Research Article
Are Famine Food Plants Also Ethnomedicinal Plants?
An Ethnomedicinal Appraisal of Famine Food Plants of Two Districts of Bangladesh

Fardous Mohammad Safiul Azam, Anup Biswas, Abdul Mannan, Nusrat Anik Afsana, Rownak Jahan, and Mohammed Rahmatullah

Department of Biotechnology & Genetic Engineering, Faculty of Life Sciences, University of Development Alternative, House No. 78, Road No. 11A (new), Dhanmondi, Dhaka 1209, Bangladesh

Correspondence should be addressed to Mohammed Rahmatullah; rahamatm@hotmail.com

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Plants have served as sources of food and medicines for human beings since their advent. During famines or conditions of food scarcity, people throughout the world depend on unconventional plant items to satiate their hunger and meet their nutritional needs. Malnourished people often suffer from various diseases, much more than people eating a balanced diet. We are hypothesizing that the unconventional food plants that people eat during times of scarcity of their normal diet are also medicinal plants and thus can play a role in satiating hunger, meeting nutritional needs, and serving therapeutic purposes. Towards testing our hypothesis, surveys were carried out among the low income people of four villages in Lalmonirhat and Nilphamari districts of Bangladesh. People and particularly the low income people of these two districts suffer each year from a seasonal famine known as Monga. Over 200 informants from 167 households in the villages were interviewed with the help of a semistructured questionnaire and the guided field-walk method. The informants mentioned a total of 34 plant species that they consumed during Monga. Published literature shows that all the species consumed had ethnomedicinal uses. It is concluded that famine food plants also serve as ethnomedicinal plants.

1. Introduction

Human beings need food for survival and to satiate their hunger. Plants have always constituted a major food source for people throughout the world since the advent of humans. During times of natural disasters like inclement weather conditions, populations suffering from severe food shortages become heavily reliant on wild food plants for survival [1]. This has given rise to the concept of famine plants [2]. Rodale and McGrath [3] stated that famine plants have been eaten and utilized for centuries. Certain “wild-foods” are enjoyed and therefore collected and consumed every time when ready and these are important “famine-foods” during periods of food shortage [4].

The human population of the western Sahel has been reported to depend on a number of wild plant foods, and this dependency increases during drought conditions [5]. However, scarcity of food or in practicality, famine condition, is also a common occurrence with people who live in poverty and so cannot afford their daily requirements of a normal and conventional diet. Such food scarcity/famine (famine and food scarcity have been considered equivalent in this paper in the sense that both conditions lead to inadequate intake of daily conventional food items) can be observed among the people of Bangladesh, about a third of those who live below the poverty level income, defined as less than US$ 1 per day. Moreover, people of the northern districts of Bangladesh are subjected each year to a seasonal famine known as Monga. Monga usually occurs twice a year; the greater Monga (boro Monga) occurs during the lean season preceding the harvest of paddy in the Bangla months of Ashwin and Kartik (mid-September to mid-November), and
the smaller Monga (choto Monga) occurs during the lean season preceding the harvest of paddy in between the Bangla months of Chaitra and Jaistha (mid-March to mid-June). It is to be noted that rice (obtained after dehusking paddy) is the staple cereal of the people of Bangladesh and is the major item consumed by the poorer rural people with lentils and an occasional sidedish of a vegetable. Monga occurs due to a number of factors, lack of adequate water supply during the above months and lack of diversification of jobs (most people being agricultural laborers with little cultivable land of their own). The agricultural laborers, landless farmers, and the marginal farmers suffer from acute food shortage during Monga [6].

Lalmonirhat and Nilphamari districts are two districts in the northern part of Bangladesh, which suffer from Monga. The people in these districts, particularly the rural poor, are the worst sufferers and suffer during Monga from acute food shortages. We have previously shown that a number of nonconventional plant items are consumed by the poor people of the northern districts of Bangladesh during Monga [7]. In fact, such consumption of nonconventional plant items during times of food scarcity has been reported by us for other districts of Bangladesh, like Rangamati and Kurigram [8, 9]; Rangamati district does not suffer from Monga, but food scarcity exists among segments of the mainstream population as well as tribal people. Also notably, Rangamati district is in the southeastern portion of the country. During our survey in Kurigram district on famine food plants, we noted a distinct correlation between nonconventional plants consumed during food scarcity and their folk medicinal usage; in other words, most of the plants consumed had folk medicinal uses [10].

Chronic lack of food causes the people to suffer from malnutrition with consequent wasting away of body and weakening of the body’s immune systems [11]. This can cause a number of diseases to occur because of the body’s weak defenses against invading pathogens. Lack of proper diet can not only cause shortage of macronutrients like carbohydrates, proteins, and lipids, but also cause lack of vitamins and essential micronutrients with concomitant arising of ailments like anemia, night blindness, beriberi, pellagra, kwashiorkor, and marasmus, to name only a few. Thus nonconventional food items should not only be edible, but also satiate the hunger and meet the body’s nutritional needs adequately.

