

Exploration and documentation of ethnobotanicals used by traditional healers from Purulia district of West Bengal, India

Tulika Bhattacharjee¹, Ghanashyam Mahato^{2*}, Nilanjana Banerjee³

¹Centre for Life Science, Vidyasagar University, Midnapore, India.

²Department of Botany, A.M. College, Jhalda, India.

³Department of Botany, Vidyasagar University, Midnapore, India.

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ABSTRACT

Traditional healers of the Purulia district use their traditional knowledge in ethnomedicine for the treatment of several human ailments. The main objective of this investigation is to gather information on medicinal plants used to treat various ailments by local inhabitants of the Purulia district and document them in digitized form. All the information such as various doses, methods of formulations, and modes of administration were recorded along with the local name, family, plant parts used, and short profile of information the basis of semi semi-structured questionnaire and focus group discussions. A total of 51 herbal plants under 34 families are used by the informants either as a mono herbal drug or polyherbal drug to treat various ailments. The most commonly used plant part is the leaf followed by the root, whole plant, flower, fruit, bark, bulb, latex, stem, and rhizome. These plant parts are used to treat dermatological problems, general health problems, abdominal problems, and ear, nose, throat problems. Ethnobotanical data was analyzed using appropriate statistical methods such as use value and fidelity level. Hence, this could be summarized that collected ethnobotanical information on therapeutic plants of the Purulia district was documented in digitalized form for knowledge preservation for further studies on them as well as by pharmaceutical industries.

INTRODUCTION

Plants possess medicinal properties due to the presence of diverse bioactive compounds. Since antiquity, several reports have been published on medicinal plants in drug discovery [1]. Medicinal plants are considered as primary health care system for the rural population in many countries till now [2]. Utilizing plants for medication is less detrimental and also less expensive [1]. To reduce human suffering, herbs have played an important role in traditional and also in the new generation [3]. Primeval ethno pharmacology has been contemplated as a major tool in the new drug discovery. Herbal medicines are a favored form of complementary and substitute medicine practiced worldwide to treat various types

of disorders [4]. Indigenous use of botanicals takes part in a crucial role in human and livestock wellness in a wider part of the world notably in impoverished and developing countries [3]. Crude herbal compositions with or without additives are described to have an outstanding therapeutic value [3]. As reported by Sofowora [5] about 60%–85% of the inhabitants in the countries of the developing world have to depend on traditional medicine [5]. The application of traditional medicine is extensive in India, Korea, Japan, Sri Lanka, Thailand, Pakistan, and China [6,4].

India is rich in medicinal plants. From the ancient period plants were used to cure various diseases in different districts in India [7]. Ethnomedicinal plants are also used widely in Ayurvedic treatment [8].

Almost 25% of modern medicines are obtained from nature, some of which were extracted from traditional uses [9]. Humans depend greatly on plants and their products for food, shed, clothing, and also for their benefaction to support the ecosystem [10]. The tribal people live in or near the forest

*Corresponding Author

Ghanashyam Mahato, Department of Botany, A.M.College, Jhalda, India.

E-mail: ghana.mahato@gmail.com

area so they collect the plants easily and make use of them for treatment of diseases caused by some infectious pathogens [11]. The healers of particular tribal regions use different parts of plants and make a paste with the help of different natural ingredients and apply them on the patients' wounded areas or instruct them to take the medicines orally for a certain period [12].

The tribal people of the Purulia district follow the traditional ethnomedicinal practices for the treatment of many diseases. The medicine men collect the necessary plant materials from the forest according to the diseases and make medicine from them and give them to the sick persons [2]. The documentation of traditional knowledge of ethnobotanicals in the study area provides a scientific database for the validation and preservation of traditional knowledge [13]. It also opens up opportunities for future research and development of new plant-based medicines [3]. The conservation and sustainable use of ethnobotanicals can contribute to the socio-economic development of local communities as well as ensure the availability of these plants for future generations [13]. This study will contribute to the documentation of traditional knowledge on medicinal plants in the Purulia district of West Bengal, India.

MATERIALS AND METHODS

Study area

Purulia is situated in the westward of West Bengal in India (Figure 1). It has a latitude and longitude of 22°C6' to 23°C5' N and 85°C7' to 86°C6' E, respectively. Geographically,

Purulia covers 6,259 km² area [13]. In summer the average temperature of this area is 40°C and in winter the average temperature is 10°C [2]. Here, the rainfall ranges between 1,100 and 1,500 mm yearly [13]. The flora of the district is comprised of several species of medicinal plants. The vegetation in the district ranges from tropical deciduous forests to dry scrublands and grasslands. The forest part shows several species of trees including sal, teak, bamboo, and mahua [13].

