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Review Article

SWEET POTATOES FOR DIABETES MELLITUS: A SYSTEMATIC REVIEW

Srijita Dutta

Dept. of Pharmacology, NSHM College of Pharmaceutical Technology, NSHM Knowledge Campus, 124 (60), B. L. Saha Road, Kolkata-700053, India

ABSTRACT

Diabetes mellitus (DM) is a chronic metabolic disorder in which prevalence has been increasing steadily all over the world. As a result of this trend, it is fast becoming an epidemic in some countries of the world in the next decade due to increase in ageing population, thereby adding to the already existing burden for healthcare providers, especially in poorly developed countries. Sweet potato (*Ipomoea batatas*) is a plant found in the tropical and subtropical belts and is one of the most nutritious tropical and subtropical vegetables. As well as being popular in cooking in countries in Asia-Pacific, Africa and North America, sweet potato is also used in traditional medicine for the treatment of diabetes mellitus. Research in animal and human models suggests a possible role of sweet potato in glycaemic control. This review article evaluated the effects of sweet potato for type 2 diabetes mellitus & also to investigate whether there is enough evidence from medical trials to show whether sweet potato works as a treatment for diabetes. There are many varieties of sweet potatoes and sweet potato preparations. More trials are needed to assess the quality of the various sweet potato preparations as well as to evaluate further the use of different varieties of sweet potato in the diet of diabetic people.

Keywords: Diabetes mellitus, Sweet potato, Glycaemic, Diabetic diet.

INTRODUCTION

Diabetes is a chronic medical condition which involves elevated blood sugar levels. The metabolism of carbohydrates, proteins, and fats directly or indirectly results in producing the substance glucose, also known as blood sugar. Glucose is required to supply energy to every cell in the human body. If glucose levels become too high, then they become poisonous to the brain and other body organs.[1] With diabetes, two main problems can happen. One is a deficiency of insulin, a hormone made by the pancreas that carries glucose into cells. The second is the resistance of the cells to insulin so that blood sugar cannot go into the cells. According to the American Diabetes Association, 6.2% of the population has diabetes; with one third of the people unaware they have the disease.[2] One in every sixteen people has diabetes. Diabetes mellitus is a group of metabolic disorders in which the body doesn't produce adequate insulin, the hormone used to metabolize blood sugar (glucose). When glucose isn't metabolized efficiently, blood sugar levels rise, and this leads to reduced energy, growth, and immune response.[2] Eventually, this can cause damage and eventual failure of many organs, such as heart, blood vessels, kidneys, nerves, and eyes.

DIABETES DIVIDED INTO THREE PREVALENT FORMS

Type 1 Diabetes

Typically referred to as insulin-dependent or juvenile-onset, seems to be an autoimmune

disease (where the body's own immune cells attack it) and is the most serious of the two.[3]

Type 2 Diabetes

Often called adult-onset or non-insulin dependent diabetes, is by far the more common of the two: about 90 to 95 percent of the diabetes in the United States is type 2. It strikes during adulthood, most often in the elderly or in the obese over forty. It is becoming more and more normal with children, because of the lack of exercise, obesity, and poor dietary habits. People who have type 2 can create sufficient insulin, but the insulin and the glucose it transports cannot effectively enter into the cells.[3] This group of diabetes is frequently linked to a diet that is high in refined carbohydrates and low in fiber, and it can usually be treated with an effective diet, exercise, and specific nutritional supplements. The third category is referred to as gestational diabetes, diabetes that happens during a woman's pregnancy.[4]

All 3 types of diabetes are quite serious health conditions. When left unmonitored and untreated, blood-sugar levels can swing from drastically low (hypoglycemia) to alarmingly high (hyperglycemia). Hypoglycemia occurs quickly and leaves patient feeling dizzy, pale, sweaty, and confused. Patient may feel uncoordinated or have palpitations. If glucose levels aren't increased, symptoms could grow worse, and patient could lapse into a coma.[4] Hyperglycemia isn't much better. It may take hours or days to develop and can result in diabetic keto acidosis, a life-threatening condition. In the long run, both type 1 and type 2 diabetes can lead to heart disease, kidney and nerve disorders, loss of vision, along with other problems. The high levels of blood sugar can also leave the body susceptible to infection. For those who have type 1 diabetes, scientist needs to work closely with a capable doctor and follow a lifelong treatment plan that includes medication, dieting and exercise. Complementary therapies, while they may not replacement for conventional medical treatment, can offer helpful support to taxed endocrine and other systems and help reduce the need for medications and minimize the long-term complications of the disease.[4] In uncommon cases many people could possibly get off insulin therapy when a comprehensive natural approach is followed. Those with type 2 diabetes should also take their disease seriously can consult a doctor on a consistent basis; however, they'll usually realize that a comprehensive dietary, exercise, and supplemental program will reduce or get rid of the need for medication. No matter which type of diabetes one should have, he/she must always talk to doctor about any therapies which plan to include into treatment protocol. And never stop medication without a doctor's consent.[5]

