conservation strategy is addressed using birds and plants.

Keywords: Urbanization, Ecosystem, Pollination, major issue, nectar

Introduction: Nectarivores birds play a vital role in the ecosystem, as pollinating birds are attracted to flowers to feed on the nectar. Incidentally, pollen attached itself, thus helping to transfer it as it travelled from flower to flower. Nectar contains water, fructose, glucose, and sucrose, but it also contains several proteins, salts, acids, and essential oils that give energy to the birds. In summertime, the birds need water to survive, and nectar plants are the ultimate choice. Basically, the birds that feed on common nectar plants are *Calotropis gigantea*, *Lantana camara*, *Ipomoea carnea*, *Streblus asper*, (Plate 1; Das et al. 2023) etc. The common birds are the Purple Sunbird, Asian Pied Starling, Asian Green Bee-Eater, Spotted Dove, Baya weaver, Jacobin cuckoo, etc. A long time ago, birds chirping was the most alarming or soothing song in any part of the world, but due to sudden changes, now it has become a major concern. Many birds have come into threatened or extinct categories because of poaching, extreme climatic changes, water body areas diminishing, sand mining of river areas, habitat destruction for urbanization, cutting down trees, high-voltage wires from poles, etc. In many urban areas, the birds are only seen as fewer in number because there are no food or shelter plants for them. That is why many cities are now experiencing high temperatures, making it difficult for people to survive. Some forest areas or patches are seen in India, which is a hub of food and shelter for birds. That is why it is low in temperature, but now many forests are also being cleaned off for mining purposes and urbanization, which is now an alarming issue. In maintaining such burning issues, some steps need to be taken, like the plantation of nectar plants, seed balls, and grass species near river areas. These are some conservation approaches that maintain the ecosystem (Das et al. 2023). Keeping this in view, an attempt has been made to document the nectar plants associated with birds, major threats, and address the conservation strategies in India.

Methodology: The survey was carried out in the years 2022–2023 near Mahanadi River areas of Cuttack district, Odisha. The reading takes place in the morning and evening, when birds are seen the most. The available nectar plants are listed in urban as well as forest areas. The birds and plants were identified by Dr. Sanjeet Kumar (Plate 2).

Results and discussion: The result revealed that 20 common birds feeding on nectar plants were enumerated ([Table 1](#)). The most seen birds that feed on nectar are the Asian Pied Starling, Baya Weaver, Jacobin Cuckoo, Black Drongo, Spotted Dove, etc. ([Plate 3](#)). The nectar plants are *Erythrina variegata*, *Bombax ceiba*, *Ficus benghalensis*, *Butea monosperma*, *Ficus religiosa*, *Streblus asper*, *Samanea saman*, etc. ([Plate 4](#)). Many researchers reported on nectar plants associated with birds in the years [1984–2016](#). Reports on conservation strategies are few in number. In [2012](#), Schondube reported the nectar and birds' association. In [2015](#), Schmid et al. reported the nectar-feeding birds. In [2020](#), Geerts et al. reported the nectar-feeding bird in South Africa. In [2023](#), Guchhait et al. reported the relationship between nectar birds and flowering plants. Therefore, due to urbanization in many places, some are in the near-threatened and extinct categories. Before it all goes extinct, it will be a major concern for ecology to conserve it. Keeping this in view, an attempt has been made to enumerate the nectar plants associated with them and their conservation strategies.

