

ETHNOMEDICINAL STUDY FOCUSING ON ANTI-DIABETIC PLANTS USED BY THE COMMUNITY LIVING IN AND AROUND DHAKA

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Abstract

The present article mainly focused on the ethnomedicinal plants used by the community living in and around Dhaka to manage the diabetes. Ethnomedicinal data were collected using semi-structured interviews with key informants during June 2017 to July 2018 followed by field interviews, plant interviews, checklist interviews and group discussion techniques. A total of 92 ethnomedicinal plant species under 46 families have been documented. These species were used to treat 55 ailments through 200 formularies. Herbs are the most common medicinal plants in the study area followed by trees, shrubs and climbers. Leaf is mostly used for the preparation of herbal medicine. Among the total 92 ethnomedicinal plants, 11 species have been used for diabetes management by the community people. Disease category diabetes showed maximum factor informant consensus value. Most cited ethnomedicinal plant species for the diabetes management are *Gynura nepalensis* DC., *Coccinia grandis* L. Voigt, *Aloe vera* (L.) Burm. f., *Syzygium cumini* (L.) Skeels, *Swietenia mahagoni* (L.) Jacq., *Momordica dioica* Roxb. ex. Willd., *Catharanthus roseus* (L.) G. Don, *Streblus asper* Lour., *Bryophyllum pinnatum* (Lamk.) Oken, *Tamarindus indica* L. and *Scoparia dulcis* L. The results in the present study for diabetes management were very preliminary and based on which sound conclusion was not possible. Further ethnopharmacological study is very essential on such species to validate their efficacy in the management of diabetes. Our findings also provide baseline data to establish a connection between the traditional users of medicinal plants and scientific communities, which can be substantial in novel drug discovery. Furthermore, ethnomedicinal data is of significant value for conservation managers and policy makers for sustainable management of ethnomedicinal plant species, which are under threat due to rapid urbanization.

Introduction

Diabetes is an increasingly serious health disorder to the mankind. It is related to other life killing diseases. The management of diabetes is a global problem until now and successful treatment is not yet discovered. Searching for new antidiabetic drugs from natural plants is still attractive because they contain substances which take alternative and safe effect on diabetes. Dhaka is the dwelling place for more than 20 million people. Due to inappropriate lifestyle, maximum people here in Bangladesh have been suffering from diabetes (Akter *et al.* 2014). All diabetic patients have not got access to modern medicines because of high cost and less availability. Poor sections of diabetic patients are bound to look for medicinal plants as an alternative source of medicine. They even get medicinal plants from vendors selling in the footpaths of Dhaka city. Unfortunately, knowledge on medicinal plants in and around Dhaka city is hard to be found in written form. However, some knowledge has been transferred orally from

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one generation to another. Habitats of medicinal plants in and around Dhaka city is in a fragile state because of rapid urbanization, globalization, introduction of modern culture and anthropogenic pressures. Maximum ethnomedicinal plants will be lost before proper documentation and scientific evaluations for the welfare of mankind. Research on ethnomedicinal plants used for the treatment of diabetes has been carried out in the Indian subcontinent, by the Native Americans, Chinese, South Americans and Asian Indians (Mentreddy *et al.*, 2005, Grover *et al.* 2002, Mukharjee *et al.* 2006). Recently, there has been a growing interest in the herbal medicine in care and management of diabetes both in developing and developed countries, due to their natural origin and less side effects (Modak *et al.* 2007, Hasani-Ranjbar *et al.* 2009).

In Bangladesh a good number of ethnobotanical works have been done in different upazilas, districts, and communities. Most noteworthy works are Mia and Huq (1988), Hassan and Khan (1986, 1996), Alam *et al.* (1996), Uddin *et al.* (2001), Khan *et al.* (2002), Yusuf *et al.* (2002), Uddin *et al.* (2004), Uddin *et al.* (2006), Yusuf (2006), Yusuf and Uddin (2006), Uddin and Roy (2007), Roy *et al.* (2008), Emily *et al.* (2010), Uddin *et al.* (2012), Sajib and Uddin, (2013), Haque *et al.* (2014) and Uddin and Hassan (2014), Uddin *et al.* (2015a), Uddin *et al.* (2015b), Uddin *et al.* (2017), Haque *et al.* (2017), Uddin and Haque (2018), Shethi and Uddin (2018), Uddin *et al.* (2019). No such works have covered ethnobotanical study focusing antidiabetic plants in and around Dhaka city. In order to save the knowledge of medicinal plants for the future drug research for diabetes management, an attempt has been made to record ethnomedicinal plants used by community living in and around Dhaka, to determine most cited medicinal plants for diabetes management and threats of medicinal plants with suggesting their conservation.

