

Ethnobotanical Study on Medicinal Plants Used by the Ethnic People of Khagrachhari District, Bangladesh

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ABSTRACT: The present study deals with important ethnopharmacological information, both in qualitative and quantitative manners on medicinal plants of Khagrachhari district of Bangladesh. The survey was conducted in a period of six months from January 2016 to June 2016 and was interviewed among 155 ethnic people including tribal, Bengalis and 14 traditional health practitioners of eight upazillas in open and semi structured form. The most of the interviewees were Chakma (82%), Marma (8%) and the rest were Tripura (2%) and Bengalis (8%). The total ethnomedicinal plant species was 94, among them 92 were angiosperms, one was gymnosperm and one fern. The plant species belonging to 44 families and 86 genera are used to treat about 53 types of ailments. The different life forms among the species are 28 herbs, 25 trees, 24 shrubs and 17 climbers. The survey showed that the most commonly used plant part was leaves (34.55%) and the most frequent method of preparation was extraction (39.18%) against different ailments. The major treatment options of the medicinal plants of Khagrachhari hilly areas are identified from the study and recommended to take immediate measures for conservation of traditional knowledge of the area. This study showed a hopeful perception for future studies, flaking light on taking immediate measures on inventory of medicinal plants of hilly areas, documentation of verbal information, conservation of threatened plant species, sustainable management of risky areas and preservation of traditional knowledge of herbal medicine in Khagrachhari district, Bangladesh.

Key words: Medicinal plants, traditional knowledge, ethnopharmacological studies, endangered plant species, Khagrachhari.

INTRODUCTION

Ethno-medicine system mentions the study of traditional medicine practice which is concerned with the social and cultural interpretations of health, diseases, illness addressing to the healthcare seeking process and remedial practices.^{1,2} The practice of ethno-medicine is a multi-disciplinary system founding the use of plants in spiritual and natural environment for healing the people for millennia.³

Still now, about 80% of the world's populations mostly rely on plants and plant based medicinal system for healthcare.⁴ The system has preserved its popularity in all regions of the developed and developing countries and its use is rapidly increasing in the industrialized countries.⁵ According to the World Health Organization, traditional or complementary medicines are used for healing by roughly 50% of people in Europe & North America, 70% of people in Canada and 90% of people worldwide.⁵ South Africa and China have returned to the traditional feature of healthcare which are not limited to the poor, but extended to all societal

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classes.³ Most of the developing countries like India, Srilanka, Pakistan, Nepal and Bhutan are growing their interest towards traditional healing systems day by day.⁶ Bangladesh has made a tremendous development on complementary medicinal system because of its vast plant biodiversity, wide varieties of ethnic groups and rich in folklore use like others.⁷ About 6,000 species of homegrown and naturalized plants growing in the country of which more than one thousand plant species contain medicinally active chemical substances.^{8,9} Most of the village people and tribal communities of Bangladesh are largely dependent on the traditional or folklore medicinal systems to treat diseases as a mean of primary healthcare.⁷

Khagrachhari is a densely forested area with a large number of plant species and different ethnic communities in Bangladesh.⁸ The total area is covered by a mass of hills, rivers, watercourses, swamps, cliffs covered with bamboo brakes, tall trees and creeper jungles.¹⁰ The tribal people and local communities largely depend on their indigenous treatment systems and local healthcare practitioners, or traditional healers called *Boidyas* due to their strong confidence in the remedial properties of traditional medicinal systems and lack of access to modern medicinal facilities. However, the traditional treatment systems are now seriously depleted due to deforestation, environmental pollution, modern civilization, illiteracy, poverty, the death of *Boidyas* and lack of documentation of ethnomedicinal knowledge (they are transferred from one generation to the next generation only verbally).¹¹ Although there are rich traditional practices of ethnic medicine in the Khagrachhari hill tract, only a limited number of surveys have been carried out in these areas among tribal communities.¹⁰⁻¹² In this communication, an ethnobotanical survey has been carried out among the ethnic people throughout the Khagrachhari district with the help of traditional health practitioners in order to identify medicinally important plants and to preserve information regarding traditional uses of these medicinally important plants.

MATERIALS AND METHODS

Study area. Khagrachhari is a hilly district located in the southeastern part of Bangladesh and lies between 22°38' and 23°44' N latitudes and between 91°44' and 92°11' E longitudes. It is bounded on the north and west by India, on the east by Rangamati district and on the south by Chattogram and Rangamati. The total area is 2,749.16 sq. km of which 2242.44 sq. km is under forest. The district consists of 8 upzilas, which are Dighinala, Khagrachharisadar, Lakshmichhari, Mahalchhari, Manikchhari, Matiranga, Punchhari, and Ramgarh (Figure 1). According to Bangladesh's population census¹³ the total population of the area was 525,664 and the indigenous communities of this area are Chakma, Marma, Tripura and Tanchanga.

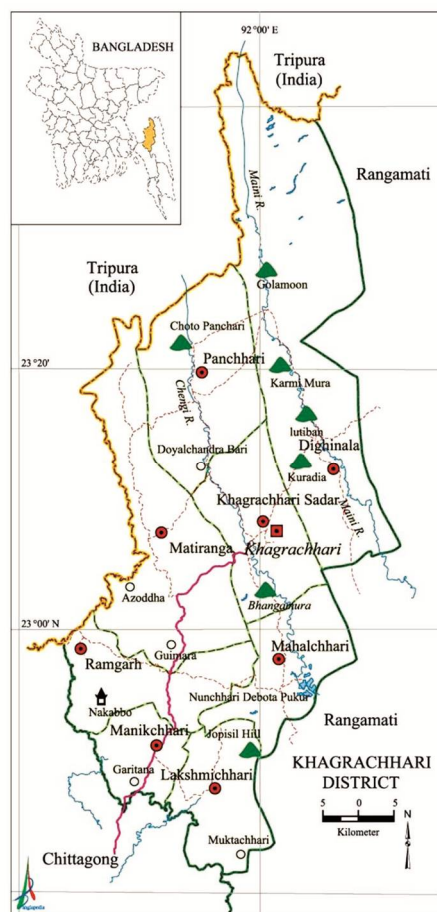


Figure 1. The study area in eight upzilas (round red marks) of Khagrachhari district, Bangladesh (Banglapedia, 2012).

