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A Review Article on Sitagliptin and Some Medicinal Plants with Antidiabetic Activity

Gupta Lavisha*[*1], Ravindra [2], Chauhan Chetan[3], Sharma Manisha [4]

[1]M. Pharma in Pharmaceutical Quality Assurance BN College of Pharmacy Udaipur
[2]Associate Professor, BN College of Pharmacy Udaipur
[3]Professor and Principal, BN Institute of Pharmaceutical Sciences, Udaipur
[4]Senior Executive of Quality Assurance, Mednext Biotech. Limited. Udaipur

ABSTRACT

Sitagliptin is a DPP-4 inhibitor recently approved for the treatment of type 2 diabetes. Like other DPP-4 inhibitors, its action is mediated by increasing levels of the incretin hormones glucagon-like peptide-1 (GLP-1) and gastric inhibitory polypeptide (GIP). Sitagliptin is effective in lowering HbA1c, fasting and postprandial glucose as monotherapy and in combination with other oral antidiabetic agents. It stimulates insulin secretion in hyperglycemia and inhibits glucagon secretion. It is weight neutral in clinical trials. This article reviews the mechanism of action, pharmacology and clinical efficacy and safety of sitagliptin in the treatment of type 2 diabetes.

In recent years, herbal medicine has exploded and gained popularity in developing and developed countries due to its natural origin and fewer side effects. An extensive study of medicinal plants used in the treatment of diabetes was collected. It is a metabolic disorder of the endocrine system and affects almost 10% of the world's population, and the number of sufferers is increasing every day. The presented profiles include information on the scientific and family name, the plant parts used and the experimental model, the degree of hypoglycemic activity and the active chemical substances. The large number of plants described in this review (108 plant species belonging to 56 genera) clearly demonstrated the importance of herbal plants in the treatment of diabetes. The effects of these plants can delay the onset of diabetic complications and improve metabolic disorders. This work encourages researchers to continue investigating the potential use of medicinal plants in diabetes prevention.

Different plants used to treat diabetes. Diabetes is one of the most common non-communicable diseases in the world. It is the fourth leading cause of death in most developed countries and even an epidemic in many developing and newly industrialized countries. This is a serious threat in the 21st century. Since ancient times, plants have been an exemplary source of medicine. Ayurveda and other Indian literature mentioned the use of plants in the treatment of various diseases. Of the estimated 250,000 higher plants, less than 1% have been studied pharmacologically and very few for diabetes. There are few systematic studies on traditional medicinal plants for diabetes.

Diabetes is a metabolic disorder characterized primarily by hyperglycemia resulting from disturbances in insulin secretion or insulin action, or both. It is divided into two types, type I and type II diabetes. Risk factors affecting diabetes include genetic factors, obesity, hypertension, etc. Many drugs such as biguanides, sulfonylureas, meglitinides, etc. are traditionally used to treat diabetes. Medicinal plants are traditionally widely used in India for the prevention and treatment of diabetes. This review article contains a description of herbs that are said to be good diabetes remedies.

Keywords: DPP-4 inhibitor, Medicinal plant, Diabetic drug, Diabetes, Hyperglycemia.

INTRODUCTION:

Diabetes is a condition in which blood sugar is higher than normal. That way, you can check if the food you eat helps control blood sugar. Before we look for answers on how to cure diabetes naturally at home, we should understand the food we eat. Some foods raise blood sugar quickly. These are foods with a high glycemic index. Although some foods are known to release glucose very slowly. These are foods with a low glycemic index (potential natural diabetes remedies). Therefore, the right choice of natural foods with a low and high glycemic index can help regulate sugar levels.

Medicinal plants are still an important therapeutic aid in alleviating human diseases. During the past 2,500 years, very strong traditional medical systems such as Chinese, Ayurvedic and Unani were born and practiced on the eastern continent. These traditions continue to flourish because; Approximately 80 percent of people in developing countries rely on these medical systems for their primary health care needs [1] . These plants contain substances that can be used for therapeutic purposes and are the starting material for the synthesis of medicinal substances [2]. Certain herbs have been extensively studied and found to have specific effects on the nervous, circulatory, respiratory, digestive and urinary systems. and genitals, skin, vision, hearing and taste [3] . Diabetes is a group of metabolic changes characterized by hyperglycemia resulting from impaired insulin secretion, action, or both. It consists

of two types: Type I and Type II. Type 1 diabetes, often called juvenile diabetes, is insulin-dependent and is known to affect only 5% of diabetics. Type II, which does not depend on insulin, usually occurs in adults over 40 years of age. Chronic hyperglycemia in diabetes has already been shown to be associated with long-term damage, dysfunction, and ultimately organ failure, especially in the eyes. kidneys, nerves, heart and blood vessels [4]. It has adverse effects on carbohydrate, lipid and protein metabolism, leading to chronic hyperglycemia and lipid profile abnormalities. They lead to several secondary complications such as polyurea, polyphasia, ketosis, retinopathy and cardiovascular disease [5]. Despite the introduction and widespread use of hypoglycemic agents, diabetes and its complications continue to be a major health problem worldwide, affecting almost 10% of the world's population [6] and considered a leading cause of high blood sugar. economic damage, which in turn can hinder the development of nations [7]. It is expected to become one of the leading causes of disability and killers in the world within the next 25 years. Many factors influence the development of diabetes and are called susceptibility or risk factors. Environmental factors such as diet, obesity and a sedentary lifestyle increase the risk of diabetes. Other important risk factors are family overcrowding, insulin resistance, nutritional status, age and lifestyle changes due to urbanization [8]. Until now, the treatment of diabetes is a global problem and no successful treatment has yet been found [9].

Diabetes mellitus (DM) is the most common hormonal disease, currently affecting more than 100 million people worldwide, and the number of diabetics is increasing due to population growth, aging, obesity and disability 1 - 2 . India is the second most populous country in the world and has more people with type 2 diabetes than any other country because the disease occurs in both sexes and in all age groups from 3-4 years.

According to the World Health Organization, 422 million adults suffered from diabetes in 2014. It causes 1.5 million deaths in 2012, and it is seen that most of the population suffers mainly from type 2 diabetes. It was also established that type 2 diabetes used to be diagnosed in adults, but now also occurs in children5. Oxidative stress is a known pathogenic mechanism in the development and progression of diabetes caused by increased production of free radicals and decreased antioxidant defense6-8.

According to recent estimates, approximately 438 million people (7.8%) of the adult population will suffer from diabetes by 20305. Some reasons such as stress, rapid development of cities and a significant increase in purchasing power, lifestyle and ease of metro life have led to health problems and an increasing number of people suffering from these diseases 6 . The cost of treating diabetes and its complications exceeds $100 billion annually, and complications are much less common and mild in people with well-controlled blood sugar7. Treatment of diabetes with synthetic drugs is generally not recommended due to its high cost and side effects. Therefore, it is necessary to develop traditional and alternative medicine. Herbal medicines are an important part of traditional medicine, and the literature shows that more than 400 plant species have antidiabetic effects8.