Materials and Methods

Dhaka district is located in between 23°53' and 24°06' N and in between 90°01' and 90°37' E. The total area of the district is 1,464 km². It is bounded by Gazipur and Tangail district to the north, Munshiganj district to the south, Narayanganj district to the east, Manikganj and Rajbari to the west. Dhaka is the capital city of Bangladesh and mainly stands on the bank of Buriganga river. Turag, Shitalakhya and Balu rivers encircle the city. It has been estimated that Dhaka city had 20 million people in 2018 and is one of the largest cities of the world. The area enjoys hot, wet and humid tropical climate. The public health and quality life in Dhaka city are severely affected by traffic congestion and air pollution. Water bodies and wetlands around Dhaka city are facing destruction as these are being filled up to construct multistoried buildings and other real estate developments. Dhaka has no natural forest cover but a good number of exotic tree species are planted in and around Dhaka city including parks, gardens, road dividers, footpaths and house yard. Luxuriant growth of seasonal herbs, aquatics and climbers were observed in and around Dhaka city during growing season. Some native tree species were also found in Dhaka. A good number of people possess traditional botanical knowledge and they use such plant species in their primary health care management.

The selected spots including Kamrangirchar, Keraniganj, Atibazar, Ashulia, Mirpur, Gulishtan, Sher-e-bangla nagar, Purbachal, Uttara, Boldagarden, Ramna park and DU campus area were visited during different seasons of 2017 and 2018. The data have been recorded through semi-structured interviews, key informant discussions and informal conversations with community people and herbal practitioners (Alexiades 1996). During the field survey, information on uses of plants to treat humans, parts used, modes of preparation and administration have been documented along with vernacular names. A total of 162 people have been interviewed for the study age ranged between 20 to 80. Among the informants majority are Muslims and the rest are from other

religions. Education level is up to SSC and professionally they are farmers, day laborers, house wives, herbal practioners and small shopkeepers.

Voucher specimen for each medicinal plant has been collected and processed using standard herbarium techniques (Hyland 1972, Alexiades 1996). The specimens have been identified consulting different Floras viz., Hooker 1872-1897; Prain 1903; Uddin and Hassan 2004; Siddiqui *et al.* 2007 and Ahmed *et al.* 2008a, 2008b, 2009a, 2009b, 2009c, 2009d. Specimens available at Dhaka University Salar Khan Herbarium (DUSH) and Bangladesh National Herbarium have also been consulted in identifying the collected plant specimens. Voucher specimens have been deposited at DUSH. In order to estimate use diversity of the medicinal plants and to determine which plants are particularly interesting in the search for bioactive compounds, Factor of informant consensus (Fic) was calculated (Heinrich *et al.* 1998). Citation frequency (Cf) values are also been determined for most common medicinal plants in the study area. Cf values of medicinal plants were estimated using the formula:(number of people interviewed citing species/the total number of people interviewed) x100 (Friedman *et al.* 1986).

Results and Discussion

A total of 92 ethnomedicinal plant species under 46 families have been recorded from the study area. These are used against 55 ailments through 200 formularies. The present results are the indication of rich ethnomedicinal plants with use diversity in the study area. Though Dhaka city is devoid of natural forests nowadays but urban people have still some link with natural ethnomedicinal plants for their primary healthcare. This is proved from the current research results. Apart from this explanation community living around Dhaka city is still in primitive mode of lifestyle in practices. For each species scientific name, local name, family, parts used, ailments and mode of treatment are presented (Table 1). Among the total plants, 11 species have been used for diabetes management by the community people (Table 2).

Table 1. Diversity of ethnomedicinal plants with local uses in the study area.

Scientific name	Local name	Family	Parts used	Ailments	Treatment mode
<i>Abroma augusta</i> (L.) L. f., Z-68	Ulotkambal	Sterculiaceae	Stem	Constipation	Stem soaked in water for whole night then the extract is taken
			Leaves	Body cooling	Juice is taken
<i>Acacia catechu</i> (L. f.) Willd., Z-41	Khoirkata	Mimosaceae	Root	Dysentery	Root juice is taken
<i>Achyranthes aspera</i> L., Z-22	Apang	Amaranthaceae	Root	Jaundice	Root juice is taken
<i>Acorus calamus</i> L., Z-39	Boss	Araceae	Root	Reduce cholesterol	Cooked root is eaten
<i>Adhatoda zeylanica</i> Medic., Z-07	Bashok	Acanthaceae	Leaves	Cough	Leaves chewed directly
				Cough and Cold	Decoction is taken Leaf juice mixed with basil is taken 1 spoon each time
<i>Aegle marmelos</i> (L.) Corr., Z-52	Bel	Rutaceae	Fruit	Dysentery	Juice is taken
<i>Allium sativum</i> L., Z-58	Roshun	Liliaceae	Bulb	Pain	One cube is taken in the evening

Table 1 contd.

