Indigenous Traditional Knowledge and Advancement in Medicinal Plants Research

Durga Prasad Barik
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CONTENTS

CLIMBERS USED AS A FOOD PLANT BY THE SANTHAL COMMUNITY

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ABSTRACT

Santhal community is one of the oldest tribe in India. The tribe has a long history of traditional practices for using plant parts as a food and medicine which makes them one the most ethnic tribe. They usually formulate the herbal drugs from nutraceutical plants available in their near forest and treat various ailments. Their traditional knowledge itself a gem to solve food and healthcare problems. Mainly the problem includes the food scarcity and to cure diseases. The objective of the present study was to conduct ethnobotanical study and collect information regarding specific climbers used as food plants by the Santhal community. Survey was carried out during the period of 2019-2022 in Odisha and Jharkhand states of India through random questionnaire. The results revealed that about 25 common climbers are used as a food by the Santhal. The most common enumerated climbers used as a food are Benincasa hispida, Citrullus lanatus, Cucumis melo, Coccinia grandis, Cucurbita maxima, Cucurbita moschata, Momordica dioica, Momordica charantia, Trichosanthes dioica, Trichosanthes cucumerina, Luffa cylindrica, Luffa aegyptiaca, Lagenaria siceraria etc. The chapter highlights the food values of locally available climbers to fight against food problems.

Keywords: *Santhal community, forest, traditional knowledge, food value, diseases*

INTRODUCTION

The current vision of FAO (Food and Agricultural Organization) is world free from hunger and malnutrition, where food and agriculture contribute to improving the living standards of all, especially the poorest, in an economically, socially and environmentally sustainable manner' (FAO 2017; Kumar et al. 2016). The vision itself indicate that after lot of efforts, we are not able to get adequate food for all. About 795 million people still suffer from hunger, and more than two billion from micronutrient deficiencies or forms of over nourishment.

In India, half of population is struggling to find food on their plate, coping with stern starvation and droughts with on the flipper side. India is home to the largest number of hungry people in the world with over 200 million people (FAO 2017; Kumar et al. 2016). The Global Hunger Index (GHI) 2021 ranks India at the 101st position (out of 116 countries), which the index characterizes as "serious" food security situation (www.globalhungerindex.org/india.html). Government of India continuous working on this problem and Government extends additional free food grains scheme through march 2022 On November 24, 2021, India's Union Cabinet approved the extension of the scheme that provides 5 kilograms of food grains per month free of cost for the beneficiaries under the National Food Security Act (IGF 2022).

The above all data and information reveals that whole world is working on food problems but not able to solve it and food security, malnutrition and other allied aspects are visible in root level even there are numbers of food plants are available in wild and described in traditional practices of ethnic community. Keeping this in view, an attempt has been carried out to enumerate the climbers used as a food by the Santhal community to highlights their importance to fight against food problems globally.

Santhal community are an ethnic group native to India. Santhal community holds traditional practices which are done centuries from their ancestors. Traditional practices are a knowledge hub, which is the answer to many burning contemporary questions. Tribal people from all over the world have indigenous traditional knowledge which can be key to today's problem of food scarcity. Currently the food scarcity and microbial diseases are the major problems throughout the world. Tribal people are more depending on forest for their food, economic and medicinal purposes (Dolui et al. 2014). Many food plants are consumed by the tribes collected from the nearby forest in the form of tubers, rhizomes, shoots, flowers, fruits, seeds, etc. as a supplement in their diet.

Among the food plants, climbers are characterized by the weak stem, long and its use external support to grow and carry their weight. These plants use a special type of structure called tendrils to climb and take support (Ali et al. 2016). Climbers are used as food and apart from food values, they have medicinal values too (Mallick et al. 2020). So, the tribal people consumed these wild climbers which can be helpful for treating food and health problems. After the COVID-19, everyone is finding the solution to this pandemic through getting nutraceutical. Many researchers have found out that before people used to have better immunity level compare to present day. Therefore, traditional knowledge from tribal people can be the key to fight against the food problems. Less work has done on climbers used as food plants by Santhal community. Hence, need a proper and sound proof documentation on these food plants.

METHODOLOGY

The survey was carried out during the year 2019-2022 in Odisha and Jharkhand, India. Through a series of semi- questionnaire conducted with Santhal community. The information collected from aged people (35-65 years) regarding the food values of climbers. The plant was identified by the authors with the help of literature (Haines 1925; Saxena and Brahman 1995).

RESULTS AND DISCUSSION

The survey works raveled that Santhal community usually use 25 species of climbers belonging to the 17 genera and 6 families. It was noticed that 14 species represented by 10 genera of family Cucurbitaceae. The most common climbers used as a food belongs to Cucurbitaceae are *Benincasa hispida, Citrullus lanatus, Cucumis melo, Coccinia grandis, Cucurbita maxima, Cucurbita moschata, Momordica dioica, Momordica charantia, Trichosanthes dioica, Trichosanthes cucumerina, Luffa cylindrica, Luffa aegyptiaca, Lagenaria siceraria* and *Cucumis strignus*. It was observed that 4 climbers belong to Dioscoreaceae followed by Convolvulaceae (2 species), Fabaceae (2 species), Basellaceae (1 species), Caesalpiniaceae (1 species) and Asclepiadaceae (1 species). Details are listed in Table 1 & Plate 1. Mainly they are consumed as a vegetable.

They have traditional technique to consumed such types of climbers which need a specific mode of cooking due to anti-nutritional factors in some plants. Other researchers have also documented on climbers as a food plant. In 2017, Singh and Kumar reported climbers having food values from Nepal like *Coccinia grandis, Cucurbita maxima, Gymnema sylvestre, Luffa cylindrica, Momordica charantia* etc. In 2017, Kumar et al. reported that tubers of *Dioscorea alata, Dioscorea bulbifera, Dioscorea hispida, Dioscorea oppositifolia* are consumed as a food by local tribe in Odisha. Mallick et al. (2020) reported that in tribal areas of Odisha, local community use climbers as food plants like *Momordica dioica, Coccinia grandis, Ipomoea aquatica, Luffa aegyptiaca* etc. Santhal community has good traditional knowledge on climbers which can be used for many purposes (Figure 1). They consume them for food as well for medicinal purposes.

They are consuming such species which makes their immunity stronger than the people living in city areas. After the COVID-19, people are going back to the traditional food to make their

immunity level strong. Therefore, the traditional knowledge needs a proper documentation on food plants consumed by the tribal people.

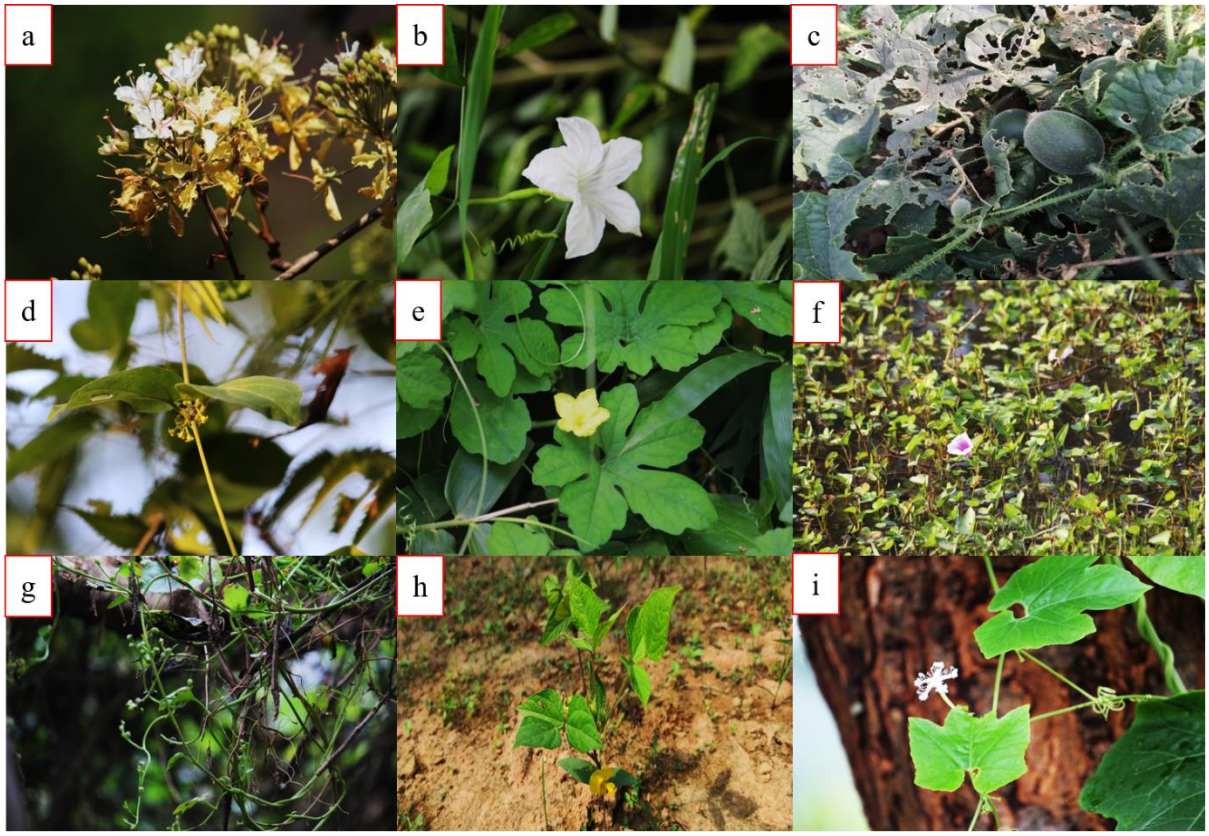

Plate 1: Some common climbers as a food plants used by Santhal community, a) *Bauhinia vahlii*, b) *Coccinia grandis*, c) *Cucumis melo*, d) *Gymnema sylvestre*, e) *Momordica charantia*, f) *Ipomoea aquatica*, g) *Basella alba*, h) *Vigna mungo*, i) *Trichosanthes cucumerina*

Table 1: Some common climbers as food plants used by Santhal community

Botanical name	**Family**	**Common name**	**Parts used**
Bauhinia vahlii	Caesalpiniacea	Siali	Seed
Benincasa hispida	Cucurbitaceae	Panikakharu	Fruit
Citrullus lanatus	Cucurbitaceae	Tarbuj	Fruit
Coccinia grandis	Cucurbitaceae	Kundri	Fruit
Cucumis melo	Cucurbitaceae	Bing Dimbu	Fruit
Cucurbita maxima	Cucurbitaceae	Pumpkin	Fruit
Cucurbita moschata	Cucurbitaceae	Kondha	Fruit
Dioscorea alata	Dioscoreaceae	Desi alu	Tuber
Dioscorea bulbifera	Dioscoreaceae	Pita alu	Tuber
Dioscorea hispida	Dioscoreaceae	Bayan aalu	Tuber
Dioscorea oppositifolia	Dioscoreaceae	Panialu	Tuber
Gymnema sylvestre	Asclepiadaceae	Mera-singi	Leaves
Ipomoea aquatica	Convolvulaceae	Kalama Saga	Fruit
Momordica dioica	Cucurbitaceae	Kankad	Fruit
Momordica charantia	Cucurbitaceae	Kalara	Fruit
Rivea hypocrateriformis	Convolvulaceae	Phang	Leaves
Trichosanthes dioica	Cucurbitaceae	Potol	Fruit
Trichosanthes cucumerina	Cucurbitaceae	Chachindra	Fruit
Vigna mungo	Fabaceae	Munga	Seeds

Luffa cylindrica	Cucurbitaceae	Dedha jingo	Fruit
Luffa aegyptiaca	Cucurbitaceae	Nenua	Fruit
Lagenaria siceraria	Cucurbitaceae	Lau	Fruit
Cucumis trigonus	Cucurbitaceae	Bhuin dim	Fruit
Butea superba	Fabaceae	Lata palash	Flowers
Basella alba	Basellaceae	Puraiaala	Leaf & stem

Plate 2 : Field survey with Santhal community in study areas

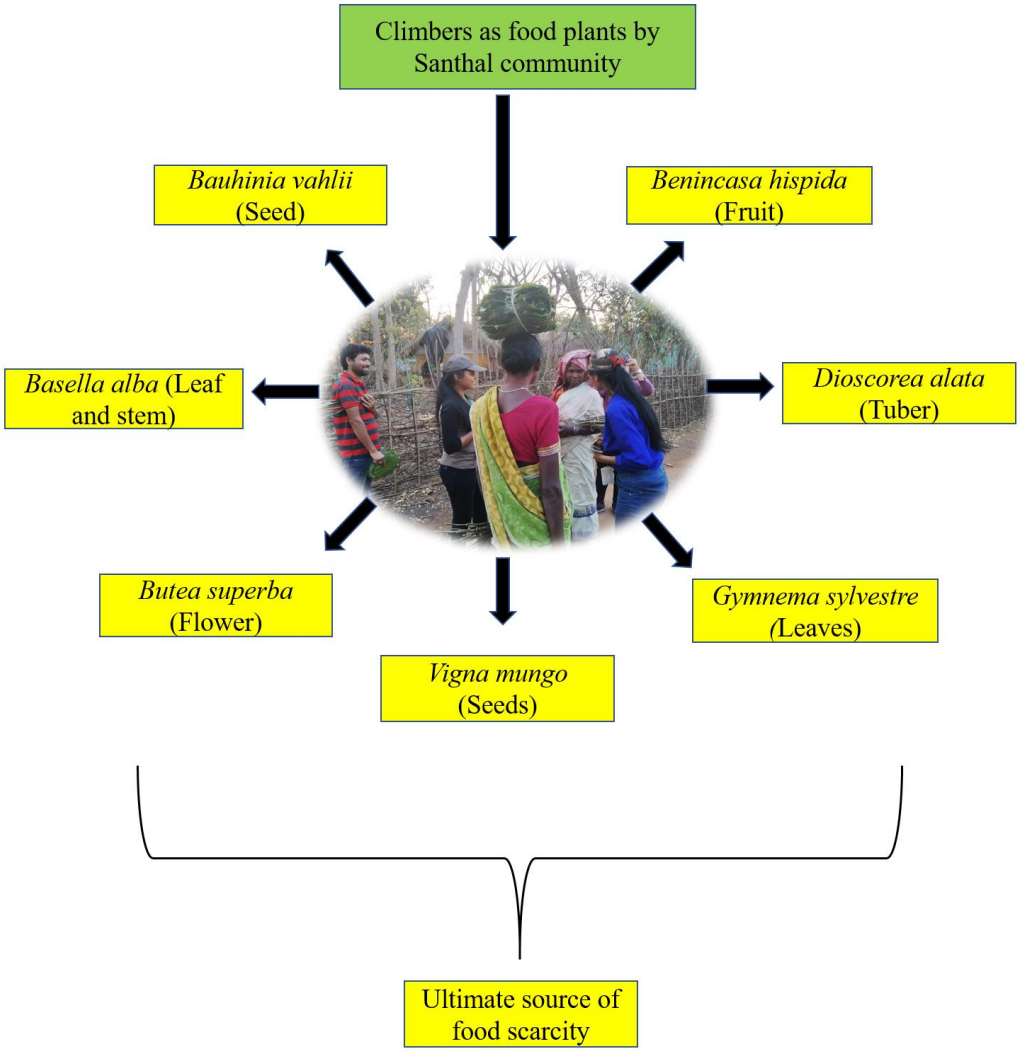

Figure 1: Uses and future aspects of climbers used as a food by Santhal

CONCLUSION

Santhal community has sound knowledge of indigenous traditional practices which can be the panacea keys to food scarcity problems. In this era, the traditional knowledge is diminishing day-by-day due to people are being modernized. In tribal communities, the traditional knowledge is transferred from generations to generations. Among them, Santhal consumed many wild foods collected from nearby forest areas. Among them, climbers play important role and easily available near villages. The present paper highlights the food values of locally available climbers. They could be used to develop future horticultural plants for rural and urban food baskets. Therefore, their whole lifestyle is connected to forest and to understand such knowledge a valid documentation needs to be encountered in a scientific manner.

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MEDICINALLY IMPORTANT UNEXPLORED PLANTS GROWING NEAR WATER BODIES IN BONAIGARH, SUNDARGARH, ODISHA

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ABSTRACT

This paper reports on important unexplored medicinal plants growing near water bodies from Bonaigarh, Sundargarh district of Odisha that can be used to treat and cure a number of ailments. Data were collected through series of questionnaire with elderly people residing in that regions. A list of 30 unexplored plant species along with their botanical names, local names, family, parts used and medicinal uses has been discussed. Most of the plant species from this region belong to the family Acanthaceae, Polygonaceae and Moraceae. Different parts of these unexplored plants such as fruits, roots, leaves, bark are used to treat and cure different human disorders and diseases. Thus there is a need to carry out the study on medicinal values of plants growing near water bodies.

Keywords: *Unexplored aquatic plants, Diseases, Bonai, Sundargarh, Odisha, India*

INTRODUCTION

Odisha is a homeland for lots of indigenous people. Majority of the population resides in rural areas. Bonaigarh, also known as Bonai, is a subdivision of Sundargarh district of the state Odisha. It is located at 21.75° N latitude and 84.97° E longitude. The town is surrounded by the river Brahmani and the Khandadhar and Singsardei Hills. This district falls under Peninsular Sal type and dry deciduous mixed forest. From last decades, we are losing the potentials of medicinal agents due to anti-microbial resistance and at the same time need novel agents to fight against novel pathogenic microbes. Both are serious problems in health care systems. A lot of information regarding aquatic plants remains unexplored, unnoticed and undocumented due to lack of communication. Local inhabitants traditionally use aquatic plants in their day-to-day life because they have many medicinal uses. People utilize the plant parts like leaves, roots, fruits etc. that are useful in treating many health problems such as respiratory problems, diabetes, skin infections etc.