Ethnobotanical survey study. The study was performed from January 2016 to June 2016 and survey related permission was obtained from the authorities of Khagrachhari district. A total of eight upzilas of Khagrachhari district were covered during the study time and about 155 local people and 14 traditional health practitioners (THPs) were interviewed who had applied or empirical knowledge of local medicinal plants using an open and semi-structured interview. Most of the interviewers were from *Chakma, Marma, Tripura* and the rest were Bengalis. During the survey, the demography and socio-cultural variations of the informants' like age, gender, experience and educational background on the use of ethno-medicinal plants were taken into consideration. The information collection process was accomplished with the help of local residents and a written document regarding the survey was obtained from each informant. The traditional practitioners (*Boidyas/Hakims*) were identified by a local person who was familiar with them and who communicated with this contact person regularly. Each *Boidya/Hakim* was interviewed alone to confirm the confidentiality and then the plant related data were ascertained by other people who are familiar with the plants.

After preliminary screening, the targeted medicinal plants were photographed, collected, dried on the spot and taken to Dhaka for identification and confirmation by one of the authors (MZU), a taxonomist, at the Department of Botany, University of Dhaka, Bangladesh. Then the plant specimens were submitted to the Bangladesh National Herbarium, Dhaka, and a voucher specimen of each plant was deposited with an accession number followed by five-digits, including DACB-(XXXXXX) for future references. The five-digit accession number is provided in Table 1.

Data analysis. A database was developed on Microsoft Excel with the collected information. The primary data were represented and calculated using the total number of information.

RESULTS AND DISCUSSION

The survey was designed using open and semi-structured interviews among traditional health practitioners and local communities to find out the usefulness of 94 plant species with potential ethno-medicinal properties. Among the total plant species 92 were angiosperms, one was gymnosperm and one was fern. The plant species belong to 44 families and 86 genera and treat about 53 types of ailments. Among the species 25 are trees, 24 shrubs, 28 herbs and 17 climbers. Some similarities between plant species were observed, according to the previous reports.¹⁴⁻¹⁸ The fern is *Adiantum caudatum* Klotzsch used in rash or inflammation and gymnosperm is *Cycas pectinatus* Griff used in stomach problem. Rest of the plants are used to treat different ailments like blood purifier (*Abrus precatorius* L., *Aphanamixis polystachya* (Wall.) Parker); leukorrhea (*Saraca asoca* (Roxb.) de Wilde); dysentery (*Terminalia chebula* (Gaertn.) Retz., *Dillenia indica* L., *Dillenia pentagyna* Roxb., *Cissus assamica* (Laws.) Craib.); abdominal pain (*Paederia foetida* L.); malaria (*Flemingia macrophylla* (Willd.) Merr., *Lantana camara* L.); diabetes (*Xanthium indicum* Koenig, *Oroxylum indicum* (L.) Kurz., *Phyllanthus emblica* L., *Cissus adnata* Roxb., *Cassia tora* L.); rheumatism (*Urena lobata* L., *Gardenia coronaria* Ham., *Ficus racemosa* L.); swollen testicles (*Vitex trifolia* L.f.); impotence (*Sterculia villosa* Roxb., *Clausena heptaphylla* (Roxb.) Weight & Arn.); abscess (*Sida cordifolia* L., *Bombax ceiba* L.); snake bite (*Pothos scandens* L., *Cassia hirsuta* L., *Commelina benghalensis* L.); hysteria (*Passiflora foetida* L.); menstrual disorder (*Terminalia bellirica* (Gaertn.) Roxb., *Jasminum sambac* L. Ait.); leucoderma (*Hemidesmus indicus* R. Br.); anemia (*Antidesma acidum* Retz.); gonorrhoea (*Dipterocarpus turbinatus* Gaertn. F., *Dalbergia stipulacea* Roxb.); bone fracture (*Bridelia tomentosa* Blume, *Bauhinia purpurea* L.); sex stimulant (*Ipomoea mauritiana* Jacq.) (Table 1). In some cases, two or more plants showed similar ailments properties such as *Oroxylum indicum* Vent. and *Dillenia indica* L. are used to treat diarrhoea, *Ocimum sanctum* L. and *Adhatoda vasica* L. for colds and fever (Table 1).

Table 1. Medicinal plants used by the ethnic people of Khagrachhari district, Bangladesh.