Scientific name	Local name	Family	Parts used	Ailments	Treatment mode
			Bulb	Heart disease	Bulb is eaten in empty stomach
				Tonic	Juice is taken
<i>Aloe vera</i> (L.) Burm. f., Z-13	Alovera	Crassulaceae	Leaves	Stomachache	Leaf juice is taken
				Dysentery	Inner mucilage of leaves is taken
				Diabetes	Inner mucilage of leaves is taken
			Latex	Skin disease	Latex juice is applied
				Jaundice	Latex juice is taken
				Hair treatment	Paste is applied
				Diabetes	Latex is taken
				Constipation	Latex is taken
<i>Alternanthera sessilis</i> (L.) R. Br. ex Roem & Schult., Z-70	Haicha	Amaranthaceae	Leaves	Antioxidant	Cooked leaves are taken
<i>Amaranthus spinosus</i> L., Z-74	Katanote	Amaranthaceae	Root	Menstruation	Root juice is taken
				Diabetes	Root is eaten for 1 month
<i>Anacardium occidentale</i> L., Z-62	Kajubadam	Anacardiaceae	Fruit	Heart disease	Fruits are eaten directly
				Bone fracture	Fruit is eaten directly
<i>Andrographis paniculata</i> (Burm. f.) Wall. ex Nees, Z-08	Kalomegh	Acanthaceae	Leaves	Female disease	Juice is taken
				Cough	Leaves are chewed
				Cold	Leaves are chewed
				Blood purifier	Paste is taken
<i>Areca catechu</i> L., Z-110	Supari	Arecaceae	Fruit	Heart disease	Raw young fruit is taken
<i>Artocarpus heterophyllus</i> Lamk., Z-78	Kathal	Moraceae	Latex	Ring worm	Latex is applied directly
			Fruit	Antioxidant	Fruit is eaten
<i>Asparagus racemosus</i> Willd., Z-19	Shatamuli	Liliaceae	Stem	Liver complain	Inner part is eaten
			Root	Gastritis	Powdered root is taken
<i>Azadirachta indica</i> A. Juss., Z-47	Neem	Meliaceae	Leaves	Stomach pain	Powder is taken
				Skin disease	Decoction is used for taking bath
				Pesticide	Decoction is sprayed
				High blood pressure	Leaves powder is taken
				Hair treatment	Paste is applied for killing lice
				Diabetes	Juice is taken
<i>Baccaurea ramiflora</i> Lour., Z-102	Lotkon	Euphorbiaceae	Fruit	Cold treatment	Juice is taken

Table 1 contd.

Scientific name	Local name	Family	Parts used	Ailments	Treatment mode
<i>Bombax ceiba</i> L., Z-48	Shimul	Bombacaceae	Root	Gonorrhoea Calcium deficiency	Cold extract is taken in empty stomach in the morning Inner part is taken
<i>Brassica campestris</i> L., Z-61	Ryesorisa	Brassicaceae	Seed	Skin disease	Seed oil is applied
<i>Bryophyllum pinnatum</i> (Lam.) Oken, Z-27	Pathorkuchi	Crassulaceae	Leaves	Stomach pain Joint pain Gastritis Gallbladder Dysentery Cuts and wounds Constipation Cold Cholera Acne	Leaves are chewed Leaves juice is taken Leaves are chewed three times in a day Juice is taken Leaves are chewed Paste is applied Leaves are chewed Paste is applied Paste is applied directly Juice is taken
<i>Cajanus cajan</i> (L.) Millsp., Z-85	Orhor	Fabaceae	Leaves	Jaundice Jaundice	Leaf juice is taken Juice is taken in empty stomach
<i>Calotropis gigantea</i> (L.) R. Br., Z-55	Akanda	Asclepiadaceae	Leaves	Pain	Cold extract is taken Juice is taken Juice is taken
<i>Catharanthus roseus</i> (L.) G. Don, Z-14	Noyontara	Apocynaceae	Flower Leaves	Diabetes	Flowers are chewed in empty stomach twice per day Half cup leaves juice is taken twice per day
<i>Cassia alata</i> L., Z-29	Dadmardan	Caesalpiniaceae	Leaves	Eczema	Leaves juice is taken
<i>Centella asiatica</i> (L.), Urban, Z-106	Manik pata	Apiaceae	Leaves	Stomach treatment Stomach pain Dysentery Diarrhoea Constipation Brain promoting	Juice is taken Leaves paste is taken with ginger and salt Juice is taken in empty stomach Juice is taken Leaves juice is taken Leaves paste is taken Leaves are chewed
<i>Cinnamomum camphora</i> (L.) J. Presl, Z-63	Korpur	Lauraceae	Fruit	Antibacterial	Fruits are taken
<i>Clerodendrum viscosum</i> Vent., Z-15	Vat	Verbenaceae	Leaves	Liver control Worm	4-5 leaves are chewed Leaves paste is taken until cure

Table 1 contd.