Ethnobiological data collection and analysis

The field study was conducted in 10 sessions from July 2021 to February 2022 based on ethnobiological investigations. Around five to six traditional healers participated in each session. A total number of 55 traditional healers participated in this study. Key informants belonging to various age groups were selected based on age, ethnicity, knowledge about ethnobotanical drugs, minimum 5 years of experience in healing, and recommendations obtained from local leaders of the villages. Informants were assured by me that data obtained from this study would be used only for research purposes. All informants were more than 18 years of age and participated voluntarily. Informants were also found intense knowledge about habit type, flowering time, method of preparation, and side effects of ethnobotanicals. A sheet of semi-structured questionnaire was prepared to collect data systematically along with a short profile of informants.

As the authors know the native language of healers so semistructured questionnaire were prepared in Bengali for the data collection based on the standard ethnobotanical method [13,14]. In this study, health problems were



Figure 1. Map of study area, "Purulia."

Table 1. Ethnobotanical used for some diseases treatment.

SL. no	Scientific name	Local common name	Family	Habit	Plant parts used	Ailments	UV
1	<i>Achyranthes aspera</i> L.	Apang	Amaranthaceae	Herb	Roots	Stomach problems and boil	0.50
2	<i>Aervajavanica</i> (Burm.f.)Schult.	Lal godh	Amaranthaceae	Herb	Leaves	Skin infections and cut	0.33
3	<i>Aervasanguinolenta</i> (L.) Blume	Chaldhua	Amaranthaceae	Herb	Aerial parts	Cut	0.39
4	<i>Ageratum conyzoides</i> L.	Bhabry	Asteraceae	Herb	Leaves	Boil and cut	0.22
5	<i>Allium sativum</i> L.	Peyaj	Amarylidaceae	Herb	Bulb	Boil and stomach disorder	0.30
6	<i>Aloe vera</i> L.	Ghritokumari	Xanthorrhoeaceae	Herb	Leaves	Cut, inflammation, ulcerand acne	0.65
7	<i>Andrographis paniculata</i> (Burm.f.) Wal. Ex. Nees	Kalmegh	Acanthaceae	Herb	leaves	Stomach problem and ulcer	0.45
8	<i>Annona squamosa</i> L.	Atapata	Annonaceae	Tree	Leaves	Boil and Pimple	0.26
9	<i>Aristolochia indica</i> L.	Eswar mul	Aristolochiaceae	Climber	Leaves	Snake bite, skin infection	0.14
10	<i>Artemisia vulgaris</i> L.	Nag dona	Asteraceae	Herb	Leaves	Sinus	0.28
11	<i>Azadiractaindia</i> A. Juss.	Neem	Meliaceae	Tree	Leaves, roots, barks, flowers and fruits	Exima and skin disease	0.77
12	<i>Basella alba</i> L.	Pui	Basellaceae	Vine	Leaves	Blisters and burn	0.1
13	<i>Bauhinia purpuria</i> L.	Kanchan	Leguminosae	Shrub	Leaves	Boil and burn	0.17
14	<i>Boerhaviadiffusa</i> L.	Kathasag	Nyctaginaceae	Herb	leaves	Cut and skin infection	0.37
15	<i>Bombax ceiba</i> L.	Bokul	Bombacaceae	Tree	Leaves	Mouth infection	0.26
16	<i>Calendula officinalis</i> L.	Ganda	Asteraceae	Herb	Leaves	Blisters and burn	0.33
17	<i>Calotropis procera</i> (Aiton) R. Br.	Akanda	Asclepidaceae	Shrub	Leaves and latex	Burn	0.19
18	<i>Clerodendrum serrata</i> (L.) Steane&Mabb.	Brambhajosthi	Lamiaceae	Tree	Roots and leaves	Asthma, Fever, Anti-oxidant, respiratory diseases	0.44
19	<i>Cotula anthemoides</i> L.	Tar dingla	Asteraceae	Herb	Aerial part	Cut and bleeding	0.81
20	<i>Croton bonplandianus</i> Baill..	Bhabri	Euphorbiaceae	Herb	Leaves	Darmatophytosis, Fungal infection	0.57
21	<i>Curcuma longa</i> L.	Holud	Zingiberaceae	Herb	Rhizomes	Skin infection, Stomach disorder	0.79
22	<i>Datura metel</i> L.	Dhutura	Solanaceae	Shrub	Leaves	Skin infection	0.13
23	<i>Dioscoreaalata</i> L.	Barahakanta	Dioscoreaceae	Vine	Leaves	Sexual hormone imbalance in men	0.18
24	<i>Elephantopusscaber</i> L.	Moyurjhuti	Asteraceae	Herb	Roots	Menstrual pain	0.43
25	<i>Euphorbia milii</i> var. <i>longifolia</i> D. Moul.	Nath jhokha	Euphorbiaceae	Herb	Leaves and stem	Abscess	0.15
26	<i>Ficus benghalensis</i> L.	Bot	Moraceae	Tree	Leaves and barks	Skin infection and pimple	0.11
27	<i>Ficus hispida</i> L. f.	Dummur	Moraceae	Tree	Leaves and latex	Burn and blisters	0.22
28	<i>Gendarussa vulgaris</i> Nees	Bisalyakarani	Apocynaceae	Tree	Leaves	Skin infection and inflammation	0.31
29	<i>Glossocardia bidens</i> (Retz) Veldkamp	Bishainandi	Asteraceae	Herb	Leaves, Roots, Flowers	Pimples and Skin infection	0.89
30	<i>Grangeamaderaspatena</i> (L.) Poir	Bhuikodom	Asteraceae	Herb	Roots	Tumors	0.13
31	<i>Helicteresisora</i> L.	Aatmora	Malvaceae	Tree	Fruits	Body pain	0.22
32	<i>Hemidesmus indicus</i> (L.) R.Br.	Anantamul	Apocynaceae	Herb	Aerial parts	Ulcer and skin infection	0.57