Because these symptoms might not seem serious, some people with diabetes remain undiagnosed. If they apply to patients, a doctor should be consulted as quickly as possible.[6]

- Frequent urination (children may be constant bedwetters)
- Strong thirst
- Blurred vision
- Excessive appetite
- Irritability
- Weight loss
- Fatigue

Root Causes of Diabetes

- Heredity
- A poor diet (specifically in type 2 diabetes)
- Lack of Vitamin D
- Obesity
- An autoimmune reaction (due to a viral infection, environmental toxin, food allergy) is one proposed theory as to the origin of some causes of type 1 diabetes.[7]
- Chronic stress and the resulting stress hormone imbalance
- Nutritional deficiencies, especially of chromium, B vitamins, zinc, vanadium.

GLYCEMIC INDEX

Glycemic Index (GI) is a measurement carried out on carbohydrate-containing foods and their impact on our blood sugar. GI is a relatively new way of analyzing foods. Previously, most meal plans designed to improve blood sugar analyzed the total amount of carbohydrates (including

sugars and starches) in the foods themselves. GI goes beyond this approach, looking at the impact of foods on actual blood sugar.[8] In other words, instead of counting the total amount of carbohydrates in foods in their unconsumed state, GI measures the actual impact of these foods on blood sugar.

There are various research methods for assigning a GI value to food. In general, the number is based on how much a food item raises blood glucose levels in healthy research participants compared with how much pure glucose raises their blood glucose. GI values are generally divided into three categories:[8]

- Low GI: 1 to 55
- Medium GI: 56 to 69
- High GI: 70 and higher

One limitation of GI values is that they don't reflect the likely quantity one would eat of a particular food.

MANAGEMENT

Through lifestyle and diet modification. Studies have shown that there was significant reduction in the incidence of type 2 DM with a combination of maintenance of body mass index of 25 kg/m^2, eating high fibre and unsaturated fat and diet low in saturated and trans-fats and glycemic index, regular exercise, abstinence from smoking and moderate consumption of alcohol.[9] Suggesting that majority of type 2 DM can be prevented by lifestyle modification. Patients with type 2 DM should receive a medical nutrition evaluation; lifestyle recommendations should be tailored according to physical and functional ability.[10]

PHARMACOLOGICAL AGENTS

- **Biguanides**

  Biguanides, of which metformin is the most commonly used in overweight and obese patients, suppresses hepatic glucose production, increases insulin sensitivity, enhances glucose uptake by phosphorylating GLUT-enhancer factor, increases fatty acid oxidation, and decreases the absorption of glucose from the gastrointestinal tract.[11]

- **Sulphonylureas**

  These generally well tolerated but because they stimulate endogenous insulin secretion, they carry a risk of hypoglycemia.[10] Elderly patients, with DM who are treated with sulfonylureas have a 36% increased risk of hypoglycemia compared to younger patients.[13] Glyburide is associated with higher rates of hypoglycemia compared to glipizide.[14]

- **Meglitinides**

  Repaglinide and nateglinide are non-sulfonylurea secretagogues which act on the ATP-dependent K-channel in the pancreatic beta cells thereby stimulating the release of insulin from the beta cells, similar to sulfonylurea, though the binding site is different.[16] Meglitinides have a rapid onset and a short duration of action (4-6 hrs) and thus lower risk of hypoglycemia.

