



ROLE OF MEDICINAL PLANTS IN THE TREATMENT OF DIABETES: A REVIEW

Pharmacy

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ABSTRACT

Since ancient time medicinal plants are playing a vital role in the treatment of various diseases. Plants consist of several phytoconstituents, phytochemicals which have great potential in the treatment of several disorders. Only one thing is there is a need to explore them and transform them in the form of affordable with less side effect and more patient compliance medicine.

"Diabetes" This word is familiar to everyone, and mostly everyone is aware of its consequences. The data shows that the reason for half of all deaths is because of Diabetes. Plant sources are rich with several hypoglycemic compounds, but due to so-called development of modern medicines, it has been ignored. However, now a days several research is going on the medicinal plants and claimed activities, even though there is a need of extensive and fruitful research work as the result may turn into safe, affordable and efficacious drug.

Keeping the same in view this manuscript has been prepared wherein few plants or its parts are being discussed which have claimed antidiabetic activity but scientifically not proven yet, even very few literatures/manuscript has been published claiming their antidiabetic property. Hence, this manuscript may help the researchers in exploring the antidiabetic herbal medicines or the phytoconstituents which may be useful in the treatment of deadly disorder i.e. Diabetes.

KEYWORDS

Diabetes, Phytoconstituents, Hypoglycemia, Antidiabetic agents

INTRODUCTION

Plants are claimed for the treatment of several diseases from ancient time. Earliest description of curative properties of medicinal plants is found in Rig-Veda (2500 - 1800 BC). Charaka Samhita and Sushruta Samhita give extensive description on various medicinal herbs. The indigenous medicines like -Ayurveda, Siddha and Unani based plant products in amelioration of several diseases. Ayurvedic system of medicine is mostly based on the treatment of diseases by using plant/its parts. This system of medicine is one of the ancient systems which have been practiced when there was no allopathic system. It has been proven that phytochemical present in the plants would be a great tool for the treatment of diseases; only thing required is to explore them dedicatedly. Now in modern era several new diseases are a challenge for human being, and hence there is need of exploring new drugs for treatment, prevention and diagnosis of the same, and in this plants/phytoconstituents can play a vital role. Country like India where more than seventy percent population rely on agriculture and the rate of illiteracy as well as poverty is more, there is a need of exploring efficacious but cost effective medicines so that each and everyone can have better treatment. Considering this in view, plants can be a great choice. We need to explore our ancient systems on the basis of vast research and clinical trials of the claimed uses of plant drugs.

DIABETES

Diabetes mellitus (or "diabetes") is basically a blood sugar disease in which the body either does not produce or does not properly utilize insulin.

"Madhumeha" or Diabetes is a metabolic disorder which is widespread all over the world especially in Asian countries. Because of lack of proper treatment or unavailability of drugs which can cure this disorder completely the management is quite difficult for whole world. It is a global disease and if we analyze the data we will find an explosive boost in the diabetes cases especially in past few decades. It is one of the major health concerns worldwide. Particularly in India, there are currently 50 million people with diabetes, which is projected to increase by 90 million by the end of 2030. More than 800 species of the plant have been claimed to possess anti-diabetic properties. Native Americans, Chinese, South Americans and Asian Indians are using several plants for prevention or management of diabetes. Since, it is a metabolic disorder it is affecting several organs/systems because of effect or alterations in metabolism of protein, carbohydrate and fat. Allopathic treatment has several associated side or adverse effect and therefore there is risk of late stage complications that means a patient

suffering with diabetes will have several other painful complications throughout life and is difficult to get rid of them. Medicinal plants with antidiabetic activities are therefore can play an important and alternative role by diabetic patients and health care professionals. As we know that medicinal plant are less expensive, with less or no side effect and hence exploration of same would be great alternative for the treatment of such chronic diseases. Extensive research and development efforts in this particular area is very much required so that potent antidiabetic agents, phytochemicals etc can be identified and thus effective and inexpensive new drug development can take place.