The scientists throughout the world are screening new agents from plant wealth. For the screening, the unexplored plant species are more suitable. Among the plant wealth, the aquatic plants are more important and unexplored. The conservation of these species through community and sustainable uses is also needed. Aquatic plants are recognised as biological indicators, climate change indicators, food plants, water pollution indicators and medicinal plants. They are very important to maintain the wetland ecology. Therefore, an attempt has been made to gather the information on medicinally important aquatic plants through available in & around Bonaigarh, Sundargarh. The paper highlights 30 common medicinally important aquatic plants.

METHODOLOGY

The survey was carried out in the year of 2020-2022 to collect information from traditional people on the use of medicinal plants that are unexplored in Bonaigarh, Sundargarh district of Odisha (Plate 1). A series of questionnaire and personal interview was conducted during field trips to collect the data. The plant species were identified by authors with the help of local people.

Table 1: Medicinal uses of unexplored aquatic plants

Plant Name	Local Name	Family	Parts Used	Uses
Nymphaea nouchali	Nila kain	Nymphaeaceae	Root	Root decoction is used to cure food poisoning.
Drosera indica	Konkikhai	Droseraceae	Apical part	Apical part is used to treat respiratory problems.
Grangea maderaspatana	Painjari	Asteraceae	Leaves	Powdered dry leaves or wet-leaf compress are applied to contusions.
Canscora diffusa	Burrurria	Gentianaceae	Leaves	Leaves are used as leafy vegetable against stomach pain.
Nymphoides hydrophylla	NIL	Menyanthaceae	Leaves	Leaf juice is used as an antidote for scorpion sting and snake bite.
Nymphoides indica	Panisiuli	Menyanthaceae	Root	Root is used against ageing.
Coldenia procumbens	Gondhrilata	Boraginaceae	Leaves	Fresh leaves are pulped-up and applied as a poultice to areas of rheumatic swelling.
Rotula aquatica	Jamchi	Boraginaceae	Root tuber	Root decoction is used to treat blood disorders.
Merremia tridentata	Budhi lai	Convolvulaceae	Root	Root decoction is used to cure diabetes.
Lindernia antipoda	Shavel saag	Linderniaceae	Leaves	Decoction of leaves is used as dewormer.
Limnophila indica	Keralata	Plantaginaceae	Leaves	Infusion of leaves is used in the treatment of diarrhoea.
Limnophila repens	Amra	Plantaginaceae	Leaves	Consumed as a leafy vegetable in stomach pain.
Utricularia aurea	Bhaturidala	Lentibulariaceae	Apical part	Decoction of apical part is used to treat respiratory problems.
Utricularia striatula	NIL	Lentibulariaceae	Apical part	Decoction of apical part is used to treat respiratory problems.
Hygrophila auriculata	Koilikhia	Acanthaceae	Leaves	Leaves are burnt and the smoke is used to treat corneal ulcers.
Justicia gendarussa	Nila nirgundi	Acanthaceae	Leaves	Leaves are used to treat gonorrhoea.
Thunbergia fragrans	Chakrakedar	Acanthaceae	Leaves	Leaves are used as poultice in skin diseases.
Strobilanthes auriculatus	Painya	Acanthaceae	Leaves	Leaves paste is used in skin infection.
Stachytarpheta cayennensis	Sapura	Verbenaceae	Leaves	Tea of the leaves help to control diabetes.

Lippia javanica	Nagdabana	Verbenaceae	Leaves	Tender leaf is consumed as a vegetable; Mature leaf paste is used in skin infections.
Persicaria glabra	Sukuripota	Polygonaceae	Leaves	Tender leaf is consumed as a vegetable; Mature leaf paste is used in skin infections.
Persicaria stagnina	Garaara	Polygonaceae	Leaves	Leaves are cooked and consumed in indigestion problem.
Polygonum plebeium	Chanti saga	Polygonaceae	Seed	Crushed seeds are cooked and eaten as remedy for bowel complaints.
Homonoia riparia	Pani begunia	Euphorbiaceae	Root	Root decoction used in the treatment of piles.
Mallotus nudiflorus	Pani gambhari	Euphorbiaceae	Root	Root decoction is used to relieve gout.
Ficus hispida	Baidimiri	Moraceae	Root	Consuming root powder with buttermilk to improve digestion.
Ficus nervosa	Pakhad dimri	Moraceae	Fruit	Fruit is used to prevent indigestion.
Streblus asper	Sahada	Moraceae	Bark	Bark infusion is used for constipation.
Ottelia alismoides	Pani kundri	Hydrocharitaceae	Leaves	Leaves are applied to the arms and legs as poultice against fever.
Monochoria hastata	Dumdum	Pontederiaceae	Root	Rhizomes are powdered with charcoal and used as scurf.

RESULTS AND DISCUSSION

The results enumerated 30 medicinally important unexplored plant species that grow near water bodies. Out of 30 plant species, it was found that the table contained 17 families. Acanthaceae family has majority of four plant species. Polygonaceae and Moraceae family has three plant species. Menyanthaceae, Boraginaceae, Plantaginaceae, Lentibulariaceae, Verbenaceae and Euphorbiaceae has two plant species and rest others belong to the family of Nymphaeaceae, Droseraceae, Asteraceae, Gentianaceae, Convolvulaceae, Linderniaceae, Hydrocharitaceae and Pontederiaceae. Details are listed in Table 1, Plate 2, Figure 1 & Figure 2. All these plant species were identified for having various medicinal uses from their parts(leaves, root, fruit, bark and apical parts).

Three plant species i.e., *Limnophila repens, Lippia javanica* and *Persicaria glabra* are used for consumption as leafy vegetable. Root decoction of *Nymphaea nouchali* is used to cure food poisoning. Apical parts of *Utricularia aurea, Utricularia striatula* and *Drosera indica* is good for respiratory problems. Leaves of *Grangea maderaspatana* are used to heal from contusions. Leaf juice of *Nymphoides hydrophylla* is used as an antidote against scorpion sting and snake bite. Root decoction of *Merremia tridentata* and leaves of *Stachytarpheta cayennensis* as tea is used to cure and control diabetes. Jain et al. (2007) reported 42 species of aquatic/semi-aquatic plants which are used as herbal remedies by the ethnic communities. They have explained about 18 families and 25 genera. Das et al. (2016) reported 26 aquatic plants having medicinal uses.

Plate 1: Field survey on unexplored aquatic plants

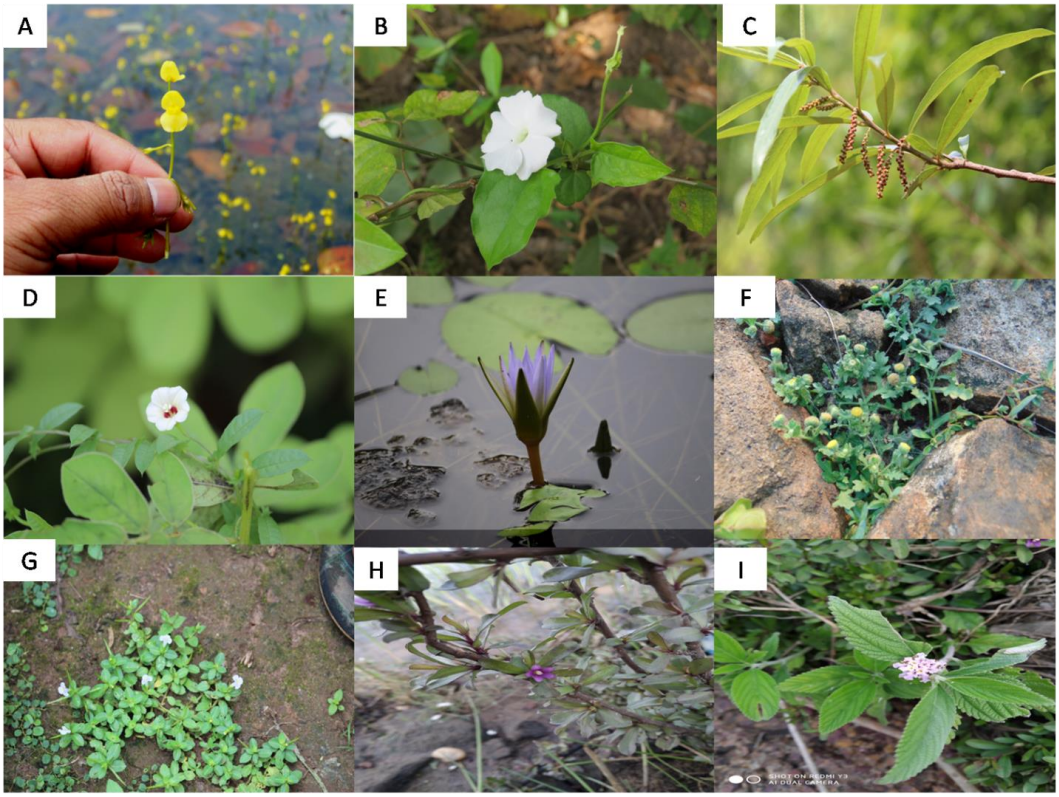

Plate 2: Some unexplored aquatic plants A) *Utricularia aurea,* B) *Thunbergia fragrans*, C) *Homonoia riparia*, D) *Merremia tridentata*, E) *Nymphaea nouchali*, F) *Grangea maderaspatana*, G) *Lindernia antipoda*, H) *Rotula aquatica*, I) *Lippia javanica*

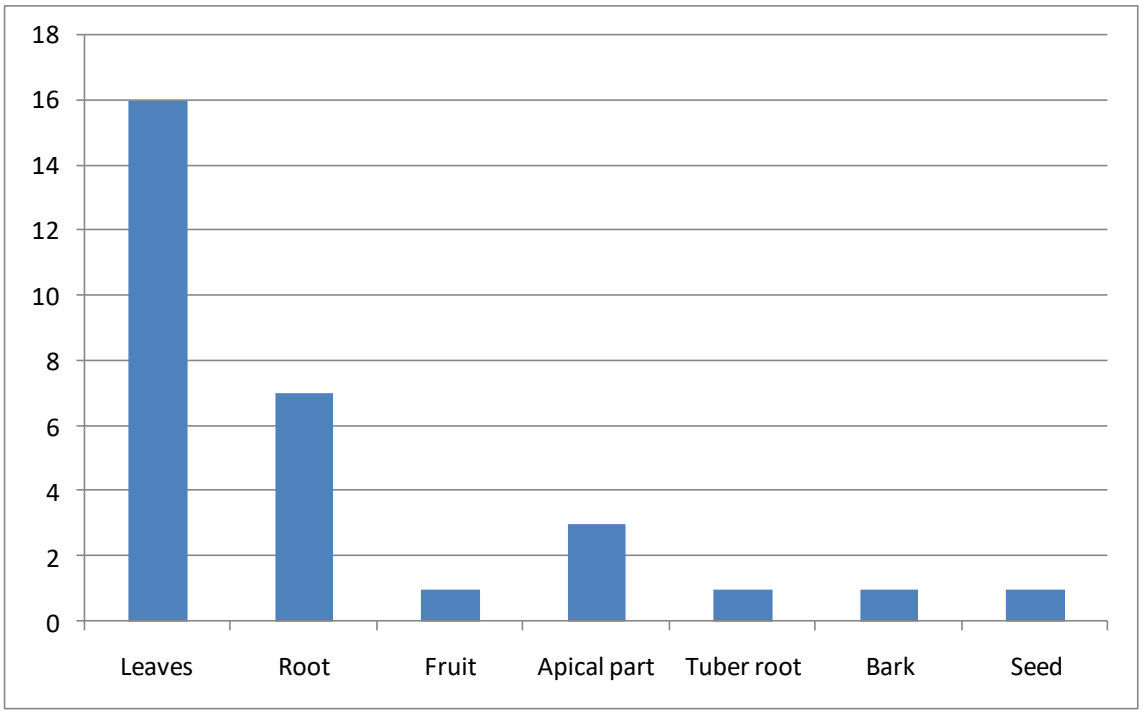

Figure 1: Frequency of uses of enumerated plant parts

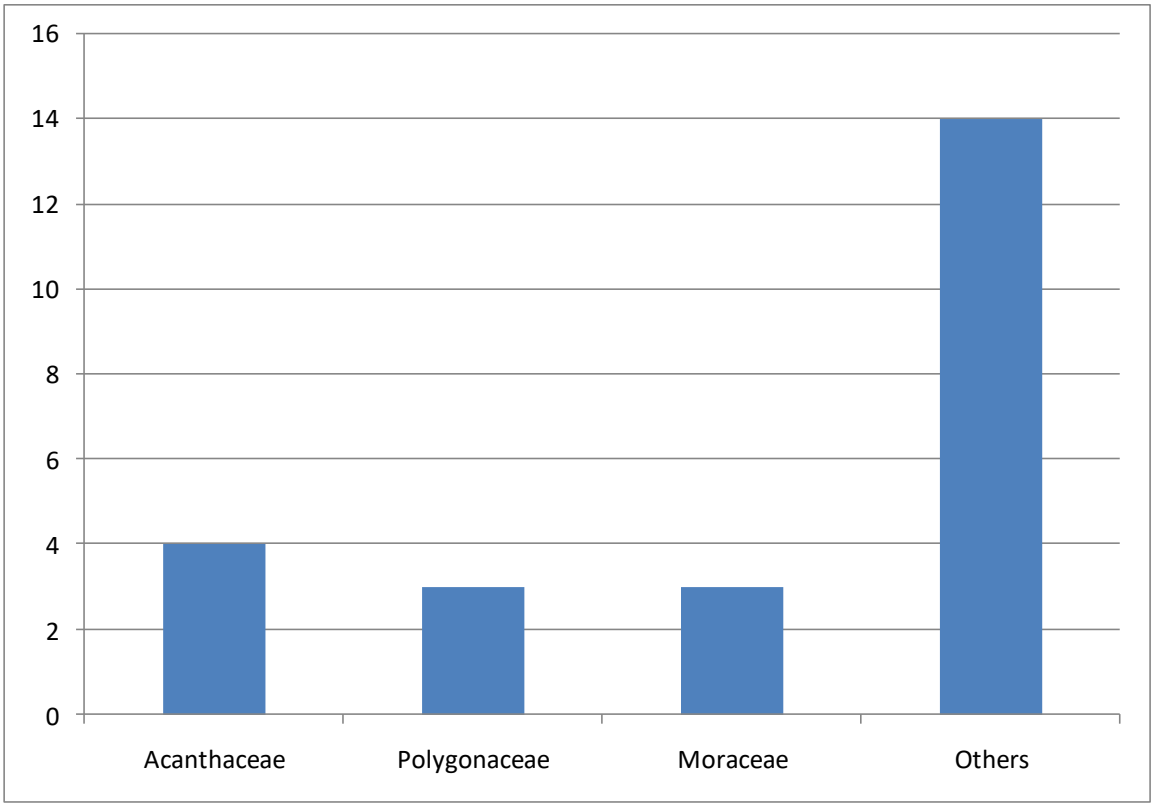

Figure 2: Number of medicinally important aquatic plants as per the family

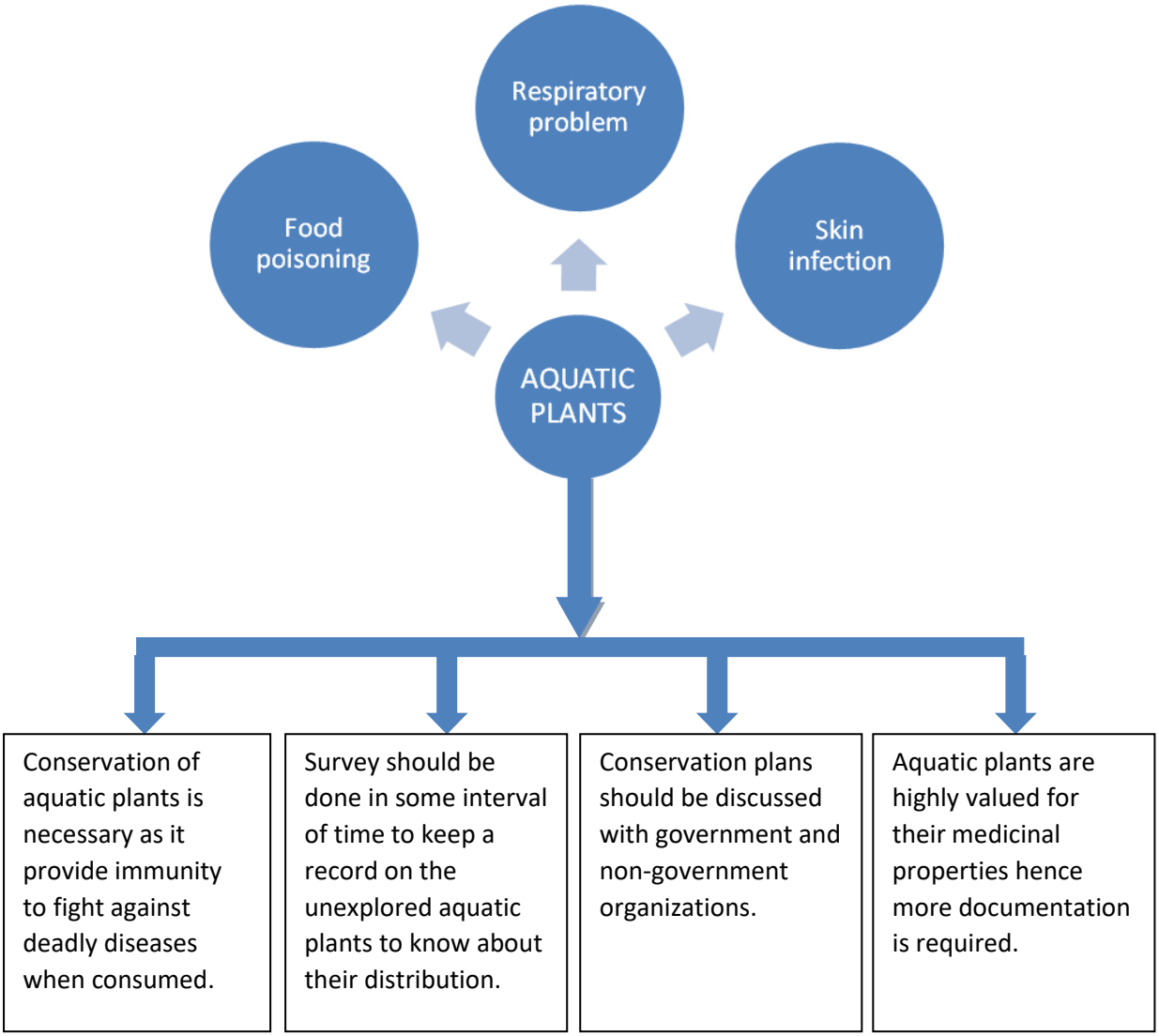

Figure 3: Common uses and future aspects of plants grow in and around water bodies in study areas

They explained about free-floating hydrophytes, rooted hydrophytes with floating leaves, submerged floating hydrophytes, rooted submerged hydrophytes and wetland hydrophytes. Sen and Behera (2018) reported 32 aquatic plants having ethno-medicinal uses. They explained the medicinal values of *Ludwigia octovalvis*, *Commelina benghalensis*, *Drosera burmannii*, *Marsilea quadrifolia*, *Nelumbo nucifera*. Misra et al. (2012) reported 25 wetland plant species which are consumed as food as leafy vegetable. They have explained about *Alternanthera sessilis*, *Aponogeton undulatus*, *Hydrolea zeylanica*, *Glinus oppositifolius*, *Polygonum barbatum* etc.