Continued

SL. no	Scientific name	Local common name	Family	Habit	Plant parts used	Ailments	UV
33	<i>Hibiscus rosa-sinensis</i> L.	Jaba	Malvaceae	Shrub	Leaves and flowers	Acne and dandruff	0.69
34	<i>Justicia adhatoda</i> L.	Basak	Acanthaceae	Shrub	Leaves	Cold and cough	0.81
35	<i>Lawsoniainermis</i> L.	Natur	Lythraceae	Shrub	Leaves	Cut	0.21
36	<i>Madhuca longifolia</i> (Koning) J.F.Macbr.	Mahua	Sapotaceae	Tree	Flower	Burn and ulcer	0.55
37	<i>Mangifera indica</i> L.	Aam	Anacardiaceae	Tree	Leaves	Injury	0.37
38	<i>Paederia scandens</i> (Lour.) Merr.	Gondhobhadule	Rubiaceae	Climber	Leaves	Cold and cough	0.53
39	<i>Pennisetum pedicellatum</i> Trin.	Dinonath	Poaceae	grass	Whole plant	Lack of breast milk production of cattle	0.62
40	<i>Phyllanthus fraternus</i> G.L. Webster	Gach amla	Euphorbiaceae	Herb	Whole plant	Diarrhoea and digestive problems	0.71
41	<i>Phyllanthus virgatus</i> G. Forst.	Bhui amla	Euphorbiaceae	Herb	Whole plant	Digestive problems	0.73
42	<i>Plumeria rubra</i> L.	Gulancha	Apocynaceae	Shrub	Roots	Diabetes and Stomach aches	0.47
43	<i>Scoparia dulcis</i> L.	Bondhone	Plantaginaceae	Herb	Whole plant	Kidney disorder and stomach problems	0.38
44	<i>Syzygiumcumini</i> (L.) Skeels	Jaam	Myrtaceae	Tree	Leaves	Injury and cut	0.66
45	<i>Terminalia chebula</i> Retz.	Hartuki	Combretaceae	Tree	Fruits	Stomach problems	0.73
46	<i>Tridax procumbens</i> L.	Targanda	Asteraceae	Herb	Leaves	Cut and bacterial infection	0.49
47	<i>Tamarindus indica</i> L.	Tetul	Leguminosae	Tree	Fruits	Ulcer	0.78
48	<i>Typhonium trilobatum</i> (L.) Schott	Liribishi	Araceae	Herb	Leaves	Dog bite	0.24
49	<i>Urginea indica</i> (Roxb.) Kunth	Bonpiyaj	Liliaceae	Herb	Bulbs	Cut and ulcer	0.65
50	<i>Vachellianilotica</i> (L.) P.J.H. Hurter & Mabb.	Guhebabla	Fabaceae	Tree	Roots	Hysteria	0.17
51	<i>Vitex negundo</i> L.	Nishinda	Lamiaceae	Shrub	Leaves	Puss of inner side of the ear	0.26

