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ORIGINAL ARTICLE

A Comparative Analysis of Medicinal Plants used by Several Tribes of Chittagong Hill Tracts Region, Bangladesh to Treat Helminthic Infections

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ABSTRACT

Chittagong Hill Tracts region is largely a forested region in the south-eastern part of Bangladesh. A number of tribes are settled in this region. Helminthiasis (infestation of intestine with parasitic worms) is fairly prevalent within the tribes because of poor sanitary conditions. The tribal people visit their own traditional medicinal practitioners to treat helminthic infections, more so because modern medicinal facilities are absent within the forested areas. Tribal traditional medicinal practitioners rely on medicinal plants for treatment of helminthiasis. The objective of the present survey was to conduct a survey among the Chak, Chakma, Marma, Murong, Rakhain and Tonchonga tribal traditional medicinal practitioners to learn more about medicinal plants used by them for treatment of helminthic infections. Helminthic infections are prevalent worldwide and medicinal plants can be a potential source for discovery of more efficacious drugs. A total of 10 plant species distributed into 8 families were observed to be used by the surveyed tribes to treat helminthiasis. The number of medicinal plants used by the Chak, Chakma, Marma, Murong, Rakhain and Tonchonga tribes to treat helminthic infections were respectively, 1, 4, 1, 3, 3, and 3. *Ananas comosus* (L.) Merr. was used in common by the Chak, Chakma, Rakhain, and Tonchonga tribes. *Cassia alata* L. was used in common by the Chakma and Murong tribes. *Erythrina variegata* L. was used in common by the Chakma, Marma, and Murong tribes. The various plant parts used included leaves, roots, barks, flowers, and fruits. The percent use of these plant parts were, respectively, 52.6, 15.8, 21.1, 5.3 and 5.3%. Mostly, a single plant or plant part was used for treatment of helminthiasis, although use of combinations of plant parts was also observed in three instances. There was only one instance where a combination of plant species was used. The Chakma tribe used a combination of leaves of *Ananas comosus* along with roots of *Areca catechu* L. and bark of *Erythrina variegata* for treatment of helminthiasis. The medicinal plants used by the various tribes of Chittagong Hill Tracts present considerable potential for scientific studies towards discovery of more effective medicines to treat helminthiasis, which can be caused by a variety of parasitic worms and is endemic throughout the different countries of the world.

Key words: Tribal medicine, medicinal plants, helminthiasis, Bangladesh

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Introduction

Helminthiasis is infestation of the gastrointestinal tract with one or more types of parasitic worms. The worms can be roundworms like *Ascaris lumbricoides*, whipworms like *Trichuris trichiura*, hookworms like *Necator americanus* and *Ancylostoma duodenale*, pinworms like *Enterobius vermicularis* or other species of worms. Bangladesh is a developing country with a substantial section of the population living under poverty, along with lack of proper sanitation facilities and suitable quality drinking water. As a result helminthic infections are prevalent throughout the country. Rural, urban slum and tribal population are the most affected, since they are the most vulnerable section caused by insanitary conditions and lack of maintenance of proper hygiene. A high rate of infection (36.2%) of fasciolopsiasis (caused by the worm *Fasciolopsis buski*) was observed in a study conducted in children in rural Bangladesh (Rahman, K.M., 1981). Stool surveys conducted on 1,668 children aged 2-10 years in 27 villages within Dhaka district revealed an endemic prevalence of *Fasciolopsis buski* infections (Gilman, R.H., 1982). *Giardia intestinalis* and *Trichuris trichiura* infections have also been observed in children of Dhaka, which is the capital city of Bangladesh (Hall, A. and K.S. Anwar, 1991). Prevalence of *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworm has been also reported in randomized community samples of children aged 2-8 years in rural Bangladesh (Mascie-Taylor, C.G., 1999). *Ascaris lumbricoides* infestation has also been observed in a poor urban community in Bangladesh (Hall, A., 1999). The prevalence of *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworm has been reported to be respectively, 78%, 65% and 4% in a study conducted with 123 rural Bangladeshi children aged 2-5 years (Northrop-Clewes, C.A., 2001).