Scientific name	Local and Bengali name (accession no.)	Family	Life form	Part (s) used	Ailments	Method of application	No. of respondents
<i>Abroma augusta</i> L.	Thakurung-Chakma, Ulatkombol-Bangla (45327)	Malvaceae	Shrub	Stem	Diabetes, jaundice	Water extract of bark and leaf with slight salt- thrice a day	25
<i>Abrus precatorius</i> L.	Sarakao- Chakma (45435)	Fabaceae	Climber	Bark and seeds	Blood purification	Bark and seeds with sugar water extract - thrice a day.	18
<i>Adiantum caudatum</i> Klotzsch	Dewali- Chakma, Mayurshikha-Bangla (Fern)(45246)	Pteridaceae	Herb	Leaves	Inflammation/rash	Water extract of leaves (one spoonful)+sugar (1/2 spoon) - thrice a day	13
<i>Aegle marmelos</i> L. Correa	Shephal bupaong-Tripura (45242)	Rutaceae	Tree	Fruit	Laxative	Extract of plant paste (5 ml) taken twice or thrice a day or mixed the extract with mustard oil and massaged on to the infected site	33
<i>Albizia procera</i> (Roxb.) Benth.	Silkoroi- Chakma, SadaKoroi- Bangla (45486)	Mimosaceae	Tree	Leaves and bark	Worms, toothache	Water extract of bark/ leaf (one glass+table salt) - early in the morning in empty stomach. Bark ash is used to treat toothache	20
<i>Alternanthera sessilis</i> L.	Segrabaong-Chakma (45986)	Amaranthaceae	Herb	Whole plant	Gastric ulcer	Paste of green plant specially leaf/root mixed with <i>Curcuma</i> powder (25 mg) is taken (one glass) in the morning	18
<i>Antidesma acidum</i> Retz.	Prejangsee-Chakma (45326)	Euphorbiaceae	Shrub	Bark and leaves	Anemia	Water extract of bark and leaves is taken twice a day	34
<i>Aphanamixis polystachya</i> (Wall.) Parker	Pitraj-Chakma, Bangla (45669)	Meliaceae	Tree	Seed	Liver disease and blood purification	Dried seed powder (one spoonful) and one spoonful sugar mixed in water/milk- twice a day	22
<i>Argyrea nervosa</i> (Burm. F.) Boj.	Bubhtaring-Marma (45453)	Convolvulaceae	Climber	Leaves	Abscess	Dried powder of leaf mixed with coconut oil is placed into the abscess.	12
<i>Bauhinia purpurea</i> L.	Lalkadam- Tripura (45365)	Caesalpiniaceae	Tree	Bark	Bone fracture	Paste of bark placed on to the broken part	33
<i>Bombax ceiba</i> L.	Shimul- Marma, Bangla (45363)	Bombacaceae	Tree	Root	Impotence	Root paste+ filter+filtrate (20-30 ml) thrice a day	17
<i>Bridelia tomentosa</i> Blume	Ludihomboi-Marma (45654)	Euphorbiaceae	Shrub	Bark	Bone fracture	Bark paste placed on the broken part with the help of clean cloth (once for one day and washed with water the next day) and repeated for 10 days	24
<i>Callicarpa cana</i> L.	Arusha- Tripura (45495)	Verbenaceae	Tree	Whole plant	Eczema	Extract of plant paste (5 ml) taken twice or thrice a day or mixed the extract with mustard oil and massaged on to the infected site	12
<i>Careya arborea</i> Roxb.	Borpatak- Tripura (45984)	Lecythidaceae	Tree	Bark	Diarrhoea	Bark paste+filter+filtrate (10 ml) mixed with honey (one spoonful) water is taken each time after stool	17
<i>Cascabela thevetia</i> (L.) Lippold	Sanaiphul- Tripura (45762)	Apocynaceae	Shrub	Seed	Dropsy	Extract of plant paste (10 ml) taken twice or thrice a day	33
<i>Cassia fistula</i> L.	Honalu-Chakma,	Caesalpiniaceae	Tree	Fruit	Laxatives	Jelly like portion (inside fruit,	24

	Sonalu- Bangla (45249)					one spoonful) +sugar (half spoonful) -twice a day (morning empty stomach and night before food intake)	
<i>C. hirsute</i> L.	Shapdaru- Marma, Bangla (45434)	Caesalpiniaceae	Herb	Root	Snake bite	Paste of root with lime is placed on the bitten place	33
<i>C. sophera</i> L.	Dangibaong- Chakma, Kalkasunde- Bangla (45843)	Caesalpiniaceae	Herb	Whole plant	Ringworm, expectorant	Juice of leaves/bark/root with lime and water (one spoonful thrice a day)	11
<i>C. tora</i> L.	Rotha- Marma (45387)	Caesalpiniaceae	Herb	Leaves	Diabetes	Powder of dried leaf (taken with the help of three fingers, twice) and sugar (taken with the help of three fingers, once), twice after meal	22
<i>Centella asiatica</i> L. Urban	Menmeni- Marma (45465)	Clusiaceae	Herb	Whole plant	Diarrhea	Paste of whole plant+filter+filtrate with honey- twice a day in empty stomach	10
<i>Cissus adnata</i> Roxb.	Mormuizzaamila- Chakma, Bangla (45596)	Vitaceae	Climber	Stem	Jaundice	Green stem paste (one spoonful) is given thrice a day	24
<i>C. assamica</i> (Laws.) Craib	Sarbaamila- Chakma (45645)	Vitaceae	Climber	Stem	Dysentery	Filtrate of stem paste mixed with water (one glass)- is given early in the morning in empty stomach	32
<i>Clausena heptaphylla</i> (Roxb.) Weight & Arn.	Saderruchi- Chakma (45236)	Rutaceae	Shrub	Leaves	Impotence	Water extract of leaves (one glass) + ghee (1/2 spoon) + honey (1/2 spoon) given one glass is in the morning	12
<i>Clerodendrum indicum</i> (L.) Kuntze	Noligach- Chakma (45732)	Verbenaceae	Shrub	Root	Asthma	Filtrate of root paste in water (50 ml)+sugar (1/4 spoon) is given twice a day before meal	10
<i>Clitoria ternatea</i> L.	Amio- Marma, Bangla (45935)	Fabaceae	Climber	Root	Bronchitis	Root paste filtrate mixed with Tulsi leaf extract is taken twice a day for better result	17
<i>Commelina benghalensis</i> L.	Batbatiya- Chakma (45854)	Commelinaceae	Herb	Whole plant	Snake bite	Paste of whole plant mixed with lime is placed onto the bitten place	22
<i>Curcuma caesia</i> Roxb.	Muicheya- Chakma, Marma (Local) (45369)	Zingiberaceae	Herb	Rhizom e	Hernia	Dried rhizome powder (100- 150 mg) mixed in water is taken twice a day	12
<i>Cycas pectinatus</i> Griff.	Moniraj- Chakma, Bangla (Gymnosperm) (45438)	Cycadaceae	Shrub	Cones	Stomach trouble	Dried seed cone powder mixed with <i>Terminalia arjuna</i> leaf extract is taken early morning in empty stomach	24
<i>Dalbergia stipulacea</i> Roxb.	Horoiludhi- Marma (45587)	Fabaceae	Shrub	Root and Leaves	Gonorrhea	Extract of plant (root/leaf) taken 2/3 times a day	29
<i>Dalbergia volubilis</i> Roxb.	Dandauphal- Chakma (Local) (45628)	Fabaceae	Shrub	Whole plant	Gastritis	Extract of plant (200 ml) is taken once a day in the morning	33
<i>Derris robusta</i> Benth.	Gung ba- Marma (45245)	Fabaceae	Climber	Root	Sore Throat	Filtrate of root paste placed in the throat (for 30 min and then washed out) twice a day before meal	17
<i>Desmodium gangeticum</i> (L.) DC.	Bormajal- Chakma, Salpani- Bangla (45728)	Fabaceae	Herb	Roots	Anthelmin- tic, typhoid, malaria	Root paste (50-70 ml) or powder of dried root (one spoonful) - early in the morning in empty stomach	10
<i>Dillenia indica</i> L.	Ulugach- Chakma, Chalta- Bangla (45926)	Dilleniaceae	Tree	Fruits	Dysentery, diarrhea	Fruit juice (one glass) - twice a day.	28
<i>D. pentagyna</i>	Hara- Chakma,	Dilleniaceae	Tree	Bark	Blood	Paste of plant in water is	25