Scientific name	Local name	Family	Parts used	Ailments	Treatment mode
<i>Coccinia grandis</i> (L.) Voigt, Z-01	Telakucha	Cucurbitaceae	Leaves	Stomach pain	Cooked leaves are eaten
				Diabetes	Leaves are chewed Leaves juice is taken Cooked leaves are eaten
<i>Cocos nucifera</i> L., Z-99	Dab	Areaceae	Fruit	Diabetes	Cooked fruits are eaten
			Fruit	Body cooling	Fruit juice is taken
				Jaundice	Juice is taken
				Digestion	Juice is taken
<i>Colocasia esculenta</i> (L.) Schott, Z-107	Kochu	Araceae	Leaves	Snake bite	Paste is applied directly
					Paste is applied directly
				Chest burning	Cooked leaves are taken
<i>Crinum asiaticum</i> L., Z-45	Bonrosun	Liliaceae	Flower	Body pain	Cooked flowers are eaten
			Root	Asthma	Juice is taken
<i>Cuscuta reflexa</i> Roxb., Z-16	Sunnalota	Cuscutaceae	Whole plant	Jaundice	Juice is taken one spoonful twice a day
				Worm	Juice is taken one spoonful twice a day
<i>Cynodon dactylon</i> (L.) Pers., Z-53	Durba grass	Poaceae	Leaves	Jaundice	Juice is taken
			Leaves	Diabetes	Juice is taken
					Cuts and wounds
<i>Datura metel</i> L., Z-10	Datura	Solanaceae	Leaves	Skin disease	Cooked leaves are taken Leaves paste is applied
				Madness	Leaves juice is taken
<i>Eclipta prostrata</i> (L.) Mant., Z-31	Keshoraj	Asteraceae	Leaves	Hair treatment	Paste leaves is applied
					Leaves juice is applied to hair
<i>Eupatorium odoratum</i> L., Z-43	Fulkuri	Asteraceae	Leaves	Cuts and wounds	Leaves paste is applied
<i>Ficus racemosa</i> L., Z-72	Jogdumur	Moraceae	Fruit	Diabetes	Fruits are eaten
<i>Glinus oppositifolius</i> (L.) A. DC., Z-71	Geemashak	Molluginaceae	Leaves	Antioxidant	Cooked leaves are taken
<i>Glycosmis arborea</i> (Roxb.) A. DC., Z-108	Motkila	Rutaceae	Leaves	Worm	Leaves are juice applied
<i>Gynura nepalensis</i> DC., Z- 25	Gynura	Asteraceae	Leaves	Diabetes	Leaves juice is taken
					Leaves are chewed morning and afternoon
					Leaves are chewed in the morning and evening
					2-3 leaves are chewed
<i>Heliotropium indicum</i> L., Z- 18	Hathishur	Boraginaceae	Leaves	Insect bite	Paste is applied directly
				Eye treatment	Leaves juice is taken

Table 1 contd.

Scientific name	Local name	Family	Parts used	Ailments	Treatment mode
<i>Hibiscus rosa sinensis</i> L., Z-51	Roktojoba	Malvaceae	Flower	Women disease	Cold extract is taken
				Menstruation	Cold extract is taken for 1 week
				Dysentery	Flowers are taken
			Leaves	Fever	Leaves are chewed
				Diabetes	Juice of 5 leaves is taken in the morning and night
					Powder of seed, bark of arjun, fenugreek, tokma, and usufgul are taken
<i>Hygrophila auriculata</i> (Schum.) Heine, Z-93	Talmakhna	Acanthaceae	Fruit	Kidney treatment	Juice is taken in empty stomach in the morning and afternoon
<i>Hylocereus undatus</i> (Haworth) Britton & Rose, Z-111	Dragon fruit	Cactaceae	Fruit	Heart disease	Fruit is taken
<i>Hypis suaveolens</i> (L.) Poit., Z-100	Tokma	Lamiaceae	Leaves	Stomachache	Leaves juice is taken
			Seed	Body cooling	Cold extract is taken
<i>Ipomoea aquatica</i> Forssk., Z-105	Kalmisak	Convolvulaceae	Leaves	Antioxidant	Cooked leaves are eaten
<i>Lannea coromandelica</i> (Houtt.) Merr., Z-103	Jiga	Anacardiaceae	Bark	Dysentery	Juice is taken with green banana , guava and barks of mango and stone apple
				Constipation	Cold extract is taken
<i>Leucas aspera</i> (Willd.) Link, Z-80	Dondokolosh	Lamiaceae	Leaves	Cold treatment	Cooked leaves are taken
<i>Litsea glutinosa</i> (Lour.) Robinson, Z-28	Peepul tree	Lauraceae	Leaves	Diabetes	Decoction is taken
<i>Mangifera indica</i> (L.), Z-73	Aam	Anacardiaceae	Young leaf	Diabetes	Juice is taken
<i>Mentha arvensis</i> L., Z-17	Pudina	Lamiaceae	Leaves	Cold treatment	Leaves juice is taken
<i>Mikania cordata</i> (Burm. f.)Robinson, Z-83	Japanilata	Asteraceae	Leaves	Cuts and wounds	Paste is applied
			Stem	Cuts and wounds	Paste is applied
<i>Mimosa pudica</i> L., Z-02	Lajjabati	Mimosaceae	Stem	Women disease	Root is applied
			Leaves	Heart disease	Cold extract is taken
<i>Mirabilis jalapa</i> L., Z-59	Sondhamalati	Nyctaginaceae	Flower	Cold treatment	Flowers are eaten raw
<i>Momordica dioica</i> Roxb. ex. Willd., Z-46	Titakorolla	Cucurbitaceae	Fruit	Diabetes	Juice is taken in empty stomach
					Cold extract is taken
<i>Moringa oleifera</i> Lam., Z-65	Shajna	Moringaceae	Leaves	Pain	Paste is taken with black cumin and garlic
				Deworming	Paste is taken
				Constipation	Cooked drumstick is taken with black cumin and garlic
			Fruit	Constipation	Cooked fruit is eaten

Table 1 contd.

