

DETERMINATION OF LOCAL PEOPLE CONSENSUS IN THE USE OF MEDICINAL PLANTS OF THAKURGAON DISTRICT

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Abstract

Consensus in the use of medicinal plants is one of the criteria to find the potential medicinal plants for further in-depth investigation. The present study was conducted with the aim to determine the people consensus in the use of medicinal plants in Thakurgaon district. Data of medicinal plants were recorded using key informant interviews, semi structured interviews and group discussion. A total of 102 medicinal plant species under 49 families with 185 formularies to treat 54 ailments were recorded from the study area. The most frequently utilized plant species are trees (38%) followed by herbs (34%), shrubs (18%) and climbers (10%). The major part used for medicines was leaf. Oral consumption was the main mode of treatment in the study area followed by external application. The top Fic value was obtained in case of heart diseases (0.92). The most cited species used to treat this ailment was *Allium sativum*, *Phyllanthus emblica*, *Spondias pinnata* and *Terminalia arjuna*. The second highest Fic value was found in respiratory disorders (0.89) followed by cuts and wounds (0.85), skin diseases (0.84) and gastrointestinal disorders (0.81). In case of FI value, *Allium sativum*, *Spondias pinnata*, *Cynodon dactylon*, *Lawsonia inermis*, *Zingiber officinale*, *Saccharum officinarum*, *Tagetes erecta* and *Baccaurea ramiflora* were showed 100%. The species of higher citation frequency were *Allium sativum*, *Phyllanthus emblica*, *Spondias pinnata*, *Terminalia arjuna*, *Cynodon dactylon* and *Ocimum sanctum*. This study recommends that the species which showed high Fic, FI, Cf values could be used for further phytochemical analysis to investigate active compounds for the discovery of new drugs from medicinal plants.

Introduction

Ethnobotanical investigation is the gateway in identifying new plant products of potential commercial values (Uddin *et al.*, 2015). Documented medicinal plants with high degree of consensus can serve as a basis for future investigation of modern drug (khan *et al.*, 2014). The world market for herbal medicines based on traditional knowledge is now estimated at US\$ 60 billion (Breevot, 1998). In 1992, the world leaders met in Rio de Janeiro to formulate biodiversity conservation policy including agenda 21 which also gave emphasis on the documentation and sustainable utilization of traditional knowledge of medicinal plants. Indigenous knowledge of using medicinal plants for healing human ailments is however in danger of gradually become extinct, because this knowledge is passed on orally from generation to generation without the aid of a writing system (Kaido *et al.*, 1997). Most culture possess a huge store of undocumented traditional knowledge of applying herbal remedies in the treatment of diseases (Offiah *et al.*, 2011). In addition, documenting the results of scientific research into traditional medicine may

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also help to conserve an important part of an indigenous people's cultural heritage for the future generations (Mahwasane *et al.*, 2013). Ethnobotanical studies have got attention in all over the world. Unless the plants are conserved and the ethnobotanical knowledge is documented, there is a danger that both the valuable medicinal plants and the associated indigenous knowledge of the ethnic groups could vanish forever due to lack of documentation.

The documentation of indigenous knowledge of herbal medicine is an important aspect of conservation approach (Umair *et al.*, 2017). Many studies have been done on indigenous knowledge of medicinal plants in different parts of Bangladesh. Today a substantial number of drugs are developed from plants which are active against number of diseases (Principe, 2005). In spite of tremendous advances in synthetic drugs and medicine, a large number of people still believe on herbal drugs with hope of safety and efficacy (Verma *et al.*, 2008). Plants may serve as the alternative sources for the development of new anticoagulant agents due to their biological activities.

Currently medicinal plants and traditional knowledge have been eroding because of anthropogenic pressure, deforestation, pollution, modern agriculture practices, lack of awareness, unwilling to practice forefather tradition, climate change, modern culture, migrating towards urbans and no written documents. Some of such knowledge is going to be eliminated before documentation which is alarming to sustain cultural heritage (Uddin *et al.*, 2017). So, it is essential to document all traditional knowledge about herbal medicine and all medicinal plants. In order to protect such knowledge, documentation of ethnobotanical plants is already started in Bangladesh. A number of articles have been published in this field, for example, Mia and Huq (1988), Hassan and Khan (1986, 1996), Alam (1992), Alam *et al.* (1996), Uddin (2006), Uddin *et al.* (2001), Khan *et al.* (2002), Yusuf *et al.* (2002), Uddin *et al.* (2004), Uddin *et al.* (2006), Yusuf *et al.* (2006), Uddin and Roy (2007), Uddin *et al.* (2008), Uddin *et al.* (2012), Haque *et al.* (2014) and Uddin and Hassan (2014), Kona and Rahman 2016, Nahar *et al.* 2016, Faruque *et al.* (2018,2014) and Uddin *et al.* (2019). These articles listed a good number of medicinal plants of particular community or particular diseases or particular areas of Bangladesh. But there are still more medicinal plants which are being used as the sources of herbal drugs by the ethnic and local people of Bangladesh but yet to be identified scientifically. Unfortunately, no such work has covered the documentation of ethnomedicinal plants of rural people of Thakurgaon district.

The houses homesteads of each village of Thakurgaon are rich with natural plant diversity in its unique original ecosystems. The indigenous livelihood is mainly based on cultivation system. They mainly cultivate rice as a principal food and also cultivated other diversity of minor crops in and around their homes. Many indigenous species are disappearing from the area as well as many new invasive, alien species are occupying its habitats. Such loss of indigenous species might have an adverse effect on the food security and livelihoods of the area. So, there is a great necessity for recording the existing medicinal plant species through adequate ethnobotanical studies in the area before their disappearance from the natural habitats. Traditional practitioners of the area also use the medicinal plants in the treatment of various diseases. Currently medicinal plants, healthcare knowledge of medicinal plants and their habitats are vulnerable because of many threats such as lack of awareness, deforestation, urbanization, agricultural expansion, illegal logging and poaching etc. If the situation continues, important medicinal plants will be eliminated before their documentation. In the present study an attempt was made to record ethnomedicinal use of plants and to determine the consensus of local people in the use of medicinal plants for the treatment of ailments.

Materials and Methods

Thakurgaon is a district in the northwest of Bangladesh under Rangpur division. It is located between 25°40' and 26°12' N latitudes and 88°05' and 88°39' N longitudes. The district is bounded by Panchagarh district on the north, Panchagarh and Dinajpur districts on the east, and the West Bengal state of India on the south and west. This district consists of six thanas named as Thakurgaon Sadar, Ruhia, Baliadangi, Pirganj, Ranishankail, and Haripur. The climate of the district is mainly tropical dry with late monsoon. The monsoon usually begins in June and ends in October, with an average rainfall of 1700 mm. The summer average temperature is 31 °C, and the winter average temperature is 19 °C (Banglapedia, 2014). There are five forest beats present in the Thakurgaon forest range. The most dominant species in such forest beats is Sal (*Shorea robusta*). A good number of herbs, shrubs, and climbers are grown with dominant Sal trees those may have medicinal values (personal communication and observations).