Roxb.	Marma (Local) (45867)				dysentery	filtered, one spoon filtrate mixed with rice (50 g) is taken twice a day	
<i>Dipterocarous turbinatus</i> Gaertn. F.	Gajjam- Chakma, Bangla (45345)	Dipterocarpaceae	Tree	Resin	Gonorrhoea	Dried resin (10-15 mg) mixed with <i>Bryophyllum pinnatum</i> (Lam.) Oken leaf extract (10 ml) is taken orally once in the morning	18
<i>Elephantopus scaber</i> L.	Hatichada- Marma (45469)	Asteraceae	Herb	Whole plant	Measles	Dried plant powder mixed with coconut oil is massaged all over the body twice a day	22
<i>Entada phaseoloides</i> (L.) Merr.	Gila- Chakma, Bangla (45368)	Mimosaceae	Climber	Seed	All types of pain	Pulp of the seed (1/4 pulp of one seed) intake twice a day	28
<i>Eupatorium ayapana</i> Vent.	Paihu- Chakma (45637)	Asteraceae	Herb	Leaves, green bark	Gastritis, stomach trouble	Water extract of bark and leaves- taken twice a day	21
<i>Euphorbia hirta</i> L.	Noma- Chakma (Local) (45256)	Euphorbiaceae	Herb	Whole plant	Increase milk secretion	Extract of plant (after concentration, one spoonful) is taken once a day in the morning	29
<i>Ficus hispida</i> L. f.	Fahshaiba- Marma, Kakdumur- Bangla (45746)	Moraceae	Tree	Fruit	Blood pressure	One fruit paste mixed with water is given once a day	21
<i>Ficus pumila</i> L.	Ludimarbo- Marma (Local) (45948)	Moraceae	Climber	Stem	Stomach and urinary trouble	Dried bark powder (2 spoonful) + Arjun bark extract (100 ml) is given twice a day	18
<i>F. racemosa</i> L.	Zoiggadumur- Chakma, Bangla (45879)	Moraceae	Tree	Fruit	Rheumatic pain	Fruit paste with kerosene oil is massaged over rheumatic places	18
<i>Flemingia macrophylla</i> (Willd.) Merr.	Eyamimana- Marma (45356)	Fabaceae	Shrub	Whole plant	Rheumatic fever	Plant paste placed in the affected body part (once for one day and washed with water next day) and repeated for 10 days	27
<i>Garcinia cowa</i> Roxb.	Kaogola- Chakma (45484)	Clusiaceae	Tree	Bark	Astringent	Paste of bark placed in bleeding place	18
<i>Gardenia coronaria</i> Ham.	Rekphulgach- Marma (45528)	Rubiaceae	Tree	Leaves	Rheumatic pain	Oil prepared from water extracts of leaf (dried) mixed with olive oil is massaged over rheumatic places	31
<i>Glycosmis arborea</i> DC.	Hotiggira- Chakma (45649)	Rutaceae	Shrub	Leaves	Jaundice	Extract of green leaf (50 ml) or leaf powder (50 mg) taken with ½ spoonful sugar once in early morning	38
<i>Grewia asiatica</i> L.	Taratra- Marma (45268)	Titiaceae	Tree	Leaves	Dandruff	Leaf paste mixed with coconut oil is placed in the scalp for 30 min and then wash out	7
<i>Heliotropium indicum</i> L.	Etasure- Marma (45758)	Boraginaceae	Herb	Leaves	Ring worm	Paste of leaf kept in water (one glass) whole night, filtered is drunk in the morning	28
<i>Hemidesmus indicus</i> R. Br.	Chikondudhia- Chakma (45956)	Asclepiadaceae	Climber	Roots	Leucoderma	Dried root powder (100 mg) mixed in water- is taken twice a day	23
<i>Hydrolea zeylanica</i> (L.) Vahl	Rehankhuni- Marma (45835)	Hydroleaceae	Herb	Whole plant	Chest pain	Whole plant water extract (one glass) is given two/ three times a day	18
<i>Ichnocarpus frutescens</i> (L.) R. Br.	Dudhnoi- Chakma, Syamalota- Bangla (45378)	Apocynaceae	Climber	Whole plant	Toothache, scabies	Powder/ash of plant placed in the tooth root and kept for 10-20 min to treat toothache. Powder of dried plant (50 mg) mixed with mustard oil (5 ml) is massaged to the affected	26