- **Thiazolidinedione**

  Thiazolidinedione is an insulin sensitizer, selective ligands transcription factor peroxisomes proliferator-activated gamma. They are the first drugs to address the basic problem of insulin resistance in type 2 DM patients,[17] whose class now includes mainly pioglitazone after the restricted use of rosiglitazone recommended by Food and Drug Administration (FDA) recently due to increased cardiovascular events reported with rosiglitazone.[9]

- **Alpha glucosidase Inhibitors**

  Acarbose, Voglibose and Miglitol have not widely been used to treat type 2 DM individuals but are likely to be safe and effective. These agents are most effective for postprandial hyperglycemia and should be avoided in patients with significant renal impairment.[12]

DIETARY APPROACHES TO DIABETES

Food can be powerful in preventing and reversing diabetes. However, dietary approaches have changed as we have learned more about the

disease. The traditional approach to diabetes focuses on limiting refined sugars and foods that release sugars during digestion starches, breads, fruits, pasta, etc. With carbohydrates reduced, the diet may contain an unhealthful amount of fat and protein.[15] So diabetes experts have taken care to limit fats especially saturated fats that can raise cholesterol levels and to limit protein for people with impaired kidney function.

The new approach focuses more attention on fat. Fat is a problem for people with diabetes. The more fat there is in the diet, the harder time insulin has in getting glucose into the cells.[18] Conversely, minimizing fat intake and reducing body fat help insulin do its job much better. Newer treatment programs drastically reduce meats, high-fat dairy products, and oils. At the same time, they increase grains, legumes, fruits, and vegetables. One study found that 21 of 23 patients on oral medications and 13 of 17 patients on insulin were able to get off of their medications after 26 days on a near-vegetarian diet and exercise program.[19] During two- and three-year follow- ups, most people with diabetes treated with this regimen have retained their gains.[20] The dietary changes are simple, but profound, and they work. Low-fat, vegetarian diets are ideal for people with diabetes. Exercise plays an important role in diabetes management.[22, 23] Through regular exercise, the need for insulin injections or oral medications can often be reduced. This holds true not only for people with type 2 diabetes, but also to some extent for those with type 1. Exercising muscles have a voracious appetite for fuel. When an individual is engaged in regular aerobic exercise, glucose is able to enter the cells without the need for as much or perhaps any insulin.

While people with type 2 diabetes can often reduce (and sometimes eliminate) medications when their weight is reduced and food and exercise are better controlled, those with type 1 diabetes will always need a source of insulin. The cause of type 1 diabetes remains elusive. Several studies have implicated cow's milk consumption as a possible contributor.[24,25] When milk consumption patterns were examined across various nations, there was a strong correlation with the incidence of type 1 diabetes. It may be that milk proteins cause an autoimmune reaction in which the body mistakenly attacks its own insulin-producing cells. Even so, a good diet and regular exercise can minimize the amount of insulin required.

Glycemic Index Diet

A glycemic index diet is an eating plan based on how foods affect blood sugar level.The glycemic index is a system of assigning a number to carbohydrate-containing foods according to how much each food increases blood sugar. The glycemic index itself is not a diet plan but one of various tools such as calorie counting or carbohydrate counting for guiding food choices.[21] The term "glycemic index diet" usually refers to a specific diet plan that uses the index as the primary or only guide for meal planning. Unlike some other plans, a glycemic index diet doesn't necessarily specify portion sizes or the optimal number of calories, carbohydrates, or fats for weight loss or weight maintenance. Many popular commercial diets, diet books and diet websites are based on the glycemic index, including the Zone Diet, Sugar Busters and the Slow-Carb Diet.[12-15] The majority of GI diet plans suggest eating low-GI foods such as many vegetables, and whole grains. Foods that are considered to have a high-GI rating (greater than 70) are to be avoided.

THE NEW DIETARY APPROACH TO DIABETES

This new and effective approach to diabetes is remarkably simple. Here are four simple steps to managing blood sugar (and weight, blood pressure, and cholesterol) with diet.

- **Begin a Vegan Diet: Avoid Animal Products**

  Animal products contain fat, especially saturated fat, which is linked to heart disease, insulin resistance, and certain forms of cancer. These products also contain cholesterol and, of course, animal protein. It may surprise one to learn that diets high in animal protein can aggravate kidney problems and calcium losses.[26] Animal products never provide fiber or healthful carbohydrates. A vegan diet is

one that contains no animal products at all. So, one will want to avoid red meat, poultry, fish, dairy products, and eggs.

- **Avoid Added Vegetable Oils and Other High-Fat Foods**

  Although most vegetable oils are in some ways healthier than animal fats, one will still want to keep them to a minimum. All fats and oils are highly concentrated in calories. A gram of any fat or oil contains nine calories, compared with only four calories for a gram of carbohydrate.[27] Avoid foods fried in oil, oily toppings, and olives, avocados, and peanut butter. Aim for no more than 2-3 grams of fat per serving of food.

