



An Ethnomedicinal Survey of Medicinal Plants Used as Food Supplements by the Chakma Tribe of Bandarban District, Bangladesh

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Abstract

Medicinal plants serve as food supplements and provide essential nutrients to the body in addition to their use as prophylactic and curative measures for some diseases. We conducted a survey among the traditional healers of the Chakma tribe, which is the largest tribe in the Chittagong Hill Tracts region in the southeast part of Bangladesh with the objective of obtaining information on plants, which can serve as food supplements. Information was obtained from the traditional healers with the help of a semi-structured questionnaire and the guided field-work method. It was observed that several medicinal plants or plant parts are used as food supplements by the tribe. The plants included *Aegle marmelos*, *Coccinia grandis*, *Hyptis suaveolens*, *Mangifera longipes*, *Nymphaea nouchali*, *Terminalia chebula*, and *Syzygium cumini*. The plants serve as food supplements and plant parts can be taken on a regular basis for treatment and prevention of several diseases.

Key words: Ethnopharmacology, Chakma tribe, Bangladesh, medicinal plants, food supplements

Introduction

Medicinal plants have been used for centuries as food supplements or ingredients of food. The latter use includes spices and herbs to impart flavour or colour to foods as well as for dietary benefits to aid digestion or in make food more palatable. Recent years have witnessed an explosion in the use of nutraceuticals where extracts, decoctions or direct consumption of medicinal plant or plant parts in the form of pills, capsules, powders and tablets take place. A number of studies have been carried out which point to the beneficial effect of medicinal plants or plant parts when taken as food supplements. Thus these plants can serve as “functional foods”, i.e. having the additional properties of promoting health or preventing diseases in addition to their property of supplying nutrients to the body. For instance, it has been reported that oat and bean products are particularly effective cholesterol-lowering agents (1). It is to be noted that oat is also regularly eaten in many countries as a cereal, while beans are taken as vegetables. As such, these plants are important for direct consumption or as supplements to regular diet. A Netherlands Cohort Study showed that consumption of onions has an inverse relationship to incidences of stomach carcinoma (2). Various edible herbs like *Serenoa repens*, *Pygeum africanum*, *Urtica dioica radix*, and *Cucurbita peponis semen* have shown promise in the treatment of benign prostatic hyperplasia (3). Some plants, which are taken as food supplements like *Coccinia indica*, *Gymnema sylvestris*, *Aloe vera* and *Momordica charantia*, show promise for glycemic control in diabetes (4).

The practice of using medicinal plants as food supplements, as a preventive measure or to treat diseases is common throughout the world. In the indigenous health care delivery system of Ethiopia, a number of plant species are used to treat ailments associated with pyrexia. Two of the common

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plants are *Ocimum suave* and *Ocimum lamiifolium* (5). A study concluded high levels of herbal supplement use among US women, which was generally associated, with higher education and income, and health needs (6). *Smallanthus sonchifolius* (yacon) and *Lepidium meyenii* (maca) were the traditional crops of the original population of Peru and are still used by them as folk medicines. In between them, the two plants have shown considerable potential for the treatment of hyperglycemia, kidney problems and for skin rejuvenation, cytoprotective activity, fertility enhancer, aphrodisiac, adaptogen, immunostimulant, and to influence hormonal balance (7). A study conducted in Turkey concluded that a number of important herbs in the Turkish flora, which are used for edible purposes contain active components effective for increasing human health and for preventing cancer (8). Kim *et al* (9) reported *Adenophora triphylla* (a wild plant of Korea) leaves as a potential source for functional foods and a natural source of antioxidants. The plant is commonly used in food materials and in oriental medicine for its analgesic, anti-inflammatory and antitussive properties (9).