Types of Diabetes

Type 1 Diabetes

There is a specialized tissue consisting of cells which helps in making and secreting hormones. This specialized tissue is known as "Islets of Langerhans" which is named after the German pathologist Paul Langerhans. The discovery was made by him in 1869. It is like islands in the pancreas. The beta cells, produce insulin which is in response to available blood glucose. These beta cells act as factories that identify the level of glucose in the blood stream, and accordingly produce insulin to balance. The insulin instructs the body cells to utilize the sugar, which in turn normalizes blood sugar to its required range. As soon this process takes place the beta cells will reduce the output of insulin to an idle state. This process shows that how the beta cells and insulin plays a vital role in maintaining the blood glucose level. In type 1 diabetes basically the islets are destroyed by own immune system, and therefore the immune cells are unable to identify these cells and react as a foreign invaders, which in results to several autoimmune diseases including the symptoms of diabetes since the capability of producing insulin is lost.

Type 2 Diabetes

Type 2 diabetes is mainly because of improper lifestyle and lack of exercise which can result in insulin resistance. Breakdown in intercellular signaling is considered as a root cause of insulin resistance. Insulin signals a specific proteins known as GLUT-4 to rise up to the cell's membrane, here the insulin grab glucose and take it inside the cell. Those patients who are having insulin resistance, the message is not received by the cells or we can say that the cells can't hear insulin "knocking" on the door, which in turn leads to elevation in insulin and glucose level in blood.

In the early stages of insulin resistance, "compensated insulin resistance" takes place by pancreas. But as the disease prolongs the

burden of producing excessive insulin wears out the pancreas and hence unable to maintain the accelerated output, which in result, glucose levels remain elevated for prolonged time. This is called "uncompensated insulin resistance" which is advanced type 2 diabetes.

Type 2 diabetes is characterized by:

- Taking more carbohydrate rich food leads to an elevation in blood sugar levels.
- This is followed by a consequent rise in the level of insulin.
- This in turn causes blood sugar to drop.
- Eventually, this leads to toll on the body's ability to utilize insulin and thus metabolize sugar.
- Over time, the pancreas "wears out" and hence unable to overcome from insulin resistance.
- This results in the onset of diabetes.

Risk Factors for Diabetes

The following is a list of risk factors for getting diabetes:

Table-1 Risk factors for diabetes

S.N	Risk Factors
1.	• More than 20% overweight
2.	• Lack of exercise/ Physical inactivity
3.	• Family history of diabetes
4.	• Belonging to any of the following ethnic groups: African American, Native American, Latin American, Asian American, Pacific Islander
5.	• Having any history of "Impaired Fasting Glucose" or "Impaired Glucose Tolerance" during previously done blood tests.
6.	• Having more than 250 mg/dl Triglycerides level.
7.	• Having less than 35 mg/dl HDL cholesterol
8.	• Having a history of gestational diabetes or a giving birth to a baby with more than 9 pounds
9.	• Having a history blood pressure especially hypertension

Diagnosis of Diabetes

It can be diagnosed by evaluating the persisting symptoms and also with the help of lab test results. There are two common lab tests:

Fasting Plasma Glucose test (FPG):

In FPG test, blood glucose level is analyzed after an 8 hour fast. If the glucose level is higher than the normal value (100 mg/dl), then the patient has Impaired Fasting Glucose, which is actually considered as pre-diabetes. A diagnosis of Diabetes is made when an FPG level is greater than 125 mg/dl is measured on two occasions.

Oral Glucose Tolerance Test (OGTT):

This test is considered to be helpful in patients with FPG between 115 and 125 mg/dl. This is mainly for type 2 diabetes. In OGTT test, blood sugar is analyzed after a fast and then again 2 hours after drinking large quantity of glucose rich beverage. If after taking this beverage the glucose level is higher than 140 mg/dl, then there are chances of pre-diabetes. A diagnosis of Diabetes is made when an OGTT level is greater than 200 mg/dl.

