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Correlation Between Non-Conventional Plants Consumed During Food Scarcity and Their Folk Medicinal Usages: a Case Study in Two Villages of Kurigram District, Bangladesh

[1]Mohammed Rahmatullah, [1]Farhana Israt Jahan, [1]Syeda Seraj, [1]Zubaida Khatun, [1]Farhana Islam, [2]Mohammad Mafruhi Sattar, [1]Tania Khan, [1]Tasneema Ishika, [1]Mehreen Rahman, [1]Rownak Jahan

[1]Faculty of Life Sciences, University of Development Alternative, Dhanmondi, Dhaka-1205, Bangladesh.
[2]Department of Pharmacy, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh.

Mohammed Rahmatullah, Farhana Israt Jahan, Syeda Seraj, Zubaida Khatun, Farhana Islam, Mohammad Mafruhi Sattar, Tania Khan, Tasneema Ishika, Mehreen Rahman, Rownak Jahan: Correlation Between Non- Conventional Plants Consumed During Food Scarcity and Their Folk Medicinal Usages: a Case Study in Two Villages of Kurigram District, Bangladesh

ABSTRACT

Since the advent of human beings, they have probably suffered from food scarcity at various times or other as a result of a number of factors, including seasonal non-availability of food, failure of crops, and lack of game or domesticated animals. During those times, it appears to be the universal practice for humans to resort to consuming non-conventional foods, most of which are plant derived. This is more so in modern times, when the human race as a whole has become dependent on a few species of plants to serve as their staple diet. Any crop failure due to adverse weather or soil conditions lead to large-scale non-availability of food, which in its severest form is known as famine. In addition, a huge segment of the world population suffers from poverty and thus is unable to procure enough food to satisfy their hunger and nutritional requirements. This is the case also for Bangladesh where even at present, surveys indicates that around 32% of the population have incomes below the poverty level of US$ 1 per day. Additionally, the northern districts of Bangladesh suffer from a seasonal famine known as Monga during two periods every year. During these periods, the population, particularly the poorest sections of the population rely on various edible non-conventional plants to serve as their nutritional sources. We hypothesize that this choice of plants to be consumed during times of food scarcity has been a result of trial and error not only on the nutritional values of the plants, but also on their medicinal values. Diseases in a multitude of forms are present in the human population, and most of these diseases are exacerbated during malnutrition, which is a consequence of eating a less nutritional, or low amounts of diet, a phenomenon particularly present during times of food scarcity. Thus, the best choice of non-conventional plants consumed during times of food scarcity would be plants that not only serve to mitigate hunger and provide nutritional requirements, but also provide preventive as well as curative means to avoid various diseases arising out from malnutrition. To check this hypothesis, a survey was conducted among two village populations of Kurigram district in northern Bangladesh – an area prone to Monga. The non-edible conventional plant items consumed during Monga has been presented in an accompanying paper. The present study indicates that of the various plants consumed during Monga, 80% of the plants are considered to have medicinal values by the folk medicinal practitioners of Bangladesh. Moreover, the medicinal properties of most of the plants included curative properties against gastrointestinal disorders, physical weaknesses, energy deficiencies, anemia, and other disorders, which are most likely to arise from malnutrition. The results obtained in the present study validate our hypothesis that non-conventional plants eaten during times of food scarcity possess both nutritive as well as medicinal values, the latter being particularly effective against disorders arising from malnutrition.

Key words: Non-conventional food plants, folk medicine, Kurigram, Bangladesh.