<i>Ipomoea mauritiana</i> Jacq.	Bhuikumra-Tripura, Bangla (45473)	Convolvulaceae	Climber	Tubers	Sex stimulant	part to treat scabies. Powder of dried tuber (50/60 mg) mixed with sugar (1/2 spoonful) is taken with one glass of milk before intercourse	8
<i>Ixora undulata</i> Roxb.	Chikanchuilla-Chakma (45534)	Rubiaceae	Shrub	Roots	Diarrhoea	Root paste (one root for five times) mixed with fresh water is taken each time after passing stool	29
<i>Jasminum sambac</i> (L.) Ait.	Mulipai- Chakma (45658)	Oleaceae	Shrub	Leaves	Menstrual disorder	One piece of stem (weight 2/3 gm each) kept in water (one glass) over night is drank in the morning	13
<i>Justicia ganderussa</i> L. f.	Kala basak-Chakma, Bangla (45255)	Acanthaceae	Shrub	Leaves	Eczema	Powder of dried leaf mixed with mustard oil is massaged to the affected part to treat eczema	25
<i>Kalanchoe pinnata</i> Pers.	Geos- Marma (45279)	Crassulaceae	Herb	Leaves	Kidney stone, cough	Green leaves paste mixed with slight salt is given one spoonful thrice a day	28
<i>Lantana camara</i> L.	Lantana- Marma, Bangla (45764)	Verbenaceae	Shrub	Bark and leaves	Malaria	Water extract of leaves/barks (extraction period 24 hrs) one glass extract is taken in the morning	31
<i>Lasia spinosa</i> (L.) Thw.	Gandagi- Chakma (45968)	Araceae	Herb	Leaves	Piles	Water extract of leaves- is taken twice a day	12
<i>Leea sambucina</i> Willd.	Kra- Chakma (45826)	Leeaceae	Shrub	Roots	Boils	Root powder (50 mg) kept in water (for 24 hrs) - one glass extract is taken in the morning	23
<i>Leucas lavandulaefolia</i> Sm.	Pasunsa- Chakma, Bangla (45398)	Lamiaceae	Herb	Whole plant	Wounds, rheumatic pain	Plant paste placed in the wound part (once for one day and washed with water in the next day)	20
<i>Litsea glutionsa</i> (Lour.) Rob.	Menda- Chakma, Bangla (45458)	Lauraceae	Tree	Bark, leaves, roots	Dysentery (leave), leucorrhoea (roots)	For Dysentery: Water extract of leaves (one glass) + ghee (1/2 spoon) + honey (1/2 spoon) - one glass in morning (empty stomach). For Leucorrhoea: Root paste in water (one cup) + ghee (1/2 spoon) + honey (1/2 spoon) - twice a day	21
<i>Maesa montana</i> A. DC.	Sainkhuingtrang-Chakma (45545)	Myrsinaceae	Shrub	Leave	Boils	Fresh leaf paste (50/70 mg) kept in water (one glass) whole night and drank in the morning	28
<i>Maesa ramentacea</i> A. DC.	Kang boinba- Marma (45656)	Myrsinaceae	Shrub	Leaves	Wound	Leaf paste is placed on wounds	22
<i>Melochia corchorifolia</i> L.	Tikiokra- Marma (45286)	Malvaceae	Herb	Leaves	Stomach pain	Water extract of green leaf (one spoonful) mixed with sugar (1/4 spoonful) is taken daily in the morning	25
<i>Mimosa pudica</i> L.	Sadalajuri-Chakma, Sadalobjaboti-Bangla (45784)	Mimosaceae	Herb	Whole plant	Impotence, diabetes	Water extract of plant (200-300 ml) for thrice a day	27
<i>Mirabilis jalapa</i> L.	Chingba- Chakma (45973)	Nyctaginaceae	Herb	Roots	Dropsy	One third part of boiled roots water extract (250 ml) is taken thrice for one day before meal	35
<i>Nerium oleander</i> L.	Nuibang- Chakma (45864)	Apocynaceae	Shrub	Latex	Skin disease	Dried powder of latex mixed with coconut oil is massaged over whole body before bath	28