Bangladesh is a small developing country with poor resources and a population of about 150 million. A significant percentage of the population live in rural areas and have a high poverty level with earnings of less than US\$ 1 per day. Malnutrition is prevalent in the rural areas and urban slums with consequent high incidence of diseases arising from poor hygiene and malnutrition. Access to medical facilities is also poor in rural areas. Traditional medicinal practitioners form the primary health-care providers to the rural population and a substantial segment of the urban population. These practitioners, as well as the rural population rely on a number of medicinal plants, herbs and weeds to supplement food sources and for preventive measure or cure for a variety of ailments. Bangladesh also has a number of tribes residing in the northern and south-eastern forest regions of the country. Tribal people, in general are more dependent on plants and plant parts which are edible and can serve medicinal purposes. The Chakma tribe is the largest tribe residing in the Chittagong Hill Tracts region in the southeastern part of Bangladesh. They have their own tribal medicinal practitioners and distinctive food habits, which are different from the mainstream population. The tribal medicinal practitioners possess considerable expertise on medicinal plants.. The objective of the present study was to conduct an ethnomedicinal survey of the Chakma tribal healers of Chittagong Hill Tracts Region. The criteria for selecting a medicinal plant as food supplement were edibility, nutritive value (i.e. whether the plant has been reported to be a good source of macro- as well as micro-nutrients), whether the plant or plant part is used directly as food or supplemental food by the Chakmas as well as in other regions of Bangladesh, reports of pharmacological activities in plants or plant parts, and finally whether any toxic reports are present on consuming the plant for short-term or extended time periods.

Materials and Methods

Area of survey

Surveys were conducted amongst the Chakma tribal healers residing in Gundum, Tombru and Naikhongchhari villages in the Bandarban district of the Chittagong Hill Tracts region of Bangladesh from January 2008 till February 2009. There are Chakma settlements in all the three villages mentioned above. Bandarban district falls roughly between 92°10' – 92°40' E and 21°20' – 22°20' N and has an area of 4479 square kilometers. The district consists mostly of forests and hills. Annual average temperature ranges from a minimum of 13°C to a maximum of 34.6°C. Annual rainfall is in the range of 303 centimeters. The Chakmas form the largest tribe amongst the various tribal groups residing within the district. The main agricultural crops of the district are paddy, mustard, and vegetables while the main fruits cultivated are bananas, pineapples, jack-fruits, oranges and papayas.

Mode of information collection

Informed consent was obtained from the Chakma healers prior to collection of any data. Interviews were conducted in the Chakma language with the help of an interpreter. Two healers were interviewed at Tombru and one each at Gundum and Naikhongchhari. At their request, the two west of

healers of Gundum were interviewed together. A semi-structured questionnaire was used during the interview process. The basic method followed was that of the guided field-walk as described by Martin (10) and Maundu (11). Information was obtained from the healers during field-walks where the informant pointed out plant species and described their medicinal as well as any other uses. Information was obtained on the plant parts used, formulations, dosages, side-effects if any and when appropriate, whether the plant species was included in the diet for preventive or curative properties. At the request of the Chakma healers, formulations, dosage and side-effects data are not included in the paper for they requested confidentiality on these data on grounds that dissemination of these data would be detrimental to their professional practices. The healers, however, had no objections to publishing the data on medicinal plant species, their medicinal uses and whether they are used as functional foods, i.e. food supplements. Agreement was reached that any financial benefit accruing from the publication would be handed over to the healers to be spent for the general welfare of the communities.

Plant specimens were photographed as well as collected, pressed and dried in the field. Plant specimens were identified by Mr. Manzur-ul Kadir Miah (plant taxonomist at the Bangladesh National Herbarium, since retired).

Results and Discussion

Plants, their distribution into families, plant parts used and mode of application

The results of showed that 55 species of plants are used by the traditional healers of the Chakma tribe in Bandarban district, Bangladesh. These medicinal plants belong to 37 families (Table 1). The major families included Acanthaceae, Apocynaceae, Asteraceae/Compositae, Euphorbiaceae, and Fabaceae. Leaves were the most commonly used part followed by roots, barks and fruits. The mode of application was either oral or topical. In the majority of cases juice extracted from whole plant or plant part (through crushing) was either taken orally or topically applied to affected areas. This applied to cases like tonsillitis, where plant sap from *Alstonia scholaris* was massaged externally around the tonsils.

