Potential herbs for treatment and prevention of diabetes mellitus: it's manifestation

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Abstract: The use of medicinal plants for the management of diabetes offers a promising complementary approach to conventional treatments. Plants such as Bitter melon, Fenugreek, Neem, and Ginseng have shown significant potential in reducing blood glucose levels, improving insulin sensitivity, and protecting against diabetic complications. Their bioactive compounds—like charantin in bitter melon, ginsenosides in ginseng, and curcumin in turmeric work through various mechanisms, such as enhancing insulin secretion, reducing glucose absorption, and offering antioxidant protection While these plant-based remedies have been used traditionally across different cultures and have demonstrated some efficacy in scientific studies, their therapeutic effectiveness can vary.

1.INTRODUCTION

Diabetic mellitus (madhumeh) is an disease is known for ages but its pharmacotherapy is just over 19 years old. The presence of sugar in the urine of diabetes was demonstrated by Dobson in 1755. In 1889 von mering and minkowski discovered the pancreatectomised dogs become a diabetic in addition to developing digestive disturbance. The non digestive part of the pancreas islet cells was thought to be responsible for the substance which prevented diabetes and it was christened insulin by de Mayor in 1909 long before its extraction by banking and best in 1921. There are few episodes in Medical Research as dramatic as the discovery of insulin life saving agent. [1]

Type 1 diabetes mellitus

It can develop at any age but frequently occurs in children and adolescent in case of type 1 diabetes , pancreatic Beta cells are destroyed through an autoimmune mediated reaction so that pancreases unable to produce sufficient insulin to control the blood sugar level so Type 1 Diabetes is called as insulin dependent Diabetes mellitus or juvenile onset diabetes [2]

Type 2 diabetes mellitus

Type 2 diabetes mellitus is also called as noninsuline –dependant diabetes mellitus or maturity onset diabetes mellitus .There is no loss or only moderate reduction in B cell mass ; insulin in circular is low ,normal or even high no anti b- cell antibody is demonstrable; has a high degree of genetic predisposition generally has a high degree of genetic predisposition; generally has a late onset [past middle age] over 90 percent cases of diabetes are type 2 diabetes mellitus.[3]

Management and Treatment

Type 1 Diabetes: Managed through daily insulin injections or insulin pumps, along with careful monitoring of blood sugar levels and diet.

Type 2 Diabetes: Often managed through lifestyle changes such as weight loss, regular exercise, and a healthy diet. Medications like metformin are also commonly prescribed, and in some cases, insulin therapy may be necessary.

Symptoms of Diabetes Mellitus:-

Hyperglycemia,. Glycosuria, Weakness or tiredness ,Loss of body weight ,.intense thirst (polydypsia) ,. Dehydration , Breathlessness , Polyuria , Reduced visual activity ,Pains in legs , Dry skin, cracked lips ,Infection of in, lung and urinary tract ,rapid pulse , low BP [4]

2. CAUSES AND RISK FACTORS OF DIABETES

1. Type 1 Diabetes *Causes:* Type 1 diabetes is primarily caused by an autoimmune reaction, where the body's immune system mistakenly attacks the insulin-producing beta cells in the pancreas. The exact cause is unknown, but a combination of genetic susceptibility and environmental factors, such as viral infections, may trigger this response.

Risk Factors:
○ Heredity (having a parent or brother and sister with type 1 diabetes) ○ Genetic predisposition (specific genes like HLA-DQA1, HLA-DQB1) ○ Environmental triggers (viruses such as Coxsackievirus or mumps)

2. Type 2 diabetes mellitus
Causes: Type 1 diabetes is primarily caused by progressive loss of beta cells insulin secretion. Because of insulin resistance.

Risk Factors:
- Weight gain
- Reduce physical activity
- Histry of cardiovascular disease
- Women with polycystic overy disease
- Dislipidemia
- To early identification of impares fasting glucose[5]

3. COMPLICATIONS

Diabetic mellitus wich affecting on both smaller and large vessels that is microvascular and macrovascular complications respectively the microvascular risks affect the renel the most expensive complication with diabetes with persist foot ulcers and or amputations furthermore eye injury can due to blindness while macrovascular disorders such as coronary heart failure ,peripheral artery diseases and stroke .

1. The macrovascular complications of diabetes –diabetes mellitus is a complicated and persistent condition that includes lifelong medical treatment consisting of coronary artery disease with a high risk of disease on patients with multipal macrovascular complications associated with it .

2. Cerebrovascular disease macrovascular and microvascular conditions cause complex cerebrovasdcular conditions in patient with diabetes mellitus. Brain artery disorders can be categorized as ischemic cerebrovascular disease hemorrhagic cerebrovascular disease depending on pathogenesis and anatomy in diabetes mellitus cases

3. Diabetic cardiomyopathy is called as a pathological heart type because of this following risk factors can occurs such as coronary artery disease also cause hyperextension and severe valve dysfunction.