Many drugs are traditionally used to prevent and treat diabetes, such as biguanides, sulfonylureas, meglitinides, PPAR-γ agonists (glitazones), α-glucosidase inhibitors, DPP-4 inhibitors, SGLT2 inhibitors, dopamine-2 agonists, etc. . Effective diabetes treatments have not yet been achieved9. Research is currently underway to find alternative effective diabetes medications.

DIABETES MELLITUS

Diabetes is a lifelong (chronic) disease and a group of metabolic disorders characterized by high blood sugar levels (hyperglycemia) [1]. This is due to lack of insulin or insulin resistance or both. Pancreatic B cells secrete insulin to regulate blood sugar. Blurred vision, excessive thirst, fatigue, frequent urination, hunger and weight loss are some of the symptoms commonly experienced by diabetics [2].

DIABETES SIGNS AND SYMPTOMS

- Increased thirst
- Frequent urination
- Unexpected weight loss
- Increased fatigue
- Numbness and tingling, especially in the legs and arms
- Slow healing ulcers
- Red, swollen, tender gums
- Itchy skin
- Irritability
- Blurred vision

TYPES OF DIABETES:

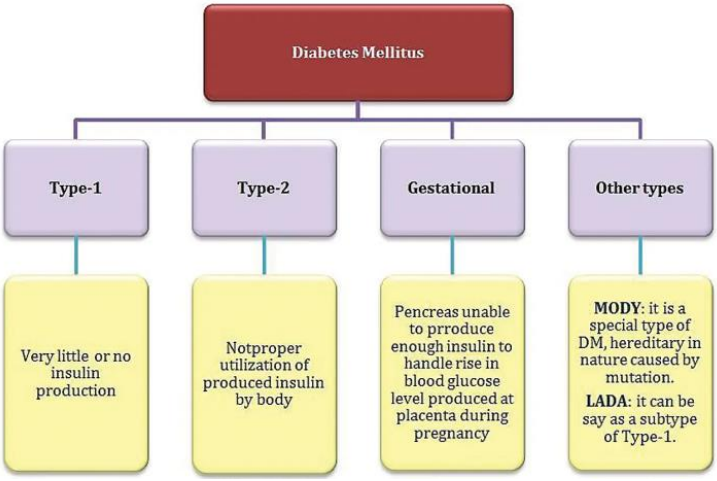


Figure: classification of diabetes according to WHO

Type 1: Diabetes is known as insulin-dependent diabetes and is characterized by insufficient insulin production and requires daily administration of insulin. This is due to cell-mediated autoimmune destruction of pancreatic b cells.

Type 2: Diabetes, commonly known as non-insulin-dependent diabetes, causes insulin to be used ineffectively. The development of type 2 diabetes is usually accompanied by the following risk factors, such as genetic factors, obesity, poor diet, insufficient physical activity, increasing age, hypertension, etc. 2-3. There is also another type of diabetes called gestational diabetes, which is mainly due to glucose intolerance and starts during pregnancy. This is a temporary condition but may be associated with a long-term risk of diabetes4.

Gestational diabetes (GDM): Diabetes diagnosed in the second or third trimester of pregnancy that is not overt diabetes.

MEDICAL TREATMENT OF TYPE 1 DIABETES

Insulin:

- Short acting insulin
- Rapid acting insulin
- Intermediate acting insulin:
- Long-acting insulin:
- Combined insulins (premixed)
- Amylinomimetic injections

MEDICAL TREATMENT OF TYPE 2 DIABETES

I. Insulin and its analogues

II. Oral hypoglycemic drugs

1. Sulfonylureas (substances that increase insulin secretion):

a) First generation: tolbutamide, chloropropamide

b) Second generation: glibenclamide, glipizide, gliclazide,

Glimepiride

2. Biguanides: Metformin

3. Meglitinides (substances that increase insulin secretion): repaglinide, nateglinide

4. Thiazolidinediones: rosiglitazone, pioglitazone

5. a - glucosidase inhibitors: acarbose, miglitol

III. Bile acid sequestration: colesevelam hydrochloride

IV. Amylin analog: Pramlintide

V. GLP-I receptor agonists: exenatide, liraglutide

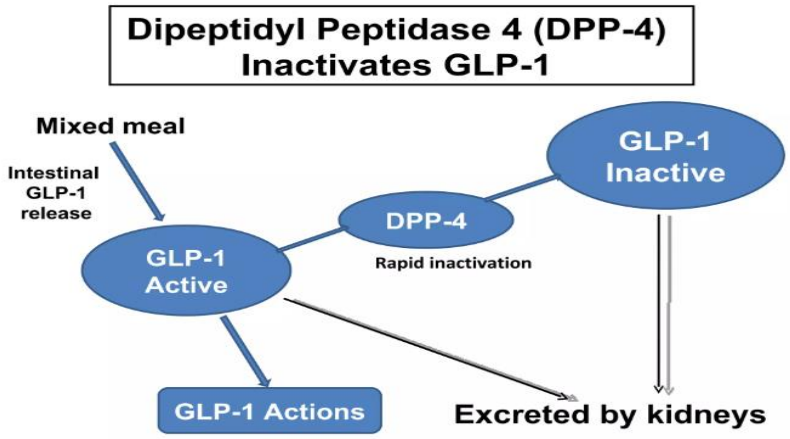
DPP-IV inhibitors: sitagliptin, vildagliptin, linagliptin, alogliptin

NEW Treatments

➤ **GLP-1 Analogs:** Exenatide

➤ **Dipeptidyl Peptidase-4 (DPP 4) inhibitors:** Sitagliptin, Saxagliptin, Vildagliptin. DPP-IV INHIBITORS/GLIPTINS

DPP-IV INHIBITORS/ GLIPTINS



DPP-IV inhibitors, or Gliptins, came into the picture when it was discovered that these compounds could change the physiological mechanism of the body. Endocrine cells in the mucosa of the small intestine normally release certain peptides in response to food, which increase food-induced insulin secretion and also modulate glucagon lowering during eating. These are called incretin hormones. There are two main physiologically important incretin hormones in humans: (1) GLP-1 (glucagon-like peptide) and (2) GIP (glucose-dependent insulinotropic polypeptide). In type 2 DM patients, postprandial secretion of GLP-1 is slightly reduced, but the effect of GLP-1 is preserved. Although GIP secretion is normal in type 2 diabetics, these individuals are relatively resistant to the acute insulinotropic effects of exogenous GIP administration.

In diabetes, GLP-I plays an important role:

a) Increases glucose-dependent secretion of insulin.

b) Reduces glucagon secretion and thus reduces postprandial and fasting hyperglycemia. Improves insulin sensitivity and promotes glucose disposal

c) Reduces gastric emptying and thus creates a feeling of satiety.

d) timulates the biosynthesis of insulin.