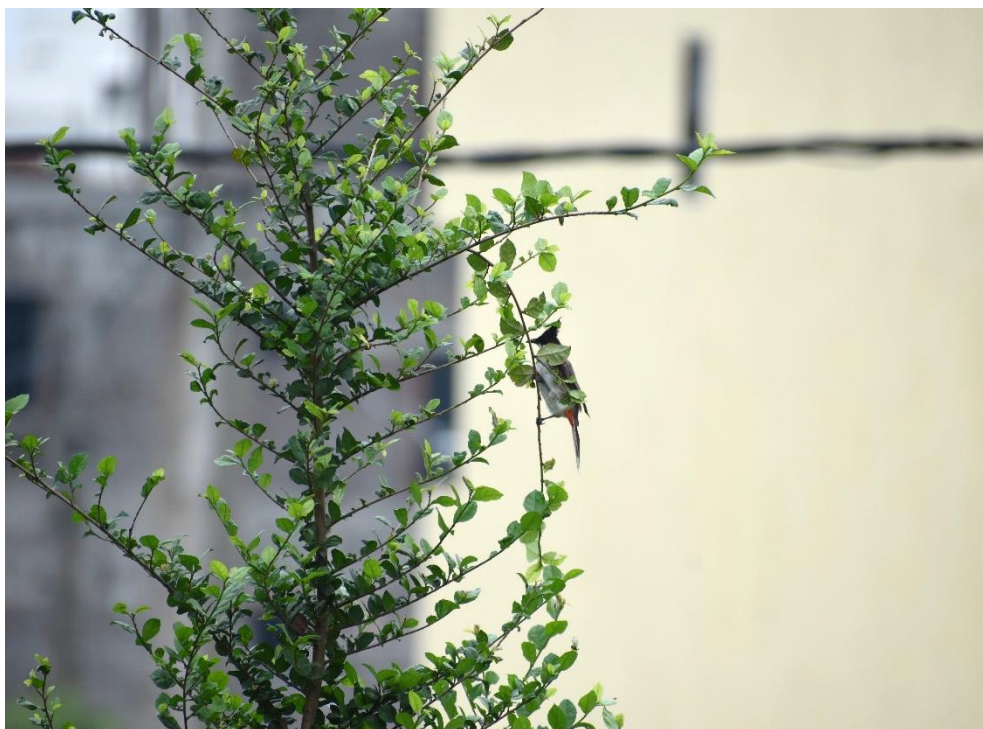


Plate 1: Red whiskered bulbul feeding nectar from *Streblus asper* (Sahada)



Plate 2: Survey work on Nectarivores birds

Table 1: Some common plants of nectar-feeding birds

Common name	IUCN status	Related plants	Medicinal value of plants
Alexandrine parakeet	NT	<i>Bombax ceiba</i> , <i>Butea monosperma</i> and <i>Erythrina variegata</i>	Cough, Dysentery, Diarrhoea, Rheumatoid arthritis
Asian green bee-eater	LC	<i>Ziziphus oenoplia</i> and <i>Lantana camara</i> ,	Hyperacidity, inflammations
Asian Pied Starling / Indian Pied Mynas	LC	<i>Bombax ceiba</i> , <i>Butea monosperma</i> , <i>Erythrina variegata</i> , <i>Ficus benghalensis</i> , <i>Lantana camara</i> and <i>Ziziphus mauritiana</i>	Stimulating appetite Dysentery, Diarrhoea, Rheumatoid arthritis, Piles, Inflammations
Baya weaver	LC	<i>Samanaia saman</i> and <i>Streblus asper</i>	Eczema, Epilepsy
Black Drongo	LC	<i>Bombax ceiba</i> , <i>Butea monosperma</i> and <i>Erythrina variegata</i>	Dysentery, Diarrhoea, Rheumatoid arthritis
Black hooded Oriole	LC	<i>Bombax ceiba</i> , <i>Erythrina variegata</i> , <i>Ficus benghalensis</i> , <i>Ficus religiosa</i> and	Dysentery, Rheumatoid arthritis, Piles, Diabetes,
Brahminy starling	LC	<i>Streblus asper</i>	Epilepsy

Chestnut-tailed Starling	LC	<i>Butea monosperma</i> , <i>Bombax ceiba</i> , <i>Erythrina variegata</i> and <i>Grevillea robusta</i>	Diarrhea, Dysentery, Rheumatoid arthritis, Sore throat
House Sparrow	LC	<i>Aloe arborescens</i> and <i>Samanaia saman</i>	Inflammation, Eczema
Jacobin cuckoo	LC	<i>Streblus asper</i>	Epilepsy
Jungle Myna	LC	<i>Bombax ceiba</i> , <i>Erythrina variegata</i> , <i>Butea monosperma</i> and <i>Spathodea campanulata</i>	Dysentery, Rheumatoid arthritis, Diarrhoea, Kidney diseases
Oriental Magpie Robin	LC	<i>Butea monosperma</i> , <i>Bombax ceiba</i> and <i>Erythrina variegata</i>	Leprosy, Urinary complaint, Joint pain
Pied bush chat	LC	<i>Ipomoea carnea</i> and <i>Choromoleana odorata</i>	Leucoderma, inflammation
Purple rumped sunbird	LC	<i>Calotropis gigantea</i>	Inflammation
Purple Sunbird	LC	<i>Butea monosperma</i> , <i>Dendrophthoe falcata</i> , <i>Morinda tinctoria</i> , <i>Woodfordia fruticosa</i> and <i>Ipomoea carnea</i>	Muscular pain, Stomach problems, Malaria, Diabetes, Skin diseases