4. Diabetic foot - Diabetic foot is arise on the soles of the feet in patients with diabetes mellitus because of peripheral neuropathy or peripheral arterial disease on all skin layers [6]

PATHOPHYSIOLOGY

Diabetes is a metabolic disorder characterized by chronic hyperglycemia due to defects in insulin secretion, insulin action, or both. The pathophysiology differs between the two primary types of diabetes—Type 1 and Type 2—but both share common features of impaired glucose metabolism and associated complications.

1. Type 1 Diabetes Mellitus (T1DM)

In Type 1 diabetes the immune system attacks because of a autoimmune disease and destroys the insulin-producing beta cells of the pancreas. This autoimmune reaction is typically initiated by environmental triggers in genetically susceptible individuals, such as viral infections (e.g., Coxsackievirus). The pulling down of beta cells leads to complete deficiency of insulin. Lacking of insulin, glucose cannot be taken up by cells, leads to hyperglycemia.

Key features include:
• Autoimmune destruction: The immune system, particularly T cells, targets the beta cells.

• Loss of insulin production: As beta cells are destroyed, insulin levels drop, leading to unregulated glucose production by the liver.

• Ketogenesis: In the absence of insulin, the body breaks down fat for energy, leading to the production of ketones, which can result in diabetic ketoacidosis (DKA), a life-threatening condition.[7]

2. Type 2 Diabetes Mellitus (T2DM)

Type 2 diabetes is distinguished by insulin resistance and a relative insulin deficiency. In the early stages, the body produces insulin, but the cells become resistant to its effects, particularly in muscle, liver, and adipose tissue. To compensate, the pancreas initially increases insulin production, but over time, beta cells begin to fail, and insulin production decreases, leading to hyperglycemia.

Key features include:

- Insulin resistance: Target cells in the liver, muscles, and adipose tissue become less responsive to insulin, primarily due to factors like obesity, which promotes the release of free fatty acids and inflammatory cytokines that interfere with insulin signaling.

- Beta cell dysfunction: Chronic hyperglycemia and increased demand for insulin lead to beta cell exhaustion and apoptosis (cell death), further reducing insulin production.

- Glucotoxicity and lipotoxicity: High glucose levels (glucotoxicity) and elevated free fatty acids (lipotoxicity) worsen insulin resistance and beta cell dysfunction, creating a vicious cycle of hyperglycemia.[8]

ALLOPATHIC REMEDIES

Ant idiabetic medicine are classified as following

1. Hormones – Insulin
2. Oral hypoglycemic agents

[a] Sulphonylureas eg- chlorpropamide, tolbutamide, glibenclamide

[b] Biguanides eg- phenformin, metformine.[9]

CRUDE DRUGS USED IN DIABETES MANAGEMENT

Several medicinal plants and crude drugs have been traditionally used for the management of diabetes, particularly in herbal and Ayurvedic medicine. These plants help regulate blood glucose levels and have been studied for their potential anti-diabetic properties.

1. Bitter Melon (Momordicacharantia)

Bitter melon, also known as bitter gourd, has been widely used in traditional medicine for managing diabetes. Its fruit contains bioactive compounds that mimic insulin and help lower blood sugar levels

Bitter melon is also called as karela or momordica charantia family of bitter melon is cucurbitaceae Biological source it consist of fresh green fruits of the plant known as momordica charantia the chemical constituent of bitter melon is charantin wich is present in leaves and fruits also chemical constituents such as carbohydrates , mineral matter , ascorbic acid ,alkaloids , glucosides saponins and mucilage .

A steroidal saponin charantin which has such a property that it has reduce blood sugar activity

Uses of karela.- used as a anti diabetic agent , stomachic , carminative , tonic and cooling also used as attreatment for gaut , rheumatism anthelmintic , anti cancer properties [10]

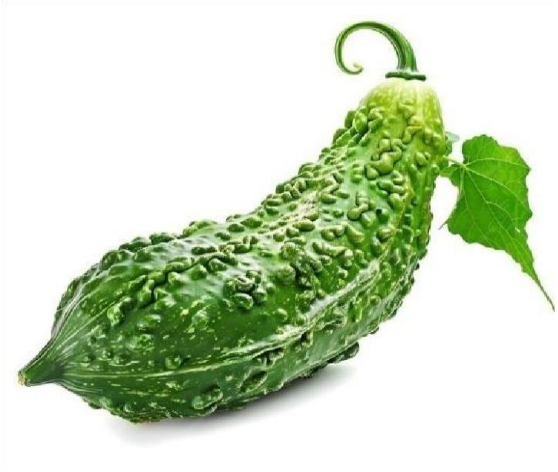

Fig 1.1 Bitter Melon

- Mechanism: Bitter melon contains charantin, polypeptide-p, and vicine, which are thought to reduce blood glucose levels. It helps improve insulin sensitivity and promotes glucose uptake in cells.

- Use in Diabetes: It is commonly used in juice, powder, or supplement form to help manage type 2 diabetes.[11,12]

2. Fenugreek (Trigonellafoenum-graecum)

Fenugreek in marathi is also called as methi.

