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Review Article

Tribal Differences in Bangladesh in the Selection of Medicinal Plants for Treatment of Gastrointestinal Disorders: A Short Review

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Abstract

Diarrhea and dysentery along with other gastrointestinal tract (GI-tract) disorders are fairly common throughout Bangladesh because of lack of quality drinking water, poor sanitation facilities, and somewhat unhygienic mode of living among the poorer but majority sections of the population. Modern medical facilities are largely unavailable to the rural population, and more so among the different tribal population scattered throughout the country. Previous surveys have indicated that the tribal population relies heavily on phytotherapeutic treatment of GI-tract disorders, the tribal medicine (TM) treatment being administered by their own tribal medicinal practitioners (TMPs) similar to folk medicine (FM) and folk medicinal practitioners (FMPs). In this review, we analyze the plants used against several GI-tract disorders by TMPs of three different tribal populations of the country, namely the Chakma tribe residing in Rangamati district in the southeast, the Mandai tribe living largely in Tangail district in the center, and the Santal tribe living in Rajshahi district in the northwest part of the country. It can be seen clearly that the three tribes used different plants for treatment of the same disorder. The review analyzes possible causes for the observed differences. The number of plants available to treat a particular disorder highlights the richness of the floral species of Bangladesh enabling the various TMPs to select different plants or combination of plants. Overall, it can be stated that the plants present rich potential for not only discovery of new drugs but also which can be used as effective and affordable herbal medicines against several GI-tract disorders.

Keywords: *GI-Tract Disorders; Phytotherapy; Chakma; Mandai; Santal*

Abbreviations

FMP: Folk Medicinal Practitioner; FM: Folk Medicine; GI-tract: Gastrointestinal Tract; TMP: Tribal Medicinal Practitioner; TM: Tribal Medicine; NO: Nitric Oxide; iNOS: Inducible Nitric Oxide Synthase; COX-2: Cyclooxygenase-2; LPS: Lipopolysaccharide

Introduction

There are no accurate and updated reports on the number of tribes and the tribal population in Bangladesh. According to some, the tribal number may be 45 or 46; others say that there may be 59 tribes [1]. There are also differences of opinion regarding 'tribal' versus

'indigenous' people. Tribal people known to the mainstream Bengali-speaking population as 'upajati' are thought to have arrived in the country within the last few hundred or fewer years. Indigenous people, on the other hand, are known as 'adivasis' or original inhabitants, meaning people who were present from the very first and who brought their habitat under control. Officially, there are no indigenous peoples in Bangladesh but only tribal people, who perhaps constitute in totality less than 2% of the 158.9 million population of Bangladesh [2].

The lot of both mainstream below poverty level income people and tribal people are disquieting, especially when their medical needs are concerned. Rural and remote area mainstream people, besides the below poverty level income group, rely substantially on folk medicinal practitioners (FMPs) and folk medicine (FM) for their health-care needs. Likewise, tribal people who usually use remote hilly forested areas as their habitat also count on their tribal medicinal practitioners (TMPs) and tribal medicine (TM) for their primary health-care needs. This is because modern clinics, hospitals and allopathic doctors are mostly present in the big cities of the country and even then their costs for treatment are not affordable to most people. FMPs and TMPs on the other hand, mainly depend on phytotherapy, that is treatment with plants and this practice is possibly going on for millennia.

The major benefit of phytotherapeutic treatment is that in most instances plants are readily available and affordable. Our various surveys suggest that the medicinal plants used by FMPs and TMPs are collected within reasonable walking distances of the practitioner's habitats [3-10]. However, our surveys also demonstrate a wide diversity in the selection of plants by FMPs and TMPs, who may be practicing in the same area or even in the same village [11]. There has been a lot of hypothesis regarding selection of plants by traditional medicinal practitioners. Plants have been categorized into 'apparent' plant species (shrubs and trees) and 'non-apparent' plant species' (herbs). Non-apparent plant species are presumed to contain more bio-active compounds and so have a higher chance of having a place within the herbal pharmacopoeia of different Brazilian ecosystems [12].

Bangladesh is said to have over 5000 angiosperm plant species [13]. As a result, potentially an FMP or a TMP can select from a large number of plants and choose even multiple plants to treat the same ailment. Plants produce phytochemicals or secondary metabolites, the pharmacological properties of any particular metabolite or metabolites determining whether the plant can be used for therapeutic purposes. The reported wide diversity in the selection of plants [11] also offers a comprehensive range of opportunities to the scientist for discovering new drug(s) against a given ailment, for plants have always proved to be excellent sources for many modern drugs. Gastrointestinal disorders are a common trait within the Bangladeshi population, particularly the poor because of unhygienic living conditions and lack of proper drinking water [13]. In this review we compare the various medicinal plants used by three different tribal groups of Bangladesh residing in three different regions of the country and discuss their selectivity differences of plants.