<i>Ocimum americanum</i> L.	Sabarang- Chakma, Tushi- Bangla (45352)	Lamiaceae	Herb	Leaves	Cold fever	Water extract of leaves (two spoon full)+sugar (1/4 spoon)-once a day (morning)	29
<i>Ophiorrhiza rugosa</i> Wall.	Rubong- Marma (45428)	Acanthaceae	Herb	Leaves	Throat pain	Leaf paste is placed in the throat for 30 min and then washes out	26
<i>Oroxylum indicum</i> Vent.	Haowalu- Chakma, Thona- Bangla (45648)	Bignoniaceae	Tree	Bark and seed	Diarrhea	One glass of water extract of bark (extraction period 24 hrs) with honey or powder of dried seed (one spoonful) in water-twice a day in empty stomach	18
<i>Paederia foetida</i> L.	Patabansludi- Chakma, Candhapata- Bangla (45549)	Rubiaceae	Climber	Root, leaves	Rheumatoid arthritis, abdominal pain	Water extract of leaf (100-120 ml) or powder of dried root (one spoonful) - early in the morning in empty stomach	20
<i>Passiflora foetida</i> L.	Jhumkoludi- Chakma (45795)	Passifloraceae	Climber	Leaves	Hysteria	Water extract of leaf (100 ml) mixed with <i>Curcuma</i> powder (5 mg) is taken twice a day	33
<i>Phyllanthus emblica</i> L.	Alomoti- Chakma (45954)	Euphorbiaceae	tree	Fruit	Jaundice	Dried/ green fruit (one piece)is given thrice a day	20
<i>Physalis minima</i> L.	Sekemthatai- Chakma (45849)	Solanaceae	Herb	Leaves	Earache	Dilute filtrate of leaf extract mixed with mustard oil is placed into ear by dropper (2/3 drops)	29
<i>Plumbago indica</i> L.	Kaingkhao- Chakma (45382)	Plumbag-inaceae	Shrub	Whole plant	Contraceptive	Taking plant powder (300 mg) thrice a day.	14
<i>Plumeria rubra</i> L.	Gulanchi- Chakma, Katgolab- Bangla (45454)	Apocynaceae	Tree	Bark	Viral fever	Bark water extract (100-150 ml) mixed with ¼ spoon sugar heated below 100 °C is taken thrice a day	19
<i>Pothos scandens</i> L.	Hijingchinepata- Chakma (45626)	Araceae	Climber	Whole plant	Snake bite	Paste of whole plant (mainly leaf/root) placed in the bitten place along with intake of leaves water extract (250 ml) once in the morning	29
<i>Premna esculenta</i> Roxb.	Kamrah- Chakma, Bangla (45524)	Verbenaceae	Shrub	Leaves	Urinary trouble	Water extract of leaves (200-250 ml) mixed with milk (50 ml) and taking twice a day	17
<i>Ricinus communis</i> L.	Rangma- Chakma, Bherenda- Bangla (45786)	Euphorbiaceae	Shrub	Seed	Constipation, joint pain	Constipation: Seed oil (one spoonful- twice a day- empty stomach). Joint Pain: Massage of seeds oil	28
<i>Saraca asoca</i> (Roxb.) de Wilde	Ashok- Chakma, Bangla (45962)	Caesalpiniaceae	Tree	Bark	Amoebiasis, leucorrhea	Water extract of bark (one glass filtrate) + ½ spoon honey–twice a day, empty stomach for Leucorrhea and early in the morning empty stomach for Amoebiasis	24
<i>Sida cordifolia</i> L.	Oakhipane- Chakma (45893)	Malvaceae	Herb	Root and leaves	Abscess	Dried powder of root/leaf mixed with coconut oil is placed into the abscess	20
<i>Solanum torvum</i> Sw.	Kajoba- Chakma (45394)	Solanaceae	Shrub	Leaves and fruit	Worms	Water extract of leaf/fruit with slight salt- thrice a day	29
<i>Stephania japonica</i> (Thunb.) Miers	Thandamanik- Chakma, Bangla (45464)	Menispermaceae	Climber	Leaves	Gastritis	Hot water extract of leaves (250 ml) taken daily empty stomach during early morning.	31
<i>Sterculia villosa</i> Roxb.	Chambai- Chakma (45634)	Sterculiaceae	Tree	Petioles	Impotence	Petiole (two pieces) taken with betel after meal followed by one glass of milk	21
<i>Streblus asper</i> Lour.	Sarbagach- Chakma (45538)	Moraceae	Tree	Leaves	Urinary inflammation	Water extract of leaf (250 ml) mixed with sugar (1/4 spoon) is given twice a day	26
<i>Terminalia bellirica</i>	Borahola- Chakma (45762)	Combretaceae	Tree	Fruit	Menstrual disorder	Dried/ green fruit (one piece)is given once in the morning	20

(Gaertn) Roxb.								
<i>T. chebula</i> (Gaertn.) Retz.	Oittal-Chakma, Haritaki- Bangla (45945)	Combretaceae	Tree	Fruit	Dysentery	Dried seeds powder (one spoonful) in water (early in the morning in empty stomach).	25	
<i>Thunbergia grandiflora</i> Roxb.	Nilludi- Chakma (45868)	Acanthaceae	Climber	Leaves	Stone in urinary bladder	Dried leaf powder (one spoonful) mixed in water and taken twice a day for 15 days	16	
<i>Trema orientalis</i> (L.) Blume	SakkaSala- Chakma (45328)	Ulmaceae	Tree	Bark	Fever with vomiting	Water extract of bark (50 ml) - thrice a day (before meal)	11	
<i>Trewia nudiflora</i> L.	Chagalladi bhangor- Chakma (45478)	Euphorbiaceae	Tree	Bark	Enlarged thyroid gland	Extract of leaves in water (extraction period 24 hrs) - one glass extract intake in the morning	29	
<i>Urena lobata</i> L.	Pobibaong- Chakma (45652)	Malvaceae	Shrub	Roots and leaves	Rheumat- ism	Paste of leaf/root placed in the arthritic part (once for one day) and washed with water next day)	17	
<i>Vitex negundo</i> L.	Niramisludi- Chakma (45562)	Verbenaceae	Shrub	Leaves	Asthma	Water extract of leaves (50 ml) +sugar (1/4 spoon)- twice a day (before meal)	33	
<i>V. trifolia</i> L.f.	Khupaninda- Chakma (45739)	Verbenaceae	Shrub	Leaves	Swollen testicles	Water extract of leaves (200- 250 ml)- once a day (morning)	19	
<i>Xanthium indicum</i> Koenig	Lengra- Chakma, Dudhnoi- Chakma (45978)	Asteraceae	Herb	Leaves	Malaria	Water extract of leaves (250 ml)+sugar (1/2 spoon)- thrice a day (before meal)	25	

Table 2. Demography of the informants and traditional health practitioners.