Corresponding Author: Mohammed Rahmatullah, Pro-Vice Chancellor University of Development Alternative House No. 78, Road No. 11A (new) Dhanmondi R/A, Dhaka-1205 Bangladesh. Fax: 88-02-8157339. E-mail: rahamatm@hotmail.com

Introduction

Human beings started as hunter-gatherers at the dawn of human civilization. It is very much possible, that even during those times, when the human population was low, and natural food in the form of plants and animals in abundance, human beings suffered from scarcity of food due to seasonal declines in availability of plant products as well as depletion of animals within a particular range of human habitat. In modern times, the human race has become almost totally dependent on a few crops like rice, wheat, sorghum, maize or potatoes as their staple food. Any failure in the production of these crops therefore leads to shortages in the food supply, causing food scarcity, which in its severest form is known as famine. Moreover, in large number of regions of the world, like the sub-Saharan region of Africa or even localized areas in a number of countries, because of poor soil and weather conditions, the supply of food is inadequate. Under such conditions of food scarcity, the people often rely on non-conventional plant items, which are edible and enable the people to satiate their hunger and meet their nutritional needs (Glew *et al*., 1997; Freiberger *et al*., 1998; Sena *et al*., 1998; Cook *et al*., 2000).

Bangladesh is a developing country with a large population size exceeding 160 million within an area of around 55,000 square miles. By a number of estimates, more than 32% of the people live below the poverty level income, which has been defined as income of US$ 1 per day. As such, food is not affordable or in short supply to around a third of the population on a daily basis. Moreover, the northern districts of Bangladesh, falling within the Rangpur division of the country, suffers from a seasonal famine called Monga, twice during the year and which peaks during the Bengali months of Kartik (mid-October till mid-November) and Chaitra (mid-March till mid-April). The Rangpur division, in northern Bangladesh comprises several districts, namely, Gaibandha, Nilphamari, Kurigram, Rangpur, and Lalmonirhat. The people of these districts are usually poor, and apart from Rangpur district, generally lacks any industrial infrastructure. Agriculture (i.e. cultivating one's own land) and agricultural laborer (i.e. cultivating other people's land on a lease or day laborer basis) forms the main occupation of the people. Because of poor soil and climatic conditions, the major portions of these five districts can cultivate paddy (the staple diet of the people) only once a year versus the three crops of paddy in other parts of Bangladesh. The demand for labor during paddy cultivation peaks during the sowing period and the harvesting period. During the off-season months, substantial segments of the people suffer from lack of employment (due to absence of any other employment-producing sectors). As any cash or food reserves start getting lower in the households (particularly the poorest households), the poorer sections of the population, in general, have to rely on non-conventional plant items collected from the wild or from fallow land to mitigate their hunger and satisfy their nutritional requirements. It is to be noted that the poorest sections of the population has to rely on non-conventional plant food items throughout the year and throughout the country, because in their day-to-day existence, they cannot afford the staple diet of the Bangladeshis, i.e. rice.

We have documented the non-conventional plants consumed during times of food scarcity in two randomly selected villages of Kurigram district, namely Chargujimari and Kumar Para in an accompanying paper (Islam *et al*., 2011). In previous reports, we had also documented the non-conventional food plants, otherwise known as famine food plants, being consumed during times of food scarcity in other parts of Bangladesh, including Lalmonirhat district, which falls within the Monga-prone Rangpur division of the country (Jahan *et al*., 2010; Biswas *et al*., 2011; Paul *et al*., 2011 a,b). Along with our famine food surveys, we had been conducting ethnomedicinal surveys among the folk medicinal and tribal medicinal practitioners of Bangladesh for the last few years (Nawaz *et al*., 2009; Rahmatullah *et al*., 2009a-c; Hasan *et al*., 2010; Hossan *et al*., 2010; Mollik *et al*., 2010a,b; Rahmatullah *et al*., 2010a-f; Jahan *et al*., 2011). Our various surveys, especially the famine food survey conducted in Talbunia village of Bagerhat district, Bangladesh raised the hypothesis that non-conventional plants selected by the people suffering from food scarcity may not have been originally selected (through possible trial and error) not only for their nutritive and hunger-satiating properties, but the selection procedure may have also possibly considered the medicinal properties of the plants, particularly properties which are particularly relevant in combating malnutrition-induced diseases. Towards testing this hypothesis a survey was conducted among two randomly selected villages of Chargujimari and Kumar Para in Kurigram district, Bangladesh as to the non-conventional plant items that are consumed by the people during times of food scarcity like Monga. The names of various non-conventional plants obtained were next checked as to their folk medicinal uses (obtained from folk medicinal practitioners or Kavirajes) as present in our database of both previously reported (references cited above) as well as non-reported medicinal plants of Bangladesh, as used in various regions of the country. The objective of the present report was to correlate the two sets of data towards checking our hypothesis, which if correct, would indicate that non-conventional plants consumed during times of food scarcity also possess medicinal values, particularly against diseases, which occur more during malnutrition induced by factors like nutritional deficiency, arising out of food scarcity.