- **Favor Foods with a Low Glycaemic Index**

  The glycaemic index identifies foods that increase blood sugar rapidly. This handy tool allows one to favor foods that have much less effect on blood sugar. High-glycaemic-index foods include sugar itself, white potatoes, most wheat flour products, and most cold cereals.[28]

- Go **High Fiber**

  Aim for 40 grams of fiber a day, but start slowly. Load up on beans, vegetables, and fruits. Choose whole grains (try barley, oats, quinoa, millet, whole-wheat pasta, etc.). Aim for at least 3 grams per serving on food labels and at least 10 grams per meal.[29]

To put these guidelines to work, focus on the New Four Food Groups. Choose unlimited amounts of grains, legumes, fruits, and vegetables. Modest amounts of nonfat condiments, alcohol, and coffee are also fine.[30]

- **Grains**

Pasta, rice, high-fiber cereals, corn, oatmeal, couscous, bulgur wheat, millet, barley, rye, etc.

- **Legumes**

Beans (black, pinto, kidney, garbanzo, white, etc.), peas, split peas, lentils, nonfat soy products.[31,32]

- **Fruits**

  All, except avocados, olives, pineapple, and watermelon. Bananas, apples, grapes, pears, peaches, oranges, melons, grapefruit, kiwi, and berries, among others, are all good choices.

- **Vegetables**

  All, except white potatoes. Examples include tomatoes, cucumbers, carrots, broccoli, cauliflower, spinach, kale, collards, squash, green beans, bok choy, sweet potatoes, and artichokes.[33]

- **Vitamin B12**

Those following a diet free of animal products should take a B12 supplement of 5 micrograms per day. Any common multiple vitamin will provide this amount.[34]

ARE SWEET POTATOES SAFE FOR DIABETICS AND PRE-DIABETICS

According to research conducted in the College of Agriculture and Life Sciences, sweet potatoes are a low-glycemic index (GI) food, which release glucose very slowly into the bloodstream.[35] Low-glycemic foods also benefit the pancreas by not overworking it and make one feel satiated longer.[36] Other research shows that sweet potatoes can help regulate blood sugar because of their ability to raise blood levels of adiponectin, a protein hormone created by fat cells, to help regulate how body metabolizes insulin.[37] Even if these findings exist, sweet potatoes should still be consumed in moderation. Keep in mind that the sweet potato is a naturally sweet food and its varieties differ with their sugar content. An example is the American sweet potato, which is grown because of its sweetness. It contains 6.5 grams of sugar per 100 grams.[38]

If anyone is a diabetic or is suffering from problems related to insulin resistance, consult doctor to know whether it's safe for his/her to consume sweet potatoes.

SWEET POTATO

Sweet potatoes are a good food choice for diabetics as they are high in fiber and have a low glycemic index. Foods with a low glycemic index have less of an immediate impact on blood glucose levels, and therefore can help diabetics control their blood sugar.

Scientific Name(s): *Ipomoea batatas* L. Family: Convolvulaceae.[39]

Common Name(s): Sweet potato, caiapo, nyamis (Africa), yam, kumara (New Zealand), camote (southwest United States).[39]

Uses

Pharmacological investigations on the antidiabetic, antihypertensive, anti-inflammatory, antimicrobial, and antioxidant activity of sweet potato have been conducted.[40]

Fiber

Sweet potatoes are also good for diabetics because they contain a good deal of fiber, particularly when the skins are left on. The amount of fiber in a food slows down the rate of digestion of the starches. This action in turn lowers the glycemic index of the sweet potato and helps keep blood sugar levels within a manageable range.[40]

Dosing

Clinical studies of the efficacy of the nutraceutical caiapo, an extract of sweet potato, used a total of 4 capsules daily, with each capsule containing caiapo 168 to 336 mg. Sweet potato is available in powder and capsule (caiapo) forms.[41] Dosage regimens vary, but most commercial manufacturers suggest 2 capsules 30 minutes before meals, up to a total of 6 capsules daily.

Contraindications

Hypersensitivity to any of the chemical components in the plant species.[42]

Pregnancy/Lactation

There are no case reports or clinical studies relevant to pregnancy or lactation. However, women with hypersensitivity reactions to the plant should avoid use.[42]

Interactions

None well documented.