Variables	Categories	No. of person	Percentage
Informants category	Traditional practitioners (<i>Boidyas</i>)	14	8.28 %
	Indigenous people	155	91.72 %
Identity of the informants	Chakma	139	82 %
	Bengalis	13	8 %
	Marma	13	8 %
	Tripura	4	2 %
Gender	Male	166	98.22 %
	Female	3	1.78 %
Age	Less than 35 years	28	16.57 %
	35-45 years	12	7.10 %
	45-55 years	87	51.48 %
	55-65 years	24	14.20 %
	More than 65 years	18	10.65 %
Experience of the traditional practitioners (<i>Boidyas</i>)	Less than 2 years	3	21.43 %
	2-5 years	5	35.71 %
	5-10 years	4	28.57 %
	More than 10 years	2	14.29 %

The survey was carried out among local inhabitants in Khagrachhari district where 92% of the informants were tribal communities e.g. Chakma, Marma and Tripura. The total interviewees were 155 of which three were women and all of the 14 *Boidyas/Hakims* were male. There was a high percent

of informants who were around 45-55 years of age (51.48%), followed by 55-65 years (14.20%), more than 65 years (10.65%) and lowest informants were 35-45 years of age (7.10%). Another prominent factor was that most of the informants and *Boidyas/Hakims* were illiterate and among them only

five informants and four *Boidyas/Hakims* were educated (Figure 2). In the case of applied or empirical knowledge, the majority of the

Boidyas/Hakims had 2-5 years of experience (35.71%) (Table 2).



Figure 2. Interview of traditional health practitioners (Boidyas/Hakims) and plant collection.

The various parts of plants like whole plant, leaves, barks, fruits, seeds, roots and stems were used in different ailments. Usually, the plant parts (Figure 3) most frequently used were the leaves (34.55%) followed by bark (16.36%), whole plant (13.64%), root (13.46%), fruits (8.16%), seeds (5.46%), stem (2.37%), and others (5.46%). The findings were

similar with another study by Faruque⁹ in Baliachhari Upazila, Rangamati district, near Khagrachhari under the Chattogram division.⁹ The most common method of preparation was extraction (39.18%), followed by paste (21.65%), powder (19.59%), infusion (14.43%), while other methods like whole plant (3.09%), and jelly (2.06%) were used less frequently (Figure 4).

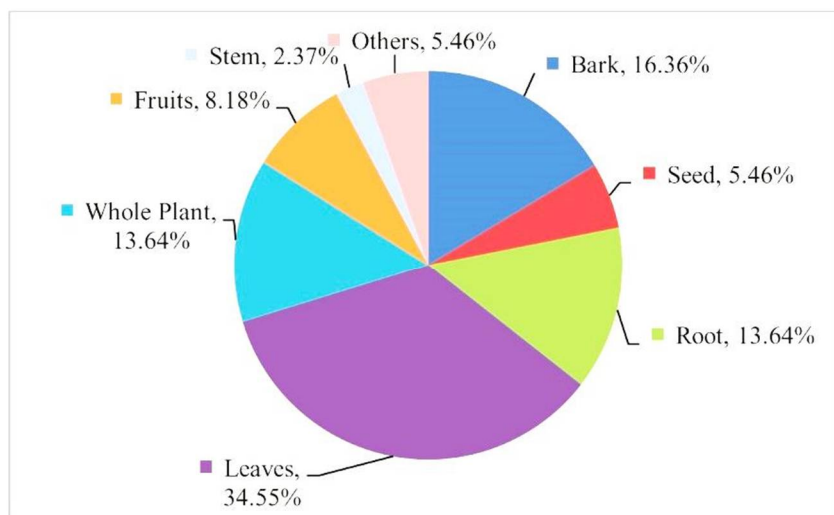


Figure 3. Different parts of the plant used in ailments.

The extract was an effortless preparation and had an advantage compared to others, which mostly depends on the ailments and the way of administration or application. In respect to the route of administration of herbal remedies, the oral route is

the most frequent one (74.13%).¹⁹ Among the external administrations, the methods were skin application, tooth application and ear's drop (Figure 5). The oral route and skin application are the most commonly used; as the local communities mainly

suffer from digestive diseases and muscular pain. The different life forms of ethno-medicinal plants are

herbs (28), trees (25), shrubs (24) and climbers (17). Among them herbs forms are predominant (Figure 6).

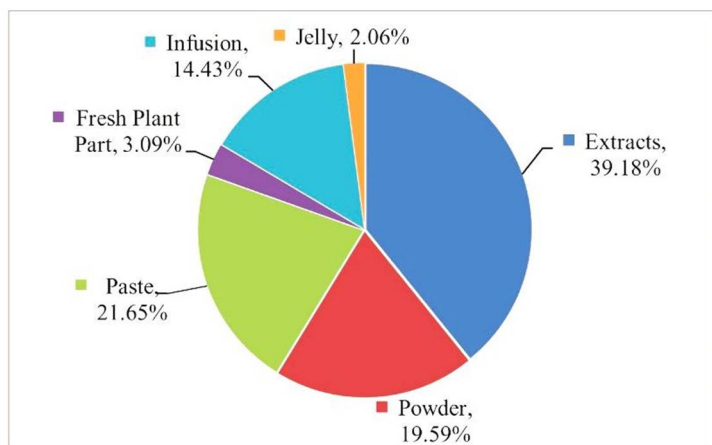


Figure 4. Different modes of preparation used by the THPs.

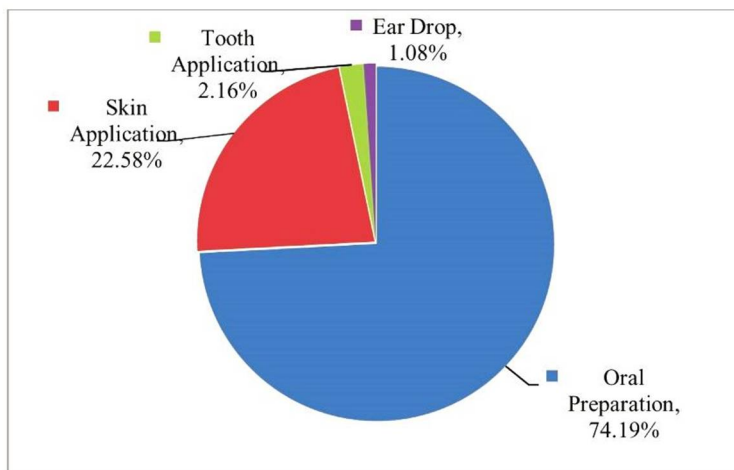


Figure 5. Types of preparations for administration or application.