Bhagyaleena and Gopalan (2018) reported 38 aquatic plants having medicinal values. They have explained the medicinal uses of *Aeschynomene aspera*, *Centella asiatica*, *Eclipta prostrata*, *Hygroryza aristata* etc. Patel (2018) reported 18 aquatic and wetland medicinal plants. He explained about the etno-medicinal uses of *Bacopa monnieri*, *Typha domingensis*, *Ricinus communis*, *Ipomoea fistulosa*, *Cynodon dactylon* etc. Ali et al. (2019) reported 42 aquatic plants having ethno-medicinal uses. Manokari (2019) reported 33 aquatic and semi aquatic plants having medicinal uses. He reported the medicinal potential of *Acorus calamus, Ammannia baccifera, Biophytum sensitivum, Canna indica, Kaempferia rotunda* etc. Aasim et al. (2019) reported 27 aquatic and semi aquatic plants having multiple medicinal uses whereas Jha (2020) reported 18 aquatic plants with their ethno-medicinal uses.

CONCLUSION

Aquatic bio-resources are not explored well in the past and presently water bodies are vanishing rapidly due to various reasons. Hence it is important to document such vital and valuable knowledge about the plant species for the future generation. Therefore necessary measures for conservation of unexplored medicinally important aquatic plants should be taken up on priority by different government and non-government organizations for ecological balance and value addition is needed to promote community conservation & sustainable utilization (Figure 3).

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PLANTS USED IN WOMEN HEALTH CARE PROBLEMS

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ABSTRACT

Healthy women represent healthy nation. Therefore, present study was investigated to document the indigenous knowledge on medicinal plants used in women health care problems by the indigenous communities. Data was collected through direct interactions with local communities of Sundargarh district, Odisha. 41 medicinal plants enumerated along with botanical name, part (s) used and uses. The most commonly used plant part was root (36%) followed by leaf (16%), fruit (10%), flower (10%), seed (8%), stem (6%), bark (6%), whole plant (6%) and aerial part (2%). Majority of the plants were trees (28%) followed by shrubs, herbs (26%) and climbers (20%). The present study highlights the importance of locally available plants in women health care problems.

Keywords: *Medicinal plants, Rural people, Women healthcare problem*

INTRODUCTION

There are lot of health problems that arise anytime and anywhere due to various known and unknown reasons. Everybody is dealing or going through some sort of health issues. Most of the time, women suffer more as their body is very sensitive and are more susceptible to diseases. Women health care problems are very diverse including amenorrhea, menorrhagia, dysmenorrhoea, menstrual disorders, urinary tract infections and many more. Menstrual cycle is very important for a female reproductive system (Motti et al. 2019). In most of the tribal and rural areas, herbal remedies or traditional medicines are considered as the oldest forms of healthcare practices for women. Herbal medicines include plants and plant based products which have significant role in treating women's health ailments (Boer and Cotingting 2014). Rural women consult their nearby traditional healers or therapists due to lack of communication, awareness and proper access to avail modern health facilities (Aziz et al. 2018). Plant-based traditional medicine tends to treat diseases and have a source for potential drug. Most of the population in rural areas largely depends on wild harvested surrounding plants (Balamurugan et al. 2018). Environmental degradation, over grazing, anthropogenic activities, deforestation, catastrophic events, introduction of invasive species etc. are making traditional medicinal plants threatened (Mishra et al. 2021). There are still many plant species and traditional medicinal knowledge that are not yet investigated and documented. Therefore, more research should be done for the wellbeing of women. This study is an attempt to enlist some useful ethnomedicinal flora from the local communities of Sundargarh district, Odisha that are used to treat a wide range of women health care problems.

METHODOLOGY

In this study, intensive field survey was carried out in Sundargarh district of Odisha. The data was collected from local people. A series of questionnaire and personal interview was conducted during field trips. The information enumerated in tabular form including plant name, vernacular name, parts used and medicinal uses. The plant species were identified by the authors.

RESULTS AND DISCUSSION

The survey works recorded nearly 41 medicinally important plant species used for treating women health care problems. Out of 41 plant species, it was found that *Hibiscus rosa-sinensis, Moringa oleifera, Cissus quadrangularis, Calotropis gigantea, Saraca asoca, Sesbania grandiflora, Mimosa pudica* and *Calendula arvensis* are used to treat irregular menstruation. *Centella asiatica, Terminalia arjuna, Justicia adhatoda, Smilax zeylanica, Sida acuta, Caesalpinia bonduc, Euphorbia hirta* and *Asparagus racemosus* are used to treat leucorrhea. *Madhuca longifolia, Hemidesmus indicus* and *Ficus benghalensis* are used to increase breast milk production. *Abutilon indicum* and *Citrus limon* are used in the treatment of amenorrhoea. *Lawsonia inermis, Tamarindus indica* and *Borassus flabellifer* act as contraceptive. *Adathoda vasica, Boerhavia diffusa* and *Cannabis sativa* are used to reduce labour pain.

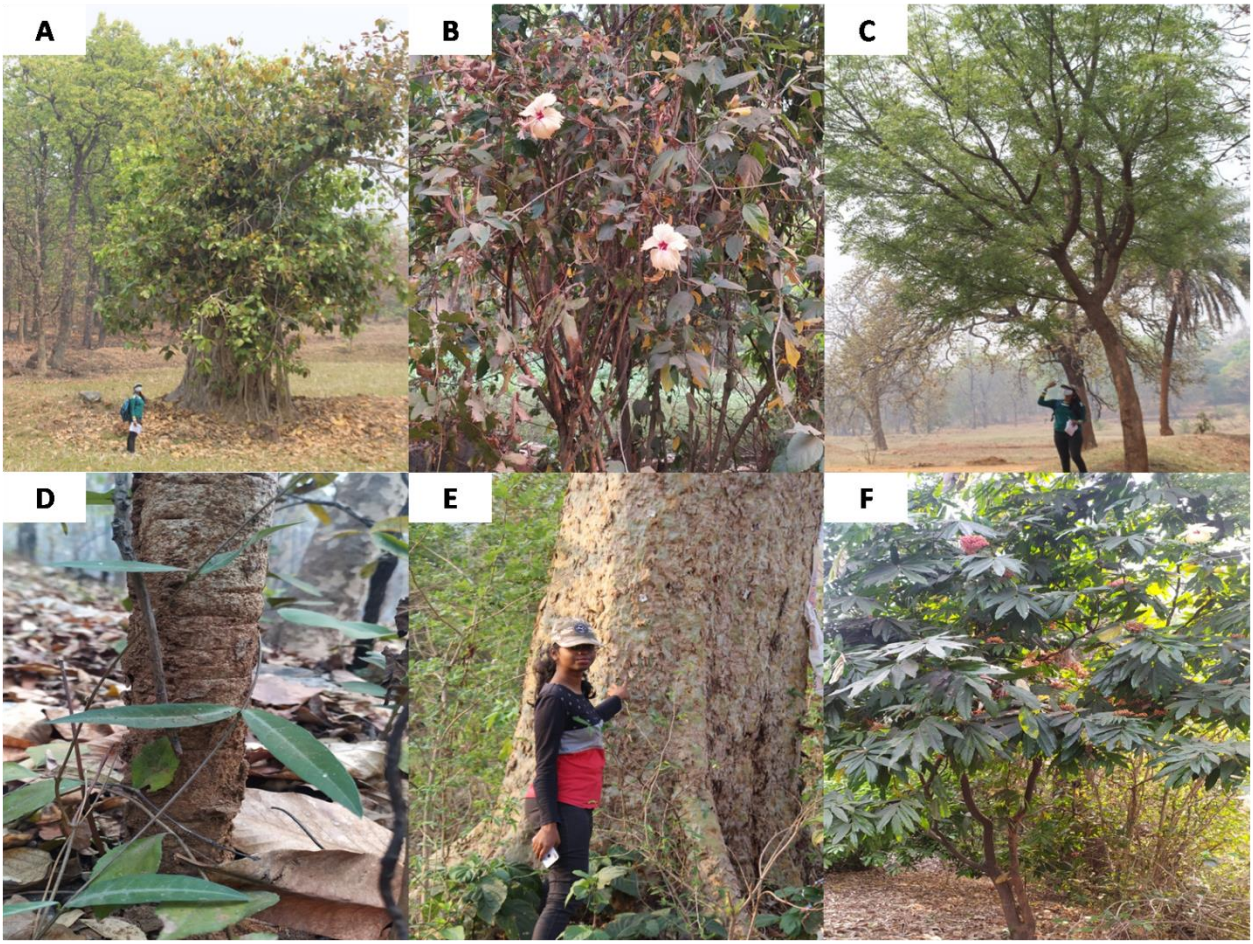

Plate 1: Plants used in women healthcare problems. A) *Ficus benghalensis*, B) *Hibiscus rosa-sinensis,* C) *Azadirachta indica*, D) *Hemidesmus indicus*, E) *Terminalia arjuna,* F) *Saraca asoca*

Table 1: Plants used in women healthcare problems

Plant Name	Parts used	Uses	Source
Abrus precatorius	Root	Root paste is used in fungal infections.	Panduranga et al. (2011); Present study
Abutilon indicum	Seed	Seed powder infusion is used in amenorrhoea	Balamurugan et al. (2018); Present study

Achyranthes aspera	Root	Root paste is used in fungal infections.	Mandal et al. (2020); Present study
Adhatoda vasica	Root	Root decoction is used to minimize labour pain	Pakkala and Patel (2021); Present study
Ageratum conyzoides	Whole plant	Whole plant extract is used in the treatment of Breast Myiasis	Ogbalu and Williams (2014); Present study
Aloe vera	Leaves	Leaves juice is used for abortion	Sadeghi and Mahmood (2016); Present study
Annona squamosa	Root	Root paste is used in fungal infections.	Srivastava et al. (2011); Present study
Aristolochia indica	Root	Root paste is used in fungal infections.	Sivasankari et al. (2014); Present study
Asparagus racemosus	Root	Root juice is used in leucorrhoea.	Rahman and Asha (2021); Present study
Azadirachta indica	Leaves	Leaves extract is used to prevent problems related to breast.	Moga et al. (2018); Present study
Benincasa hispida	Fruit	Fruit juice is used as a tonic.	Balamurugan et al. (2018); Present study
Boerhaavia diffusa	Root	Root decoction is used to hasten the delivery.	Present study
Borassus flabellifer	Root	Root paste is used as contraceptive.	Kumar et al. (2019); Present study
Caesalpinia bonduc	Seed	Seed decoction is used to cure leucorrhoea	Present study
Calendula arvensis	Flower	Flower infusion used against irregular menstruation	Present study
Calotropis gigantea	Root	Root paste is used in fungal infections.	Pattanayak et al. (2016); Present study
Cannabis sativa	Leaves	Leaves infusion facilitate easy delivery.	Jan et al. (2021); Present study
Catharanthus roseus	Leaves	Leaves juice is used against menorrhagia.	Sain and Sharma (2013); Present study
Centella asiatica	Aerial part	Paste of aerial parts is used in leucorrhoea.	Bora et al. (2016); Present study
Cissus quadrangularis	Stem	Stem juice is used in irregular menstruation.	Present study
Citrus aurantium	Fruit	Fruit extract is used in urine infections.	Present study
Citrus limon	Fruit	Fruit juice is used against amenorrhea.	Pakkala and Patel (2021); Present study
Clitoria ternatea	Root	Root decoction is used in urinary problems.	Present study
Eryngium foetidum	Whole plant	Whole plant powder with milk is used as tonic.	Present study
Euphorbia hirta	Whole plant	Whole plant powder is used in leucorrhoea.	Chinnasamy et al. (2019); Present study

Ficus benghalensis	Stem	Stem decoction is used to promote lactation.	Present study
Henidesmus indicus	Root	Root powder is used to increase breast milk secretion.	Present study
Hibiscus rosa-sinensis	Flower	Infusion of flower used in irregular menstrual cycle.	Singh et al. (2019); Present study
Jasminum angustifolium	Flower	Flower infusion is used to enhance lactation.	Balamurugan et al. (2018); Present study
Justicia adhatoda	Root	Root paste used in leucorrhoea.	Jan et al. (2020)
Lawsonia inermis	Leaves	Leaves juice is used as contraceptive.	Sahu et al. (2021); Present study
Madhuca longifolia	Leaves	Leaves paste is used to increase breast milk secretion.	Balamurugan et al. (2018); Present study
Mimosa pudica	Root	Root decoction is used to prevent the excessive menstrual bleeding.	Ahmad et al. (2012); Present study
Moringa oleifera	Leaves	Leaves juice is used against irregular menstruation.	Balamurugan et al. (2018); Present study
Phyllanthus emblica	Bark	Bark juice is used in gonorrhoea.	Islam et al. (2014); Present study
Saraca asoca	Bark	Bark decoction is used for irregular menstrual cycle.	Sahoo et al. (2020); Present study
Sesbania grandiflora	Flower	Flower paste is used for scanty menstruation.	Balamurugan et al. (2018); Present study
Sida acuta	Root	Root powder is used in leucorrhoea.	Balamurugan et al. (2018); Present study
Smilax zeylanica	Root	Root decoction is used in leucorrhoea.	Tripathy et al. (2021); Present study
Tamarindus indica	Fruit	Raw fruit is used as a contraceptive.	Pakkala and Patel (2021); Present study
Terminalia arjuna	Bark	Bark paste is used to cure leucorrhoea.	Ferdous et al. (2020); Present study

Details are listed in Table 1 and Plate 1. Root (36 %) were found to be the most used plant part followed by leaves (16 %), fruits (10 %), flowers (10 %), seeds (8 %), stem (6 %), bark (6 %), whole plant (6 %) and aerial parts (2 %). Majority of the plants were trees (28 %) followed by shrubs and herbs (26 %) and climbers (20 %). Panduranga et al. (2011) reported 37 medicinal plant species for women diseases. They explained about *Sterculia urens*, *Hybanthus enneaspermus*, *Curculigo orhiodes*, *Dodonaea viscosa* etc. Fasola (2015) has reported 61 plant species used in the treatment of female reproductive health problems. Tsobou et al. (2016) have reported 70 medicinal plant species. Aziz et al. (2018) have reported 53 medicinal plants which are used to treat gynaecological ailment by indigenous communities. Ponnaiah et al. (2018) have reported 24 medicinal plants used for female health issues. Ferdous et al. (2020) have reported 251 plant species of 94 families used for the treatment of gynaecological disorder. Sahu et al. (2021) have reported 28 species for the treatment of urogenital ailments. Jan et al. (2021) have reported 60 medicinal plant species used during pregnancy and child birth.

CONCLUSION

Preservation of traditional knowledge and conservation of locally available medicinal plants will be helpful in treating a significant number of health care problems related to women. Due to modernization and popularity of allopathic medicines, knowledge associated with indigenous plants is decreasing rapidly. These plant species are effective, easy to avail and can be used in developing new drugs for women health care. Therefore there is a need for research to document such medicinal plants before they get extinct.

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Indigofera cassioides ROTTLER ex DC. (FABACEAE): A WILD MEDICO-FOOD PLANT

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ABSTRACT

Malnutrition is a biggest problem throughout the world. In last some decades, human beings facing lot of infectious diseases too. Both problems are becoming serious for health and in the development of a nation. Both create low immunity among the populace of a boundary. Therefore, need to explore wild food plants having food and medicinal values. In this chapter, food and medicinal values of Indigofera cassioides are discussed to bring attention towards the wild nutraceutical for contemporary and upcoming future health care problems. A survey was done during 2019-2022 to collect the desired information and gathered information are presented in this chapter in the form of baseline data to make strategy with its value addition to better health and getting food security.