We have been conducting ethnomedicinal surveys among the tribal people and various regions of Bangladesh for the last few years (Hossan, M.S., 2010; Nawaz, A.H.M.M., 2009; Rahmatullah, M., 2010; Rahmatullah, M., 2009; Rahmatullah, M., 2009). Our surveys indicated that helminthic infections are quite common among the tribal population. Bangladesh has a number of tribes who mainly reside in the southeastern, northern, and north-central districts. Among them, the southeastern part of Bangladesh, known as Chittagong Hill Tracts is home to a large number of tribes including the Chak, Chakma, Marma, Murong, Rakhain, and Tonchonga tribes. The knowledge of indigenous people can be quite extensive including the climate, ecosystem, and the local flora and fauna. What is particularly important is their knowledge of medicinal plants, a knowledge which has been acquired through centuries of medicinal plant usage for treatment of various ailments. It has been pointed out that in many instances the sources of modern medicines have been plants used in indigenous cultures (Cotton, C.M., 1996). The average success rate of obtaining new medicines from botanical sources is one in 125 (McCaleb, R.S., 1997), whereas the comparative rate of success of obtaining useful medicines from synthetic chemicals is about one in 10,000 (Chadwick, D.J. and J. Marsh, (eds), 1994). The primary objective of this study was to conduct an ethnomedicinal survey among several tribes of Chittagong Hill Tracts region to learn more about use of medicinal plants for treatment of helminthic infections. Such knowledge can prove useful to modern medicine for discovery of newer and safer drugs.

Materials and Methods

The survey was conducted among the tribal traditional healers of the Chak, Chakma, Marma, Murong, Rakhain, and Tonchonga tribes who live in the two districts of Bandarban and Khagrachari in the Chittagong Hill Tracts region of Bangladesh. Informed consent was obtained of the tribal medical practitioners (TMPs) of various tribes prior to the survey. Surveys were conducted with the help of a semi-structured questionnaire and the guided field-walk method as described by Martin (1995) and Maundu (1995). In this method, the TMPs took the interviewers to places from where they collected their medicinal plants, pointed out the plants and described their uses and provided their local names. All plant specimens were collected on the spot, dried and brought back to the Bangladesh National Herbarium, Dhaka for complete identification.

Results

A total of 10 plants distributed into 8 families were found to be used by the six surveyed tribes of Chittagong Hill Tracts region. The Fabaceae family contributed the maximum number of three plants. Other plant families used by the TMPs were the Acathaceae, Arecaceae, Bromeliaceae, Malvaceae, Polygonaceae, Rutaceae, and Verbenaceae families. The results are summarized in Table 1.

Among the ten plants used by the six tribes surveyed *Ananas comosus* (L.) Merr. was found to be in common usage by the Chak, Chakma, Rakhain, and Tonchonga tribes. *Cassia alata* L. was used by both the Chakma and the Murong tribe, while *Erythrina variegata* L. was used in common by the Chakma, Marma,

Table 1: Medicinal plants used by various tribal medicinal practitioners of Chittagong Hill Tracts to treat helminthic infections.