Table 1: Medicinal plant used by the Chakma healers at the Chakma settlements of Gundum, Naikhongchhari and Tombru of Bandarban district, Bangladesh

Botanical name	Family	Local name	Parts used	Ailments treated/Uses (Administration)
<i>Acanthus illicifolius</i> L.	Acanthaceae	View-kada	Root	Aphrodisiac, joint pain, swelling (O).
<i>Justicia adhatoda</i> L.	Acanthaceae	Bashok	Leaf	Asthma, coughs, mucus, pneumonia in children (O).
<i>Justicia gendarussa</i> L.	Acanthaceae	Chaw-mukha gach	Leaf	Abscess within the nostrils (T).
<i>Sansevieria roxburghiana</i> Schult. & Schult.f.	Agavaceae	Kanfada, Kanchidi	Leaf, meristem	Ear infections, pus formation in ears, bursting of eardrums (T).
<i>Achyranthes aspera</i> L.	Amaranthaceae	Sesaika, Apang	Root	Jaundice, asthma (O).
<i>Lannea coromandelica</i> (Houtt.) Merr.	Anacardiaceae	Paharibadi	Bark	Dysentery, blood dysentery, diarrhea (O).
<i>Mangifera longipes</i> Griff.	Anacardiaceae	Uri-aam	Bark, fruit	Chronic leucorrhoea, dysentery, blood dysentery (O). Bark is used as curative, but fruits are edible and consumed when in season.
<i>Alstonia scholaris</i> (L.) R.Br.	Apocynaceae	Sytton gach	Bark, plant sap	Tonsillitis, muscle pain, abscess (plant sap, T), kala azar (plant sap, O), low semen density, fever (bark, O).
<i>Holarrhena pubescens</i> Wall. ex G. Don	Apocynaceae	Koruj gach	Bark	Leucorrhoea, bloating, diarrhea (O).