The Australian Aboriginal hunter-gatherers reportedly used to have over 800 plant foods, and that this traditional diet may have been low in carbohydrates but high in fiber, leading to protection of the Aborigines from a genetic predisposition to insulin resistance (a physiological condition in which the natural hormone, insulin, becomes less effective in lowering blood sugars) and its consequences like diabetes mellitus, coronary heart disease, and obesity [12]. These conventional food plants and medicine are interrelated as also been shown by other authors. Research in several regions has illustrated that many wild plants that are retained in local food cultures are inseparable from traditional therapeutic systems [13, 14]. Since ancient times, the thinking of “food as medicine” has existed in Chinese medical theories and Chinese food therapy [15, 16]. Etkin and Ross [17, 18] showed from their West African research that many wild plants were used both in therapeutics and for dietary purposes. We further hypothesize that through trial and error, the human population have selected famine food plants items, which not only fulfill hunger satiating and nutritional needs, but also serves a therapeutic purpose. It then follows from our hypothesis that famine food plants, in general, must also have ethnomedicinal uses.

The objective of the present survey was to conduct an ethnomedicinal appraisal of famine food plants consumed by poor villagers in four villages (Sailmari, Khurdobichondoi, Paschim Dewwabar, and Schatunama) of two adjoining districts, namely, Lalmonirhat and Nilphamari, which are two of the most Monga-prone districts in Bangladesh, and have substantial segments of the population suffering from food scarcity during Monga. The two districts are bordered on the south by Rangpur district, on the north by West Bengal State of India, on the east by Kurigram district, and on the west by Dinajpur and Panchagarh districts (Figure 1). The area of the four villages where the present survey was conducted approximates 50 square kilometers. An indigenous community, namely the Santals, inhabits portions of the two districts covered. The Santals are considered to be original settlers in this area since prehistoric times; however, the majority of the population (over 98%) of the two districts at present comprises of mainstream Bengali-speaking population.

The villages surveyed lacked any industry; as a consequence, the people are dependent on agriculture. Three of the villages Sailmari, Khurdobichondoi, and Paschim Dewwabar fell under Kaliganj and Hatibandha Upazilas (subdistricts) of Lalmonirhat district, while Schatunama fell under Dimla Upazila of Nilphamari district (Figure 1). As per National Information Services provided by the Government of Bangladesh [19], the total population of Kaliganj and Hatibanda Upazilas was 216,868 and 239,568, respectively with a literacy rate of 24, and 21.4% (it is to be noted that a person is considered literate in Bangladesh if the person can only sign his or her name without even going to primary school). The total population of Dimla Upazila is 280,076 with an average literacy level of 42.86%. Small farmers (i.e. farmers without land or having less than one-third acre of land per family) constituted over 80% of the population in the villages surveyed; these farmers mostly worked as agricultural laborers in other people's land.

The surveyed villages did not have any forest land. The villages, however, contained fallow land and “char” (river islands on the Teesta River) areas. There was some vegetative cover in the fallow lands and chars; the vegetation mostly consisted of wild herbs, shrubs, and a few trees, which were tropical and subtropical in nature.

2. Methods

2.1. Study Area and Investigative Methods. The present survey was conducted between October 2010 and August 2012. A preliminary survey was conducted among the villagers of a number of villages in Lalmonirhat and Nilphamari districts, which according to news reports of the country have a substantial number of households, who were affected
by Monga. From this preliminary survey, four villages as mentioned above were chosen in the two districts on the basis of the number of households, whose incomes were below the poverty level, and as a consequence, were more affected by Monga. More detailed surveys (comprising of a total of nine visits, each visit lasting four days on an average) were conducted in these four villages among a total of 167 households who mentioned that they consume nonconventional plant items not only during Monga, but also at other times of food scarcity, caused due to their low income levels. All together, 238 adult members (219 females and 19 males) from these households were interviewed. It is to be noted that women, particularly the adult married members of rural households, are in general responsible for cooking food and collecting nonconventional plant items (during times of food scarcity) and so possess more information on famine foods than the male members of the household. Although collecting nonconventional edible plants from the wild or fallow lands and roadsides is also shared by children along with adult female members of the household, such children were not interviewed in the present survey.

