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Review Article

Herbal Medicines and Nutraceuticals: An Emerging Alternative Therapy for Diabetes

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ABSTRACT

A common characteristic of diabetes mellitus is the condition of hyperglycemia, a chronic metabolic disorder, and has assumed a proportionate magnitude of a tremendous global health crisis. Despite their effectiveness, traditional treatment approaches frequently have negative side effects, which is why herbal medications and nutraceuticals are becoming more and more popular as alternative therapeutic options. Through blood glucose regulation, improved insulin sensitivity, and treatment of the disease's underlying causes, these natural products—which come from plants and other dietary sources—offer encouraging advantages in the management of diabetes. Many civilizations have been using herbal remedies to manage diabetes symptoms for millennia. Many plants, including *Combretum micranthum*, *Swertia punicea*, *Tinospora cordifolia*, and *Ricinus communis*, have bioactive substances that have been shown to have antidiabetic properties. In addition to supporting herbal therapies, nutraceuticals—which include functional foods, dietary supplements, and fortified products—have demonstrated promise in the treatment of diabetes. Researchers have researched common nutraceuticals like calcium, magnesium, chromium, and omega-3 fatty acids for their potential to improve lipid profiles, lower insulin resistance, and have antioxidant and anti-inflammatory properties. These compounds have additional health benefits beyond glucose control and are frequently safer and easier to obtain than conventional medicines. In conclusion, nutraceuticals and herbal remedies are a new and promising alternative treatment for diabetes. They have the potential to improve blood sugar control, lower complications, and improve diabetic patients' overall quality of life when used in conjunction with other strategies.

INTRODUCTION

Hyperglycemia of course is a signature feature of diabetes which is a long-term systemic metabolic

disorder. The body is unable to sustain glucose homeostasis at a normal level in this state. In addition to the severe or chronic condition, long-

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term symptoms of diabetes include increased urination, sleeping of the feet and legs, and other symptoms that contribute to the disease's reputation as a global cause of premature illness and mortality. Dysglycemia, a clinical condition that precedes the onset of diabetes, is characterized by reduced glucose tolerance and impaired fasting glucose. Diabetes is a dangerous illness that causes early death and major health complications. The several harmful metabolic abnormalities together referred to as metabolic syndrome or syndrome X also contribute to the condition. In many nations, diabetes accounts for more than 10% of overall health care costs. It is believed that diabetes and its consequences account for at least 1 in 20 fatalities worldwide, across all age groups. At least one in ten deaths occurs in persons between the ages of 35 and 64, a sharp increase in proportion. Nevertheless, data may understate the true death rate from diabetes. This is because, rather than dying from a diabetes-related cause, like ketoacidosis or kidney disease, people with diabetes typically pass away from cardiovascular and renal-related problems. In an unhealthy state, diabetes results in high blood sugar levels and the subsequent complication of the disease results from affecting organs through the weakening of their blood vessels. Complication of diabetes include diabetic retinopathy which is one of the foremost causes of blindness resulting from gradual injury to the fluids within the retina's blood vessels. 10% of patients with diabetes after 15 years may get serious visual impairment. Diabetic neuropathy is another problem that affects up to 50% of people with diabetes. It is characterized by damage to the nerves and the microvessels that nourish the nerve tissue. Tingling, discomfort, numbness, or weakness in the hands and feet are typical symptoms. Neuropathy in the foot raises the risk of developing foot ulcers and perhaps amputation of the limb when combined with decreased blood

flow. Furthermore, 10–20% of persons with diabetes end up with kidney failure, making diabetes one of the main causes of kidney failure. They cause heart disease and stroke; cardiovascular deaths are 50% higher in people with diabetes. Diabetes and hyperglycemia leave a pathologic mark on the vasculature, which is also where the majority of their harmful effects start.[1] Since diabetes frequently results in stroke and acute coronary syndromes, the prevention of diabetic macrovascular illnesses has received a lot of attention. In fact, when evaluating the quality of life of the patients, the morbidity linked to diabetes microvascular complications—such as retinopathy, neuropathy, nephropathy, and limb ischemia—is equally crucial. A tremendous amount of work has been done to improve vascular outcomes, especially in Type 2 diabetes, due to the burden of diabetic vascular disease. The goal of improving macrovascular outcomes by glucose-lowering interventions has shown to be mainly futile. Strict glucose management, however, does reduce diabetic microvascular problems. The therapeutic range for diabetic vascular disease needs to be reevaluated in light of this vascular mechanism, which seems to be somewhat contradictory. It is unequivocal that vascular inflammation brought on by prolonged exposure to hyperglycemia is the primary cause of numerous complications. In order to minimize diabetic vascular problems, numerous investigations have concentrated on discovering particular vascular anti-inflammatory and anti-oxidative medicines.[2] To avoid so many complications, manage overweight/obesity, or make sure adequate glucose control, it is necessary for the patient to change the lifestyle and start eating properly. The Mediterranean nutrition less than 30% fat, less than 10% saturated fat, more than 15 grams of soluble and insoluble fiber per 1,000 kilocalories, 45 to 60 percent carbohydrate, 15 to 20 percent protein should be followed.