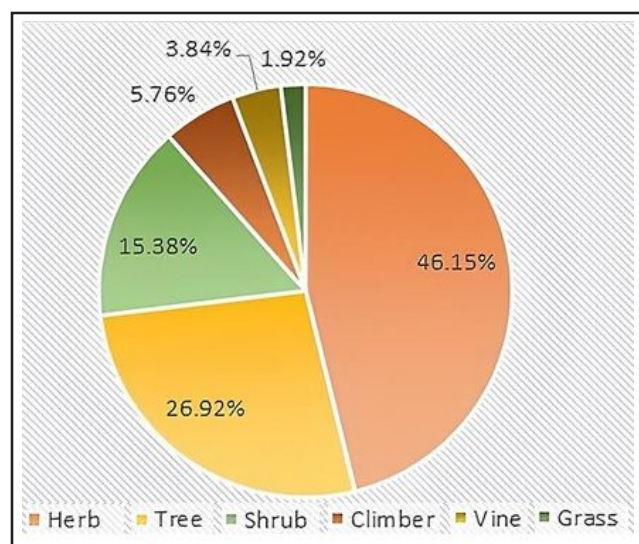


Figure 2. Percentage of habit types of the studied plants used for the treatment of some diseases.

characterized into eight major groups such as dermatological problems, general health problems, abdominal problems, ear,

nose, throat problems, nephrological problems, hormonal problems, orthopedic problems, and nervous problems. Medicinal plants mentioned by at least four informants were taken into consideration. Several plant species were collected mostly in their flowering stage for their identification but rare and protected species were avoided during the field study. These protected species were photographed only whenever possible. Some plant specimens were collected to make a herbarium and identified by herbarium specimens of the Botanical Survey of India, and rare and protected species were identified with the help of books and other authentic documents [15–18]. Nomenclatures were verified using the database available in the online at www.ipni.org. The ethnomedicinal plants mentioned in this study were arranged alphabetically. Local names of plants, scientific names, family, therapeutic use, parts of the plants that are used, method of preparation, and mode of administration were stated in the present study. Collected information was evaluated using specific quantitative parameters viz. fidelity level (FL) and use value (UV) [19].

Use value

The UV validates the comparative importance of plants recognized locally in folk medicine [20]. UV was calculated using the following formula: $UV = \sum U/n$

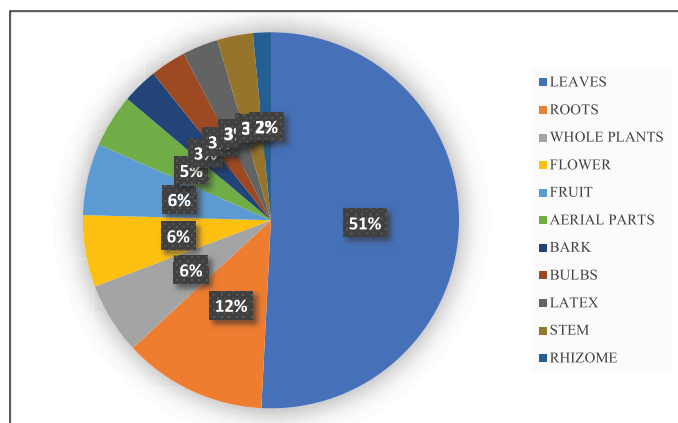


Figure 3. Percentage of plant parts utilized for the medication.

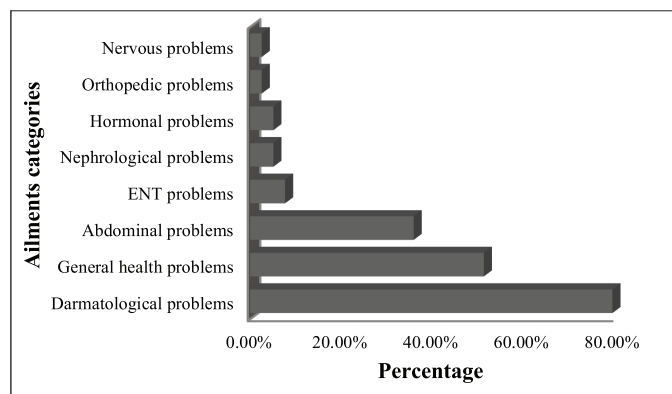


Figure 4. Percentage of plant specimens used for medication of a particular health problem.

Table 2. Specific details of formulations for treatment.