Keywords: *Wild flowers, medico-food, medicinal, tribal, nutraceutical, food scarcity*

INTRODUCTION

In 21st century, when we called ourselves, technically developed creature of the universe and technically sound in all aspects of life, still we are not able to get food security. Number of organisations are working globally on problems to get adequate food. It creates low immunity among the populace and make them sensitive to getting infectious diseases. Hence, need to search nutraceutical from the plant wealth. Plants are the major source of food and medicines from prehistoric. Wild food plant parts are collected from the forest by the tribal communities are used for various purposes globally. Tribal people depend on the forest for their life stuffs. Their indigenous traditional practices need to be conserved for addressing the solution of above cited problems. The consumption of wild food plants lead to reduce the risk of diseases and also help to enhance the immunity. Indigenous traditional practices are carried out by tribal people for a healthy lifestyles (Sharma 2016) which provide a platform for doing value additions. In urban areas, these wild food plants are unknown due to less documentation and diminishing of such practices day-by-day. Now a day's medico-food plants are on a priority list and over the past two decades, there has been a tremendous increase in the reuse of wild food plants. However, there is still a significant lack of research on such traditional knowledge. During field works, we have encountered that tribal people consume flowers, tubers, and leaves of different plant species for vegetable purposes (Yesodharan and Sujana 2007; Kumar et al. 2017; Tuladhar 2021;Present study) which help them to get strong immunity. Keeping the importance of wild edible plants and malnutrition including contemporary infectious diseases, an attempt has been made to document the wild edible plant from Sundargarh and Mayurbhanj districts of Odisha. Numbers of plants observed and among them *Indigofera cassioides* is selected for detail studies. It is commonly called Giliri in a tribal areas of Odisha state. It belong to the family Fabaceae. It is wildly distributed in India ranging from East Asia to the Himalayas. It is a shrub mostly found in a dry areas in high elevation. Branches are erect and angular. Leaves are obovate, emarginate. The flower is pink or pinkish in colour. Many flower clusters

in one branch. Its medicinal values are also documented and able to cure many diseases like cough, inflammation, arthritis, and diuretic (Gudadhe et al. 2013). The flower part is mainly used for vegetable purposes (Mohanty and Rautaray 2018; Mallick et al. 2020). The present study highlights the importance of wild edible flowers for doing value addition.

METHODOLOGY

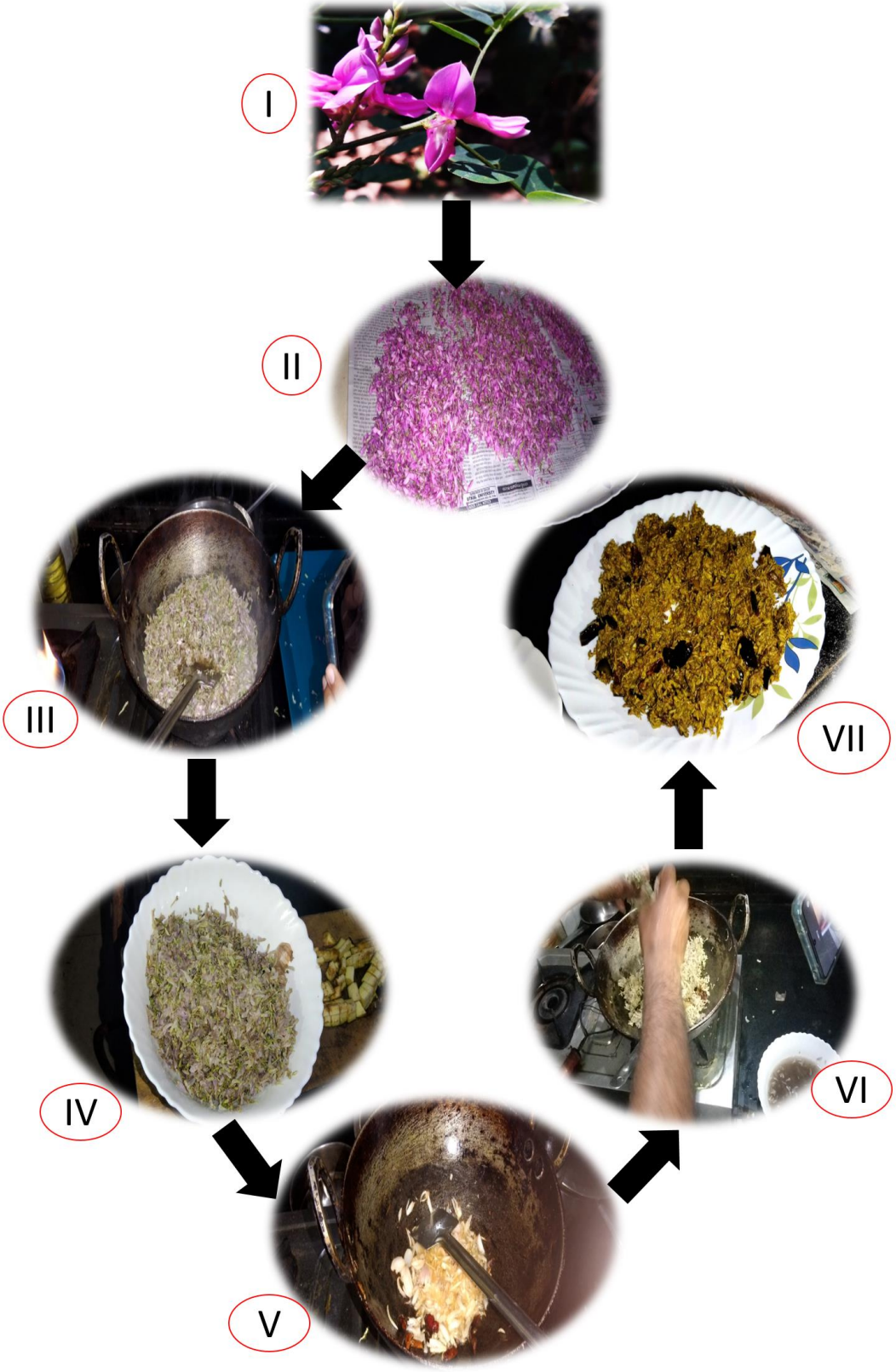
The literature and field surveys were carried out in the year 2019-2022. The interview with local people was conducted in the selected areas (Sundargarh & Mayurbhanj) of Odisha, India. The plant was identified by the authors using the literature and morphological characters (Haines 1925; Saxena and Brahmam 1995).

Plate 1: Traditional practices on *Indigofera cassioides*, a) Flowers of *Indigofera cassioides* for cooking purposes, b) Tribal women are selling flowers of *Indigofera cassioides* in Markets, c) Tribal women collected flowers from the forest area and discussion with team

RESULTS AND DISCUSSION

The survey results revealed that tribal people collect the flowers of *Indigofera cassioides* as a wild medico-food in study areas. It was noticed that the flowers are used for vegetable purposes. The flowers are collected mainly by the tribal women during February-March. Flowers of *Indigofera cassioides* have many medicinal uses and it is used in diabetes, as a tonic after delivery, in arthritis, to reduce inflammation, in liver diseases etc. Apart from medicinal and food values, it is also used for fences and fuel (Table1). It was observed that flowers are used to sell in the local markets. It holds a strong economic values. In Plate 1, it is shown that tribal women collect the flower of *Indigofera cassioides* and sell in the weekly markets. It was noticed that the process of cooking the flower is quite interesting (Plate 2). First, the buds of *Indigofera cassioides* are separated. Secondly, the flower was boiled with water (20 to 30 minutes) till the flower of pink colour turns into white. Third, take out the flower and rinse the

water, and put it aside to get cool. Fourth, place the container and add oil, onion, turmeric, salt, and vegetable like tomato or brinjal for better taste.



Snehalatha et al. (2022)

Plate 2: Flower of *Indigofera cassioides* used as a vegetable (I) Flower of *Indigofera cassioides*, (II) Separate the buds from a flower, (III) Boil the flower about 20-30 min, (IV) Take out the flower and let it cool for some time, (V) In a container add oil, onion, brinjal (VI) Add flower (VII) Flower of *Indigofera cassioides* is cooked and ready to serve as a wild nutraceutical food

Then serve as a vegetable which has both food and medicinal values. Many researchers have also reported that *Indigofera cassioides* have medicinal uses and can be used for vegetable purposes. In 2013, Gudadhe et al. reported that *Indigofera cassioides* has bioactive constituents which can be used to formulate drugs for future purposes. In 2020, Mallick et al. reported that flower is used for vegetable purposes in Odisha.

Table 1: *Indigofera cassioides* used by different people and their uses

Parts used	Uses	Source(s)
Flowers	As a leafy vegetable, used to treat diabetes.	Mallick et al. (2020); Dimri and Marndi (2017).
	Flowers are used as a wild vegetable by the Munda, Bhuian, Kisan, Santhal, Oram and Ho communities and also used to sell in the local markets.	Present study
Roots	Used as a tonic by the tribal women after delivery.	Rai (1987); Present study
Leaves	Used as a leafy vegetable and to treat arthritis, inflammation & liver problems.	Mohanty and Rautaray (2018); Kumar et al. (2013)
	Tender leaves are used to cure cough by the Bhuian tribe.	Present study
Stems	Used for fences and fuel.	Gudadhe et al. (2013)
	Flowers and stem decoction is used as a tonic.	Present study

CONCLUSION

The proper documentation and utilization of wild edible food plants can reduce the food problems and antimicrobial resistance. The consumption of such food plants able to enhance the immunity globally. The present chapter highlights the importance of such plants. *Indigofera cassioides* could be selected for value addition and advance research works. The value addition of such plants could create the livelihood opportunities among the locals and urban populace can get a nutraceutical in their food basket.

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Madhuca longifolia: ONLY CAUSE OF FOREST FIRE ?

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ABSTRACT

Forest fire is one of the burning issue throughout the world. It creates lot of negative impacts on biodiversity. There are number of causes of forest fires as per landscapes. Among the observed causes, collection of Mahua flowers (Madhuca longifolia) is very common and a major cause of forest fire. Madhuca longifolia is also known for its food, medicinal, ecological and socio-cultural values. Keeping the importance and as a causing factor of forest fire, an attempt has been made to do field survey works to collect the field information on Madhuca longifolia from selected areas of Odisha state, India. The results revealed that even Madhuca longifolia is an important tree species, it is responsible for the forest fire. The chapter brings attention towards the need of a strategy to reduce forest fire and maximum utilization of its plant parts for sustainable development and biodiversity conservation.

Keywords: *Forest fire, country liquor, food value, medicinal value, economic value, ecological values*

INTRODUCTION

Forest fire is oldest practices and it also happens naturally. Whenever, it happens in large scale, it creates lot of visible negative impacts on forest, wildlife and communities. Usually, it happens in the months of February to May, but can also depends on landscapes and weather conditions. After fire, forest loses timber, wildlife (insects, reptiles, mammals etc) along with small birds and pollinators. At the same time, forest fire contribute to increase global warming and air pollution. There are two types of forest fire is noticed, natural and manmade fires. Natural fire is caused by lightning, rolling, friction of dry bamboos etc. Manmade or anthropogenic fire is mainly due to the cigarettes smoking, camping, shifting cultivation, clearing of dry leaves in the forest and collection of NTFP (Non-timber Forest Produces). Forest fires are categories into three types- surface fire, crown fire and ground fire (Kumar et al. 2019). In day time, the fire is uncontrollable than in night time. In day time, the fire is more due to high temperature and in night, the fire is less due to the low temperature. There are numbers of causes of manmade forest fire. Among them, collection of Mahua (*Madhuca longifolia*) flowers is common. It is an deciduous tree belongs to the family Sapotaceae. Leaves are clustered at the end of the branches and elliptic. Flower is yellow in color, near the ends of the branches in cluster. Corolla yellowish–white, tube fleshy (Plate 1). Fruit berries like, ovoid, green (Gopalkrishnan and Shimpi 2012). Flowering during March-April and fruiting during April-May. On the month of March-April, the leaves are dried and start to shed. Keeping the importance of this tree, an attempt has been made to field works during the forest fire and to find out the relationship between Mahua and forest fire in selected districts of Odisha along with to gather the other importance from field and literature. The chapter highlights the importance of *Madhuca longifolia* and bring attention towards the making strategy on forest fire mitigation along with sustainable utilization.

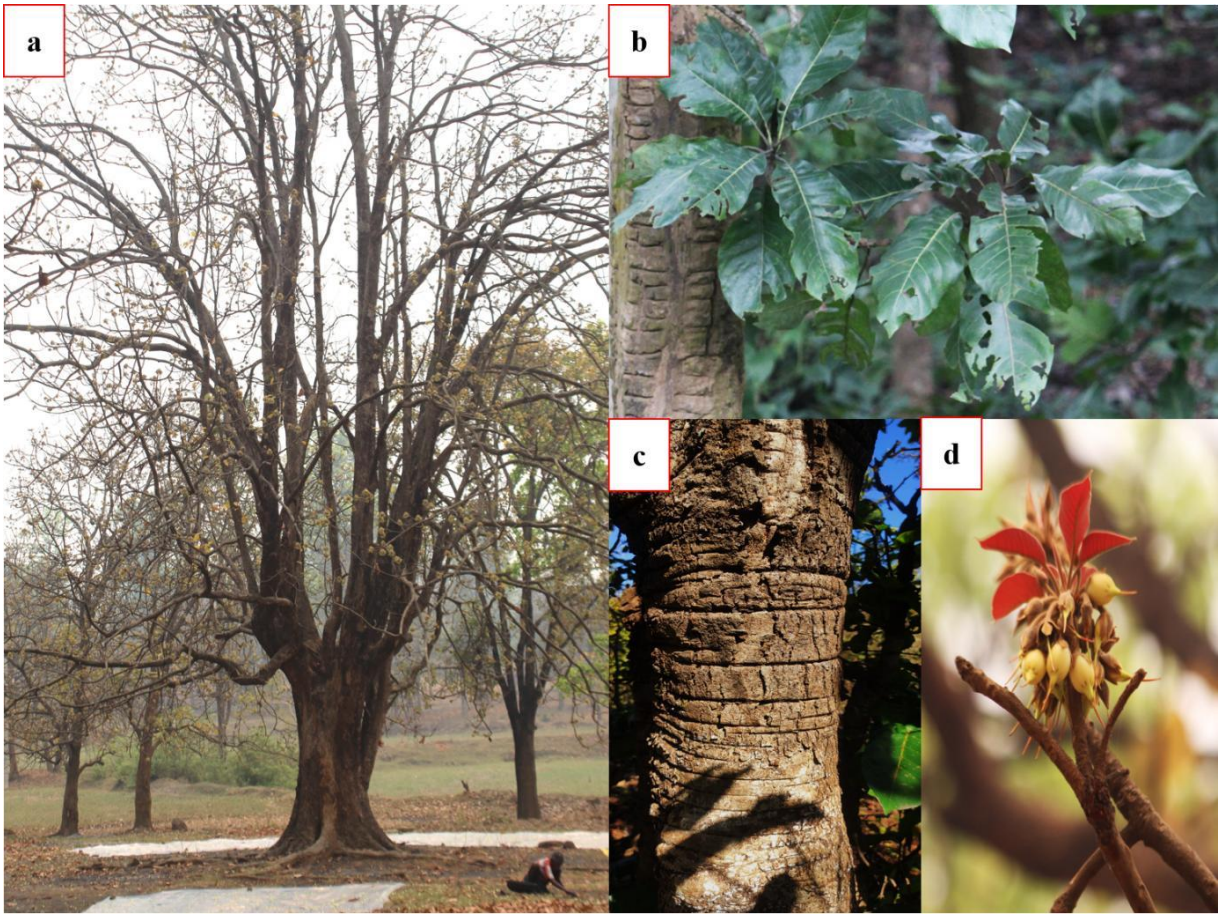

Plate 1: Plant parts of *Madhuca longifolia*, a) Whole plant, b) Leaves, c) Bark, d) Flowers

METHODOLOGY

The survey was carried out in the month of February–April 2022 in selected districts (Sundargarh & Mayurbhanj) of Odisha. Local communities were interviewed and information was collected on Forest fire & Mahua tree. Literature survey also carried out to gather the information on food and medicinal values of *Madhuca longifolia* . The selected tree species was identified using available literature (Haines 1925; Saxena and Brahman 1995).

RESULTS AND DISCUSSION

The field survey revealed that among the causes of forest fire, collection of Mahua flowers is major in study areas. The flowers are collected by tribal communities after setting fire under the Mahua tree. The ideology behind this practices is, 1) Insects will be killed, 2) The area under Mahua tree will be cleaned. For easy collection of flowers, local communities make fire and this fire slowly-slowly reach near forest lead to fire. This events were observed many times during field works. The details are illustrated using the field photographs in Plate 2. A women making fire to remove the dry leaves for the collection of Mahua flowers (Plate 2). It was observed that, the awareness programs on forest fire by the Forest Department is playing a vital role in preventing forest fire. After the lot of awareness programs, local communities set controlled fire under Mahua tree and they are also cleaning using the blower with field staffs. It was noticed that, whole family members are engaged to collect the flowers in flowering period. After collection from the field, they bring them to the house for complete drying under sunlight. In details are illustrated in Plate 3. After collection, they spread on clothes or mates for drying. It was noticed that, for drying, it takes about 1 week (Plate 4). It was observed that after drying, the flowers are stored or used to sell in the local markets (Plate 5).

Plate 2: Tribal women collect the flowers of *Madhuca longifolia* a) Burning of dry leaves, b) Sweepingthe dry leaves in one place, c) Watching over the fire to prevent forest fire

Plate 3: Local communities collecting flower from forest fringe

Plate 4: Drying of *Madhuca longifolia* under the sunlight

Plate 5: Flower of *Madhuca longifolia* in market

The dried flowers are used to make country liquor. They prepare country liquor in traditional ways during festivals and rituals. It was noticed that they use some natural fermenting agent for fermentation. The residue is used as a fodder of domestic pigs. For distillation, sometimes they use perennial water source and inside forest they prepare the mahua traditional liquor. Details are illustrated in Plate 6.