In vitro studies and animal studies have shown that both GLP-I and GIP promote the growth and survival of pancreatic cells. Dipeptidyl peptidase IV enzyme, on the other hand, rapidly inactivates these peptides. Therefore, DPP-IV inhibitors have been proposed to explore the potential of incretin hormones.

The list of available and anticipated DPP-IV inhibitors is as follows:

1. Sitagliptin (Merck Sharp and Dohme Corp, US FDA approved as Januvia in 2006)

2. Vildagliptin (Novartis, EU recognized in 2007 as Galvus)

3. Saxagliptin (Bristol-Myers Squibb, US FDA approved Onglyza in 2010)

4. Linagliptin (Boerhinger Ingelheim, US FDA approved Tradjenta in 2011)

5. Alogliptin (developed by Takeda Pharmaceutical Company Limited, approved for use in Japan)

6. Dutogliptin (developed by Phenomix Corporation)

7. Gemigliptin (developed by LG Life Sciences)

Sitagliptin, vidagliptin and saxagliptin are approved for use in India.

SITAGLIPTIN

Sitagliptin was the first DPP-IV inhibitor approved by the US FDA in 2006. It was marketed by Merck Sharp and Dohme (MSD) under the name Januvia. Sitagliptin inhibits the sustained action of DPP-4 and is indicated for the treatment of type 2 DM to improve glucose balance in combination with metformin or a thiazolidinedione (TZD) when diet and exercise plus metformin or a TZD do not provide adequate glucose balance.

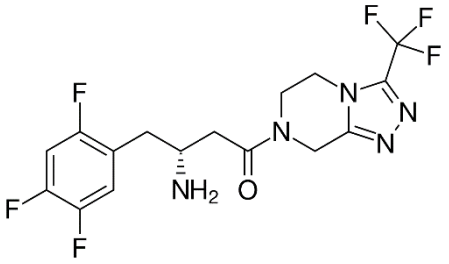
Sitagliptin Brands Available in India:

1. Januvia, Janumet (MSD)

2. Istamet, Istavel [Sun pharma (Arian)]

3. Sitar-M [Olcare (Cardium)]

4. Zita-Met (Glenmark)



MECHANISM OF ACTION OF SITAGLIPTIN

Sitagliptin is a highly selective DPP-IV inhibitor compared to other gliptins.

It is an orally active DPP-IV inhibitor that prevents the degradation of endogenous GLP-I and other incretins, enhancing their effects, thus limiting postprandial hyperglycemia.

The recommended dose is 100 mg once daily with or without food.

Sitagliptin reduces HbA1c by approximately 0.7% and is equally effective when combined with metformin or pioglitazone.

An Asian study (China-India-Korea study) showed that sitagliptin was more effective in an Indian population: HbA1c was reduced by approximately 1.3% compared to placebo.

Pharmacokinetic Parameter of Sitagliptin	
Parameter	**Value**
Bioavailability	>85%
Half-life	about 12 hours
Absorption	1-4 hours
Distribution	38% bound to proteins
Metabolism	Not significantly metabolized
Renal excretion	(80% unchanged)

Since sitagliptin is excreted by the kidneys, the dose should be adjusted if**:**

Renal Insufficency:

a) Moderate renal failure: 50 mg per day

b) Severe/end-stage renal failure: 25 mg daily

Administration of sitagliptin with other drugs, including metformin, pioglitazone, glyburide, rosiglitazone and simvastatin, did not show interactions. However, its concomitant use may increase serum digoxin concentrations.

• Sitagliptin is a pregnancy risk category B substance and should be used during pregnancy if considered necessary. Caution is also recommended for breastfeeding women.

• Currently, it is not known whether sitagliptin passes into breast milk, nor is it known whether it affects nursing infants. Safety and efficacy in patients 18 years of age have not been studied.

Efficacy & Safety of Sitagliptin in Indian T2D patients:

• Sitagliptin (100 mg) monotherapy for 18 weeks significantly improved glucose control by reducing HbA1c, fasting and postprandial glucose levels in Indian type 2 diabetics (T2D).

• Sitagliptin was well tolerated and hypoglycemia was not reported.

• Low risk of hypoglycemia

• Weight-neutral substance.

• Side effects such as nausea, constipation, diarrhea and nasopharyngitis are mild and transient.

• However, serious hypersensitivity reactions including anaphylaxis, angioedema and exfoliative skin disorders have been reported in patients treated with sitagliptin. Therefore, it is contraindicated in individuals who have had a severe hypersensitivity reaction to it.

Advantages of Sitagliptin Compared To Other Agents Used To Treat T2DM:

• Good tolerability profile and low incidence of side effects.

• The effect of incretin hormones (GLP-I, GIP) on the synthesis and release of insulin depends on glucose, so the risk of hypoglycemia is very low compared to sulfonylureas, meglitinides and insulin.

• No weight gain.

Clinical Efficacy Studies of Sitagliptin:

Double-blind, placebo-controlled studies were conducted to demonstrate the clinical efficacy of sitagliptin as monotherapy and in combination therapy.

1. Monotherapy:

Sitagliptin significantly improved HbA1C, FPG and PPG compared to placebo. It was found to be equally effective compared to metformin, SUs and thiazolidinediones. Sitagliptin monotherapy requires intact ß cells, so it is best used in people with early stage diabetes.

2. With Metformin:

This combination was found to be significantly better than placebo. Sitagliptin and metformin were well tolerated and had a lower risk of hypoglycemia than glipizide and metformin.

This combination may benefit patients with T2DM by improving the incretin axis.

3. With Pioglitazone:

Sitagliptin and pioglitazone significantly improved HbA1C and FPG compared with placebo and pioglitazone.

4. With Glimepiride:

Sitagliptin combined with glimepiride with or without metformin significantly improved HbA1C and FPG compared with placebo and glimepiride.

However, with or without the combination of sitagliptin and glimepiride and metformin, the incidence of hypoglycemia was higher and body weight increased by 1.1 kg compared to the combination of placebo and glimepiride.

In combination with sitagliptin and sulfonylurea, it may be necessary to reduce the dose of SU to reduce the risk of hypoglycaemia.

New Treatment Guidelines:

The American Diabetes Association (ADA), American Association of Clinical Endocrinologists (AACE), European Society and NICE (UK) guidelines approve sitagliptin as monotherapy and as adjunctive therapy with metformin and thiazolidinediones, especially when the patient has an increased incidence of hypoglycemia. and/or weight gain. However, sitagliptin is not approved for use in patients with type 1 diabetes or in the treatment of diabetic ketoacidosis.

Regulatory Affairs:

• In October 2006, the US Food and Drug Administration (FDA) approved sitagliptin as monotherapy and as an add-on to two other oral diabetes medications.