2.2. Mode of Interview and Plant Specimen Collection. Informed consent was first obtained from the Head of each household (in most cases being the oldest active male member) to gather information on their monthly income levels, availability of adequate food throughout the year, prevalence of diseases, occupation, literacy, consumption of nonconventional plant food items during times of food scarcity in their households, and the therapeutic uses of the nonconventional plant species. The male Heads of households themselves suggested that information on consumption of nonconventional plants be gathered from the female adult members of each household. Information was collected and recorded with the help of a semistructured questionnaire, open-ended interviews, and the guided field-walk method of Martin [20] and Maundu [21]. In this method, the women informants took the interviewers on guided field walks through areas from where they usually collected their nonconventional edible plants, pointed out the plants, and described the mode of consumption of these plants and the plant parts used for consumption, as well as medicinal values of the plants. All such plant specimens were collected from the spot, pressed, dried [22], and brought back to Dhaka for complete identification by the Bangladesh National Herbarium. Voucher plant specimens were deposited with the Plant Collection Wing of the University of Development Alternative. Nomenclature of plants was compiled from the Plant List database (http://www.theplantlist.org/). Lalmonirhat and Nilphamari are adjoining districts, and it was noticed that the pattern of consumption of nonconventional plants was basically the same for each household in all four villages of the two districts.
2.3. Search of Databases for Ethnomedicinal Uses of Plants
Ethnomedicinal uses of the plant reports were collected through searching various databases like PubMed, SCOPUS, and Google Scholar.

3. Results and Discussion

3.1. Demographic Characteristics. Of the 219 females interviewed, 76 females (34.7%) were in the age group of 21–30 years, 88 females (40.2%) were in the age group of 31–40 years, and 55 females (25.1%) were in the age group of 41–50 years. 100% of the females were married and described their occupation as housewives. The literacy rate among the females was 3.1%. Of the 19 males interviewed, 16 males (84.2%) described their occupation as agricultural laborers, while 3 males (15.8%) described themselves as small farmers with landholding not exceeding 1/3 acres. Literacy rate among the interviewed males was 7.9%. It may be noted that the literacy rate among the surveyed population was observed to be lower than the Upazila average. The informants mentioned that part of this lower literacy rate was due to age, for only recently the Government of Bangladesh has made primary education (up to Grade V) compulsory for both males and females. The other factor mentioned by the informants was that they could not even send children to schools regularly because the children were often engaged in foraging for wild edible plants because of chronic food shortages.

3.2. General Dietary Information. According to all informants, their main diet during food availability consisted of rice, which was consumed along with lentil soup (dal), vegetables, and occasionally fish or meat. Since rice contains very low amount of protein, lentils served as the main protein source in the absence of meat or fish items. During times of food scarcity, rice could not be afforded, and so they consumed nonconventional edible plants or plant parts along with lentil soup, if the latter could be afforded. Various types of lentils (pulses) are available in Bangladesh, the most costly being *Lens esculenta* and *Lens culinaris* (masoor dal) and *Vigna radiata* (mung dal). However, the poorer people cannot usually afford these two pulses and consume instead *Lathyrus sativus* (kesari dal).

3.3. Plant Habitat. Among the plants whose parts were consumed, with the exception of *Artocarpus heterophyllus*, *Corchorus capsularis*, *Moringa oleifera*, *Musa sapientum*, and *Raphanus sativus*, the rest of the plants were collected from the wild (fallow land, roadsides, open fields, or marshy areas). Aquatic wild edible plants included *Ipomoea aquatica*, *Marsilea minuta*, *Enhydra fluctuans*, *Nelumbo nucifera*, and *Nymphaea pubescens*.

3.4. Plants, Plant Parts, and Mode of Consumption during Famines. The various informants mentioned a total of 34 nonconventional plant species that they consumed during times of food scarcity. The plants were distributed into 26 families. Among these plants species, the parts consumed were leaves, stems, barks, fruits, seeds, flowers, tubers, and corms. The results are shown in Table 1. Leaves formed the major plant part consumed and constituted 44.9% of the total. Leaves were followed by stems at 18.3% and fruits at 12.2%. The results are shown in Figure 2. In other parts of the world like Niger in Africa, leaves have been reported to be primarily consumed during famines and have been shown to be excellent sources of proteins and micronutrients, particularly of plants like *Amaranthus viridis* and *M. oleifera* [23]. Notably, the leaves of these two plants were also found to be consumed by the people of the present survey areas during times of food scarcity.

Fruits were usually eaten directly in the raw state, tubers and corms in the mashed state following boiling in water, and leaves and stems taken following frying or cooking in the form of vegetables. Since the households were too poor to afford spices, essentially a little oil or a small amount of table salt was added for cooking and making the dish more palatable. The three exceptions to this generalized mode of consumption were *Centella asiatica*, *M. minuta*, and *Oxalis corniculata*. In all these three cases, juice obtained from squeezed leaves was added to lentil soup, which was then consumed. The reason for this unusual mode of consumption was attributed to age-old practices of the community. Among these plants, not all plant parts consumed were fully nonconventional. For instance, during regular times of food availability, villagers would consume leaves and stems of *Amaranthus tricolor*, seeds of *A. heterophyllus*, leaves of *C. asiatica*, leaves, stems, and tubers of *Colocasia esculenta*, leaves of *C. capsularis*, leaves of *L. aquatica*, fruits of *Musa paradisiaca*, leaf stalks of *N. pubescens*, and leaves of *R. sativus*, but only occasionally. *M. sapientum* and *Musa paradisiaca* fruits were consumed during regular times, but during times of food scarcity, other parts of the plant along with fruits were consumed.

