Natural remedies for diabetes mellitus

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ABSTRACT

Diabetes is a metabolic disorder and a progressive disease that needs proper attention as uncontrolled diabetes can lead to various acute and chronic complications such as retinopathy, nephropathy, neuropathy, gastropathy etc. Pharmacological management of diabetes is costly and has certain side effects. There is a need for the usage of natural anti-diabetic sources which could be used for treatment of diabetes since ancient times.

Key Words: Hyperglycemia, Diet, Spice, Obesity, Insulin, Metabolism.

INTRODUCTION

Diabetes mellitus (DM) being a metabolic disorder is characterized by a defect in insulin secretion, its action, or both (Bastaki, 2005). Deficiency of insulin leads to chronic hyperglycemia (increased fasting and postprandial blood sugar (glucose) levels) as well as protein, fat and carbohydrate metabolism are also disturbed (Joseph and Jini, 2011).

Diabetes mellitus is classified based on its cause and clinical signs and symptoms. In general, diabetes is classified into 4 types, that are type 1 diabetes mellitus or non-insulin dependent diabetes mellitus, type 2 diabetes or insulin dependent diabetes mellitus, gestational diabetes, and other specific types. Non-insulin dependent diabetes mellitus is the major type of diabetes in younger age groups. Though the prevalence of type 1 diabetes is increasing all over the world, yet it accounts for a minority. Children of earlier age groups are more prone to type 1 diabetes mellitus (Pierro et al., 2015).

Diabetes is a complex disease that can lead to various complications; it demands a multifarious therapeutic approach. Drug therapy is provided to patients whose cells do not respond to insulin whereas insulin deficiency is managed by insulin injections in patients who show total lack of insulin (Joseph and Jini, 2011).

TYPES OF DIABETES MELLITUS

Diabetes mellitus has following types:

Type 1 or Insulin Dependent Diabetes Mellitus (IDDM)

Younger people (Children and adolescents) are most vulnerable to Type 1 or IDDM also known as ketosis-prone or juvenile onset diabetes. IDDM is characterized by insulin deficiency and patient needs exogenous insulin for survival (Plotnick, 1994). Failure of pancreas to discharge enough insulin for the body requirements to be met is the main cause of type 1 diabetes. Glucose intolerance occurs because of progressive destruction of β-cells, as diabetes is a progressive disease. It takes months or years for enough dismantlement of β-cells for the insulin dependent diabetes mellitus to appear. This destruction might be autoimmune-mediated (in most cases) or it could be idiopathic destruction (Maahs et al., 2010).

Risk Factors

Only liability to Type 1 diabetes is inherited; not the disease itself. Type-1 Diabetes has a strong genetic factor. The risk of developing type 1 diabetes in children with diabetic father is 4- 6%, whereas those with diabetic mother it is 2-3%. If one of the parents is diabetic, then the risk is 5% (Gorrell et al., 2003).

Pathophysiology of IDDM

Insulin secretion is reduced because of the damage to pancreatic β-cells, which could be in the form of autoimmune destruction. In addition, α-cells start performing their functions abnormally as well, which cause increased discharge of glucagon in Type-1 diabetics. Blood glucose level is inversely proportional to glucagon secretion but in such patients, hyperglycemia does not suppress glucagon’s secretion (Ozougwu et al., 2013).
Non-Insulin Dependent Diabetes Mellitus
In type 2 diabetes mellitus, the first abnormality detected is abnormal sensitivity to insulin. Insulin is being produced by the pancreatic cells but their ability to produce high levels of insulin to meet the bodily demands is decreased thus causing insulinopenia, which in turn causes the development of impaired glucose tolerance and eventually the patient has to face diabetes mellitus (DeFronzo, 1992).

Clinical Features
The symptoms of Non-insulin-dependent diabetes mellitus progress slowly with the patient being asymptomatic in the beginning. Patient might face conditions like polyuria and polydipsia. Non-insulin-dependent diabetes mellitus is diagnosed during physical examination of the patient. Major symptoms include lethargy, dizziness, tiredness, leg cramps, mood swings, skin infections, itching, blurred vision and headache (Surya et al., 2014).

Pathophysiology of NIDDM
Type 2 DM is characterized by both improperly functioning β-cells as well as α-cells. Insulin insensitivity is the major factor in type 2 diabetes mellitus. Insulinopenia caused by destruction of β-cells result in reduced transport of glucose into the fat cells, liver and muscle cells. During fasting, breakdown of fat in increased causing hyperglycemia. The hepatic glucose and glucagon levels that increased during fasting are not suppressed with a meal. Patient faces hyperglycemia due to reduced secretion and increased resistance of insulin (Olokoba et al., 2012).

Gestational diabetes
Gestational diabetes mellitus (GDM) being firstly recognized during pregnancy is defined as glucose intolerance of variable severity (Kim et al., 2011). About 5% of pregnant females are affected by gestational diabetes mellitus and its frequency is expected to increase as the obesity increases. In the years following the pregnancy, the affected females are more vulnerable to type-2 diabetes mellitus. In addition, their children are vulnerable of getting obese as well as developing type-2 diabetes mellitus early in their life (Kampmann et al., 2015).