Methods

The data used in this review has been compiled from manuscripts published before. Three tribal populations have been considered, the Chakma tribe residing in the Rangamati district in the southeast [14], the Mandai tribe living largely in Tangail district in the center [6] and the Santal tribe living in Rajshahi district in the northwest part of the country [15]. The various districts are shown in figure 1. It is to be noted that the plants used against gastrointestinal disorders by the TMPs of the three tribes as discussed in this review do not reflect all the plants used by them in gastrointestinal disorders, but presents only a partial list of the plants used. The basis for the selection of the plants for further review was totally random. Other pertinent information has been collected from scientific journals abstracted in PubMed, SCOPUS and Google Scholar.

Results

The plants used by the three tribes for treatment of several gastrointestinal disorders are shown in table 1. The various gastrointestinal disorders treated by the tribal TMPs included constipation, dysentery, stomach ache, indigestion, diarrhea, and flatulence. Two important points are immediately noticeable from the Table. The first is that the same tribal TMP may be using more than one plant to

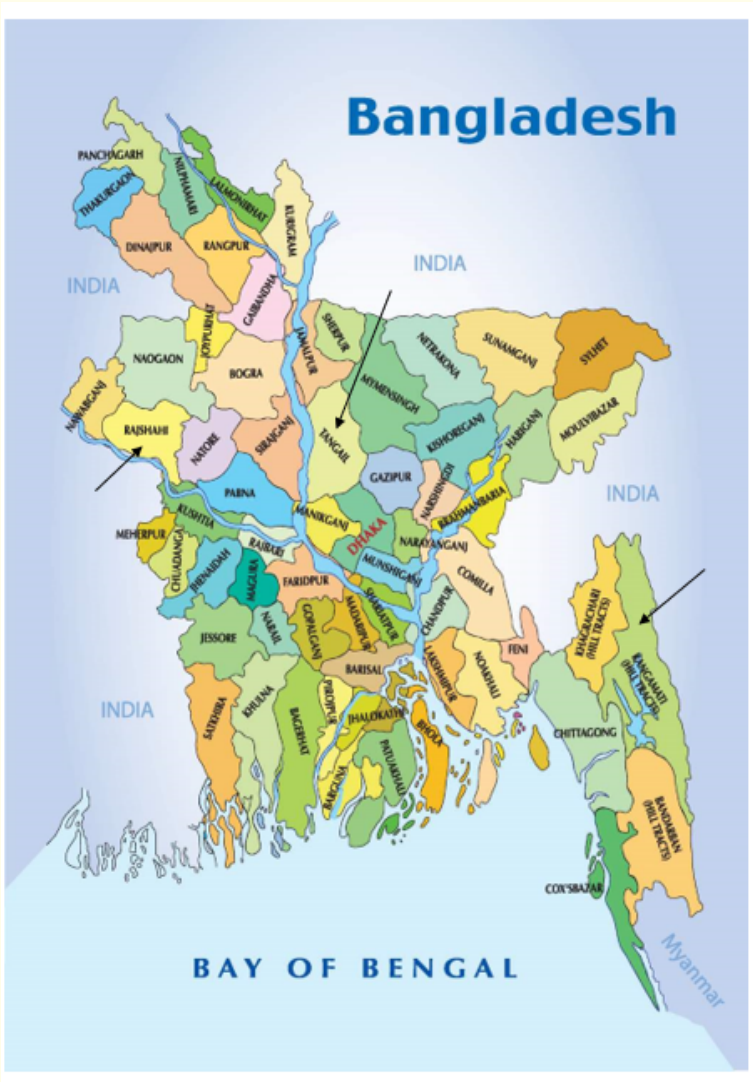

Figure 1: *District map of Bangladesh (arrows showing Tangail, Rajshahi and Rangamati districts).*