3.5. Food Uses of Famine Food Plants of Surveyed Areas in Other Parts of the World. It is of interest that the plants...
<table>
<thead>
<tr>
<th>Serial number</th>
<th>Species</th>
<th>Family</th>
<th>Local name (English name)</th>
<th>Part(s) used</th>
<th>Mode of consumption</th>
<th>Local medicinal use(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Abroma augusta (L.) L. f.</td>
<td>Malvaceae</td>
<td>Ulotkombol (Devil's cotton)</td>
<td>Bark, root</td>
<td>Juice obtained from crushed bark is taken with little salt. Smashed roots are cooked.</td>
<td>Roots used against menstrual problems, leukorrhea, stomach pain, and sexual weakness. Bark used against jaundice.</td>
</tr>
<tr>
<td>2</td>
<td>Alternanthera sessilis (L.) R. Br. ex DC.</td>
<td>Amaranthaceae</td>
<td>Shantishak (Sessile joyweed)</td>
<td>Leaf, stem</td>
<td>Fried with little oil and water.</td>
<td>Leaves used against scabies and eczema.</td>
</tr>
<tr>
<td>3</td>
<td>Amaranthus spinosus L.</td>
<td>Amaranthaceae</td>
<td>Kanta khuria (Spiny Amaranth)</td>
<td>Leaf, stem</td>
<td>Fried with little oil and water.</td>
<td>Leaves and stems used against boils, constipation, and severe malnutrition.</td>
</tr>
<tr>
<td>4</td>
<td>Amaranthus tricolor L.</td>
<td>Amaranthaceae</td>
<td>Choriadangashak (Joseph's coat Amaranth)</td>
<td>Leaf, stem</td>
<td>Fried with little oil and water.</td>
<td>Leaves and stems used against boils, constipation, and severe malnutrition.</td>
</tr>
<tr>
<td>5</td>
<td>Amaranthus viridis L.</td>
<td>Amaranthaceae</td>
<td>Khaikhuria (Green Amaranth)</td>
<td>Leaf, stem</td>
<td>Fried with little oil and water.</td>
<td>Roots used against sexual weakness.</td>
</tr>
<tr>
<td>6</td>
<td>Artocarpus heterophyllus Lam.</td>
<td>Moraceae</td>
<td>Kanthal (Jackfruit)</td>
<td>Seed</td>
<td>Roasted seeds are eaten directly or in the mashed form.</td>
<td>Seeds used against constipation.</td>
</tr>
<tr>
<td>7</td>
<td>Bombax ceiba L.</td>
<td>Bombacaceae</td>
<td>Shimul (Silk cotton tree)</td>
<td>Root</td>
<td>Cut into small pieces and boiled with a little salt.</td>
<td>Roots used against sexual weakness.</td>
</tr>
<tr>
<td>8</td>
<td>Caryota urens L.</td>
<td>Arecaceae</td>
<td>Chaguwa (Solitary fishtail palm)</td>
<td>Leaf</td>
<td>Juice obtained from crushed leaves is added to lentil soup.</td>
<td>No local medicinal uses reported.</td>
</tr>
<tr>
<td>9</td>
<td>Centella asiatica (L.) Urb.</td>
<td>Apiaceae</td>
<td>Khudimanimuni (Indian pennywort)</td>
<td>Leaf</td>
<td>Juice obtained from crushed leaves is added to lentil soup.</td>
<td>Leaves used against indigestion, diarrhoea, and dysentery.</td>
</tr>
<tr>
<td>10</td>
<td>Chenopodium album L.</td>
<td>Chenopodiaceae</td>
<td>Bothu (Lamb's quarters)</td>
<td>Leaf</td>
<td>Fried with little oil and water.</td>
<td>Leaves and stems used against liver diseases, hemorrhoids, constipation, and dysentery.</td>
</tr>
<tr>
<td>11</td>
<td>Corchorus capsularis L. (L.) Schott</td>
<td>Tiliaceae</td>
<td>Paach (Jute)</td>
<td>Leaf</td>
<td>Cut into small pieces and cooked with little salt and water.</td>
<td>Leaves used against stomach pain, liver disorders, and loss of appetite.</td>
</tr>
<tr>
<td>12</td>
<td>Dioscorea esculenta (Lour.) Burkill</td>
<td>Dioscoreaceae</td>
<td>Boro du (Lesser yam)</td>
<td>Root</td>
<td>Boiled in water and then taken in the mashed form after mixing with oil and hot peppers.</td>
<td>Tubers used against malnutrition.</td>
</tr>
<tr>
<td>13</td>
<td>Diplazium esculentum (Retz.) Soo</td>
<td>Dryopteridaceae</td>
<td>Dhika shak (Vegetable fern)</td>
<td>Leaf</td>
<td>Cut into small pieces and cooked.</td>
<td>Leaves used against fever.</td>
</tr>
<tr>
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<tr>
<td>15</td>
<td><em>Ehretia acuminata</em> R. Br.</td>
<td>Boraginaceae</td>
<td>Kath guwa (Kodo weed)</td>
<td>Fruit</td>
<td>Fruits are eaten raw.</td>
<td>No local medicinal uses reported.</td>
</tr>
<tr>
<td>16</td>
<td><em>Enhydra fluctuans</em> Lour.</td>
<td>Asteraceae</td>
<td>Hanchi shak (Water cress)</td>
<td>Leaf</td>
<td>Fried with salt and then cooked.</td>
<td>Leaves used against diabetes, low semen density, and weakness.</td>
</tr>
<tr>
<td>17</td>
<td><em>Ficus hispida</em> L.</td>
<td>Moraceae</td>
<td>Khoksha (Hairy fig)</td>
<td>Fruit</td>
<td>Fruits are eaten raw.</td>
<td>Fruits used against diabetes and hypertension.</td>
</tr>
<tr>
<td>18</td>
<td><em>Glinus oppositifolius</em> (L.) Aug. DC.</td>
<td>Molluginaceae</td>
<td>Teeta shak (Bitter leaf)</td>
<td>Leaf</td>
<td>Leaves are boiled in water followed by discarding the water and cooking the boiled leaves as vegetable.</td>
<td>Leaves used against indigestion, fever, and burning sensations in hands or feet.</td>
</tr>
<tr>
<td>19</td>
<td><em>Ipomoea aquatica</em> Forssk.</td>
<td>Convolvulaceae</td>
<td>Kolmi shak (Water spinach)</td>
<td>Leaf</td>
<td>Cut into small pieces and cooked with salt and water.</td>
<td>Leaves used against chicken pox and rheumatism, and to increase lactation in nursing mothers.</td>
</tr>
<tr>
<td>20</td>