Majority cases of gestational diabetes mellitus can be controlled with lifestyle modifications alone. Insulin is not transferred from pregnant woman to her fetus, thus it is employed as initial line medical care. Both Metformin & Glyburide are considered efficacious and safe, although we have no evidence of safety for their chronic use. According to ACOG, oral agents and insulin have same efficacy, so either can be employed as initial line medical care whereas NICE prefers metformin to insulin therapy (Kelley et al., 2015).

Other types of Diabetes Mellitus
Diabetes can be classified into other types based upon their etiology.
- Maturity onset diabetes in youth is characterized by abnormally functioning β-cells and this defect is genetic.
- Less than 10% are those having pancreatic disorders caused by infections, chemicals or drugs.
- Those having faulty insulin action.
- Those having cystic fibrosis or pancreatitis.
- Those having diseased endocrine gland (Baynest, 2015).

Complications of Diabetes
In diabetes mellitus, either small blood vessels are damaged (micro-vascular disease) or arteries are damaged (macro-vascular disease). Micro-vascular complications include neuropathy, retinopathy and/or nephropathy. Common macro-vascular complications include cerebrovascular disease and myocardial infarction (Forbes and Cooper, 2013). Generally, diabetic complications can be classified into 2 groups:

a) Acute metabolic complications: Short-term complications including ketoacidosis, hyperosmolar non-ketonic coma and hypoglycemia.
b) Late systemic complications: Long lasting complications including retinopathy, diabetic nephropathy, atherosclerosis, diabetic neuropathy, microangiopathy and infections (Ullah et al., 2015).

Current Management of Diabetes Mellitus
- Agents like Voglibose, acarbose and miglitol are used to manage post-prandial hyperglycemia. These agents decrease glucose absorption by the cells and thus manage diabetes at digestive level.
- Different therapies used to manage diabetes mellitus do have some limitations, as they are not cost effective and can show certain side effects like liver toxicity, weight gain, gastrointestinal disturbances as well as hypoglycemia.
- Biguanide such as metformin is used to potentiate glucose uptake by peripheral cells. Sulphonylureas like glibenclamide act as insulinotropic and work as secretagogue for pancreatic cells (Joseph and Jini, 2011).
The major phenolic constituents present are caffeic acid, gallic acid, kaempferol, isoquercitrin and ellagic acid. Upon usage of powder of clove buds in rats, it is proved that this powder exhibits many useful actions like hypoglycemic activities, antioxidant activities, anti-hyperlipidemic and anti-hepatotoxic activities. It slows down digestion of carbohydrates and also checks oxidative stress (Rizvi et al., 2014).

Capsicum annuum
It belongs to Solanaceae family. Serrano and Fresno are 2 different varieties of red chili powder having anti-hypercholesterolemic and anti-hyperglycemic properties. Therefore, red chili powder can be recommended for use by diabetic patients (Magied et al., 2014).

A factor that is involved in hypoglycemia might be the hindrance of reabsorption of intestinal glucose. Postprandial hyperinsulinemia could be achieved by the regular usage of chili pepper (Fathima, 2015).

Coccinia indica
Coccinia indica belongs to Cucurbitaceae family, which is abundantly grown in India and is being used traditionally for managing diabetes mellitus. In alloxan diabetic rats, Coccinia indica has proved to be hypoglycemic as well as hypolipidemic (Manjula and Ragavan, 2007). Safety and effectiveness of various parts of this plant and their derived formulations having anti-diabetic effects have also been proven by various clinical trials. Coccinia indica also possess anti-inflammatory, antipyretic, hepatoprotective, hypolipidemic and analgesic activities (Deokate and Khadabadi, 2011).

Vaccinium myrtillus
A natural source to maintain lower levels of blood sugar is blue berry (D Jini, 2011). Wild berries boost various health conditions, as they are anti-microbial, anti-inflammatory, anti-aging, anti-cancer, as well as anti-diabetic. High contents of phytochemicals like proanthocyanidins, flavonols, anthocyanins and phenolic acids are found in blue berries (Parmar and Rupasinghe, 2013).

Trigonella foenum graecum
It belongs to the family Fabaceae. It can prove beneficial for both type 2 as well as type 1 diabetes mellitus. Anti-diabetic and anti-hyperlipidemic effect of fenugreek is because of diosgenin and saponins. In laboratory animals and human beings, fenugreek can be used as a hypoglycemic herb (Aher et al., 2016).

Anti-diabetic activity of fenugreek seeds could be due to galactomannan-rich soluble fiber fraction. Pancreatic β-cells are directly stimulated by amino acids, thus the presence of amino acid 4-hydroxyisoleucine might be
 responsibly for the anti-diabetic and insulitropic properties. Delayed stomachic voidance and inhibition of aldohexose transport even have been postulated as potential mechanisms (Rashmi et al., 2011).