The study area was visited five times in different seasons of 2018 and 2019. Each field trip lasted for five to eight days. The data on medicinal uses were collected through semi-structured interviews, key informant discussions, and informal conversations with local people and also herbal practitioners. Participant observation, plant interview, field interview, and group interview were also followed to collect data (Alexiades, 1996). A total of 250 local informants, including 58% males and 42% females, were interviewed during the ethnobotanical survey. The education levels of the informants ranged from illiterate up to B.S. degrees. The informants were mainly farmers, housewives, herbal practitioners, shopkeepers, businessmen, teachers, and students. The age of the informants ranged from 21 to 80 years. Information on the uses of plants to treat humans, parts used, modes of treatment, and administration were collected during the field survey. The vernacular names were collected with the help of the local people. The recorded medicinal plants were collected from fields and gardens with notes on field characters. Voucher specimens for each medicinal plant were processed using standard herbarium techniques (Hyland, 1972 and Alexiades, 1996). Identification of plant species was done by experts in both the field and laboratory and consulting standard literature (Siddiqui *et al.*, 2007; Ahmed *et al.*, 2008-2009). In case of confusion in identity, standard literature was consulted, and relevant voucher specimens available at the Dhaka University Salar Khan Herbarium (DUSH) were also compared. All voucher specimens were deposited at DUSH. To determine people's consensus in the use of medicinal plants, factor informant's consensus (Fic), fidelity level (Fl), and citation frequency (Cf) values were calculated using standard mathematical models according to Heinrich *et al.* (1998) and Friedman *et al.* (1986).

Results and Discussion

Present study was recorded a total of 102 medicinal plant species under 49 families. These medicinal plants were used for the management of 54 ailments through 185 formularies in the study area. Maximum medicinal plant species (67%) were found under 17 families and rest medicinal plants species (37%) were found in 32 families (Fig. 1). Among the families, Araceae, Rutaceae, Cucurbitaceae, Poaceae, Fabaceae, Liliaceae, Solanaceae, Verbenaceae, Asteraceae, and Caesalpiniaceae were the dominant families with the common medicinal plant species in the study area. For each species, the scientific name, local name, family, habit, parts-use, ailments, and modes of treatment have been presented in the Table 1. It is evident from a preliminary investigation that the study area still has a huge variation of knowledge about the uses of medicinal plants. Such knowledge has been passed down orally from generation to generation and no written document found on this knowledge.

Table 1. Ethnobotanical data on medicinal plants and uses in the study area (S=Shrub, H= Herb, T=Tree, C=Climber).

Scientific name	Local name	Family	Habit	Parts use	Ailments	Treatment mode
<i>Abroma augusta</i> (L.) L. f.	Ulotkombol	Sterculiaceae	S	leaf	Heart disease	Juice is taken.
				Stem	Jaundice	Soaked in water at night then drunk in morning.
<i>Justicia adhatoda</i> L.	Bashak	Acanthaceae	S	Leaf	Cough	Leaf chewed
					Cold treatment worm	Chewed leaf is taken Juice is taken
					Asthma	Leaf juice is taken with ginger and honey
<i>Aegle marmelos</i> (L.) Corr.	Bel	Rutaceae	T	Leaf	Diarrhoea	Leaf juice is taken
				Fruit	Constipation	Fruit juice is taken
					Gastric	Fruit juice is taken
					Jaundice	Fruit juice is taken
Dysentery	Juice is taken twice per day					
<i>Albizia procera</i> (Roxb.) Benth.	Koroi	Mimosaceae	T	Leaf	Allergy	Leaf paste is applied
<i>Allium cepa</i> L.	Peaj	Liliaceae	H	Bulb	Flue	Juice is taken
<i>Allium sativum</i> L.	Rosun	Lilliaceae	H	Bulb	Heart disease	2-3 cloves are eaten in the morning
<i>Alocasia macrorrhizos</i> (L.) G. Don	Mankachu	Araceae	H	Rhizome	Rheumatic pain	Cooked rhizome is taken
<i>Aloe vera</i> (L.) Burm. f.	Aloevera	Aloaceae	H	Leaf	Diabetes	Inside portion of leaf is eaten
					Skin disease	Paste is applied externally
					Stomachache	Leaf juice is taken
<i>Alstonia scholaris</i> (L.) R. Br.	Chatim	Apocynaceae	T	Bark	Cough	Bark juice is taken
<i>Amaranthus tricolor</i> L.	Lalshak	Amaranthaceae	H	leaf	Pressure reduce	Cooked leaf is eaten
<i>Amorphophallus paeoniifolius</i> (Dennst.) Nicolson	Olkachu	Araceae	H	Rhizome	Rheumatic pain	Cooked rhizome is taken
<i>Ananas comosus</i> (L.) Merr.	Anaros	Bromiliaceae	H	Leaf	Gastric	Leaf juice taken.
					Stomachache	Juice is taken
<i>Andrographis paniculata</i> (Burm.f.) wall. ex Nees	Kalomegh	Acanthaceae	H	Leaf	Cold treatment	Leaf chewed
					Constipation	Juice is taken
					Cough	Chewed leaf is taken
<i>Arachis hypogaea</i> L.	Badam	Fabaceae	H	seed	Heart disease	Fruit juice is taken
<i>Areca catechu</i> L.	Supari	Arecaceae	T	Root	Stomachache	Root juice is taken