Botanical name	Family	Local name	Parts used	Ailments treated/Uses (Administration)
<i>Tabernaemontana divaricata</i> (L.) R. Br. ex Roemer & J.A. Schultes	Apocynaceae	Kathyamali	Root	Long-time coughs, phlegm, lung tonic, oral lesions, fever with convulsions (O).
<i>Calotropis gigantea</i> (L.) Ait.f.	Asclepiadaceae	Or gach	Leaf	Body pain (T).
<i>Blumea lacera</i> DC	Asteraceae/Compositae	Kuid-muta	Meristem	Severe eczema (T).
<i>Eclipta erecta</i> L.	Asteraceae/Compositae	Kala-hona, kala-manik	Whole plant	To keep head cool, hair loss, blackening of hair (T).
<i>Elephantopus scaber</i> L.	Asteraceae/Compositae	Mul-gach, Ak-foilla	Root	Low semen density, leukoderma, burning sensations in the body, severe leucorrhea, irregular urination, urinary pressure but passage of low quantities of urine (O).
<i>Mikania cordata</i> (Burm. F.) B. L. Robinson	Asteraceae/Compositae	Jarmani lota, Japani lota	Leaf	Scabies, infections (T), severe diarrhea, astringent (O).
<i>Heterophragma adenophyllum</i> Seem.	Bignoniaceae	Kau-a-turi	Root	Piles, constipation (O).
<i>Oroxylum indicum</i> (L.) Vent.	Bignoniaceae	Chilana gach	Fruit, bark	Pus with urine, burning sensations in urinary tract, pus with semen (fruit, O), scabies (bark, T).
<i>Bombax pentandrum</i> L.	Bombacaceae	Tula	Root from one year old plants	Low semen density, erectile dysfunction (O).
<i>Casuarinas equisetifolia</i> L.	Casuarinaceae	Jhau gach	Bark	Strengthening of gums, remove foul odor from mouth (bark is chewed and spitted out).
<i>Terminalia arjuna</i> (Roxb. ex DC.) Wight & Arn.	Combretaceae	Arjun	Bark	Abnormal heart palpitations, diarrhea, dysentery, blood dysentery, kala azar, abnormal heart palpitations, vertigo (O).
<i>Terminalia chebula</i> Retz.	Combretaceae	Hortoki	Fruit	Sedative, respiratory problems, allergy (O). Used as both preventive and curative.
<i>Costus speciosus</i> (J. König.) Sm.	Costaceae	Tiatui	Root	Jaundice, to clarify urine, kidney stones (O).
<i>Coccinia grandis</i> (L.) J. Voigt	Cucurbitaceae	Telpuchi	Vine (leaf with stem)	Diabetes, burning sensations in urinary tract (O). Used as both preventive and curative.
<i>Hodgsonia macrocarpa</i> Cogn.	Cucurbitaceae	Kaida phol, Makal phol	Fruit, skin of fruit	Stomach ache in children (fruit, O), white patches on skin of children (skin of fruit, T).
<i>Cuscuta reflexa</i> Roxb.	Cuscutaceae	Swarna lata	Vine	Astringent, malaria (O).
<i>Gelonium multiflorum</i> A. Juss.	Euphorbiaceae	Chagol ladi	Leaf	Diabetes (O).
<i>Phyllanthus reticulatus</i> Poir.	Euphorbiaceae	Dath-bohori	Stem	To strengthen gums (stem is chewed and spitted out).
<i>Premna esculenta</i> Roxb.	Euphorbiaceae	Lelom pata	Root	Diabetes (O), animal bites (T).
<i>Cassia alata</i> L.	Fabaceae	Daud gach	Leaf	Helminthiasis (O).
<i>Cassia fistula</i> L.	Fabaceae	Unalu, Banor lathi	Fruit, bark	Loss of appetite, fever (fruit, O), helminthiasis (bark, O).
<i>Cassia tora</i> L.	Fabaceae	Tankai	Leaf with root, seed	Fever, pre-fever symptoms, pain, tiredness (leaf with root, O), allergy, scabies, itches (seed, T).
<i>Clitoria ternatea</i> L.	Fabaceae	Omaio	Leaf with stem	Itches and development of black spots due to itches in children (T).
<i>Hyptis suaveolens</i> (L.) Poit.	Lamiaceae	Tokma	Fruit, seed	To maintain efficient heart functioning, heart palpitations, laxative (O). Used as both preventive and curative.
<i>Dehaasia kurzii</i> King ex Hook.f.	Lauraceae	Mojar mostapata, Modon-bocchu	Leaf with root	Aphrodisiac, impotency (O).
<i>Lygodium flexuosum</i> (L.) Sw.	Lygodiaceae	Roge-poti	Vine	Jaundice, fever (O).