**Prunus dulcis**
A Seventh Day Adventists study was conducted in which it was noticed that almonds have a potential to lower postprandial blood glucose levels as well as oxidative damage in normal healthy humans. Jenkins et al. (2006) also claimed the same effect of almonds. Almond has a sweet and a bitter variety having special dietary values. They are used in cakes and biscuits as floor, as they practically contain no starch. So diabetic patients can use these cakes and biscuits (Jini, 2011).

**Ficus religiosa**
Common name is Peepal tree. It belongs to the Moraceae family having active constituent like β-sitosterol-D-glucoside, which has blood sugar lowering effect in rabbits that are made diabetic by Alloxan and in pituitary-diabetic rats (Chandrasekar et al., 2010). Nearly every part of this plant has various medicinal uses but we are concerned with hypoglycemic effects of the plant. Bark can be used for the management of diabetes. FRAE additionally showed vital increase in serum insulin and polyose content in skeletal muscles and liver of STZ-evoked diabetic rats whereas a vital depletion within serum triglyceride level and entire cholesterol was seen (Panchawat, 2012).

**Emblica officinalis**
Amla fruit has various therapeutic applications in heart diseases, hepatic disorders, cancer and diabetes as well as it is an anti-inflammatory agent. It also shows memory effects (Dasaroju and Gottumukkala, 2014). *Emblica officinalis* fruit has anti-diabetic effect in both healthy as well as diabetic individuals. In diabetic rats, oxidative stress was reduced, so was the neuropathic pain. It can enhance oxidative stress and glycemic status in non-insulin dependent diabetic rats. Anti-diabetic property of this fruit has also reported by many articles. The exact mechanism of its hypoglycemic activity is not yet clear (Fatima et al., 2015). Amla fruit has various health benefits. It can be used in conditions like heart diseases, ulcer prevention, cancer, and hepatotoxicity as well as in diabetes (Dasaroju and Gottumukkala, 2014).

**Onion (Allium cepa)**
Onion being cultivated in India, China and United States, is a part of Amaryllidaceae family. It is used as a spice in home. It contains many essential nutrients and can be used in asthma, cholera, hepatitis and stomach disease (MSH Akash et al., 2014). Its anti-diabetic properties could be due to the active constituent allyl propyl disulfide (Andallu et al., 2001). Utilization of glucose and its cellular uptake in rats, insulin release and action might be enhanced due to onion extract like glibenclamide (Ozougwu, 2011). Due to its anti-hyperglycemic and anti-hyperlipidemic effect, non-insulin dependent diabetic patients can use onions. Onions have various health benefits. It is useful in hypertension, as hypocholesterolemic, hypoglycemic, cardiovascular diseases, as well as anti-carcinogenic (Lee et al., 2013).

**Areca catechu**
Arecoline is the active constituent having hypoglycemic activity. Subcutaneous administration of alkaloid content of *Areca catechu* can have hypoglycemic activity lasting for 4/6 hours (Patel et al., 2009). It has effective glucose lowering activity in streptozotocin induced diabetic rats (Mondal et al., 2012). *Areca catechu* flowers caused hyperglycemic effect in fasting as well as decreased weight in controlled rats (with diabetes) compared to normal rats (Ghate et al., 2014).

**Camellia Sinensis**
Green tea shows various health benefits as it is antibacterial, anti-inflammatory, anti-mutagenic, anti-diabetic, antiviral as well as anti-carcinogenic. Its aqueous extract mainly contains catechins like EC, EGC, ECG, EGCG (Rani et al., 2014). By its consumption, blood glucose level was lowered in diabetic mice but it did not affect insulin level in them. If used for long time, not only it enhances insulin sensitivity but it can also prevent insulin resistance issues, anti-hypoglycemia and other metabolic defects in rats fed by fructose (Namita et al., 2012). *Camellia sinensis* enhanced insulin activity in STZ diabetic rats. Experiments proved that its lower doses exhibit insulitropic effect (Patel et al., 2012).

**Phaseolus vulgaris**
The exact mechanism of *Phaseolus vulgaris* seeds is still unknown but various authors suggest that it stimulate β-cells of pancreas and hence insulin secretion is increased. Two possible mechanisms have been proposed and both of them focus on the role of α-amylase inhibitors and phytohae-magglutinin inhibitors (Atchibri et al., 2010).

**Syzygium cumini**
In streptozotocin (STZ) induced diabetic rats, seed extract of *Syzygium cumini* has shown anti-diabetic effect. Blood glucose levels were reduced by the compounds ‘Mycaminose’ and methanol and ethyl acetate extract was found to reduce the blood glucose level (Kumar et al., 2014).

**CONCLUSION**
It was concluded that by the usage of natural diet, one could keep his blood glucose levels steady. It has been concluded that the above-mentioned natural remedies can be used for the management of diabetes. Natural plants and their extracts have effective hypoglycemic activity. Further
research work is required on this aspect of diabetic management because natural diabetic management is convenient as well as more effective than using medicines.

CORRESPONDING AUTHOR PROFILE

Rehan Tariq is a fourth year Pharm. D student in Faculty of Pharmacy, University of Central Punjab, Lahore, Pakistan. He has keen interest in research topics related to community health issues and is actively involved in various Public Health Awareness Campaigns being conducted through platform of different NGOs.

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