Scientific name	Local name	Family	Habit	Parts use	Ailments	Treatment mode
<i>Artocarpus heterophyllus</i> Lamk.	Kathal	Moraceae	T	Leaf	Scabies	leaf boil with mustards oil then oil then taken on the affected area.
<i>Asparagus racemosus</i> Willd.	Satamuli	Liliaceae	C	Root	Gastric	Root is powdered and then taken
<i>Averrhoa carambola</i> L.	Kamranga	Oxalidaceae	T	Fruit	Cough	fruit juice is taken daily for 3-4 days.
<i>Azadirachta indica</i> A. Juss.	Neem	Meliaceae	T	Leaf	Diabetes	juice is taken
					Pox	Paste is applied externally
					Skin rash	Leaf paste is applied
<i>Baccaurea ramiflora</i> Lour.	Lotkon	Euphorbiaceae	T	Fruit	Anti-oxidant	Fruit juice is taken
<i>Bambusa tulda</i> Roxb.	Talla bash	Poaceae	T	stem	Impotence	Stem is cooked and then taken
<i>Basella alba</i> L.	Puisak	Basellaceae	C	Leaf	Wound	Leaf paste is applied in the affected area
<i>Bombax ceiba</i> L.	Shimul	Bombacaceae	T	Root	Impotence	Juice is taken
<i>Borassus flabellifer</i> L.	Tal	Arecaceae	T	Young apex	Cough	Juice is taken
<i>Bryophyllum pinnatum</i> (Lamk.) Oken	Patharkuchi	Crassulaceae	H	Leaf	Cold treatment	juice is taken
					Diabetes	juice is taken
					Jaundice	juice is taken
					Acne	Paste is applied externally
<i>Cajanus cajan</i> (L.) Millsp.	Orhor	Fabaceae	S	Leaf	Jaundice	juice is taken
<i>Calotropis procera</i> (Ait.) R.Br.	Akanda	Asclepiadaceae	S	Leaf	Ringworm	Leaf paste is applied
<i>Carica papaya</i> L.	Pepe	Caricaceae	S	Fruit	Gastric	Eating fresh fruit or as vegetable
					piles	Eating fresh fruit or as vegetable
					Jaundice	Eating fresh fruit or as vegetable
					Constipation	Cooked fruit is taken
<i>Cassia fistula</i> L.	Sonalu	Caesalpiniaceae	T	Fruit	Constipation	Juice is taken
				Leaf	Ringworm	Leaf paste is applied on affected area
<i>Catharanthus roseus</i> (L.) G. Don	Noyontara	Apocynaceae	H	Flower	Diabetes	Flower chewed
				Leaf	Diabetes	Leaf juice is taken twice per day
<i>Centella asiatica</i> (L.) Urban	Thankuni	Apiaceae	H	Leaf	Diarrhoea	Leaf paste is eaten
					Brain sharpening	Leaf chewed
					Constipation	Leaf paste is taken
					Dysentery	Leaf paste is eaten

Scientific name	Local name	Family	Habit	Parts use	Ailments	Treatment mode
<i>Cinnamomum tamala</i> Nees & Eberm.	Tejpata	Lauraceae	T	Leaf	Cough	Leaf is boiled with water and then the water is taken
<i>Cinnamomum verum</i> J. S. Presl	Darchini	Lauraceae	T	Bark	Stomachache	Paste is used with warm water
<i>Citrus aurantifolia</i> (Christm. & Panzer) Swingle	Kagolilebu	Rutaceae	S	Fruit	Toothache	Juice is taken
<i>Citrus grandis</i> (L.) Osbeck	Jambura	Rutaceae	T	Fruit	Vomiting Fever	Juice is taken Fruit is eaten with pepper
<i>Citrus limon</i> (L.) Burm. f.	Lebu	Rutaceae	S	Fruit	Cold treatment	Bud is boiled with water and taken with tea
<i>Clerodrendrum viscosum</i> pers.	Vat	Verbenaceae	S	Leaf	Digestion Fever	Bud is eaten raw Young leaf juice is taken
				Stem	Jaundice	1 cup juice per day for 7 days
				Root	Daud	Root blended with Zinger then the paste is applied
<i>Coccinia grandis</i> (L.) Voigt	Telakucha	Cucurbitaceae	C	Leaf	Dysentery	Leaf paste taken internally
				Leaf	Dysentery	1 glass of leaf juice is taken
<i>Cocos nucifera</i> L.	Narikel	Arecaceae	T	Fruit	Jaundice Diabetes Pox	juice is taken internally leaf juice is taken Juice is taken
					Diarrhoea	Juice is taken
					Jaundice	Juice is taken
					Dysentery	Juice is taken
<i>Colocasia esculenta</i> (L.) Schott	Kochu	Araceae	H	Leaf	Brain tonic	Cooked and taken internally.
<i>Coriandrum sativum</i> L.	Dhonia	Apiaceae	H	Seed	Fat remove	Soaked in water then water is taken
<i>Bannicasa hispida</i> (Thunb.) Cogn.	Chalkumra	Cucurbitaceae	C	Stem	Toothache	Stem decoction for gargling
<i>Curcuma longa</i> L.	Holud	Zingiberaceae	H	Rhizome	Blood purifier	Juice is taken
					Scabies & fungal lesion	Paste is applied in the affected area
<i>Cuscuta reflexa</i> Roxb.	Swarnalata	Cuscutaceae	C	Stem	Deworming	Juice is taken
<i>Cynodon dactylon</i> (L.) pers.	Durba	Poaceae	H	Leaf	Cuts & wounds	Leaf paste is applied
<i>Dalbergia sissoo</i> Roxb.	Shishu	Fabaceae	T	Leaf	Jaundice	Leaf juice is taken
<i>Datura metel</i> L.	Dhutura	Solanaceae	S	Leaf	Skin disease	Leaf is cooked
					Skin disease	Leaf paste is applied externally
					Paralysis	Dried crushed leaf is applied