Scientific name	Family	Local name	Parts used	Formulation(s)	Tribe name
Justicia adhatoda L.	Acanthaceae	Hongshu-bang	Leaf	Leaf juice is taken.	Marma
Areca catechu L.	Arecaceae	Supari	Root	Young leaves of *Ananas comosus* are combined with roots of *Areca catechu* and bark of *Erythrina variegata*, crushed and the juice extracted. 1 table spoonful of juice is administered orally to adults (1 tea spoonful to children) for three days.	Chakma
Ananas comosus (L.) Merr.	Bromeliaceae	1. Naindra-chena	1. Fruit	1. Fruits are taken orally.	1. Chak
		2. Anarosh	2. Young leaf	2. One young leaf is wrapped with a banana l eaf and warmed over fire. When soft, the young leaf is squeezed to extract leaf juice. 1 tea spoonful of leaf juice is orally taken.	2. Chakma, Tonchonga
		3. Anarosh	3. Young leaf	3. Young leaves of *Ananas comosus* are combined with roots of *Areca catechu* and bark of *Erythrina variegata*, crushed and the juice extracted. 1 table spoonful of juice is administered orally to adults (1 tea spoonful to children) for three days.	3.Chakma
		4. Nanderabong	4. Leaf	4. Three leaves are cut into small pieces, crushed and soakedn a glass of water i for 12 hours followed by straining of the water. Two tea spoonful of the water is administered orally to children (3 tea spoonful to adults) thrice daily for 3-5 days.	4. Rakhain
Cassia alata L.	Fabaceae	1. Plachii	1. Leaf	1. Leaves are consumed in small amounts	1. Murong
		2. Daud gach	2. Leaf, root	2. One handful of leaf is mixed with ½ handful of root, crushed and put in ½ liter water with the addition of a little salt. The mixture is boiled, strained and bottled. Two tea spoonful of the strained water is taken every morning and night for 3 days. Alternately, young leaves are cooked and taken as vegetable for 3 days. Alternately, crushed leaves are made into bean seed-size pills. One pill is taken every morning for 3 consecutive days.	2. Chakma
Cassia fistula L.	Fabaceae	Unalu	Bark	Crushed bark is mixed with molasses, dried and made into bean seed-sized pills. 1 pill is taken every morning on an empty stomach for 3-5 days.	Chakma

Table 1: Continue

Erythrina *variegata* L.	Fabaceae	1. Kasai-pang	1.Bark	1. Powdered bark is taken orally.	1. Marma
		2. Krong-shing	2. Bark	2. Juice from crushed bark is taken orally.	2. Murong
		3. Painna-madar	3. Bark	3. Juice is extracted from crushed bark. One tea spoonful of juice is taken every morning on an empty stomach for 3 consecutive days.	3. Chakma
Hibiscus. rosa sinensis L	Malvaceae	Hong-rang-paing	Leaf, flower	Juice of leaves and flowers is administered orally.	Rakhain
Polygonum hydropiper L.	Polygonaceae	Mra-che-bang	Leaf, root	A combination of leaves and roots are taken orally.	Marma
Citrus *aurantifolia* Swingle	Rutaceae	Oir-koram	Leaf	Juice from 4-5 leaves is mixed with a glass of water and taken twice daily for seven days.	Murong
Clerodendrum viscosum Vent.	Verbenaceae	Gomkha	Leaf, root	Four handfuls of roots are mixed with 5 handfuls of leaves; leaves and roots are sliced into small pieces and mixed with 1 liter of water where the leaves and roots are crushed. The water is then left along with crushed leaves and roots for 12-14 hours with frequent squeezing of leaves and roots. Following that time period, the water is strained and bottled. Two tablespoonful of the strained water is taken thrice daily on an empty stomach for 7 days.	Rakhain

Table 2: Phytochemicals present in some of the plants used by the surveyed tribes for treatment of helminthic infections.