• In March 2007, it was approved by the European Union.

• In April 2007, the FDA approved a combination of sitagliptin and metformin for the treatment of type 2 diabetes.

• Sitagliptin is currently approved in 70 countries.

Sitagliptin Summary:

✓ DPP-4 Inhibitor

✓ There is no clinically significant hypoglycaemia

✓ Reduces HbA1c

✓ Weight neutral

✓ Stimulates insulin secretion

✓ Good tolerance

✓ Prevents glucagon secretion

✓ Slows down gastric emptying

✓ Reduces food intake

✓ Improves blood pressure

✓ Improves inflammatory markers.

Herbs Used To Treat Diabetes

Plants have always been a very good source of medicine and many of the medicines available today are derived directly or indirectly from them. The use of herbs in treatment has certain advantages such as easy availability, few side effects, etc. This review describes medicinal plants for diabetes that have a good therapeutic effect based on a comprehensive review of the literature. In India, many medicinal plants have been found to be useful in the treatment of diabetes. Ethnobotanical data indicate that about 800 plants may have antidiabetic potential10.

Why herbs for diabetes:

- Medicinal plants are a potential source of medicines
- Minor Side Effects
- Low Costs
- Solve Financial Problems
- Wide Availability
- Experimentally Evaluated

Ethnobotanical data suggest that approximately 800 plants may have antidiabetic potential, of which Momordica charantia, Pterocarpus marsupium and Trigonella foenum greacum are all known to be useful in the treatment of type 2 diabetes[3],[8]. Several such herbs have shown antidiabetic activity when evaluated by various experimental methods. A wide variety of plant-derived active ingredients representing different types of biological activity, including alkaloids, glycosides, galactomannan pistol, polysaccharides, peptidoglycans, hypoglycans, guanidine, steroids, carbohydrates, glycopeptides, terpenoids, amino acids, and inorganic ions, have shown activity. , including the treatment of diabetes [10]. Tables 1 and 2 show a list of medicinal plants with antidiabetic effects according to the parts used and the mode of action.

1. Thespesia Populnea

Thespesia populnea Thespesia populnea (Malvaceae) is the most famous evergreen tree, commonly known as the tulip tree of India. The plant is common in tropical regions and coastal forests of India. The ethanol extract of the bark and leaves of the plant has a hypoglycemic effect, which was evaluated in streptozotocin (STZ)-induced diabetic rats and compared with the standard drug glibenclamide. It was assumed that the extract prevents the formation of free radicals31.

2. Ficus

Ficus racemosa (Moraceae) is used in traditional medicine to treat several diseases, including diabetes. The ethanol extract of the bark had antihyperglycemic and hypoglycemic effects in alloxan-induced diabetic rats. A dose of 100–500 mg/kg of the extract significantly reduced blood glucose24. The antidiabetic potential of the methanol stem bark extract of Adansonnia digitata (Bombacaceae) was investigated in streptozotocin-induced diabetic mice. The plant extract was administered intraperitoneally to rats at doses of 100, 200 and 400 mg/kg. The results show that the bark extract reduced hyperglycemia to a great extent25.

3. Afzelia the African

Antidiabetic properties of Afzelia africana (leguminosae) stem bark aqueous extract and its beneficial effects on hematological parameters reported in streptozotocin-induced diabetic rats. The extract was administered in a dose of 200 mg/kg, which significantly lowered blood sugar. Apart from hyperglycemia, it also prevents various complications of diabetes26.

4. Berberis Aristata

Berberis aristata (Berberidaceae) is used in traditional Indian medicine to treat diabetes. The antidiabetic effect of the methanolic extract of this plant was observed in streptozotocin-induced diabetes in adult male Wistar rats. Unlike diabetes drugs, it is also used for antibacterial, antimenstrual, diarrhea, eye diseases, skin diseases, etc. 27.

5. Elaeodendron Glaucum

Elaeodendron glaucum (Celastraceae) is a medium-sized tree found throughout India, Australia, America, South Africa and tropical Asia. A methanolic extract of this plant has antidiabetic activity in normal and alloxan-induced heterozygous adult Charles Foster (CF) albino rats28.

6. Terminalia Arjuna

The stem bark of Terminalia arjuna has antidiabetic activity, which was studied in alloxan-induced diabetic rats. The ethanol extract of the bark was administered in doses of 250 and 500 mg/kg, which significantly lowers blood sugar and reduces the activity of glucose-6-phosphatase, fructose-1, 6-disphosphatase, aldolase and increases the activity of phosphoglucoisomerase. and hexokinase in tissues29**.**

7. Ougeinia Oojeinensis

Ougeinia oojeinensis (Leguminosae) bark was found to have hypoglycemic and hypolipidemic properties in alloxan-induced diabetic rats. Bark extract was administered orally at a dose of 200 mg/kg due to its hypoglycemic effect. The extract also reduces elevated biochemical parameters such as triglyceride, low-density lipoprotein, total cholesterol, etc.

8. Bougainvillea glabra (B.G.)

Bougainvillea glabra is also called the garden glory of the Nyctaginaceae family. It is native to South America and is a popular plant in California and Florida. Aqueous and methanolic leaf extracts have antidiabetic potential studied in alloxan-induced diabetes mellitus in male albino rats. Phytochemical screening shows the presence of alkaloids, flavonoids, saponin and cardiac glycosides. 100 mg/kg and 400 mg/kg B.G. significantly reduced blood glucose in diabetic animals20. Cajanus cajan is commonly known as pigeon pea and belongs to the Fabaceae family. The findings showed that the methanol leaf extract of Cajanus cajani has antidiabetic activity, which was studied in alloxan-induced diabetic and oral glucose-fed rats. It was investigated that the extract (400 and 600 mg/kg) significantly lowered the fasting blood glucose of alloxan-induced diabetic rats in a dose-dependent manner, reaching the maximum hypoglycemic effect after 4-6 hours. The extract also significantly inhibited the peak postprandial rise in blood glucose in normal rats by 101.8% and 57.40%

9. Aframomum Melegueta

Medications currently used to treat pain and inflammatory conditions are either steroidal (eg corticosteroids) or non-steroidal (eg aspirin). All these drugs have more or less side effects and toxic effects, such as kidney failure, allergic reactions, hearing loss, or can increase the risk of bleeding by affecting platelet function. 9 On the contrary, many herbal medicines have been used for a long time without side effects. Therefore, efforts should be made to introduce new medicinal plants to develop more effective and cheaper medicines. Plants represent a large natural source of useful compounds that can play a leading role in the development of new medicines.10 In this review, an attempt was made to summarize various medicinal plants with antidiabetic and pain relief properties that may be useful to mankind.