Materials and methods

The collection of data on non-conventional plants consumed during times of food scarcity like Monga in two randomly selected villages of Kurigram district, namely Chargujimari and Kumar Para, have been detailed in an accompanying paper (Islam *et al*., 2011). Information on folk medicinal usages of the plants were collected from various surveys among the different regions of Bangladesh as well as various tribal populations, as detailed before (Rahmatullah *et al*., 2009a-c; Hasan *et al*., 2010; Hossan *et al*., 2010; Mollik *et al*., 2010a,b; Rahmatullah *et al*., 2010a-f; Jahan *et al*., 2011). Briefly, information was collected from folk medicinal practitioners (Kavirajes) with the help of a semi-structured questionnaire and the guided field-walk method of Martin (1995) and Maundu (1995). All plant specimens as shown by the Kavirajes were collected and identified either at the Bangladesh National Herbarium or by Mr. Manjur-Ul-kadir Mia, ex-Curator and Principal Scientific Officer of the Bangladesh National Herbarium.

Results and discussion

Food scarcity, or absence of monetary ability for purchasing food, or a combination of both can lead to food shortages in households, and which affects more the poorest households than the more affluent ones. During times of food scarcity, if food is scarce in one region, and the prices increase considerably, the affluent households can either afford to procure food at higher prices, or go elsewhere for the time being where food is more available at prices they can afford. The poorer sections of the population, who in rural Bangladesh, are essentially agricultural laborers being employed in a seasonal manner, are vulnerable because they cannot afford food at higher prices, even in normal times their stock of food or cash reserves are low, and they cannot seek employment elsewhere like the large cities because of their lack of skills. In the northern districts of Rangpur division in Bangladesh, the poorest households suffer from food shortages throughout the year. This food shortage becomes more acute during the yearly famine – Monga, which peaks twice during the year in the Bengali months of Kartik and Chaitra. At times like this, even medium income households suffer from food shortages. To cover this food and nutritional deficit, the affected population relies on consumption of non-conventional plant items, which they do not normally consume or consume rarely under conditions of food availability and food availability (particularly of the staple diet, rice).

A total of 25 non-conventional plant species distributed into 18 families were reported to us by the poorer households of the two villages surveyed, as to be consumed during times of food scarcity, particularly Monga. A number of the plants Like *Amaranthus spinosus* and *Amaranthus viridis* were collected from the wild. Some plants were cultivated like *Basella alba*, and which was consumed throughout the year or sold, but which was consumed more during times of food scarcity, and formed the main dish in the absence of rice. During normal periods of food availability, rice formed the main dish and the major source of carbohydrates with vegetables as the side dish. During times of food scarcity, vegetables often formed the main dish, or sometimes a side-dish to other carbohydrate-rich non-conventional edible plant items like fruits of *Dioscorea bulbifera*. Other plants like *Moringa oleifera* had their fruits consumed normally; at times of food scarcity, people consumed the leaves of the plant also with the fruits. This had a certain advantage for while fruits were only available seasonally, leaves were available throughout the year, and could be used as a good source of nutritious food during the whole year. A detailed account of the non-conventional plant species consumed in the two villagers surveyed can be obtained elsewhere (Islam *et al*., 2011). Of the 25 plants reported to be consumed particularly during food scarcity, our accumulated reports on folk medicinal uses of the plants showed that 20 plants had published (or still to be published) folk medicinal uses. The results are shown in Table 1.

