A Review of Scientific Literature on Anti-diabetic Activity in Medicinal Plants Used by Folk Medicinal Practitioners of Two Villages in Narail and Chuadanga Districts, Bangladesh for Treatment of Diabetes


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ABSTRACT

An ethnomedicinal survey conducted amongst folk medicinal practitioners (Kavirajes) of two villages in Narail and Chuadanga districts of Bangladesh revealed the use of twenty four medicinal plant species for treatment of diabetes or alleviating diabetic symptoms in human patients. Perusal of the available scientific literature on the anti-diabetic plant species showed that out of the twenty four medicinal plants used, fifteen plant species have been reported in the scientific literature to possess considerable anti-diabetic properties directly in the form of ability to reduce blood sugar following administration, or possess properties, which can alleviate diabetic symptoms or reduce the risk factors for diabetes, including anti-oxidant and hypolipidemic properties. Overall, it can be concluded that the considerable expertise gained by the Kavirajes through long-term practice as well as passage of accumulated knowledge from generation to generation has practical validity and is not based on superstitions or myths about these plants. The close coincidences between the use of medicinal plants by the Kavirajes and their real time scientific validity studies suggest that these plants (some of which are yet to be scientifically studied) have considerable potential for discovery of novel anti-diabetic agents. Diabetes is a debilitating disease affecting millions of people worldwide including Bangladesh, and for which allopathic medicine has no known cure. As such, efforts should be made to collect information from other Kavirajes in other villages and towns of Bangladesh on anti-diabetic plants and formulations for their uses.

Key words: Medicinal plants, folk medicine, diabetes, anti-diabetic activity, Bangladesh

Introduction

Folk medicinal practitioners are an established part of the traditional medicinal system in Bangladesh. These practitioners, usually known by the name Kaviraj, usually do not go for complicated medicinal formulations as is present in other traditional forms of medicine in Bangladesh, like the Ayurvedic or Unani system of medicine. Kavirajes, for most practical purposes, rely on simple concoctions of a single medicinal plant, and rarely uses combination of plants for treatment of any specific ailment. Even the simple concoctions, in the majority of cases, consist of extract of juice from macerated plant part(s) followed by oral or topical administration, depending upon the disease. It is really surprising to notice that although the Kavirajes do not use, or are even aware of modern diagnostic procedures, they treat complicated diseases like diabetes,
rheumatoid arthritis, or even cancer, which they diagnose only through a thorough physical examination of the patient, measuring the pulse, and noticing the frequency, quantity and color of excretory products like stool, urine, and sometimes sweat.

Because of the advances in global civilization, the knowledge of the Kavirajes, and indeed Kaviarjes as a profession is on the decline in Bangladesh, because the young generation is seeking better and less rigorous ways of income. On the other hand, Kavirajes have been practicing for centuries, and since their knowledge is passed on from generation to generation, over the years they have attained considerable knowledge on medicinal plants and their uses. From the fact that their profession and knowledge is based at least to a certain extent on the satisfaction of the patients, it can be inferred that the medicinal plant knowledge of the Kavirajes have a certain degree of efficacy for the diseases that they treat, for their patients visit them year after year. For this reason, we have been conducting ethnomedicinal surveys among the Kavirajes of various villages in various regions of Bangladesh for the last few years. Besides Kavirajes (who belong to the mainstream population), we had been also conducting ethnomedicinal surveys among the tribal medicinal practitioners, who also use medicinal plants in their treatments, and can be considered as Kaviarjes, even though each tribe may have their own names in their own languages for such practitioners. Several accounts of these surveys among the Kavirajes and tribal medicinal practitioners have been reported (Hossan et al., 2010; Mollik et al., 2010; Nawaz et al., 2009; Rahmatullah et al., 2009a-c; Rahmatullah et al., 2010a-d).

