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Phytotherapy in diabetes: a review of plant

Monika Kuc - kuc.monika96@gmail.com; Medical Faculty, Institute of Medical Sciences, Collegium Medicum, Oleska Street 48, 45-052 Opole Poland

Katarzyna Cyboran - katarzyna_cyboran@o2.pl; Medical Faculty, Institute of Medical Sciences, Collegium Medicum, Oleska Street 48, 45-052 Opole Poland

Damian Machaj - damian10b10@o2.pl; Faculty of Medicine, Medical University of Wroclaw, Wybrzeże L. Pasteura Street 1, 50-367 Wrocław Poland

Tomasz Korzec – tkorzec@poczta.fm; Faculty of Medicine, Medical University of Lublin, Aleje Racławickie 1 Street, 20-059 Lublin Poland

Konrad Kania – 1konradkania@gmail.com; Faculty of Medicine, Medical University of Lublin, Aleje Racławickie 1 Street, 20-059 Lublin Poland

ABSTRACT

More than 200 species of plants possess antidiabetic properties which were evaluated mostly by screening tests without digging far for the exact mode of action. Searching among the different literature resources and various database, this article provides a comprehensive review on the available antidiabetic plants that have been approved by pharmacological and clinical evaluations, and which their mechanism(s) of action is assured.

KEY WORDS: phytotherapy, diabetes, hyperglycemia, hypoglycemic effect, medicinal plants

INTRODUCTION

According to the World Health Organization (WHO), diabetes (Diabetes mellitus) is one of the most dangerous social and civilization diseases. About 422 million people worldwide have diabetes, the majority living in low-and middle-income countries, and 1.6 million deaths are

directly attributed to diabetes each year. Both the number of cases and the prevalence of diabetes have been steadily increasing over the past few decades. [1]. Diabetes mellitus refers to a metabolic disease of various etiologies characterized by chronic hyperglycemia with disturbances in carbohydrate, fat and protein metabolism due to a defect in insulin secretion and / or function. Diabetes mellitus causes chronic damage, dysfunction and failure of various organs.

Phytotherapy is a method which can be used at every level of health prevention. It significantly increases awareness of issues related not only to the problem of diabetes and obesity, but also health in general. This takes advantage of the healing effects of plant materials. Modern phytotherapy is based on drugs with a specific pharmacological effect, composed of active substances isolated from plants [2]. According to WHO research, 80% of the world's population now uses phytotherapy as part of health care. It can only provide as herbalism is esteemed among people [3].

Herbal products can contain several active ingredients or compounds that can act in different ways to affect multiple biological pathways and alleviate the symptoms of diabetes with multiple benefits. The plants that are used are categorized according to their proved mode of action and are classified into those that act by inhibiting glucose absorption from intestine, increasing insulin secretion from the pancreas, inhibiting glucose production from hepatocytes, or enhancing glucose uptake by adipose and muscle tissues [4].

The applicable standards for the treatment of type 2 diabetes suggest the use of drugs appropriately selected for the patient and change his lifestyle [5].

	Metformin	Sulfonylureas	GLP-1 receptor agonists	DPP-4 inhibitors	PPAR-γ agonist	SGLT-2 inhibitors
Effect/mechanism	Decreased hepatic glucose production, increased insulin sensitivity	Increased insulin secretion regardless of the severity of hyperglycemia	Increased hyperglycemia-mediated insulin secretion, decreased appetite	Increased hyperglycemia-mediated insulin secretion	Increased insulin sensitivity	Induction of glucosuria
Hypoglycemic effect	High	High	High	Medium	High	High
Plasma insulin	↓	↑↑	↑↑	↑	↓	↓
LDL cholesterol	↓	↔	↓	↓ or ↔	↔	↔or ↑
HDL cholesterol	↑	↔	↑	↑	↑	↑
Triglycerides	↓	↔	↓	↔	↓	↔
Body weight	↓ or ↔	↑	↓↓	↔	↑	↓
Risk of hypoglycemia	↔	↑	↔	↔	↔	↔
Adverse effects	Gastrointestinal upset	Hypoglycemia, increase in body weight	Gastrointestinal upset (nausea, vomiting)	No significant	Fluid retention (edema), increase in body weight, increased risk of long bone fractures	Genital fungal infections, increased thirst
Beneficial cardio-vascular effect			Yes**			Yes**^
Contraindications	Organ failure (heart, brain, liver, kidneys#, respiratory), alcohol abuse	Heart, liver, kidney failure	Gastrointestinal neuropathy	Liver failure	Heart or liver failure, bladder cancer	Significant reduction of glomerular filtration rate#