Red vented bulbul	LC	<i>Capparis spinosa</i> , <i>Erythrina variegata</i> , <i>Spathodea campanulata</i> , <i>Woodfordia fruticosa</i> , <i>Careya arborea</i> , <i>Cocos nucifera</i> , <i>Bauhinia variegata</i> , <i>Clitoria ternatea</i> , <i>Clerodendrum infortunatum</i> , <i>Tabernaemontana divaricata</i> and <i>Bombax ceiba</i>	Rheumatism, Limbs and joint pain, Kidney diseases, Diabetes, Diarrhoea, Arthritis, Scabies, Appetizer, Antioxidant, Liver disorders, Dysentery
Rose-ringed Parakeet	LC	<i>Erythrina variegata</i> and <i>Butea monosperma</i>	Diarrhea, muscular pain
Spotted dove	LC	<i>Sterculia foetida</i> and <i>Spathodea campanulata</i>	Skin diseases, kidney diseases
Tawny bellied Babbler	LC	<i>Erythrina variegata</i> and <i>Bombax ceiba</i>	Diarrhea, Dysentery
Yellow-eyed Babbler	LC	<i>Erythrina variegata</i> and <i>Ziziphus oenophila</i>	Diarrhoea, Ascaris infection

(LC: Least Concern; NT: Near Threatened)

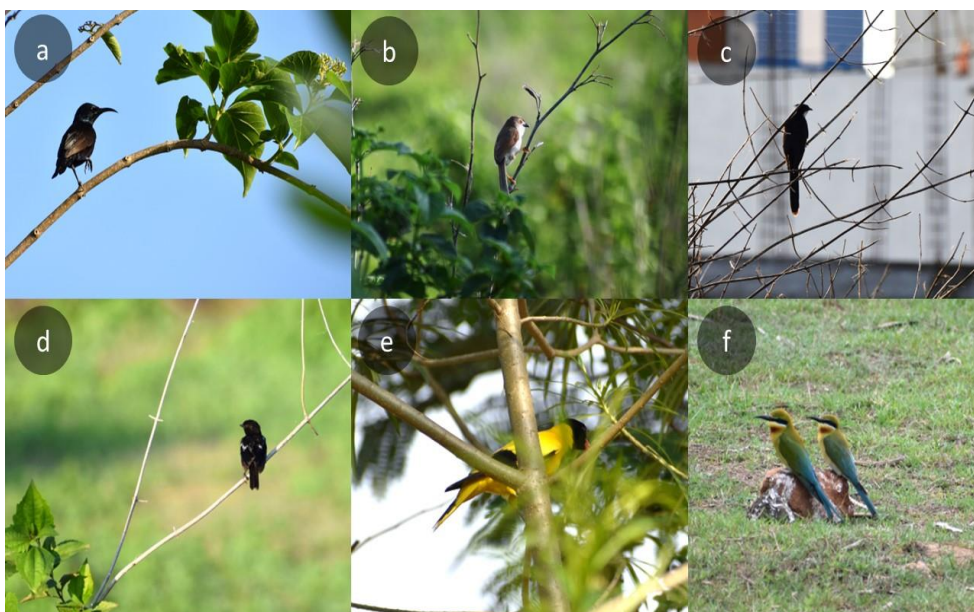


Plate 3: Nectar birds and associated with the flora a) Purple sunbird, (b) Yellow-eyed babbler, (c) Jacobin cuckoo, (d) Pied bush chat, (e) Black-hooded oriole, (f) Blue-tailed bee-eater



Plate 3: Birds feed on nectar plant (a) *Erythrina variegata*, (b) *Butea monosperma*, (c) *Calotropis gigantea*, (d) *Ipomoea carnea*, (e) *Spathodea campanulate*, (f) *Bombax ceiba*