10. Anacardium occidentale (cashew)

Anacardium occidentale (Anacardiaceae) methanol leaf extract was studied in streptozotocin-induced diabetic rats. Oral administration of methanol extracts at doses of 35, 175 and 250 mg/kg significantly lowers blood glucose in diabetic rats. Fractions of hexane and ethyl acetate showed the most striking effect, suggesting the presence of non-polar and polar hypoglycemic compounds in the plant17. Another study investigated that a methanolic extract of the stem bark of the cashew plant has antidiabetic effects in fructose-fed (diabetic) rats18.

11. Ipomoia Digitata

The antidiabetic activity of different fractions of Ipomoia digitata was investigated in alloxan-induced diabetic rats. The extract was used in a dose of 100 mg/kg, medium dose of 200 mg/kg, high dose of 400 mg/kg of body weight. Glibenclamide (10 mg/kg of body weight) was used as a standard comparison32.

12. Ginseng

Methanolic extract of the root of Nyctanthes arbortristis (Oleaceae) has safe and potent antidiabetic activity studied in alloxan-induced diabetic rats. The antidiabetic effect was compared with a standard drug such as glibenclamide. A methanolic extract at a dose of 500 mg/kg was found to have significant hypoglycemic effects 35 . Ginseng (Araliaceae) is a well-known medicinal plant used in traditional oriental medicine. In recent decades, ginseng root has gained popularity as a dietary supplement in the United States. It was also often used in medicine to treat diseases such as diabetes. The mechanism behind this effect is that ginseng increased insulin release from pancreatic β-cells, which is likely due to increased β-cell stimulation and increased insulin synthesis.

13. Anthocephalus Indicus

Root extract of Anthocephalus indicus (Rubiaceae) was reported to have hypoglycemic, lipid-lowering and antioxidant effects in alloxan-induced diabetic rats. Oral administration of an ethanol extract of the root (500 mg/kg body weight) for 21 days significantly reduced blood glucose, triglycerides, total cholesterol, phospholipids and free fatty acids37.

14. Syzium Cumin (SC)

Syzygium cuminia (Myrtaceae) has been widely used in India as a traditional medicinal system to treat diabetes. SC seed extract showed antidiabetic activity against streptozotocin (STZ)-induced diabetic rats. The compound "Mycaminose" and the ethyl acetate and methanol extract were found to lower blood glucose47.

15. Brassica Juncea

Brassica juncea is a traditional medicinal plant that belongs to the cruciferous family. Aqueous extract of its seeds has potent hypoglycemic activity, which was studied in STZ-induced diabetic male albino rats. Doses with hypoglycemic effects have been reported at 250, 350, 450 mg/kg43. A hypoglycemic effect was observed in the aqueous extract of Carica papaya (Caricaceae) seeds in normal male Wistar rats. The crude extract was found to significantly and progressively reduce fasting blood sugar (FBS), triglycerides (TG), total cholesterol (TC), LDL-c and VLDL-c in a dose-dependent manner. In addition to its hypoglycemic effect, it is also cardioprotective and hypoglycemic44.

Sr. No.	Plant Name	Family	Useful Part
1.	Abroma augusta L.f.	Sterculiaceae	**Bark and Flower**
2.	Annona squamosa L.	Annonaceae	**Leaves**
3.	Barleria cristata L.	Acanthaceae	**Roots**
4.	Beta vulgaris L.	Betulaceae	**Bark**
5.	Calamug rotang L.	Arecaceae	**Bark**
6.	Cannabis sativa L.	Cannabinacae	**Resin & Leaves**
7.	Desmodium gyrans L.	Papilionaceae	**Roots**
8.	Dioscorea alata L.	Dioscoreaceae	**Rhizome**
9.	Eryngium foelidum L.	Apiaceae	**Whole Plant**
10.	Ficus fistulosa L.	Moraceae	**Fruit**
11.	Gymnema sylvestris	Asclepiadaceae	**Leaves**
12.	Hordeum Vulgare L.	Poaceae	**Seed**
13.	Ipomaea balatus L.	Convolvulaceae	**Tuberus Roots**
14.	Juslicia adhatoda L.	Acanthaceae	**Leaves**
15.	Kyllianga bulbosa	Cyperaceae	**Whole Plant**
16.	Lysium barbala L.	Solanaceae	**Fruits**
17.	Momordica charanlia	Cucurbitaceae	**Fruit**
18.	Nepeta cataria L.	Lamiaceae	**Leaves & Flowering**
19.	Oplopanax horridum	Umbelliferae	**Root**
20.	Picrorhiza kurrooa	Scrophulariaceae	**Herb**
21.	Quercuslineala Blume	Fagaceae	**Stem bark**
22.	Rotula aquatica Lour.	Boraginaceae	**Root**
23.	Swertia chirata	Gentianaceae	**Whole Plant**
24.	Trigonellafoenum graecum L.	Papilionaceae	**Seed**
25.	Bauhinia variegata Linn.	Fabaceae	**Leaves**

List of Some Medicinal Plants Used In The Treatment of Diabetes

Natural Remedies Are Effective Against Diabetes

Natural Home Remedies for Diabetes:

Nature contains a mixture of things that have been used in medicine for centuries. Many plants have medicinal value and have been used to treat various ailments. Science has used the gifts of nature to produce medicines that can be used directly for treatment. Natural products require proper information before using them. Many diabetics looking for natural home remedies for diabetes are already in the kitchen. People who joined Breathe Well-being were happy to find that they didn't have to spend extra on supplements and protein powders to meet their body's needs and correct their diabetes.

1. Cure leaves for diabetes: Curry leaves are the best natural antioxidants. They are known to control high blood sugar. Mixed with cinnamon and fenugreek seeds, they increase the absorption of glucose into the cells. The Diabetes Reversal Diet includes smoothies and drinks that act as antioxidants and thus regulate blood sugar. Here is a recipe for one of the high sugar home remedies and we believe that all the ingredients are available in your kitchen.

2. Jamun Seeds for Diabetes (Jamun Seeds Powder): Jamun seeds (blackberries) are considered effective home remedies for diabetes. These seeds are a rich source of jambolino and jambosin. These two ingredients help slow down the release of glucose into the blood. It also reduces the symptoms of frequent urination and thirst. See how to do this, one of the most effective home remedies for diabetes.

3. Fenugreek seeds: Fenugreek seeds (Methi seeds) are a rich source of glucomannan fiber. This fiber helps delay the absorption of sugar from the intestines. Alkaloids in the seeds, such as fednugresin and the amino acid 4 hydroxyisoleucine, act on the pancreas to release insulin, which helps control high blood sugar levels. Follow the instructions below and use one of the most effective and common natural diabetes remedies.

4. Amla juice for diabetes: Indian gooseberries or amla are powerful antioxidants. When it comes to the best home remedies for high blood sugar, Amla is the perfect choice. Being a rich source of vitamin C, amla has been widely used to boost immunity. Amla can control the inflammation of the pancreas and thus help in the proper production of insulin. It increases the body's response to insulin and regulates carbohydrate metabolism, which helps control high blood sugar levels.

