

ETHNOBOTANICAL USES AND INFORMANT CONSENSUS FACTOR OF MEDICINAL PLANTS IN BARISAL DISTRICT, BANGLADESH

UZZAL HOSSAIN AND M. OLIUR RAHMAN¹

Department of Botany, University of Barisal, Barisal-8200, Bangladesh

Keywords: Ethnomedicinal plants; Informant consensus factor; Citation frequency; Fidelity level; Barisal.

Abstract

An ethnobotanical study was carried out to identify ethnomedicinally important plants of Barisal district of Bangladesh, document their traditional uses, and determine the consensus factor among the Folklore Medicinal Practitioners (FMPs). A total of 106 ethnomedicinal species under 55 families have been identified from Barisal district, which are used for treating 51 ailments with 120 formularies. Among the species, herbs constituted 59%, shrubs 15% and trees 26% of the total. Leaf was found to be the most frequently utilized plant part (44.33%), and most of the medicines were prepared in the form of juice (36%). The Factor of Informants Consensus (FIC) value ranged from 0.622 to 0.951 and the highest FIC value was found in cut, wound and bleeding. The highly cited species for these ailments are *Mikania cordata* (Burn.f.) Robinson, *Cynodon dactylon* (L.) Pers. and *Chrozophora tinctoria* (L.) A. Juss. Citation frequency (Cf) ranged from 20.93 to 67.44, and 11 species were found to have over 50% of Cf value. Fidelity level (Fl) value ranged from 69 to 100% and 17 species attained 100% Fl value. Our findings could provide baseline data to establish a tie between the traditional health practitioners and scientific communities, and finding out potential bioactive compounds for novel drug discovery.

Introduction

Bangladesh is endowed with wealth of ethnomedicines that includes Ayurveda, Unani, Homeopathy, Folk medicines and Tribal medicines. Over 80% of the world's population depends on herbal and alternative medicines for their primary health care (WHO, 2001; Kong *et al.*, 2009). Moreover, herbal medicines have entered into the mainstream of global economy (UNEP, 2001). Traditional and alternative medicines reform health sector globally. Folk medicine is probably the most common among the aforesaid traditional medicinal practices and folk medicinal practitioners (FMPs) depend mainly on medicinal plants. Medicinal plants used for treatment of particular disease varies considerably among FMPs. In Bangladesh, studies investigating documentation and the sustainability of the commercial trade in medicinal plants are at an initial stage. For documentation of the practices along with plants used by FMPs, ethnomedicinal surveys among various FMPs and tribal medicinal practitioners of Bangladesh are in progress.

Ethnomedicinal knowledge of plants has been decreasing at alarming rate from the nature before proper documentation and evaluation (Uddin *et al.*, 2015). In Bangladesh, several attempts have been made to document traditional knowledge of ethnomedicinal plants, and folk medicine has experienced a revival since last two decades (Hassan and Khan, 1986; Mia and Huq, 1988; Alam, 1992; Alam *et al.* 1996; Yusuf *et al.*, 2006; Uddin and Hassan, 2014). All those studies listed medicinal plants of particular community, particular diseases or particular areas of

¹Department of Botany, University of Dhaka, Dhaka-1000, Bangladesh. Corresponding author: E-mail: prof.oliurrahman@gmail.com

Bangladesh (Uddin *et al.*, 2015). However, many unexplored areas and communities remain in the country and many more medicinal plants used as sources of herbal drugs by the ethnic, FMPs and local people of Bangladesh yet to be revealed. In this context, no study has been carried out on documentation and quantitative analyses of ethnomedicinal plants used by rural people and folk medicinal practitioners of Barisal district. Therefore, the objectives of the present study include: to identify the most and frequently used medicinal plant species used by the local people and FMPs in Barisal district through Informant Consensus Factor, to document their traditional uses, to determine the consensus of medicinal uses, and finally to make a basis for future investigation for potential drug candidates through quantitative analyses.

Materials and Methods

Study area:

Barisal as one of the riverine southern district of Bangladesh lies between 22°27' and 22°52' N and 90°01' and 90°43' E. The district is demarked by Madaripur, Shariatpur and Chandpur districts on the north, Patuakhali, Barguna and Jhalkhati districts on the south, Bhola and Lakshimpur districts on the east, and Pirojpur, Jhalkhati and Gopalganj districts on the west. Barisal district consists of 10 upazillas, *viz.*, Agailjhara, Babuganj, Bakerganj, Banaripara, Barisal Sadar, Gaurnadi, Hizla, Mehendiganj, Muladi and Wuzirpur. The area enjoys tropical climate with high rainfall during monsoon period. The soil texture of the area is clay loam and saline in habitat (Shil and Saleque, 2016). Though there is no any natural forest in Barisal except the governmental planned afforestation program in coastal belt, banks of rivers and all homesteads are usually covered by dense green foliage of wide variety of both native and exotic species resulting in vegetation enrich in biodiversity.

Plant samples and data collection:

Plant samples were collected from the study area during field surveys in different seasons from May 2017 to April 2018. The data of medicinal uses were gathered through semi-structured interviews, key informant discussions and informal conversations with folk medicinal practitioners (FMPs) called herbal practitioners or locally known as *Kabiraz* (Alexiades, 1996). A total of 43 informants mostly male with the age ranging from 24 to 75 years of old were interviewed. Education levels of the informants were from Secondary School Certificate (SSC) to Bachelor of Science (BSc) degrees. Some of the informants were diploma trained in folk medicinal practice from Ayurveda or Unani College at home or abroad. Professionally they were mostly farmers, small shopkeepers, street hawkers, school teachers and volunteer FMPs. Information on uses of plants for treating different ailments, parts used and mode of preparation as well as administration was gathered during the field study. Specimens of each medicinal plant were collected, critically studied and identified by experts and using standard literature (Hooker, 1872-1897; Prain, 1903; Dassanayake and Fosberg, 1980-1991; Ahmed *et al.*, 2008-2009). Voucher specimens were prepared using standard protocol (Hyland, 1972; Alexiades, 1996) and preserved at the Department of Botany, University of Barisal.