Botanical name	Family	Local name	Parts used	Ailments treated/Uses (Administration)
<i>Lawsonia inermis</i> L.	Lythraceae	Mehedi	Leaf	Severe headache (O), to keep head cool (T), aphrodisiac, chronic dysentery (O).
<i>Urena lobata</i> L.	Malvaceae	Bulbuli gach, Kuidda gach	Leaf	Pus with semen, burning sensations in urinary tract, lower abdominal pain, pressure for urination but passage of only a few drops of urine, urinary tract infections (O).
<i>Melastoma malabathricum</i> L.	Melastomataceae	Putti gach	Root	Jaundice (O).
<i>Azadirachta indica</i> A. Juss.	Meliaceae	Neem	Leaf, stem	Bloating, vomiting (leaf, O), scabies, eczema, skin diseases (leaf, T), strengthening of gums (stem is chewed and spitted out).
<i>Swietenia macrophylla</i> King.	Meliaceae	Mehegoni	Seed	Diabetes (O).
<i>Stephania japonica</i> (Thunb.) Miers	Menispermaceae	Muicchani lota	Leaf	Low semen density, burning sensations during urination, urine coming out in several streams (O).
<i>Streblus asper</i> Lour.	Moraceae	Aurga	Leaf with stem	Syphilis, passage of blood or blood clots with urine, low semen density, aphrodisiac (O).
<i>Syzygium cumini</i> (L.) Skeels	Myrtaceae	Kali-jaam	Seed, fruit	Diabetes, urinary problems, relaxant. Used as both preventive and curative.
<i>Nymphaea nouchali</i> Burm.f.	Nymphaeaceae	Lal shapla	Root	Reduces heavy excess menstrual bleeding (O). Used as curative, but also taken as vegetable.
<i>Andropogon acicularis</i> Willd.	Poaceae	Naanochi	Soft root	Animal bites (T).
<i>Polygonum hydropiper</i> L.	Polygonaceae	Bish-kadali	Leaf	Helminthiasis, bloating (O).
<i>Drynaria quercifolia</i> (L.) J. Smith	Polypodiaceae	Gundirmul	Root	Gonorrhoea, frequent urination (O).
<i>Acrostichum aureum</i> L.	Pteridaceae	Moun shak	Leaf with stem	Low semen density, impotency, leucorrhoea (O, cooked and eaten as vegetable).
<i>Zizyphus oenoplia</i> (L.) Mill.	Rhamnaceae	Pahari boroi	Root	Dysentery (O).
<i>Aegle marmelos</i> (L.) Corr.	Rutaceae	Cip-bael	Fruit	Dysentery, blood dysentery, chronic leucorrhoea (O). Used as both preventive and curative.
<i>Datura metel</i> L.	Solanaceae	Dhutura	Seed	Rheumatic pain (T).
<i>Pterospermum semisagittatum</i> Blanco	Sterculiaceae	Lanachar gach	Root with bark	Blood dysentery, mental instability, piles (O).
<i>Clerodendrum viscosum</i> Vent	Verbenaceae	Choit ghata	Leaf with root	Sudden stomach pain, gastric problems, fever, loss of appetite, digestive aid (O).
<i>Vitex negundo</i> L.	Verbenaceae	Miunda gach	Leaf	Pain and blood during and after urination, allergy (O), scabies (T).
<i>Alpinia nigra</i> (Gaertn.) B. L. Burt.	Zingiberaceae	Khet-tara	Root	Paralysis (O).

Plants which can be used as food supplements are indicated in bold lettering. O stands for oral administration and T stands for topical application of the indicated plant part. Unless otherwise mentioned (like chewing followed by spitting), juice collected from the indicated plant part(s) were orally administered or topically applied. Also note that one plant (*Acrostichum aureum*) was cooked and eaten as vegetable only during the duration of the sickness and so has not been considered as food supplement.

Medical applications

It was observed that single plant was used by Chakma traditional healers for treatment of a single ailment or diverse ailments. Combination of plants was not observed. Apart from *Calotropis gigantea*, *Blumea lacera*, *Gelonium multiflorum*, *Cassia alata*, *Melastoma malabathricum*, *Swietenia macrophylla*, *Andropogon acicularis*, *Zizyphus oenoplia*, *Datura metel* and *Alpinia nigra*,

which were used to treat a single ailment, the other 45 plants were utilized to treat multiple ailments. Occasionally, different parts from the same plant may be used to treat different ailments. For instance, sap of *Alstonia scholaris* was used for treating tonsillitis, muscle pain, abscess pain, and kala azar, while bark of the plant was used to treat low semen density, and fever. The leaves of *Azadirachta indica* were used to treat bloating, vomiting, scabies, eczema and other skin diseases, while the stem was used for strengthening of gums. The same plant part may be used for both oral and topical applications. Leaf juice of *Azadirachta indica* was administered orally for treatment of bloating or vomiting, but used topically for scabies, eczema and other skin diseases. Although the present survey did not find usage by Chakma traditional healers of combination of different plants to treat ailments, combination of plant parts from the same plant was found to be used quite frequently. To cite only two examples, the leaves and roots of *Dehaasia kurzii* were used in combination to treat impotency and as an aphrodisiac. The leaves and stems of *Acrostichum aureum* were used in combination to treat low semen density, impotency, and leucorrhea. The surveyed data suggests that respiratory tract disorders, gastrointestinal tract disorders, skin disorders, urinary tract disorders, helminthiasis and diabetes are quite common amongst the Chakmas. Kala azar, a chronic and potentially fatal disease (also known as leishmaniasis) is also present within the Chakmas and treated with a number of plants like *Alstonia scholaris* or *Terminalia arjuna*. Malaria, which is another potentially fatal disease, is treated with vines of *Cuscuta reflexa*.