Plant name	Phytochemicals reported
Justicia adhatoda L.	1,2,3,9-tetrahydro-5-methoxypyrrolo-(2,1-B)-quinazoline-3-ol; 2',4-dihydroxychalcone-4-glucoside; 6-hydroxypeganine; 9-acetamido-3,4-dihydropyrido-(3,4-B)-indole; adhatodic acid; adhatodine; adhatonine; anisotine; anisotinine; arachidic acid; behenic acid; b-sitosterol; b-sitosterol-b-D-glucoside; betaine; cerotic acid; deoxyvascinone; lignoceric acid; linoleic acid; *O*-ethyl-a-D-galactoside; oleic acid; oscine; peganine; vasakin; vasicine; vasicinine; vasicinol; vasicinone; vasicol; vasicoline; vasicolinone; visicinolone [17].
Areca catechu L.	Arecaidine; arecaine; arecolidine; arecoline; b-carotene; b-sitosterol; capric acid; D-catechin; diosgenin; galactan; gallic acid; guvacine; guvacoline; heneicosanic acid; homoarecoline; isoguvacine; kryptogenin; lauric acid; leucocyanidine; leucopelargonidine; linoleic acid; margarinic acid; myristic acid; nonadecanic acid; oleic acid; palmitoleic acid; philobaphene-tannin; stearic acid [17].
Ananas comosus (L.) Merr.	2,5-dimethyl-4-hydroxy-3(2H)-furanone; 5-hydroxytryptamine; acetaldehyde; acetic acid; acetone; acetoxyacetone; acrylic acid; a-linolenic acid; a-tocopherol; amyl caproate; ananasic acid; b-carotene; b-methyl-thiopropionic acid ethyl ester; b-methyl-thiopropionic acid methyl ester; biacetyl; bromelain; bromelin; butyl formate; chavicol; citric acid; d-octalactone; dimethyl malonate; ergosterol peroxide; ethyl acetate; ethyl acrylate; ethanol; ethyl-b-acetoxyhexanoate; ethyl-b-hydroxyhexanoate; ethyl-b-methylthiopropionate; ethyl butyrate; ethyl caproate; ethyl caprylate; ethyl formate; ethyl isobutyrate; ethyl isovalerate; ethyl lactate; ethyl propionate; ferulic acid; g-butyrolactone; g-caprolactone; g-octalactone; indole acetic acid oxidase; isobutanol; isobutyl acetate; isobutyl formate; isocapronic acid; isopropyl-isobutyrate; L-malic acid; methanol; methyl acetate; methyl-b-acetoxyhexanoate; methyl-b-hydroxybutyrate; methyl-b-hydroxyhexanoate; methyl-b-methylthiopropionate; methyl butyrate; methyl caproate; methyl caprylate; methyl isobutyrate; methyl isocaproate; methyl isovalerate; methyl-*N*-propyl-ketone; *N*-valerianic acid; oleic acid; oxalic acid; *P*-coumaric acid; palmitic acid; palmitoleic acid; pentanol; propyl acetate; propyl formate; serotonin; stearic acid; stigmast-5-ene-3-b-7-a-diol; *trans*-tetrahydro-a-a-5-trimethyl-5-vinylfurfuryl-alcohol [17].

Table 2: Continue

Cassia alata L.	Cassiaindoline (alkaloid) [18]; chrysoeriol; kaempferol; quercetin; 5,7,4'-trihydroflavanone; kaempferol-3-*O*-b-D-glucopyranoside; kaempferol-3-*O*-b-D-glucopyranosyl-(1-›6)-b-D-glucopyranoside; 17-hydrotetratriacontane; n-dotriacontanol; palmitic acid ceryl ester; stearic acid; palmitic acid [19]; kaempferol-3-*O*-gentiobioside; aloe emodin [20]; alquinone (anthraquinone) [21]; chrysoeriol-7-*O*-(2"-*O*-b-D-mannopyranosyl)-b-D-allopyranoside; rhamnetin-3-*O*-(2"-*O*-b-D-mannopyranosyl)-b-D-allopyranoside (flavonoid glycosides) [22].
Erythrina variegata L.	Eryvarins M-O (isoflavonoids); eryvarins P, Q (2-arylbenzofurans); eryvarin R (3-aryl-2,3-dihydrobenzofuran) [23]; 5,4'-dihydroxy-8-(3,3-dimethylallyl)-2"-methoxyisopropylfurano[4,5:6,7]isoflavone; 5,7,4'-trihydroxy-6-(3,3-dimethylallyloxiranylmethyl)isoflavone; 5,4'-dihydroxy-8-(3,3-dimethylallyl)-2"-hydroxymethyl-2"-methylpyrano[5,6:6,7]isoflavone; 5,4'-dihydroxy-2'-methoxy-8-(3,3-dimethylallyl)-2",2"-dimethylpyrano[5,6:6,7]isoflavone; euchrenone b10; isoerysenegalensein E; wighteone; laburnetin; lupiwighteone; erythrodiol; oleanolic acid [24]; eryvarins F, G (3-phenoxychromones) [25]; eryvarinols A, B (diphenylpropan-1,2-diols) [26].
Polygonum hydropiper L.	1,4-cineole; acetic acid; a-pinene; baldrianic acid; b-pinene; b-sitosterol-glucoside; borneol; bornyl acetate; camphor; caprionic acid; carvone; cinnamic acid methyl ester; cinnamic alcohol; confertiflorin; confertifolin; ellagic acid; fenchone; formic acid; gallic acid; isodrimeninol; isodrimenol; isopolygodial; isorhamnetin; isotadeonal; kaempferol; malic acid; melissic acid; *P*-cymol; persicarin; persicarin-7-methyl ether; phellandrene; poligonone; polygodial; polygonal; polygonolide; quercetin; quercetin-7-glucoside; quercitrin; rhamnazin; rhamnesin; rutin; sitosterol; tannic acid; terpineol; valerianic acid [17].