Data analysis:

Factor of informant consensus (Fic): Factor of informant consensus (Fic) was computed using the following formula:

$$Fic = \frac{N_{ur} - N_{taxa}}{N_{ur} - 1}$$

Where, N_{ur} is the number of use reports in each category and N_{taxa} is the number of species in each category (Heinrich *et al.*, 1998).

Citation frequency of medicinal plants (Cf %): Cf values are useful to determine most common medicinal plants in the study area. Citation frequency values of medicinal plants were estimated using the formula:

$$\text{Citation frequency (Cf \%)} = \frac{n}{N} \times 100$$

Where, n refers to number of people interviewed citing species, N refers to total number of people interviewed (Friedman *et al.*, 1986).

Fidelity level (Fl %): The percentage of informants claiming the use of a plant species for the same major purpose was estimated using the Fidelity level index as determined by the following formula:

$$\text{Fidelity level (Fl \%)} = \frac{I_p}{I_u} \times 100$$

Where I_p denotes to number of informants who indicate use of a species for the same major ailment, I_u refers to total number of informants who mentioned the same plant for any other use (Friedman *et al.*, 1986).

Results and Discussion

Diversity of medicinal plants - Habit, habitat and parts used:

The present study revealed identification and documentation of 106 medicinal plant species belonging to 96 genera and 52 families from Barisal district used by local folklore medicinal practitioners (FMPs) for 51 ailments with 120 formularies (Table 1). In the present study, the highly reported species were herbs (59%) followed by trees (26%) and shrubs (15%) (Fig. 1A). Several authors reported the common use of herbaceous medicinal plants (Addo-Fordjour *et al.*, 2008), and the herbs attributed to their wide range of bioactive ingredients (Gazzaneo *et al.*, 2005). Herbs, and trees are most commonly used as medicine by the traditional healers (Uniyal *et al.*, 2006), which were supported by our study. Among the species reported 47.16 % was found to be cultivated, 33.01% wild and 19.81% wild but cultivated in home gardens.

The study area represents diverse habitats including homestead gardens, roadsides, arable lands, river side, wastelands, muddy area etc. and medicinal plants were collected from those habitats. The highest number of ethno-medicinal plants were collected from homestead garden representing 24% followed by arable lands covering 23% of the total species (Fig. 1B). The family Asteraceae was found to be the highest represented family in terms of number of species (5.7%), followed by Apocynaceae and Rutaceae (4.7% each). The families Apiaceae, Arecaceae, Convolvulaceae and Euphorbiaceae constitute 3.8% each of total species, while Acanthaceae, Caesalpiniaceae, Combretaceae, Cucurbitaceae, Lamiaceae, Myrtaceae and Poaceae represent 2.8% each of the total ethnomedicinal plants identified from the study area. The other families provide less than 2% representation of the species. With respect to the parts used, the study showed that plant parts used by the local FMPs of Barisal for treating different diseases were mainly leaves, fruits and seeds. In the case herbaceous plants aerial parts or sometimes the whole plant was employed. Leaf was found to be most frequently utilized plants part (44.33%), followed by fruits (24.5%), stems (8.5%), roots, flowers and stem barks (5.7% each), and latex, whole plant and seeds (4.7% each) (Fig. 2). The predominant use of leaf used by the folk medicinal practitioners for different therapies has been attested by other studies.

In an ethnobotanical survey of medicinal plants of two villages of Gaurnadi upazila in Barisal district, Biswas *et al.* (2011) showed that leaves constituted the major part of plants used by the folk medicinal practitioners. While conducting an ethnobotanical survey in the Garo ethnic community Ramatullah *et al.* (2009) found that leaves formed the major plant part used followed

Table 1. Plants used by Folklore medicinal practitioners (FMPs) in Barisal district to treat different ailments.