treat similar type of gastrointestinal disorder. For instance, the Mandai TMP used either *Curcuma aromatica* Salisb. (Zingiberaceae) or *Smilax zeylanica* L. (Smilacaceae) for treating stomach ache and indigestion. The Mandais also used two formulations for the treatment of dysentery; interestingly, one was a monoherbal and the other a polyherbal formulation. Similarly, the Chakma TMP used either *Adiantum philippense* L. (Adiataceae) or *Desmodium triquetrum* (L.) DC. (Fabaceae) for the treatment of dysentery; the TMP also used either *Acorus calamus* L. (Acoraceae) or *Cissus quadrangularis* L. (Vitaceae) for treatment of constipation. The Santals used three different plants for treatment of dysentery, the plants being *Holarrhena pubescens* Wall. ex G. Don (Apocynaceae), *Streblus asper* Lour. (Moraceae), and *Cyperus scariosus* R.Br. (Cyperaceae). The second point is that the three tribal TMPs selection of plants differed basically completely between them (for instance, the plants used to treat dysentery by the Chakmas, Mandais and Santals were totally different from each other).

Scientific name of plant, (Family), English name	Part used	Gastrointestinal ailment used for	Tribe
Acorus calamus L. (Acoraceae) Sweet flag	Leaf	Constipation	Chakma
Adiantum philippense L. (Adiantaceae) Walking maidenhair fern	Leaf	Dysentery	Chakma
Desmodium triquetrum (L.) DC. (Fabaceae) Trefle Gros	Leaf	Dysentery	Chakma
Cissus quadrangularis L. (Vitaceae) Veldt grape	Stem	Constipation	Chakma
Curcuma aromatica Salisb. (Zingiberaceae) Wild turmeric	Rhizome	Stomach ache, indigestion	Mandai
Smilax zeylanica L. (Smilacaceae) Ushaba	Root	Stomach ache, indigestion	Mandai
Evolvulus nummularius L. (Convolvulaceae) Dwarf morning glory + *Zingiber officinale* Roscoe (Zingiberaceae) Ginger + *Alternanthera sessilis* (L.) DC. (Amaranthaceae) Sessile joyweed	Root + Rhizome + Root	Dysentery	Mandai
Streblus asper Lour. (Moraceae) Siamese rough bush + *Hemidesmus indicus* R.Br. (Apocynaceae) Indian sarsaparilla	Gum + Root	Stomach ache, diarrhea	Mandai
Achyranthes aspera L. (Amaranthaceae) Prickly chaff flower	Root	Dysentery	Mandai
Holarrhena pubescens Wall. ex G. Don (Apocynaceae) Ivory tree	Seed	Dysentery	Santal
Benincasa hispida (Thunb.) Cogn. (Cucurbitaceae) Wax gourd	Seed	Stomach ache, flatulence	Santal
Cassia sophera L. (Fabaceae) Algarrobilla	Leaf	Constipation	Santal
Streblus asper Lour. (Moraceae) Siamese rough bush	Root	Dysentery	Santal
Cyperus scariosus R.Br. (Cyperaceae) Cypriol	Root	Dysentery	Santal

Table 1: *Some plants used to treat gastrointestinal disorders by three tribal groups of Bangladesh.*

There may be a simple explanation for the use of multiple plants for the treatment of the same disease. Not all plants are perennials; a number of the medicinal plants used by the TMPs were annuals and available only during parts of the year. Moreover, roots from a number of plants were used, which possibly is the most destructive way of using a plant. The collection of roots, particularly of small plants ensures that the plant will not survive. And unless a new plant is immediately planted in the same place, it may in the long run lead to total scarcity of the plant being used. So out of necessity, if not for other reasons, a TMP or an FMP has to have knowledge of the use of multiple plants to treat the same disease or risk running out of plants. However, the diversity of selection of plants is something more difficult to explain in a small country like Bangladesh. The country extends from 20’34N to 26’38N latitude and from 88’01E to 92’41E longitude. Thus the climate and the vegetation do not show any drastic differences between north, south, east and west. Some differences are observed for the southeast and southwestern regions and north of the central region, where the country is dotted with small hills and forested. In records kept from 1948 - 2013, the minimum and maximum temperatures recorded in Teknaf in the southeast tip of Bangladesh were 9.5 and 38.0°C, respectively. The maximum and minimum temperatures in Dinajpur in the northwest corner of Bangladesh were 3.9 and 43.6°C, respectively. The magnitudes of normal maximum and minimum temperatures are very close to each other throughout the country [16]. Thus, other factors must account for the variability in medicinal plant selection by the TMPs of various tribes.

