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Original Article

Investigation of Medicinal Plants Used to Treat Malaria by the Ethnic People of Purulia District, West Bengal, India

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ABSTRACT

Background: One of the most prevalent serious medical issues worldwide is Malaria. It is caused by different *Plasmodium* sp. and can infect people by the bite of a female *Anopheles* sp. mosquito. It is important to explore for alternative drug of the Malaria treatment, particularly those made from plants, because the majority of endemic areas have *Plasmodium* resistance to the malarial drugs used today. Purulia is the western district of West Bengal. It lies between 22°60′ and 23°50′ north latitude and 85°76′ and 86°65′ east latitude. Almost eleven ethnic groups (Bhumij, Birhor, Gond, Kharia, Kharwar, Kurmi, Lodha, Malpaharya, Munda Oraon, Santal) present in this district. **Objectives:** This study main aims to record medicinal plants used to treat Malaria by the ethnic people of Purulia district, West Bengal, India. **Materials and Methods:** Semi-structured questionnaires, interviews with traditional ethnic people and focused group discussions were used to gather ethnobotanical data of antimalarial plants. **Results:** The 41 ethnomedicinal plants utilized by the local herbal healers to treat Malaria in the Purulia district of West Bengal, India and belonging to 25 families were documented. **Conclusion:** Traditional healers are the main source of knowledge on medicinal plants. This knowledge has been transmitted orally from one generation to the next generation. The present documentation is a preliminary attempt to pave the path for developing a digitized database in the future.

Keywords: Ethno-medicinal plants, Traditional healers, Malaria, Purulia.

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INTRODUCTION

One of the most prevalent serious health issues in sub-Saharan Africa, South America and South-East Asia including India is Malaria. It is a serious illness that kills millions of children, pregnant women and adults every year.[1] It is caused by different *Plasmodium* species and spreads to human by the bite of female *Anopheles* species mosquitoes, called "malaria vectors".[2] *Plasmodium ovale, Plasmodium vivax, Plasmodium malariae, Plasmodium falciparum* and *Plasmodium knowlesi* are the causative agents. *P. falciparum, P. ovale, P. vivax* and *P. malariae* are the four parasite species that cause Malaria in humans. Clinically, *P. falciparum* and *P. vivax* are the two most prevalent species, although *P. falciparum* is the deadliest and causes the most lethal side effects including cerebral malaria.[3] The clinical signs of malaria can range from an acute febrile illness with fever, headache, chills and vomiting to fatal sequelae such severe anaemia, respiratory difficulty related to metabolic acidosis or cerebral malaria that can ultimately result in death.[2] Malaria is still one of the top global health challenges largely children in Africa.[4] According to the World Health Organization, malaria affects nearly 2 billion people in more than 100 countries and an estimated 4,45,000 people died from malaria in 2017 and the problem is particularly severe on the African continent due to the chronic poverty and restricted access to healthcare facilities there.[5] There have been reports of child mortality in Africa and malaria infections have been linked to one-tenth of pregnancy-related deaths.[2-6] Because of pathogenic drug resistance, vector control measures and human migration, it had an impact on the morbidity and mortality rate. According to the most recent estimates from the WHO, there are 300-500 million new clinical cases worldwide each year and 1 million people die from malaria.[4] The strategies of malaria treatment are to treat the clinical symptoms, to end the acute blood infection, to remove hypnozoites from the liver to avoid relapses in the future, and to stop the spread of infection.[7]

The main therapeutic option for malaria at this time is Artemisinin-based Combination Therapy (ACT), as quinolines (quinine, chloroquine, and mefloquine) have been known to cause cardiotoxicity and the parasites have already evolved strong resistance to them.[8,9] Sadly, several sources have also claimed

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that *P. falciparum* is resistant to artemisinin.[2] The major issue with this treatment is the development of medication resistance, which frequently results in treatment failure. Therefore, it is very essential to explore for more effective anti-malarial drugs which can be derived from medicinal plants.