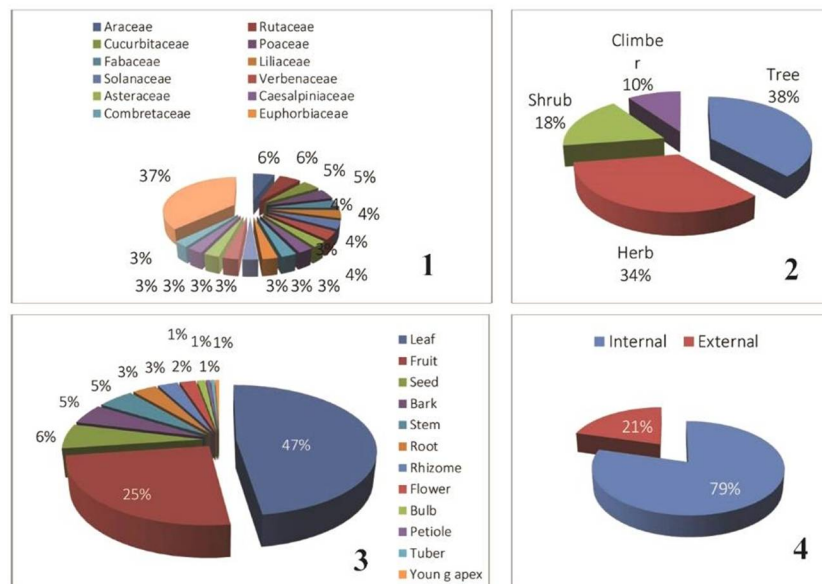
Scientific name	Local name	Family	Habit	Parts use	Ailments	Treatment mode
<i>Daucus carota</i> L.	Gajor	Apiaceae	H	Root	Heart disease	Root juice is taken
<i>Dillenia indica</i> L.	Chalta	Dilleniaceae	T	Leaf	Headache	Leaf paste is applied externally
				Fruit	Tumor	Leaf paste is applied
				Leaf	Diarrhoea	Fruit juice is taken internally
<i>Diospyros malabarica</i> (Desr.) Kostel.	Gab	Ebenaceae	T	Leaf	Diarrhoea	Leaf paste is applied
				Leaf	Headache	Leaf paste is applied externally
<i>Diplazium esculentum</i> (Retz.) Sw.	Deki shak	Athyriaceae	H	Leaf	Pressure reduce	Leaf is cooked
<i>Eclipta prostrata</i> (L.) Hassk.	Kalokeshi	Asteraceae	H	Leaf	Hair treatment	Leaf paste is applied
<i>Elaeocarpus robustus</i> Roxb.	Jolpai	Elaeocarpaceae	T	Fruit	Appetizer	Fruit juice is taken
<i>Enhydra fluctuans</i> Lour.	Helencha	Asteraceae	H	Leaf	Ulcer	Leaf juice is taken
					Eye treatment	Cooked leaf is taken
					Diabetes	Cooked leaf is taken
					worm	Cooked leaf is taken
					Jaundice	Leaf juice is taken
<i>Ficus bengalensis</i> L.	Bot	Moraceae	T	Fruit	Diabetes	Cooked fruit is taken
<i>Ficus racemosa</i> L.	Jogdumur	Moraceae	T	Fruit	Diabetes	Cooked leaf taken
<i>Gloriosa superba</i> L.	Ulotchandal	Lilliaceae	C	Root	Stomachache	Juice is taken
<i>Glycosmis pentaphylla</i> (Retz.) A. DC.	Motkila	Rutaceae	S	Leaf	Diarrhoea	juice is taken internally
				Stem	Toothache	Stem used as brushing teeth
<i>Hibiscus rosa-sinensis</i> L.	Joba	Malvaceae	S	Leaf	Liver control	Leaf soaked in water at night then taken in the next morning
				Flower	Hair fall	Flower paste is applied over head
				Leaf	Hair tonic	Leaves are used in preparation of hair tonic
					Dysentery	Leaf juice is taken internally twice a day
<i>Ipomea aquatica</i> Forssk.	Kalmi shak	Convolvulaceae	H	Leaf	Eye treatment	Leaf is cooked
<i>Lagenaria siceraria</i> (Molina.) Standl.	Lau	Cucurbitaceae	C	Seed	Kidney infection	Cooked seed is eaten
<i>Lawsonia inermis</i> L.	Mehedi	Lythraceae	S	Leaf	Hair treatment	Leaf paste is applied externally
<i>Leucas aspera</i> (willd.) Link	Dondokolos	Lamiaceae	H	Leaf	Cold treatment	Juice is taken

Scientific name	Local name	Family	Habit	Parts use	Ailments	Treatment mode
<i>Litsea glutinosa</i> (Lour.) Robinson	Menda	Lauraceae	T	Bark	Dysentery	Bark soaked in water and then taken
<i>Mangifera indica</i> L.	Aam	Anacardiaceae	T	Leaf	Diarrhoea	Leaf juice is taken
				Leaf	Diarrhoea	crushed and then taken in empty stomach once per day
					Heart disease	Young leaf juice is taken
					Toothache	Chewed young leaves
				Fruit	Jaundice	Fresh fruit juice is taken
<i>Melia azedarach</i> L.	Ghora neem	Meliaceae	T	seed	Diabetes	Fresh fruit juice is taken
				Leaf	Liver control	Leaf juice is taken
					Piles	Juice is taken
					Skin disease	Leaf paste is applied
					Menstrual disorder	Juice is taken
<i>Mentha arvensis</i> L.	Pudina	Lamiaceae	H	Leaf	Stomachache	Leaf juice is taken
<i>Mimosa pudica</i> L.	Lajjaboti	Mimosaceae	H	Stem	Fever	Paste is applied externally
				Root	Pain	Root paste is applied externally
<i>Momordica charantia</i> L.	Karolla	Cucurbitaceae	C	Leaf	piles	juice is taken internally
				Fruit	worm	Fruit juice is taken
<i>Momordica cochinchinensis</i> (Lour.) Spreng	Kakrol	Cucurbitaceae	C	Fruit	Diabetes	Fruit juice is taken
<i>Moringa oleifera</i> Lamk.	Sajna	Moringaceae	T	Fruit	Diarrhoea	Juice is taken
<i>Murraya paniculata</i> (L.) Jack.	Kamini	Rutaceae	S	Leaf	Stomachache	Cooked fruit is taken
					Toothache	Juice is taken
<i>Musa acuminata</i> Colla	Kola	Musaceae	H	Flower	Heart disease	Fruit juice is taken internally
<i>Nigella sativa</i> L.	Kalojira	Ranunculaceae	H	Fruit	Piles	Flower paste is eaten
				Seed	Dysentery	Young fruit paste is eaten
<i>Nyctanthes arbor-tristis</i> L.	Shiuliful	Verbenaceae	S	Leaf	Liver control	Crushed seed is taken
<i>Ocimum sanctum</i> L.	Tulshi	Lamiaceae	H	Leaf	Fever	Juice is taken
					Constipation	Dried crushed leaf is taken with raw honey
					Tuberculosis	Leaf juice is taken with Ada
<i>Oryza sativa</i> L.	Dhan	Poaceae	H	Seed	Ringworm	Leaf paste is applied
<i>Phyllanthus emblica</i> L.	Amlaki	Euphorbiaceae	T	Fruit	Cough	Leaf juice is taken with honey
					Diarrhoea	Powder is taken
					Heart disease	Juice is taken
					Constipation	Fruit juice is taken
					Hair fall	juice is applied overhead

