PREVENTION AND MANAGEMENT OF DIABETES MELLITUS THROUGH CLASSICAL VEGETABLES OF AYURVEDA
A CRITICAL REVIEW

RAGHAVENDRA NAIK¹, SNEHA D BORKAR², R N ACHARYA³

Department of Dravyaguna,¹,² Institute for Post Graduate Teaching and Research in Ayurveda, Gujarat Ayurved University, Jamnagar, 361 008 Gujarat (India)
Department of Agada Tantra,² Mahatma Jyotiba Fule Ayurveda Mahavidyalaya, Chomu village, Dist: Jaipur, 303702 Rajasthan (India)

Abstract: Ayurvedic literature enlisted vegetables under the group “Shakavarga”, where the properties and indications of individual plant in different disease conditions, have been described. In clinical practice, these plants were also prescribed by traditional practitioners as Pathya (wholesome diet). Ayurveda promotes the use of Pathya in the prevention as well as management of many diseases including Prameha (Diabetes mellitus). In the present review, plants described in Shakavarga, indicated as Pathya in Prameha were compiled from 15 different Ayurvedic classical texts. The obtained data has been analysed and being presented in a precise manner with regards to their reported activity in diabetes. In the present study, it is observed that about 332 plants were described under Shakavarga, among which 29 Shaka (Vegetables) are indicated in Prameha. Out of these, botanical identity of 27 plants has been established. Maximum number of vegetables belongs to the family solanaceae and cucurbitaceae. Different parts i.e. leaves (15), fruits (9), Rhizome/tuber (4), shoot/stem (1) are used as vegetable in Prameha. Among the 29 classical vegetables indicated in Prameha, 18 have been reported for their efficacy in the management of diabetes mellitus on different animal experimental models. The present review reports the importance of use of classical vegetables as Pathya in diabetes. The observed result may be helpful in planning further scientific studies about the efficacy of these plants on prevention as well as management of diabetes.

Keywords: Classical vegetables, Diabetes mellitus, Pathya, Prameha, Shakavarga.

INTRODUCTION

In Ayurvedic clinical practice, Ahara (Diet) is considered as best preventive medicine and is considered one among the Traya- upastambha (Three basic pillars of life) i.e. Ahara (Diet), Nidra (Sleep) and Brahmacharya (Celibacy) (Charaka Samhita, Sutra Sthana 11/35).¹¹ Ayurveda promotes the use of Pathya (Wholesome diet) in the prevention as well as management of diseases. The significance of Pathya (Wholesome diet) has been quoted as “there is no need of any medicine, if an individual follows Pathya (Wholesome diet) and there is no use of medicine if a person does not follow Pathya (Wholesome diet) (Lolimbaraja, 1947).²² Understanding the importance of Ahara (Diet), both as a causative as well as curative agent in disease conditions, separate chapters have been allotted to the dietetic items in the classical texts under different group of food items such as Dhanyavarga (Group of grains), Mamsavarga (Group of flesh), Shakavarga (Group of vegetables) etc. (Charaka Samhita, Sutra Sthana 27/6).³³

The health benefit of vegetables under Shakavarga, has long been identified by the authors of various classical texts of Ayurveda and their properties, indications in different disease conditions including Prameha has been described. Prameha has been correlated with the signs and symptoms of diabetes (Minal P Mawale, Sanket V Pajai, 2014).⁴⁴

The prevalence of diabetes is predicted to double globally from 171 million in 2000 to 366 million in 2030 (Wild S et al, 2004).⁵⁵ India, the present capital of diabetic of the world, is heading towards a diabetic
explosion, with 70 million people to be affected by 2015 (http://timesofindia.indiatimes.com). [16] Diabetes can damage the heart, blood vessels, eyes, kidneys, and nerves. In a multinational study, it is concluded that 50% of people with diabetes die of cardiovascular disease (primarily heart disease and stroke) (Morrish NJ et al. 2001). [17] Although it is widely believed that diabetes mellitus is the result of a complex interplay between genetic and environmental factors, compelling evidence from epidemiologic studies indicates that the current worldwide diabetes epidemic is largely due to changes in diet and lifestyle (Schulze MB, Hu FB, 2005). [8] Modification of diet is one of the major cornerstones linked with reducing the risk of wide range of diseases like diabetes, cardiovascular diseases etc.

The latest scientific evidences also provides greater support for the role vegetables in protecting different diseases. Studies also show that greater intake of green leafy vegetables was associated with a 14% reduction in risk of type 2 diabetes (Patrice Carter et al. 2010). [9]

Since diet forms the mainstay in the management of diabetes mellitus, there is scope for exploiting the antidiabetic potency of vegetables especially to examine the long term beneficial effect of dietary vegetables, to identify the active principle, and to understand the mechanism of action, which is at present unclear. Hence the potentiality of vegetables described under Shakavarga in classical texts of Ayurveda needs to be compiled and presented in a single place to find out any possibilities of their dietetic importance.