Plants have been used as a vital component of traditional indigenous treatment methods since the beginning of time.[10] The tribal people inhabit very distant locations from urban area without hospitals. They are entirely reliant on the healers or local ethnic people in their area. Local herbal practitioners or healers use medicinal plants for the general public at very cheap cost.[11] In India, there are more than 5.3 crore tribal people who belong to 550 tribal communities under 227 linguistic groups. They recurrently use the various parts of plant of their local areas to treat and prevent various diseases in both themselves and domesticated animals. According to the WHO, traditional medicine is used by 80% of the world's population and has been proven to be both safe and effective.[12] In developing countries, a large number of people live in extreme poverty and some of them are suffering from various illnesses and even dying because they lack access to proper medicine. India has 45,000 different plant species, of which 15,000 are blooming plants and 7,000 have been identified as medicinal plants.[13,14] In West Bengal, Purulia district is a reliable source of medicinal plants used as folk remedies. Traditional knowledge and folklore are presently diminishing as a result of the destruction of forest areas and the removal of tribal inhabitants brought about by industrialization. Therefore, it is very necessary to thoroughly document the traditional knowledge that is presently available for proper application and scientific research.

Study Area

For the current study, data were gathered randomly from various villages in the Purulia district. It is situated in the westernmost of West Bengal, India (Figure 1). This region has a 6259 km^2 area and is located between 22º6′ and 23º5′ N latitude and 85º7′ and 86º6′ E longitudes. The Purulia district has a subtropical climate with deciduous forests and a wealthy population of Palash, Sal, Mahul etc. The temperature can reach 52°C during the summer season and there is an average annual rainfall of 1300 mm. It is located on the Plateau of Chotonagpur which has an undulating landscape and lateritic soil. According to census (2011), 18.45% among the total tribal population are resides in Purulia district. The tribal communities in this district are mainly Santal, Sardar, Lohara, Shikari, Bhumij, Lodha, Shabar, Mahali and Munda. Tribal people live in forested areas and rely on forest resources for their survival. The indigenous people's cultural and religious practises include using traditional treatments. Rural tribal communities prepare medicine from various part of plant.[15] The tribal people of this study area have rich patrimony related to plant utility.

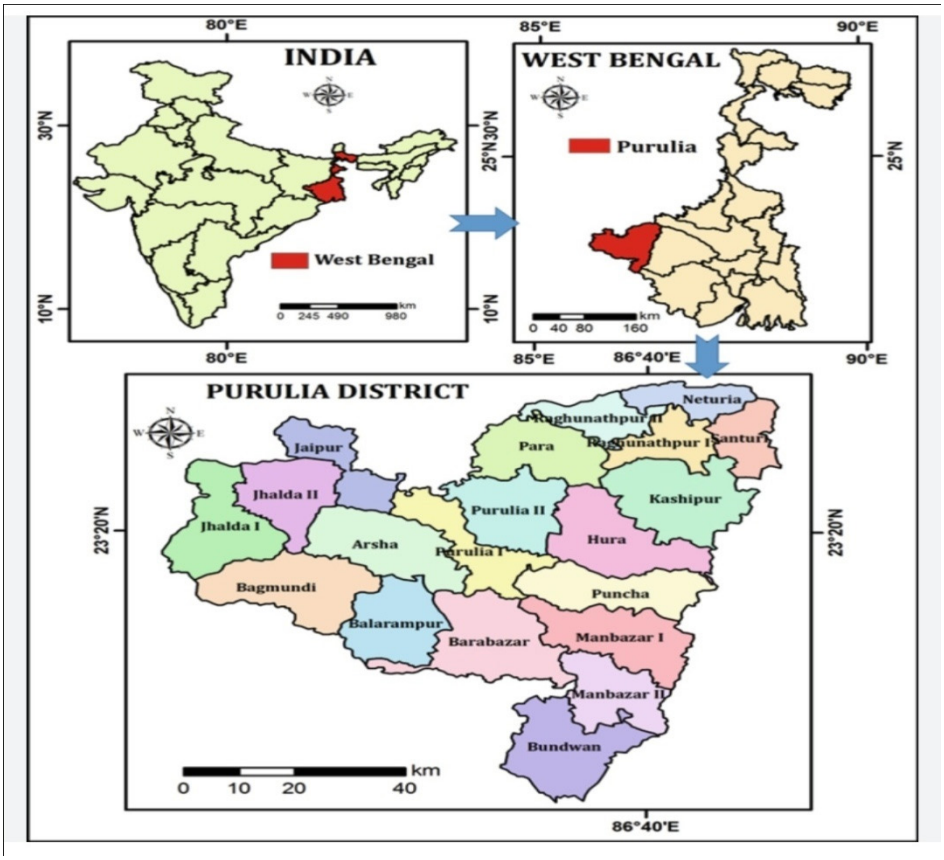

Figure 1: Map of study area.