Any lack of adequate food intake leads to malnutrition and energy deficiency. These would cause a general weakening of the body system, including the immune system, causing the body to be susceptible to a host of diseases. While malnutrition can cause problems like weakness of body, deficiency in energy, or anemia, the general weakening of the immune system caused through malnutrition may bring on a number of diseases, particularly diseases caused by microbial factors. Protein-energy malnutrition (caused through inadequate appropriate food intake) is a serious problem in Bangladesh, which is exacerbated during times of food scarcity and seasonal famines like Monga. Because of inadequate food intake, people become underweight, and the most susceptible segments of the population are women and children. Diarrhea has been reported among young children, who are severely underweight (Nahar *et al*., 2010). Intestinal mucosal function has been reported to be severely impaired among severely underweight children (Hossain *et al*., 2010). Enterotoxigenic *Escherichia coli* (ETEC), *Cryptosporidium* sp., and *Entamoeba histolytica* were significantly more prevalent in malnourished children, as observed in a study with children suffering from diarrheal illnesses (Mondal *et al*., 2009). Prolongation of diarrhea due to cholera has been reported in patients with severe malnutrition (Palmer *et al*., 1976).

Table 1: Plants consumed during times of food scarcity in Chargujimari and Kumar Para villages of Kurigram district, Bangladesh and their uses in folk medicine.