Dietary Management in Diabetes

In the treatment of diabetes the diet therapy plays an important role and as it is well known that it is mainly based on natural and hence it is economical and feasible as well. Proper diet plan helps in improving digestion and The proper intake of diet in diabetes improves the digestion and also helps in proper and required gastric secretions, which results in decrease in the output of overall body fluids e.g. urine, sweat etc. It is highly recommended in early stage of disease and in case of non insulin dependent diabetes mellitus (NIDDM), which is mainly related to diet. Diet which is rich in carbohydrates and fat mostly results in type-2 diabetes in the later stages of life. If a patient with type-II diabetes mellitus following proper diet plan can control the glucose level without the use of hypoglycemic agents or insulin.

Role of Medicinal Plant in Diabetes Management or in the Treatment

In Ayurveda there are several plants which has antidiabetic potential has been explained especially for the treatment of NIDDMs ,apart from this there are several plants or extracts has been experimentally evaluated and active constituents which are having antidiabetic properties has been isolated. Such plants and remedies mentioned and used for the treatment of diabetes mellitus date back to the ancient

authorities like Bhṛigu, Charaka, Sushruta and Vagbhatta, the last three called Vriddha-trayi of Ayurveda [1]. Phytomedicine has an important role especially in developing countries since there is lack of resources, high rate of poverty and limited health facilities and services. A comprehensive approach was drawn by World Health Assembly.

This was to include:

- A therapeutic classification of medicinal plants in different countries.
- Scientific criteria and methods for assessing the safety of medicinal plants products.
- International standards and specification for identity purity, strength and manufacturing practices.
- Methods for safe and effective use of medicinal plants products.

Plants based drugs can be used directly i.e. they may be collected, dried and used as therapeutic agents (crude drugs), or their constituents/ active principles separated by various chemical processes which are employed as medicines. The phytochemicals identified from traditional medicinal plants are presenting an exciting opportunity for the development of new types of therapeutics [2]. This has accelerated the global effort to harness and harvest those medicinal plants that bear a substantial amount of potential photochemical showing multiple beneficial effects in combating diabetes and diabetes-related complications. Moreover, during the past few years some of the new bioactive drugs isolated from hypoglycemic plants showed antidiabetic activity with more efficacy than oral hypoglycemic agents used in clinical therapy. Many ethno botanical surveys on medicinal plants used by the local population have been performed in different parts of the world including Morocco, Saudi Arabia, Taiwan, Trinidad and Tobago [3-8]. A number of reviews have been published on plants screened for hypoglycemic activity in India [9-19]. Two exhaustive reviews have been published based on global literature survey on 150 plants and 343 plants from different parts of the world [20, 3].

Presently, the United States is the largest market for Indian botanical products accounting for about 50% of the total exports. Out of this, only 40 percent is value addition and 60 per cent is export of raw medicinal plant. Hence it is proposed that in future we should decrease exporting raw medicinal plant and export only value-added products to realize higher earnings. Japan, Hong Kong, Korea and Singapore are the major importer of Traditional Chinese medicine taking 66% share of China's botanical drugs export. Globally, there have been concerted efforts to monitor quality and regulate the growing business of herbal drugs and traditional medicine. Health authorities and governments of various nations have taken an active interest in providing standardized botanical medication. United States congress has fuelled rapid growth in the nutraceutical market with passage of the Dietary Supplement Health and Education Act in 1994.

US Food and Drug Administration (FDA) has recently published the International Conference on Harmonization guidance Common Technical Document addressing concerns related to quality of medicines that also include herbals [21]. The National Centre for Complementary and Alternative medicine has been inaugurated as the United States Federal Government's lead agency for scientific research in this area of medicine. World Health Organization (WHO) is also been regarding traditional medicine and has been active in creating strategies, guidance and standards of botanical medicines [22, 23]. Thus, the global scenario illustrates vividly both promise and challenges presented by the traditional medicines.