MATERIALS AND METHODS

Data Collection

For the present investigation, the field survey was carried out from 22 field sessions based on ethnobiological explorations from 2021 to 2022. The main emphasis was given to the remote places of the district. During the field survey, detailed ethnobotanical information on wild plants was recorded after careful discussion by interviewing several tribal persons; especially older men and women who were alive at times when their culture was subjected to fewer imputes from contemporary society. Interviews were open-ended and conducted with the help of a semi-structured questionnaire. The questionnaires were used to obtain information on medicinal plants with their local names, parts used, a common method of preparation etc. Informants were asked to come to the field and show the plants they commonly used as medicine against malaria.[16,17] Herbarium specimens of these medicinal plants mostly in their flowering stage were collected for future reference. The obtained data were recorded in note book. The medicinal plant specimens were identified with the help of authentic herbarium specimens of Botanical survey of India, taxonomist, books, floras and revisions.[18-21] and preserved, recorded and documented in the herbarium of our colleges.

The collected data was analyzed with their Use Value (UV). The UV was calculated using the formula: UV=(ΣU/n), where UV is the use value of a particular species, 'U' is the total number of use reports among the informers, and 'n' represents the total number of informants interviewed for a given plant.[22] Values vary from approximately 1 to 0. High UV indicates that a certain plant has a lot of use reports and is considered more important for treatment.

RESULTS

Demographic features of informants

68 informants (82.4% males and 17.6% females) aged between 20 to more than 60 years were interviewed. Only a small percentage of the ethnic peoples had secondary and university education and the majority only had elementary school. Some ethnic people had no formal education at all. 22% of respondents were older than 60 and 64.7% of them were between the ages of 40 and 60. Just 13.2% of them are between the ages of 20 and 40 and none of them are younger than 20. There was variation in the healers' treatment patterns. While 19.1% only occasionally used their ethnobotanical expertise, nearly 80.9% did so regularly. The healers received their traditional knowledge from both sources (13.2%), from family members (69.1%) and through training (17.6%) (Figure 2). Their main source of medicinal plants was the forest. The primary source of income for their family was agriculture. The farmers who served as healers used both mono and poly-herbal compositions to prepare medicine to their patients.

Ethnomedicinal plant diversity and uses reported by the Informants

Anti-malarial plants were enlisted with scientific names, followed by local name, family, habit, plant part (s) used and common method of preparation (Table 1). The highest number of anti-malarial plants were recorded in four families viz. Verbenaceae (4 species), Myrtaceae (3 species), Lamiaceae (3 species), Fabaceae (3 species).