Scientific name	Local name	Family	Parts used	Ailments	Treatment mode
<i>Murraya koenigii</i> (L.) Spreng. , Z-75	Kamini	Rutaceae	Leaves	Toothache	Decoction is taken
<i>Musa sapientum</i> L., Z-50	Kacha kola	Musaceae	Latex Inner part	Skin disease Heart disease	Latex is applied Cooked inner part is taken
				Gastric	1 fruit with 4/5 bed bugs is taken
				Diabetes	Juice is taken
			Fruit	Digestion	Juice is taken
				Cold treatment	Fruits are taken directly
<i>Nigella sativa</i> L., Z-49	Kalojira	Apiaceae	Fruit	Heart disease	Black cumin with honey is taken for 1 month
				Hair treatment	Paste is applied
<i>Ocimum gratissimum</i> L., Z-06	Ramtulsi	Lamiaceae	Leaves	Asthma	Leaves juice is taken
<i>Ocimum sanctum</i> L., Z-05	Tulsi	Lamiaceae	Leaves	Cough	Leaves are chewed
				Cold treatment	Young leaves juice is taken
<i>Paederia foetida</i> L., Z-32	Gondhovadali	Rubiaceae	Leaves	Dysentery	Leaves juice is taken
<i>Phyllanthus emblica</i> L., Z-95	Aamloki	Euphorbiaceae	Fruit	Heart disease	Mixture of amla , myrobalan and beleric cold extract are taken
<i>Phyllanthus reticulatus</i> Poir. , Z-104	Chitki	Euphorbiaceae	Leaves	Diabetes	Cold extract is taken
<i>Plantago ovata</i> Forssk. , Z-88	Usufgul	Plantaginaceae	Seed coat	Pressure	Cold extract is taken
				Diabetes	Cold extract is taken
				Constipation	Cold extract of seeds is taken
<i>Psidium guajava</i> L. Bat., Z-67	Peara	Myrtaceae	Leaves	Toothache	Decoction is applied
			Fruit	Toothache	Fruits are eaten
<i>Rauvolfia serpentina</i> (L.) Benth. ex Kurz, Z-04	Sharpagandha	Apocynaceae	Root	Madness treatment	Root juice is taken
				Heart disease	Powder is taken after meal twice per day
				Deworming	Powder is taken after meal twice per day
				Blood pressure	Powder is taken after meal twice per day
<i>Saccharum spontaneum</i> L. , Z-40	Gandari	Poaceae	Whole plant	Jaundice	One glass juice is taken twice per day
<i>Saraca asoca</i> (Roxb.) de Wild., Z-26	Ashok	Fabaceae	Bark	Anti leukemia	Cold extract is taken in empty stomach
<i>Scoparia dulcis</i> L., Z-34	Chinigura	Scrophulariaceae	Whole plant	Dysentery	Juice is taken
				Diabetes	Powder is taken in empty stomach in the morning
			Leaves	Diarrhoea	Juice is taken

Table 1 contd.

Scientific name	Local name	Family	Parts used	Ailments	Treatment mode
				All disease	Cooked leaves are taken
<i>Senna alexandrina</i> Mill., Z-97	Sonapata	Caesalpinaceae	Leaves	Gastric	Cold extract is taken
<i>Spondias pinnata</i> (L. f.) Kurz, Z-87	Amra	Anacardiaceae	Fruit	Weight loss Heart disease	Cold extract is taken Fruits are eaten
<i>Streblus asper</i> Lour., Z-42	Sheora	Moraceae	Leaves	Diabetes	Leaves juice is taken
			Root	Bone fracture	Cooked leaves are taken Root paste is applied
			Latex	Acne	Latex is applied
<i>Strychnos nux-vomica</i> L., Z-84	Kuchila	Loganiaceae	Leaves	Jaundice	Cold extract is taken
<i>Swertia perennis</i> L.	Chirata	Gentianaceae	Leaves	Fever	Cold extract is taken
				Blood purifier	Paste is taken
<i>Swietenia mahagoni</i> (L.) Jacq, Z-03	Mahogany	Meliaceae	Seed	Pesticide	Cold extract is sprayed
				Joint pain	Crushed seed is taken after meal twice per day
				Diabetes	Juice is taken in empty stomach Crushed seed mixed with fenugreek is taken twice per day
<i>Syzygium cumini</i> (L.) Skeels, Z-82	Kalojam	Myrtaceae	Seed	Jaundice	Juice is taken
				Diabetes	Powder of black berry with fenugreek fruits are mixed with water and then is taken 1 teaspoon once a day, fruit taken directly
			Leaves		Leaves are chewed
<i>Tagetes patula</i> L., Z-101	Gada	Asteraceae	Leaves	Antiseptic	Leaf paste is applied
<i>Tamarindus indica</i> L., Z-66	Tetul	Caesalpinaceae	Fruit	Urine infection	Cold extract is taken
				High pressure	Fruit juice is taken
				Diabetes	Juice is taken in empty stomach
<i>Terminalia arjuna</i> (Roxb. ex DC.) Wight & Arn., Z-09	Arjun	Combretaceae	Bark	High pressure	Juice is taken in empty stomach
				Heart disease	Powdered bark is taken in empty stomach early in the morning

Table 1 contd.

