

Nutraceutical Based Approach to Combat Diabetes Mellitus



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Abstract

Nutrients, herbals and dietary supplements are major components of nutraceuticals which are instrumental in maintaining health, act against various disease conditions and thus promote the quality of life. Diabetes mellitus is one of them. Management of diabetes with nutraceuticals-based approach includes intake of functional foods and herbal supplements. Nutraceuticals are food supplements and have nutritional value and exhibit significant clinical & pharmacological activity. The potency of herbal drugs is significant & they have negligible side effects than the synthetic antidiabetic drugs.

Keywords: Diabetes; Nutraceuticals; Herbs; Supplements; Functional food

Introduction

Diabetes mellitus is a group of diseases characterized by high levels of glucose in the blood resulting from defects in insulin production (insulin deficiency), insulin action (insulin resistance), or both. Consistently high levels of glucose in the bloodstream damage the nerves and blood vessels, and can lead to heart disease, stroke, high blood pressure, blindness, kidney disease, amputations, and dental disease. According to IDF Diabetes Atlas 2017, Some 425 million people worldwide, or 8.8% of adults 20-79 years, are estimated to have diabetes. About 79% live in low and middle-income countries. The number of people with diabetes increases to 451 million if the age is expanded to 18-99 years. If these trends continue, by 2045, 693 million people 18-99 years, or 629 million of people 20-79 years, will have diabetes.

Nutraceuticals and Diabetes

Several medicinal plants are used as hypoglycaemic in the Indian system of medicines, including Ayurveda. Nutraceuticals denote foods having medicinal effect on the health of human beings. Nutraceuticals have the capability to control diabetes.

Categories of nutraceuticals and their role in diabetes

Nutraceuticals are non-specific biological therapies used to promote wellness, prevent malignant processes and control symptoms. These can be grouped into the following three broad categories [1].

1. Substances with established nutritional functions, such as vitamins, minerals, amino acids and fatty acids - Nutrients
2. Herbs or botanical products as concentrates and extracts - Herbals
3. Reagents derived from other sources (e.g. pyruvate, chondroitin sulphate, steroid hormone precursors) serving specific functions, such as sports nutrition, weight-loss supplements and meal replacements-Dietary supplements.

Nutraceutical antidiabetic herbs

Acacia arabica (Babul): It is of Mimosaceae family and found all over India mainly in the wild habitat. It acts through release of insulin from pancreatic beta cells, which accounts for the hypoglycaemic activity [2]. Powdered seeds of *Acacia arabica* when administered orally (2,3 and 4g/kg body weight) to normal rabbits induced hypoglycaemic effect by initiating release of insulin from pancreatic beta cells [3].

Aegle marmelos (Holy Fruit Tree): It is of Rutaceae family and found in the plains and sub mountain regions of India. The proposed mechanism of action is that it increases utilization of glucose; either by direct stimulation of glucose uptake or via the mediation of enhanced insulin secretion [4]. Antihyperglycemic activity of the leaves in glucose induced hyperglycaemic rat at an oral dose equivalent to 250mg/kg [5].

Allium cepa (Onion): It is of Liliaceae family and cultivated as an annual all over the country. It lowers blood glucose level and has potent antioxidant activity, which may account for the hypoglycaemic potential [5]. Hypoglycaemic activity of the onion is attributed to the allyl propyl disulphide and allicin.

Allium sativum (Garlic): It is of Liliaceae family. It has strong antioxidant activity and rapid reactivity with thiol containing proteins responsible for the hypoglycaemic property [6]. Allicin, has been shown to have significant hypoglycaemic activity. Ethanol, petroleum ether and ethyl acetate extract in alloxanized rabbits at a dose of 0.25mg/kg, orally shows antihyperglycemic activity 79.3g of bulb is enough for control of diabetes.

Aloe Vera (Aloe): Aloe Vera maintains glucose homeostasis by controlling the carbohydrate metabolizing enzymes [7] and stimulates insulin release from pancreatic beta cells [8]. Hypoglycaemic activity of the plant (200 and 300 mg/kg p.o.) has been done on normal fasted rats, oral glucose-loaded rats and streptozotocin-induced diabetic rats [8]. Aloe Vera showed antihyperglycemic activity when one tablespoonful aloe juice was given orally in the morning and at bedtime to diabetic patients for 42 days. Leaf pulp juice of 10–20 ml is used to control diabetes.

Azadirachta indica (Neem): It is of Meliaceae family. It inhibits action of epinephrine on glucose metabolism, resulting in increased utilization of peripheral glucose [9]. Hydro alcoholic plant extract in normal rats and in glucose fed and streptozotocin induced diabetic rats' shows hypoglycemic activity [10,11]. Leaf juice of 10-20ml is used to control diabetes.

Caesalpinia bonducella (Fever Nut): It is of Caesalpinaceae family. It increases the release of insulin from pancreatic cells. Aqueous and 50% ethanolic seed extracts in normal and streptozotocin-diabetic rats' shows hypoglycemic and antihyperglycemic activities [11]. 1-3g of Seed kernel powder is used to control diabetes.