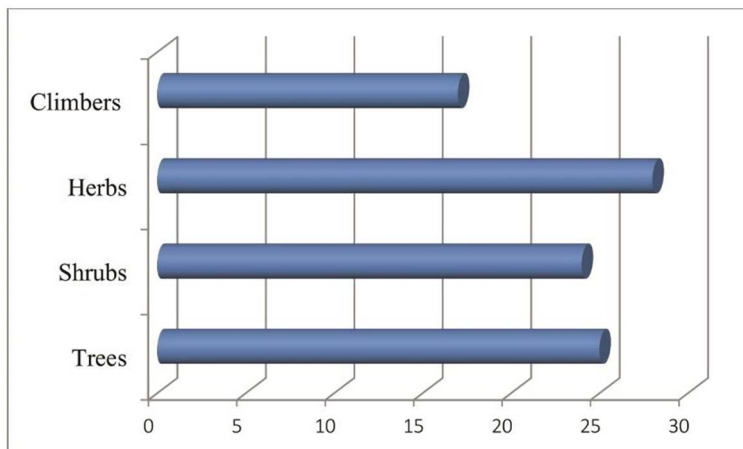


Figure 6. Different life forms of ethnomedicinal plants found in survey study.

All the documented plant species show potential medicinal properties and further investigation into these plants can be value-added to be useful toward the progression of future lead compounds. In most cases, leaves with or without other plant parts are used in the treatment procedure. The ease of usability to leaves enlightened their numerous inclusions in most of the preparations compared to berks, roots, fruits and whole plants.^{18,20} In addition, using leaves could be concerning preservation of the plants because most of the plants are being uprooted which might be the cause of loss of the plant and put the species in a vulnerable situation.²¹⁻²³ We have documented relevant formulation procedures, dose, duration of treatment on the basis of their observations of the type of ailments and seriousness of the disease (Table 1). For the treatment of abdominal pain, water extract (100-120 ml) of dried powdered leaf of *Paederia foetida* L. or powdered dried root of one spoonful mixed with honey is used. This medication is taken orally once a day in the early morning with an empty stomach. Similar opinions were recorded by other researchers and showed ethanolic extract performed better activity than water extract.^{8,24} On the other hand, powder of dried root or leaf (one spoon full) of *Sida cordifolia* L. mixed with coconut oil (quantity sufficient) and placed on the abscess showed a better result. This is taken thrice a day and after each time washes out the exudates with clean water. Ethanol extract of *Sida cordifolia* L. roots showed better therapeutic activity than water extract for the treatment of abscess.²⁵ Similar activities are also performed by *Argyrea nervosa* (Burm. f.) Boj. *Sida cordifolia* L. also showed other therapeutic activities like analgesic activity and antioxidant activity.^{6,10} Other ailments status mentioned in table 1 also demonstrated by researchers over time such as paste of *Garcinia cowa* Roxb. bark an effective astringent⁴ & *Aphanamixis polystachya* (Wall.) Parker seed in liver disease.⁵ In addition, *Saraca asoca* (Roxb.) de Wilde bark in leucorrhoea^{15,26}, *Paederia foetida* L. leaves and root in bone fracture²⁷, *Plumbago indica* L. whole plant as contraceptive²⁸, *Cassia tora* L. leaves in diabetes¹⁶,

Sterculia villosa Roxb. petioles in impotence²⁹, *Lantana camara* L. bark and leaves in malaria³⁰, *Vitex trifolia* L. leaves in swollen testicles treatment²⁹, *Ipomoea mauritiana* Jacq. tuber as sex stimulant have been used in the territory.²⁶ Traditional health practitioners often used one single plant species in the treatment of different ailments like *Litsea glutionsa* (Lour.) Rob. in dysentery and leucorrhoea, *Cassia sophera* L. in ringworm and expectorant, *Saraca asoca* (Roxb.) de Wilde in amoebiasis and leucorrhoea, *Ricinus communis* L. in constipation and joint pain etc.

CONCLUSION

The indigenous people of the Khagrachhari hilly areas depend on the traditional based systems and rely on the practical knowledge of the THPs for the management of their health problems. Different types of plant species had been identified from the hilly areas and their medicinal values are being evaluated by several researchers. But now-a-days, the valued medicinal plants have lost their existence due to disastrous events like urbanization, deforestation, road contraction, wood collection, illegal encroachment of forest and hills, *jhum* cultivation and natural calamities like cyclones and floods. Furthermore, the death of traditional health practitioners will result in an immediate loss of this critical traditional knowledge, as it is only passed down orally due to a lack of proper documentation. Thus, immediate measures like inventory of medicinal plants of hilly areas, documentation of verbal information, conservation of threatened plant species, sustainable management of risky areas, training of THPs, and awareness about the importance of biodiversity should be taken immediately by the government as well as local charitable organizations to conserve the exploitation of potential medicinal plants. By following these necessary steps we can protect the important vulnerable plant species from being endangered in the Khagrachhari district.

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Contribution of the authors

All the authors contributed in this research work through participation in gathering information and plants collection. Identification of plants and documentation was done by MZU, drafting of manuscript was done by BKS and data analysis & finalization of manuscript writing was done by RB under the guidance of SCB. Project designing and overall supervision of the survey work was also done by SCB.

Conflict of interest

No conflict of interest among the authors exist.
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