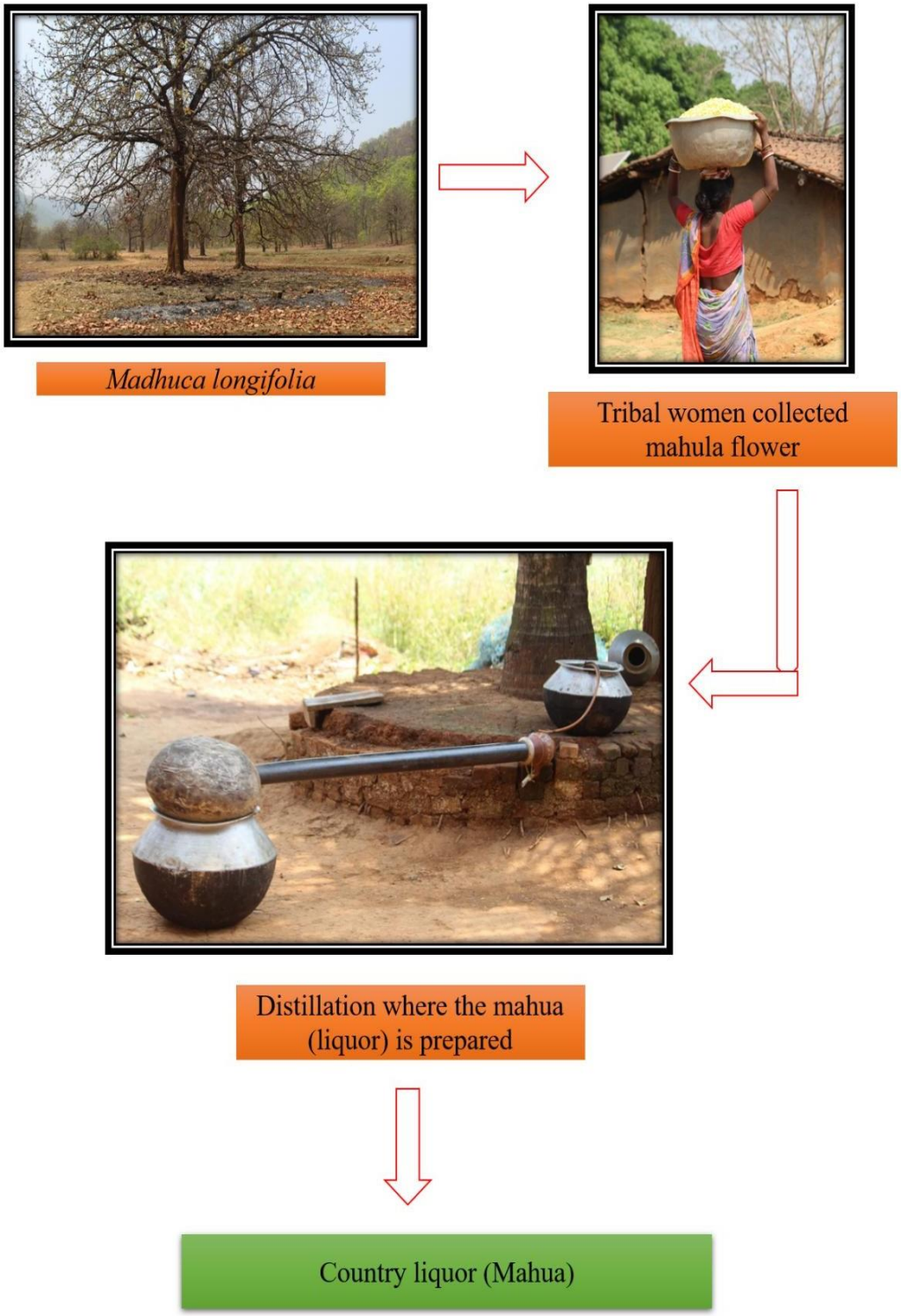

Plate 6: Illustration on preparation of liquor

Ecological values of *Madhuca longifolia* : Apart from a major cause of forest fire, it also holds another important feature as it is a host plant to many orchid species like *Vanda* species, *Luisia* species, *Acampe* species, *Oberonia* species etc. Plate 7 shows that, it is the host of many epiphytic orchid species which play important role in ecological balance and conservation of Orchid species.

Plate 7: Orchid species on *Madhuca longifolia* a) Many orchid species on *Madhuca longifolia,* b-d) Orchid species

Food values of *Madhuca longifolia* : It was observed that mahua flower is used for sweetening in halwa, making laddu (a type of sweet) and cooked with vegetables. Seed oil is also used for cooking purposes (Sinha et al. 2017).

Medicinal values of *Madhuca longifolia*: It is noticed that the plant parts of *Madhuca longifolia* is used in divers diseases and disorders. The flower possesses antibacterial and anthelmintic activity. Medicinally the flower is used for cooling agent, skin diseases, anthelmintic. The seed possess anti- inflammatory and antiulcer activity (Sunita and Sarojini 2013). Bark is used to treat diabetes, bronchitis, headache, piles and ulcer (Jha and Mazumder 2018; Mishra and Poonia 2019). The fruit is used to treat tonsillitis. Leaves is used to treat eczema, wound healing, anti-burns (Saif et al. 2020). The metal nano- particles synthesis with plant part extracts of *Madhuca longifolia* is able to inhibit the growth of gram negative pathogenic bacteria and able to restore the renal function along with prevent cellular damages. The plant parts also possess different types of bioactive compounds like phenolic compounds, ketones, aldehydes, quercetin etc (Annalakshmi et al. 2013; Das et al. 2018; Patil et al. 2018; Peter and Prince 2018).

Economic values of *Madhuca longifolia* : During the survey, it was observed that fresh and dried flowers are used to sell in the local markets. The seed oil is also used to sell.

CONCLUSION

The present study concluded that collection of flowers of *Madhuca longifolia* is a major cause of forest fire in study areas. The plant parts of *Madhuca longifolia* is used as a food and having medicinal values. The flowers create livelihood to the local communities. Therefore, the study indicates that need a strategy for the collection of flowers without making fire along with proper value addition.

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MEDICINAL VALUES OF *AMORPHOPHALLUS* SPECIES

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ABSTRACT

The tribal community of Odisha is a treasure of traditional knowledge which is used to treat many diseases and disorders. They use diverse plant species along with wild tuberous plants for the same. Among them, Amorphophallus species are common and belongs to the family Araceae. Amorphophallus species are used both as food as well as a medicinal agent. The popularity of these species has declined in the urban areas, but it has some highly nutritional values, which makes it a potent wild food. Amorphophallus paeoniifolius is used in dysentery, stomach ache, piles, asthma, etc. It is also used as food in tribal areas. Amorphophallus bulbifer is also used to treat many ailments like rheumatism, skin infection, etc. The present study implies that particular Amorphophallus species have food and medicinal values which needs more documentation & bio-chemical works for value addition.

Keywords: *Tribal community, Nutraceutical, Medicinal values, Food values*

INTRODUCTION

Tribal population constitutes an important place in India and all over the world. Tribal people, mostly consume leafy vegetables, tuberous plants, which grow in the wild or they cultivate in their home gardens. The tribal people consumed them for food and medicinal purposes. Worldwide, mankind is facing food scarcity, which is a greater problem for human beings. Reduced food intake and poor excess food intake in underdeveloped countries, resulting in malnutrition and health hazards, but in the meantime, the problem is on the edge and it needs to be sorted out soon. Whereas food scarcity is the major problem, and wild food plants like leafy vegetable, tuberous plant have become a savior. The tribal communities have a hub of traditional knowledge on wild food and medicinal agents. The tribal people have more knowledge about the tuberous plant and how to consume it with no complications. *Amorphophallus* species belong to the family Araceae having round tuber known as corm. It often grows along the roadside, in the village areas, and moist areas. It is commonly known as elephant foot yam, devil tongue etc. Mostly, the tuberous plant is washed thoroughly and successive boiling is done to remove the bitterness. Many plants of the family Araceae have been reported but some have been less documented. *Amorphophallus bulbifer* (Roxb) Blume is a cormous plant commonly known as devil tongue. It is widely distributed from Burma to the Himalayan regions of Asia. It is mostly found at high altitudes and in moist areas. *Amorphophallus bulbifer* is commonly used in ayurvedic medicine in India (Shete et al. 2015). *Amorphophallus paeoniifolius* is a stout herbaceous plant. It is largely cultivated in India, specifically Punjab, West Bengal, Assam and Sri Lanka. It is commonly known elephant foot yam. It is also used as food (Dey et al. 2012). The present study highlights the ethnomedicinal values of *Amorphophallus paeoniifolius* and *Amorphophallus bulbifer*.

METHODOLOGY

Ethno-botanical exploration was undertaken in the tribal areas of Odisha. Details on the information regarding the identification of medicinal plants, diseases to be treated, and the mode of uses were collected. A periodic semi-questionnaire was collected from tribal people and listed in Table 1. The

plant was identified by the Dr. Sanjeet Kumar, CEO Ambika Prasad Research Foundation, Odisha, India.

RESULTS AND DISCUSSION

The study was carried out in the tribal areas of Odisha (Mayurbhanj, Athagarh, Khordha and Dhenkanal). *Amorphophallus* species have a wide range of food and medicinal values. The analysis of data revealed that leaf, corm, tuber, petiole and rhizome are used to treat various diseases. *Amorphophallus paeoniifolius* (Plate 1b) also known as olua is used to treat many diseases like dysentery, poor appetite, sinusitis, stomach problem, piles, asthma, jaundice. *Amorphophallus bulbifer* known as ban olua is used to treat skin infection, jaundice, rheumatic and joint pain. Other researchers also documented that the *Amorphophallus paeoniifolius* and *Amorphophallus bulbifer* (Plate 1a) is used to treat various ailments. In 2009, Das et al. reported that *Amorphophallus paeoniifolius* has medicinal uses in Tripura. In 2012, Reddy et al. reported that *Amorphophallus bulbifer* has anti-inflammatory activity and other compounds which can treat various diseases. In 2015, Shete et al. reported that the tuber of *Amorphophallus bulbifer* has antibacterial activity. In 2016, Padhan and Panda reported that the tuber of *Amorphophallus paeoniifolius* is used to treat piles. In 2017, Rahmatullah et al. reported that *Amorphophallus bulbifer* is used to treat jaundice in Bangladesh. Many researchers have worked on these particular species but need more work on these aspects which could cure many diseases in the future.

Table 1: Ethno-medicinal values of *Amorphophallus paeoniifolius* and *Amorphophallus bulbifer*

Plant Name	Local Name	Parts used	Uses	Location
Amorphophallus paeoniifolius	Olua Banaolua Badaolua	Leaf	The leaf is used in the treatment of dysentery.	Mayurbhanj
			The leaf is consumed against poor appetite.	Aathgarh
			Apical shoots are used to cure sinusitis.	Khordha
		Corm	Dried corms are used against stomach problems.	Mayurbhanj
			Dried corms are used for the treatment of piles.	Aathgarh
			It has appetizer properties.	Khordha
			The corm has blood purifier properties and is used in the treatment of asthma.	Khordha
		Whole plant	Dried powder of whole plant is mixed with curd to treat jaundice.	Mayurbhanj
			The whole plant is used to improve poor appetite.	Aathgarh
			The whole plant is used to treat stomach problems.	Dhenkanal
Amorphophallus bulbifer	Ban Olua	Corm	The corm is used to treat skin infection	Khordha
		Tuber	The tuber is cooked and	Mayurbhanj

			eaten to get relief from jaundice; It also possess antibacterial activity.	
		Petiole and rhizome	Small pieces of fresh petiole and bulbils of this plant are cooked as vegetables with dry fish and taken with rice once a day for 10-12 days for rheumatic or joint pain.	Dhenkanal

Plate 1: A) *Amorphophallus bulbifer*, B) *Amorphophallus paeoniifolius*

CONCLUSION

The consumption of wild food plants by tribal people in Odisha is already in a flashlight zone, but it is not consumed by the urban people due to less documentation on these wild food plants. The documentation is a necessary for the authentication to consume such wild plants available in forest area. *Amorphophallus* species are widely used by tribal people to treat various ailments. Such knowledge needs sound proof documentation. Many researchers have worked out on these particular species, even it is still unknown to the urban areas. It should be introduced as a course menu food item.

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Buchanania cochinchinensis (Lour.) M.R. ALMEIDA: A WILD NUTRACEUTICAL OF INDIA

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ABSTRACT

Nutraceutical is a popular term in food biology and pharmacology due to dual values (Food & medicine). The recent health problems being attention towards the screening of natural nutraceutical from the nature. Buchanania cochinchinensis is a tree species native to India and fruits are used as a food and medicines. Therefore, this tree is suitable for detail studies to do value addition & sustainable utilization from wild to keep nature healthy. The present study revealed that it is a tree having food, ethnomedicinal, pharmacological, ecological and socio-cultural values. The present chapter highlights the importance of wild nutraceutical.

Keywords: *Buchanania cochinchinensis, Medicinal value, Food value, Pharmacological value, Economic value*

INTRODUCTION

Let food be the medicine and medicine be the food- a statement given by the Hippocrates which need badly to fight against novel diseases and disorders. Almost, every year, we are facing new health care problems related to inadequate food and poor immune systems. Researchers throughout the world are working on screening of food and medicinal agent to mitigate and medicinal insufficiency. Hence the best way would be to search a agent having food and medicinal values. Having such food as traditional practices and has a low history based on natural sciences. Re-need of such neutraceutical is observed due to urban lifestyle. The new lifestyle and modern fooding leads to heart disease, cancer, osteoporosis, arthritis and many more. Consumption of neutraceutical prevent arthritis, cold and cough, sleeping disorders, digestion, blood pressure, depression, diabetes etc. Keeping the importance of neutraceuticals, an attempt has made together the information from field and literature on *Buchanania cochinchinensis*, a wild tree bearing edible fruits having medicinal values. The chapter highlights the importance of wild edible fruits as a nutrition and fight against diseases and disorders. *Buchanania cochinchinensis* belongs to the family *Anacardiacea*. In India, it is mostly found in the states of Chhattisgarh, Rajasthan, Jharkhand, Gujarat, Madhya Pradesh, Odisha, Maharashtra, Uttar Pradesh, Bihar and Andhra Pradesh (Nishad et al. 2019). It is an evergreen medium-sized tree generally 40-50 ft tall with straight cylindrical trunk (Siddiqui et al. 2014). It prefers yellow sandy-loam soil to grow and unliveable in waterlogged areas (Rajput et al. 2018). The bark is rough and dark grey or black in colour (Banerjee and Bandyopadhyay 2015). Leaves are coriaceous, 6-7-inch-long, broadly oblong with blunt tip and rounded base and have 10-20 pairs of straight parallel veins (Habib and Shrivastava 2017). Flowering starts from January to March, appears to be small and hard sessile greenish-white. Fruit is drupe containing single seed with sweet acidic pulp, green when immature and dark black at its mature stage (Malik et al. 2012). Ripen from April to May and remain on the tree for a quite long time (Sahu et al. 2015).

METHODOLOGY

During floristic survey and other exploration works of Ambika Prasad Research Foundation in different districts of Odisha, information was collected on *Buchanania cochinchinensis* and discussed in the chapter. The selected tree is identified by the authors.

RESULTS AND DISCUSSION

The field and literature survey revealed that *Buchanania cochinchinensis* (Plate 1) is a tree and found in deciduous forest and have a good population in study areas. It was noticed that it is an associated species of sal tree and one of dominant tree of sal vegetation.

Food values

During survey, it was noticed that ripen fruits are edible seeds of *Buchanania cochinchinensis* are slightly flattened, lentil-sized and has almond-like flavour and eaten in raw or roasted form (Khatoon et al. 2015). Nuts are used in preparing sweet dishes such as halwa, kheer, laddu, barfi, shrikhand (Prasad 2020). Fruits can be used for preparing value added products like squash and fermented beverage like wine (Srivastava et al. 2017).

Ethnomedicinal values

Tribal folk reveals that all plant parts of *Buchanania cochinchinensis* i.e. roots, leaves, fruits, kernels and gum are widely used to treat various diseases like skin disease, blood disease, diarrhoea etc. It is used in the form of decoction to treat haemorrhage. Powder of kernel with milk is used as aphrodisiac. Powder of bark mixed with honey is useful in blood dysentery (Neeraj et al. 2020). The gum extracted from the stem bark, root and dried leaves in powdered form mixed with buttermilk is used for treating diarrhoea. The oil extracted from the fruit is used against skin diseases. It helps in removing dark spots from the face. Seed powder mixed with milk is used as a face pack for glowing face (Das 2018).

Biochemical significance

Many phytoconstituents are present in all the parts of *Buchanania cochinchinensis* like tanins, flavonoids, saponins, phenols etc. that are used for numerous medicinal purpose (Sharma et al. 2021). The seed contains carbohydrate (12.1%), protein (19.0-21.6%), fibre (3.8%), fat (59.0%), moisture (3.0%), iron (8.5 mg), phosphorus (528.0 mg), ascorbic acid (5.0 mg), thiamine (0.69 mg), riboflavin (0.53 mg), calcium (279.0 mg) and niacin (1.50 mg) (Thounaojam and Dhaduk 2020). During fever and burning sensation, powdered kernel with milk is used as aphrodisiac (Banerjee and Bandyopadhyay 2015). Crushed or powdered leaves are useful for wound healing. Root extract is used for curing biliousness and blood disease (Rajput et al. 2018).