Diabetes is a debilitating disease suffered by millions of people throughout the world and for which modern allopathic medicine has no known cure. Although the primary symptoms of diabetes are high levels of blood sugar and passage of sugar through urine, the disease progressively can lead to diabetic retinopathy, nephropathy, and neuropathy, besides increasing the risks for hypertension, cardiovascular disorders, and other diseases. In modern times, incidences of this disease is on the rise globally because of a more sugar-rich and fat-rich diet, as well as adoption of a more sedentary lifestyle, particularly in the cities. The prevalence of type 2 diabetes was found to be 8.5% in a randomly selected subject group of 975 people of both sexes in an urbanizing rural community of Bangladesh (Rahman et al., 2007). A substantial number of the rural population of Bangladesh rely on Kavirajes for treatment of diabetes, either because of inaccessibility to modern clinics and doctors or non-affordability in the purchase of high-priced allopathic anti-diabetic drugs. Since patient satisfaction in the treatment of diabetes is often reported for treatment by the Kavirajes, the objective of the present study was to conduct an ethnomedicinal survey among the Kavirajes of two adjoining villages of Narail and Chuadanga districts in Bangladesh to document their use of anti-diabetic medicinal plants, and (b) to review the potency of the medicinal plants used by the Kavirajes against reported anti-diabetic activities on these plants in the scientific literature. The first objective has been reported in an accompanying paper, while this paper will deal on a review of the scientific literature on the anti-diabetic medicinal plants used by the Kavirajes and determine the validation of these plants’ folk medicinal use.

Materials and Methods

The collection of data through interviews of Kavirajes was conducted with the help of a semi-structured questionnaire and the guided field-walk method of Martin (1995) and Maundu (1995). Briefly, in this method, the Kavirajes took the interviewers on field-walks to areas from where they usually collected their medicinal plants, pointed out the plants and described their uses. Plant specimens were collected and dried on the spot. Plant identifications were done by Mr. Manjur-ul-Kadir Mia, ex-Curator and Principal Scientific Officer of the Bangladesh National Herbarium.

A search of the relevant scientific literature was made through perusal of scientific journals and conducting searches through various scientific databases. All plants were screened for reported pharmacological activities, which could prove relevant to their folk medicinal use by the Kavirajes.

Results and Discussion

A total of 24 medicinal plant species distributed into 20 families were observed to be used by the Kavirajes of the area surveyed for treatment of diabetes. It was observed that the plant parts used for treatment included leaves, stems, barks, fruits, seeds, and tubers as well as whole plants. Particularly interesting was the use of cluster of flowers as well as the inner portion of trunk of Musa sapientum. Notably, both plant parts were advised by the Kavirajes to be taken in the cooked form. The information is shown in Table 1.

A perusal of the reported anti-diabetic and relevant activities of the anti-diabetic plants used by the Kavirajes showed that 15 out of the 24 plants used had reported anti-diabetic activities. The results are shown in Table 2. Besides anti-diabetic activity, which was directly related to lowering of blood sugar, the plants
Momordica charantia L. Observed anti-hyperglycemic and anti-oxidative effect of aqueous extract of fruit pulp in Terminalia chebula and Terminalia belerica. Anti-diabetic and anti-oxidant activity reported for the plant (Sabu and Kuttan, 2009); positive Cuminum cyminum L. Anti-hyperglycemic activity and inhibition of advanced glycation end product formation reported in Terminalia chebula. 