MATERIALS AND METHODS


OBSERVATION AND RESULTS

A separate group in the name of Shakavarga has been allotted to the vegetables by all the Samhitas and majority of Nighantus. Different Shaka varga dravyas indicated in Prameha (Diabetes mellitus) according to their part used are classified in table 1. It is observed that, out of about 332 classical vegetables described under Shakavarga, 29 are indicated in Prameha. Different parts of the plants like leaves (15), fruits (9), Rhizome/tuber (4), shoot/stem (1) are used as vegetable in Prameha (Diabetes mellitus).

Classical vegetables, indicated in Prameha (Diabetes mellitus), and their equivalent botanical name, family and pharmacological properties are given in Table 2. Among 29 classical vegetables indicated for Prameha (Diabetes mellitus), botanical identity of 27 plants (Fig. 1-27) has been established (P V Sharma, 2009) [25, 26] and the botanical identity of two plants is yet to be confirmed. Majority of these vegetables belongs to the family solanaceae and cucurbitaceae.

Majority of the plants indicated in Prameha (Diabetes mellitus) are having Katu (Pungent), Tikta (Bitter) Rasa (Taste), Laghu (Light), Ruksha (Dry) guna (Property), and Usna virya (Hot in potency). In Prameha, there will be vitiation of Doshas and Dusshyas which are Kleda predominant. So, in its management such drugs are to be selected which are acting against Meda and Kleda.

Most of the plants described under hakavarga are collected from wild source and very few are cultivated today (Table 3). During the ancient period, man had to depend entirely on plant products which he could found in his natural surroundings. Because, plants were the common and important source of life, during that period, and there was no concept of cultivation. But, today a small plot near to the house has been used for growing a variety of vegetables according to the season. The plants like Brahmi, Brihatti, Chakramarda, Dronapushpi, Kakamachi, Kantakari, Kemuka, Kiratatitka, Loni, shittivaraka, Sunishannaka etc. can be cultivated in Kitchen garden to grow healthy, fresh vegetables.
Analysis of information regarding the anti-diabetic potential of vegetables from various research journals reveals that, among the 29 classical vegetables indicated in Prameha (Diabetes mellitus), 18 have been reported for their efficacy in the management of diabetes and related complications on different animal experimental models.

**Centella asiatica** (Linn.) Urban. (Mandukaparni)

The leaves of *Mandukaparni* have been reported as *Shaka* (Table-2). Traditionally, leaves and young stems are chopped into small pieces and used as vegetable (Packiaraj, P. et al. 2009). The ethanolic and methanolic extracts of the leaves of *C. asiatica* at a dose of 250 mg/kg has shown significant anti-diabetic activity (P.K. Chauhan et al. 2010). In another experimental study, *C. asiatica* powder in a dose of 50, 100 and 200 mg/kg significantly lowered the blood glucose levels. Maximum reduction in BG, TG, TC, HDL, LDL, SGOT and SGPT were observed at a dose level of 50 mg/kg (Sonia Rahman et al. 2011).

**Cassia tora** Linn. (Chakramarda)

The leaves of *Chakramarda* have been mentioned as *Shaka* in the classics (Table-2). Traditionally, leaves are used as vegetables (Dhore M.M et al. 2012). Methanolic extract of *C. tora* leaves at a dose of 50, 100 and 250 mg/kg, showed reduction in blood glucose, lipid levels in Alloxan-induced diabetogenic rats. In addition, Methanolic extract of *C. tora* decreased oxidative stress by improving endogenous antioxidant levels and which showed regenerative effects on β cells that produce more insulin (Penchala Narasimhulu et al. 2014).

**Leucas cephalotes** Spreng. (Dronapushpi)

The leaves of *Dronapushpi* have been mentioned as *Shaka* in the classics (Table-2). Traditionally, young leaves are also used as vegetable (Packiaraj, P. et al. 2009). Ethanolic extract of *L. cephalotes* leaves showed anti hyperlipidemic effect and anti-diabetic activity at doses of 150, 300 & 450mg/kg, where the extract at the dose of 450mg/kg was found to be more potent (K N Reddy et al. 2007).

**Tinospora cordifolia** (Wild.) Miers. (Guduchi)

The leaves of *Guduchi* have been mentioned as *Shaka* in the classics (Table-2). Traditionally, leaves of *Guduchi* are used as vegetable (K N Reddy et al. 2007). The aqueous, alcoholic, and chloroform extracts of the leaves of *T. cordifolia* at the dose of 50, 100, 150 and 200 mg/kg exerted a significant hypoglycemic effect in normal as well as in alloxan-treated rabbits (Wadood N et al. 1992). Ethanolic extracts of *T. cordifolia* leaves at the dose of 200 and 400 mg/kg showed significant antidiabetic activity in diabetic animals and has an efficacy of 50% to 70% compared to insulin (Chandra Shekhar Singh et al. 2013).