Pharmacological values

Buchanania cochinchinensis have been reported to possess pharmacological activity such as anti-microbial, anti-oxidant, anti-inflammatory activity etc. Ethanolic extract of roots have good antiulcer activity (Kodati et al. 2010). The leaves have haemoprotective capability potential, i.e., antihaemolytic activity (Shinde et al. 2017). Stem bark contains tannins, saponins, flavonoids, triterpenoids, alkaloids and reducing sugar. It is reported for having anti-microbial, anti-oxidant, oxidative stress and genotoxicity properties (Srivastava et al. 2018). Leaves contain various secondary metabolites like flavonoids, saponins, alkaloids, polyphenols, steroids, glycosides, triterpenoids, myricetin 3′-rhamnoside-3-galactoside, tannins, quercetin-3-rhamnoglucoside, kaempferol, kaempferol-7-O-glucosides. Methanol leaf extract have anti-bacterial and anti-fungal activities, comparable with standard antibiotics like fluconazole (10mg), ampicillin Penicillin-G and Streptomycin (10disc) (Elias et al. 2021). Kernel of the fruit contains about 52% oil. The oil extracted

from the kernels is used in cosmetic manufacturing as a substitute for olive and almond oils (Kumar et al. 2014).

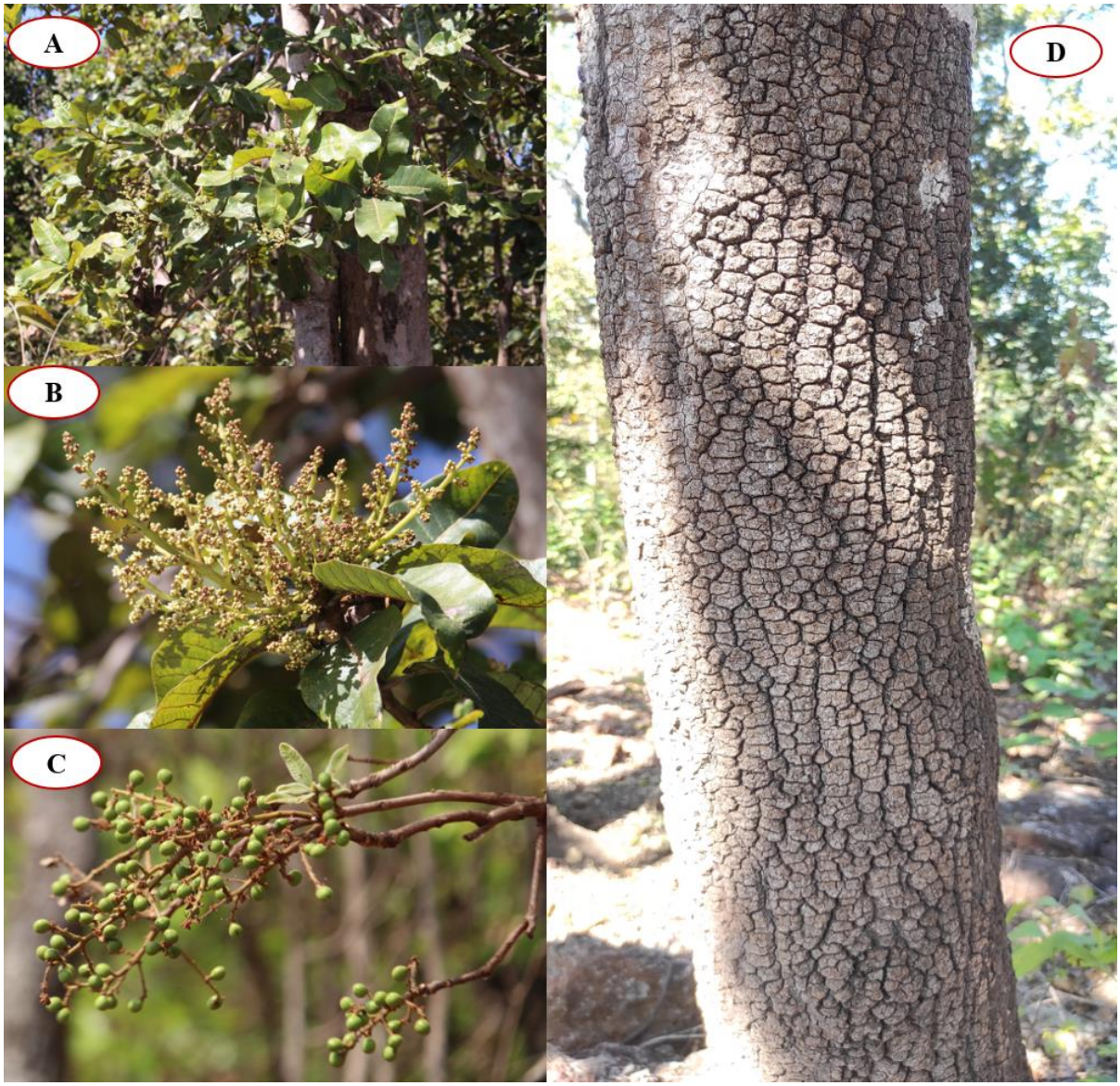

Plate 1: Plant parts of *Buchanania cochinchinensis,* A) Leaves, B) Flowers, C) Fruits and D) Bark

Economic values

As per the Tribal Cooperative Marketing Development Federation of India Limited (TRIFED), fruits of *Buchanania cochinchinensis* has an estimated total potential of 10 million kilogram per annum and an estimated value of 230 crores in Indian rupees. In foreign market, fruit nuts are in high demand. It is used as fuel and fodder (Singh et al. 2018). Fruits are sold at the nearby local market at the rate of Rs. 80-100 per kg which eventually help in generating an income source to the tribal communities (Srivastava et al. 2017).

FUTURE PROSPECT

At present, population of *Buchanania cochinchinensis* is vanishing from its natural habitat due to various reasons like poor seed germination, long fruiting period, slow growing, destructive harvesting practices, overexploitation, uprooting of trees, biotic and abiotic factors. Therefore, there is an urgent need to make a strategy to conserve its important tree species. Installation of nursery by the Forest

Department can help in saving the plant from threatened status. There are various products that can be obtained from *Buchanania cochinchinensis* in the form of food, medicine, beverages etc. that would not only promote the value addition and it has noticed that fruits are used to sell in the local weekly markets, in study areas. It will help in generating small scale industry which will enhance the income of rural communities for their livelihood. For increasing the economic value, proper machinery setup is required to install because most of the procedure is done manually which time is consuming. If there would be proper laws against the harvesting procedure, one can contribute towards the conservation with utilising the plant species in a sustainable way.

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SOME COMMON PLANTS USED IN THE RITUALS OF SUNDARBAN AREAS, WEST BENGAL, INDIA: A SOURCE OF CONSERVATION PRACTICES AND SUSTAINABLE USE

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ABSTRACT

Sustainable and adaptive livelihood is an approach and effort to go beyond conventional practices. A number of sustainable developments from different rituals of Sundarban areas have addressed the conservation of different species that promoting sustainable agriculture, ensuring healthy lives and give traditional knowledge for food security with conservation of local medicinal plants. Keeping the importance of folk cultures, an attempt has been made to document the information related to folk cultures in selected areas of Sundarban for understanding the scientific values to manage the biological resources in sustainable manner. Different rituals like Ghatbari puja, Benaki puja, Kulimongalbar, Shastipuja, Manasa puja etc are selected for present study. The results are documented in this chapter which could be base line data for the management of biological resources and to understand the sustainable use.

Keywords: *Sustainable use, conservation practices, food security, traditional knowledge, medicinal plants*

INTRODUCTION

The sunderbans, the largest mangrove forest on earth, and now second amazing natural resources of the World (Hussain et al. 2017). It is a home of Royal Bengal Tiger and many tribal communities (Jalais 2010). They use the available local bioresources in sustainable manner in day-to-day life. The sustainable utilization gives sustainability in Sundarban ecological systems. This delicate relationship is needed and very important for all. Due to anthropogenic activities and natural hazards, we are losing this delicate relationship resulted ecological unbalance in mangrove ecosystem of Sundarban and their associated communities. Therefore, need work in alarming rate to restore the bioresources. For restoration and other related works need to know the past and present practices by the local communities. In this regard, the rituals are important source to understand the sustainable utilization of bioresources with massage for the conservation to restore and balance the ecosystem. Keeping the importance of rituals, author has taken an attempt to document some common plants used in different rituals by the local communities of selected areas of Sundarban. The short communication gives a base line data and bring attention towards the documentation of rituals having sound ecological values.

METHODOLOGY

Data collection: The data was collected through a set of questions. The old people were interviewed and information was noted down. The plants are identified by the author. The selected areas of Sundarban are following for data collection: 1) Sagar, 2) Namkhana,3) Kakdwip, 4) PatharPratima,5) Mathurapur-1, 6) Mathurapur-2, 7) Kultali, 8) Joynagar-1, 9) Joynagar-2, 10) Canning–1, 11) Canning-2, 12) Basanti, 13) Gosaba, 14) Haroa, 15) Minakhan, 16) Hasnabad, 17) Hingal gang, 18) Sandeshkhali-1, and 19) Sandeshkhali–2.

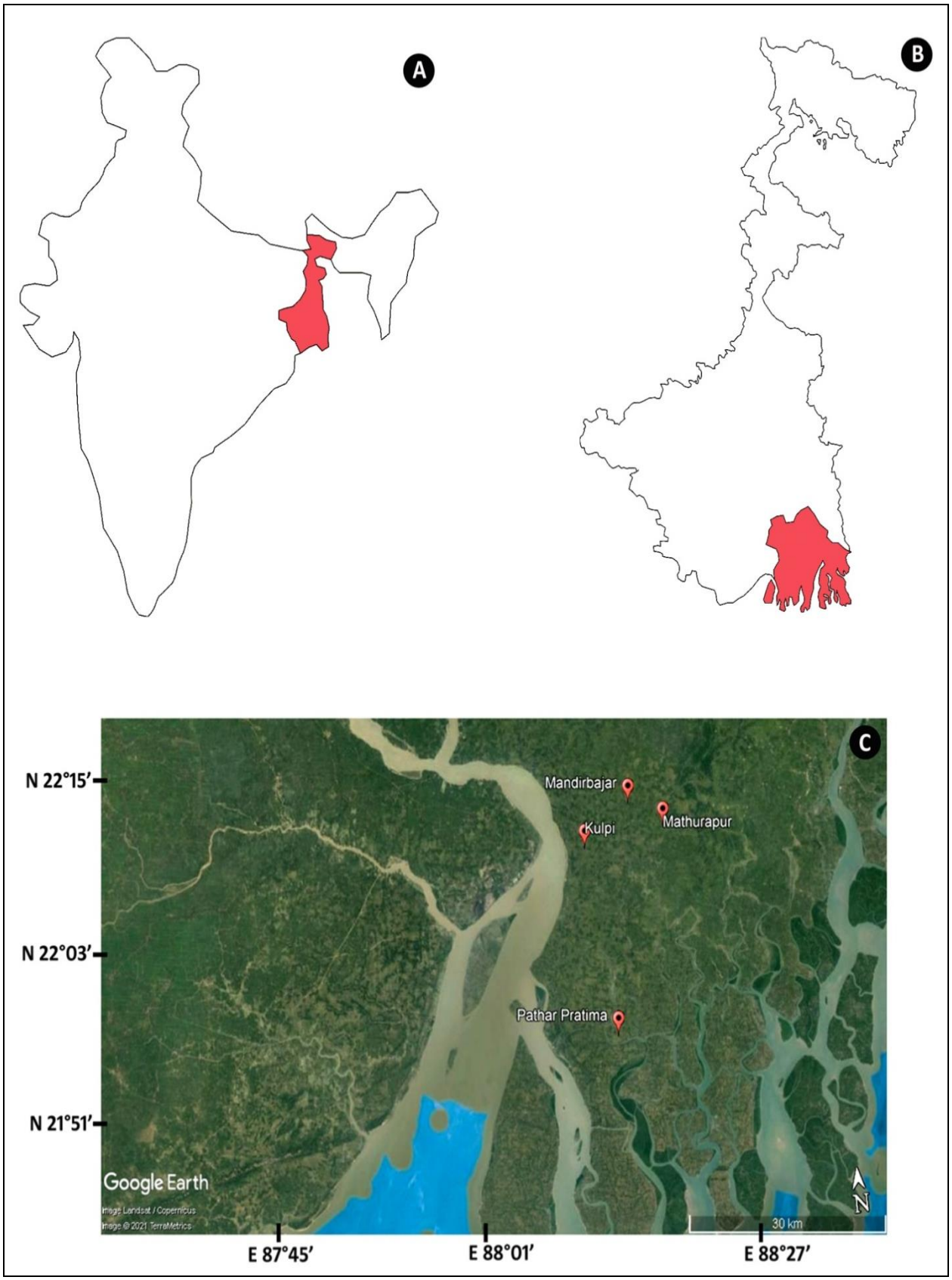

Figure 1: Geographical location of study area

RESULTS AND DISCUSSION

In the present works, the popular rituals are observed in the selected areas of Sundarban and found that some common plants are used in popular rituals having food, medicinal, economic, ecological and socio-cultural values with a message to use in sustainable manner. The results revealed that about 7 plants are used in most of rituals by the local communities. These are *Oryza sativa*, *Hygrophila spinosa, Ipomoea aquatica, Artocarpus heterophyllus, Cynodon dactylon, Ziziphus jujuba* etc. It was observed that the practices of such plants give massage for the conservation of wildlife and sustainable use of available biological resources (Table 1). In 2014, Mondal et al. documented the bioresources used by the local community of Sundarban.

Table 1: Significance of rituals in Sundarban areas, India

Scientific name	Part used	Ethnic & medicinal importance	Conservation values
Oryza sativa	Mature inflorescence	Young (paddy spike) inflorescence of rice and sum symbolized structure made by mud soil like monitor lizard that's indicate the protection of rice field.	Protection of Monitor Lizard
	Mature Inflorescence	Used for symbol of Mahalakshmi & that is all source of economy & food.	Conservation of Indigenous variety of rice
Hygrophila spinosa	Twig with flower	Flowers are used to cure diarrhea.	Conservation of Medicinal plants through sustainable use
Ipomoea aquatica	Twig	The twig is used as popular vegetables.	Conservation of Medicinal plants through sustainable use
Artocarpus heterophyllus	Fruit	Fruits are edible	Conservation of Medicinal plants through sustainable use
Cynodon dactylon	Twig	Make pest by its twig and use to stop bleeding after cut.	It is taken as spiritual but all those activities have medical importance.
Ziziphus jujuba	Fruits	Fruits are edible.	Conservation of food plants through sustainable use
Musa x paradisiaca	Pair of fruit	Fruit is a source of minerals.	Conservation of cultural plants through sustainable use

CONCLUSION

The present work bring attention towards the need of more exploration works for documenting the rituals and the associated bioresources of Sundarban areas for the conservation of indigenous traditional knowledge (ITK). The ITKs could be helpful to screen new food and medicinal agents for future.

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PHYTOCHEMICAL AND PHARMACOLOGICAL ACTIVITY OF GENUS *CURCUMA* – A REVIEW

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ABSTRACT

Genus Curcuma holds presence in ancient Ayurveda and has been immensely used as both traditional and modern medicine. The genus is widely distributed in tropical Asia and the Asian–Pacific region as wild and even cultivated form. The genus consists of rhizomatous annual or perennial herb and belongs to Zingiberaceae family. Rhizome is the most used part of the plant. Many pharmacological, molecular and phytochemical studies have been conducted on several species of Curcuma worldwide. Phytochemicals such as sesquiterpenoids, germacrone, xanthorrhizol and curcuminoids are found to be some of the bioactive compounds and also shows encouraging pharmacological activities including anti-inflammatory activity, anti-oxidant activities and even cytotoxicity against cancerous cell. Whereas, curcumin and its structural analogues are the medically most valuable compound for the genus. This review paper is an attempt to assemble phytochemicals and some of the pharmacological activities of the genus Curcuma.