Adverse Reactions

Historical and clinical data document no serious adverse reactions. Patients with known hypersensitivity reactions to the plant may develop generalized urticaria, hypotension, and edema of the hands and face.[43] Dizziness, loss of consciousness, nausea, vomiting, and a sensation of tickling and tightness in the throat have been documented.

Toxicology

Very little toxicity data are available about the plant. Animal studies document temporary neurological effects followed by extensive liver necrosis for 3 sesquiterpenoids in sweet potato with a median lethal dose varying from 184 to 266 mg/kg.[44] Sweet potato consumption should be avoided by individuals hypersensitive to any of the chemical components in the plant species.[34]

Botany

The sweet potato plant originated in Central America. Although China is considered the leading producer of sweet potatoes, the plant is widely cultivated and consumed throughout the world. It is a herbaceous perennial vine with alternate heart-shaped, lobed leaves and medium-sized flowers. The root is edible and is often long and tapered. The skin may be red, purple, or brown and white in color. The interior, or flesh, may be white, yellow, orange, or purple. The leaves and shoots sometimes are eaten as greens.[44]

History

Sweet potato is the world's sixth largest food crop and is important for the growing populations in Asian and African countries. The plant has been used medicinally in Japan for treating diabetes and other diseases. American Indians used sweet potato to treat thirst and weight loss attributed to diabetes.[45-47]

Chemistry

There are numerous, extensive phytochemical investigations. Most studies focus on the nutraceutical properties and understanding the physiological functions of sweet potato. Only selective studies will be discussed because of the extent of these investigations. The root and skin contain most of the studied medicinal components. High levels of polyphenols, such as anthocyanins and phenolic acids (eg, caffeic acid), have been isolated from sweet potato. Chlorogenic, dicaffeoylquinic, and tricaffeoylquinic acids are derivatives of

caffeoylquinic acid that protect the root from fungal diseases and have potential cancer chemoprotective effects. The numerous acylated anthocyanins are the major color constituents in the storage roots and are important in the plant's use in diabetes.[45]

The plant's antioxidant activity is associated with its alpha-tocopherol content, which is the most common form of vitamin E, and comprises 25 mg per 100 g of sweet potato shoots. The 2 storage proteins, sporamins A and B, account for more than 80% of the total protein isolated from the roots of sweet potato.[46,47]

Pharmacology

Pharmacological investigations on the antidiabetic, antihypertensive, anti-inflammatory, antimicrobial, and antioxidant activity of sweet potato in animals have been conducted.[40]

- *Cardiovascular effects in vitro data*

  An extract was examined for relaxant activity on isolated rat vascular aortic preparations. Sweet potato showed 97% relaxation activity for endothelium-intact aortic ring preparations but only 35% in the mesenteric vascular bed. The vasorelaxation mechanism of action was similar to that of the pharmacological agent acetylcholine.[32]

- *Antioxidant effects In vitro and in vivo data-*

  The major phenolic components in a 70% methanol extract of sweet potatoes showed strong antioxidant activity in a linoleic acid-aqueous system.[33] Anthocyanins of purple sweet potato (PSP) have antioxidant activity. DPPH (1,1-diphenyl-2-picrylhydrazyl) radical scavenging activity in collected urine samples increased in PSP anthocyanin-injected rats and in 6 PSP beverage-administered human volunteers. The degree of radical-scavenging activity for some of the anthocyanins was higher than that for ascorbic acid.[34]

- *Immune system effects animal data*

  Sweet potato fiber may be useful in combination with other therapeutic agents used in skin wound therapy. The healing effect of sweet potato fiber was evaluated for burns or decubital wounds in rats over 19 days. Outcome measures included reduction in size and changes in quality of the wounds. Rats treated with the sweet potato fiber covering had reduced wound areas by 21% at day 9, 19.5% at day 11, and 18.7% at day 13, compared with controls. Healing times for both groups were 19 days for treated rats and 21 days for controls.[35]

In a mouse model, purified sweet potato polysaccharide (PSPP) isolated from the roots acted as a biological response modifier. In a dose-dependent manner, mice treated with PSPP (50, 150, and 250 mg/kg body weight for 7 days) had increased in phagocytic function, hemolytic activity, and serum IgG concentration.[31]