Scientific name	Bangla name	Family	Part used	Ailments	Administration
<i>Abroma augusta</i> (L.) L. f.	Ulotkombol	Sterculiaceae	Stem	Impotence, Irregular menstrual	Soaked water taken
<i>Acorus calamus</i> L.	Boch	Araceae	Rhizome	Cold and Cough	Decoction taken internally
<i>Adhatoda zeylanica</i> Medikus	Basak	Acanthaceae	Leaf	Cold and Cough	Juice taken internally
<i>Aegle marmelos</i> (L.) Corr.	Bel	Rutaceae	Leaf	Impotence, Fertility	Juice taken internally
			Fruit	Constipation	Ripe fruit, powder of green dry fruit taken
<i>Alocasia cucullata</i> (Lour.) G. Don	Biskocho	Araceae	Rhizome	Rheumatic pain	Eaten after cooking
<i>Aloe vera</i> (L.) Burm. f.	Gritokumari	Liliaceae	Leaf	Hair growth, Impotence, Fairness, Irritation	Juice taken internally
<i>Alternanthera philoxeroides</i> (Mart.) Griseb.	Helenchha	Amaranthaceae	Aerial part	Constipation	Eaten after cooked
<i>Amorpha phalloides</i> (Dennst.) Nicolson	Olkocho	Araceae	Stem	Piles	Eaten after cooked
<i>Pyrethrum indicum</i> Roxb.	Akorkora	Asteraceae	Fruit	Impotence	Raw fruit taken
<i>Ananas comosus</i> (L.) Merr.	Anaros	Bromeliaceae	Fruit	Anthelmintic, Fever	Raw fruit taken internally
<i>Andrographis paniculata</i> (Burm. f.) Wall. ex Nees	Kalomegh	Acanthaceae	Leaf	Fever, Malaria	Juice taken internally
<i>Anthocephalus chinensis</i> (Lamk.) A. Rich ex Walp.	Kadam	Rubiaceae	Leaf	Rheumatic pain, Bone fracture	Leaf paste taken externally
<i>Artocarpus heterophyllus</i> Lamk.	Kanthal	Moraceae	Latex	Ringworm	Raw latex applied externally
			Fruit	Digestion	Raw fruit taken internally
<i>Asparagus racemosus</i> (Wild) Oberm.	Shotomuli	Liliaceae	Root	Impotence	Juice taken internally
<i>Averrhoa carambola</i> L.	Kamranga	Oxalidaceae	Fruit	Jaundice	Decoction of dry fruit taken internally
<i>Azadirachta indica</i> A. Juss.	Neem	Meliaceae	Leaf	Pox, Abscess, Diabetes, Anthelmintic	Decoction used externally and juice, powder taken internally
<i>Bacopa monnieri</i> (L.) Punnell	Brammi	Scrophulariaceae	Leaf	Mental peace, Brain tonic	Eaten after cooked
<i>Bambusa</i> sp.	Bansh	Poaceae	Young shoot	Constipation	Taken internally after cooked
			Young leaf	Digestion of baby	Juice taken internally

Table 1 Contd.

Scientific name	Bangla name	Family	Part used	Ailments	Administration
<i>Bombax ceiba</i> L.	Shimul	Bombacaceae	Root	Impotence	Juice taken internally
<i>Borassus flabelifer</i> L.	Tal	Areaceae	Spine	Abnormal testicle formation	Spine taken externally
<i>Bryophyllum pinnatum</i> (Lamk.) Oken	Pathorkuchi	Crassulaceae	Root	Contraceptive	Juice taken internally
<i>Calotropis gigantea</i> (L.) Ait.	Boro Akando	Asclepiadaceae	Leaf	Gastric, Gallbladder stone	Juice taken internally
<i>Carica papaya</i> L.	Pepe	Caricaceae	Leaf	Leaf	Juice taken internally
			Latex	Latex	Raw latex applied externally
			Latex	Anthelmintic	Raw latex applied externally
			Green fruit	Constipation	Eaten at raw or after cooked
<i>Carissa carandus</i> L.	Koromcha	Apocynaceae	Ripe fruit	Digestion	Raw fruit taken internally
<i>Cassia fistula</i> L.	Sonalu	Caesalpinaceae	Fruit	Appetizer	Raw fruit eaten
<i>Catharanthus roseus</i> (L.) G. Don	Noyanntara	Apocynaceae	Fruit	Anthelmintic	Juice taken internally
<i>Centella asiatica</i> (L.) Urban	Thankuni	Apiaceae	Leaf	Diabetes, Cancer	Juice taken internally
<i>Chrozophora tinctoria</i> (L.) A. Juss.	Nillkonthi	Euphorbiaceae	Whole plant	Cold fever	Eaten raw or after cooked
<i>Cinnamomum tamala</i> Nees & Eberm	Tejpata	Lauraceae	Flower	Stomach pain, Cut and Wound	Decoction and juice taken both externally and internally respectively
<i>C. zeylanicum</i> Breyne	Darchimi	Lauraceae	Leaf	Cough, Appetizer, Vomiting	Raw leaf smelled, powder taken internally
<i>Citrus grandis</i> (L.) Osbeck	Jambura	Rutaceae	Stem bark	Vomiting, Appetizer	Dry bark eaten, powder taken internally
<i>C. lemon</i> (L.) Burm. f.	Lebu	Rutaceae	Leaf	Vomiting	Raw leaf smelled
<i>Clerodendrum viscosum</i> Vent	Bhat	Verbenaceae	Fruit	Cold fever, Jaundice	Raw fruit taken
<i>Coccinia grandis</i> (L.) Voigt	Telakucha	Cucurbitaceae	Leaf	Vomiting	Raw leaf smelled
<i>Cocos nucifera</i> L.	Narikel	Areaceae	Fruit	Jaundice, Scurvy	Raw fruit taken
<i>Crotalaria juncea</i> L.	Junjuni	Fabaceae	Leaf	Fever, Anthelmintic	Juice is taken
<i>Cuminum cyminum</i> L.	Jira	Apiaceae	Peduncle	Diabetes	Raw fruit taken
			Fruit	Impotence	Juice taken internally
			Leaf	Diarrhoea	Fruit water taken
			Leaf	Eczema	Juice taken internally
			Fruit	Diarrhoea	Seed soaked water taken, powder taken internally

Table 1 Contd.