<td><em>Ipomoea batatas</em> (L.) Poir.</td>
<td>Convolvulaceae</td>
<td>Misti aloo (Sweet potato)</td>
<td>Leaf</td>
<td>Cut into small pieces and cooked with salt and water.</td>
<td>Leaves used against diarrhea and debility.</td>
</tr>
<tr>
<td>21</td>
<td><em>Leucas aspera</em> (Willk.) Link</td>
<td>Lamiaceae</td>
<td>Kanshika (White dead nettle)</td>
<td>Leaf from young plants</td>
<td>Cut into small pieces and cooked with a little salt.</td>
<td>Leaves used against body pain, coughs, and mucus.</td>
</tr>
<tr>
<td>22</td>
<td><em>Malva verticillata</em> L.</td>
<td>Malvaceae</td>
<td>Napa shak (Chinese mallow)</td>
<td>Leaf</td>
<td>Cooked with little water and salt.</td>
<td>No local medicinal uses reported.</td>
</tr>
<tr>
<td>23</td>
<td><em>Marsilea minuta</em> L.</td>
<td>Marsileaceae</td>
<td>Dhel manimuni (Dwarf water clover)</td>
<td>Leaf</td>
<td>Leaves are squeezed to obtain juice, which is consumed with lentil soup.</td>
<td>Leaves used against edema, sexual weakness, mucus and fever.</td>
</tr>
<tr>
<td>24</td>
<td><em>Moringa oleifera</em> Lam.</td>
<td>Moringaceae</td>
<td>Saazna (Drumstick tree)</td>
<td>Leaf, immature fruit</td>
<td>Leaves are cooked with a little soda and consumed. Fruits are cooked as vegetables.</td>
<td>Leaves and fruits used against fever, boils, cold, and joint pain.</td>
</tr>
<tr>
<td>25</td>
<td><em>Musa x paradisiaca</em> L.</td>
<td>Musaceae</td>
<td>Anajee kola (Plantain)</td>
<td>Flower, fruit, pseudostem</td>
<td>Immature flowers are taken in the mashed form with a little salt after boiling. Unripe fruits are boiled and taken in the mashed form or cooked as vegetable. Pseudostems from young plants are cooked as vegetable.</td>
<td>Fruits used against anemia, hematemesis, and dysentery. Flowers and pseudostems used against chronic dysentery.</td>
</tr>
<tr>
<td>26</td>
<td><em>Musa x sapientum</em> L.</td>
<td>Musaceae</td>
<td>Aeta kola (Banana)</td>
<td>Flower, fruit</td>
<td>Immature flowers are boiled and taken in the mashed form with a little salt. Ripe fruits are taken raw or smashed and kept in water for 10–12 hours followed by drinking the mixture.</td>
<td>Fruits against stomach pain, diarrhea, and skin eruptions. Flowers used against diabetes.</td>
</tr>
<tr>
<td>27</td>
<td><em>Nelumbo nucifera</em> Gaertn.</td>
<td>Nelumbonaceae</td>
<td>Padma, Dhepra (Sacred lotus)</td>
<td>Leaf stalk</td>
<td>Leaf stalks are fried with a little salt.</td>
<td>Leaves and leaf stalks used against weakness.</td>
</tr>
<tr>
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</tr>
<tr>
<td>28</td>
<td><em>Nymphaea pubescens</em> Willd.</td>
<td>Nymphaeaceae</td>
<td>Shapla, Shaluk (Hairy water lily)</td>
<td>Leaf stalk, corm</td>
<td>Leaf stalks are fried with a little salt. Corms are roasted and taken with a little salt.</td>
<td>No local medicinal uses reported.</td>
</tr>
<tr>
<td>29</td>
<td><em>Oxalis corniculata</em> L.</td>
<td>Oxalidaceae</td>
<td>Amrul (Creeping woodsorrel)</td>
<td>Leaf</td>
<td>Juice obtained from crushed leaves is taken with lentil soup.</td>
<td>Leaves used against dysentery and as antidote to poison.</td>
</tr>
<tr>
<td>30</td>
<td><em>Raphanus sativus</em> L.</td>
<td>Cruciferae</td>
<td>Mula (radish)</td>
<td>Leaf</td>
<td>Cut into small pieces and cooked in water with some salt and a little oil.</td>
<td>No local medicinal uses reported.</td>
</tr>
<tr>
<td>31</td>
<td><em>Saccharum spontaneum</em> L.</td>
<td>Poaceae</td>
<td>Keshur, Kashia danda (Wild sugar cane)</td>
<td>Stem</td>
<td>Stems are chewed and the ensuing juice is taken orally.</td>
<td>Stem juice used against jaundice and sexual weakness.</td>
</tr>
<tr>
<td>32</td>
<td><em>Scoparia dulcis</em> L.</td>
<td>Scrophulariaceae</td>
<td>Misti pata (Sweet broomweed)</td>
<td>Leaf</td>
<td>Leaves are cooked with a little salt.</td>
<td>Leaves used against fever, dysentery, blood dysentery, and gastric ulcer.</td>
</tr>
<tr>
<td>34</td>
<td><em>Spilanthes paniculata</em> Wall. ex DC.</td>
<td>Asteraceae</td>
<td>Oshun shak, Roshun shak (Para cress)</td>
<td>Leaf, stem</td>
<td>Cut into small pieces and cooked.</td>
<td>Leaves and stems used against rheumatism.</td>
</tr>
</tbody>
</table>
consumed during times of food scarcity in the surveyed areas are also used as normal or famine foods in other regions of the world, although the same plant part may not be consumed. Food uses of some of the plants are shown in Table 2. For instance, leaves and seeds of *Abronia augusta* are considered edible in Papua New Guinea and Sikkim, India, respectively [24, 25]. The surveyed population consumed the barks and roots of the plant. Leaves of *Alternanthera sessilis* are also considered edible in Papua New Guinea [24]; the surveyed population consumed leaves and stems. Leaves of *Amaranthus spinosus* and *Amaranthus viridis* are eaten as leafy vegetables in Assam, India [26]; the local people consumed both leaves and stems. The flowers of *Bombax ceiba* are considered edible in Arunachal Pradesh, India [27]; the local people consumed the roots of the plant.