Famine food plant name (local name)	Family	Plant part(s) used for consumption	Folk medicinal use of plant part (s) in various regions of Bangladesh including area surveyed
Amaranthus spinosus L. (Kanta khuria) English name: Prickly amaranth	Amaranthaceae	Leaves	Leucorrhea, diarrhea, dysentery, jaundice, eczema, fever, edema, colic, boils, abscesses, debility, diabetes, appetite stimulant, rheumatic pain, pain in the bones, pus or blood coming out with urine, loss of appetite, gonorrhea.
Amaranthus tricolor L. (Laal shak) English name: Elephant-head amaranth	Amaranthaceae	Whole plant	Cuts and wounds, skin diseases, debility, anemia, dysentery.
Amaranthus viridis L. (Khuria shak) English name: Slender amaranth	Amaranthaceae	Leaves, young stems	Loss of appetite, fistula, piles, sprain, colic, constipation, acidity, malnutrition in newly delivered mother.
Colocasia esculenta (L.) Schott. (Jongli kochu)English name: Green taro	Araceae	Leaves, stems, swollen roots	Indigestion, cancer, baldness, piles, tuberculosis, edema, stomach ache, infertility, cuts and wounds, indigestion, rheumatic pain, debility, severe jaundice, constipation, paralysis.
Eclipta prostrata L. (Kalo keshari shak) English name: False daisy	Asteraceae	Leaves	Jaundice, constipation, tumor, alopecia, diarrhea, dysentery, colic, malaria, poisonous animal or insect bites, vomiting, burning sensations in hands or feet, indigestion, fever, puerperal fever, diabetes, eye diseases, passing of blood with urine, eczema, stomach ache.
Basella alba L. (Puin shak) English name: Indian spinach	Basellaceae	Leaves, young stems	Syphilis, intestinal disorders, tumor, acne, leucorrhea, bloating, sore throat, hepatic disorders, anemia, burns, skin diseases, coughs, colds, to increase weight.
Raphanus sativus L. (Mula shak) English name: Leafy daikon	Brassicaceae	Young plants, radish	Indigestion, hepatic disorders, insomnia, gastritis, blood dysentery, sexual disorders, kidney disorders, indigestion, acidity, edema.
Chenopodium album L. (Bothua shak) English name: Common lamb's-quarters	Chenopodiaceae	Leaves, young stems	Liver diseases, pain, helminthiasis, energy deficiency, lack of vitamins.
Ipomoea aquatica Forssk. (Kolmi shak) English name: Swamp morning glory	Convolvulaceae	Leaves	Chicken pox, rheumatic swelling, diabetes, snake bite, skin disorders, to increase lactation in nursing mothers, leucorrhea, burning sensations in the body.
Ipomoea batatas (L.) Lam. (Mishti alu) English name: Sweet potato	Convolvulaceae	Swollen roots	Spleen enlargement, bloating, burns, anorexia, energy deficiency, loss of virility, diarrhea, inflammation, snake bite, hepatitis.
Brassica campestris L. (Shorisha shak) English name: Field mustard	Cruciferae	Young plants	Rheumatoid arthritis, joint pain, coughs, bronchitis, syphilis, leprosy.
Cucurbita maxima Duch. (Mishti kumra) English name: Melon pumpkin	Cucurbitaceae	Young leaves, stems, fruits	Cancer, nervous disorders, helminthiasis, hot sensations in body, inflammation, gastrointestinal problems, joint pain, cold, constipation, piles.
Dioscorea bulbifera L. (Gach alu) English name: Air yam	Dioscoreaceae	Fruits	Goiter, cancer, syphilis, antidote to poisoning, cuts and wounds, piles, skin diseases, inflammation, tumor, diarrhea, sexual weakness, hydrocele, hernia, inflammation, indigestion, malnutrition, sexually transmitted diseases, loss of strength.
Diplazium esculentum (Retz.) Sw. (Dheki shak)English name: Vegetable fern	Dryopteridaceae	Whole plant	Diabetes, skin disorders, dysentery.
Cajanus cajan (L.) Millsp. (Arhor kalai) English name: Pigeon pea	Fabaceae	Seeds	Jaundice, bronchitis, itches, edema, tumor, coughs, snake bite, diabetes, stimulant, stomatitis, coughs, piles.
Lathyrus sativus L. (Khesari dal) English name: White pea	Fabaceae	Seeds, young leaves	Antidote to poisoning, cuts and wounds, dysentery, bloating, scabies, eczema, allergy.
Leucas aspera (Willd.) Spreng. (Kansisha, Dome kolosh) English name: White dead nettle	Lamiaceae	Leaves, young stems	Antidote to poisoning, febricity, hypertension, diarrhea, dysentery, edema, snake bite, fever, eczema, energy stimulant, loss of strength, bone fracture, whitish discharge in urine (men), gout, jaundice, hepatitis B, impotency, colic, coughs, mucus, stomach ache, bloating, peptic ulcer, dysentery, cuts and wounds (to stop bleeding), skin disorders, joint pain, headache, throat pain, lesions within the nose, nose-bleed, bacterial infections, tooth infections, sudden feeling of warmth in head, goiter in women, respiratory difficulties, loss of appetite, blood purifier, indigestion.
Malva verticillata L. (Napa shak) English name: Cluster mallow	Malvaceae	Whole plant	-
Moringa oleifera Lam. (Shojina shak) English name: Horseradish tree, Drumstick tree	Moringaceae	Leaves, fruits	Colds, boils, fever, joint pain, gout, hypertension, constipation, epilepsy, skin eruptions, leucoderma, fever, helminthiasis, body ache, tonic, chicken pox, stomach ache, stomach ache due to vomiting, vomiting, diarrhea, dysentery, sterility, cancer, myopathic spasm, night blindness, inflammation, hernia, cardiovascular disorders, mental disorders, paralysis, tetanus, pain, diabetes, leprosy, conjunctivitis, acidity, rheumatic fever, decreased bile secretion, appetite stimulant, formation of blood clots on skin, frequent urination.
Musa paradisiacal L. (Aanti kola) English: Plantain	Musaceae	Inner portion of trunk, flower cluster	Chronic dysentery, stomach pain, diarrhea, diabetes.
Echinochloa colona (L.) link (Boro dubla, Moina ghas) English name: Jungle rice	Poaceae	Seed	-
Hordeum vulgare L. (Para) English name: Barley	Poaceae	Seeds	-
Paniculum miliaceum L. (Cheena) English name: Broomcorn millet	Poaceae	Seeds	-
Setaria italica (L.) P. Beauv. (Kaun) English name: Foxtail millet	Poaceae	Seeds	-
Corchorus capsularis L. (Tita pat) English name: White jute	Tiliaceae	Young plants	Indigestion, edema, diarrhea, itches, stomach ache.