Scientific name	Bangla name	Family	Part used	Ailments	Administration
<i>Curcuma longa</i> L.	Holud	Zingiberaceae	Rhizome	Blood purification, Dermal rot	Paste taken externally, juice taken internally
<i>Cynodon dactylon</i> (L.) Pers.	Durba	Poaceae	Whole plant	Cut and wound, Menstrual over bleeding	Paste taken externally, juice taken internally
<i>Datura metel</i> L.	Dutura	Solanaceae	Leaf	Dog bite	After cooking taken internally
<i>Dillenia indica</i> L.	Chalta	Dilleniaceae	Leaf	Abdominal pain	Juice taken internally
			Flower	Hair growth	Juice taken externally
			Fruit	Constipation	Raw fruit eaten
<i>Eclipta prostrata</i> (L.) Mant.	Keshoraj	Asteraceae	Whole plant	Jaundice, Hair fall	Juice taken internally
<i>Elaeocarpus robustus</i> Roxb.	Jalpai	Elaeocarpaceae	Fruit	Hypertension	Raw fruit eaten
<i>Euphorbia tirucalli</i> L.	Khirbrikkho	Euphorbiaceae	Stem bark	Wound	Juice taken internally
<i>Ferula asafoetida</i> L.	Hingo	Apiaceae	Leaf	Cold cough	Juice taken internally
<i>Ficus racemosa</i> L.	Jagdumur	Moraceae	Fruit	Diabetes	Eaten after cooked
<i>Garcinia cowa</i> Roxb.	Kawfal	Clusiaceae	Fruit	Hypertension	Juice taken internally
<i>Glycosmis arborea</i> (Roxb.) A. DC.	Hotigira	Rutaceae	Stem bark	Dysentery	Juice taken internally
<i>Gynura procumbens</i> (Lour.) Merr.	Diabetes gach	Asteraceae	Leaf	Diabetes	Juice taken internally
<i>Heliotropium indicum</i> L.	Hatishur	Boraginaceae	Leaf	Eye irritation	Juice taken externally
<i>Hibiscus mutabilis</i> L.	Sthalpodmo	Malvaceae	Leaf	Irregular menstrual	Juice is taken internally
<i>H. rosa-sinensis</i> L.	Roktozoba	Malvaceae	Flower	Bleeding	Juice taken externally
			Flower bud	Abortion	Paste taken externally
<i>Holarrhena antidiysenterica</i> (L.) Wall. ex Decne.	Kurchi	Apocynaceae	Leaf	Dysentery	Juice taken internally
<i>Hygrophila auriculata</i> (Schum.) Heine	Kulakhara	Acanthaceae	Leaf	Impotence, Dysentery	Juice taken internally
<i>Hyptis suaveolens</i> (L.) Poit.	Tokma	Lamiaceae	Seed	Dysentery	Juice is taken internally
<i>Ipomoea digitata</i> Linn.	Bhuikumra	Convolvulaceae	Stem	Abscess, Digestion	Seed taken with water
<i>I. fistulosa</i> L.	Dholkalmi	Convolvulaceae	Latex	Impotence	Juice taken internally
<i>I. aquatica</i> Forssk.	Kalmishak	Convolvulaceae	Leaf	Fungal disease	Raw latex applied externally
<i>Lawsonia inermis</i> L.	Mehedi	Lythraceae	Leaf	Constipation, Pox	Eaten after cooking
			Leaf	Hair growth, Dandruffs	Juice taken externally
<i>Mangifera indica</i> L.	Aam	Anacardiaceae	Leaf	Abdominal pain	Juice taken internally
			Fruit	Digestion	Raw fruit taken
			Seed	Diabetes	Powder of semi-dried seed taken internally

Table 1 Contd.

Scientific name	Bangla name	Family	Part used	Ailments	Administration
<i>Mentha spicata</i> L.	Pudina	Lamiaceae	Whole plant	Cough, Constipation	Eaten at raw, after cooked, decoction taken internally
<i>Mesua ferrea</i> L.	Nageshwar	Clusiaceae	Flower	Dysentery	Juice is taken internally
<i>Mikania cordata</i> (Burm. f.) Robinson	Assam lata	Asteraceae	Leaf	Cut and wound, Gastric	Juice applied externally and internally
<i>Mimosa pudica</i> L.	Lazzabati	Mimosaceae	Root	Dysentery	Juice is taken
<i>Momordica cochinchinensis</i> (Lour.) Spreng.	Bonkakrol	Cucurbitaceae	Stem	Constipation	Juice is taken internally
<i>Moringa oleifera</i> Lamk.	Sojina	Moringaceae	Leaf	Eye ache, Diabetes	Eaten at raw, also after cooked
			Fruit	Constipation	Taken after cooked
<i>Murraya paniculata</i> (L.) Jack	Kamini	Rutaceae	Leaf	Teeth ache	Juice taken internally
<i>Musa paradisiaca</i> L.	Kala	Musaceae	Peduncle	Constipation	Eaten after cooked
			Green fruit	Loose motion	Raw fruit eaten
			Ripe fruit	Digestion	Raw fruit eaten
			Ripe fruit bark	Appetizer	Decoction of bark taken
<i>Nerium indicum</i> Mill.	Korobi	Apocynaceae	Fruit	Abscess	Juice taken externally
<i>Nyctanthes arbor-tristis</i> L.	Sheuli	Oleaceae	Leaf	Fever	Juice taken internally
<i>Ocimum tenuiflorum</i> L.	Tulsi	Lamiaceae	Leaf	Cough, Cold fever	Juice taken internally
<i>Operculina turpethum</i> (L.) Silva Manso.	Teuri	Convolvulaceae	Root	Constipation	Juice taken internally
<i>Paederia foetida</i> L.	Gandhobaduli	Rubiaceae	Leaf	Appetizer	Juice taken internally
<i>Pandanus odoratus</i> Ridl.	Polaupata	Pandanaceae	Leaf	Appetizer	Taken after cooking
<i>Phyllanthus emblica</i> L.	Amlaki	Euphorbiaceae	Fruit	Gastric, Mouth blow	Raw fruit eaten
<i>Piper chaba</i> Trel. & Yunck	Choi	Piperaceae	Stem	Appetizer, Digestion	Juice taken internally
<i>P. longum</i> L.	Lota pipul	Piperaceae	Leaf	Jaundice, Constipation	Juice taken internally
<i>Plumbago indica</i> L.	Roktochita	Plumbaginaceae	Leaf	Diarrhoea	Juice taken internally
<i>Polyalthia longifolia</i> Sonn.	Debdaru	Annonaceae	Stem bark	Cut and wound	Juice taken externally
<i>Psidium guajava</i> L.	Peyara	Myrtaceae	Leaf	Abdominal pain	Juice taken internally
<i>Punica granatum</i> L.	Dalim	Punicaceae	Leaf	Dysentery	Juice taken internally
			Flower	Abdominal pain	Juice taken internally
<i>Rauwolfia serpentina</i> L.	Sarpogandha	Apocynaceae	Root	Snake bite, Anxiety, Hypertension	Juice taken both internally and externally
<i>Ricinus communis</i> L.	Verenda	Euphorbiaceae	Root bark	Bone fracture pain	Paste taken externally
<i>Saccharum officinarum</i> L.	Akh	Poaceae	Stem	Jaundice	Sap is taken