Scientific name	Local name	Family	Habit	Parts use	Ailments	Treatment mode
<i>Piper betle</i> L.	Pan	Piperaceae	C	Leaf	Cuts& wounds	Leaf juice is applied
<i>Psidium guajava</i> (L.)	Peyara	Myrtaceae	T	Fruit	Dysentery	Young leaves is eaten with little salt
<i>Punica granatum</i> L.	Dalim	Punicaceae	S	Fruit	Bad smell Diarrhoea	Fruit is taken internally Juice is taken
<i>Ricinus communis</i> L.	Verenda	Euphorbiaceae	S	Seed	Vomiting Constipation	juice is applied Oil is taken
<i>Saccarum officinarum</i> L.	Akh	Poaceae	H	Stem	Jaundice	Juice is taken
<i>Scoparia dulcis</i> L.	Chinipata	Scrophulariaceae	H	Leaf	Dysentery	Leaf juice is taken.
<i>Senna alata</i> (L.) Roxb.	Dadmardan	Caesalpiniaceae	S	Leaf	Skin disease	Paste is applied
<i>Sesamum indicum</i> L.	Til	Pedaliaceae	H	Seed	Ring worm Gastric	Paste is applied 5/6 till taken with honey internally.
<i>Solanum melongena</i> L.	Begun	Solanaceae	S	Fruit	Fat remove	Boiled fruit is eaten
<i>Solanum nigrum</i> L.	Titbegun	Solanaceae	H	Fruit	Allergy	Fruit is taken internally.
<i>Solaunum tuberosum</i> L.	Alu	Solanaceae	H	Tuber	Cuts & wounds	Paste is applied externally
<i>Spondias pinnata</i> (L. f.) Kurz	Amra	Anacardiaceae	T	Fruit	Heart disease	Fruit juice is taken
<i>Sterculia villosa</i> Roxb. ex Smith	Udal	Sterculiaceae	T	Petiole	Impotence	Juice is taken
<i>Swietenia mahagoni</i> Jacq.	Mehogony	Meliaceae	T	Seed	Diabetes	Juice is taken
<i>Syzygium cumini</i> (L.)Skeels	Kalojam	Myrtaceae	T	Leaf	Dysentery	One cup leaf juice is taken with honey in the morning.
<i>Syzygium samarangense</i> (Blume) Merr. & Perry	Jamrul	Myrtaceae	T	Fruit Leaf	Diabetes Stomachache	Juice is taken Juice is taken
<i>Tagetes erecta</i> L.	Gada	Asteraceae	H	Leaf	Cuts & wounds	Leaf paste is applied
<i>Tamarindus indica</i> L.	Tetul	Caesalpiniaceae	T	Fruit	Heart disease	Juice is taken
<i>Tectona grandis</i> L. f.	Shegun	Verbenaceae	T	Leaf	Jaundice	Leaves decocted and the water is taken in every morning. Juice is taken
<i>Terminalia arjuna</i> (Roxb. ex DC.) Wight & Arn.	Arjun	Combretaceae	T	Bark	Heart disease	Powdered bark is mixed with amlaki & Bohera then taken 1 spoon twice per day
					Gastric	Bark soaked in water and the water is taken
					Jaundice	Bark soaked in water and the water is taken
					Heart disease	Powdered bark is taken in empty stomach early in the morning

Scientific name	Local name	Family	Habit	Parts use	Ailments	Treatment mode
<i>Terminalia bellirica</i> (Gaertn.) Roxb.	Bohera	Combretaceae	T	Bark	Deworming	Fruit shell is taken for 7 days
				seed	Skin disorder	seed oil is used
<i>Terminalia chebula</i> Retz.	Haritaki	Combretaceae	T	Bark	Diabetes	Juice is taken
				Fruit	Blood purifier	Fruit soaked in water then water is taken
					Gastrointestinal disorders	Fruit soaked in water then water is taken
<i>Vitex trifolia</i> L. f.	Nishinda	Verbenaceae	S	Leaf	Insomnia	Leaf is kept under pillow
<i>Zingiber officinale</i> Rosc.	Ada	Zingiberaceae	H	Rhizome	Cough	Rhizome juice is taken with tea
<i>Ziziphus mauritiana</i> Lamk.	Boroi	Rhamnaceae	T	Leaf	Wound	Leaf is applied

Plant species recorded as medicinal plants were classified into trees (38%), herbs (34%), shrubs (18%), and climbers (10%) (Fig. 2). It was observed that local people use trees more than herbs, shrubs, and climbers to cure different kinds of diseases. They took these medicinal plants because of their easy availability in collection, lack of side effects, and abundance in the area. In the present study, different plant parts are used in the treatment of different ailments, which were also documented. Leaves were the leading parts used (Fig. 3). From the present study, it was observed that 79% of treatments were taken internally and 21% were applied externally (Fig. 4). These data indicated that Thakurgaon district still supports rich medicinal plants with diverse applications.



Figs 1-4: 1. Different medicinal plants families. 2. Different life forms of species. 3. Different plant parts used for medicines. 4. Application modes of medicinal plants.

The reported ailments in the study area were classified into 8 different major disease categories to calculate the Fic values including heart diseases, gastrointestinal disorders, diabetes, skin diseases, respiratory disorders, cuts and wounds, jaundice and kidney diseases, and others. The results could be useful in prioritizing medicinal plants for further scientific validation of plant products as pharmacologically effective remedies with higher Fic values. The product of this factor ranges from 0 to 1. A high value (close to 1.0) indicates that relatively few taxa are used by a large proportion of the informants. A low value indicates that the informants disagree on the taxa to be used in the treatment within a category of illness. Higher Fic values can thus be used to pinpoint particularly interesting species for the search of bioactive compounds. Maximum values of Factor of Informant Consensus (Fic) were obtained in the cases of heart diseases (0.92) followed by respiratory disorders (0.89), cuts and wounds (0.85), skin diseases (0.84), gastrointestinal disorders (0.81), and others (0.58) (Table 2).

Table 2. Values of factor of informant consensus in the uses of medicinal plants among the informants.

Category	No. of use report (Nur)	No. of species (Ntaxa)	Factor of informant consensus (Fic)
Heart diseases	171	14	0.92
Gastrointestinal disorders	191	38	0.81
Diabetes	56	15	0.75
Skin diseases	148	24	0.84
Respiratory disorders	100	12	0.89
Cuts & wounds	35	6	0.85
Jaundice	66	18	0.74
Others	79	34	0.58

In order to identify medicinally important plant species in the study area, the fidelity level (FI) was calculated. The medicinal plants that are widely used by the local people for particular ailment have a higher value than those that are less used. The fidelity level (FI) of the 15 most important plant species ranged from 60.98% to 100% (Table 3). *Allium sativum* L., *Spondias pinnata* (L. f.) Kurz., *Cynodon dactylon* (L.) pers., *Lawsonia inermis* L., *Zingiber officinale* Rosc., *Saccharum officinarum* L., *Tagetes erecta* L., and *Baccaurea ramiflora* Lour. species showed 100% fidelity level (FI). Medicinal plant species obtained maximum FI value is the valid indication to investigate further for new drugs.

Citation frequency was calculated to determine the most popular medicinal plants in study area. A total of 11 medicinal plant species of different citation values are presented in the Table 4. *Allium sativum* L. is the most cited species in study area. Second cited medicinal species is *Phyllanthus emblica* L. These two medicinal plant species are very popular in the study area to treat heart disease.

Ethnobotanical information is today recognized as the most effective method of identifying new medicinal plants or refocusing on those plants reported in earlier studies for the possible extraction of beneficial bioactive compounds. At the global level, about 80% of local people depend on old-style herbal systems to cure their health disorders. In the past, due to a shortage of doctors and hakims, people used medicinal plant species for various diseases because they were considered to have fewer side effects and could be easily obtainable. Ethnobotanical knowledge is transferred from generation to generation, but without proper documentation, such knowledge may disappear.

Table 3. Fidelity level (FI) values of the frequently reported plants and their major uses.