Biological source - it consist of dried seeds and leaves of Trigonella foenum-gracum .Belonging to the family Fabaceae

Geographical source –fenugreek is found in native of south Easterrn Europe and West Asia.now cultivated in india Fenugreek consist rich source of protein, minerals, vitamins, carotene, fiber, carbohydrates, bioactive compounds .

Fig .2.1 Fenugreek

Fenugreek seeds are a popular herbal remedy for diabetes. They contain soluble fiber, which helps slow down the absorption of carbohydrates and sugar, helping to regulate blood glucose levels

Mechanism: Fenugreek seeds are rich in galactomannan and 4-hydroxyisoleucine, compounds that improve insulin function and reduce glucose absorption from the digestive tract.

Use in Diabetes: Consuming fenugreek seeds or extracts helps manage blood sugar levels, especially in type 2 diabetes.[13,14]

3. Gymnema (Gymnema sylvestre)

It consists of leaves of Gymnama sylvestre. Belonging to Family - Asclepiadaceous
Gudmar, /mdhu nashini

Geographical distribution – It is also found in Northern and western parts of India occationaliy It is cultivated for medicinal purpose.

Fig 3.1 Gymnema

Chemical constituents:- it consist of Hentriacontane, pentriacontane, phytin, alpha and beta chlorophylls ,resin, tartaric acid ,formic acid butyric acid, mucilage inositol, d-quircitol, gymnemic acid, anthraquinone derivative. Gymnemic acid is antisacchrine principle occurring as potassium salt.

uses:- It is used as Anti Diabetic, stomachia, stimulant,, laxative and diuretics .the antidiabetic formulations of this drug are commercially available.

Hypoglycemic effect of this drug is due to indirect stimulation of insulin secretion by pancreas. [15]

Gymnema is known in Ayurvedic medicine as "gurmar," meaning "sugar destroyer." It is used to suppress the taste of sugar and help control sugar absorption.

Mechanism: Gymnemic acids in the plant help block sugar absorption in the intestines and increase insulin secretion. It also helps regenerate beta cells in the pancreas.

Use in Diabetes: It is used to lower blood sugar levels in people with type 2 diabetes and reduce sugar cravings.[16,17]

4. Cinnamon (Cinnamomumverum)

Cinnamon consists of dried inner bark of Cinnnamomum zeylanicum belomging to family Lauraceae It Is also called as kalmi ,Dalchini in marathi

Fig 4.1 Bark of Cinnamon

It is mostly distributed in Shrilanka and Malabar coast of india.

Main active chemical constituents is Eugenol it also contains cinnamaldehyde and polyphenols[18]

Cinnamon is commonly used as a spice, but it also has medicinal properties that help manage diabetes by lowering blood sugar levels.

Use in Diabetes: Regular consumption of cinnamon in small amounts, either as a spice or in supplement form, can aid in blood sugar control in type 2 diabetes [19].

5. TURMERIC

Turmeric is also called as Indian saffron, haldi, haridra.

The biological source of turmeric is it consist of dried, as well as fresh rhizomes of plant known as curcuma longa linn

Turmeric belonging to the family Zingiberaceae.

Fig 5.1 Rhizome of Turmeric

Geographical source -Turmeric is found in the tropical countries and also cultivated in india ,china and west Pakistan it is largly cultivated at maharashtra

Chemical constituents of turmeric-volatile oil, resin, curcuminoids, termeron, zingiberene, borneol, caprylic acid, turmeric oil. The main chemical constituent of turmeric is curcumin which possess antimicrobial,anti-inflammatory and also antidiabetic property.

Mechanism: Curcumin, the active compound in turmeric, has anti-inflammatory and antioxidant properties. It helps improve insulin sensitivity and reduces glucose levels.

Uses- Turmeric is used as antiseptic, expectorant, condiment / spice and colouring agent also used for diabetes.[18]

6.GINSENG

Ginseng is also called as Panax, Pang, Ninjin
Biological source of it is the dried root of various species of panax such as P. ginseng P japonica,P. notoginseng.

Belonging to the family –Araliaceae

Fig 6.1 Root of Ginseng

Geographical source of Ginseng is widely grows in korea, china and Russia.In india at present it is cultivated in kohima.

Ginseng consist of Chemical constituents of several saponin glycosides such as oleanolic acid, panaxadiol and panaxatriol. Uses of Ginseng are, stimulant and sedative, also used as aphrodisiac, It is also used as prolonging life of elderly and diabetic persons .[18]

Mechanism: Ginsenosides, the active compounds in ginseng, have been shown to improve insulin secretion, enhance glucose uptake, and reduce insulin resistance.[20]

CONCLUSION

Many natural plants consists of a rich source of bioactive chemicals, which are free from undesirable side effects and contains very powerful pharmacological actions. Plants have been considered a fundamental source of potent abtidiabetic drugs .Nowadays treatments of diseases including diabetes using medicinal plant are recommended because these plants contain various phytoconstituents such as flavonoids , terpenoids , saponins ,carotenoides ,alkaloids,and glycosides which may possess ant diabetes activities . we use medicinal plant for the management of of diabetes because they have few side effects and more effective as compare to allopathic medicine .

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