5. Lady Finger for Diabetes (Okra): Okra, commonly known as bhindi or ladyfinger, is an excellent source of fiber, vitamins and minerals. It is a low-calorie, low-glycemic index diet. For people who constantly think about "Home Remedies for High Blood Sugar", Okra is the perfect food for them. Myricetin in okra helps increase the absorption of blood sugar into the cells. The green bark and seeds of the plant help lower blood sugar by slowing the absorption of sugar from the intestines. Therefore, it helps to lower blood sugar. Make your own lightning and improve your blood sugar.

6. Moringa or Birch: Moringa has many medicinal benefits that help regulate blood sugar and is one of the best home remedies for high blood sugar. It has been found to contain antioxidants and vitamin C.

7. Apple cider vinegar: Apple cider vinegar is often considered the best home remedy for type 2 diabetes, although its effects are subjective. The main compound in apple cider vinegar is acetic acid. And acetic acid is probably an important part of its health benefits. There are many evidence-based approaches to using ACV.

8. Cinnamon: Cinnamon, an aromatic spice with a rich history, can be useful in the treatment of diabetes. Its unique properties make it a popular choice among natural remedies. Find out how cinnamon can positively affect blood sugar.

9. Diabetic Oats: Oats are often considered a nutritional powerhouse and offer many health benefits, especially for diabetics. These versatile grains are recognized for their significant effects on blood sugar regulation and overall well-being. Dive into the world of oats and learn how this humble but powerful food can play a key role in supporting healthy lifestyles for people with diabetes.

10. Aloe Vera for Diabetes: Known for its healing properties, Aloe Vera can be a valuable addition to your diabetes treatment plan. Discover simple yet effective ways to use the power of aloe vera to improve blood sugar and overall health.

Food	**Benefits**	**Taste**	**Availability**
Curry Leaves	Curry leaves contain Mahanimbine, a compound that aids in diabetes by lowering blood sugar and improving insulin sensitivity.	Mild, slightly bitter	Widely Available
Cinnamon	Cinnamon contains cinnamaldehyde, a compound that helps mimic insulin, aiding glucose uptake by cells and reducing blood sugar.	Slightly sweet, aromatic taste	Widely Available
Fenugreek Seeds	Fenugreek seeds contain 4-hydroxyisoleucine, a compound that aids in reducing sugar absorption from the gastrointestinal tract.	Slightly bitter, nutty taste	Widely Available
Aloe Vera	Contains compounds like polysaccharides and phytosterols that have sugar-regulating properties and antioxidants.	Aloe vera gel has a mild, slightly bitter taste.	Widely Available
Amla Juice	Contains a compound called galactomannan, which helps to slow down the absorption of sugar into the bloodstream.	Sour	Available in most stores

Oats	Oats contain soluble fiber, beta-glucans, which help stabilize blood sugar levels. Oats are also a good source of fiber and provide sustained energy.	Nutty taste	Available in most stores
Apple Cider Vinegar	Contains acetic acid, which helps to lower blood sugar levels. It also helps promote satiety.	Tart, acidic, and tangy flavor	Available in most stores
Moringa/Drumsticks	Contain a compound called moringa oleifera, which has been shown to lower blood sugar levels. Also helps improve heart health.	Bitter taste	Might not be available everywhere
Ladyfinger	Ladyfinger may help regulate blood sugar levels and support digestion. Additionally, it's rich in vitamins, antioxidants, and dietary fiber.	Mild, slightly earthy aftertaste	Widely available
Jamun Seeds	Helps lower sugar levels, improve insulin sensitivity, and reduce inflammation.	Sweet, slightly sour	Widely available

DISCUSSION

In this review, we can use all the above mentioned drugs and herbs are used to treat diabetes. Some herbs are mostly used in rural areas; because there are many medicinal plants in these regions. Therefore, treating diabetes with plant compounds that are readily available and do not require labor-intensive pharmaceutical synthesis seems very attractive. This review attempted to investigate diabetes drugs and can be useful for health professionals, researchers and researchers working in the field of pharmacology and therapy to develop diabetes drugs.

SUMMARY

Although sitagliptin is an expensive drug, the main advantage of this drug is that it has a low risk of hypoglycemia, is a weight neutral agent and also helps to improve the lipid profile of patients. Although the potential cytoprotective effect of sitagliptin and other DPP-IV inhibitors in humans has not yet been proven, it may be ideal for the prevention of type 2 DM. Sitagliptin may be useful in preventing diabetes in patients with prediabetes. Because these patients have sufficient ß cell mass, they may benefit most from this agent.

In India, various herbs are traditionally used to treat diabetes. Current research on the antidiabetic effects of medicinal plants is helping to develop effective herbal medicines for this purpose. Important information about medicinal plants is needed to find new potential antidiabetic drugs. This article is prepared to provide correct information about medicinal plants with antidiabetic properties. The herbal information discussed here may be useful in further research on diabetes. Metabolic imbalance leading to diabetes is a feature of the materialistic world. Differences in social structure, psychological stress, obesity, hormonal imbalance and heredity optimize pandemic growth. Growing diabetes needs extremely effective treatment. These efforts can provide comprehensive treatment and justify the role of new traditional medicinal plants with antidiabetic activity.

REFERENCES

1. WHO expert consultation. Report of the expert committee on the diagnosis and classification of diabetes mellitus. Diabetes Care 2002; 25: 5–20.

2. Newman B., Selby J. V., King M. C., Slemenda C., Fabsitz, R., Friedman, G. D. Concordance for type 2 (non-insulindependent) diabetes mellitus in male twins. Diabetology 1987; 30: 763–768. Doi: 10.1007/BF00275741.

3. Kaprio J., Tuomilehto J., Koskenvuo M., Romanov K., Reunanen A., Eriksson J. et al. Concordance for type 1 (insulin-dependent) and type 2 (non-insulin dependent) diabetes mellitus in a population-based cohort of twins in Finland. Diabetology 1992; 35: 1060–1067. Doi: 10.1007/BF02221682.

4. Bellamy L., Casas J. P. Hingorani, A. D. Williams D. Type 2 diabetes mellitus after gestational diabetes: a systematic review and meta-analysis. Lancet 2009; 373: 1773–1779. Doi: 10.1016/S0140-6736(09)60731-5.

5. WHO. Global report on diabetes 2016; Geneva: WHO.

6. Ceriello A. Oxidative stress and glycemic regulation. Metabolism 2000; 49: 27–29. Doi: 10.1016/S0026- 0495(00)80082-7.

7. Maritim A. C., Sanders R. A., Watkins, J. B. Diabetes, oxidative stress, and antioxidants: a review. Journal of Nabarun Mukhopadhyay et al. Int. Res. J. Pharm. 2019, 10 (2) 35 Biochemical and Molecular Toxicology 2003; 17: 24–38. Doi: 10.1002/jbt.10058.