Scientific name	Ip	Iu	FI (%)
<i>Allium sativum</i> L.	51	51	100
<i>Spondias pinnata</i> (L. f.) Kurz	24	24	100
<i>Cynodon dactylon</i> (L.) pers.	20	20	100
<i>Lawsonia inermis</i> L.	15	15	100
<i>Zingiber officinale</i> Rosc.	15	15	100
<i>Saccharum officinarum</i> L.	11	11	100
<i>Tagetes erecta</i> L.	10	10	100
<i>Baccaurea ramiflora</i> Lour.	10	10	100
<i>Tamarindus indica</i> L.	15	16	93.75
<i>Azadirachta indica</i> A. Juss.	15	18	83.33
<i>Terminalia arjuna</i> (Roxb. ex DC.) Wight & Arn.	20	26	76.92
<i>Ocimum sanctum</i> L.	16	23	69.57
<i>Glycosmis pentaphylla</i> (Retz.)	11	16	68.75
<i>Citrus aurantifolia</i> (Crist)Sw.	15	22	68.18
<i>Coccinia grandis</i> (L.) Voigt	12	19	63.16
<i>Phyllanthus emblica</i> L.	25	41	60.98

Table 4. Citation frequency of most cited medicinal plants.

Scientific name	Local name	Citation	Citation frequency (Cf)
<i>Allium sativum</i> L.	Rosun	51	20.4
<i>Phyllanthus emblica</i> L.	Amlaki	25	10
<i>Spondias pinnata</i> (L.f.) Kurz	Amra	24	9.6
<i>Terminalia arjuna</i> (Roxb. ex DC.) Wight & Arn.	Arjun	20	8
<i>Cynodon dactylon</i> (L.) pers.	Durba	20	8
<i>Ocimum sanctum</i> L.	Tulshi	16	6.4
<i>Citrus aurantifolia</i> (Christm. & Panzer) Swingle	Kagogilebu	15	6
<i>Lawsonia inermis</i> L.	Mehedi	15	6
<i>Zingiber officinale</i> Rosc.	Ada	15	6
<i>Citrus limon</i> L.	Lebu	15	6
<i>Tamarindus indica</i> L.	Tetul	15	6
<i>Azadirachta indica</i> A. Juss.	Neem	15	6

In the present study, carried out in Thakurgaon district, 102 plant species have been used for the treatment of different ailments. The present ethnobotanical survey showed that there is variation in the uses of medicinal plants by the local people. Among the plant parts, leaves were the most commonly utilized plant parts for the preparation of plant-based medicine, which was similar to (Uddin *et al.*, 2017; Sajib and Uddin, 2013). It has been reported that the use of leaves is better for the survival of medicinal plants compared to the whole plant, roots, and stem, which may pose a severe threat to the local flora (Zheng, 2009).

From the present study, the maximum number of species under 49 families were identified for the treatment of several diseases. Among them, Araceae and Rutaceae were the most commonly used families for medicinal purposes, followed by Cucurbitaceae, Poaceae, Fabaceae, Liliaceae, Solanaceae, Verbenaceae, Asteraceae, and Caesalpiniaceae in the study area. The most commonly cited mode of preparation is juice, which is made by the local people of the study area. There are many other modes of preparation of medicine, such as paste, decoction, crushing, and cooking. Maximum local people are administered orally or internally. The results are supported by Uddin *et al.* (2017) and Uddin *et al.* (2015), who observed the same in different regions of Bangladesh.

Highest Fic values were found in cases of heart diseases. The most commonly cited species used to treat this ailment are *Allium sativum* L., *Phyllanthus emblica* L., *Spondias pinnata* (L.f.) Kurz, and *Terminalia arjuna* (Roxb. ex DC.) Wight & Arn. Another report showed that the bulb of *Allium sativum* L. is used to reduce chest pain, relieve pressure, and treat ringworm (Uddin *et al.*, 2015). *Terminalia arjuna* (Roxb. ex DC.) Wight & Arn. is used for the treatment of heartache, which is also used for the same purpose reported from different areas of Bangladesh (Uddin *et al.*, 2012; Uddin and Hassan, 2014). This plant is also used for stomachache, cough, diabetes, menstruation, gastric pain, and dysentery (Uddin *et al.*, 2006, 2012, 2017; Islam *et al.*, 2014; Uddin *et al.*, 2015a, b). *Terminalia arjuna* (Roxb. ex DC.) Wight & Arn. is a popular Indian medicinal plant, and its bark has been used for over centuries as a cardioprotective. The cardioprotective effects, particularly of the bark of *Terminalia arjuna* (Roxb. ex DC.) Wight & Arn., are well known. Such species can be used for further phytochemical analysis to find active compounds for heart disease (Uddin *et al.*, 2019). Respiratory disorders scored the second-highest Fic values. *Ocimum sanctum* L., *Zingiber officinale* Rosc., and *Adhatoda vasica* Nees are the most cited species used to treat respiratory disorders. *Ocimum sanctum* L. showed the highest Fic value among them. Another study from Bangladesh found that the plant species *Ocimum sanctum* L. was also used for the treatment of cough disorders (Uddin *et al.*, 2017; Sajib and Uddin 2015; 2013). The third highest Fic value was found for cuts and wounds. The most cited plant species was *Cynodon dactylon* (L.) Pers., used for the treatment of cut injury (similar to Khan *et al.*, 2002, Uddin *et al.*, 2017; Khatun and Rahman, 2018; Yasmin and Rahman, 2017). In the present study, *Allium sativum* L., *Spondias pinnata* (L. f.) Kurz, *Cynodon dactylon* (L.) Pers., *Lawsonia inermis* L., *Zingiber officinale* Rosc., *Saccharum officinarum* L., *Tagetes erecta* L., and *Baccaurea ramiflora* Lour. showed 100% fidelity level (F1). *Allium sativum* L. obtained the highest Cf value, meaning that such species are very important plant species in the study area. *Phyllanthus emblica* L., *Spondias pinnata* (L. f.) Kurz, *Terminalia arjuna* (Roxb. ex DC.), *Cynodon dactylon* (L.) Pers., and *Ocimum sanctum* L. were also the most cited plant species in the study area.

Phytopharmacological investigation has led to the discovery of plant-derived drugs that are effective in the treatment of certain diseases and has renewed interest in plant-based medicines. Therefore, these species should be increased and protected in the area. The present analysis has confirmed their popularity among the local people of the Thakurgaon district. The present survey revealed that 103 medicinal plant species were used for 54 ailments with 185 formulas by the local people of the study area. The record of 103 medicinal plant species is an indication of rich ethnobotanical knowledge among the local people of Thakurgaon district.