3.6. Local Ethnomedicinal Uses of Plants Consumed during Famines. With the exception of five plants, the rest 29 plants (85.29% of total) were reported by the informants to have medicinal uses. The frequency of plant use in different categories of disorders is shown in Figure 3. Gastrointestinal disorders had the maximum frequency of ethnomedicinal use (22.05%), followed by skin disorders (8.82%). Other major disorders against which plants were reported to have ethnomedicinal uses included sexual disorders, hepatic disorders, and fever (7.35% each). The rural population and particularly the surveyed rural poor households were found to live under unhygienic conditions and with poor sanitation and drinking water quality. These factors along with possible fall of immunity due to malnutrition [11] can lead to various diseases, and gastrointestinal disorders and skin diseases would constitute the major disease forms. Other studies have also indicated the prevalence of gastrointestinal disorders among the Bangladeshi rural population [28, 29].

3.7. Ethnomedicinal Uses of the Famine Food Plants in Other Regions of the World Including Bangladesh. To validate our hypothesis that, through trial and error, the human population has selected famine food plants items, which not only fulfill hunger satiating and nutritional needs, but also serves a therapeutic purpose, it was of interest to examine published reports on ethnomedicinal uses of the famine food plants of the survey areas in other parts of the world, including Bangladesh. The results are presented in Table 3. It is to be noted that only a selection of available reported ethnomedicinal uses of the plants are presented in Table 3. Not surprisingly, the ethnomedicinal uses of the local famine food plants were much greater when other regions of the world were taken into account. However, some local medicinal uses were in common with uses in other regions (i.e., treatment of menstrual problems with *A. augusta* or use of *C. asiatica* for treatment of gastrointestinal disorders).