8. Vos T., Flaxman A. D., Naghavi M., Lozano R., Michaud C., Ezzati M. et al. Years lived with disability (YLDs) for 1160 sequelae of 289 diseases and injuries 1990-2010: a systematic analysis for the global burden of disease study 2010. Lancet 2012; 380: 2163–2196. Doi: 10.1016/S0140-6736(12)61729- 2.

9. Inzucchi SE, Bergenstal RM, Buse JB et al. Management of hyperglycemia in type 2 diabetes, 2015: A patient-centered approach: Update to a position statement of the American Diabetes Association and the European Association for the study of diabetes. Diabetes Care 2015; 38(1): 140-149.

10. Alarcon-Aguilara FJ, Roman-Ramos R, Perez-Gutierrez S, Aguilar-Contreras A, Contreras-Weber CC, Flores-Saenz JL. Study of the anti-hyperglycemic effect of plants used as antidiabetics. Journal of Ethnopharmacology 1998; 61: 101- 110.

11. Umara A, Qamar U, Bala Y, Bashar Bello MS. Antihyperglycemic activity of the leaves of Tetracera scandens (Dilleniaceae) in alloxan induced diabetic rats. Journal of Ethnopharmacology 2010; 131:140–145.

12. Arulrayan N, Rangasamy S, James E, Pitchai D. A database for medicinal plants used in the treatment of diabetes and its secondary complications. Bioinformation 2007; 2:22 -23.

13. Thomas, M.C. Diuretics, ACE inhibitors and NSAIDs – the triple whammy. Medical Journal of Australia, 2000; 172: 184- 185.

14. Vittalrao AM, Shanbhag T, Kumari KM, Bairy KL and Shenoy S, Evaluation Of Antiinflammatory And Analgesic Activities Of Alcoholic Extract Of Kaempferia Galanga In Rats, Indian J Physiol Pharmacol, 2011; 55(1): 13–24.

15. Mojekwu TO, Yama OE, Ojokuku SA, Oyebadejo SA. Hypoglyceamic effects of aqueous extract of Aframomum melegueta leaf on alloxan-induced diabetic male albino rats. Pacific Journal of Medical Sciences 2011; 8:28-36.

16. Noor A, Gunasekaran S, Soosai A, Minicab, Vijayalakshmi MA. Antidiabetic activity of Aloe vera and histology of organs in streptozotocin induced diabetic rats. Current science 2008; 94:1070-1076.

17. Rehman SU, Jafri SA, Hassan S, Ishtiaq N, Muhammad N. Study on antidiabetic effect of Aloe vera extract on alloxan induced diabetic rats. Libyan Agriculture Research Center Journal International 2011; 2: 29-32.

18. Chattopadhyay RR. Possible mechanism of antihyperglycemic effect of Azadirachta indica leaf extract. Journal of Ethnopharmacology 1999; 67:373–376.

19. Modak M, Dixit P, Londhe J, Ghaskadbi J, Paul T, Devasagayam A. Indian herbs and herbal drugs used for the treatment of diabetes. J Clin Biochem Nutr 2007; 40:163–173.

20. Yaheya M, Ismail M. Clinical Evaluation of Antidiabetic Activity of Bael leaves. World applied sciences journal 2009; 6:1518-1520.

21. Sokeng SD, Lontsi D, Moundipa PF, Jatsa HB, Watcho P, Kamtchouing P. Hypoglycemic effect of Anacardium occidentale methanol extract and fractions on streptozotocininduced diabetic rats. Global Journal of Pharmacology 2007; 1:01-05.

22. Shibib BA, Khan LA, Rahman R. Hypoglycaemic activity of Coccinia indica and Momordica charantia in diabetic rats: depression of the hepatic gluconeogenic enzymes glucose-6- phosphatase and fructose-1, 6-bisphosphatase and elevation of both liver and red-cell shunt enzyme glucose6-phosphate dehydrogenase. Biochem J 1993; 292: 267-270.

23. Emmanuel S, Sheeba Rani, Raja Sreekanth. Antidiabetic activity of Cassia occidentalis in streptozotocin-induced diabetic rats: a dose dependent study. International journal of pharma and bio sciences 2010; 1: 1-12.

24. Sophia D, Manoharan S. Hypolipidemic activities of ficus racemosa linn bark in alloxan induced diabetic rats. Afr. J. Trad. CAM, 2007; 4 (3): 279 – 288.

25. Tanko Y, Yerima M, Mahdi MA, Yaro AH, Musa KY, Mohammed A. Hypoglycemic Activity of Methanolic Stem Bark of Adansonnia digitata extract on blood glucose levels of Streptozotocin-induced Diabetic wistar rats. International Journal of Applied Research in Natural Products, 2008; 1(2):32- 36.

26. Oyedemi SO, Adewusi EA, Aiyegoro OA, Akinpelu DA. Antidiabetic and haematological effect of aqueous extract of stem bark of Afzelia africana (Smith) on streptozotocin-induced diabetic wistar rats. Asian Pacific Journal of Tropical Biomedicine 2011: 353-358.

27. Keshri Umashanker PD, Chandra S, Janardan S, antidiabetic efficacy of ethanolic extract of holarrhena antidysenterica seeds in streptozotocin – induced diabetic rats and it's influence on certain biochemical parameters, Journal of Drug Delivery & Therapeutics; 2012, 2(4), 159-162.

28. Lanjhiyana S, Garabadu D, Ahirwar D, Bigoniya P, Rana AC, Patra KC et al. Antidiabetic activity of methanolic extract of stem bark of Elaeodendron glaucum in alloxanized rat model. Advances in applied science research, 2011; 2(1): 47-62.

29. Ragavan B, Krishnakumari S. Antidiabetic effect of T. Arjuna bark extract in alloxan induced diabetic rats. Indian Journal of Clinical Biochemistry, 2006; 21(2): 123-128.

30. Velmurugan C, Sundaram T, Sampath RK, Vivek B, Sheshadri S, Kumar A. Anti diabetic and hypolipidemic activity of bark of ethanolic extract of Ougeinia oojeinensis (ROXB.). Med J Malaysia 2011; 66: 22-26.

31. Parthasarathy R, Ilavarasan R, Karrunakaran CM. Antidiabetic activity of Thespesia Populnea bark and leaf extract against streptozotocin induced diabetic rats. International Journal of PharmTech Research, 2009; 1: 1069-1072.

32. Keshari A, Tripathi PK, Srivastava A, Vishwas R, Formulation and evaluation of effervecent floating tablets of antidiabetic drug, Journal of Drug Delivery & Therapeutics. 2015; 5(6):43- 55

33. Sharma V, Samantha KC, Pooja. Hypoglycemic activity of methanolic extract of Tectona grandis linn. root in alloxan induced diabetic rats. Journal of Applied Pharmaceutical Science, 2011; 1: 106-109.