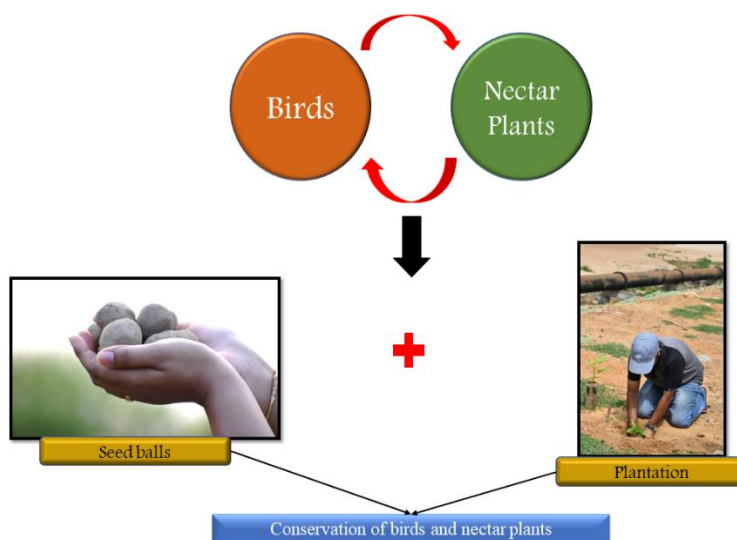


Figure 1: Future aspects of conservation strategies

Conclusion: After several calamities like COVID-19, earthquakes, cyclone, etc., it is now an ultimate resolution to maintain our ecosystem and to take steps that need to be taken before it is too late and human extinction. Due to the vast reasons behind the extinction of bird species, the foremost steps will be the conservation aspects needed to overcome such issues as plantations or seed balls to bring back the nectar plants and their associated birds (Figure 1).

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Plantago asiatica subsp. *erosa* (Wall.) Z.Yu Li: A less known nutraceutical herb of Northeast India

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Abstract: The rich plant diversity of Northeast India is deeply associated with the lives of different tribal and indigenous communities in the region as a natural source of food, medicine, and other purposes. Plantains are considered very nutritious but most are less known for their edibility. *Plantago asiatica* subsp. *erosa* is a swamp herb known for its high medicinal uses and food values in Northeast India. The nutraceutical value of this species is less known by people, even though it is distributed in other parts of the country. Many regions of developing and under developed countries with high populations are prone to hunger, malnutrition, or cannot afford to get healthy nutritional diets. The exploration of wild nutraceutical plant species of *Plantago* is attempted to be documented here with its morphological characters for identification and ethnobotanical uses with respect to food and medicinal uses from the Northeast region of India. This documentation could be helpful to people be aware of the common nutraceutical plants and how they could be helpful to reduce food insecurity around the world. This could be also helpful to draw the attention of the researchers to work on the pharmacological aspects and value addition of this species.

Keywords: Ethnobotany, nutritional herb, exploration, food, medicine

Introduction: Northeast India is blessed with enormous plant diversity with various habits (Kumar et al. 2018; Kumar and Thorat 2018; Devi et al. 2018; Devi et al. 2019; Devi et al. 2020; Kumar et al. 2022). Although many such plant diversity may be distributed in other parts of the country, its rich ethnobotanical uses of many species are confined to many tribal and indigenous communities of Northeast India. Consumption of natural nutraceutical plants unknowingly keeps them healthy, young and prevent from many diseases and disorders. However, the influence of many foreign cultures, food habits, lifestyle have affected to some extent. Most of the local markets of Northeast India are unique as many of such wild edible foods, medicine or nutraceutical are easily available for consumption with reasonable prices. The utility of each species may differ from one place to another. This could be one of the reasons why a lower-income family could access a healthy diet and nutrition. Many of the nutraceutical plants and their parts stimulate the immune system and prevent several health issues. A recent report of the World Bank Global Food and Nutrition Security 2023 revealed high food inflation occurring worldwide, affecting 63.2 % of low-income countries, 79 % of lower middle-income countries, 67 % of upper middle-income countries, and 78.9 % of high-income countries. The current scenario of hunger prevalent worldwide is about 9.2 % in 2022, as stated in the report of FAO's 2023 State of Food Insecurity and Nutrition. It has also revealed that 29.6 % of the global population has been affected by moderate or severe food insecurity problems, with 11.3 % of the population affected by severe food insecurity. In 2021, more than 42 % of the global population will be unable to afford a healthy diet (<https://www.worldbank.org/en/topic/agriculture/brief/food-security>).

Urbanisation in every nook and corner of the world has driven many challenges in healthy food availability, agricultural systems, mode of food production, unhealthy diets, shrinking of natural forests and agricultural lands, use of fertilisers and pesticides, adulteration, high food price inflation, etc. The genus *Plantago* comprises about 200 species, mostly small herbs commonly termed plantains. Plantains like *Plantago major* have been reported for their therapeutic uses as an antioxidant agent, wound healing agent, and preventer of infection. It is also used to treat diarrhoea and as an anti-inflammatory agent. Plantains are considered rich sources of nutrients

like calcium, vitamin A, C, and K (Miraj 2016). However, *Plantago asiatica* subsp. *erosa* is native to the Indian subcontinent and south-central China. Globally, it is distributed in India, the East Himalaya, South-central China, Bhutan, and Sri Lanka. In India, it is distributed in Northeastern states like Manipur, Nagaland, Sikkim, Meghalaya, etc., and other parts like West Bengal (Sankara et al. 2020). Exploration of wild edible foods and nutraceutical plants with indigenous traditional knowledge could be helpful to inform people about the alternative source of expensive healthy diets and medicines. Such plants could be cultivated and valued as an option affordable to lower-income sections of society. The ethnobotanical uses of *Plantago asiatica* subsp. *erosa* in the Meitei community of Manipur (Devi et al. 2022) in the Northeast part of India and neighbouring countries are described here with morphological characters for easy identification in the field.

