Diabetes: Medicinal Herbs to Support Blood Sugar Management in Non-Insulin-Dependent Diabetes

HRB 620b Herbal Therapeutics II

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Background

Diabetes Mellitus is a chronic metabolic disorder characterized by elevated blood sugar levels (hyperglycemia) and glucose present in the urine (glycosuria). Insulin, a hormone produced in the pancreas, regulates blood sugar by removing glucose (sugar) from the blood, allowing it to enter cells throughout the body. It is important for other metabolic processes, as well. When there is insufficient insulin, or the body is not reacting to the insulin that is present, the levels of glucose in the blood begin to rise. Sufficiently high levels of blood glucose result in the body burning alternative sources of energy, like fats, leaving their metabolites, ketones, in the blood. Metabolic changes can result, impairing the body's ability to handle fats, leading to a buildup of fat throughout their arteries. Ultimately this can contribute to serious health problems such as: blindness, kidney failure, heart attack, and stroke.

There are two types of diabetes: Insulin-Dependent Diabetes Mellitus (IDDM) and Non-Insulin-Dependent Diabetes Mellitus (NIDDM). IDDM, often referred to as Type I, is usually characterized by significant lack of insulin production. There are many theories about the cause of the disease, however it is not entirely understood. Type I diabetes must be treated with dietary modifications and exogenous insulin supplementation.

NIDDM, Type II, also involves a deficiency of insulin, however it is much less severe. Sometimes the insulin is being produced, but no longer effective. Treatment for this type of diabetes does not require insulin since the body is still producing it. Common treatment involves the use of hypoglycemic agents, glucosidase inhibitors, dietary modifications, and preparations designed to delay absorption of glucose.

Present Case

Herbal medicine has been used to treat diabetes for thousands of years. There are over one thousand plants that have been used historically for treating symptoms of diabetes. Plants

and plant extracts act in a variety of specific and non-specific ways, with the secondary metabolites from the plants either directly lowering glucose levels in the blood while others impact glucose metabolism. Metformin, the first drug created for the treatment of Type II diabetes, was developed after the discovery that goat's rue, *Galega officinalis*, contained a guanidine alkaloid that potentiated the activity of insulin. That alkaloid, galegine, is structurally similar to the synthetic metformin (Bone, 2003).

Testing of plants for hypoglycemic activity is primarily focused on the bioactivity of compounds related to glucose homeostasis The mechanisms of actions vary widely, with some effects appearing immediately, and others requiring longer periods of time. Many plants have demonstrated beneficial actions related to symptoms of diabetes other than just blood glucose regulation, however they are beyond the scope of this paper.

Clinical studies have demonstrated that certain medicinal plants can stimulate insulin secretion, augment various receptors involved in the process, prevent insulin resistance before it develops, up-regulate or promote translocation of glucose transporter type 4 (GLUT-4), inhibit glucagon-like peptide-1 (GLP-1) secretion and advanced glycation end product (AGE) formation. The number of herbs that lower blood sugar levels is extensive and prohibitively long.

A widely used Ayurvedic herb, "gurmar", or gymnema, (*Gymnema sylvestre*) was described in ancient texts as useful when urine is sweet and has been documented as an antidiabetic medication for over 2000 years. The name gurmar means "sugar destroyer" in Hindi. Controlled trials utilizing *Gymnema sylvestre* found that a preparation of 400 mg/day of Gymnema extract significantly lowered blood glucose and glycosylated haemoglobin over the course of 18 to 20 minutes, resulting in levels unparalleled by the group receiving conventional treatment. The authors concluded that the herb may promote insulin production and act as a regenerative agent, to include in damaged pancreatic tissue. It is suggested that these actions are due to the gymnemic acids (El-Houri, et al., 2014). A recent randomized, double-blind controlled trial was unable to demonstrate antidiabetic effects, but did have statistically significant reductions in body weight (Martínez-Abundis, 2016).

Another traditional remedy with thousands of years of use in Ayurvedic medicine is *Coleus forskohlii.* The traditional use was for cardiovascular and digestive disorders, however it is a powerful herb for endocrine function because it has the unique ability to increase production of cyclic AMP (cAMP, adenylate cyclase), an important messenger used by many hormones and neurotransmitters (Bone & Mills, 2013). While it does not cross into the cell, it is used for intracellular signal transduction, triggering changes in the cell's function. There are numerous physiological and biological effects from elevated levels of cAMP, however relative to the metabolic system, cAMP can trigger increased insulin production, stimulates the release of glucagon, stimulates the breakdown fat and inhibits glucose uptake. Since obesity and adipose tissue play a role in insulin resistance, this herb could play a powerful role as both a hypoglycemic and a fat loss aid at a dosage of at least 50mg/day of forskolin, a diterpene extracted from the plant. This dosage was found to be effective in several clinical trials and studies. The results of another study found that an oral dose of 250mg/day for 12 weeks lowered body fat content in obese men, raised their testosterone levels, and increased their bone mass (Godard, Johnson, & Richmond, 2005). Another herb that has been found to have similar impact in promoting fat loss is licorice *Glycyrrhiza glabra*.

Clinical trials support the use of fenugreek *Trigonella foenum-graecum,* leaf or seed, at 5g/day for improved blood glucose. It is also reported to promote pancreatic cell renewal (Kalailingam et al., 2014). Nopal, or prickly pear cactus *Opuntia ficus-indica*, has been used as an indigenous remedy for diabetes for hundreds of years. In vivo studies have shown that Opuntia lowers has promise in blended whole plant form, juice extracts, and isolated constituents. It has been found to both lower blood glucose and increase insulin levels (Leem, Kim, Hahm, & Kim, 2016). The sulfur-containing compounds, allyl propyl disulfide and allicin, found in onions *Allium cepa,* and garlic *Allium sativum,* exhibit hypoglycemic effects by competitive interaction with insulin.

Cinnamon has been lauded for its support in blood sugar management. There are conflicting studies on the efficacy and particular species responsible for the hypoglycemic action. A meta-analysis found that 1-6 grams of powdered cinnamon (*Cinnamomum verum* and

Cinnamomum cassia) had positive impact on blood sugar levels, however more studies are needed. There is insufficient quality clinical date to evaluate bitter melon *Momordica charantia,* however one of its hypoglycemic peptides, Polypeptide-p, also known as "plant insulin" has been clinically demonstrated to be effective for humans when administered subcutaneously.

Other promising medicinal herbs with strong supporting clinical research are *Ganoderma lucidum* Reishi mushroom and *Fucus vesiculosus,* a brown algae seaweed known as "bladderwrack" in western herbal medicine. Both are nutritional powerhouses.

Conclusion:

Medicinal plants can effectively serve as an adjunctive treatment or natural alternative to commercial oral hypoglycemic medications. There is insufficient clinical data to support each of the thousands of plants that have been used in traditional medicine systems for blood sugar management. There is sufficient clinical research to support the use of some of these, such as: *Gymnema sylvestre, Coleus forskohlii, Glycyrrhiza glabra,* and *Trigonella foenum-graecum,* among others.

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