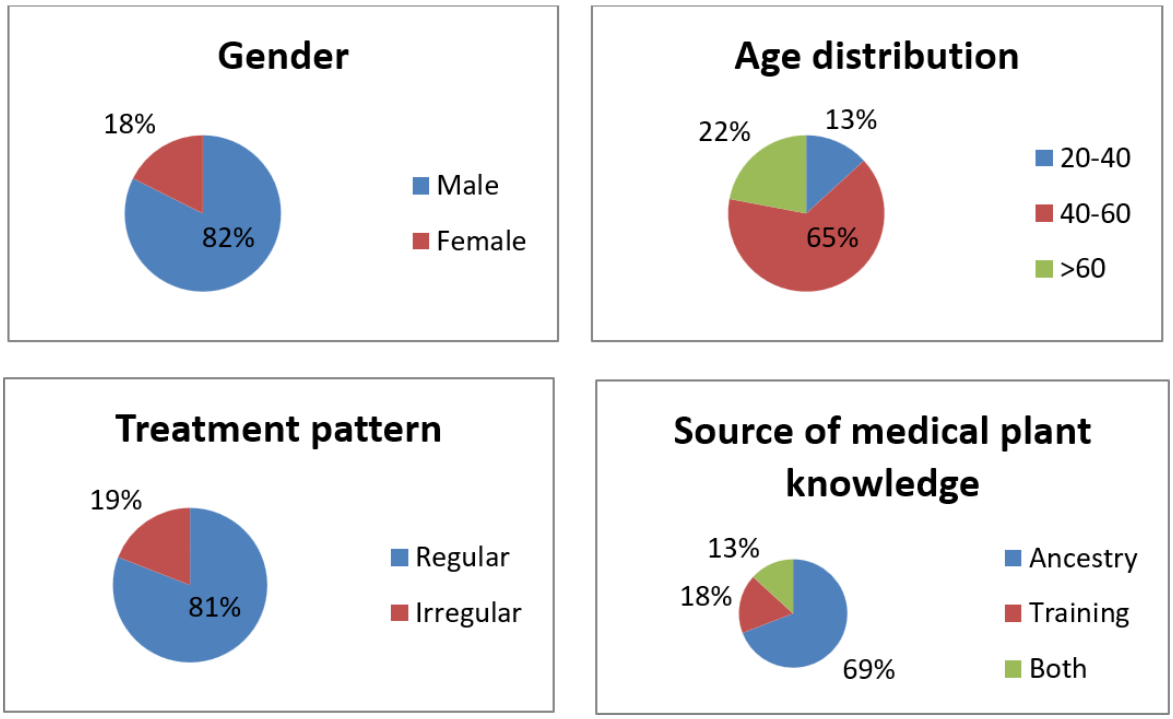

Figure 2: Demographic profile of informants.

Table 1: Medicinal Plants used by various ethnic people of Purulia for Treatment of Malaria and Accompanying Symptoms.

Sl. No.	Scientific Name	Common Name in Bengali	Family	Habit	Parts used	Common method of preparation	Use Value
1	*Acmella caulirhiza* Del.	Ushni shak	Asteraceae	Shrub	Aerial parts	Decoction	0.29
2	*Aleo vera* L. ex Webb.	Gritakumari	Liliaceae	Herb	Leaves	Infusion	0.62
3	*Allium sativum* L.	Rasun	Liliaceae	Herb	Dry fruits	Infusion	0.74
4	*Alstonia scholaris* (L.) R. Br.	Chatim	Apocynacece	Tree	Leaves and bark	Decoction, Infusion	0.89
5	*Amaranthus spinosus* L.	Kanta note	Amaranthaceae	Herb	Roots	Infusion	0.22
6	*Anacardium occidentale* L.	Kajubadam	Anacardiaceae	Tree	Leaves and bark	Decoction	0.25
7	*Andrographis paniculata* (Burm.f.) Nees	Kalmegh	Acanthaceae	Herb	Whole plant	Decoction	0.74
8	*Aristolochia indica* L.	Ishwarmul	Aristolochiaceae	Creeper	Leaves and Bark	Decoction, Infusion	0.10
9	*Azadirachta indica* A. Juss.	Neem	Meliaceae	Tree	Root, stem, bark and leaves	Decoction, Infusion	0.76
10	*Cajanus cajan* Millsp.	Raher	Fabaceae	Shrub	Leaves	Decoction	0.86
11	*Carica papaya* L.	Pipa	Caricaceae	Shrub	Leaves and fruits	Infusion	0.62
12	*Cleome gynandra* L.	HurHuria	Cleomaceae	Herb	Leaves and roots	Decoction	0.15
13	*Clerodendrum viscosum* Vent.	Ghetu	Verbenaceae	Herb	Leaves	Decoction	0.91
14	*Commelina forskaolii* Vah	Kana shak	Commelinaceae	Herb	Leaves	Decoction	0.32
15	*Cymbopogon citrates* (DC.) Stapf	Lemon ghas	Poaceae	Herb	Leaves	Decoction	0.37
16	*Cyperus articulatus* L.	Mutha ghas	Cyperaceae	Herb	Tuber	Decoction	0.28
17	*Dioscorea bulbifera* L.	Gethu aalu	Dioscoreaceae	Creeper	Leaves	Decoction	0.22
18	*Eucalyptus globules* Labill.	Eucalyptus	Myrtaceae	Tree	Leaves	Decoction	0.35
19	*Flacourtia indica* (Burm.f.)Merr.	Bunj	Salicaceae	Shrub	Roots	Decoction, Infusion	0.13
20	*Hedyotis corymbosa* L.	Khet papri	Rubiaceae	Herb	Whole plant	Decoction	0.85