Plants used by the Chakma tribe which can serve as food supplements.

A total of seven plants were found to be consumed by the Chakma tribe or administered by tribal healers and which can serve as food supplements. These plants belonged to seven families (Table 1). Fruits formed the major part of the plant that was consumed. The various ailments for which plant or plant parts were used for preventive or curative purposes included gastrointestinal disorders, urinary tract disorders, heart problems, and respiratory problems. Both our published and unpublished observations as shown in Table 2 indicated that the seven plants or plant parts are used by other tribes or in other regions of Bangladesh to treat a wide variety of ailments, as a preventive measure against several ailments, as well as to maintain good health.

Table 2: Uses of “food supplement” plants in Table 1 by other tribes or in other regions of Bangladesh*

Botanical name	Ailments/Uses	Comments
<i>Aegle marmelos</i> (L.) Corr.	Indigestion, piles, constipation, respiratory problems, inflammation, insect or snake bites, heart palpitations, fever, clearing of bowels, to keep body cool, diarrhea, dysentery, diabetes (12, 13, 14); leucorrhea, sex stimulant, inflammation, diabetes, peptic ulcer, sedative, colic, appetizer, snake bite, laxative, flatulence, malaria, soothing of the body, insect bite, ear infection, eye disease, jaundice, gonorrhoea, cancer, hepatic disorders, tuberculosis, asthma, coughs, to increase sperm count, influenza, pain, paralysis, piles, vomiting tendency (unpublished observations).	Plant parts used include whole plant, leaf, root, bark, flower, fruit (both unripe and ripe), and seed. The fruit is edible and both unripe and ripe fruits are eaten on a regular basis. Fruits are considered as serving both preventive and curative purposes in gastrointestinal disorders like stomachache, indigestion, diarrhea, and dysentery. Some traditional healers consider the pulp of the ripe fruit as having hypoglycemic properties.
<i>Coccinia grandis</i> (L.) J. Voigt	Diarrhea, blood dysentery, dizziness from sunstroke, dysentery, leucorrhea, menstrual problems, diabetes (13, 15); edema, eye diseases, bloating, hypertension, inflammation, coughs, jaundice, mental diseases, lung disorders, dermatitis, typhoid, burning sensations in hands or feet, to induce vomiting, bed-wetting in children (unpublished observations).	Plant parts used include whole plant, leaf, stem, root, and flower. The leaf is frequently consumed or raw leaf juice taken to keep blood sugar under control during diabetes. The leaves and stems of the plant are also cooked and eaten as vegetable.
<i>Hyptis suaveolens</i> (L.) Poit.	Liver diseases, cancer, constipation, insect repellent, expectorant, cuts and wounds (to stop bleeding), malaria, indigestion, headache, rheumatoid arthritis, laxative, gonorrhoea, diabetes, dermatitis, lack of appetite (unpublished observations).	Plant parts used include leaf, bark, root, fruit, seed, and whole plant. Seeds are considered throughout the country as having laxative effects. They are soaked overnight in water and taken the following morning to get relief from constipation. It also has a soothing effect on the stomach. Soaked seeds are also taken as preventive medicine for flatulency.