Insulin:

Your body requires insulin either produced naturally in your pancreas or prescribed especially to help your body to convert glucose into energy. Hyperglycemia is caused by a lack of insulin produced in the pancreas or due to problem in the usage of insulin in the body. This is the effect of diabetes. The islets of Langerhans are where within the pancreas islets of insulin are produced from the beta cells. Peripheral vascular disease, coronary artery disease, stroke, and other vascular complications include diabetes mellitus type 1 and, rarely, type 2 as principal causes. Recombinant DNA technology began to create insulin in the 1980s, largely replacing insulin derived from animal sources. Regular insulin is a prandial, short-acting insulin that has a sizable basal component. NPH insulin is an insulin with an intermediate half-life that offers both prandial and basal coverage with broad peak activity. Rapid-acting analog insulins such as aspart, glulisine, and lispro closely resemble physiological prandial state.

Herbals in diabetic management:

Diabetes mellitus, which is a systematic metabolic disease, is characterised by relatively low levels of insulin, high level of blood glucose and high levels of amino acids in the blood. It is commonly linked to the onset of micro and macrovascular disorders, such as nephropathy, cardiovascular, cerebrovascular, and neuropathy.[3] Certain consequences have been known to be linked to the condition these include; poor quality of life and higher morbidity and mortality risks.[4] In 2000, the predicted global prevalence of diabetes across all age categories was 2.8%, and by 2025, it is expected to rise to 5.4%. Insulin and a range of oral antidiabetic medications, including glinides, biguanides, α -glucosidase inhibitors, and sulfonylureas, are currently the available treatments for diabetes. Products in developing nations are costly and difficult to obtain. Due to

the potential benefits, there is currently a growing interest in herbal therapies.[5] Diabetes mellitus has long been treated with medicinal and herbal plant products in many different countries. There are approximately a thousand plants listed in the ethnobotanical literature that may have antidiabetic potential. Some of these medicinal plants listed, along with therapeutic effectiveness of plant extracts, and their hypoglycemic properties such as *Combretum micranthum*, *Ricinus communis*, *Tinospora cordifolia*, *Swertia punicea*.

Ricinus communis:

The traditional Chinese medication used to treat diabetes mellitus is *Ricinus communis*. It is also referred to as castor oil and is called Erandah in Sanskrit, Amudam, which is in Telugu, and Arandi in Hindi. It was actually grown all over India for its seeds. is composed of oil and belongs to Euphorbiaceae plant family. This plant's root, stem, and many leaves High affecting more than 50% of their ethanolic extract having hypoglycaemic effect.[6] parts, the root, and seed oil of this plant has been used in treating diseases affecting the liver and inflammation. in ayurvedic pharmacopoeia [7], the exact mechanism of action of the *Ricinus communis* root extract, It seems to have possibility to form an effective phytomedicine for the treatment of diabetes.



Figure. No 1: Ricinus Communis

Swertia Punicea:

The most popular traditional medications for treating diabetes are those derived from swertia plants.[8] The whole SW punicia 5.6kilogram plant was extracted at room temperature with 90 % ethanol to give 940 Gms crude extract. A number of plant extracts and xanthonoids—the main class of chemicals that make up this genus—have been found to have notable hypoglycemic properties. [9] Further,ethanol extracts and soluble of the ethyl acetate fraction of Swertia punicea have hypoglycaemic activity. Moreover, in STZ-induced type-2 diabetic mice, which were treated by the ethanol extracts and the ethyl acetate soluble faction of Swertia That was why in the present study on rats, it was possible to establish that puncticea possessed hypoglycemic effects and can be further utilized in the treatment of IR.[10] Significant components of this plant, bellidifolin and methylswertianin, are responsible for hypoglycemic action. Two significant components of this plant, bellidifolin and 90% ethanolicianin, are responsible for hypoglycemic action.