Sl. No.	Scientific Name	Common Name in Bengali	Family	Habit	Parts used	Common method of preparation	Use Value
21	*Holarrhena pubescens* (Buch.-Ham.) Wallich ex Don	Kurchi	Apocynaceae	Tree	Bark	Decoction, Infusion	0.35
22	*Jatropha gossypifolia* L.	Verenda	Euphorbiaceae	Shrub	Seed	Infusion	0.18
23	*Lantana camara* L.	Kutus	Verbenaceae	Shrub	Leaves	Decoction	0.65
24	*Leucas calostachys* Oliv	Dandakalas	Lamiaceae	Shrub	Leaves and roots	Decoction	0.73
25	*Leucas martinicensis* (Jacq.) Ait.f.	Dhrub	Lamiaceae	Herb	Leaf	Decoction	0.76
26	*Mangifera indica* L.	Aam	Anacardiaceae	Tree	Leaves and bark	Decoction, Infusion	0.47
27	*Martynia annua* L.	Baghnakhi	Martyniaceae	Herb	Seed	Infusion	0.88
28	*Momordica charantia* L.	Kalla	Cucurbitaceae	Creeper	Leaves	Decoction	0.54
29	*Nyctanthes arbor-tristis* L.	Shiuli	Oleaceae	Tree	Leaves	Decoction	0.16
30	*Ocimum sanctum* Linn.	Tulsi	Lamiaceae	Herb	Leaves	Decoction	0.56
31	*Psidium gujava* L.	Aajir	Myrtaceae	Tree	Leaves and bark	Decoction	0.20
32	*Rauwolfia serpentina* Benth. Ex Kurz.	Sarpagandha	Apocynaceae	Shrub	Root bark	Infusion	0.91
33	*Ricinus communis* L.	Castor bean	Euphorbiaceae	Shrub	Roots and leaves	Decoction, Infusion	0.19
34	*Rottboellia exaltata* L.f.	Malanda	Poaceae	Herb	Aerial part	Decoction	0.13
35	*Scoparia dulcis* L.	Ban dhone	Scrophulariaceae	Herb	Leaves	Decoction	0.88
36	*Solanum aculeastrum* Dunal.	Gatbegun	Solanaceae	Shrub	Fruit	Infusion	0.38
37	*Solanum incanum* L.	Kantabegun	Solanaceae	Herb	Fruit	Infusion	0.41
38	*Tamarindus indica* L.	Tatul	Fabaceae	Tree	Roots and Leaves	Decoction, Infusion	0.57
39	*Tridax procumbens* L.	Tridhara	Asteraceae	Herb	Whole plant	Decoction, Infusion	0.26
40	*Vachellia nilotica* (L.) P.J.H. Hurter & Mabb.	Babla	Fabaceae	Tree	Leaves	Decoction	0.12
41	*Zingiber officinale* Roscoe	Aada	Zingiberaceae	Herb	Rhizome	Chewed	0.28

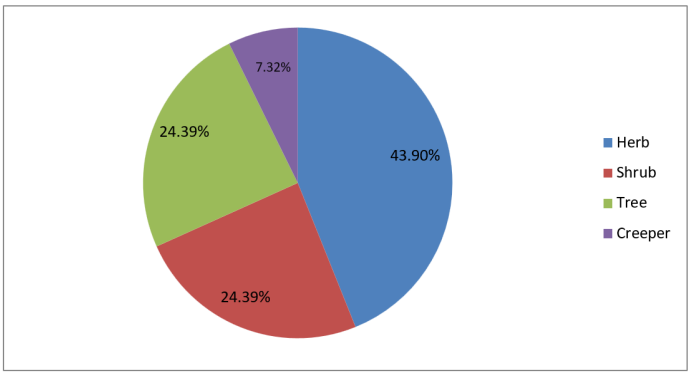

Figure 3: Percentage of habit types of total studied plant specimens used to treat Malaria.