Scientific name	Local name	Family	Parts used	Ailments	Treatment mode
				Heart disease	Powdered bark mixed with amla and beleric then is taken 1 spoon twice per day
<i>Terminalia bellirica</i> (Gaertn.) Roxb., Z-109	Bohera	Combretaceae	Fruit	Gastric	Cold extract is taken in the morning
<i>Terminalia citrina</i> (Gaertn.) Roxb. ex Fleming, Z-94	Horitaki	Combretaceae	Fruit	Heart disease	Cold extract is taken in the morning
<i>Tinospora cordifolia</i> (Wild.) Hook. f. & Thoms., Z-91	Aamkuruj	Menispermaceae	Stem	Diabetes	Cold extract is taken
<i>Trigonella foenum-graaceum</i> L., Z-81	Methi	Fabaceae	Leaves	Diabetes	Cold extract is taken
<i>Vitex negundo</i> L., Z-24	Nishinda	Verbenaceae	Leaves	Insomnia	Leaves are kept under pillow
<i>Vitis quadrangularis</i> Wall. ex Wight & Arn., Z-60	Harvanga	Vitaceae	Stem	Bone fracture	Paste is applied
<i>Vitis vinifera</i> L., Z-98	Angur	Vitaceae	Fruit	Diabetes	100gm is taken in the morning and night
<i>Wedelia chinensis</i> (Osbeck) Merr., Z-37	Vingoraj	Asteraceae	Leaves	Hair treatment	Leaves paste is applied
<i>Withania somnifera</i> (L.) Dunal, Z-44	Orshogondha	Solanaceae	Root	Energy tonic	Root powder is taken
<i>Xanthosoma violaceum</i> Schott, Z-64	Dudkachhu	Araceae	Leaves	Diabetes	Cooked leaves are taken
<i>Zanthoxylum rhetsa</i> (Roxb.) DC., Z-96	Bajna	Rutaceae	Fruit	Gastric, Weakness	One glass of juice is taken, Oil is taken
<i>Zingiber officinale</i> Rosc., Z-54	Ada	Zingiberaceae	Rhizome	Gastric	Juice is taken

The medicinal plants used for the diabetes management are not equally important. Some species are more important than others. Widely cited species for particular purpose by the community people are considered popular species. According to community people most cited medicinal plant species for the diabetes management are *Gynura nepalensis* DC., *Coccinia grandis* L. Voigt, *Aloe vera* (L.) Burm. f., *Syzygium cumini* (L.) Skeels, *Swietenia mahagoni* (L.) Jacq, *Momordica dioica* Roxb. ex Willd., *Catharanthus roseus* (L.) G. Don, *Streblus asper* Lour., *Bryophyllum pinnatum* (Lamk.) Oken, *Tamarindus indica* L. and *Scoparia dulcis* L. Such citations are the indication of importance of ethnomedicinal plants in the study area. Most cited species are also good candidate for further ethnopharmacology studies to find new compounds.

Life form of medicinal plant species showed variations. In our study herbs are the common ethnomedicinal plants followed by trees, shrubs and climbers (Fig. 1). This pattern of life forms was found in the previous research (Uddin *et al.* 2017). In case of parts used, leaf is always dominant parts used for the preparation of herbal medicine by community people found in the present study (Fig. 2). Such use trend is the indication of sustainable resource exploitation from the nature.

Table 2. Most cited medicinal plant species for diabetes management.

Species	Local name	Parts used	Ailments	Treatment mode	Citation
<i>Gynura nepalensis</i> DC., Z-25	Gynura	Leaves	Diabetes	Leaf juice is taken, Leaves are chewed morning and afternoon	103
<i>Coccinia grandis</i> L. Voigt., Z-01	Telakucha	Leaves, Fruit	Diabetes	Leaves are chewed directly, Leaf juice is taken, cooked leaves area eaten, cooked fruits are eaten	100
<i>Aloe vera</i> (L.) Burm. f., Z-13	Alovera	Leaves	Diabetes	Inner mucilage of leaves is taken	60
<i>Syzygium cumini</i> (L.) Skeels, Z-82	Kalojam	Leaves, fruit, Seed	Diabetes	Leaves are chewed, pulp of fruit is taken, powder of seed mixed with water is taken	45
<i>Swietenia mahagoni</i> (L.) Jacq, Z-03	Mahogany	Seed	Diabetes	Seed powder is taken in empty stomach, Crushed seed mixed with fenugreek and is taken twice per day	44
<i>Momordica dioica</i> Roxb. ex. Willd., Z-46	Korla	Fruit	Diabetes	Juice is taken in empty stomach	42
<i>Catharanthus roseus</i> (L.) G. Don, Z-14	Noyontara	Flower	Diabetes	Flower is chewed in empty stomach twice per day, Half cup leaves juice is taken twice per day	40
<i>Streblus asper</i> Lour., Z-42	sheora	Leaves	Diabetes	Leaf juice is taken	33
<i>Bryophyllum pinnatum</i> (Lamk.) Oken, Z-27	Pathorkuchi	Leaves	Diabetes	Juice is taken	32
<i>Tamarindus indica</i> L., Z-66	Tetul	Fruit, Leaves	Diabetes	Juice is taken in empty stomach, leaves are chewed	32
<i>Scoparia dulcis</i> L., Z-34	Chinigura	Leaves	Diabetes	Powder is taken in empty stomach in the morning	27