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<tr>
<th>Serial Number</th>
<th>Scientific Name</th>
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<td>1</td>
<td>Terminalia chebula Retz.</td>
<td>Bohera Fruit</td>
<td>Tree inner portion of trunk (locally known as thore)</td>
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<td>2</td>
<td>Terminalia belerica</td>
<td>Aam Bark</td>
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<td>3</td>
<td>Cuminum cyminum L.</td>
<td>Jeera Seed</td>
<td>Tree inner portion of trunk (locally known as thore)</td>
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<td>4</td>
<td>Mikania cordata (Burm.f.) B. L. Robinson</td>
<td>Aam Bark</td>
<td>Tree inner portion of trunk (locally known as thore)</td>
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<td>5</td>
<td>Emblica officinalis Gaertn.</td>
<td>Amlolki Fruit</td>
<td>Tree inner portion of trunk (locally known as thore)</td>
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<td>6</td>
<td>Terminalia chebula Retz.</td>
<td>Bohera Fruit</td>
<td>Tree inner portion of trunk (locally known as thore)</td>
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<td>7</td>
<td>Coccinia grandis (L.) J. Voigt</td>
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<td>Tree inner portion of trunk (locally known as thore)</td>
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<td>Monordica charantia L.</td>
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<td>10</td>
<td>Tamarindus indica L.</td>
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<td>11</td>
<td>Flacourtia indica (Burm.f.) Merr.</td>
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<td>12</td>
<td>Swertia chirata (Roxb. ex Fleming) H. Karst.</td>
<td>Chiroti Whole plant</td>
<td>Whole plant</td>
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<td>13</td>
<td>Azadirachta indica A. Juss.</td>
<td>Neem Bark</td>
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<td>14</td>
<td>Tinospora cordifolia (Willd.) Hook.f. &amp; Thoms.</td>
<td>Guloncho Top portion of stem</td>
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<td>15</td>
<td>Ficus hispida L.f.</td>
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<td>16</td>
<td>Musa sapientum L.</td>
<td>Kola Cluster of flowers</td>
<td>Flower</td>
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<td>17</td>
<td>Psidium guajava L.</td>
<td>Myrtaeace Myrtaea</td>
<td>Bark</td>
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<td>18</td>
<td>Syzygium cumini (L.) Skeels</td>
<td>Myrtaeace Jaam</td>
<td>Bark, seed</td>
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<td>19</td>
<td>Piper cubeba L.f.</td>
<td>Piperaceae Kabab chinu</td>
<td>Fruit</td>
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<td>20</td>
<td>Piper longum L.</td>
<td>Piperaceae Pipul</td>
<td>Fruit</td>
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<tr>
<td>21</td>
<td>Aegle marmelos (L.) Corr.</td>
<td>Rutaceae Bel</td>
<td>Fruit</td>
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<tr>
<td>22</td>
<td>Solanum torvum Swartz</td>
<td>Solanaceae Tt baegun</td>
<td>Fruit</td>
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<tr>
<td>23</td>
<td>Centella asiatica (L.) Urb.</td>
<td>Umbelliferae Thanakuni</td>
<td>Leaf</td>
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<tr>
<td>24</td>
<td>Amomum aromaticum Roxb.</td>
<td>Zingiberaceae Elach</td>
<td>Fruit</td>
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Table 2: Continue