**Solanum nigrum** Schrad. (Kakamachi)

The leaves of *Kakamachi* have been mentioned as *Shaka* in classics (Table-2). Traditionally, leaves of this plant are used as vegetable (S. Muhammad, M. A. Shinkafi, 2014). The aqueous and hydro-alcoholic extracts of leaf, fruit and stem of *S. nigrum* plant, at the dose of 200 and 400mg/kg showed hypoglycemic activity in Sprague Dawley rats. Aqueous extracts of leaf and fruit possess significant hypoglycemic effect in dose dependent manner, followed by hydroalcoholic extracts (Rajani Chauhan et al. 2012).

**Solanum xanthocarpum** Schrad. & Wendl. (Kantakari)

The fruit of *Kantakari* has been mentioned as *Shaka* in the classics (Table-2). Aqueous extract of the fruits of *S. xanthocarpum* Schrad. & Wendl. was found to possess significant hypoglycemic activity. An in vitro study on glucose utilization by isolated rat hemi diaphragm suggests that, the aqueous extract may have direct insulin like activity which enhances the peripheral utilization of glucose and have extra pancreatic effect (Kar DM et al. 2006).

**Momordica charantia** Linn. (Karavellaka)

The fruit of *Karavellaka* has been mentioned as *Shaka* in the classics (Table-2). 70% v/v hydro-alcoholic extract of fruit of *M. charantia* at a dose of 300 mg/kg, significantly reduced fasting blood glucose and normalized the lipid profile, renal profile and hepatic profile in Alloxan induced diabetic rats. Histopathological changes of pancreas and liver were improved by the treatment that confirmed its protective
role in diabetes (Alimuddin Saifi et al. 2014). M. charantia fruit at doses of 150 mg/kg and 300 mg/kg administered for 30 days in alloxan induced diabetic rats showed significant antihyperglycemic activity by lowering blood glucose and GHb%, percent glycosylated hemoglobin (Nafisa PC Fernandes et al. 2007). Ethanol extract of M. charantia at a dose of 200 mg/kg suppressed gluconeogenesis in normal and streptozotocin (STZ) induced diabetic rats by depressing the hepatic gluconeogenic enzymes fructose-1, 6-bisphosphatase and glucose-6-phosphatase (Md. Alamgir et al. 2012). The water extract of the fruit of M. charantia L., 3 weeks after oral administration reduced the blood glucose and significantly lowered the serum insulin level in KK-Ay mice (Miura T et al. 2001).

Momordica dioica Roxb. (Karkotaki)

The fruit of Karkotaki has been mentioned as Shaka in the classics (Table-2). Traditionally, fruit is used as vegetable (Jadhav V.D et al. 2011). M. dioica extract at a dose of 300 mg/kg, markedly reduced the serum glucose, and increased serum insulin and urea levels in streptozotocin-diabetic rats. Histologic observation of kidney suggests its protective effect on kidney in severe diabetes (Rajnish Gupta et al. 2011). The ethyl acetate and alcohol extracts of M. dioica fruits in a dose of 200 mg/kg showed significant anti-diabetic activity in alloxan-induced diabetic rats (G. Thirupathi Reddy et al. 2006). Hexane extract and ethyl acetate soluble fraction of methanol extract of M. dioica fruit pulp at a dose of 400 mg/kg reduced elevated blood glucose levels, total cholesterol and triglyceride levels in diabetic rats (Kaliappan Ilango et al. 2009).

Costus speciosus (Koenig) Sm. (Kebuka)

The rhizome of Kebuka has been mentioned as Shaka in the classics (Table-2). Traditionally, rhizome is used as vegetable (K N Reddy et al. 2007). Ethanol extract of C. speciosus rhizome at a dose of 200mg/kg showed significant reduction in blood glucose, glycosylated hemoglobin, blood urea, serum uric acid, serum creatinine, triglycerides, total cholesterol, phospholipids, low density lipoprotein (LDL), very low density lipoprotein (VLDL), and increase in liver glycogen, insulin and lactate dehydrogenase(LDH) (J. Revathy et al. 2014). C. speciosus nanoparticles in the dose of 50, 100 and 150 mg/kg significantly decreased the blood glucose, serum total cholesterol, triglyceride, LDL cholesterol, alterations in the expression of insulin (I&II) and gluconeogenic genes, DNA fragmentation (Ebtihal F. Alamoudi et al. 2014).

Aqueous and methanol extracts of C. speciosus rhizomes reduced initial blood glucose level of 387 to 120 mg/dl and 303 to 161 mg/dl respectively at the end of 240 minutes (M. S. Rajesh, 2009). Costunolide from the hexane extract of C. speciosus root at the dose of 5, 10, 20 mg/kg significantly decreased glycosylated hemoglobin (HbA1c), serum total cholesterol, triglyceride, LDL cholesterol (James Eliza et al. 2009).