Figure No. 2: Swertia Punicea

Tinospora cordifolia: [Gulvel Plant]

Eighty nine percent of the shrubs used belonged to an important family known as Menispermaceae from the old medical system as a medicine. Giloy translates to Tinospora cordifolia or Guduchi in

Hindi language. Raw stem of Giloy is considered to be highly effective due to its rich nutritional value and because it contains alkaloids but stem root as well as leaves can also be utilised.[11] A shloka of Charak Samhita says that Giloy is one of the main herabol that has bitter taste. It is employed in several diseases and has Vata and Kapha reducing properties also. It is also called Heart leaves Moonseed from the shape of the leaves and the hue of the red berry like fruit. Due to the presence of alkaloids, diterpenoids and glycosidic compounds, the plant T.cordifolia is classified as antidiabetic herbal medicine in the Indian Ayurvedic Pharmacopoeia. Many studies and researches both in vitro and in vivo aimed to determine that the three alkaloids, palmatine, jatrorrhizine, and magnoflorin shared the Responsibility for hyperglycemic effect in a way of inhibiting gluconeogenesis process, releasing insulin and stimulate insulin like activity.[12]



Figure No. 3: Tinospora Cordifolia

Combretum micranthum:

In Northwestern Nigeria, a medicinal herb called Combretum micranthum is used to cure diabetes. It is a member of the Combretaceae family and is popularly referred to as "geza" in Hausa. It is a wellknown ethnomedical herb that is used to treat a variety of illnesses in West Africa.[13] In Nigeria the largest percentage of population depends on the result given by herbs with about eighty percent of the people seeking medical attention from this practice. Antioxidant,

antibacterial, and anti-inflammatory activities are all the other uses of this plant. Using a Soxhlet extractor, the aqueous extract of *Combretum micranthum* was made. It was then dried at 45 degrees Celsius in an evaporator and kept at 4 degrees Celsius until it was needed. The use of glucose tolerance test and the fasting blood sugar evaluation were used to assess the hypoglycemic effect. In normal rats, the following effects of this plant extract were identified: That antihyperglycemic beneficence of this plant, two groups of animals which includes diabetic group and nondiabetic group were used.



Figure No. 4: Combretum Micranthum

Nutraceuticals in Diabetes Management:

Functional foods are being used today in the management of diseases. Nutraceuticals can also be defined more narrowly as naturally occurring functional or medicinal foods or bioactive phytochemicals that provide disease preventing or health enhancing properties.[14]

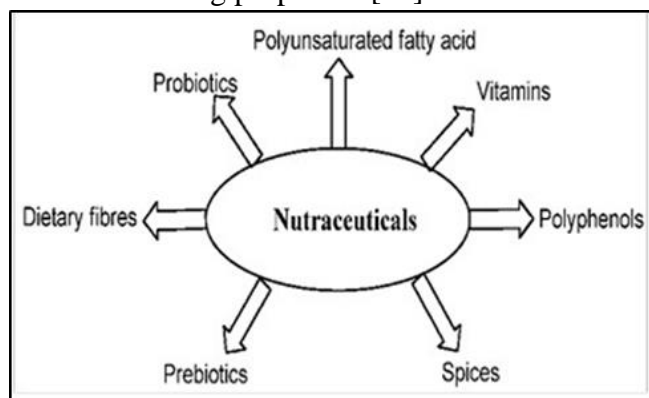


Figure No. 5: Diabetes-Preventive Nutraceuticals
Vitamin E:

The main role of vitamin E, an important fat-soluble vitamin, is that of an antioxidant. Diabetes incidence has been linked to low vitamin E levels, and some studies indicate that antioxidant levels may be lower in diabetics. Additional information points to the conclusion that diabetics may also need increased amounts of antioxidants to combat the effects of their high blood sugar levels. However, vitamin E overdose is not well defined and it is considered safe to take vitamin E supplements in doses not exceeding 400 IU. Although there have been no increase reported in supplement trials that have tracked subjects prothrombin times, doses higher than 800 IU may affect blood clotting.[15]

α -lipoic acid:

The content of the naturally occurring lipoic acid have been established to exert potent ROS scavenging activity. It is the only element in its oxidized state that can scavenge free radicals and ascend to quench several ROS. Besides, it is still not clear what role their capacity to chelate Transition metal elements and replenish other antioxidant such as glutathione, ascorbate and α tocopherol while dihydrolipoic acid and α lipoic acid are redox active pairs. Here evidence has been provided showing that α -lipoic. It has been observed that acid protects the retina from ischemia-reperfusion pathology both in animal model and rate retina. Diabetic retinopathy is defined by the ischaemic insult to the retina as one of the critical drivers of vision loss. Lipoic acid provides an approximate increase of between 18 – 20 percent on the insulin sensitivity of patients with type 2 diabetes mellitus. Significant improvement in acute diabetic neuropathy manifestations and inhibition of the disease progression were established in the α -lipoic acid clinical trials analysis.[16]

Calcium/ Vitamin D:

Reduced calcium consumption was associated with a raised risk of diabetes in one of the first

large prospective studies investigating the influence of habitual diet on the incidence of the disease. In the subsequent analysis that controlled for a number of these variables, women with the highest calcium intake quintile had 30% reduced diabetes risk over six years.[17] Rather surprisingly, it appears that none of them has taken this line more recently. No one using the sun exposure as a parameter or using regular vitamin D intake has done a prospective, prospective research on its relation to diabetes. Nevertheless, according to theory, it seems that preserving adequate calcium vitamin D could help to effectively retain insulin sensitivity, and therefore prevent diabetes mellitus through the reduction of PTH.[18]

Coenzyme Q10:

It is impossible to exaggerate the significance of this vitamin, mainly because many medications required to treat diabetes and its consequences deplete Coenzyme Q10. A dietary strategy for insulin resistance that shows promise is coenzyme Q10, at least for people who have hypertension. Singh et al conducted an eight-week randomized, double blind trial. Clouding 59 hypertensive patients, the authors compared the use of a vitamin B complex to water soluble CoQ10 at a dosage of 60mg bid. According to their findings, this dosage of CoQ10 reduced fasting insulin and glucose levels, which may imply better insulin resistance.[19]

Chromium:

It has been found that diabetics may be low in the trace mineral chromium. Chromium intake augmentation has been suggested as a means by which patients with type 2 diabetes mellitus could enhance their glucose tolerance and their insulin sensitivity levels. Supplementation with Chromium was reported to enhance the glucose and insulin sensitivity in both Normal and Diabetic adults. In a meta analysis of randomized controlled trials in the former group there was a slight but

significant improvement in glycaemic control for the former group of patients; the latter group did not receive any benefit.[20] The ADA has stated that the current evidence regarding the supplementation of chromium in individuals with diabetes is data conflicting.

Vitamin C:

It reduces lipid peroxides in erythrocytes and the accumulation of sorbitol due to diabetes in animals. In diabetic patients with T2DM and decreased vitamin C concentration, vitamin C supplementation (800 mg/day) restores vitamin C concentrations only partly but does not affect insulin resistance or endothelial functions.[21]

Carbohydrates:

The energy substrate that has the biggest effect on glycaemic levels is carbohydrates. The postprandial reaction is primarily caused by the overall amount of carbs consumed, but other factors may also be involved, including the type of carbohydrates, their fiber content, how they are cooked, their maturity level, etc. Moreover, preprandial glycaemia and the distribution of macronutrients within a meal (fats and proteins) were also which hypoglycemic drugs are administered—insulin or tablets—can and does make a difference to post-prandial glycaemia. The majority of scientific societies approve the principle that the carb intake of each person should be individualized and all endorse carbs are found in fruits, cereals, pasta, legumes, vegetables, and tubers. Eating legume starches appears to have a beneficial effect on glycaemia, even though there are no long-term trials to support this claim. This is because eating legume starches has a consistent influence on postprandial glycaemia, with no abrupt spikes, potentially preventing both postprandial hyperglycaemia and late hypoglycaemia.[22]

Fibers:

However, foods containing dietary fiber such as fruits and vegetables are recommended; whole



grain is emphasized. Even though fiber's capacity to reduce the risk of many chronic diseases is proven, its effects on lipid and glycaemic regulation remain unset. They suggest consuming no less than 26 grams per day for women and no less than 38 grams of dietary fiber per day for men. Diabetic patients also ought not to be given more fiber for there are no reasons to it.[23]

Vanadium:

It is suggested that this mineral is recommended for both type 1 and type 2 diabetes mellitus because of its insulin like activity through which transports glucose into the cells. Taking vanadium also included lowering of the hemoglobin A1c, cholesterol, and Overall, the effects of adding vanadium was the lower of the hemoglobin A1c, cholesterol. Actual lower HbA1c and better fasting glucose (the amount of sugar in blood first thing in the morning) may be achieved by taking dosages between 45 and 150 mg/day. According to toxicity studies, most people may safely and well tolerate these dosage levels. Some people have moderate gastrointestinal upset, either at larger dosages (up to 400 mg/day) or during the first week of treatment.[24]

CONCLUSION:

Herbal medicines and nutraceuticals represent a promising alternative therapy for diabetes management, offering potential benefits in glycemic control, reduction of complications, and improvement of overall health. It has fewer side effects compared to conventional pharmacological treatments. However, while the potential is significant, further research is essential to establish standardized dosages, identify mechanisms of action, and ensure safety and efficacy. As awareness grows, integrating these natural remedies into a comprehensive diabetes management plan may enhance patient outcomes and quality of life, but should always be approached under the guidance of healthcare professionals.

Herbal medicines and nutraceuticals hold promise as an emerging alternative therapy for diabetes management. While more research is needed, these natural interventions offer a complementary approach to conventional treatments, potentially improving the quality of life for individuals with diabetes.

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