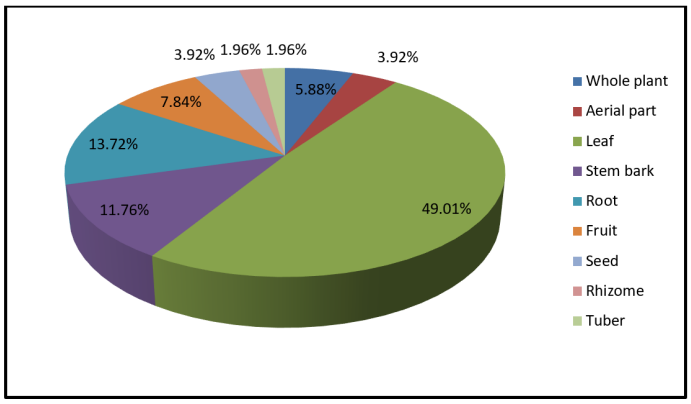

Figure 4: Percentage of plant parts used for medication.

The distribution of plant habit types, plant part (s) used and method of preparations are illustrated in Figures 2-4 respectively. Out of 41 species, 43.90% herbaceous plants are mostly used for medication followed by 24.39% trees, 24.39% shrubs and 7.32% creeper (Figure 3). Leaves (49.01%) were found to be the most favored plant parts followed by roots (13.72%), whole plant (5.88%) and stem barks (11.76%) (Figure 4).

DISCUSSION

Nature has gifted India with a lot of herbal medicines, which indigenous people acquire, preserve, and pass on to the next generation. The use of herbal medicines is widespread in this region with a higher percentage of the tribal as well as nontribal population relying on it. This is because of a lack of awareness and lack of modern medical facilities available in their region and also the high cost of modern medical systems for treatment are unaffordable by tribal people.[23,24] Medicinal plants have always been considered a healthy source of life for people. The therapeutical properties of medicinal plants are very useful in healing various diseases. A remarkably high diversity of ethno-medicinal plant species was documented to treat malaria from the study area.

CONCLUSION

The traditional healers are the main source of knowledge on medicinal plants. This knowledge has been transmitted orally from one generation to the next generation; however, it seems that it is vanishing from modern society since younger people are not interested to carry on this tradition. Religious and cultural faith, poor economy and lack of modern medicinal facilities in the villages of the study area seem to be the cause of utilization of those plants. Isolation of active compounds, phytochemicals and pharmacological investigation are desired to validate the claims of the traditional healers. Greater efforts are required to document traditional knowledge of the local people to prepare a comprehensive account of it, which will open new vistas in plant research, which are much safer, less costly and eco-friendly.

This classical knowledge, inherited by these local tribal healers from their ancestors is rapidly vanishing due to the degradation of forest covers, uprooting of tribal population due to fast urbanization, industrialization and above all indifferent attitude of the younger generation, although still maintaining the skeletal structure of primary healthcare system of Purulia district. Therefore, the present documentation is a preliminary attempt to pave the path for developing a digitized database in the future. Proper planning and management is the need of the age for sustainable exploitation and conservation.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

mm: Millimeter; **Km:** Kilometer; **◦:** Degree; **min:** Minutes; **UV:** Use Value; **%:** Percent; **L.:** Carl Linnaeus.

SUMMARY

Plants in the traditional Indian systems of medicine were used for a variety of alleviations or sufferings of mankind from the olden days. Complicating the matter of identifying all such medicinal plants is that there are no readily available sources of information which are found scattered throughout the world in classical old literature and books on medical botany. In ethnomedico-botanical survey reports for specific geographic regions and or for different ethnic groups, such secrets locked in the minds of indigenous peoples; traditional healers etc., are less likely to be discovered. Therefore, it is very necessary to

thoroughly document the traditional knowledge that is presently available for proper application and scientific research.

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