Swertia chirata (Buch-Ham) (Kiratatikta)

The leaves of Kiratatikta have been mentioned as Shaka in the classics (Table-2). Methanolic extract of S. chirata at a dose of 50mg/kg showed significant antidiabetic activity in comparison to control group but less marked antidiabetic activity when compared to the standard glibenclamide group (Kavitha KN, and Dattatri AN, 2015). The ethanolic extract of S. chirata, at the dose of 250mg/kg and 500mg/kg showed significant antidiabetic activity and beneficial effect on cholesterol and triglyceride level (Arya Renu et al. 2011). Ethanol extract of leaves and its pet-ether, dichloromethane and methanol fraction of S.chirata at a dose of 250 mg/kg showed significant hypoglycemic activity. About 32% and 47.2% reduction of blood glucose level was seen after 3 hours of test sample administration (Khondoker Dedarul Alam et al. 2011). The ethanol extract, hexane fraction and chloroform fraction of whole plant of S. chirata at doses of 150mg/kg and 250mg/kg showed significant antidiabetic potential in diabetic rats (R Arya et al. 2011).

Luffa acutangula (Linn.) Roxb. (Koshataki)

The fruits of Koshataki have been mentioned as Shaka in the classics (Table-2). Different extracts of L. acutangula at the dose of 100, 200 and 400 mg/kg, were studied in the management of diabetes and related complications in diabetic rats. The methanol extract at a dose of 100 mg/kg was found to be active, but the antidiabetic activity was increased significantly at a dose of 200 and 400 mg/kg as compared to the aqueous extract (B. P. Pimple et al. 2011).
**Ipomoea digitata** Linn. (Kshiravidari)

The tuber of *Kshiravidari* has been mentioned as *Shaka* in the classics (Table-2). Hydroalcoholic extract of *I. digitata* tuber in the dose of 100 and 200 mg/kg showed a significant reduction in the blood glucose level compared with the control. In the chronic study, all treatments showed a significant blood glucose reduction in diabetic rats (Pandey AK et al. 2013).[58] Alcohol and water extracts of *I. digitata* in the dose of 100 mg/kg, 200 mg/kg, and 400 mg/kg showed significant Anti-diabetic activity against alloxan induced diabetic rats. During LD50 studies up to the dose level of 2 g/kg, for both the extracts no mortality was observed in any animals (N. Minaz et al. 2010).[59]

**Allium sativum** Linn. (Lashuna)

The bulb of *Lashuna* has been mentioned as *Shaka* in the classics (Table-2). Daily treatment of STZ-induced diabetic rats with an extract of raw garlic (500mg/kg intraperitoneally) for seven weeks showed 57% less serum glucose, 40% lower serum cholesterol levels and 35% lower triglyceride compared to control diabetic rats (Martha Thomson et al. 2007).[60] Garlic extract at a dose of 0.1, 0.25 and 0.5 g/kg significantly decreased serum glucose, total cholesterol, triglycerides, urea, uric acid, creatinine, AST and ALT levels, while increased serum insulin in streptozotocin-induced diabetic (A. Eidi et al. 2006).[61]

An in vitro assessment of aqueous extracts of *A. sativum* Linn. roots at concentrations of 5, 10, 20 and 40g plant extract on glucose diffusion in intestine, glucose movement across the dialysis membrane was reduced up to 54% as compared to the control. Extracts having 10, 20, 40 g/L concentrations significantly prevented glucose transfer (Jawaria Younas, Fatma Hussain, 2014).[62] A. sativum aqueous extracts at the doses of 200, 250 and 300mg/kg produced a dose dependent significant reduction in the blood glucose levels, total serum lipid and total serum cholesterol when compared with that of the control rats (Ozoegwu, J. C, Eyo, J. E, 2010).[63] S-allyl cystein sulfoxide, the precursor of Allicin and garlic oil, is a sulfur containing amino acid, controlled lipid peroxidation better than glibenclamide and insulin. It also stimulated in vitro insulin secretion from beta cells isolated from normal rats (Eidi A et al. 2005).[64] Pre-administration of garlic extract seven days before and 14 days after the induction alloxan induction prevented the elevation of blood glucose in alloxan induced rats (Ojo R. J et al. 2012).[65] Ethanolic extract of *A. sativum* bulbs at a dose of 100, 250 and 500 mg/kg produced significant hypoglycemic effects in normal fasted animals after 7 days and 14 days. Ethanolic extract in a dose of 500 mg/kg reduced the blood glucose level by 49% after two weeks treatment of albino rats (V. K. Shakya et al. 2010).[66]

In a clinical study, initially all the subjects were given powdered bulbs of *A. sativum* orally, at 20 mg/kg, 30 mg/kg and 45 mg/kg doses, for 14 days. At day 15, blood and urine sampling was done. After 1 week, all the subjects were administered aqueous extract of *A. sativum* bulbs orally, at 20 mg/kg, 30 mg/kg and 45 mg/kg doses, for 14 days. Both the dosage forms decreased blood and urine glucose levels in type-II diabetics (Akbar Waheed et al. 2014).[67]