Taken together, the available ethnomedicinal reports on the nonconventional plants consumed by the villagers surveyed, strongly validates our hypothesis that famine food plants are also ethnomedicinal plants. That the exact ethnomedicinal value be actually known is possibly not necessary; just the mere observation that consumption of these plants satiate hunger, meet nutritional needs to a lesser or greater extent, and somehow prevents diseases from occurring can be valid reasons for selection of particular nonconventional plants and not others. For instance, the informants did not mention any medicinal uses for the plants, namely, *Caryota urens*, *Ehretia acuminata*, *Malva verticillata*, *N. pubescens*, and *R. sativus* (Table 1); however, all four plants have reported ethnomedicinal uses in other parts of the world (Table 3). The reasons for discarding other wild or nonconventional plants can be due to a variety of reasons ranging from toxicity and lesser palatability to lesser fulfillment of nutritional needs, with all these factors being easily manifested.

The question then arises as to why did not the villagers surveyed in the present study consume these nonconventional plant items on a regular basis? One answer provided by the villagers themselves was that they did not find these nonconventional plant items as palatable (in their words tasty) as their regular diet of rice and lentils. A further answer could be that they were unaware of all the health benefits that these nonconventional plants offered (as also suggested from a comparison of local medicinal uses of the plants versus ethnomedicinal uses in other parts of the world), and so they stuck to their millennia old dietary habits. Another possible reason could be that they once were aware of the ethnomedicinal benefits of the plants consumed but have lost some of that knowledge over time. In fact, “optimum foraging strategy” theory [30] implies that all animals forage in such a way as to maximize their net energy intake per unit time. We extend this hypothesis to include that humans forage or rather use famine food plants in such a manner which besides maximizing their net energy intake per unit time also provides them with health benefits in the form of preventing or curing diseases. This also makes sense; during malnutrition arising out of food scarcity, humans may have reduced strength and weakened body defenses; as such, they would include food, which would offer both nutritional as well as therapeutic benefits. It is interesting to note that
Another study in Northeast Thailand also found that half of the weedy vegetables consumed by the people are also regarded as sources of medicine [31]. That various wild plants can serve as both food and medicine has been reported from various regions of the world including Palestine and China [32, 33].

The major finding of this study is that, since famine food plants have the real possibility of multiple ethnomedicinal uses, such plants throughout the world merit further scientific studies to fully explore their medicinal potentials. Moreover, since famine food plants are mostly wild but edible and can grow under inclement weather conditions without