effect demonstrated on pancreatic islets of alloxan diabetic albino rats by alcoholic extract of whole fruit powder (Singh et al., 2008); reported decrease in insulin resistance and visceral obesity in mice on high fat diet by plant extract (Shih et al., 2008); reported anti-diabetic activities of triterpenoids isolated from fruits mediated through activation of AMPK pathway (Tan et al., 2008); regeneration of b-cells in islets of Langerhans of diabetic rats by acetone extract of fruits (Singh and Gupta, 2007a); suppression of postprandial hyperglycemia in rats by extract of plant parts (Uebanso et al., 2007); reported improvement by fruit extract of insulin sensitivity by increasing skeletal muscle insulin-stimulated IRS-1 tyrosine phosphorylation in high-fat-fed rats (Sridhar et al., 2008); anti-diabetic and anti-lipidemic properties reported of standardized fruit extract (Fernandes et al., 2007); reported reparative effects by plant part extract on HIT-T15 pancreatic b-cells (Xiang et al., 2007); increased glucose uptake and adiponectin (a protein hormone exclusively secreted from adipocytes into bloodstream that modulates a number of metabolic processes, including glucose regulation and fatty acid catabolism) secretion in 3T3-L1 adipose cells by aqueous extract (Roffley et al., 2007); inhibition of increases in blood glucose and serum neutral fat by saponin fraction obtained from the plant (Oishi et al., 2007); hypoglycemic and hypotensive effects reported for whole plant aqueous extract in rats (Ojewole et al., 2006); anti-diabetic activity reported for major constituents isolated from the plant (Harinantenaina et al., 2006); extraction of a slow acting protein from fruit pulp with insulin secretagogue and insulinomimetic activities (Yibchoh-anun et al., 2006); restoration of impaired estrous cycle in alloxan-induced diabetic rats by fruit juice (Reyes et al., 2006); reduced adiposity, increased serum adiponectin concentration and increased lipid oxidative enzyme activities in diet-induced obese rats fed freeze-dried fruit juice, which can be beneficial for obese persons for obesity is a leading factor for diabetes (Chan et al., 2005); reported hypoglycemic effects of crude polysaccharides from the plant in mice (Zheng et al., 2005); significant hypoglycemic activity observed in STZ-induced diabetic mice following administration of Dianex, a polyherbal formulation containing aqueous extract of the plant (Mutalik et al., 2005); anti-oxidant properties reported for seeds in STZ-induced diabetic rats (Satishekar and Subramanian, 2005); anti-diabetic activity reported for seeds in STZ-induced diabetic rats (Sekar et al., 2005); preventive effects in alterations in lipid profile and lipogenic enzymes in alloxan diabetic rats with a combination of sodium orthovanadate and fruit extract (Yadav et al., 2005); significant decrease in triglyceride, low density lipoprotein and a significant increase in high density lipoprotein level and oral glucose tolerance shown with methanol extract of fruit in diabetic rats (Chaturvedi et al., 2004); synergistic effect reported for fruit extract with both metformin and glibenclamide in patients with non-insulin dependent diabetes mellitus (NIDDM) (Tongia et al., 2004); stimulation of glucose and amino acid uptakes in L6 myotubes by fruit juice (Cummings et al., 2004); partial reversal or normalization of various parameters in STZ-induced diabetic rats by plant juice, including reductions in Na+ and K+-dependent absorptions of glucose by the brush border membrane vesicles of the jejunum, normalization of diabetes-induced reduction in the mean cross-sectional myelinated nerve fibers, axonal area, myelin area and maximal fiber area (Ahmed et al., 2004); suppression of a lowering of energy turnover inherent with aging in diabetic rats by malt vinegar of fruit (Ichikawa et al., 2003); suppressive activity reported for fruits along with exercise on blood glucose levels in type 2 diabetic mice (Miura et al., 2004); reported inhibitory action on monosaccharide uptake in rat everted gut sacs in vitro by aqueous extract of plant (Mahommoodally et al., 2004); anti-hyperglycemic effects reported for extracts of fresh and dried fruits in diabetic rats (Virdi et al., 2003); reduction of adiposity, lowering of serum insulin and normalization of glucose tolerance in rats fed a high fat diet by freeze-dried juice of fruits (Chen et al., 2003); reported prevention of experimental diabetic cataract by extract of the plant (Rathi et al., 2002); reported hypoglycemic activity of fruit in type 2 diabetic mice (Miura et al., 2001); partial but significant attenuation of renal hypertrophy in STZ-diabetic mice by extract of the plant (Grover et al., 2001); partial substantial prevention by plant extract of hyperglycemia and hyperinsulinemia in high fructose diet fed rats (Vikrant et al., 2001); hypoglycemic and hypcholesterolemic effect of fruit extract in STZ-induced diabetic rats (Ahmed et al., 2001); aqueous extract of fruit reportedly caused reduction in STZ-induced hyperglycemia in mice, as well as STZ-induced lipid peroxidation in pancreas of mice, RIN cells and islets, and STZ-induced apoptosis in RIN cells (Sitasawad et al., 2000); anti-atherogenic and hypoglycemic activity observed with freeze-dried fruit powder in rats fed with cholesterol-free and cholesterol-enriched diets (Jayasooria et al., 2000); modulation of xenobiotic metabolism and oxidative stress in STZ-diabetic rats fed with fruit extract suggesting that the extract may play a therapeutic role in management of Type 1 diabetic patients (Raza et al., 2000); hypoglycemic action reported for alcohol extract of fruit pulp in STZ-diabetic rats (Sarkar et al., 1996); hypoglycemic effect of aqueous extract of fruits reported in normoglycemic and cyproheptadine-induced hyperglycemic mice (Cakici et al., 1994); hypoglycemic effects reported for fruit pulp, seed, and whole plant in normal and diabetic model rats (Ali et al., 1993); delayed cataract formation in diabetic Charles Foster rats reported with fruit extract (Srivastava et al., 1988); extra pancreatic effect in the form of increased glucose uptake by tissues without concomitant increase in tissue respiration and increased glycogen content of liver and muscle observed with oral administration of fruit juice in rats (Welihinda and Karunanyake, 1986); reported isolation of a galactose binding lectin with insulinomimetic activities from seeds (Ng et al., 1986); insulin releasing activity reported for the plant (Welihinda et al., 1982).