Formulations	Plants used individually or combinedly	Plant parts used	Additives	Method of preparation	Mode of application
MF1	<i>Achyranthes aspera</i> L.	Roots	Water	Paste	Consume in empty stomach
MF2	<i>Aervajavanica</i> (Burm.f.) Juss. Ex Schult.	Leaves	Water	Paste	Apply on infected skin
MF3	<i>Aloe vera</i> L.	leaves	Water	Paste	Apply on infected area
MF4	<i>Aristolochia indica</i> L.	Leaves	water	Small tablets	Consume in empty stomach
MF5	<i>Artemisia vulgaris</i> L.	Leaves	Water	Form nasal drop	Apply twice a day for 3 days
MF6	<i>Cissus quadrangularis</i> L.	Stem and leaves	Water	Paste	Apply on the broken area
MF7	<i>Clerodendrum serrata</i> (L.) Steane&Mabb.	Roots and leaves	Honey	Small tablets	Consume after breakfast and lunch
MF8	<i>Croton bonplandianus</i> Bill..	Leaves	Milk	Small pills	Consume twice a day
MF9	<i>Datura metel</i> L.	Leaves	Not needed	Form of ash	Apply on the infected part
MF10	<i>Euphorbia milii</i> var. <i>longifolia</i> D. Moul.	Leaves and stem	Water	Paste	Apply on the abscess
MF11	<i>Gendarussa vulgaris</i> Nees	Leaves	Water	Paste	Apply on skin infection
MF12	<i>Glossocardia bidens</i> (Retz) Veldkamp	Leaves, roots and flowers	Water	Paste	Apply on infected area
MF13	<i>Grangeamaderaspatena</i> (L.) Poir	Roots	Water	Pate	Apply on tumor
MF14	<i>Helicteres isora</i> L.	Fruits	Mastered oil	Boil with mastered oil	Massage the oil on body
MF15	<i>Justicia adhatoda</i> L.	Leaves	Water	Boil in water	Drink the warm syrup thrice a day
MF16	<i>Pennisetum pedicellatum</i> Trin.	Whole plant	Not needed	Cut and dried	Consumed daily
MF17	<i>Terminalia chebula</i> Retz.	Fruits	Water	Soak in water whole night	Consumed daily in empty stomach
MF18	<i>Typhonium trilobatum</i> (L.) Schott	Leaves	Water	Paste	Apply on the wound
MF19	<i>Vachellianilotica</i> (L.) P.J.H.Hurter&Mabb.	Roots	Kidney bean's root, Water	Paste and make juice	Drink the juice early morning
MF20	<i>Vitex negundo</i> L.	Leaves	5 Garlic cloves, some marijuana	Extractas ear drop	Apply in the ear before bed time

Continued

Formulations	Plants used individually or combinedly	Plant parts used	Additives	Method of preparation	Mode of application
PF1	<i>Achyranthes aspera</i> <i>L., Aervasanguinolenta</i> (L.) Blume, <i>Ageratum conyzoides</i> L., <i>Cotula</i> <i>anthemoides</i> L.	Roots, aerial parts, leaves, aerial parts	Honey and Water	Grind all parts and make paste	Apply on affected part
PF2	<i>Aristolochia indica</i> L., <i>Azadiractaindia</i> A. Juss., <i>Calendula officinalis</i> L., <i>Curcuma longa</i> L., <i>Madhuca longifolia</i> (Koning) J.F.Macbr.	Leaves, bark, leaves, rhizome, flower	Water	Grind all parts and make paste	Apply on infected areas twice a day
PF3	<i>Aloe vera</i> L., <i>Aristolochia</i> <i>indica</i> L., <i>Curcuma longa</i> L., <i>Elephantopus scaber</i> L.,	Leaves, leaves, rhizome, roots,	Black cumin, rock salt	Grind all ingredients and make small tablets	Consume twice a day
PF4	<i>Ageratum conyzoides</i> L., <i>Cotula</i> <i>anthemoides</i> L., <i>Hibiscus rosa-sinensis</i> L.	Leaves, aerial parts, leaves	Cow milk, honey	Prepare mixture with all parts after grinding	Two table spoons of mixture before meal
PF5	<i>Andrographis paniculate</i> (Burm.f.) Wal. Ex. Nes, <i>Azadiractaindia</i> A. Juss., <i>Croton</i> <i>bonplandianus</i> Baill.	Leaves, flower, leaves	Black salt, water	Paste and make tablets	Consume in empty stomach
PF6	<i>Aristolochia indica</i> L., <i>Bauhinia</i> <i>purpuria</i> L., <i>Cotula anthemoides</i> L., <i>Glossocardia bidens</i> (Retz) Veldkamp, <i>Madhuca longifolia</i> (Koning) J.F.Macbr., <i>Urginea indica</i> (Roxb.) Kunth	Leaves, leaves, Aerial parts, whole plant, flower, bulbs	Rice washed water	Prepare dough with the grinded mixture and make small cakes	Consumed in warm condition once a day
PF7	<i>Ficus benghalensis</i> L., <i>Hemidesmus</i> <i>indicus</i> (L.) R.Br., <i>Lawsonia inermis</i> L.	Bark, aerial part, leaves	Chun	Grind all ingredients and make paste	Apply on skin infection
PF8	<i>Cotula anthemoides</i> L., <i>Mangifera indica</i> L., <i>Tamarindus indica</i> L.	Aerial parts, leaves, fruits	Cow urine	Prepare a paste	Apply on the affected portion
PF9	<i>Bombax ceiba</i> L., <i>Dioscorea alata</i> L.	Leaves, leaves	Jujube fruit, winter cherry fruit, nutmeg, Honey,	Grind all ingredients and make tablets	Consume twice a day
PF10	<i>Justicia adhatoda</i> L., <i>Paederia scandens</i> (Lour.) Merr.	Leaves, feaves	Water and honey	Boiled in water	Drink the juice with honey for 5 days
PF11	<i>Phyllanthus fraternus</i> G.L. Webster, <i>Phyllanthus virgatus</i> G. Forst.	Whole plant, whole plant	Black salt and lemon juice	Dried all parts and Grind to make dust	Consume the dust after meal
PF12	<i>Aervajavanica</i> (Burm.f.) Schult., <i>Aloe</i> <i>vera</i> L., <i>Boerhaviadiffusa</i> L.,	Leaves, leaves, leaves,	Water	Prepare a paste	Apply on infected area
PF13	<i>Aloe vera</i> L., <i>Hibiscus rosa-sinensis</i> L.	Leaves, flower	Water	Extract gel from <i>A. vera</i> L. leaves and make paste with <i>Hibiscus</i> leaves	Apply on the scalp before taking bath