Methodology: The ethnobotanical information has been collected from different people in the Meitei community of Manipur about the uses of *Plantago asiatica* subsp. *erosa*, and different modes of use have been listed (Kumar et al. 2021). Also, a comparative account of the ethnobotanical data on the uses of the same plant that has been reported from other Northeast states is given in Table 1. A brief description of *Plantago asiatica* subsp. *erosa* is also given hereunder.

Results and discussion

Plantago asiatica subsp. *erosa* (Wall.) Z.Yu Li

It is a swamp or moist loving perennial herb of the family Plantaginaceae. Leaves are simple, elliptic, subacute, attenuate at the base, sometimes with oblong or oblanceolate lobes or dentate structure, mostly glabrous and sometime puberulous, 3-5 parallel veins, broad channeled and long petiole; inflorescence dense spikes, flowers subsessile, bracts ovate or elliptic, sepal oblong to elliptic, concave, keel projecting, corolla white, obtuse to narrowly triangular, slightly lobed at the apex; fruit capsule, seeds many, oblong and black when matured (Figure 1).

Ethnobotanical Uses: The ethnobotanical survey at the present study for the Meitei community of Manipur revealed that it is locally known as Yempat. The leaves are slightly roasted over a direct flame and then applied externally

to treat boils and swellings. The soup of the leaves is taken to reduce high blood pressure. People collect the leaves, semi-cook them, and mix them with spices and fermented fish to prepare a delicacy called Kangsu (semi-cooked salad). Although it is edible and used for therapeutic purposes, it is not available in Imphal. Hoakip and his coworkers recently reported on the wild edible foods of Tengnoupal District of Manipur and revealed that the leaves are cooked as leafy vegetables by the Thadou Kuki tribe of Manipur and are available in local markets ([Haokip and Panmei 2022](#)). The leaves are considered as medicinal agent, so people cook and eat them to treat various ailments like stomachaches, dysentery, and kidney problems. The fresh plant paste can be applied to cuts and wounds ([Chetri et al. 2018](#); [Lea and Limasenla 2020](#)). Again, the decoction of the whole plant is used to reduce high fever ([Shiddamallayya et al. 2018](#); [Table 1](#)). The different medicinal and food uses are shown in [Figure 2](#).

Table 1: Ethnobotanical uses of *Plantago asiatica* subsp. *erosa*

Plant part used	Ethnobotanical uses	Place	Source
Leaves	Slightly roasted directly on fire and applied externally for treatment of boils and swellings	Manipur, India	Present study
Leaves	Soup is taken to reduce high blood pressure	Manipur, India	Present study
Leaves	Eaten as semi-cooked salad (Kangsu)	Manipur, India	Present study
Whole plant	Plant paste is applied to cuts & wounds	Bhutan	Chetri et al. (2018)
Leaves	Fresh leaf paste applied to cuts and wounds	Nagaland, India	Lea and Limasenla (2020)
Whole plant	Cooked and taken to treat stomachache,	Nagaland, India	Lea and Limasenla (2020)

	dysentery & kidney problems		
Whole plant	Decoction of the whole plant is used to reduce high fever	Sikkim, India	Shiddamallayya et al. (2018)
Leaves	Cooked as leafy vegetables	Manipur, India	Haokip and Panmei (2022)