and Murong tribes. However, the mode of use varied between tribes or as in the case of *Ananas comosus*, two different modes of use were observed in the Chakma tribe. Apart from one mode of use in the Chakma tribe, where *Ananas comosus* was used in combination with *Areca catechu* L. and *Erythrina variegata*, in all other cases, a single plant was used for treatment of helminthic infections. Powdered plant part, juice extracted from plant part or water in which a plant part was soaked was the usual mode of formulation and administered orally. One exception was the case of *Cassia fistula* L., where crushed bark was mixed with molasses prior to administration. Molasses was possibly used as a binding agent in this case, for following mixing with molasses the bark-molasses combination was dried and made into pills prior to administration.

Leaves formed the part of the plant used predominantly in the formulations and accounted for 52.6% of the total uses. Leaves were followed by barks (21.1%), roots (15.8%), and flowers and fruits (5.3% each). It is interesting that whole plants, seeds or stems did not form a part of the formulations of all six tribes surveyed. Several instances were observed where a combination of two plant parts was administered as treatment for helminthic infections. A combination of leaves and roots of *Cassia alata* was used by the Chakma tribe; a combination of leaves and flowers of *Hibiscus rosa sinensis* L. was used by the Rakhain tribe; a combination of leaves and roots of *Polygonum hydropiper* L. was used by the Marma tribe; and a combination of leaves and roots of *Clerodendrum viscosum* Vent. was also used by the Rakhain tribe.

Discussion

The pharmacological activities of different phytochemicals present within the plant decide whether the plant may be useful in treatment of any specific ailment or multiple ailments. A partial list of phytochemicals present in some of the plants used by the various tribes for treatment of helminthic infestations is provided in Table 2. The list has been compiled from a search of Duke's database (Duke, J.A., 1992) and other published sources (referenced within Table 2). One or more phytochemicals may potentially possess anthelmintic activity; however, detailed scientific studies need to be carried out.

Justicia adhatoda L. has been reported to be commonly used in the indigenous medicinal system of Naga tribes in India for curing intestinal worm infections. Its efficacy has been demonstrated using *Hymenolepis diminuta*-rat experimental model (Yadav, A.K. and V. Tangpu, 2008). A combination of pumpkin seeds and aqueous extract of *Areca catechu* L. nuts reportedly demonstrated promising results in heterophyiasis (infection caused by *Heterophyes heterophyes*) in puppy dogs (Mahmoud, L.H., 2002). The same combination also demonstrated promising results in infections with *Taenia saginata* (Chung, W.C. and B.C. Ko, 1976) and tapeworms (Feng, L.C., 1956). Other plants need to be studied, but since they have been used with success by the tribal people of Chittagong Hill Tracts for centuries, they present considerable potential for discovery of new medicines for treatment of helminthic infections, which are prevalent worldwide.

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