Emblica offinialis Gaertn. In vitro antioxidant and inhibitory potential of fruits reported against LDL oxidation and key enzymes linked to type 2 diabetes (Nampoothiri et al., 2011); anti-hyperglycemic, anti-hyperlipidemic and anti-LDL effects reported for a polyherbal formulation – Dihar, containing among other plant components, extract of Emblica oficinalis plant part (Patel et al., 2009); delay of STZ-induced diabetic cataract in rats by extract of plant part and enriched tannoids (Suryanarayana et al., 2007); anti-diabetic and anti-oxidant properties reported for the plant (Sabu and Kuttan, 2002).
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**Tamarindus indica** L.   
Aqueous extract of seeds reportedly partially restored pancreatic β cells and repaired STZ-induced damages in rats (Hamidreza et al., 2010); protection of testicular dysfunctions in STZ-induced diabetic rats by MTEC – a formulated drug containing aqueous-methanol extract of the plant (Mallick et al., 2007); attenuation of hyperglycemia and hyperlipidemia in STZ-induced diabetic rats by aqueous extract of seed (Maiti et al., 2005); anti-diabetic effect reported for aqueous extract of seeds in STZ-diabetic rats (Maiti et al., 2004).

**Swertia chirata** (Roxb. ex Fleming) H. Karst.   
Used as an anti-diabetic plant in Ayurvedic system of traditional medicine in India and Bangladesh; bioactive constituents reportedly include the xanthone and secoiridoid glycosides consisting of mangiferin, amarogentin, amaroswerin, sweroside and swertiamarin (Suryawanshi et al., 2006); significant blood glucose lowering in alloxan-diabetic rats seen with vacuum dried 95% ethanolic extract of plant (Kar et al., 2003).

**Azadirachta indica** A. Juss.   
Anti-hyperglycemic, anti-hyperlipidemic and anti-oxidant effects reported for a polyherbal formulation – Dihar, containing among other plant components, extract of Azadirachta indica plant part (Patel et al., 2009); chloroform extract of the plant exhibited in murine diabetes model good oral tolerance activity, inhibited intestinal glycosidase activity, increased showed increases in glucose-6-phosphate dehydrogenase activity and hepatic, skeletal muscle glycogen content after 21 days of treatment, and at the same time demonstrated a regeneration of insulin-producing cells and corresponding increase in the plasma insulin and c-peptide levels suggesting that the plant can be a good anti-diabetic agent (Bhat et al., 2009); the plant has been described as a good source of amylase inhibitors (Bhat et al., 2008); hypoglycemic effect observed with seeds in type 2 (NIDDM) diabetes mellitus (Waheed et al., 2006); Danex, a polyherbal formulation containing aqueous extract of the plant along with other components has been reported to have hypoglycemic effects in STZ-diabetic mice; additionally, the elevated levels of triglyceride, cholesterol, ALT, AST, urea and creatinine in diabetic mice were significantly reduced following administration of Danex (Matalik et al., 2005); reported protective role of extract of seeds in STZ-diabetic rats (Gupta et al., 2004); significant blood glucose lowering in alloxan-diabetic rats seen with vacuum dried 95% ethanolic extract of plant (Kar et al., 2003); reported hypoglycemic activity of plant in both normal and alloxan diabetic rabbits (Khosla et al., 2000).