Clinical data

A randomized, crossover study involving 16 healthy, nonsmoking adults (7 men and 9 women) examined the effects of physiological doses of purple sweet potato leaves (PSPL) over 6 weeks. During week 1, control and experimental groups were subjected to a low-polyphenol diet. During weeks 2 and 3, the experimental group consumed a PSPL diet consisting of 200 g daily of PSPL, and the control group consumed a diet consisting of low polyphenols and carotenoids adjusted to the same level as that of PSPL.[49] The washout diet followed week 4. During weeks 5 and 6, experimental and control groups switched diets. Results from blood and urine samples indicate that dietary intervention in the form of PSPL consumption modulated various aspects of immune function, including increased proliferation responsiveness of peripheral blood mononuclear cells, secretion of cytokines IL-2 and IL-4, and increased lytic activity of natural killer cells.[36]

Similar immune system effects also have been documented for the white-skinned sweet potato (WSSP).[37]

Diabetes In Vitro Data

In a free-glucosidase (AGH) assay system, potent AGH inhibitory activity was seen with anthocyanin extracts from the storage roots of PSP (IC_{50} = 0.36 mg/mL). The extracts also inhibited alpha-amylase activity, indicating a potential role in suppressing the increase in postprandial glucose levels.[38]

Animal data

The antidiabetic activity of WSSP versus troglitazine was examined in Zucker fatty rats over 8 weeks. After starting oral dosing with WSSP, hyperinsulinemia was reduced 23%, 26%, 60% and 50%, at 3, 4, 6, and 8 weeks, respectively. WSSP also inhibited increases in blood sugar levels after administration of a glucose challenge test during week 7. Histology of the pancreas showed regranulation of pancreatic islet B cells. Isolation and purification of the antidiabetic component in WSSP was unsuccessful.[32,39] Evidence and similar experiments in rats indicate that acylated anthocyanins, such as caffeoylsophorose, are responsible for alpha-glucosidase inhibition of the extract. The production of adiponectin by transgenic sweet potatoes has gained pharmaceutical interest. Adiponectin is a cytokine produced and secreted only from adipose tissue and is found in human plasma. Low levels of this cytokine or protein are associated with type 2 diabetes mellitus, obesity, and hypertension.[38,50]

Clinical data

Caiapo, an extract of WSSP, improves glucose tolerance by reducing insulin resistance without affecting body weight or insulin secretion and clearance. A 6-week, prospective, placebo-controlled, randomized, double-blind study involving 18 men examined the effects of caiapo. Patients were randomized into 3 groups and received a total of 4 tablets daily containing placebo, caiapo 168 mg, or caiapo 336 mg.[48] Outcome measures assessed included an intravenous glucose tolerance test and oral glucose tolerance test. Overall, only high-dose caiapo improved metabolic control by decreasing insulin resistance without affecting body weight. No serious side effects were observed.[35,51] Results from an uncontrolled study in 145 Japanese patients with type 2 diabetes treated with the nutraceutical caiapo indicated a decrease in blood glucose levels.[35]

Other Pharmacological Activity

Chemoprotective effects may be associated with the anthocyanins and phenolic acids in sweet potato. Sweet potato contains provitamin A or beta-carotene and clinical studies document its potential role as a long-term, food-based strategy in reducing vitamin A deficiency in children in many developing countries.[33,34,52,53]

Beneficial Compounds Found in Sweet Potatoes

While orange sweet potatoes have anti-carcinogenic properties, it was found that purple sweet potatoes have better cancer-fighting abilities because they have cyanidins and peonidins, which have a positive effect against cancer cell growth. These cancer-fighting compounds, which are more prevalent in the flesh than in the skin,[40] are found to help reduce the potential dangers of heavy metals, such as mercury, cadmium, and arsenic. This is beneficial to individuals diagnosed with digestive problems like irritable bowel syndrome and ulcerative colitis, as well as to those who wish to reduce their exposure to metal toxins.[41] Sweet potatoes also contain two important antioxidant enzymes: copper/zinc superoxide dismutase and catalase. According to one study, purple sweet potatoes have more than three times the antioxidant activity than that of one blueberry.[42]

In addition to sweet potatoes' antioxidant content, these vegetables are also great sources of vitamins C and B5, copper, dietary fiber, niacin, potassium, and iron.[43]

Japanese Sweet Potato may Cure Diabetes Along with Coffee and Ginkgo

A white sweet potato extract from the *Ipomoea batatas* plant may cure diabetes, adding to other recent research showing blood sugar reducing benefits from coffee, the gingko tree, and nuts. Diabetes is at epidemic proportions but traditional medicine has used plants to treat this condition worldwide.[50]