MF, Monoherbal Formulations (One Plant used for formulations); PF, Polyherbal Formulations (More than one plant used for formulations).

Table 3. FL of described plants.

Types of health-related problems	Name of the diseases	Scientific name of plants with FL percentage
Abdominal problems	Diarrhoea	<i>Phyllanthus fraternus</i> G.L. Webster (44%)
	Digestive problems	<i>Phyllanthus fraternus</i> G.L. Webster (38.66%), <i>Phyllanthus virgatus</i> G. Forst. (41.07%)
	Stomach problems	<i>Achyranthes aspera</i> L. (45%), <i>Allium sativum</i> L. (29.56%), <i>Andrographis paniculate</i> (Burm.f.) Wal. Ex. Nes (27.89%), <i>Curcuma longa</i> L. (67.66%), <i>Plumeria rubra</i> L. (19.26%), <i>Scoparia dulcis</i> L. (15.05%), <i>Terminalia chebula</i> Retz. (72.11%)
	Ulcer	<i>Aloe vera</i> L. (9.76%), <i>Andrographis paniculate</i> (Burm.f.) Wal. Ex. Nes (52.43%), <i>Hemidesmus indicus</i> (L.) R.Br. (18.81%), <i>Tamarindus indica</i> L. (13%)
	Abscess	<i>Euphorbia milii</i> var. <i>longifolia</i> D. Moul. (59.44%)
	Acne	<i>Aloe vera</i> L. (21.01%)
	Antioxidant	<i>Clerodendrum serrata</i> (L.) Steane & Mabb. (46.77%)
	Bacterial infection	<i>Tridax procumbens</i> L. (27.34%)
	Blisters	<i>Basella alba</i> L. (17.02%), <i>Calendula officinalis</i> L. (7.99%)
	Boil	<i>Achyranthes aspera</i> L. (26.11%), <i>Ageratum conyzoides</i> L. (43.33%), <i>Allium sativum</i> L. (56.67%), <i>Annona squamosa</i> L. (44.33%), <i>Bauhinia purpuria</i> L. (11.11%)
Dermatological problems	Burn	<i>Basella alba</i> L. (7.77%), <i>Bauhinia purpuria</i> L. (22.08%), <i>Calendula officinalis</i> L. (11.11%), <i>Calotropis procera</i> (Aiton) R. Br. (52.22%), <i>Ficus hispida</i> L. f. (13.64%), <i>Glossocardia bidens</i> (Retz) Veldkamp (81.04%)
	Dandruff	<i>Hibiscus rosa-sinensis</i> L. (53.21%)
	Exima	<i>Azadiractaindia</i> A. Juss. (89%)
	Fungal infection	<i>Croton bonplandianum</i> L. (30%)
	Inflammation	<i>Aloe vera</i> L. (28.44%), <i>Glossocardia bidens</i> (Retz) Veldkamp (78.99%)
	Pimple	<i>Annona squamosa</i> L. (19.58%), <i>Ficus benghalensis</i> L. (37.21%)
	Skin infection	<i>Aervajavanica</i> (Burm.f.) Schult. (17%), <i>Aristolochia indica</i> L. (57.44%), <i>Azadiractaindia</i> A. Juss. (68.55%), <i>Boerhaviadiffusa</i> L. (57.16%), <i>Curcuma longa</i> L. (42.66%), <i>Datura metel</i> L. (27.22%), <i>Ficus benghalensis</i> L. (70%), <i>Gendarussa vulgaris</i> Nees (43.77%), <i>Glossocardia bidens</i> (Retz) Veldkamp (68.22%), <i>Hemidesmus indicus</i> (L.) R.Br. (47.11%)
	Mouth infection	<i>Bombax ceiba</i> L. (8.7%)
	Puss of inner side of ear	<i>Vitex negundo</i> L. (23.35%)
	Sinus	<i>Artemisia vulgaris</i> L. (50%)
ENT problems	Asthma	<i>Clerodendrum serrata</i> (L.) Steane & Mabb. (25.78%)
	Bleeding	<i>Cotula anthemoides</i> L. (51.33%)
	Body pain	<i>Helicteres isora</i> L. (66.57%)
	Cold and cough	<i>Justicia adhatoda</i> L. (34.74%), <i>Paederia scandens</i> (Lour.) Merr. (57.99%)
	Cut	<i>Aervajavanica</i> (Burm.f.) Schult. (16.07%), <i>Aervasanguinolenta</i> (L.) Blume (13.66%), <i>Ageratum conyzoides</i> L. (20%), <i>Aloe vera</i> L. (8.88%), <i>Boerhaviadiffusa</i> L. (49.30%), <i>Cotula anthemoides</i> L. (44.11%), <i>Lawsoniainermis</i> L. (17.43%), <i>Syzygium cumini</i> (L.) Skeels (36.66%), <i>Tridax procumbens</i> L. (28.55%), <i>Urginea indica</i> (Roxb.) Kunth (31.44%)
	Dermatophytosis	<i>Croton bonplandianum</i> L. (41.88%)
	Dog bite	<i>Typhonium trilobatum</i> (L.) Schott (44%)
	Fever	<i>Clerodendrum serrata</i> (L.) Steane & Mabb. (18.77%)
	Injury	<i>Mangifera indica</i> L. (33.11%), <i>Syzygium cumini</i> (L.) Skeels (37.28%)
	Lack of milk production in cattle	<i>Pennisetum pedicellatum</i> Trin. (80.33%)
General health problems	Respiratory disease	<i>Clerodendrum serrata</i> (L.) Steane & Mabb. (19.09%)
	Snake bite	<i>Aristolochia indica</i> L. (16.73%)
	Tumors	<i>Grangea maderaspatena</i> (L.) Poir (37.88%)
	Menstrual pain	<i>Elephantopus scaber</i> L. (52.55%)
	Sexual hormone imbalance in men	<i>Dioscorea alata</i> L. (27.09%)