**Tinospora cordifolia** (Wild.) Hook. f. & Thoms.   
Beneficial effects reported for the plant against high fructose diet induced in carbohydrate and lipid metabolism abnormalities (hyperglycemia, hyperinsulinemia, hypertriglyceridaemia, insulin resistance, and elevated levels of hepatic total lipids, cholesterol, triglycerides, and free fatty acids) in Wistar rats (Reddy et al., 2009); Anti-hyperglycemic, anti-hyperlipidemic and anti-oxidant effects reported for a polyherbal formulation – Dihar, containing among other plant components, extract of Tinospora cordifolia (Patel et al., 2009); reported hypoglycemic activity of an anti-oxidant compound saponarin, characterized as a-glucosidase inhibitor present in the plant (Sengupta et al., 2009); anti-hyperglycemic effect reported for Ilogen-Excel, an Ayurvedic polyherbal formulation containing the plant among other constituents; the preparation when administered to STZ-diabetic rats caused reduction in blood glucose, glycosylated hemoglobin, plasma thiobarbituric acid reactive substances and hydroperoxides and caused increased levels in plasma insulin, hepatic glycogen nd total hemoglobin (Umamaheswari and Mainzen Prince, 2007); reported restoration of antioxidants in alloxan-induced diabetic Wistar rats by ethanolic extract of the plant, which can be beneficial during diabetes (Prince et al., 2004); hypoglycemic and hypolipidemic action reported for alcohol extract of roots in diabetic rats (Stanely Mainzen Prince and Menon, 2003).

**Musa sapientum** L.   
Anti-oxidant and anti-hyperglycemic actions reported for methanol and aqueous extracts of roots in alloxan-induced diabetic Wistar rats (Adedoye et al., 2009); hypoglycemic and anti-oxidant effect of ethanol extract of flowers found in alloxan diabetic rats (Dhanabal et al., 2005); administration of chloroform extract of flowers reportedly led to lowering of blood sugar and glycosylated hemoglobin and an increase in total hemoglobin, as well as demonstrated anti-oxidant effect in alloxan diabetic rats (Pari and Maheshwari, 1999); anti-hyperglycemic effect observed following administration of plant (Alarcon-Aguilar et al., 1998).

**Psidium guajava** L.   
Anti-oxidant and anti-glycative effects described for ethyl acetate fraction of leaf in STZ-diabetic rats (Soman et al., 2010); anti-hyperglycemic, hypolipidemic and hepatoprotective effects reported for raw fruit peel in experimental diabetes (Rai et al., 2010; Rai et al., 2009); reported potential of fruits in preventing diabetes in quid-chewing population of Papua New Guinea (Owen et al., 2008); anti-hyperglycemic effects observed with aqueous and ethanol extract of leaves in STZ-diabetic Sprague-Dawley rats (Shen et al., 2008); anti-diabetic activity reported for ethanol extract of stem bark (Mukhtar et al., 2006); hypoglycemic activity reported for leaf extracts (Wang et al., 2005); anti-diabetic effect of leaf extract in type 2 diabetic mice model (Oh et al., 2005).

**Syzygium cumini** (L) Skeels   
Anti-hyperglycemic, anti-hyperlipidemic and anti-oxidant effects reported for a polyherbal formulation, with vacuum-drying extract of the plant in streptozotocin diabetic rats (Patel et al., 2009); reported inhibition of adenosine deaminase activity and reduction of glucose levels in hyperglycemic patiencys by aqueous extract of leaves (Bopp et al., 2009); anti-oxidant activity reported for leaf extracts (Ruan et al., 2008); therapeutic effect reported for fenuric acid isolated from an ethereal fraction of ethanolic extract of seeds against streptozotocin diabetic male rats (Mandal et al., 2008); α-glucosidase inhibitory activity reported for seed kernal in vitro and in Goto-Kakizaki rats (Shinde et al., 2008); reported decrease of blood sugar on administration of ethanolic extract of seeds in alloxan diabetic albino rats (Singh and Gupta, 2007b); anti-hyperglycemic effect reported for dried bark when administered to mice (Villaseñor and Lamadrid, 2006); high phenolic content and anti-oxidant activity observed in seeds (Bajpai et al., 2005); hypoglycemic effects observed with defatted seeds and water soluble fiber from seeds in alloxan diabetic rats (Pandey and Khan, 2002); reduction of tissue damage in diabetic rat brain reported for aqueous and alcoholic extract of seeds (Stanely Mainzen Prince et al., 2003).
contains other activities related to amelioration of diabetes-induced symptoms as well as lowering risk factors for diabetes to occur. For instance, mangiferin, a reported constituent of the plant *Mangifera indica*, prevented nephropathy progression in streptozotocin-induced diabetic rats (*Li et al.*, 2010). This is an important effect for diabetes is considered a debilitating disease precisely for its ability to damage and reduce functions of major body organs like heart, kidneys, eyes, and the brain. The stem bark of the plant has reported hypoglycemic effect; notably the bark was used by the Kavirajes of the survey area for treatment of diabetes. Peel extracts of the fruit reportedly also caused amelioration of atherogenic diet induced dyslipidemia, hypothyroidism and hyperglycemia (*Parmar and Kar*, 2008). Fruit peels were not used by the Kavirajes, suggesting that the Kavirajes, at least of the area surveyed, were not aware of the anti-diabetic properties of fruit peels of the plant. The finding highlights the importance of more scientific studies on plants used by the Kavirajes, for like in this instance Kavirajes can benefit from scientific studies and start using plant parts, relevant properties of which they were not aware before.