Figure 1: *Plantago asiatica* subsp. *erosa* (Yempat) in its habitat

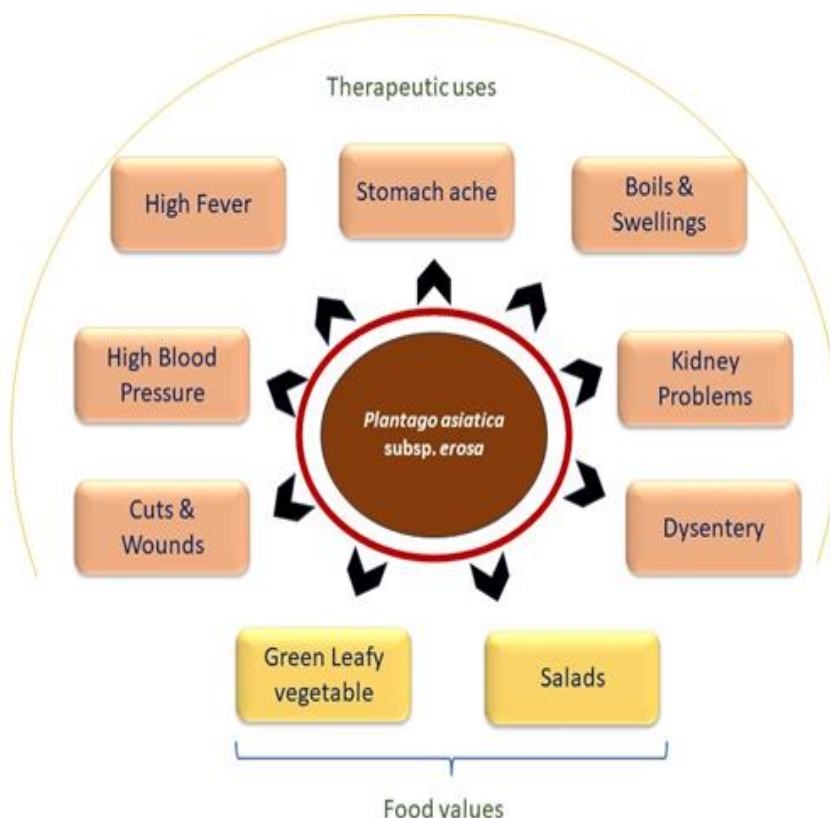


Figure 2: Therapeutic uses and food values of *Plantago asiatica* subsp. *Erosa*

Conclusion: Indigenous traditional knowledge of wild food and medicinal plants is unique for the same or different plant species from varied tribal and indigenous communities in Northeast India. This is applicable to other parts of India, where a single plant species may have numerous modes of use in their respective cultures and traditions. Here, the exploration of the ethnobotanical uses of *Plantago asiatica* subsp. *erosa* from the Meitei community and the comparative account of the different modes of use from different states of Northeast India as a nutraceutical could help people all over the world become aware of its edibility and therapeutic uses. This also draws the attention of the researchers to work more into the pharmacological aspects of the species for future drug development. On the other hand, cultivation of the species and value addition of the product can be taken up and made available at affordable prices as an alternative nutraceutical plant.

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Schizophyllum commune (Kanglayen): A lesser-known edible mushroom of Northeast India

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Abstract: The diversity of mushrooms is enormous in India and there are varied species of wild mushrooms that are edible. But when specific wild edible plants or mushrooms are deeply rooted with a specific culture, tradition, and cuisine of an indigenous community of a region, it is not only an awareness of the active biodiversity, but a matter of pride associated from generations. This document represents the long-run tradition of cuisine made from a lesser-known wild edible mushroom i.e., *Schizophyllum commune* in Northeast India. Although, the diversity is not confined to only this region of India, not much edibility is reported from other parts of India. An experiment has also been carried out to check the presence of primary and secondary metabolites and results showed that the mushroom is rich in nutrients like proteins and amino acids, secondary metabolites like tannins and terpenoids in aqueous extract. The high nutritive value and the easy availability of this mushroom makes it a potential food item that could be included in our daily diets. This could also be cultivated to fight nutrient deficiency, malnutrition, famine or as a food security for the growing population of the country.

Keywords: Kanglayen, wild edible mushroom, protein source, lesser-known, traditional cuisine