In India, about 9000 licensed units manufacture traditional medicines with or without proper standardization [24]. Most of the Indian manufactures do not follow WHO guidelines for quality control. Thus, adulteration of market samples remains a major problem in domestic and export market of Indian herbal products. Therefore, the government of India has promulgated GMP regulations for traditional systems of medicines to improve the quality and standards of Ayurvedic, Siddha and Unani drugs in Pharmacies. New rules regarding essential infrastructure manpower and quality control requirements came into force from 2000 and form part of the Drugs and Cosmetic Act 1940 [25]. Licensing of Ayurvedic medicine is also governed under Drug and Cosmetic Act 1940.

Two examples of plants which has great potential in the treatment of several diseases:

Table-2 Examples of plants with claimed activities including antidiabetic activity Probable Mechanism of Action of Phyto Constituents in the Treatment of Diabetes are Mentioned in the Following Table:

Plant Name	Pharmacological Activity
<i>Coccinia indica</i>	Anti inflammatory, anti pyretic and analgesic activity of fruits and leaves. Leaves are in use for the treatment of several ailments such as wound healing, ulcers, fever, asthma, hepatoprotective, antioxidant, anti-inflammatory, and antinociceptive, antidiabetic, hypolipidemic, antibacterial and antitussive activities
	Hypoglycemic activity of coccinia indica leaves,
	Antibacterial
	Anthelmintic activity
	Potential for controlling An. stephensi mosquito
<i>Zea mays</i>	Edema, cystitis, gout, nephritis, kidney stones, obesity, as well as prostatitis and similar ailments
	Corn silk possesses hypoglycemic, anti-tumor, antioxidant, anti-fatigue and anti-fungal properties
	Antioxidant
	Anti-prostatitis and antispasmodic
	Diuretic and a decoction of the silk is taken for the treatment of urinary troubles and gallstones
	Antihyperlipidemic
	Anti-obesity
	Antidiabetic
	Anti tumor, Anti cancer

Table-3 Probable antidiabetic mechanism of action of phyto constituents

S.N	Probable Mechanism of action by Antidiabetic phytomedicine
1.	Stimulate insulin secretion
2.	Promote β -cell regeneration
3.	Inhibit activities of α -glucosidase
4.	Increase insulin secretion from pancreatic β -cell
5.	Regulate the activity of carbohydrate metabolizing enzymes
6.	Control glucose metabolizing enzymes activities
7.	Up regulate expressions of insulin receptor and glucose transporter
8.	Regulate the activities of glucose metabolizing enzymes
9.	Inhibit α -amylase activity and α -glucosidase
10.	Enhance glycogenesis by liver
11.	Alleviate intestinal and renal disaccharides
12.	Reduce the activities of glucose-6-phosphatase
13.	Improve the insulin signaling molecules
14.	Enhance glycogenesis by liver
15.	Alleviate intestinal and renal disaccharides
16.	Increase glucose utilization in the skeletal muscle
17.	Increase muscle glycogen store
18.	Increase the biosynthesis of insulin in the pancreas
19.	Activate the insulin signaling cascade
20.	Increase the activities of glycolytic enzymes
21.	Inhibitors of α -Glucosidases

CONCLUSION

Since ancient times, plants have been an exemplary source of medicine. Ayurveda and other Indian literature mention the use of plants in treatment of various human ailments. India has about 45 000 plant species and among them, several thousands have been claimed to possess medicinal properties. Research conducted in last few decades on plants mentioned in ancient literature or used traditionally for diabetes has shown anti-diabetic property.

Natural products compounds discovered from medicinal plants (and their analogues thereof) have provided numerous clinically useful drugs and still remain as an essential component in the search for new medicines. So, these traditionally used plants can be exploited effectively in order to find New Chemical Entity for treatment of diabetes.

Hence the small but having greater future perspectives review was performed systematically which may be helpful for the researchers in finding new alternatives for the treatment of diabetes.

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