Discussion

The cause(s) of selection of a particular medicinal plant over others is still a somewhat unresolved issue among scientists (including ethnobotanists). Various causes have been advanced at different times, which may be appropriate for a particular traditional medicinal practitioner, region, cultural including religious practices, apparent versus non-apparent plant species, and organoleptic properties. The

issue of selection of non-apparent plants (herbs) over apparent plants (shrubs and trees) has been discussed earlier (for a fuller discussion, see [12]). It has been said that human beings originally used plants for therapeutic purposes after noticing such use by animals. It has been shown that of the 53 plant species used by the wooly spider monkeys (*Brachyteles arachnoids*) in Intervales State Park of São Paulo State, Brazil thirteen species were used by humans residing around the park for medicinal purposes [17]. Medicinal plant(s) used for control of nematode infections have been observed in chimpanzees in the Mahale mountains of Tanzania [18]. An extensive review of the gorilla diet in the wild has shown that 118 medicinal plant species are present in their diet [19].

Selection of medicinal plants can also depend on organoleptic properties like taste, smell, color, and appearance of the plant [20]. Such properties are also used for selection of medicinal plants in Bangladesh by TMPs and FMPs. The red flowers of *Hibiscus rosa-sinensis* are used to treat excessive bleeding (replacement of red with red) by the Tudu sub-clan of the Santal tribe in Joypurhat district, Bangladesh [21]. Availability, ease of collection, distance to be covered to collect plants, and trial and error can be other factors behind the selection of plants by an FMP or TMP. It is not known how the present plants were selected by the respective TMPs. The selection is not possibly based on ease of availability. For instance, *Achyranthes aspera* can usually be found in disturbed areas, roadsides, and forest margins. As such, it should have been used by the Chakma tribe because they reside in forest areas and margins. Yet the plant is used by the Mandais living in flat land areas.

Similar to the Chakma TMP, in ancient Chinese medicine, *Acorus calamus* was used to treat constipation; in India, the plant has ethnic uses as a carminative [22]. Various phytochemicals of biological importance has been isolated from the plant, like alpha- and beta-asarones, alpha-selinene, camphene, terpineol, epieudesmin, borneol, linalool, elemicin, and ursolic acid [22]. Although the activities of these phytochemicals are yet to be evaluated for their effectiveness against constipation, one or more of these compounds may possibly be found to be effective. Of the 30 species of *Adiantum* genus found in China, half are used to cure diseases, which includes diarrhea [23]. Hopane and isohopane type triterpenoids have been isolated from the plant, which can account for the anti-diarrheal effect [24]. However, the mechanism for the anti-diarrheal effect remains to be elucidated.

In Tamilnadu, India, villagers of Sivagangai district drink leaf decoction of *Desmodium triquetrum* twice a day for 2 - 3 days to cure diarrhea and dysentery. Hyperforin and trigonelline are present in leaves of the plant [25]. Hyperforin is known to have anti-inflammatory and antinociceptive effects; the compound decreased nitric oxide (NO) production and also decreased gene expressions of inducible nitric oxide synthase (iNOS) and cyclooxygenase-2 (COX-2) in lipopolysaccharide (LPS)-induced RAW 264.7 macrophages [26]; the anti-inflammatory effect can be beneficial in patients with chronic diarrhea caused by inflammatory bowel disease [27] and in patients suffering from pain during chronic diarrhea. Flebil, an herbal medication containing *Cissus quadrangularis*, has been found to be effective in irregular bowel activity (constipation or diarrhea); the ingredients of the plant include quercetin and kaempferol [28]. It has been reported that quercetin promotes gastrointestinal motility and mucin secretion in loperamide-induced constipation of rats [29].

Therapeutic studies have shown that curcumin - a compound present in *Curcuma* genus plants like *Curcuma longa* and *Curcuma aromatica* is beneficial in digestive diseases [30]. *Smilax zeylanica* is used by folk medicinal practitioners (FMPs) of Bangladesh for treatment of various gastrointestinal disorders [31]. Roots of the plant reportedly contain diosgenin, steroids, phenols, flavonoids and saponins [32]. Diosgenin has been shown to suppress intestinal inflammation including occurrence of diarrhea [33]. In the polyherbal formulation for dysentery used by the Mandais, *Evolvulus nummularius* methanol extract has been shown to possess anti-bacterial activity against various Gram-positive and Gram-negative bacterial strains; this can be due to presence of tannins, flavonoids and triterpenoids in the extract [34]; a compound identified as 3-*O*-(4-stearoyl-Z-coumaroyl)-stigmast-5,*E*-22-dien-3-beta-ol isolated from the plant was found to be moderately active against several bacterial species [35]. *Alternanthera sessilis* is used in folk medicine of Pakistan to treat diarrhea and dysentery; crude ethanolic extract of the plant reportedly showed spasmolytic activity in isolated rat jejunum preparations in potassium-induced spastic contractions [36]. Anti-diarrheal activity of crude aqueous extract of the plant has been shown in castor oil-

induced diarrhea in mice [37]. Beneficial effect of *Zingiber officinale* in infectious diarrhea has been reported; various mechanisms have been proposed for the effect like inhibition of colonization by enteropathogens, inhibition of intestinal motility, and spasmolytic action with the active constituents being proposed as zingerone, tannins and flavonoids. The anti-diarrheal effect of *Zingiber officinale* rhizomes has been reviewed [38].