*See Table 19.3. **Proven for some drugs of this class, according to the recent results from randomized clinical trials
^For empagliflozin and canagliflozin, there were no differences in cardiovascular outcome trials between higher and lower doses: 10 mg vs. 25 mg and 100 mg vs 300 mg, respectively
#Use of specific medications according to the current summary of product characteristics wording as related to the estimated glomerular filtration rate.
DPP-4 — dipeptidyl peptidase-4; GLP-1 — glucagon-like peptide 1; HbA_{1c} — hemoglobin A_{1c}; HDL — high-density lipoprotein; LDL — low-density lipoprotein; PPAR-γ — peroxisome proliferator activated receptor gamma; SGLT-2 — sodium-glucose transport protein 2

Drug used for the treatment of diabetes type 2 [5].

HYPOGLYCEMIC PLANTS

In the phytotherapy od diabetes, we can use: *Galega officinalis, Morus alba, Phaseolus vulgaris, Trigonella foenum-graecum, Medicago sativa, Zea mays* and *Zingiber officinale* [6]. But the most popular supplements in Poland are supplements containing *Morus alba.*

Examination on white mulberry extract has shown its antioxidant capacity. This has been observed to reduce postprandial blood glucose levels possibly by preventing glucose absorption in the gut through inhibition of the alpha-glycosidase enzyme, as well as an increase in insulin secretion into the blood [6,7]. Mohammadi and Naik [8] in their studies showed that rats who have used white mulberry extract, there is an increase in the mass and diameter of the pancreatic islets compared with the control. The results of these studies indicate the ability of the extract to regenerate beta cells and restore their secretory activity. Despite its hypoglycaemic effect, it has antifungal, antibacterial and antiviral properties [9]. Mulberry leaves also contain flavonoids that inhibit the enzyme responsible for synthesis of sorbitol from excess glucose to, which reduces the risk of neuropathy and cataracts [11].

4-hydroxyisoleucine in fenugreek stimulates insulin secretion in a glucose-dependent manner. Moreover, the seeds were reported to reduce blood glucose and cholesterol levels. This effects can be observed as improvement of fasting blood glucose level, lipid levels, HbA1c level, 24-hour urine glucose excretion and oral glucose tolerance test. Side effects of fenugreek were not noticed [7].

Guanidine contained in *Galega officinalis* and *Phaseolus vulgaris* reduces blood glucose levels and body weight. Additionally, the *Phaseolus vulgaris* extract increases insulin concentration and has a beneficial effect on cholesterol and triglyceride levels. Probably the hypoglycaemic effect is achieved by activation and membrane translocation of GLUT-1 and GLUT-4 transport channels [10,12]. But the main activity of *Phaseolus vulgaris* is believed to be a diuretic [12]. Guanidines have become a precursor to the synthesis of antidiabetic drugs such as metformin.

Zingiber officinale has demonstrated beneficial effects on hyperglicemia in several experimental studies, by increasing insulin sensitivity and synthesis, and glucose uptake by tissues, and by reducing oxidative stress, whilst protecting pancreatic β-cells [4]. Ginger works by inhibiting α-glucosidase and α-amylase, lowering fasting blood glucose. Ginger extract can increase the expression of the type 4 glucose transporter (GLUT-4) as well as lower fasting insulin levels and the HOMA-IR index of insulin resistance [13].

Medicago sativa contains significant amounts of nicotinic acid [10]. It is used in the treatment of carbohydrate metabolism disorders, fatigue syndromes and perimenopausal. The infusion of the herb alfalfa lowers serum glucose and also increases insulin secretion by β cells of Langerhans islets. In patients treated with high doses of nicotinic acid was observed slower progression of the disease [14].

SUMMARY

Currently, pharmacotherapy of diabetes is sufficient to control the disease well. We have many medications at our disposal that can be used as monotherapy or as polytherapy. An important

element in the treatment of diabetes is a lifestyle change: a healthy diet and increased physical activity. It is worth considering the use of herbal preparations especially in the early stages of the disease and the prediabetic state or as an addition to treatment. The plants listed in the article can be used individually or in appropriately composed mixtures.

Diabetes mellitus is a serious disease that requires looking at many levels. But with proper treatment, self-control and a healthy lifestyle, patients have the chance to live a normal and long life.

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