Continued

Types of health-related problems	Name of the diseases	Scientific name of plants with FL percentage
Nephrologicalproblems	Diabetes	<i>Plumeria rubra</i> L. (30.14%)
	Kidneydisorders	<i>Scoparia dulcis</i> L. (12.22%)
Nervousproblems	Hysteria	<i>Vachellianilotica</i> (L.) P.J.H.Hurter&Mabb. (14.55%)
Orthopedicproblems	Brokenbone	<i>Cissus quadrangularis</i> L.(6.76%)

where UV represents the UV of species, *U* represents the total number of respondents who reported the use of particular species, and *n* represents the total number of informants interviewed for a specific plant. High UV indicates the particular plant is medicinally important and it has several uses [21].

Fidelity level

The percentage of informants affirming the use of a specific plant species for a similar major perseverance was calculated through FL [22].

The formula is as follows: $FL\ (\%) = N_p/N \times 100$

Here, FL is FL, *N_p* describes the number of informants who independently mentioned the use of a species for the same diseases, and *N* describes the total number of informants who indicated the plant for any specific ailment [21].

RESULTS

Medicinal plant diversity and distribution

Medicinal plants were enlisted with scientific names and author citations, followed by local names, families, habits, and plant parts used against each disease (Table 1). Fifty-one plant species were identified and documented in this study which belonged under 51 genera and 34 plant families (Table 1). The highest number of medicinal plants were recorded in Asteraceae (7 species) followed by Amaranthaceae (3 species), Euphorbiaceae (3 species), and Malvaceae (2 species). It was found that the same plant species have a same local name in various parts of the study area among the different ethnic communities. This gives a strong homogeneity of vernacular nomenclature among inhabitants in the Purulia district, which is an indication of the transfer of indigenous knowledge. Medicinal plants were unevenly distributed to different blocks of the district but most of the species were available to Ajodhya Hill, Pancheyet Hill, Rakab Forest, Murguma Forest area, Bandwan Forest area, and Tara Forest.