Consensus of people in the use of medicinal plants has resulted in the recording of 102 medicinal plant species under 49 families with 185 formularies to treat 54 ailments. The present results are the indication of rich medicinal plant species with variation of health care knowledge in Thakurgaon. The results of this study will be useful in selecting potential medicinal plants for further study to find new sources of drugs. The top Fic (Factor informant consensus) value was obtained in case of heart diseases (0.92). The most cited species used to treat this ailment are *Allium sativum* L., *Phyllanthus emblica* L., *Spondias pinnata* (L.f.) Kurz, and *Terminalia arjuna*

(Roxb. *ex DC.*) Wight & Arn. The second highest Fic value was found in respiratory disorders (0.89) followed by cuts and wounds (0.85), skin diseases (0.84) and gastrointestinal disorders (0.81). In case of Fl (Fidelity level) value, *Allium sativum* L., *Spondias pinnata* (L.f.) Kurz, *Cynodon dactylon* (L.) Pers, *Lawsonia inermis* L., *Zingiber officinale* Rosc., *Saccharum officinarum* L., *Tagetes erecta* L. and *Baccaurea ramiflora* Lour. showed 100%. According to the Cf (Citation frequency) the most cited species are *Allium sativum* L., *Phyllanthus emblica* L., *Spondias pinnata* (L.f.) Kurz, *Terminalia arjuna* (Roxb. *ex DC.*) Wight & Arn., *Cynodon dactylon* (L.) Pers. and *Ocimum sanctum* L. From the study of people consensus, it is recommended that species which showed high Fic, Fl, Cf values could be used for further ethno-lead phytochemical analysis to investigate active compounds for the discovery of drugs from medicinal plants. The present study also revealed that the medicinal plants and traditional knowledge of such plants in the Thakurgaon district are in a threatened condition due to different disturbances, and some suggestions have been made for sustainable conservation. The findings of the present study are very preliminary. Further long-term studies are needed.

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References

- Ahmed, Z.U., Islam, M.A., Begum, Z.N.T., Hassan, M.A., Khondker, M., Rahman, M.M., Kabir, S.M.H., Ahmad, M., Ahmed, A.T.A., Rahman, A.K.A. and Haque, E.U. (Eds.) 2008-2009. Encyclopedia of flora and fauna of Bangladesh **6–12**. Angiosperms: Dicotyledons and Monocots. Asiat. Soc. Bangladesh, Dhaka.
- Alexiades, M.N. (Ed.) 1996. Selected guidelines for ethno botanical research: a field manual. The New York botanical garden, New York. pp. 1–306.
- Alam, M.K. 1992. Medical ethno-botany of the Marma tribe of Bangladesh. *Econ. Bot.* **46**(3): 330–335.
- Alam, M.K., Choudhury, J. and Hassan, M.A. 1996. Some folk formularies from Bangladesh. *Bangladesh J. Life Sci.* **8**(1): 49–63.
- Breevot, P. 1998. The booming of US botanical market: A new overview of herbal gram **44**: 33–46.
- Banglapedia, 2014. http://en.banglapedia.org/index.php?title=Thakurgaon_District.
- Friedman, J., Yaniv, Z., Dafni, A. and Palewitch, D. 1986. A preliminary classification of healing potential plants, based on a rational analysis of an ethno pharmacological field survey among Bedouins in the Negev Desert, Israel. *J. ethnopharmacol.* **16**: 275–287.
- Faruque, M.O., Uddin, S.B., Barlow, J.W., Hu, S., Dong, S., Cai, Q., Li, X. and Hu, X. 2018. Quantitative Ethnobotany of Medicinal Plants Used by Indigenous Communities in the Bandarban District of Bangladesh. *Front. Pharmacol.* **9**: 40.
- Faruque, O. and Uddin, S.B. 2014. Ethnomedicinal study of the Marma community of Bandarban Districts of Bangladesh. *Acad. J. Med. Plants* **2**: 014–025.
- Heinrich, M., Ankli, A., Frei, B. and Weimann, C. 1998. Medicinal plants in Mexico: healers consensus and cultural importance. *Social Sci. and Medi.* **47**: 1859–1871.
- Hassan, M.A. and Khan, M.S. 1986. Ethnobotanical record of Bangladesh-1: Plants used for healing fractured bones. *J. Asiatic Soc. Bangladesh. Sci.* **12**(1&2): 33–39.
- Hassan, M.A. and Khan, M.S. 1996. Ethnobotanical record of Bangladesh-2. Plants used for healing cuts and wounds. *Bangladesh J. Plant Taxon.* **3**(2): 49–52.