Table 1 Contd.

Scientific name	Bangla name	Family	Part used	Ailments	Administration
<i>Santalum album</i> L.	Sadachondan	Santalaceae	Root, stem, leaf	Impotence	Juice taken internally
<i>Senna alata</i> (L.) Roxb.	Dadmordan	Caesalpiniaceae	Leaf	Ringworm, Anthelmintic	Leaf paste is taken externally, decoction taken internally
<i>S. sophera</i> (L.) Roxb.	Kalkesunda	Caesalpiniaceae	Leaf	Gonorrhea	Juice taken internally
<i>Spilanthes acmella</i> Murr.	Topful	Asteraceae	Flower	Teeth ache, Scurvy	Decoction taken externally
<i>Spondias pinnata</i> (L. f.) Kurz	Amra	Anacardiaceae	Fruit	Scurvy, Hypertension	Raw fruit eaten
<i>Stephania japonica</i> (Thunb.) Miers	Muchmilata	Menispermaceae	Leaf	Mental peace	Paste applied externally
<i>Sweritia chirata</i> Ham.	Chirata	Gentianaceae	Stem	Allergy, Blood purification	Stem soaked water taken
<i>Swietenia mahagoni</i> Jacq.	Mehogani	Meliaceae	Seed	Diabetes	Seed soaked water, powder taken internally
<i>Syzygium cumini</i> (L.) Skeels	Kalojam	Myrtaceae	Seed	Diabetes, Dysentery	Decoction powder taken internally
<i>S. samarangense</i> (Blume) Merrill & Perry	Jamrul	Myrtaceae	Leaf	Tooth ache	Paste taken externally
<i>Tamarindus indica</i> L.	Tentul	Mimosaceae	Seed Fruit	Diabetes Hypertension, Dysentery	Decoction taken internally Raw fruit taken internally, powder of seed taken internally
<i>Terminalia arjuna</i> (Roxb. ex DC.) Wight & Arn.	Arjun	Combretaceae	Stem bark	Heart problem, Cold fever, Diabetes	Juice taken internally
<i>T. bellirica</i> (Gaertn.) Roxb.	Bohera	Combretaceae	Fruit	Asthma	Fruit juice taken internally, powder of seed taken internally
<i>T. catappa</i> L.	Kat badam	Combretaceae	Fruit	Appetizer	Raw fruit taken internally
<i>T. chebula</i> Retz.	Horitaki	Combretaceae	Fruit	Appetizer	Juice, powder of seed taken internally
<i>Tinospora crispa</i> (L.) Hook. f. & Thoms.	Gulonch	Menispermaceae	Stem	Allergy	Decoction taken internally
<i>Vitex negundo</i> L.	Nisinda	Verbenaceae	Leaf	Abscess, Asthma	Paste taken externally, powder taken internally
<i>Vitis quadrangularis</i> Wall. ex Wight & Arn.	Harjora lota	Vitaceae	Leaf	Bone fracture	Paste taken externally
<i>Withania somnifera</i> (L.) Dunal	Aswagandha	Solanaceae	Leaf	Weakness	Juice taken internally
<i>Xanthium strumarium</i> L.	Gaghra	Asteraceae	Leaf	Loose motion	Juice taken internally
<i>Xanthosoma violaceum</i> Schott.	Kalakachu	Araceae	Latex	Cut and wound	Raw sap applied externally
<i>Zingiber officinale</i> Ross.	Ada	Zingiberaceae	Rhizome	Appetizer	Juice taken internally

by whole plant and fruits. Recently, Uddin *et al.* (2015) reported leaf as frequently used plant part for folk medicine preparation. In addition, several tribal communities utilized leaves for preparation of herbal medicines (Prabhu *et al.*, 2014; Vijaykumar *et al.*, 2015). Leaves are used mostly in herbal preparation because collection of leaves is easier than underground parts, flowers or fruits (Giday *et al.*, 2009). Our results were found consistent with other studies where leaf was reported as frequently used plant part for folk medicine preparation (Yigra, 2010; Ullah *et al.*, 2013). However, Ribeiro *et al.* (2014) reported that stem bark had the highest number of citations, followed by leaves, fruits and roots. This could be explained by the fact that the prime use of stem bark is common among people in the semi-arid region for different ailments, even when other structures, for instance leaves, are obtainable (Albuquerque *et al.*, 2012).