Botanical name	Ailments/Uses	Comments
<i>Mangifera longipes</i> Griff.	None reported in the ethnobotanical surveys except for its use by the Chakma tribe.	Fruits are edible and consumed when seasonally available. <i>Mangifera longipes</i> is not available in Bangladesh apart from the Chittagong Hill Tracts region. In the rest of the country, the more common species is <i>Mangifera indica</i> .
<i>Nymphaea nouchali</i> Burm.f.	Burning sensations in urinary tract, leucorrhea (14); indigestion, heart diseases, cuts and wounds (to stop bleeding), stomachache, diarrhea, diabetes (unpublished observations).	Plant parts used include whole plant, stem, root tops, and flower. The plant is edible and is eaten as vegetable, particularly by the rural population of the country.
<i>Syzygium cumini</i> (L.) Skeels	Inflammation, infrequent urination, burning sensations in urinary tract, fever, gastrointestinal problems, diarrhea, blood with stool, toothache, skin disorders, diabetes (12, 15); constipation, dermatitis, toothache, skin disorders, sex stimulant, anemia, wounds, eczema, hepatitis, piles, rheumatoid arthritis, tooth infections, liver dysfunction, short-sightedness, allergy (unpublished observations).	Plant parts used include leaf, bark, fruit, seed and seed kernel. The fruit is edible and enjoys consumer demand. Fruit, besides being nutritive, is also considered to lower blood sugar level during diabetes. Crushed seeds are taken as preventive measure every morning to control blood sugar.
<i>Terminalia chebula</i> Retz.	Appetite stimulant, aids digestion, acidity, stomachic (13, 16); asthma, cardiovascular disorders, eye diseases, itches, night blindness, cancer, jaundice, bronchitis, leucorrhea, tumor, tuberculosis, ulcer, burns, low sperm count, urinary troubles, coughs, bloating, biliary problems, acne, helminthiasis, hepatic disorders, leprosy, malaria, hepatitis, debility, abscess pain, fever, to blacken hair (unpublished observations).	Plants parts used include leaf, bark, fruit, seed, and whole young plants. The fruit is edible and considered to provide protection against diverse ailments and disorders as well as to maintain good health. Fresh fruits are consumed when available; during off season, dried fruits are consumed.

* It is to be noted that some of the uses of plants have been published (References 12-16), and others have been unpublished. These observations form a part of our on-going ethnobotanical surveys of various tribes and regions in Bangladesh.

Pharmacological and nutritive evaluation of plants

Aegle marmelos is traditionally used in India to cure diarrhea, intestinal disorders, fever, scurvy, coughs, cold and diabetes. Methanolic extracts of plant parts like leaves, bark, fruit rind and fruit pulp have demonstrated the presence of carbohydrates, proteins, amino acids, anthocyanins, sterols, flavonoids and glycosides. The various plant parts also demonstrated significant antioxidant activities (17), which can have both preventive and curative effects in a number of ailments like cardiovascular disorders, inflammation, and respiratory tract disorders. In another study on the antioxidant effects of bark of this plant, it was observed that an aqueous-alcoholic extract showed high nitric oxide (NO) quenching potential, which correlated with presence of phenolic compounds and tannins in the bark (18). The seed oil of the plant reportedly possesses compounds with antimicrobial activity (19), and the fruit has been shown to have potential *in vitro* to combat oxidative stress (20).

Coccinia grandis is used by the indigenous peoples of India to treat gout and hepatic disorders. A study with the methanol extract of the plant found significantly decreased serum urate levels when compared to hyperuricaemic controls along with significant inhibition of xanthine oxidase activity in mice (21). Ethanol extract of the plant reportedly demonstrated significant triglyceride and cholesterol lowering effects in dyslipidemic hamster model, which has been attributed to a C-60 polyphenol present in the plant (22). Methanolic extract of the fruits and leaves have been shown to demonstrate hepatoprotective activity against carbon tetrachloride-induced hepatic injury in rats (23, 24). Hydromethanolic extract of the leaves has been reported to possess free radical scavenging and antioxidant activities, which has been attributed to presence of phenolic and flavonoid compounds in leaves (25). The hypocholesterolemic and antioxidant activity justify prophylactic use of the plant by the Chakmas in diabetes.

The essential oil from whole plant or plant parts of *Hyptis suaveolens* contain numerous pharmacologically active compounds, among which are β -caryophyllene, α -phellandrene,

caryophyllene oxide (26), sabinene, 1,8-cineole, γ -terpinene, fenchone, and fenchol (27). β -Caryophyllene is known to exert negative inotropic effects in heart muscle (28) validating its use by the Chakmas for heart palpitations or arrhythmias. The plant contains a high percentage of crude alkaloids and flavonoids (29). The percentage of crude protein in seeds, leaves, and stems has been shown to be 14.7, 11.38, and 6.56%, respectively (30). Although *Mangifera longipes* (used by the Chakmas as treatment for chronic leucorrhea and gastrointestinal disorders like dysentery and blood dysentery) has not been studied, methanolic extracts of seeds of a related species *Mangifera indica* have been reported to possess anti-diarrheal activity (31). The aqueous decoction of flowers of the plant has also been reported to act as an anti-ulcer agent in mice and rats (32).