By far the most scientifically studied plant was *Momordica charantia*. The fruits of this plant have a long history of use by both folk medicinal practitioners of Bangladesh as well as Ayurvedic medicinal practitioners for treatment of diabetes. Scientific studies have suggested that other plant parts of this plant, notably the seeds, also have anti-hyperglycemic effect. Moreover, the effects of various plant parts of this plant include anti-oxidative effect (*Tripathi and Chandra*, 2010), which is beneficiary for diabetic patients in reducing major organ damages. Healing of wounds is a major problem for diabetic patients; extract of fruits of this plant has been shown to promote wound healing in streptozotocin-induced diabetic rats (*Teoh et al.*, 2009). Saponins (*Han et al.*, 2008) and triterpenoid fractions (*Tan et al.*, 2008) have been isolated from the plant with reported anti-diabetic activity. Whole fruit powder reportedly showed beneficial effects on pancreatic islets of alloxan diabetic rats (*Singh et al.*, 2008), suggesting that the fruits may play a role in the generation of pancreatic islet cells, which can be damaged during diabetes leading to impaired secretion of insulin, and thus raising blood sugar levels. Fruits also showed beneficial effects in diabetic animals through prevention of diabetes-induced lipid profile and activities of lipogenic enzymes in alloxan diabetic rats (*Yadav et al.*, 2005). This finding shows that the fruits can reduce the risk factors for cardiovascular disorders resulting from diabetes. Seeds of the plant have also been shown to possess anti-diabetic activity (*Satishsekar and Subramanian*, 2005; *Sekar et al.*, 2005). The seeds were not used by the Kavirajes, but the scientific finding of seeds having anti-diabetic effects once again highlights that scientific research on the plants used by the Kavirajes and proper dissemination of this knowledge can prove useful in increasing the Kavirajes’ ability for treatment of diseases.

That 15 plants out of the 24 anti-diabetic plants used by the Kavirajes showed scientific relevancy in their use strongly suggests that the accumulated knowledge of the Kavirajes gained through centuries old practice by successive generations, can indeed be beneficial to science in the quest for more efficacious drugs. The
Kavirajes did not use any modern diagnostic procedures for recognizing diabetes. Yet the information shows that not only they could recognize diabetes through their own methods, but also used plants, whose relevancies of use are continually being demonstrated by scientific methods. It should also be pointed out that the other 9 plants, which have not been reported in the scientific literature for anti-diabetic activities, are yet to be studied for their relevant pharmacological effects. Also interesting is the fact that there is a close correlation between the plant parts used by the Kavirajes for diabetes treatment and the scientific findings of relevant anti-diabetic activities in the same plant parts. It is therefore quite possible that the plants used by the Kavirajes have strong potential for discovery of efficacious drugs, which not only merely alleviates diabetes-induced symptoms, but may also prove to be cure for the disease itself.

References