**Portulaca oleracea** Linn. (Lonî)

The leaves of *Lonî* have been mentioned as *Shaka* in the classics (Table-2). Traditionally, tender leaves and shoots are collected eaten as vegetable (Sibangini Misra, Malaya K. Misra, 2013).[68] In an acute oral toxicity study of 50% ethanolic extract of *P. oleracea* whole plant, 50% of the animals died at the dose level of 500 mg/kg and 100% animals died at the dose levels of 1000,1500 and 2000mg/kg indicating that, the dose below than 500mg/kg b.w is safe for further studies. In hypoglycemic activity the dose of 400mg/kg b.w showed a highly significant reduction of serum glucose levels (Sabeeha Shafi, Nahida Tabassum, 2013).[69] Extract of *P. oleracea* leaves in a dose of 100mg/kg and 250mg/kg for three weeks showed significant reduction in thiobarbituric acid reactive substances (TBRAS) and increase in glutathione reductase (GSH-R) in both liver and kidney of STZ diabetic rats (Alok Sharma et al. 2008).[70]

*P. oleracea* extract alone and plus gliclazide exhibited a significant decrease in the level of blood glucose and increase in serum insulin level as compared to untreated diabetic rats (Gamal A. El-Sherbiny et al. 2005).[71]
**Trichosanthes dioica Roxb. (Patola)**

The fruits of Patola have been mentioned as Shaka in the classics (Table-2). Aqueous extract of *T. dioica* fruits at a dose of 1000 mg/kg body weight reduced the levels of fasting blood glucose, postprandial glucose, aspartate amino transferase, alanine amino transferase, alkaline phosphatase, creatinine, urine sugar and urine protein whereas total protein and body weight was increased. No toxic effect was observed during LD50 study (Rai DK *et al*. 2008).\(^\text{[72]}\)

Aqueous fruit extract of *T. dioica* exhibited maximum fall in blood glucose level of 23.8% in normal rats and of 31.3% in mild diabetic rats with the dose of 1000mg/kg. In severely diabetic, fasting blood glucose, postprandial glucose, total cholesterol, and triglyceride levels were reduced by 28.7, 30.7, 57.2, and 18.5% respectively (Prashant Kumar Rai *et al*. 2013).\(^\text{[73]}\)

**Dioscorea bulbifera Linn. (Varahikanda)**

The tuber of Varahi has been mentioned as Shaka in the classics (Table-2). Traditionally, tubers and bulbs are used (Bhogaonkar Prabha Y *et al*. 2010).\(^\text{[74]}\) Ethanolic extract of *D. bulbifera* tuber at a dose of 380, 760 and 1140 mg/kg body weight exhibited significant reduction in the blood glucose levels of the albino rats (J. E. Okon, A. A. Ofeni, 2013).\(^\text{[75]}\) Aqueous extract of *D. bulbifera* at 250, 500 and 1000 mg/kg doses administered for 3 weeks to STZ treated rats and for 4 weeks to high fat diet fed mice showed significant antihyperglycemic and antidiyslipidemic effects (Zabeer Ahmed *et al*. 2009).\(^\text{[76]}\)

**Adhatoda vasica Nees (Vasa)**

The leaves of Vasa have been mentioned as Shaka in classics (Table-2). Traditionally, young twigs and leaves are used as vegetable (J. K. Tiwari *et al*. 2010).\(^\text{[77]}\) Flowers of this plant are also used as vegetable in traditional practice (Jiji P, 2014).\(^\text{[78]}\) *A. vasica* ethanolic extract and fractions showed dose dependent in-vitro antidiabetic activity and inhibition of á-glucosidase and á-amylase enzyme (Vadivelan R *et al*. 2015).\(^\text{[79]}\)

50 and 100 mg/kg of ethanolic extracts of Justicia adhatoda leaves in normal and experimental diabetic rats produced a significant reduction in blood glucose levels from 2 to 6 days of treatment as compared to the root extract of *J. adhatoda* (100 mg/kg) and glibenclamide (5 mg/kg) (Muhammad Gulfraz *et al*. 2011).\(^\text{[80]}\)

**Solanum melongena Linn. (Vrintaka)**

The fruits of Vrintaka have been mentioned as Shaka in classics (Table-2). Methanolic extract of *S. melongena* L. and *S. macrocarpon* exhibited mild á-amylase and stronger á-glucosidase inhibitory activities in a dose dependent manner. The inhibition of starch hydrolyzing enzymes and antioxidant activities suggested their potential use in the dietary management or control of postprandial hyperglycemia associated with type-2 diabetes (Esther E. Nwanna *et al*. 2013).\(^\text{[81]}\)