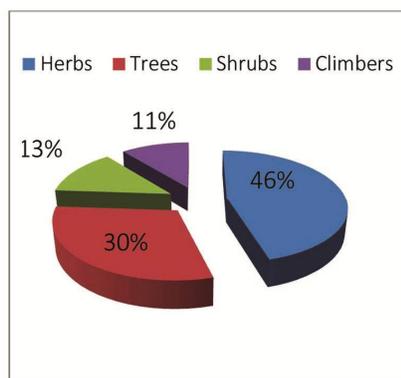


Fig. 1. Life forms ethnomedicinal plants.

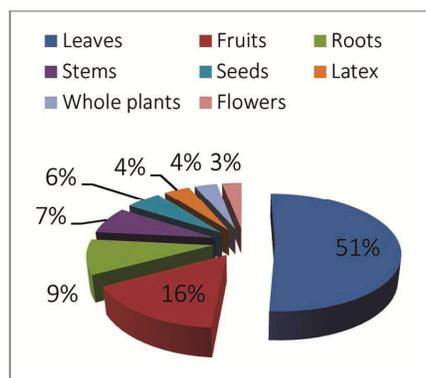


Fig. 2. Diversity of parts used.

Fic values have been calculated to know the consensus of local people in use of ethnomedicinal plants. The disease category diabetes attained highest Fic value followed by respiratory tract, gastrointestinal tract, heart disease, dermatological, toothache, diarrhea, dysentery, hair tonic, jaundice, cuts and wound, bone, menstruation, fever and bodyache, urinary tract, impotence and others (Table 3). Diabetes is managed by 11 ethnomedicinal plant species. Most cited medicinal plants for the management of diabetes are *Gynura nepalensis* (Gynura), *Coccinia grandis* (Telakucha), *Aloe vera* (Alovera), *Syzygium cumini* (Kalojam), *Swietenia mahagoni* (Mahogany) and *Momordica dioica* (Titakorolla). These six species are very popular and in some cases are sold in the market for diabetes management.

Table 3. Values of Factor of informant consensus (Fic)

Disease categories	Number of taxa	Used report	Fic values
Diabetes	11	589	0.983
Respiratory tract	12	232	0.952
Gastrointestinal tract	17	312	0.949
Heart disease	25	361	0.933
Skin disease	9	112	0.928
Toothache	2	13	0.917
Diarrhoea and dysentery	11	95	0.894
Hair tonic	6	48	0.894
Jaundice	9	60	0.864
Cuts and wound	7	41	0.85
Menstruation	5	21	0.8
Fever and bodyache	8	29	0.75
Urinary tract	2	3	0.5
Impotence	8	12	0.363
Others	15	86	0.835

Gynura (*Gynura nepalensis*) also called diabetic plant was reported as new record from Bangladesh (Uddin *et al.* 2015). As *Gynura* proved to be an ethnomedicinal plant species for diabetes management, plantlets of this species is sold in the local market. Leaves of this plant are used by the people without further process. According to community people, the plants with bitter and sour taste are suitable for diabetes. In the present research *Gynura* was cited by maximum people for the management of diabetes in Dhaka city. Telakucha (*Coccinia grandis*) is a native wild climber growing everywhere in the roadsides and fallow lands. Due to unsustainable collection from the nature, the species has become vulnerable. As the species is important for diabetes management, distribution status in the country needs to be assessed. A further pharmacological study is necessary to find active chemical from this wonderful ethnomedicinal plant species. In our study Telakucha showed second highest citation in the use for diabetes treatment. A good number of ethnobotanical studies conducted in Bangladesh was supported Telakucha used to reduce blood sugar (Roy *et al.* 2008, Uddin *et al.* 2015, 2017). The species

Telakucha also used for gonorrhoea and skin disease (Islam *et al.* 2010). It is also used for burning (Roy *et al.*, 2008).