During this ethnobotanical survey it was observed that the demand for folklore medicine is increasing day by day. As a result, a good number of medicinal plant species or plant parts are being used by the FMPs. Excessive use of roots, flowers, fruits, seeds and sometimes whole plant may destroy the plant or make hindrance in regeneration, and have impact on population existence. For sustainable use of these medicinal plants conservation measures through both *in-situ* and *ex-situ* methods to be adopted, and traditional healers to be very cautious during harvesting these parts at least keeping some plants for sustainable regeneration.

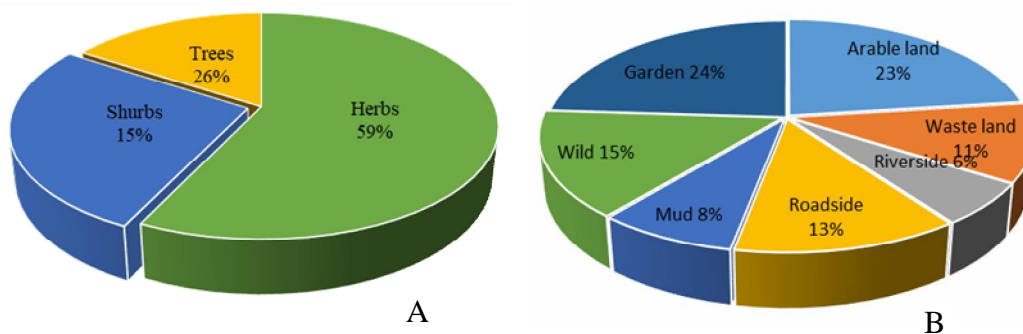


Fig. 1. Comparative analysis of ethnomedicinal plants of Barisal district. A. Percentage of habit; B. Percentage of habitat.

Modes of preparation and administration:

The modes of preparation of herbal medicines were in the forms of paste, powder, decoction, juice, raw and fumes. The majority of the plant remedies was prepared by juice (36%) followed by raw (17%), powder (13%), boiled (12%), decoction (10%), paste (8%) and seed oil (4%) (Fig. 3A). In terms of administration, oral administration was found as the principal mode of intake of medicine (65%) followed by administration of dermal (19%), nasal (9%) and others (7%) (Fig. 3B). We have found that, FMPs in the investigated area often mix water as a solvent for preparation of juice after crushing, and sometimes milk or honey is added as a solvent to increase the viscosity of the preparation. It has also been reported that different parts of some toxic plants are boiled into water to wash out the toxic substances and mixed with milk to make medicines. In an ethnoveterinary study Parthiban *et al.* (2016) showed that paste was the frequently used mode of preparation, which was found inconsistent with the present study.

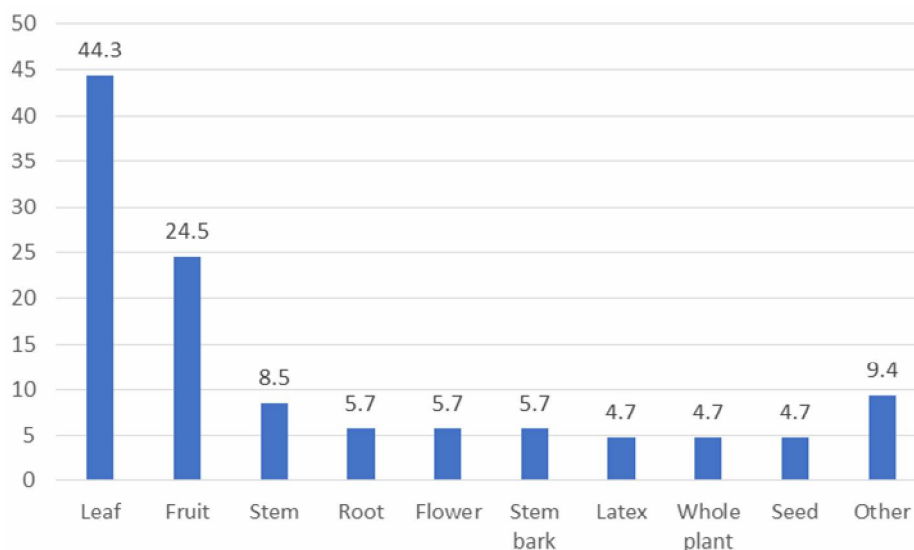


Fig. 2. Use report of different parts of ethnomedicinal plants of Barisal district for treating different ailments.

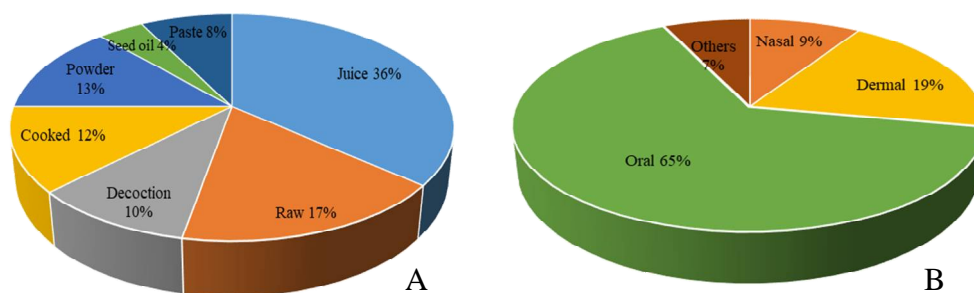


Fig. 3. Mode of preparation and administration of ethnomedicinal plants of Barisal district. A. Percentage of mode of preparation; B. Percentage of routes of administration.