- Haque, T., Uddin, M.Z., Saha, M. L., Mazid, M. Z., and Hassan, M.A. 2014. Propagation, antibacterial activity and phytochemical profiles of *Litsea glutinosa* (LOUR.) C.B. Robinson; Dhaka Univ. J. Biol. Sci. **23**(2):165–171.
- Hyland, B.P.M. 1972. A technique for collecting botanical specimens in rain forest. *Flora Malesiana Bull.* **26**: 2038–2040.
- Islam, M. K., Saha, S., Mahmud, I., Mohamad, K., Awang, K., Jamal Uddin, S., Rahman, M. M., and Shilpi, J. A. 2014. An ethnobotanical study of medicinal plants used by tribal and native people of Madhupur forest area, Bangladesh. *J. Ethnopharmacol.* **151**: 921–930.
- Khatun, M.M. and Rahman, A.H.M.M. 2018. Medicinal Plants Used by the Local People at the Village Pania under Baghmara Upazila of Rajshahi District, Bangladesh. *Discovery* **54**(266): 60–71.
- Kaido, T.L., Veale, D.J.H., Havlik, I. and Rama, D.B.K. 1997. Preliminary screening of plants used in South Africa as traditional herbal remedies during pregnancy and labour. *J. Ethnopharmacol.* **55**: 185–19.
- Khan, I., Abdelsalam, N.M., Fouad, H., Tariq, A., Ullah R. and Adnan, M. 2014. Application of Ethnobotanical Indices on the Use of Traditional Medicines against Common Diseases. *Evid Based Complement Alternat Med.* 2014: 635371.
- Khan, M.S., Hassan, M.A. and Uddin, M.Z. 2002. Ethnobotanical survey in Rema-Kalenga wildlife sanctuary (Habiganj) in Bangladesh. *Bangladesh J. Plant Taxon.* **9**(1): 51–60.
- Kona, S. and Rahman, A.H.M.M. 2016. Inventory of Medicinal Plants at Mahadebpur Upazila of Naogaon District, Bangladesh. *Appl. Ecol. Environ. Sci.* **4**(3): 75–83.
- Mahwasane, S.T., Middleton, L. and Boadua, N. 2013. An ethnobotanical survey of indigenous knowledge on medicinal plants used by the traditional healers of the Lwamondo area, Limpopo province, South Africa. *South African J. Bot.* **88**: 69–75.
- Mia, M.M.K. and Huq, A.M. 1988. A preliminary ethno-botanical survey in the Jointiapur, Tamabil and Jafflong area, Sylhet, Bangladesh. *Nat. Herb. Bull.* **3**: 1–10.
- Nahar, J., Kona, S., Rani, R., Rahman, A.H.M.M. and Islam, A.K.M.R. 2016. Indigenous Medicinal Plants Used by the Local People at Sadar Upazila of Naogaon District, Bangladesh. *Int. J. Adv. Res.* **4**(6): 1100–1113.
- Offiah, N.V., Makama, S., Elisha, I.L., Makoshi, M.S., Gotep, J.G., Dawurung, C.J., Oladipo, O.O., Lohlum, A.S. and Shamaki, D. 2011. Ethnobotanical survey of medicinal plants used in the treatment of animal diarrhoea in Plateau State, Nigeria. *BMC Veterinary Research.* **7**: 36.
- Principe, P. 2005. Monetising the Pharmacological Benefits of Plants. US Environmental Protection Agency, Washington DC, 1991.
- Siddiqui, K.U., Islam, M.A., Ahmed, Z.U., Begum, Z.N.T., Hassan, M.A., Khondker, M., Rahman, M.M., Kabir, S.M.H., Ahmad, M., Ahmed, A.T.A., Rahman, A.K.A. and Haque, E.U. (Eds.) 2007c. Encyclopedia of Flora and Fauna of Bangladesh. Angiosperms: Monocotyledons (Agavaceae-Najadaceae). *Asiat. Soc. Bangladesh* **11**: 1–399.
- Sajib, N.H. and Uddin, S.B. 2013. Medico-Botanical Studies of Sandwip Island in Chittagong, Bangladesh. *Bangladesh J. Pl. Taxon.* **20**(1): 39–49.
- Sajib, N.H., and Uddin, S.B. 2015. Ethnomedinal study of plants in Hathazari, Chittagong, Bangladesh. *Pertanika J. Trop. Agric. Sci.* **38**(2): 197–210.
- Uddin, M.S., Chakma, J.J., Alam, K.M.M. and Uddin, S.B. 2015a. Ethno-medico Studies on the Uses of Plant in the Chakma Community of Khagrachari District, Bangladesh. *J. Med. Plants Stud.* **3**(1): 10–15.
- Uddin, M.S., Chowdhury, V., Uddin, S.B. and Howlader, M.S.A. 2015b. Ethnomedicinal Plants Used for the Treatment of Diarrhoea and Dysentery by the Lushai Community in Bandarban District, Bangladesh. *J. of Advancement in Medical and Life Sciences* **2**(4): 1-8.
- Uddin, M.Z. and Hassan, M.A. 2004. Flora of Rema-Kalenga wildlife sanctuary. IUCN Bangladesh Country Office, Dhaka, Bangladesh, 120 pp.
- Uddin, M.Z. and Hassan, M.A. 2014. Determination of informant consensus factor of ethnomedicinal plants used in kalenga forest, Bangladesh. *Bangladesh J. Plant Taxon.* **21**(1): 83–91.

- Uddin, M.Z. and Roy, S. 2007. Collection and management of selected medicinal plants in Rema-Kalenga wildlife sanctuary. Making conservation work: linking rural livelihoods and protected area management in Bangladesh edited by Fox, J. Bushley, B.R., Dutta S. and Quazi, S.A. 2007. Monograph of East-West Center, Hawaii, USA. pp. 66–83.
- Uddin, M.Z., Arefin, M.K., Alam, M.F., Kibria, M.G., Podder, S.L. and Hassan, M.A. 2017. Knowledge of ethnomedicinal plants and informant consensus in and around Lawachara National Park. *J. Asiat. Soc. Bangladesh Sci.* **43**(1): 101–123.
- Uddin, M.Z., Hassan, M.A. and Sultana, M. 2006. Ethnobotanical survey of medicinal plants in Phulbari Upazila of Dinajpur District, Bangladesh. *Bangladesh J. Plant Taxon.* **12**(1): 63–68.
- Uddin, M.Z., Hassan, M.A., Rahman, M.M. and Arefin, M.K. 2012. Ethno-medico-botanical study in Lawachara National Park, Bangladesh. *Bangladesh J. Bot.* **41**(1): 97–104.
- Uddin, M.Z., Kibria, M.G. and Hassan, M.A. 2015. Study of ethnomedicinal plants used by the local people of Feni District, Bangladesh. *J. Asiat. Soc. Bangladesh, Sci.* **41**(2): 203–223.
- Uddin, M.Z., Khan, M.S. and Hassan, M.A. 2001. Ethno medical plants records of Kalenga forest range (Habiganj), Bangladesh for malaria, jaundice, diarrhea and dysentery. *Bangladesh J. Plant Taxon.* **8**(1): 101–104.
- Uddin, M.Z., Roy, S., Hassan, M.A. and Rahman, M.M. 2008. Medicobotanical report on the Chakma people of Bangladesh. *Bangladesh J. Plant Taxon.* **15**(1): 67–72
- Uddin, S.N. 2006. Traditional uses of ethnomedicinal plants of the Chittagong Hill Tracts. Bangladesh National Herbarium, Dhaka. pp. 879.
- Uddin, S.N., Uddin, M.Z., Hassan, M.A. and Rahman, M.M. 2004. Preliminary ethnomedicinal plant survey in Khagrachari district, Bangladesh. *Bangladesh J. Plant Taxon.* **11**(2): 39–48.
- Uddin, M.Z., Rifat, A.B., Mitu, F.Y. and Haque, T. 2019. Ethnomedicinal plants for prevention of cardiovascular diseases in Bangladesh. *Bangladesh J. Plant Taxon.* **26**(1): 83–95.
- Umair, M., Altaf, M. and Abbasi, A.M. 2017. An ethnobotanical survey of indigenous medicinal plants in Hafizabad district, Punjab-Pakistan. *PLoS One.* **12**(6):e0177912.
- Verma, S. and Singh, S.P. 2008. Current and future status of herbal medicines. *Veterinary World.* **1**: 347–350.
- Yasmin, F. and Rahman, A.H.M.M. 2017. Ethnomedicinal Plants Used by the Santal Tribal Practitioners at Sadar Upazila of Joypurhat District, Bangladesh. *Indian J. Sci.* **24**(93): 435–453.
- Yusuf, M., Rahman, M.A., Choudhury, J.U. and Begum, J. 2002. Indigenous knowledge about the use of Zingibers in Bangladesh. *J. Econ. Taxon. Bot.* **26**(3): 566–570.
- Yusuf, M., Wahab, M.A., Choudhury, J.U. and Begum, J. 2006. Ethno-medico-botanical knowledge from Kaulkhali proper and Betunia of Rangamati district. *Bangladesh J. Plant Taxon.* **13**(1): 55–61.
- Zheng, X.L. and Xing, F.W. 2009. Ethnobotanical study on medicinal plants around Mt. Yinggeling, Hainan Island, China. *J. Ethnopharmacol.* **124**(2): 197–210.

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