Sweet Potato Diabetes Research

Researchers are now studying the *Ipomoea batatas* plant, a traditional sweet potato remedy from the mountains of Japan. The white sweet potato has been used for centuries in Japan to treat high blood pressure, anemia and diabetes.[51] The raw potatoes come from the Kagawa region of Japan, a mountainous region between Osaka

and Hiroshima. Recent research with the sweet potato extract has shown promise in stabilizing blood sugar in type 2 diabetes. A study in Austria and Italy enlisted 60 participants who consumed 4 g of an extract of the white sweet potato, called caiapo. After three months, many reported reduced blood sugar of 15 points.[48] When participants consumed 2 grams of the extract, their results were not curative, but those on the 4 gram a day diet showed at least a 13 percent reduction in fasting blood sugar, as well as a 30 percent drop in cholesterol and a 13 percent drop in LDL cholesterol.[53] The caiapo extract seems to have an effect by decreasing insulin resistance; however, further tests are needed to confirm these findings. Sweet potatoes join the ranks of other foods thought to help reduce insulin resistance and prevent the onset of diabetes, such as coffee and nuts.[52-54]

CONCLUSION

DM is a metabolic disease that can be prevented through lifestyle modification, diet control, and control of overweight and obesity. Education of the populace is still key to the control of this emerging epidemic. Novel drugs are being developed, yet no cure is available in sight for the disease, despite new insight into the pathophysiology of the disease. Pharmacological investigations on the antidiabetic, antihypertensive, anti-inflammatory, antimicrobial, and antioxidant activity of sweet potato have been conducted. But there is insufficient evidence to recommend sweet potato for diabetes mellitus. Improvement in trial methodology as well as addressing the issues of standardization and the quality control of preparations of other varieties of sweet potato are required. For medical nutritional therapy, further observational trials and RCTs evaluating the effects of sweet potato are needed to guide any recommendations in clinical practice.

Figure 1: Sweet Potatoes[15]