34. Mashirkar VJ, Deshmukh VN, Jadhav JK, Sarkar DK. Anti diabetic activity of the ethanolic extract of Pseudarthria viscida root against alloxan induced diabetes in albino rats. Research J Pharm and Tech, 2008; 1: 541-546.

35. Sharma V, Marwaha A, Pooja. Hypoglycemic activity of methanolic extracts of Nyctanthes arbortristis linn root in alloxan induced diabetic rats. Int J Pharm Pharm Sci 2011; 3:210-212.

36. Xie JT, Mehendale S, Yuan CS. Ginseng and Diabetes. American Journal of Chinese Medicine 2005; 33: 397–404.

37. Kumar V, Khanna AK, Khan MM, Singh R, Singh S, Chander R et al. hypoglycemic, lipid lowering and antioxidant activities in root extract of Anthocephalus indicus in alloxan induced diabetic rats, Ind J Clin Biochem 2009; 24 (1): 65-69.

38. Djomeni PD, Ledong T, Asongalem EA, Dimo T, Sokeng SD, Kamtchouingc P. Hypoglycaemic and antidiabetic effect of root extracts of Ceiba pentandra in normal and diabetic rats. Afr. J. Trad. Cam 2006; 3: 129 – 136.

39. Lawrence AO, Okwusidi JI, Ayodele OS. Antidiabetic, Effect of Anacardium occidentale stem bark in fructose diabetic rats, Pharmaceutical Biology 2005; 43:589–593.

40. Grace IA, Oluwakemi TA, Bamidele VO, Ayodele OS. Antidiabetic Properties of the aqueous leaf extract of Bougainvillea glabra (Glory of the Garden) on Alloxan-Induced Diabetic Rats. Rec Nat Prod 2009; 3:187-192.

41. Jeppesen PB, Gregersen S, Alstrup KK, Hermansen K. Stevioside induces antihyperglycaemic, insulinotropic and glucagonostatic effects in vivo: studies in the diabetic Goto-Kakizaki (GK) rats. Phytomedicine. 2002;9(1):9–14.

42. Jeppesen PB, Gregersen S, Poulsen CR, Hermansen K. Stevioside acts directly on pancreatic beta cells to secrete insulin: actions independent of cyclic adenosine monophosphate and adenosine triphosphate-sensitive K^+-channel activity. Metabolism. 2000;49(2):208–214.

43. Souza A, Mbatchi B, Herchuelz A. Induction of insulin secretion by an aqueous extract of Tabernanhte iboga Baill. (Apocynaceae) in rat pancreatic islets of Langerhans. J Ethnopharmacol. 2011;133(3):1015–1020.

44. Esmaeili MA, Yazdanparast R. Hypoglycaemic effect of Teucrium polium: studies with rat pancreatic islets. J Ethnopharmacol. 2004;95(1):27–30.

45. Mirghazanfari SM, Keshavarz M, Nabavizadeh F, Soltani N, Kamalinejad M. The effect of Teucrium polium L. extracts on insulin release from in situ isolated perfused rat pancreas in a newly modified isolation method: the role of Ca^{2+} and K^+ channels. Iran Biomed J. 2010;14(4):178–185.

46. Yazdanparast R, Esmaeili MA, Helan JA. Teucrium polium extract effects pancreatic function of streptozotocin diabetic rats: a histopathological examination. Iran Biomed J. 2005;9(2):81–85.

47. Noor H, Ashcroft SJH. Pharmacological characterisation of the antihyperglycaemic properties of Tinospora crispa extract. J Ethnopharmacol. 1998;62(1):7–13.

48. Broca C, Gross R, Petit P, Sauvaire Y, Manteghetti M, Tournier M, et al. 4-Hydroxyisoleucine: experimental evidence of its insulinotropic and antidiabetic properties. Am J Physiol. 1999;277(4 Pt 1):E617–E623.

49. Haeri MR, Izaddoost M, Ardekani MR, Nobar MR, White KN. The effect of fenugreek 4-hydroxyisoleucine on liver function biomarkers and glucose in diabetic and fructose-fed rats. Phytother Res. 2009;23(1):61–64.

50. Abdel-Zaher AO, Salim SY, Assaf MH, Abdel-Hady RH. Teucrium polium antidiabetic activity and toxicity of Zizyphus spina-christi leaves. J Ethnopharmacol. 2005;101(1–3):129–138.

51. Eidi A, Eidi M, Esmaeili E. Antidiabetic effect of garlic (Allium sativum L.) in normal and streptozotocin-induced diabetic rats. Phytomedicine 2006; 13 (9-10): 624-629.

52. Fatemeh Forouzanfar, Bibi Sedigheh Fazly Bazzaz, Hossein Hosseinzadeh. Black cumin (Nigella sativa) and its constituent (thymoquinone): a review on antimicrobial effects. Iranian Journal of Basic Medical Sciences. 2014; 17(12): 929–938.

53. Pari L, Sankaranarayanan C. Beneficial effects of thymoquinone on hepatic key enzymes in streptozotocinnicotinamide induced diabetic rats. Life Sciences 2009; 85(23-26): 830-834. Doi: 10.1016/j.lfs.2009.10.021.

54. Najmi A, Haque SF, Naseeruddin M, Khan RA. Effect of Nigella sativa oil on various Clinical and biochemical parameters of metabolic syndrome. International Journal of Diabetes in Developing Countries 2008; 16: 85–87.

55. K. Subashini, Asha P.K. Review for the Phytochemical Constituents Present in Psidium Guajava L. and Psidium Guajava. International Journal of Trend in Research and Development 2017; 4(3): 399-400.

56. Oh WK, Lee CH, Lee MS, Bae EY, Sohn CB, Oh H. Antidiabetic effects of extracts from Psidium guajava. Journal of Ethnopharmacology 2005; 96(3): 411-5.

57. Committee on Herbal Medicinal Products (HMPC). EMA/HMPC/239269/2011. 27 March 2012 Assessment report on Fraxinus excelsior L. or Fraxinus angustifolia Vahl, folium.

58. Eddouks M, Maghrani M. Phlorizin-like effect of Fraxinus excelsior in normal and diabetic rats. Journal of Ethnopharmacology 2004; 94(1): 149-54.

59. Paras Sharma, Gargee Dubey and Sunil Kaushik. Chemical and Medico-biological profile of Cyamopsis tetragonoloba (L) Taub: An overview. Journal of Applied Pharmaceutical Sciences 2011; 1(2): 32-37.

60. Mahomed IM, Ojewole JA. Hypoglycemic effect of Hypoxis hemerocallidea corm (African potato) aqueous extract in rats. Methods and Findings in Experimental and Clinical Pharmacology 2003; 25(8): 617.