Keywords: *Genus Curcuma, pharmacological, phytochemicals, curcumin, Ayurveda, Zingiberaceae family, sesquiterpenoids, germacrone, xanthorrhizol, curcuminoids, cancerous cell*

INTRODUCTION

Some plants have been discovered for decades and used as traditional medicine in different developing countries including India. Plants synthesize hundreds of biochemical compounds for functions including defense against insects, herbivorous animals, fungi, and diseases. The place and roles of plants in medicine were totally altered in the 19th century by application of chemical analysis (Dutta 2015). The history of medicinal plants dictates how important they are in healing several complications and discovering new drug molecules in the modern era. Medicinal plants are considered as rich resources of traditional medicines and from these plants many of the modern medicines are produced. For thousands of years medicinal plants have been used to treat health disorders and to prevent diseases epidemics. Various phytochemicals with potential biological activity have been identified in the plants (Rahaman et al. 2021). Secondary metabolites, are group of bioactive substances which have diverse classes of compounds like alkaloids, terpenoids, phenols, flavonoids, tannins, saponins, etc., and are produced through secondary metabolism in different plants. The secondary metabolites produced by the plants are usually responsible for the biological characteristics of plant species used throughout the world. The secondary metabolites present in plant are commercially important and find use in a number of pharmaceutical compounds (Dutta 2015). Phytochemical analysis of ethnomedicinal plants for secondary metabolites is an important area of research because of its relevance for the discovery of therapeutic agents and providing clues for new sources of bioactive compounds. The medicinal value of plants lies in the phytochemicals that have definite physiological action on the human body (Farooqui and Farooqui 2019). The genus *Curcuma* is a difficult subject for taxonomists and plant explorers owing to its occurrence in remote and inaccessible areas and its short flowering period (Sasidharan and Sivarajan 1989). Curcuma, is a very important genus which is distributed in tropical Asia and the Asia–Pacific region. The *Curcuma* genus consists of rhizomatous annual or perennial herb in the Zingiberaceae family. The word "Curcuma" is derived from the Arabic word "Kurkum" meaning yellow colour of the rhizome. It was termed as "herb of sun" in vedic period. Most of the species of *Curcuma* are naturally present in tropical evergreen areas. It is an economically important genus having many different uses. It is widely used as flavouring agent, spices, food preservative, medicines, dyes, starch, cosmetics and ornamentals (Weiss 2002). The genus contains more than 120 species and many of them

are of economic and medical importance and exhibit wide variation at intraspecific and interspecific levels. Four tribes of the Zingiberaceae family, namely, Zingibereae, Hedychieae, Globbeae, and Alpinieae, are distributed on the basis of morphologic traits, such as the location of ovaries, alterations of the productive anther, staminodes development, and the orientation of rhizome shooting leaves (Rahaman et al. 2021). The rhizome is the most used part of the plant. Many of the biological activities is attributed to non-volatile curcuminoids and other volatile chemicals. Curcuminoids vary in chemical structures, physico-chemical characteristics as well as the functional properties. The genus *Curcuma* consists of about 110 species distributed mainly in South and Southeast Asia. Malaysia, Indo-china, Northern Australia, Thailand, India, etc. are the most suitable places to grow *Curcuma* species. Prana (1977) suggested two main centres of domestication. One in India, where *Curcuma amada, C. angustifolia, C. aromatica, C. caesia and C. longa* are produced and other one in Java with production of *C. mangga, C. phaeocaulis, C. aeruginosa, C. xanthorrhiza, C. soloensis, C. colorata, C. heyneana and C. purpurascens*. *C. amada* Roxb. originated in Indo-Malayan region of Asia (Table 1). The plant is widely distributed in tropical areas of Asia and Africa and cultivated mainly in Gujarat, West Bengal, Uttar Pradesh and southern parts of India. *Curcuma angustifolia* Roxb. originated in southern Asia (Table 1). Wild varieties are grown in India, especially in the northeast and western coastal plains and hills. It is also found in Burma, Laos, Nepal, and Pakistan. *Curcuma aromatica* Salisb. is native to eastern and southern parts of India. The plant is distributed throughout India and mainly cultivated in Karnataka and West Bengal. *C. caesia* Roxb. This herb is available throughout north-east and central India. It is widely found in Java, India and Myanmar. It grows well in moist deciduous forest. It is rarely found in parts of Madhya Pradesh, Jharkhand, Chhattisgarh and Odisha. *C. comosa* Roxb. is widely grown in tropical and subtropical areas of Asia (Table 1). *Curcuma longa* is an ancient crop having its origin and domestication in South Asia. It is widely used and cultivated in India, China and south east Asia. *C. xanthorrhiza* is native to North East India and is widely cultivated in many parts of India, Srilanka and China. To recognize the *Curcuma* species, single flexible anthers formed in flowers and large compound spike inflorescences with spiral bracts are prominent characteristics.

TABLE 1: List of Species of Genus *Curcuma* along with their common names and distribution (Ravindran et al. 2007)

SPECIES	COMMON NAME	DISTRIBUTION (Native to)
C. aeruginosa Roxb.	Black curcuma	Cambodia, Myanmar, Thailand, Vietnam, Indonesia, Malaysia, Japan
C. amada Roxb.	Amada, mango-zinger, mamidi allam	India, Bangladesh
C. angustifolia Roxb.	East India arrowroot, tikur	India, Myanmar, Nepal, Pakistan
C. aromatica Salisb.	Wild turmeric, yellow zedoary	India, Nepal, Srilanka
C. caesia Roxb.	Black turmeric	India
C. comosa Roxb.	Na-nwin-khar	Thailand, Myanmar
C. longa L.	Turmeric, haldi, kurkuma	India-Pakistan-Bangladesh subcontinent
C. mangga Val. & Zijp.	Mango turmeric	Java, Thailand
C. petiolata Roxb.	Queen lily	Myanmar, Indonesia

C. phaeocaulis Valeton	E zhu, peng e zhu	China, Indonesia, Vietnam
C. pseudomonata J. Graham	Hill turmeric, bon holud	Bandarban district of Southeast hills of Bangladesh
C. rotunda L.	Chinese keys	China, Indonesia, Thailand, Myanmar
C. xanthorrhiza Roxb.	Temu lawak	Indonesia, Malaysia
C. zedoaria (Christm.) Roscoe.	Kua, cedoaria, temu putih, er-chu	Inonesia, Malaysia, India-Pakistan-Bangladesh subcontinent

Habit: Curcuma species are perennial rhizomatous herbs.During the dry season, the leafy shoot die off. Mostly plants are medium-sized - 0.5 to 1.5 m tall, whereas the smallest species are just about 10 – 20 cm (e.g. *C. bhatii, C. reclinata*), while the stately ones can reach up to 2.5 - 3.5 m (e.g. *C. zanthorrhiza*, *C. latifolia*)

Rhizome: rhizomes are sometimes considered to be fleshy and aromatic. Rarely in some species rhizomes are branched. Rhizomes are stuck with roots and tubers are often ellipsoidical or conical. Root arises from bulb or sometimes from primary fingers and are generally fleshy.

Leaf: Basal leaf lamina are typically oblong, lanceolate, broad, or rectangular in form, and linear. Leaves have a basal sheath and are either sessile or petiolate. Colour of the leaf lamina is generally bright green to deep green above and pale green beneath.

Pseudostem: Pseudostem (false stem) is formed by closely enclosed leaf sheaths and are surrounded by leafless base. It differs from species to species and in some species they are missing.

Inflorescence: Inflorescence is always terminal in position (Fig. 1b). If inflorescence arises from non-leafy shoot it is termed as lateral inflorescence and it mostly appears after pre-monsoon rain. The inflorescence can be cylindric, conic or ovoid in shape. Bracts are usually large and forms pouches by joined to each other at the base. The free ends of the bracts are normally wide spread, each subtending a cincinnus of 2-10 flowers. In many species the uppermost bracts, which are called "coma", are longer than the rest and differently coloured. They are usually sterile.

Flowers: Flowers are enclosed by bracteoles, comprises of tubular, unequally toothed and sometimes pink or violet coloured calyx (Fig -1b). In most species, calyx is unilaterally splited. Corolla-tube is more or less funnel shaped; with unequal corolla- lobes, the dorsal slightly larger than the lateral ones, and hooded apex. Staminodes are elliptical, petaloid, oblong or linear. Labellum (transformed anthers) has a thickened middle part and lateral lobes are thinner which overlaps the staminode. Stamen has a short filament, with constricted apex. Anther-crest is usually small. Anther spurs vary in many shapes and sizes have important characters for infra-generic classification. Ovary is glabrous or pubescent, and 3-lobed (Faiz et al. 2015).

Fruit & seeds: The fruit is thin-walled, round capsule, dehiscing, usually light green, creamy or greenish-white in colour. Seeds of *Curcuma* species are ovoid, light brown to dark brown coloured and shiny and always arrilate. The arillate seeds have two seed coats, the outer one is thicker than the inner one. Seeds are filled with enormous endosperm and the embryo is in the upper side of ovule. Arillus are uniform throughout the genus, although their shape and number of lobes, relative size of the lobes may differ among the species. Once the seeds are ripe, fruit gets open and arillus getsdetached from the seed and rot within few days. Various species are used as medicine, spice, food colouring and flavouring, as a yellow dye for silk and cotton, baskets and various handicrafts, and as a part of religious rites since age old. Nowadays, it has great commercial prospective for Asian countries. The economically most important plant of the genus is *Curcuma longa*, which is turmeric. Most used *Curcuma* species is *Curcuma longa* L., among other *Curcuma* species of economic importance include *C. aromatica* Salisb., *C. amada* Roxb., *C. caesia* Roxb., *C. aeruginosa* Roxb., and *C. zanthorrhiza* Roxb.. These are

still in cultivation in almost all Asian countries in large or semi-large scale as sources of medicines, condiments, species and also for extraction of aromatic oils. Tribal and native people use *Curcuma* species as medicinal plants, spices and food (Kaliyadasa and Samarshinge 2019).

SOME COMMON *CURCUMA* SPECIES

Curcuma amada: It imparts smell of raw mango but looks like a zinger, thus it is named as mango-zinger. The plant is available from November to April.

Curcuma anguistifolia: It is commonly known as tikur and East India arrowroot. The rhizome of the plant mostly contains carbohydrate. The extracted starch is consumed as arrowroot powder and holds medicinal usage.

Curcuma aromatica: is known for their high therapeutic potentials. It is also known as "kasturi-manjal" in south India. Despite the medicinal usage it also serves as bio-resource of anti-oxidants in food industry. ***Curcuma caesia:*** It is commonly known as kali haldi. In the traditional system of medicine, fresh and dried rhizomes are used.

Curcuma comosa: In Myanmar, *Curcuma comosa* is called Sa-nwin-ga, and local people use the rhizome of the plant as a traditional medicine.

Curcuma longa: It is known as "haldi" in hindi and Urdu, "kurkum" in arabic and "turmeric" worldwide. It have many utilizations for food, pharmaceutical industry, and animals. The rhizome of *C. longa* are known to be antiseptic. It has been widely used as a spice, food preservative and coloring material thus considered as golden spice.

Curcuma xanthorrhiza: It is used as anti venom for Indian cobra, also used as a tonic, and to treat digestive problems (Rajkumari and Sanatombi 2017).

Curcuma caesia: in the traditional system of medicine, both fresh and dried rhizomes are used in treating asthma, tumours, bruises, leucoderma, piles, bronchitis etc. *C. longa* - Turmeric traditionally involved in Ayurveda, Indian traditional medicine, and is classified as medicinal plant. Rhizome gernerally contains carbohydrates (69.4%), proteins (6.3%), fats (5.1%) and minerals (3.5%). Its paste is used in cleansing, disinfecting the skin. Turmeric having anti- inflammatory, anticholeratic, antimicrobial, insect repellent, antirheumatic, antifibrotic, as well as anti-cancerous properties (Li et al. 2011). Turmeric oil is used in aromatherapy. They are also used for the treatments of various ailments and metabolic disorders.

Curcuma manga: It is used traditionally as treatment of stomachache, wound healing, skin diseases, chest care and postpartum care (Abas et al. 2005). *C. xanthorrhiza* is widely udes as rheumatic medicine, for bruisesa and sprains, analgesics, aromatic stomachics, gonorrheal discharges and also as blood purifier (Elliot and Brimacombe 1987).

MEDICINAL VALUES

Genus *Curcuma* has a long history of traditional usage along with folk medicine. Many species of the genus possess a considerable amount of therapeutic potency by which numerous health disorders can be managed, including stomach ulcers, spleen, enlarged liver, hepatic disorders, skin diseases, chest pain, cough, diabetes, rheumatism, and blood purification. They are also considered as nutritionally rich foods because *Curcuma* plants are source of carbohydrates, proteins, starch, fats, minerals and vitamins. Rhizomes and other plant parts of *C. aeruginosa*, *C. caesia, C. angustifolia*, *C. phaeocaulis*, *C. leucorrhiza*, *C. mangga*, *C. longa*, and *C. purpurascens* have been established as a treatment for quite a lot of physiological disorders, such as dysentery, indigestion, stomach ulcer, gastrointestinal disorders, diabetes, enlarged liver and spleen, fever, boils, cough, scabies, body pain, chest pain, hepatic disorders, bruises, anorexia, rheumatism, dyspepsia, wound healing, sinusitis, bleeding, and infection (Kaliyadasa and Samarshinge 2019). Traditional medicinal systems like Ayurveda and Unani have given much importance to *Curcuma amada* (mango ginger) as an antipyretic, appetizer, aphrodisiac alexiteric, diuretic, and laxative and to cure problems like asthma, bronchitis itching, hiccough, skin diseases and inflammation due to injuries (Samant 2012). The juice of *Curcuma anguistifolia* is rubbed on swelling and the paste is used to hasten the joining of fractures, cooling, demulcent and nutritious. It is also used

for dysentery, dysuria and gonorrhoea. The rhizomes are used in fracture and swelling of bones (Sharma et al. 2019). *C. aromatica* is widely used as tonic, carminative, blood purifier, contaceptive purpose and also used against snakebite. It is widely used in Thai and Chinese traditional medicine for anti-tumor therapy, blood stasis, throat infections, and to promote wound healing (Sikha and Harini 2015). *C. comosa* is used in Thai traditional medicine to reduce the postpartum uterine pain. This plant also shows other biological properties such as insecticidal, anti- inflammatory, and inhibitory effects on cell proliferation. *Curcuma comosa* is used as traditional medicine for hypertension, diabetes mellitus and stomach ache (Suksamrarn et al. 1997). Species of Curcuma has been recognized and used worldwide in various forms due to its other multiple benefits. For example - in South Asian countries such as India, Srilanka and Nepal, turmeric is used in curries; in Thailand, it is used in cosmetics; in Japan, it is served in tea; in China, it is used as dye; in Malaysia, it is used as an antiseptic; in Korea, it is served in drinks; and in many places is used as preservative and coloring agent (Rahaman et al. 2021). Rhizomes of C. angustifolia, *C. leucorrhiza*, and *C. caulina* are good sources of carbohydrates hence they are used as nutritious food substitutes, and also as substitution for true arrowroot powder (Rajkumari and Sanatombi 2017). Rhizomes of C. *aeruginosa, C. amada, C. aromatica, C. longa, C. pierreana, C. pseudomontana, C. xanthorrhiza*, and *C. zedoaria* are often used as spices and natural dyes, as well as coloring and flavoring agents in culinary purposes, which is primarily due to their aromatic fragrance. Other than rhizome, tuberous roots, inflorescence, and rootstocks, are also good sources of carbohydrates and proteins and are used in cooking preparations and as food appetizers and vegetables (Rahaman et al. 2021). Paste of the rhizome is also widely used by many big companies in the form of cosmetics. Various phytochemical investigations of *Curcuma* species resulted in the identification and isolation of sesquiterpenoids and diarylheptanoids as major constituents and they also showed encouraging pharmacological activities including anti-inflammatory activity, anti-oxidant activities and cytotoxicity against cancerous cell (Rajkumari and Sanatombi 2017). Whereas Curcumin and its structural analogues are the medically most valuable compound for the genus. Phytochemical screening of the ethanolic extract of most of the species shows the presence of phenols, flavonoids, alkaloids, terpenoids, tannins and saponins. Almost 720 compounds, including 102 diphenylalkaloids, 529 terpenoids, 15 flavonoids, 19 phenylpropene derivatives, 7 steroids, 3 alkaloids and 44 other chemicals are isolated and identified from almost 32 species (Sun et al. 2017). The compounds identified by essential oil extraction of *C. aromatica* are germacrone, curdione, dehydrocurdione, furanodienone, zederone, curzerenone, curzeone, comosone II, gweicurculactone, curcumenol, isoprocurcumenol, zedoarondiol, vanillin, curcumin and β-sitosterol (Table 2).

Table 2: List of *Curcuma* spp. with their major bioactive compounds

Species Name	Major bioactive compound	Reference
C. aeruginosa	Aerugidiol, camphor, 1,8-cineole, Curcumenol, Curdione, Curzerenone, Dehydrocurdione, Difurocumenone, β-elemene, Isocurcumenol, β-pipene, Zedoalactone A, Zedoalactone B, Zedoarondiol	Masuda et al. 1991; Jirovetz et al. 2000; Kim et al. 2002; Mau et al. 2003; DNP, 2001; Bats et al. 1999; Takano et al. 1995
C. amada	Amadannulen, zederone, difurucumenonol, labdane diterpene dialdehyde, amadaldehyde, camphor, (Z)-β-farnesene, guaia-6-9-diene, α-longipinene, α-guaiene, curzerenone, myrcene, β-pipene, β-ocimene	Faiz et al. 2015; Policegourda et al. 2010; Policegourda et al. 2007a; Padalia et al. 2013; Singh et al. 2010; Mustafa et al. 2005
C. angustifolia	Curzerenone, Xanthorrhizol, Methyleugenol, Palmitic acid, Germacrone, Camphor, Isoborneol, Curdione, β-elemenone, γ-eudesmolacetate	Jena et al. 2017
C. aromatica	Bis-demethoxycurcumin, Curcumin, Curcumapentadecanol, Demethoxycurcumin,	Gupta et al. 1999; Singh et al. 2002; Jena et al. 1964;