Introduction: *Schizophyllum commune* is a lesser-known wild edible mushroom. It is also known as split gill mushroom and they prefer to grow on hard wood logs or bamboo surfaces as scattered or clustered forms. It has unique enzymes that degrade all lignocellulosic biomass. The genome has been reported to contain 240 genes that code for glycoside hydrolases. The distribution records showed that it is found in every continent of the world except the Antarctic poles where no woods are present as a substrate for the mushroom (Imtiaz et al. 2008). The mushroom has been reported to be eaten in Mexico, some parts of Nigeria, and some Asian countries. Reports of edibility in India is found only from Northeastern states of India like Manipur, Mizoram, Tripura, etc. Food scarcity and food security issues are common in the world especially for the developing and underdeveloped countries (Rout et al. 2020; Mishra et al. 2021). Relying on specific foods for mass production may sometimes lead to an expensive form of nutrition. A latest report of the World Bank states that approximately 9.2% of the world population are facing hunger in 2022 as compared to 7.9% in 2019. About 29.6% of the world population are affected by food insecurity. About 42% of the world population are unable to afford healthy diet as in 2021 (Mukherjee et al. 2023). The alternative to expensive healthy diet needs to be explored from different regions, cultures, and traditions of the world to find some of the possible solution for the food insecurity problems (Kumar et al. 2012). Mushrooms are nutritious source of food that people already know. However, only few species of the mushrooms are well cultivated and marketed (Kumar et al. 2022). There are several wild edible mushrooms that are widely available in many regions of the world but due to the unawareness of their edibility, nutritive value, and economic value, not many people get the nutrition out of it. Here, the importance of regional food come into play with the wild edible food plants and mushrooms. Regional and seasonal wild food plants and wild edible mushrooms play an important role to cope with food insecurity, famine, malnutrition, etc. Such foods are highly nutritious, easily available, cheap, mostly without adulteration and chemicals (Kumar et al. 2021). *Schizophyllum commune* (Figure 1) is one such wild edible mushroom that is less known about its edibility and very less reports are found. Although, there are less edibility reports, it is loved as a delicious cuisine by the Meitei community of Manipur. In Manipuri language, it is known as

Kanglayen. The delicacy made of *S. commune* is considered special and has been deeply rooted with the culture and tradition of this community of Manipur. The mode of preparation, its nutritive values and secondary metabolites examined are given here.

Methodology: Preparation of the regional delicacy of *S. commune*: The delicacies made of *S. commune* is locally known as “Kanglayen paknam”- Kanglayen refers to *S. commune* mushroom and paknam refers to the spicy cake. The preparation of the Kanglayen paknam starts by cleaning the mushroom well 4 to 5 times till the dirt and dust are well removed. It is then mixed with spices like red chili powder, turmeric, green chilli, ginger, and coriander. Good amount of local spice herb like *Allium hookeri* and a roasted fermented fish is the key to enhance the flavour. Gram flour is added with little water and the whole ingredients are mixed well. It is then wrapped in turmeric leaves and layered again with banana leaves. It is steamed until it is cooked and transferred to a pan and roasted till the outer layer turns brown and crispy. The wrappings are later removed and can be served.



Figure 1: *Schizophyllum commune* in natural habitat

Phytochemical analysis of aqueous extract of *S. commune* (Kumar and Jena 2014; Bhaigyabati et al. 2017; Shaikh and Patil 2020; Figure 2)

Test for Primary metabolites

Test for Carbohydrate: The filtrate (2 ml) mixed with few drops of Fehling's solution A and Fehling's solution B and kept in water bath for 5 minutes. Red precipitate shows presence of carbohydrate.

Test for Sucrose: The filtrate (2 ml) mixed with 2 to 3 drops of iodine. Bluish black color shows presence of iodine.

Test of Starch: The filtrate (2 ml) mixed with 2-3 drops of HCl and heated on water bath for 5 minutes. It was then removed from water bath and mixed with 2-3 drops of NaOH and Benedict's Reagent. The change in color from bluish green to red orange shows the presence of starch.

Test for Lipid: The filtrate (2 ml) mixed with 2-3 drops of Sudan 3. The pink droplets show the presence of lipids.

Test for Amino acid: The filtrate (2 ml) mixed with 3-4 drops of Ninhydrin and heated on water bath for 30 minutes or till it turns purple. The purple color shows the presence of amino acid.

Test for Protein: The filtrate (2 ml) mixed with 2-3 drops of Milan's Reagent and heated on water bath for 30 minutes. The pink color shows the presence of protein.

Test for Secondary metabolites

Test for Saponin: The filtrate (2 ml) mixed with 1m distilled water and shaken vigorously. The presence of persistent froth shows the presence of saponin.

Test for Tannin: The filtrate (2 ml) mixed with 3-4 drops of 0.1% Lead Acetate. The presence of precipitation shows the presence of tannin.

Test for Flavonoid: The filtrate (2 ml) mixed with 1m of 10% NaOH solution and 2-3 drops of H₂SO₄. The change in color from yellow to colorless shows the presence of flavonoids.



Figure 2: Phytochemical analysis of aqueous extract of *Schizophyllum commune*; a. Test for secondary metabolites b. Test for primary metabolites

Test for terpenoids: The filtrate (2 ml) mixed with 1ml of chloroform and 3-4 drops of conc. H_2SO_4 . The reddish-brown color ring at the interface shows the presence of terpenoids.

Test for Phenolic compounds: The filtrate (2 ml) mixed with 3-5 drops of 1% Ferric Chloride solution. The formation of bluish black color shows the presence of phenolic compounds.