Micronutrient deficiencies and anemia are already major health concerns in Bangladesh (Jamil *et al*., 2008). Childhood anemia and vitamin A deficiency has also been reported for rural Bangladesh; in one study 56% of the children were found to be underweight, and 17% were severely underweight; 18% were wasted, and 1% were severely wasted; 45% were stunted and 20% were severely stunted (Faruque *et al*., 2006). Anemia and inadequate vitamin A status have even been reported for adolescent schoolboys in the capital city Dhaka of Bangladesh (Ahmed *et al*., 2006). Quite obviously, these deficiencies and consequent rise of diseases would be greater when the population is suffering from chronic or acute food shortages, as happens during times of food scarcity.

It is interesting to note that 14 out of the 25 non-conventional plants consumed during times of food scarcity in the two surveyed villages have folk medicinal usages in Bangladesh for treatment of gastrointestinal disorders, among which the most prevalent being diarrhea and dysentery. These 14 plants are *Amaranthus spinosus*, *Amaranthus tricolor*, *Amaranthus viridis*, *Colocasia esculenta*, *Eclipta prostrata*, *Basella alba*, *Ipomoea batatas*, *Cucurbita maxima*, *Dioscorea bulbifera*, *Diplazium esculentum*, *Lathyrus sativus*, *Leucas aspera*, *Moringa oleifera*, and *Corchorus capsularis*. Gastrointestinal disorders are widely prevalent in rural

Bangladesh because of the general lack of proper sanitary conditions and the poor quality of drinking water. This type of disorders would affect any malnourished population from the first instance of malnourishment and is expected to rise during times of food scarcity or famines. That the majority of non-conventional plants consumed during times of food scarcity are against gastrointestinal disorders strongly suggest that our hypothesis is correct, that is non-conventional plants consumed during times of food scarcity or famines, whenever they may have been selected through a possible process of trial and error, have been selected both on the basis of their nutritional status as well as their ability to treat or prevent malnourishment-induced diseases.

The other plants consumed during times of food scarcity or Monga in the two villages surveyed also support our hypothesis. *Amaranthus viridis* and *Dioscorea bulbifera* are prescribed by the Kavirajes for direct treatment of malnutrition. *Amaranthus spinosus*, *Amaranthus tricolor*, and *Colocasia esculenta* are prescribed by the Kavirajes for treatment of physical weakness or debility, which are direct consequences of lack of intake of adequate nutrition (food). *Amaranthus tricolor* and *Basella alba* are folk medicinal treatments for anemia. *Basella alba* is also prescribed by the Kavirajes to increase weight in underweight children or adults. *Chenopodium album*, *Ipomoea batatas*, *Cajanus cajan*, and *Leucas aspera*, among other uses, are used by the Kavirajes for treatment of energy deficiency, which can also be a consequence of inadequate nutritional uptake. *Chenopodium album* is further given by the Kavirajes to treat deficiency of vitamins. *Ipomoea aquatica* is given by the Kavirajes to increase lactation in nursing mothers. Such lactation would be severely impaired if the mother herself suffers from lack of nutrition.

Taken together, 80% of the edible plants (non-conventional) consumed during times of food scarcity had folk medicinal uses. This would lead strong credence to our hypothesis about the selection of plants being made both on their nutritional status as well as medicinal values. This phenomenon has been observed before. It has been reported that the Australian Aboriginal hunter-gatherers 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 pre-disposition 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 (Brand-Miller and Holt, 1998). As such, the plants consumed during times of food scarcity or famines hold enormous potential for further research as to their nutritional contents (which may prove to be better than conventional food items), as well as for their medicinal properties. Moreover, quite a number of these types of plants grow in the wild under adverse weather and soil conditions, which could make them desirable items to cultivate in various regions of the world lacking climatic and soil conditions for cultivation of the major cereal crops. A combination of these three factors, namely nutritional properties, medicinal values, and ability to grow under adverse conditions can in a combined manner make the plants obtained in the present survey to be widely cultivated in many regions of the world and so avert both famine as well as famine-induced diseases.

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