Factors of informant consensus (Fic):

Factors of informant consensus were calculated to evaluate use diversity of the medicinal plants and to determine which plants are particularly interesting in search for bioactive compounds. Table 2 showed that the calculated Fic value varied from 0.622 to 0.951. The highest Fic value was found in cut, wound and bleeding (0.951) and subsequently in rheumatic pain (0.935), oral diseases (0.912), hypertension (0.902), hair tonic (0.857), dysentery and diarrhoea (0.847), abdominal pain (0.833), diabetes (0.818), dermatological diseases (0.813), cough, cold and fever (0.792), jaundice (0.769), urogenital and venereal problems (0.768), parasitic disease (0.706), and constipation and appetite loss (0.622) (Table 2). The highest Fic value for cut, wound and bleeding are noted in very few number of plant species.

The highly cited species for cut, wound and bleeding are *Mikania cordata*, *Cynodon dactylon*, and *Chrozophora tinctoria* and a large proportion of people employ these species to treat these ailments. Results obtained from this study were found consistent with Uddin *et al.* (2015) where

they reported high Fic value for the ailments cut and wound in a survey in Feni district of Bangladesh. In a quantitative ethnobotanical study among indigenous communities in Bandarban district of Bangladesh, Faruque *et al.* (2018) found Fic value of the cut and wound ailment category as 0.59. They reported the highest Fic value in the digestive system disorders including gastritis, diarrhoea, ulcers, constipation, digestive aid, piles, carminative, flatulence, indigestion, colic and anthelmintic, which was not supported by the present study. Variation in Fic value might be due to availability and diversity of medicinal plants and its associated knowledge in a particular locality, restriction in exchange of ethnobotanical knowledge from one generation to another and one locality to other. The highest number of ethnomedicinal species were used to treat constipation and appetite loss (29 species) followed by treatment of urogenital and venereal diseases (17 species). Only two species were documented for treatment of rheumatic pain.

Table 2. Consensus of agreement on the uses of medicinal plants among informants.

Ailments	No of use reports (N_{ur})	No. of taxa (N_{taxa})	Fic value
Constipation and appetite loss	75	29	0.622
Parasitic diseases	18	6	0.706
Urogenital and venereal	70	17	0.768
Jaundice	27	7	0.769
Cough and cold fever	54	12	0.792
Dermatological diseases	65	13	0.813
Diabetes	67	13	0.818
Abdominal pain	25	5	0.833
Dysentery and diarrhoea	60	10	0.847
Hair growth and tonic	22	4	0.857
Hypertension	42	5	0.902
Oral diseases	35	4	0.912
Rheumatic pain	32	3	0.935
Cut, wound and bleeding	82	5	0.951

Citation frequency (Cf):

The citation frequency in the investigated ethnomedicinal plants ranged from 20.93 to 67.44. Eleven species were found to have over 50% of Cf value, viz., *Adhatoda zeylanica*, *Aegle marmelos*, *Andrographis paniculata*, *Bryophyllum pinnatum*, *Ficus racemosa*, *Gynura procumbens*, *Mikania cordata*, *Ocimum tenuiflorum*, *Piper chaba*, *Spondias pinnata* and *Syzygium cumini* (Table 3). The high Cf value of medicinal plants is the signal of popular and common species in the study area which can be employed for further analysis to find out new drugs.

Fidelity level (Fl):

The fidelity level value is useful for identifying the informants' most preferred species in use for treating certain ailments. The analyzed results represented that fidelity level value ranged from 69 to 100%. A total of 17 species were found to have 100% Fl value and these are: *Vitex negundo*, *Azadirachta indica*, *Piper chaba*, *Paederia foetida*, *Ocimum tenuiflorum*, *Aegle marmelos*, *Dillenia indica*, *Mikania cordata*, *Gynura procumbens*, *Syzygium cumini*, *Bryophyllum pinnatum*, *Spondias pinnata*, *Elaeocarpus robustus*, *Abroma augusta*, *Azadirachta indica*, *Calotropis gigantea* and *Senna alata* (Table 4). These high fidelity level values indicate that the informants do have inclination to rely on one specific plant species for treatment of one particular disease rather than several diseases.

Table 3. Citation frequency of some selected medicinal plants of Barisal district.