Test for reducing sugar: The filtrate (2 ml) mixed with 2 drops of Fehling's solution A and Fehling's solution B and kept in water bath. The formation of orange color precipitate shows the presence of reducing sugar.

Test for steroids: The filtrate (2 ml) mixed with 2 ml chloroform and 2 ml conc. H_2SO_4 . The formation of upper red layer and lower yellow with green fluorescence shows the presence of steroids.

Test for Alkaloids: The filtrate (2 ml) mixed with 3 drops of Dragondorff's reagent. The formation of orange red precipitate shows the presence of alkaloids.

Test for Carbonyl compounds: The filtrate (2 ml) mixed with 3-4 drops of 2,4-dinitro phenyl hydrazine. The presence of yellow crystals shows the presence of carbonyl compounds.

Results and discussion: The regional cuisine made from a lesser-known wild edible mushroom like *Schizophyllum commune* is described here to create awareness to as many people as possible about the edibility of nutritious mushrooms like *S. commune*. The preparation methodology involving spices and herbs like *Allium hookeri* and leaves of *Curcuma longa* enhances the nutritional content of the food. *Allium hookeri* is rich in protein, sugar, fibre, total phenols, phytosterols and ascorbic acid (Ayam 2011); the leaves of *Curcuma longa* is rich in phenolic compounds and flavonoids and so it acts as an active antioxidant activity (Kim et al. 2019). Such preparations contain almost negligible processed food products and are considered as healthy diet and nutrition (Figure 3).

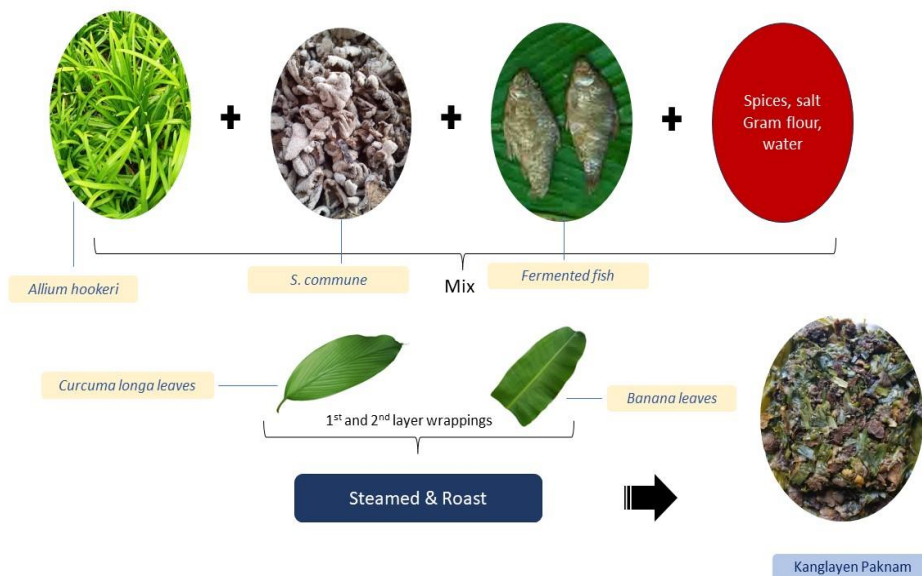


Figure 3: Preparation of Kanglayen Paknam; a delicacy made with *Schizophyllum commune*

The present experiment carried out to check the phytochemical analysis of the aqueous extract of *S. commune* showed the presence of primary metabolites like amino acids and proteins and secondary metabolites like tannin and terpenoids. Earlier report revealed that methanol extract of *S. commune* showed the presence of flavonoids, phenols and saponin (Teoh et al. 2013) and ethanol extract showed the presence of saponin, tannins, alkaloids, flavonoids, terpenoids, proteins and carbohydrates (Acanto et al. 2021). Devi and her co-workers reported the antioxidant activity of *S. commune* due to the presence of phenols, flavonoids, and ascorbic acid (Devi et al. 2014). Experimental cultivation of *S. commune* had been reported with a comparative nutritional analysis with the wild *S. commune*, results showed that there is no much difference in the nutritional content like fat, protein, fibre and carbohydrate (Herawati et al. 2016). Consumption of this mushroom in different modes altering the mixing ingredients can benefit with varied nutritional availability.

Conclusion: The exploration of wild edible mushrooms from different regional cuisines and delicacies around the world could help people become aware of the easily available nutrients that they can get. This can help fight the food insecurity and hunger issues that the world is facing. People who cannot afford healthy nutritional diets can have alternatives if such nutritional, natural sources of food are available for consumption.

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