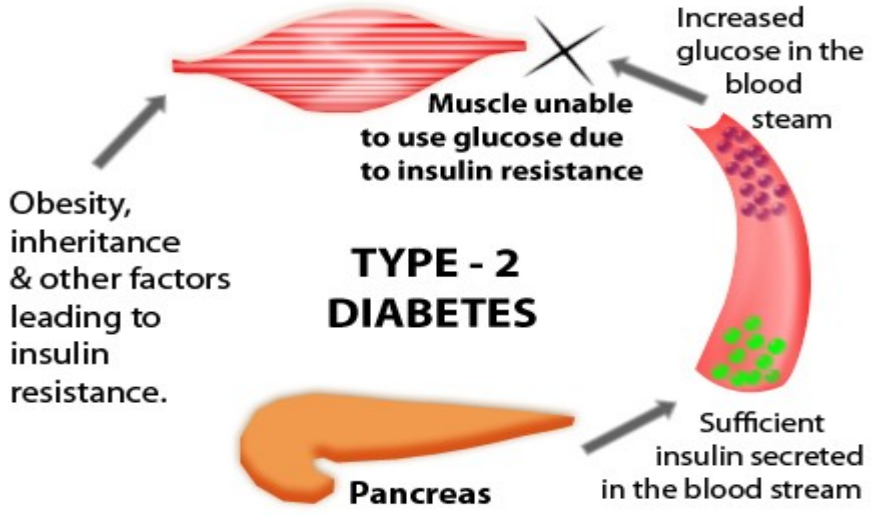

Figure 2: Type 2 Diabetes

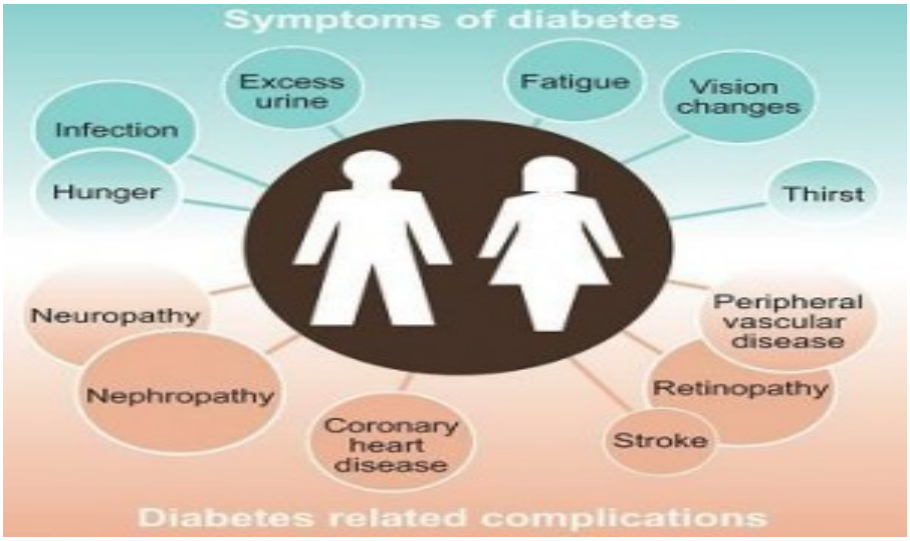

Figure 3: Symptoms of Diabetes

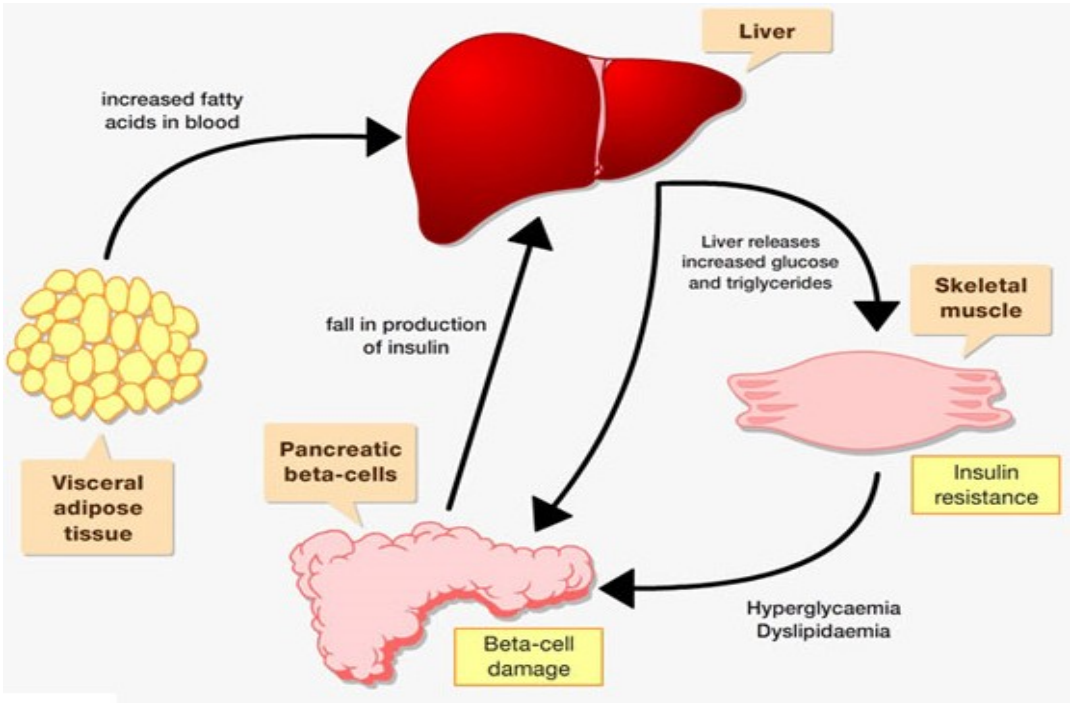

Figure 4: Root Causes of Diabetes

Figure 5: Dietary Approaches to Diabetes

Table1: Quick Glycemic Guide[21]

High-GI (avoid)	**Low-GI** (enjoy)
White or wheat bread	Pumpernickel, rye, multigrain, or sourdough bread
Most cold cereals	Old-fashioned oatmeal, bran cereals, Grape-Nuts
Watermelon, pineapple	Most fruits
Baking potatoes	Sweet potatoes
Sugar	Pasta
	Rice, barley, couscous
	Beans, peas, lentils
	Most vegetables

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Correspondence Author:
Srijita Dutta
Dept. of Pharmacology, NSHM College of Pharmaceutical Technology, NSHM Knowledge Campus, 124 (60), B. L. Saha Road, Kolkata-700053, India

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