Alovera (*Aloe vera*) is a wonderful herbaceous medicinal plant used in healthcare purpose from ancient time. The species is now sold in the commercial super market. A group of farmers cultivated this species in Natore Upazila. Alovera jel mixed with other medicinal plant parts is used to make energy drink in the urban footpath. Poor section of people in Dhaka city particularly rickshaw pullers, day laborers and enthusiastic people used to take this drink with faith to get relief from diabetes and other stomach related diseases and even to improve body energy. During our study a good number of people cited this species to be used in diabetes management. Alovera is also used for impotence in Bangladesh (Uddin *et al.* 2015, 2017). Kalojam (*Syzygium cumini*) is a native plant species of Bangladesh. It grows well in the natural forests and as well as homestead areas. Community people believed that fruits of Kalojam may purify human blood and seed powder also reduces blood sugar. It has been sold in the urban markets. In the present study many people cited that both fruits and seeds of Kalojam are used in diabetes management in Dhaka city. This type of result is also supported by previous research done in Bangladesh (Uddin *et al.* 2004). Kalojam is also used for jaundice in many parts of Bangladesh (Uddin *et al.* 2001, Khan *et al.* 2002). It is also used for toothache, and blood dysentery (Uddin *et al.* 2004). Mahogoni (*Swietenia mahagoni*) is an exotic timber yielding species naturalized in Bangladesh from long before. The plants produced oval shaped large fruits on the branch top. It contains huge number of seeds in each fruit. The pulp of the seeds is bitter in test. Community people claimed that cold extraction of seeds can reduce blood sugar but over intake may cause poison to human body. In the present study we found Mahogany was used in diabetes management by the people in and around Dhaka city. This finding is supported by previous research work done in Bangladesh (Haque *et al.* 2017). Titakorolla (*Momordica dioica*) is a very popular vegetable always sold in the all markets of Bangladesh. In our survey many people cited that Titakorolla used to manage diabetes by both urban and rural people. Same use of Titakorolla for diabetes management was reported from Feni district (Uddin *et al.* 2015). The present finding of Titakorolla to manage diabetes is accordance with previous findings.

During data collection we saw a good number of vendors sitting along the footpath of the Dhaka city roads and were selling crude medicinal plant parts and juice of mixture of those parts. Poor people are confident enough on such mixture and they regularly take it for caring of diabetes. In some cases, a good number of people were watching the vendor but they were refrained from take it because of hygienic question. Long term research is necessary to evaluate and validate the traditional practices displayed in the city footpath.

Observations in the field and discussions with local people, a good number of threats to ethnomedicinal plants have been identified. The most serious threats are exotic timber species plantation in and around homestead, fallow lands, roadsides and even in cultivated lands. *Acacia auriculiformis*, *Acacia mangium*, *Eucalyptus camadulensis*, *Samanea saman*, *Dalbergia sissoo*, *Laeucaena leucocephala*, *Swietenia mahagoni* and *Cassia siamea* are most preferred plant species for plantation. According to community people perception such species are very selfish plants and they do not support native species under their canopy. Medicinal plants and their traditional knowledge are in very rare in practice because of less availability in the area. As there is no written documentation on the medicinal plants, with the extinction of senior people traditional medicinal knowledge also eliminated from the urban society. They also informed us urbanization in and around Dhaka city is another challenge to ethnomedicinal plants habitats. There is ample opportunity to work on this issue but the project is very small budgeted. The current work is very preliminary. Lack of awareness among the community people is another threat to ethnomedicinal plants in the study area. People are careless to plant resources in some extend. They only care

timber, ornamental and fruit plants. Currently they also started to care plants in roof garden. Availability of the modern medicines which promotes the negligence of use of herbal medicines among the community people in the study area is also threats to medicinal plants. Senior people with herbal knowledge do not like to share their knowledge with juniors. Due to sudden death of such people, herbal knowledge of the area lost forever.

A list of suggestion has been made based on present survey results and observations. Distribution map can be made for all culturally important medicinal plant species in the study area. Population status of such species across the habitats can be measured. Current rate of exploitation of ethnomedicinal plants by the community people could be calculated. If it seems vulnerable in the natural habitats, necessary measures for *ex situ* conservation could be taken. Awareness programs among the local influential persons who can make change can be created. Culturally important and most cited ethnomedicinal plants should be brought under plantation programs.

Conclusion

Diabetes is a life killing disease to the mankind. It has no permanent and final treatment in our hand. Diabetes can be controlled through management and maintenance of lifestyle activities including changing in food habit, regular exercise and proper sleeping time. In the present study documentation of total 92 ethnomedicinal plant species under 46 families in and around Dhaka city is the indication of rich ethnomedicinal plants with use diversity. Among them 11 species are used for the management of diabetes. However, all of these 11 species are not equally important in the management of diabetes. Most cited medicinal plant species for diabetes management are *Gynura nepalensis* DC., *Coccinia grandis* L. Voigt, *Aloe vera* (L.) Burm. f., *Syzygium cumini* (L.) Skeels, *Swietenia mahagoni* (L.) Jacq, *Momordica dioica* Roxb. ex. Willd., *Catharanthus roseus* (L.) G. Don, *Streblus asper* Lour., *Bryophyllum pinnatum* (Lamk.) Oken, *Tamarindus indica* L. and *Scoparia dulcis* L. The present result is very preliminary and based on which sound conclusion is not possible. Further ethnopharmacological study is very essential on such species to prove their efficacy in the management of diabetes. Our findings also provide baseline data to establish a connection between the traditional health practitioners and scientific communities, which could be substantial in novel drug discovery. Furthermore, ethnobotanical data is of significant value for conservation managers and policy makers for sustainable management of medicinal plant species, which are under threat due to over exploitation.

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