	Acetoxyneocurdione, 13-acetoxydehydrocurdione, β-bisabolene, Bisabola-3,10-diene-2-one, Bisacumol, Borneol, β-3-carene, Carvacol, 1,8-cineole, Germacrone, Isoborneol, Caryophyllene oxide, Camphor, ar-turmerone, α-turmerone, Piperitenone, β-elemene, β-elemenone, Curzerenone, Curdione	Chai et al. 2012; Revathi and Malathy 2013; Angel et al. 2014; Kee et al. 2014; Pant et al. 2013
C. caesia	Borneol, Bornyl acetate, 1,8-cineole, Camphor, α-curcumene, γ-curcumene, β-elemene, (E)-β-ocimene, ar-turmerone, Germacrone,	Pandey and Chowdhury 2003; Behura and Srivastava 2004
C. comosa	(E)-5-Acetoxy-1,7-diphenyl-1-heptene, (E)-1,7-Diphenyl-1-hepten-5-one, (E)-1,7-Diphenyl-1-hepten-5-ol, (E)-1,7-Diphenyl-3-hydroxy-1-hepten-5-one, (E)-7-(3,4-Dihydroxyphenyl)-5-hydroxy-1-phenyl-1-heptene , (1E,3E)-1,7-Diphenyl-1,3-heptadien-5-ol, (E)-1,7-Diphenyl-1-hepten-5-one, (E)-5-Hydroxy-7-(4-hydroxyphenyl)-1-phenyl)- 1-heptene, Myrciaphenone A Phloracetophenone	Suksarman et al. 1997; Jurgens et al. 1994; Claeson et al. 1993; DNP 2001; Yoshikawa et al. 1998; Piyachaturawat et al. 2002
C. longa	Bisdemethoxycurcumin, Curcumin, Demethoxycurcumin, Dihydrocurcumin, Cyclocurcumin, Bisacurone, α-turmerone, β-turmerone, ar-turmerone, ar-curcumyl alcohol, coronadiene, cyclohexanecarboxylic acid methyl ester, isopulegol, 2-menthen-1-ol, octahydrocurcumin, β-sesquiphellandrene, β-curcumene, β-caryophyllene, α-curcumene, α-cedrene, isolongifolol	Park and Kim 2002; Bats et al. 1999; Bansal et al. 2002; He et al. 1998; Kaewkroek et al. 2012; Ragasa et al. 2005; Herebian et al. 2009; Kim et al. 2000; Abdel-Lateff et al. 2016 Hasan et al. 2016
C. mangga	Myrcene, β-pinene, caryophyllene oxide, caryophyllene, β-sitosterol, curcuminoids, 8,12-epoxygermacra-1, 2-methen-1-ol, copallic acid, isopulegol, zerumin A and B communic acid, coronadiene, octahydrocurcumin	Kamarezi et al. 2012; Wahab et al. 2012; Kaewkroek and Nair 2012; Mahek et al. 2011; Liu and Nair 2011
C. phaeocaulis	Curcumenol, isocurcumenol, α-spinasterol, curcumin, ar-tumerone, germacrone, curzerenone, phaeocaudione, phaeocaucone, procurcumenol, procurcumadiol, zedoarofuran, curcolonol, neolitacumone A, β-elemene, curcumol, neocurdione	Jang et al. 2016; Ma et al. 2015a; Ma et al. 2015b; Ma et al. 2015c; Oh et al. 2014; Chen and Lu 2006; Gan et al. 2015
C. pseudomontana	β-Elemenone, pseudocumenol, germacrone, 2-(4-methoxyphenyl) N, N-trimethyl-1-pyrrolamine, and (1,5 dimethyl-4-hexenyl)-4-methylbenzene	Muniyappan and Nagarajan 2014
C. xanthorrhiza	Xanthorrhizol, β-curcumene, ar-curcumene, camphor, γ-curcumene, (Z)-γ-bisabolene, (E)-β-farnesene, α-curcumene, ar-turmerone, β-atlantone, germacrone, β-curcumene, β-sesquiphellandrene, curzerenone, β-turmerone,	Jantan et al. 2012; Matsuura et al. 2007; Yamada et al. 2009; Park et al. 2015; Schmidt et al. 2015; Choi et al. 2005

	curcumin, mono-demethoxycurcumin, 3'-demethoxycyclocurcumin, furanodiene, furanodienone	
C. zedoaria	Epicurzerenenone, ar-curcumene, zingiberene, β-sesquiphellandrene, curzerene, germacrone, furanodiene, furanodienone, zederone, curzerenone, curzeone, dehydrocurdione, curcumenone, zedoaronediol, curcolone, procurcumenol, curcumin, 13-hydroxycurzerenone, oxocurzerenone	Angel et al. 2014; Makabe et al. 2006; Chen et al. 2016

Table 3: List of *Curcuma* spp. with their major pharmacological activity

Species Name	Major pharmacological activity	Reference
Curcuma aeruginosa	Anti-microbial	Kamazeri 2012
	Anti-inflammatory	Asih 2015
Curcuma amada	Anti-oxidant	Policegoudra et al. 2007
	Anti-inflammatory	Mujumdar et al. 2000
	Antitubercular	Singh et al. 2010
Curcuma angustifolia	Anti-ulcerogenic	Rajashekhara et al. 2014
Curcuma aromatica	Wound healing	Kumar et al. 2009
	Anti-cancer	Anoop 2015
		Jee et al. 1998
	Antioxidant	Jiang et al. 2005
		Al-Reza et al. 2010
	Larvicidal	Das et al. 1999
		Pitasawat et al. 2003
Curcuma caesia	Smooth muscle relaxant	Arulmozhi et al. 2006
	Scavenging/ antioxidant	Karmakar et al. 2011
Curcuma mangga	Antiallergic	Tewtrakul et al. 2007
	Analgesic	Ruangsang et al. 2010
	Anti-oxidant	Wan-Ibrahim et al. 2010
	Antiproliferative and antitumor	Liu et al. 2011

	Apoptotic and cytotoxicity	Hong et al. 2016
Curcuma longa	Anti-cancer	Kuttan et al. 1985
	Neuroprotective	De Alcantara et al. 2017
	Antidiabetic	Na et al. 2013
	Anti-inflammatory	Chandrasekaran et al. 2013
	Antimalarial	Odugbemi et al. 2006
	Anti-coagulant	Ammon et al.1991
		Srivastava et al. 1985
Curcuma phaecoulis	Anticoagulant and anti tumor	Chen et al. 2011
	Antifungal	Li et al. 2011
	Antiulcerogenic	Matsuura et al. 2007
Curcuma pseudomontana	Anti-microbial	Begam et al. 2014
	Antitubercular	Hiremath et al. 2013
	Anticancer	Bisht et al. 2014
Curcuma xanthorrhiza	Cytotoxicity activity	Nurcholis 2017
	Hepatoprotective activity	Devaraj et al. 2014
	Anti-inflammatory	Cho et al. 2017
Curcuma zedoaria	Anti-tumor	Lakshmi et al. 2011
	Anti-bacterial/ antimicrobial	Chachad et al. 2016
	Anti-amoebic	Raghuveer et al. 2004
	Anticancer	Carvalho et al. 2010
		Syu et al. 1998
	Hepatoprotective activity	Bugno et al. 2007
		Matsuda et al. 1998
	Antivenom	Daduang et al. 2005

BIOACTIVE COMPOUNDS AND PHARMACOLOGICAL VALUES

Curcumin being the most active compound of curcuminoids have several pharmacological properties and potential against diseases (Dosoky and William 2018). Curcuminoids (curcumin, demethoxycurcumin, and bisdemethoxycurcumin) are nontoxic polyphenolic derivatives of curcumin

that possess wide range of biological activities. Yellow colour of the rhizome is due to Curcumin (diferuloylmethane) which comprises of 94% curcumin I, 6% curcumin II and 0.3% curcumin III (Xiang et al. 2018). Curcumin shows the highest availability in *C. longa* (125mg/100g), whereas in other species availability of curcumin is comparatively such as 8mg/100g in *C. caesia*, 11mg/100g in *C. amada* and 15mg/100g in *C. leucorrhiza* (Dutta 2015). Rhizomes of *C. angustifolia* contains secondary metabolites such as alkaloids, curcumin, flavonoids, oils, terpenoids, phenols, glycosides tannins,steroids and saponins (Table 2). *Curcuma caesia* contains maximum curcuminoid, flavonoids, phenolics, different amino acids, protein and high alkaloid content as bioactive components. Phytochemical analysis of the rhizomes of *C. leucorrhiza* shows the presence of alkaloids, tannins, steroids, anthocyanins, terpenoids, triterpenoids, flavonoids, phenols, phlobatannins, and guaianolide sesquiterpene lactone. Many steroids, tannins, alkaloids, and flavonoid compounds are found in the rhizomes of *C. pseudomontana* (Dutta 2015). Bioactive sesquiterpenes compounds such as germacrone, zederone, dehydrocurdione, curcumenol, zedoarondiol, and isocurcumenol along with β-pinene or other sesquiterpene lactones are present in *C. aeruginosa* (Bats et al. 1999). Rhizome extract and phytochemical analysis of rhizome of *C. phaeocaulis* shows the presence of guaiane-type sesquiterpenes, germacrane-type sesquiterpenoid, salvialane-type sesquiterpene, γ-elemene-type sesquiterpenes, eudesmane-type sesquiterpene, cyclic diarylheptanoid, and cadinane-type sesquiterpenes (Jang et al. 2016). *C. xanthorrhiza* contains xanthorrhizol (a natural sesquiterpenoid), curcumin analogues including 1-(4-hydroxyl-3,5-dimethoxyphenyl)-7-(4-hydroxy-3-methoxyphenyl)-(1E, 6E)-1 and 6-heptadiene-3,4-dione (Schmidt et al. 2015).Several medical properties have been ascribed to many species of *Curcuma* genus. Rhizome being the most used part of the plant, is known to have therapeutic compunds and are used by medical practitioners. Bio-active compounds of *Curcuma* species possesses a wide range of pharmacological properties, including anti-inflammatory, anti-cancerous, anti-microbial, anti-proliferative, anti-hepatotoxic, hypocholesterolemic, anti-diarrheal, anti-diabetic, and insecticidal activities (Table 3). Curcuma essential oils are also known to enhance immune function, aid blood circulation, amplify toxin elimination, and stimulate digestion (Raut and Karuppayil 2014).

Antioxidant activity

Curcumin has the ability to improve systemic markers of oxidative stress (Sahebkar et al. 2015). It can increase activities of antioxidants such as superoxide dismutase (SOD) (Panahi et al. 2016a). Curcumins can scavenge different forms of free radicals, such as reactive oxygen (ROS) and nitrogen species (RNS) (Menon and Sudheer 2007) and also can inhibit ROS generating enzymes such as lipoxygenase,etc. (Lin et al. 2007). Moreover, curcumin is a structured scavenger of peroxyl radicals like vitamin E. Hence, it is also considered as a chain-breaking antioxidant (Priyadarsini et al. 2003). The antioxidant mechanism of curcumin is ascribed to its unique conjugated structure, which includes two methoxylated phenols and an enol form of β-diketone (Fagodia et al. 2017). The rhizome extract of *C. aromatica* were found to be effective antioxidant agents which are the sesquiterpenoids present in the volatile oil (Jiang et al. 2005). The methanol extract of essential oil from the leaves of *C. aromatica* showed superoxide radical scavenging activity (Al-Rheza et al. 2010).

Anti-inflammatory activity

Curcumin has been shown to inhibit a number of different molecules involved in inflammation including phospholipase, lipooxygenase, leukotrienes, thromboxane, prostaglandins, nitric oxide, collagenase, elastase and hyaluronidase (Chainani 2003). Studies shows bisdemethylcurcumin (BDC) has more potential as an anti- inflammatory, anti-proliferative agent and in inducing ROS. Like *C. longa* Roxb., the *Curcuma xanthorrhiza* Roxb. rhizome is also the most important part that exerts anti-inflammatory effects and xanthorrhizol is the common component identified from the extracts. Different extracts and their derivaties of *C. zedoria* shows distinct anti- inflammatory actions. The rhizome of *Curcuma amada* Roxb. shows anti-inflammatory activity in cases of acute and chronic administration in albino rats (Naik et al. 2000).

Antibacterial activity

Curcumin and the EO extracted from *Curcuma* species can put down the growth of various bacteria like *Staphylococcus*, *Streptococcus*, *Lactobacillus*, etc (Bhavani and Sreenivasa 1979). The aqueous extract

of *Curcuma longa* rhizomes shows antibacterial effects (Kumar et al. 2001). Curcumin also suppresses growth of *Helicobacter pylori* CagA+ strains in vitro (Mahady et al. 2002). *C. aromatica* and *C. xanthorrhiza* shows high antibacterial activity against some gram-negative bacteria which are pathogenic to human being (Anjusha and Gangaprasad 2014).

Antiviral activity

Curcumin acts as an inhibitor of Epstein–Barr virus key activator BamH fragment Z left frame 1 (BZLF1) protein transcription in Raji DR-LUC cells (Taher et al. 2003). Curcumin in the course of inhibitory activity against the enzyme called inosine monophosphate dehydrogenase (IMPDH) is considered as an effective antiviral compound (Dairaku et al. 2010). According to the Li et al. 1993, curcumin to be an effective compound to inhibit the HIV-1 LTR-directed gene expression without any major effects on cell viability. Moreover, curcumin reserved the acetylation of Tat protein of HIV significantly by p300 related with invasion of HIV-1 multiplication (Balasubramanyam et al. 2004).

Antifungal activity

Prevention of fungal growth may depend on concentration of curcumin present in the plant part. Dried powder of Curcuma rhizome addition in tissue culture shows considerable repressing activity against fungal infections (Ungphaiboon et al. 2005). The methanolic extract of *C. longa* showed antifungal activity against *Candida albicans* and *Cryptococcus neoformans* (Kim et al. 2003). Rhizome extract of C. *longa* shows antifungal effect against *Phytophthora infestans, Rhizoctonia solani*, and *Erysiphe graminis* (Chowdhury et al. 2008). Curcumin oil also shows antifungal effect against *Fusarium solani* and *Helmintho sporium* (Prucksunand et al. 2001). Curcumin shows more dominant effect against *Paracoccidioides brasiliensis* as compared to fluconazole but it did not show any activity to growth of *Aspergillus* species (Martins et al. 2009).

Antiprotozoan activity

It has been reported that the ethanol extract from rhizomes of some of the *Curcuma spp.* possesses anti-*Entamoeba histolytica* activity and anti- *Leishmania* activity in vitro (Koide et al. 2002). Various synthetic derivatives of curcumin show anti- *Plasmodium falciparum* effects (Rasmussen et al. 2000).

Anti-cancer activity

Curcumin possesses anti-cancerous activities by effecting on various biological pathways involved in mutagenesis, oncogene expression, tumorigenesis, metastasis, and apoptosis. It also shows anti-proliferative effect in multiple cancers, and acts as an inhibitor of the transcription factor nuclear factor-B and downstream gene products. Curcumin, an antioxidant extracted from *C. aromatica*, has been broadly studied and showed anticarcinogenic properties in a vivid range of cell lines (Jee et al. 1998). In a study, crude ethanolic extract of *C. zedoaria* rhizome exhibited an inhibitory effect against OVCAR-3 cells (human ovarian cancer) (Anuchapreeda et al. 2002).

Anti-tumour activity

Germacrone from *Curcuma aromatica* induces cell cycle arrest and promotes apoptosis. It also might be a potent chemo preventive drug for gliomas as it regulates the expression of proteins related with apoptosis (Liu et al. 2014).

Antitubercular activity

According to Singh et al. 2010 labdane diterpene dialdehyde was firstly isolated from chloroform extraction of rhizomes of C. *amada* and the compound indicates antitubercular activity against *Mycobacterium tuberculosis* H37Rv strain.

Antidiabetic activity

Galactose-induced cataract formation can be prevented by curcumin (Suryanarayana et al. 2003). Blood sugar level in alloxan-induced diabetes in rat is reduced by curcumin (Arun and Nalini 2002). Advanced glycation products which induce complications in diabetes mellitus also can be decreased by curcumin (Nwozo et al. 2014). Ethanolic extract from the rhizome containing both curcuminoids and sesquiterpenoids is more powerfully hypoglycemic (Nishiyama et al. 2005).

Hepatoprotective activity

The hepatoprotective effects of curcumin might be because of antioxidant activity and free radical scavenging mechanisms. In the case of hepatoprotective activity, *C. xanthorrhiza* hexane extract exhibited prominent improvement in terms of a biochemical liver function, antioxidative liver enzymes, and lipid peroxidation activity (Devaraj et al. 2014). The ethanolic extract of *Curcuma Longa* rhizomes shows notable hepatoprotective effect when orally administrated. The main constituents of *C. longa* rhizome ethanolic extract are the flavonoid curcumin, several volatile oils and other flavonoids such as atlantone, tumerone, and zingiberene (Salama et al. 2013). Hepatoprotective volatile oils (mainly sesquiterpenes) were isolated from the aqueous acetone extract from rhizome of *C. zedoaria* (Kanase and Khan 2018).

Wound healing activity

The powdered rhizome of *C. aromatica* exhibits wound healing activity in rabbits. Studies also shows notable wound healing activity in excision wound models, which was done to investigate the wound healing property of *C. aromatica* rhizome extracts (Kumar et al. 2009).

Anticoagulant activity

Components like p-hydroxycinnamoyl(feruloyl) methane, 5-dione (curcumin), 1, 7- Bis(4-hydroxy-3-methoxyphenyl)-1,6-3, and p,p'-dihydroxydicinna-moylmethane were found to be the principle compound of *C. longa* with anticoagulative activity (Ammon and Wahl 1991). Srivastava et al. 1985 stated that curcumin represses collagen and adrenaline-induces of platelet accumulation in in-vitro as well as in in-vivo conditions.

Insecticidal effect

Through studies it has been found that the volatile compound ar-turmerone of *Curcuma* spp. can be used as low-cost biological insecticide for integrated management in vegetable production of cabbage looper (Abbott 1925). The rhizome extract of *Curcuma longa* has mortality action against *Tribolium castaneum* (red flour bettle) adults (Talukder and Howse 1993). *Reticulitermes flavipes* (termite) when exposed to various solvent extracts of turmeric to examine any potential insecticidal properties showed that termiticidal components of turmeric are extractable as a mixture of compounds mainly ar-turmerone, turmerone, and curlone (Alshehry et al. 2014). Turmeric is also toxic to *Sitophilus zeamais* (maize weevil) and *Spodoptera frugiperda* (fall armyworm). Essential oil extracts from *C. longa* leaf are also toxic against *Sitophilus oryzae* and *Rhyzopertha dominica* (Tavaresa et al. 2013).

CONCLUSION & FUTURE ASPECTS

Genus *Curcuma* is among one of the promising medicinal plants with several pharmacological impact as well as other uses. This review paper gives an overview on the potential of different *Curcuma* spp. concerning their traditional medicinal value and also biological acivity. Although there are numerous *Curcuma* species, phytochemicals constituents and their pharmacological activities have been looked into only for few commonly used species. Various studies illustrated that these *Curcuma* spp possess antioxidant, antimicrobial, anti-inflammatory, antitumor, antitubecular, wound healing activity, anticancer, anticoagulant, hepatoprotective and insecticidal effect. Further research on pharmacological studies of unexamined phytochemicals and novel constituents will provide vast opportunities for the growth of pharmaceutical products and new plant-based food resources. This review article concluded that the *Curcuma* species have great ability in inventive research in future and will be called as one of the most useful medicinal plants. This review provides a detail account of the species and may help in future for more studies on the species concerned.

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