The fruits of *Syzygium cumini* (used by the Chakmas to treat diabetes) contain antioxidant tannins (33). Leaf extracts also contain antioxidant activity, which has been attributed to the presence of phenolic compounds like ferulic acid and catechin (34). Ferulic acid, which is also present in seeds of this plant, has been implicated in amelioration of diabetes due to its pancreatic β -cell regenerative effect and/or due to its antioxidant properties (35). The seeds are rich in flavonoid compounds, which reportedly demonstrated both hypoglycemic and hypolipidemic effects in streptozotocin-induced diabetic rats (36). Seed kernels have been reported to possess α -glucosidase inhibitory activity *in vitro* and in Goto-Kakazaki (GK) rats and could be a mechanism by which this plant exerts its anti-diabetic potential (37). Ethanolic extract of seeds showed presence of novel androstane derivatives and reduced elevated blood glucose levels in alloxan-induced diabetes in rats (38). Fruit pulp is rich in carbohydrates, proteins and minerals (especially calcium), phenols, anthocyanins and flavonoids and demonstrated *in vitro* antioxidant activities (39). The seeds have been found to be rich in elements like zinc, chromium, vanadium, potassium, and sodium – all elements being considered to play an important role in contributing to hypoglycemic activity (40). Alcoholic extract of seeds has been found to contain strong antioxidant compounds like gallic acid, ellagic acid, corilagin and related ellagitannins, 1-galloyl glucose, 3-galloyl glucose, and quercetin (41). Taken together, the reported chemical profile of fruits and seeds of *Syzygium cumini* suggest presence of compounds with strong antioxidant properties, which if consumed on a regular basis can be a preventive measure against a diverse variety of diseases.

The edible fruits of *Terminalia chebula* (used by the Chakmas to combat respiratory problems and allergy) reportedly contain 10.3 and 14.5 times more vitamin C and protein, respectively, when compared to apples. The minimum recommended dietary allowances for micronutrients like Se, K, Mn, Fe and Cu can be met if 100g of the raw fruit is eaten (42). The plant can thus be of potential nutritive value, while antioxidant like vitamin C present in the plant can be of aid in alleviating respiratory problems. Strong polyphenolic antioxidants like ellagic and gallic acid have also been reported in this plant (43). In Thailand, the plant reportedly is used to treat diabetes in the traditional medicinal system. Strong antioxidant activity has been confirmed in the plant (44). In traditional Indian medicine, the plant is used for strengthening the body immune system as well forming a rich source of essential nutrient elements; the fruits are especially enriched in magnesium (45). The immunomodulatory activities of the plant have been confirmed in studies on neutrophil functions (46). The aqueous extract of the fruits has also been confirmed to have strong antioxidant properties (47, 48) and has been postulated to play a role in the hepatic prevention of oxidative damage in living systems (48). Taken together, it appears from the available studies that fruits of *Terminalia chebula* are a good source of macro- as well as micronutrients, besides possessing components with strong antioxidant activities. Considering also the reported immune-stimulating activity, the plant can play an important role both in prevention of ailments as well alleviating infective diseases.

Overall, a pharmacological and nutritive evaluation of plants used by the Chakma tribe indicates that the seven plants (or plant parts) reported in the present study has good potential both as food supplements and be of use medicinally. Thus they can play the role of functional foods. Various plant parts like fruits, seeds and stems are edible and are eaten on a regular basis by the tribal people when

in season without any known ill effects. Since modern medical facilities are out of reach from a substantial section of the population of the country, regular use of the above plants by the general population as food supplements can serve both preventive and curative purposes. This should also reduce the cost of health care, which a majority of the population can ill afford with incomes at or below 1 US\$ per day. The present study is expected to generate enough interest towards more effective conservation, cultivation and consumption of the seven plants described in the study.

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