In an experimental study, diets based on eggplant with peel showed a significant reduction of plasma glucose levels, which was not observed in the peeled eggplant diet. Compound responsible for the hypoglycemic effect may be present in the peel of the eggplant (Derivi, 2002).\(^\text{[82]}\)

**DISCUSSION**

Most vegetables are low in calories and carbohydrates, great source of fiber, vitamins, minerals, and antioxidants making them ideal food for people with diabetes. Water-soluble dietary fibers can delay sugar digestion and absorption (Jenkins DJ *et al*. 1978).\(^\text{[83]}\) They reduce the insulin level and hormones in the digestive tract and bring about improvement of insulin sensitivity and glucose utilization (Monnier LH, 1982), (Mann JI, 1986).\(^\text{[84]}\),\(^\text{[85]}\)

Among the classical vegetables indicated in Prameha (Diabetes mellitus), maximum are reported for their efficacy in diabetes and other related complications in different animal models. Different vegetables like Costus speciosus, Dioscorea bulbifera, Momordica charantia and Allium sativum are found effective in reducing Serum triglycerides, Serum cholesterol and HDL. Protective effect of *Allium sativum*, Luffa acutangula, Momordica dioica, Momordica charantia, Trichosanthes dioica and Portulaca oleracea against complications related to Kidney and liver is confirmed by many research studies. Pre-administration of *Allium sativum* extract before induction of diabetes prevented the elevation of blood glucose in alloxan induced rats, this shows the role of Garlic in prevention of diabetes.
CONCLUSION

The present review reports the use of different vegetables in prevention as well as management *Prameha* (Diabetes mellitus), in the classical texts of Ayurveda. 19 plants have been reported for their antidiabetic effect and protective action against various complications related to diabetes in experimental studies. The observed result may be helpful in planning further scientific studies about the efficacy of these plants on prevention as well as management of diabetes mellitus. These vegetable can be cultivated in Kitchen garden according to the season of availability to grow healthy, fresh vegetables.
<table>
<thead>
<tr>
<th>No.</th>
<th>Photograph</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><a href="image1">Arkapushpi (H. ada-kodien)</a></td>
</tr>
<tr>
<td>2.</td>
<td><a href="image2">Brihati (S. indicum)</a></td>
</tr>
<tr>
<td>3.</td>
<td><a href="image3">Chakramarda (C. tora)</a></td>
</tr>
<tr>
<td>4.</td>
<td><a href="image4">Dronapushpi (L. cephalotes)</a></td>
</tr>
<tr>
<td>5.</td>
<td><a href="image5">Eranda (R. communis)</a></td>
</tr>
<tr>
<td>6.</td>
<td><a href="image6">Gojhva (L. pinnatifida)</a></td>
</tr>
<tr>
<td>7.</td>
<td><a href="image7">Guduchi (T. cordifolia)</a></td>
</tr>
<tr>
<td>8.</td>
<td><a href="image8">Kakamachi (S. nigrum)</a></td>
</tr>
<tr>
<td>9.</td>
<td><a href="image9">Kantakari (S. xanthocarpum)</a></td>
</tr>
<tr>
<td>10.</td>
<td><a href="image10">Karavellaka (M. charantia)</a></td>
</tr>
<tr>
<td>11.</td>
<td><a href="image11">Karkotaki (M. dioica)</a></td>
</tr>
<tr>
<td>12.</td>
<td><a href="image12">Kebuka (C. speciosus)</a></td>
</tr>
<tr>
<td>13.</td>
<td><a href="image13">Kiratatikta (S. chirata)</a></td>
</tr>
<tr>
<td>14.</td>
<td><a href="image14">Koshataki (L. acutangula)</a></td>
</tr>
<tr>
<td>15.</td>
<td><a href="image15">Kshiravidari (I. digitata)</a></td>
</tr>
</tbody>
</table>
16. LASHUNA (A. sativum)
17. LONI (P. oleracea)
18. MANDUKAPARNI (C. asiatica)
19. PATOLA (T. dioica)
20. SAPTALA (E. dracunculoides)
21. SHITIVARAKA (C. argentea)
22. SUNISHANNAKA (M. minuta)
23. SUVARCHALA (M. rotundifolia)
24. VARAHI (D. bulbifera)
25. VASA (A. vasica)
26. VENU (B. bambos)
27. VPRINTAKA (S. melongena)
Table 1. Part wise distribution of classical vegetables used in Prameha (Diabetes mellitus)