Ailments	Species	Number of informants (n)	Citation frequency (%)
Abortion	<i>Hibiscus rosa-sinensis</i>	12	27.90
Abscess	<i>Vitex negundo</i>	15	34.88
	<i>Azadirachta indica</i>	17	39.53
Allergy	<i>Tinospora crispa</i>	10	23.80
Appetizer	<i>Piper chaba</i>	21	48.84
	<i>Paederia foetida</i>	18	41.86
	<i>Terminalia chebula</i>	21	48.84
Cold and cough	<i>Adhatoda zeylanica</i>	22	51.16
	<i>Ocimum tenuiflorum</i>	24	55.81
Constipation	<i>Aegle marmelos</i>	23	53.48
	<i>Dillenia indica</i>	17	39.54
	<i>Carica papaya</i>	14	32.55
Cut, wound and bleeding	<i>Mikania cordata</i>	26	60.46
	<i>Cynodon dactylon</i>	16	37.20
	<i>Chrozophora tinctoria</i>	14	32.55
Dandruffs	<i>Lawsonia inermis</i>	9	20.93
Diabetes	<i>Gynura procumbens</i>	29	67.44
	<i>Ficus racemosa</i>	24	55.81
	<i>Syzygium cumini</i>	22	51.16
	<i>Azadirachta indica</i>	18	41.86
Diarrhoea	<i>Plumbago indica</i>	10	23.25
Digestion	<i>Piper chaba</i>	22	51.16
	<i>Carica papaya</i>	17	39.53
	<i>Glycosmis arborea</i>	13	30.23
Dysentery	<i>Holarrhena antidysenterica</i>	19	44.18
	<i>Ananas comosus</i>	17	39.53
	<i>Clerodendrum viscosum</i>	16	37.20
	<i>Andrographis paniculata</i>	24	55.81
Fertility	<i>Aegle marmelos</i>	25	58.13
Gallbladder stone	<i>Bryophyllum pinnatum</i>	23	53.48
Hair tonic	<i>Aloe vera</i>	15	34.88
	<i>Eclipta prostrata</i>	21	48.84
Hypertension	<i>Spondias pinnata</i>	13	30.23
	<i>Elaeocarpus robustus</i>	17	39.53
	<i>Garcinia cowa</i>	11	25.58
Impotence	<i>Aegle marmelos</i>	14	32.55
	<i>Aloe vera</i>	14	32.55
	<i>Holarrhena antidysenterica</i>	12	27.90
	<i>Abroma augusta</i>	13	30.23
Jaundice	<i>Saccharum officinarum</i>	16	37.20
	<i>Averrhoa carambola</i>	11	25.58
	<i>Eclipta prostrata</i>	9	20.93
Loose motion	<i>Musa paradisiaca</i>	20	46.51
Pox	<i>Azadirachta indica</i>	17	39.53
Rheumatic pain	<i>Calotropis gigantea</i>	14	32.55
	<i>Anthocephalus chinensis</i>	14	32.55
Ringworm	<i>Senna alata</i>	15	34.88
Scurvy	<i>Spondias pinnata</i>	23	53.48
	<i>Spilanthes acmella</i>	13	30.23
Stomach pain	<i>Mangifera indica</i>	10	23.25
	<i>Dillenia indica</i>	19	44.18
Vomiting	<i>Citrus grandis</i>	9	20.93
	<i>Cinnamomum tamala</i>	12	27.90

Table 4. Fidelity level (FL %) of frequently cited plant species with major uses.

Ailments	Species	Number of informants (I _p)	Total number of informants (I _t)	FL (%)
Abortion	<i>Hibiscus rosa-sinensis</i>	12	15	80
Abscess	<i>Vitex negundo</i>	15	15	100
	<i>Azadirachta indica</i>	17	17	100
Allergy	<i>Tinospora crispa</i>	10	14	71
Appetizer	<i>Piper chaba</i>	21	21	100
	<i>Paederia foetida</i>	18	18	100
Cold and cough	<i>Adhatoda zeylanica</i>	22	24	92
	<i>Ocimum tenuiflorum</i>	24	24	100
Constipation	<i>Aegle marmelos</i>	23	23	100
	<i>Dillenia indica</i>	17	17	100
Cut, wound and bleeding	<i>Mikania cordata</i>	26	26	100
	<i>Cynodon dactylon</i>	16	18	89
	<i>Chrozophora tinctoria</i>	14	17	82
Diabetes	<i>Gynura procumbens</i>	29	29	100
	<i>Ficus racemosa</i>	24	26	92
	<i>Syzygium cumini</i>	22	22	100
	<i>Azadirachta indica</i>	18	20	90
Diarrhoea	<i>Plumbago indica</i>	10	12	83
Digestion	<i>Piper chaba</i>	22	24	92
	<i>Carica papaya</i>	17	20	85
Dysentery	<i>Glycosmis arborea</i>	13	16	81
	<i>Holarrhena antidysenterica</i>	19	23	83
Fever	<i>Ananas comosus</i>	17	19	89
	<i>Clerodendrum viscosum</i>	16	19	84
	<i>Andrographis paniculata</i>	24	24	100
Fertility	<i>Aegle marmelos</i>	25	26	96
Gallbladder stone	<i>Bryophyllum pinnatum</i>	23	23	100
Hair tonic	<i>Aloe vera</i>	15	17	88
	<i>Eclipta prostrata</i>	21	24	88
Hypertension	<i>Spondias pinnata</i>	13	13	100
	<i>Elaeocarpus robustus</i>	17	17	100
	<i>Garcinia cowa</i>	11	13	85
Impotence	<i>Aegle marmelos</i>	14	15	93
	<i>Holarrhena antidysenterica</i>	12	14	86
	<i>Abroma augusta</i>	13	13	100
Jaundice	<i>Saccharum officinarum</i>	16	18	89
Loose motion	<i>Musa paradisiaca</i>	20	22	91
Pox	<i>Azadirachta indica</i>	17	17	100
Rheumatic pain	<i>Calotropis gigantea</i>	14	14	100
	<i>Anthocephalus chinensis</i>	14	16	88
Ringworm	<i>Senna alata</i>	15	15	100
Scurvy	<i>Spondias pinnata</i>	23	26	88
	<i>Spilanthes acmella</i>	13	15	87
Stomach pain	<i>Mangifera indica</i>	10	13	77
	<i>Dillenia indica</i>	19	22	86
Vomiting	<i>Citrus grandis</i>	9	13	69
	<i>Cinnamomum tamala</i>	12	16	75

The present investigation is the first ethnobotanical effort to document and carry out quantitative analyses of medicinal plants used by the local folk medicinal practitioners in Barisal district. The study revealed that Barisal district has a plenty of medicinal plants and the amazing

update is that a great portion of medicinal plants are found in homestead. The local people of the investigated area still depend on traditional medicine despite the modern medical facilities are accessible indicating the importance of traditional medicines. Documentation and preservation of traditional knowledge on indigenous medicinal plants is not only indispensable for the communities, but also valuable for ethnopharmacological studies. In novel drug discovery our findings could provide baseline data to launch a bridge between the scientific communities and traditional health practitioners. In this regard, further scientific investigation on these medicinal plants for phytochemical, biological and clinical studies is greatly needed.

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