<table>
<thead>
<tr>
<th>Species</th>
<th>Use as food plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abroma augusta L.</td>
<td>Leaves are considered edible in Papua New Guinea [24] and seeds in Sikkim, India [25].</td>
</tr>
<tr>
<td>Alternanthera sessilis (L.) R. Br. ex DC.</td>
<td>Leaves are considered as wild edibles in Papua New Guinea [24].</td>
</tr>
<tr>
<td>Amaranthus spinosus L.</td>
<td>Consumed as leafy vegetable in Assam (India) [26].</td>
</tr>
<tr>
<td>Amaranthus tricolor L.</td>
<td>Considered an edible vegetable in North India [34].</td>
</tr>
<tr>
<td>Amaranthus viridis L.</td>
<td>Consumed as leafy vegetable in Assam (India) [26].</td>
</tr>
<tr>
<td>Artocarpus heterophyllus Lam.</td>
<td>Fruits and seeds consumed in Malaysia [35].</td>
</tr>
<tr>
<td>Bombax ceiba L.</td>
<td>Flowers eaten as vegetable in Arunachal Pradesh of India [27].</td>
</tr>
<tr>
<td>Caryota urens L.</td>
<td>Pith used as famine food in South India [36].</td>
</tr>
<tr>
<td>Centella asiatica (L.) Urb.</td>
<td>Considered a leafy vegetable in Assam (India) [26].</td>
</tr>
<tr>
<td>Chenopodium album L.</td>
<td>Considered a leafy vegetable in Assam (India) [26].</td>
</tr>
<tr>
<td>Colocasia esculenta (L.) Schott.</td>
<td>Considered a leafy vegetable in Assam (India) [26].</td>
</tr>
<tr>
<td>Corchorus capsularis L.</td>
<td>Leaves are eaten in the cooked form in some Asian countries [37].</td>
</tr>
<tr>
<td>Dioscorea esculenta (Lour.) Burkill</td>
<td>Tubers are reported as wild edible in the islands of Remote Oceania [38].</td>
</tr>
<tr>
<td>Diplazium esculentum (Retz.) Sw.</td>
<td>Leaves consumed in Yunnan, China [39].</td>
</tr>
<tr>
<td>Bhretia acuminata R. Br.</td>
<td>Fruits are eaten raw by aboriginals in Australia [40].</td>
</tr>
<tr>
<td>Enhydra fluctuans Lour.</td>
<td>Leaves and stems consumed as leafy vegetable by ethnic communities in Tripura, India [41].</td>
</tr>
<tr>
<td>Ficus hispida L.</td>
<td>Fruits are eaten raw in Arunachal Pradesh of India [27].</td>
</tr>
<tr>
<td>Glinus oppositifolius (L.) A. DC.</td>
<td>Young leaves and stems consumed as vegetable in West Bengal, India [42].</td>
</tr>
<tr>
<td>Ipomoea aquatica Forsk.</td>
<td>Leaves and stems are cooked and consumed in Malaysia [35].</td>
</tr>
<tr>
<td>Ipomoea batatas (L.) Lam.</td>
<td>Leaves and stems are cooked and consumed in Malaysia [35].</td>
</tr>
<tr>
<td>Leucas aspera (Willd.) Link</td>
<td>Young leaves consumed during famine in Kurigram district, Bangladesh [10].</td>
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<tr>
<td>Malva verticillata L.</td>
<td>Young leaves consumed as soup in Korea [43].</td>
</tr>
<tr>
<td>Marsilea minuta L.</td>
<td>Leaves and stems consumed as vegetable in Jharkand, India [44].</td>
</tr>
<tr>
<td>Moringa oleifera Lam.</td>
<td>Leaves, fruits, flowers consumed in the cooked form in many countries of South Asia and Africa [45].</td>
</tr>
<tr>
<td>Musa paradisiaca L.</td>
<td>Fruits consumed in the unripe state in tropical countries [46].</td>
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<tr>
<td>Musa sapientum L.</td>
<td>Ripe fruits consumed throughout the world [47].</td>
</tr>
<tr>
<td>Nelumbo nucifera Gaertn.</td>
<td>Consumed as vegetable in various parts of India [48].</td>
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<tr>
<td>Nymphaea pubescens Willd.</td>
<td>Roasted endosperm consumed by rural communities in Assam, India [49].</td>
</tr>
<tr>
<td>Oxalis corniculata L.</td>
<td>Consumed by tribal communities of Central India during times of food scarcity [50].</td>
</tr>
<tr>
<td>Raphanus sativus L.</td>
<td>Dietary vegetable in Asian countries, particularly China, Japan, and Korea [51].</td>
</tr>
<tr>
<td>Saccharum spontaneum L.</td>
<td>Stems used to mitigate thirst or hunger by tribes in Parambikulam Wildlife Sanctuary, Kerala, India [52].</td>
</tr>
<tr>
<td>Scoparia dulcis L.</td>
<td>Consumed as vegetable in northeastern Thailand [53].</td>
</tr>
<tr>
<td>Sesbania grandiflora (L.) Pers.</td>
<td>Flowers and buds consumed as vegetable in India [54].</td>
</tr>
<tr>
<td>Sphagnetic paniculata Wall. ex DC.</td>
<td>Special food item prepared from the plant during religious festivals by the Mising community of Assam, India [55].</td>
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<td><em>Amaranthus viridiss L.</em></td>
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<tr>
<td>34</td>
<td><em>Spilanthes paniculata</em></td>
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</tbody>
</table>
any particular care [1], they can potentially be sources of both future foods and medicine.

4. Conclusion

Famine food plants have generally been mentioned as unconventional dietary items and consist of wild edible plants. It was our hypothesis that such plants also serve therapeutic purposes and can be considered ethnomedicinal plants. Through local surveys among famine-affected population of two districts of Bangladesh on the unconventional plants they consume during famine periods, along with local and other reported ethnomedicinal uses on these plants, we have validated our hypothesis.

Conflict of Interests

The authors declare that they have no competing interests.

Authors’ Contribution

Fardous Mohammad Safiul Azam, Anup Biswas, Abdul Mannan, Nusrat Anik Afhsana, and Rownak Jahan participated and completed the survey and searched relevant ethnomedicinal literature under the supervision of Mohammed Rahmatullah and submitted an initial report of the survey. Mohammed Rahmatullah analyzed the data and wrote the paper. All authors edited the paper and read and approved the final paper.

References


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