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Part used</th>
<th>Name of the Shaka (Vegetable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Patra (Leaf)</td>
<td><strong>Arkapushpi, Brahmi, Chakramarda, Dronapushpi, Ghoti, Gojihva, Guduchi, Kakamachi, Kirata tikta, Loni, Saptala, Shitivara, Sunnishanaka, Suvarchala, Vasa</strong></td>
</tr>
<tr>
<td>2</td>
<td>Phala (Fruit)</td>
<td><strong>Brihahi, Eranda, Kantakari, Karavellaka, Karkotaki, Koshataki, Patola, Phanphata, Vriniaka</strong></td>
</tr>
<tr>
<td>3</td>
<td>Kanda (Tuber)</td>
<td><strong>Kemuka, Kshira vidari, Lashuna, Varahi</strong></td>
</tr>
<tr>
<td>4</td>
<td>Nala (Stem)</td>
<td><strong>Venu karira</strong></td>
</tr>
</tbody>
</table>
Table 2. Botanical equivalents and properties of classical vegetables used in <i>Prameha</i> (Diabetes mellitus)

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Shaka</th>
<th>Botanical name / Family</th>
<th>Rasa</th>
<th>Guna</th>
<th>Veerya</th>
<th>Vipaka</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Arkapushpi</td>
<td>Holostemma adakodien Schult. (Asclepiadaceae)</td>
<td>-</td>
<td>Laghu</td>
<td>-</td>
<td>-</td>
<td>[11]</td>
</tr>
<tr>
<td>3</td>
<td>Chakramarda</td>
<td>Cassia tora Linn. (Caesalpiniaceae)</td>
<td>Raksha, Laghu</td>
<td>Sheeta</td>
<td>-</td>
<td></td>
<td>[10],[11],[12],[13],[16],[18],[19],[20]</td>
</tr>
<tr>
<td>4</td>
<td>Dronapurshpi</td>
<td>Leucas cephalotes Spreng. (Labiateae)</td>
<td>Katu, Lavana, Guru,</td>
<td>Ruksha, Ushna</td>
<td>Madhura</td>
<td></td>
<td>[10],[11],[13],[15],[18],[19],[22]</td>
</tr>
<tr>
<td>5</td>
<td>Eranda</td>
<td>Ricinus communis Linn. (Euphorbiaceae)</td>
<td>Kashaya, Snigdha, Ushna</td>
<td>-</td>
<td>-</td>
<td></td>
<td>[11],[12]</td>
</tr>
<tr>
<td>6</td>
<td>Ghoti</td>
<td>Amla</td>
<td>-</td>
<td>Amla</td>
<td>Ushna</td>
<td></td>
<td>[22]</td>
</tr>
<tr>
<td>7</td>
<td>Gojiha</td>
<td>Launea pinnatifida Cass. (Asteraceae)</td>
<td>Kashaya, Tikta</td>
<td>Sheeta</td>
<td>-</td>
<td>Madhura</td>
<td>[10],[11],[12],[13],[16],[18],[19],[22]</td>
</tr>
<tr>
<td>8</td>
<td>Gaduchi</td>
<td>Tinospora cordifolia (Willd.) Miers (Menispermacaeae)</td>
<td>Kashaya, Katu, Tikta</td>
<td>Laghu</td>
<td>Ushna</td>
<td>Madhura</td>
<td>[10],[11],[12],[13],[16],[19],[20]</td>
</tr>
<tr>
<td>9</td>
<td>Kakamachi</td>
<td>Solanum nigrum Linn. (Solanaceae)</td>
<td>Katu, Tikta</td>
<td>Snigdha</td>
<td>Sheeta</td>
<td>Katu</td>
<td>[10],[11],[12],[13],[14],[15],[16],[17],[18],[19],[20],[21]</td>
</tr>
<tr>
<td>10</td>
<td>Kantakari</td>
<td>Solanum xanthocarpum Schrad. (Solanaceae)</td>
<td>Tikta, Katu</td>
<td>Laghu, Ruksha, Ushna</td>
<td>-</td>
<td></td>
<td>[11],[13],[15],[19],[22]</td>
</tr>
<tr>
<td>11</td>
<td>Karavellaka</td>
<td>Momordica charantia Linn. (Cucurbitaceae)</td>
<td>Tikta</td>
<td>Sheeta, Laghu</td>
<td>-</td>
<td>Katu</td>
<td>[10],[11],[12],[13],[14],[15],[16],[17],[18],[19],[20],[23]</td>
</tr>
<tr>
<td>12</td>
<td>Karkotaki</td>
<td>Momordica dioica Roxb. (Cucurbitaceae)</td>
<td>Madhura, Tikta</td>
<td>-</td>
<td>Ushna</td>
<td>Katu</td>
<td>[10],[11],[12],[13],[14],[15],[16],[17],[18],[19],[20],[22]</td>
</tr>
<tr>
<td>13</td>
<td>Kemuka</td>
<td>Costus speciosus (Koenig) Sm. (Zingiberaceae)</td>
<td>Tikta, Katu</td>
<td>Laghu</td>
<td>Sheeta</td>
<td>Katu</td>
<td>[10],[11],[12],[13],[19],[21]</td>
</tr>
<tr>
<td>14</td>
<td>Kiratatikta</td>
<td>Swertia chirata (Buch-Ham) (Gentianaceae)</td>
<td>Tikta</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>[11]</td>
</tr>
<tr>
<td>15</td>
<td>Koshataki</td>
<td>Luffa acutangula (Linn) Roxb. (Cucurbitaceae)</td>
<td>Tikta</td>
<td>Laghu, Ruksha, Sheeta</td>
<td>-</td>
<td>-</td>
<td>[11],[12],[13],[15],[16],[17],[18],[21],[24]</td>
</tr>
<tr>
<td>16</td>
<td>Kshiravidari</td>
<td>Ipomoea digitata Linn. (Convolvulaceae)</td>
<td>Madhura, Amla, Kashaya, Tikta</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>[18],[20],[22]</td>
</tr>
<tr>
<td>17</td>
<td>Lashuna</td>
<td>Allium sativum Linn. (Liliaceae)</td>
<td>Katu, Madhura</td>
<td>Tikshn, Guru Snigdha, Picchila,</td>
<td>Ushna</td>
<td>Katu</td>
<td>[11],[12],[13],[17],[20]</td>
</tr>
<tr>
<td>18</td>
<td>Loni</td>
<td>Portulaca oleracea Linn. (Portulaceae)</td>
<td>Amla, Lavana</td>
<td>Ruksha, Guru</td>
<td>Ushna</td>
<td>-</td>
<td>[10],[11],[12],[13],[15],[17],[18],[19],[20],[21],[22]</td>
</tr>
<tr>
<td>19</td>
<td>Mandakaparni</td>
<td>Centella asiatica</td>
<td>Tikta, Laghu</td>
<td>Sheeta</td>
<td>Madhura</td>
<td>[16],[18]</td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>Name</td>
<td>(Linn.) Urban. (Umbelliferae)</td>
<td>kashaya</td>
<td>Laghu, Snigdha, Ushna</td>
<td>-</td>
<td>Katu</td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>----------</td>
<td>-----------------------------</td>
<td>--------------------------</td>
<td>-----------------------</td>
<td>---</td>
<td>-----</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Patola</td>
<td>Trichosanthes dioica Roxb. (Cucurbitaceae)</td>
<td>Tikta, Madhura</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Guru, Ushna</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Phanphata</td>
<td>-</td>
<td>Madhura, Tikta</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Guru, Ushna</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Saptala</td>
<td>Euphorbia dracunculoides Lam (Euphorbiaceae)</td>
<td>Tikta</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Shitivara</td>
<td>Celosia argentea Linn. (Amaranthaceae)</td>
<td>Madhura, Kashaya</td>
<td>Ruksha, Sheeta, Laghu</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Sunnishanaka</td>
<td>Marsilea minuta Linn. (Marselaceae)</td>
<td>Madhura, Kashaya</td>
<td>Ruksha, Sheeta, Laghu</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Suvarchala</td>
<td>Malva rotundifolia Linn. (Malvaceae)</td>
<td>Madhura, Ruksha, Sheeta</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Varahi</td>
<td>Dioscorea bulbifera Linn. (Dioscoreaceae)</td>
<td>Katu, Tikta, Madhura</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Vasa</td>
<td>Adhatoda vasica Nees. (Acanthaceae)</td>
<td>Tikta, Katu</td>
<td>Laghu, Sheeta, Katu</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Venu karira</td>
<td>Bambusa bambos (L.) Voss. (Poaceae)</td>
<td>Madhura, Ruksha,</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Vrintaka</td>
<td>Solanum melongena Linn. (Solanaceae)</td>
<td>Madhura, Teekshna, Ushna, Laghu</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