Ethnomedicinal use of plants stated by the selected informants and documentation of their usage

The distribution of plant habit types and plant part (s) used are illustrated in Figures 2 and 3, respectively. Among the various habit types, 46.15% were herbaceous plants, 26.92% trees, 15.38% shrubs, 5.76% climbers, 3.84% vines, and 1.92% grasses were used for the treatment of diseases (Fig. 2). Among the parts used, leaves were the most preferable plant parts (52%), followed by roots (13%), flowers, whole plants, fruits, aerial parts, bark, latex, and bulbs as shown in Figure 3.

The majority of the identified medicinal plants were used for the treatment of dermatological problems (59.61%),

general health problems (38.46%), and abdominal problems (28%) (Fig. 4). Quantitative ethno botanical study found high UV for *Glossocardia bidens* (Retz) Veldkamp (0.89), *Justicia adhatoda* L. (0.81), *Cotula anthemoides* L.(0.81), *Curcuma longa* L. (0.79), *Azadiractaindia* A. Juss. (0.77), *Phyllanthus virgatus* G. Forst. (0.73), and *Phyllanthus fraternus* G.L.Webster (0.71) (Table 1). The majority of the preparations in the study area were made from dried parts of ethnobotanicals followed by fresh parts. Traditional healers employ different methods of formulations of conventional medicine for the treatment of various ailments. A total number of 20 mono-herbal formulations (MFs) and 13 poly-herbal formulations (PFs) were reported as shown in Table 2.

FL of the described plants

High FL was recorded for three plants viz. *Azadiractaindia* A. Juss. (89%), *G. bidens*(Retz) Veldkamp (81.04%), and *Pennisetum pedicellatum* Trin. (80.33%) as shown in Table 3.

DISCUSSION AND CONCLUSION

We report a total of 51 ethnobotanicals belonging to 34 plant families which are used directly or with some additives for the treatment of 8 different health problems in Purulia district. A high number of species reported designates that the district has a wide diversity of flora used against various ailments and rich indigenous traditional knowledge. Families Asteraceae, Apocyanaceae, and Amaranthaceae are widely documented in herbal formulations in parts of the district [2,13]. Asteraceae is reported to have a wide range of bioactive constituents thus contributing to the high UV of members of the family for medicinal purposes [13]. The UV of *G. bidens* (Retz) Veldkamp under Asteraceae is high as the different parts of it provide the necessary properties to cure diseases [2]. Dried parts of ethnobotanical plants are used widely as they are easy to preserve for a long time even when the season is not favorable for the particular plants to grow. Some healthy fresh parts of the plants are also used in some cases of disease treatment. This study corroborates the findings of Modak *et al.* [13]. In the present study, healers preferring to use leaves in comparison to other plant parts. The use of leaves for medicinal purposes is preferred by most ethnobotanical studies because they are available in most seasons and they are quickly reachable in the time of urgent situations [2,13]. The tribal people usually face dermatological problems possibly because of poor skin hygiene, environment, and weak immune system [9]. So, dermatological conditions are mostly treated. In most cases, the drug formulation is made from PFs because the mutual effect of the phytochemicals of different plants may recover the rate of curing [23–25]. Ethnobotanicals with high

FLs are considered potential plants for further biochemical investigation and are worthy of priority interest [26,27]. The popularity of herbs as a source of herbal therapy is often attributed to their higher pharmacologically active constituents than trees [27]. Shrubs are preferred due to their availability throughout the year as they are relatively drought-resistant and unaffected by seasonal changes [28]. The lifesaving herbs and trees are decreasing day by day due to a lack of awareness among the public about the conservation of threatened species which can be achieved by educating them about the importance of conservation [28,29]. But with the help of local tribal medicine men, the primary health care system through ethnomedicine is still preserved. This present manuscript is an initial step to introduce folk medicine in digital format for future use and also preserve them from extinction.

In conclusion, the documentation of traditional medicinal knowledge on ethnobotanicals in the study area could contribute to safeguarding the traditional knowledge, which is still transferred verbally among the local people. Furthermore, the information obtained from this investigation will provide a basis for biochemical studies that could further be used to develop new drugs.

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LIST OF ABBREVIATIONS

FL, Fidelity level; MF, Monoherbal formulation; PF, Polyherbal formulation; UV, Use value.

AUTHOR CONTRIBUTIONS

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work. All the authors are eligible to be an author as per the International Committee of Medical Journal Editors (ICMJE) requirements/guidelines.

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This study does not involve experiments on animals or human subjects.

DATA AVAILABILITY

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