Coccinia indica (Kundru): It is of Cucurbitaceae family. It suppresses glucose synthesis, through depression of the key gluconeogenic enzymes glucose-6-phosphatase and fructose-1,6-bisphosphatase and enhances glucose oxidation by shunt pathway through activation of its principal enzyme glucose-6-phosphate dehydrogenase [12]. Dried extract (500mg/kg p.o., for 6 weeks) in 30 diabetic patients give antihyperglycemic activity [13]. 3-6g powder of Whole plant and 5-10ml juice is used to treat diabetes.

Eugenia jambolana (Jamun): It is of Myrtaceae family. The activity may be mediated through an insulin release mechanism [14] or due to alteration in hepatic and skeletal muscle glycogen content and hepatic glucokinase, hexokinase, glucose-6-phosphate and phosphofructokinase levels in diabetic mice [15]. In India decoction of kernels of Eugenia jambolana is used as household remedy for diabetes. Aqueous, alcoholic extracts and lyophilized powder (200mg/kg per day) of the plant in

hyperglycaemic animals shows hypoglycaemic effect [16]. It also shows blood glucose lowering activity of aqueous seed extract (2.5 and 5.0g/kg body weight p.o. for 6 weeks) along with an increase in total haemoglobin and antioxidant activity in diabetic rats [17].

Gymnema sylvestre (Gurmar): This Indian plant has traditionally been used to treat diabetes—and is helpful for both Type I and Type II diabetics. It increases secretion of insulin, it promotes regeneration of islet cells, it increases utilization of glucose and it is shown to increase the activities of enzymes responsible for utilization of glucose by insulin-dependent pathways, an increase in phosphorylase activity, decrease in gluconeogenic enzymes and sorbitol dehydrogenase and it also causes inhibition of glucose absorption from intestine [18,19]. In liquid form (extract), 25 to 75ml per week is recommended. Best results of this medicine will come after 6 to 12 months of continuous use [20].

Linum usitatissimum (Flax Seeds): Flax seeds are the dried ripe seeds of family Linaceae. Flax seeds contain antioxidants and have high dietary fibre that can help diabetics by inhibit lipid peroxidation and scavenging of hydroxy radicals. Dietary fibres of flaxseeds contain about 6% mucilage which has nutritional value. Secoisolariciresinol diglycoside (SDG), a plant lignan found in flaxseed, has been found to possess antioxidant properties [21].

Momordica charantia (Bitter Gourd): It is of Cucurbitaceae family, cultivated all over India for its fruits. It may act by increasing hepatic glycogen [22]. The fruits and seeds yielded a polypeptide, p-insulin, which was considered like bovine insulin [23]. Vicine is the hypoglycaemic constituent in the seed. There is blood glucose level reducing activity of fruit powder in fasted alloxan-induced diabetic rats after a treatment for 15 days [22].

Ocimum sanctum (Tulsi): It is of Labiatae family, the aqueous extract of leaves of Ocimum sanctum showed the significant reduction in blood sugar level in both normal and alloxan induced diabetic rats. It may act by cortisol inhibiting potency [24]. Leaf powder, given along with food for 1 month, in normal and diabetic rats reduces fasting blood glucose level [25]. 50-10ml plant infusion is used as dosage of tulsi.

Pterocarpus marsupium (Vijaysar): It is of Papilionaceae family; found throughout the tropical zones of India in the hilly regions. Different parts of the plant like bark, latex, etc. were investigated and reported to have hypoglycaemic activity [26,27]. Various active components like epicatechin, marsupsin, pterosupin and pterostilbene, isolated from the bark and heartwood of the plant, were also found to possess blood sugar lowering activity [28]. Stem bark -32-50g for decoction is used to control diabetes.

Trigonella foenum-graecum (Fenugreek): It is of Papilionaceae family, widely cultivated in many parts of India. It increased glucose-induced insulin release through a direct effect

on the isolated islets of Langerhans. Various extracts of different parts of this plant; fibres, proteins and saponins isolated from the seeds were investigated and found to possess significant hypoglycaemic activity [29]. Trigonella seeds and the major alkaloid component, Trigonelline, exerted a mild hypoglycaemic effect. 3-5g of seed powder is used to treat diabetes [30].

***Tinospora cordifolia* (Guduchi):** It is of Menispermaceae family, found in tropical India and the Andamans. Various extracts of the leaves of this plant were investigated for their blood sugar lowering activity in normal and alloxanized rabbits in graded doses and the findings have proved that the plant has potent hypoglycaemic activity [31].

Conclusion

Nutraceuticals are food supplements and have nutritional value. All the nutrients discussed in this review have exhibited significant clinical & pharmacological activity. There is increasing demand by patients for use of the natural products with antidiabetic activity. A well-balanced vegetarian diet chosen to form a variety of foods when complemented with other healthy lifestyle practices would significantly decrease the risk for diabetes mellitus. The efficacy of hypoglycaemic herbs is achieved by increasing insulin secretion, enhancing glucose uptake by adipose and muscle tissues, inhibiting glucose absorption from intestine and inhibiting glucose production from hepatocytes. A place for nutraceuticals in clinical practice is emerging, but important pharmaceutical and clinical issues need to be addressed by further research.

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