References: [10],[11],[12],[13],[14],[15],[16],[17],[18],[19],[20],[21],[22],[23],[24]
Table 3. Source of availability of classical vegetables

<table>
<thead>
<tr>
<th>Cultivated vegetables</th>
<th>Wild vegetables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karavellaka, Karkotaki, Koshtaka, Patola, Vrintaka</td>
<td>Arkapushpi, Brihiti, Chakramarda, Dronapushpi, Eranda, Gojihva, Guduchi, Kakamachi, Kantakari, Kenuka, Kiratatikta, Kshiravidari, Loni, Mandukaparni, Saptala, Shivitarka, Sunishhamaka, Suvarchala, Varahi, Vasa, Venu karira</td>
</tr>
</tbody>
</table>

References


2. Lollimbaraj, Vaidya jeewanam, Commented by Shri Kalika charan Pandeya and Shri Brahmarshankara Shastri: 1/10, 1947, Jaya Krishna Das Hari Das Gupta, India. (Lollimbaraj, 1947)


73. Prashant Kumar Rai, Sharad Kumar Gupta, Amrita Kumar Srivastava, Rajesh Kumar Gupta, GeetaWatal, A Scientific Validation of Antihyperglycemic and Antihyperlipidemic Attributes of Trichosanthes dioica, Volume 2013, Article ID 473059, 7 pages (Prashant Kumar Rai et al. 2013)