In vivo anti-diarrheal activity of methanol extract of *Streblus asper* leaves has been shown in Swiss albino rats, the activity being attributed to decrease of gastrointestinal motility by the extract [39]. The plant was used by the Mandai tribe in a polyherbal formulation for treatment of stomach ache and diarrhea. A number of phytochemicals has been reported from the plant; the list includes alpha-amyrin, lupeol, n-triacontane, betulin and oleanolic acid [40]. Lupeol reportedly showed beneficial effects in models of chronic non-specific intestinal inflammatory diseases, including ulcerative colitis and Crohn's diseases [41]. Methanolic extract of *Hemidesmus indicus* roots has been shown to be effective against castor oil-induced diarrhea in rats; the extract also showed anti-bacterial activity against *Salmonella typhimurium*, *Escherichia coli* and *Shigella flexneri*. The anti-diarrheal effect possibly stemmed from inhibition of intestinal motility and anti-bacterial activity [42]. In some parts of India, *Achyranthes aspera* is used to treat dysentery [43]. The plant contains compounds like luteolin, apigenin, p-coumaric acid, chlorogenic acid, ursolic/oleanolic acid, and quercetin, some of which have anti-inflammatory properties and contribute to the anti-dysentery effect [43]. The roots of the plant reportedly contain ecdysterone [44]. Another plant *Sida spinosa* L., also used in traditional medicine for dysentery contains ecdysterone [45].

Holarrhena pubescens (synonym: *Holarrhena antidysenterica*) is a widely used plant for treatment of dysentery in Bangladesh and elsewhere [46]. The bark is used in Ayurvedic and Unani medicines in India, and is active against *Staphylococcus aureus*, *Entamoeba histolytica* and *Escherichia coli*. The bark contains the alkaloid conessine, which is effective against dysentery [47]. In a fairly recent review, *Benincasa hispida* has been mentioned to have analgesic and anti-microbial effects, which can account for its use in stomach ache. In Asian communities, the plant is also used for gastrointestinal problems. The major constituents of the plant include flavonoids, glycosides, beta-sitosterin, and uronic acid [48]. Leaves of *Cassia sophera* were used by the Santals to treat constipation. Leaves are known to contain butanedioic acid, 1,2,4-butanetriol triacetate, 7-hexadecene, *E*-15-heptadecenal, 1,2-benzenedicarboxylic acid, 3-eicosene, and 10-heneicosene. In Indian folk medicine, the plant is used for gastrointestinal tract disorders [49]. The leaves and seeds are used in Ayurveda for treating constipation [50]. *Cyperus scariosus* is another plant, which has traditional uses in India for treatment of diarrhea and dysentery. Various phytochemicals have been reported from the plant like alpha- and beta-pinene, myrecene, cyperol, aristolone, patchoulane, citral, and spathulenol [51].

Irrespective of the above outlined various modes of selection of medicinal plants, since almost total variations in tribal selections of plants were observed it is very much possible that cultural factors may have also played a part. Most tribes in Bangladesh still possess animistic dogmas and whether such beliefs play a part in the selection of medicinal plants is a question, which needs to be further explored. A further point and an important point to be noted is that there appears to be strong rationalization for selection of the plants by the tribal medicinal practitioners (TMPs) based on phytochemical profiles and pharmacological activity study reports on the plants in scientific journals. What scientists are now concluding has been identified through some unknown basis (but could be trials and errors among other factors) by TMPs at some undetermined period following advent of human beings. As such, the plants can contribute towards the discovery of novel drugs without low or no adverse effects, which has formed an important need for human beings in the modern era.

Conclusion

There is a large amount of diversity in the selection of medicinal plants among the various tribes of Bangladesh for the treatment of even the same disease. Such diversity not only points to the floral diversity present in Bangladesh, but also offers scientists a plethora of plants from which new drugs can be obtained. Such diversity also points to the importance of medicinal plant conservation.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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