

Hypoglycemic Influence of Phytochemical Compounds of Medicinal Plants and their Mechanism Action

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Abstract

Diabetes is very common among all social classes and among all age groups. Diabetes is represented in two types, the first type and usually it comes at a young age, and its main reason is the failure of the pancreas, which is the organ responsible for producing insulin, which is the hormone responsible for the metabolism of glucose, which causes its rise in diabetes, the second type and most often affects people after the age of 20 who have it. Some of the factors that cause diabetes, in which the pancreas is an active organ that produces insulin and performs its function, but there is something that prevents it from doing its job due to the presence of insulin resistance, and this is often what appears in people with obesity. Modern science has turned to alternative medicine to treat many diseases, including type 2 diabetes, in order to reduce the side effects of prescription drugs. In this review, some natural compounds will be summarized that may contribute to treating type 2 diabetes or trying to control and control it so that no complications occur.

Keywords: Phytochemical compounds; Diabetes mellitus; Type II; Natural products; Antidiabetic effect

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Citation: Elbossaty W (2021) Hypoglycemic Influence of Phytochemical Compounds of Medicinal Plants and their Mechanism Action. Health Sci J. 15 No. 3: 815.

Received with Revision March 02, 2021, **Accepted:** March 15, 2021, **Published:** March 19, 2021

Background

There are currently more than 415 million people suffering from diabetes worldwide, according to statistics from the International Diabetes Federation, and these numbers are expected to rise due to wrong practices by people in terms of eating habits and lack of exercise [1].

Type 2 diabetes represents approximately 90% of the total number of people infected with diabetes. If it is not controlled, this will lead to the occurrence of many health complications that have a negative impact on both the individual and society. In addition, it burdens the community in searching for solutions to this problem, seeking a way to prevent the development of the disease and control its complications [2].

Since ancient times, some medicinal plants have proven great effectiveness in treating diabetes, controlling blood levels and eliminating insulin resistance, which is the main cause of type 2 diabetes [3].

There are strategies in the treatment of patients with type 2 diabetes, some of which cause reducing insulin resistance by improving the efficiency of sensitivity to such as the metformin group, and others that stimulate the pancreas to secrete a large amount of insulin such as sulfonylureas. And all the strategies,

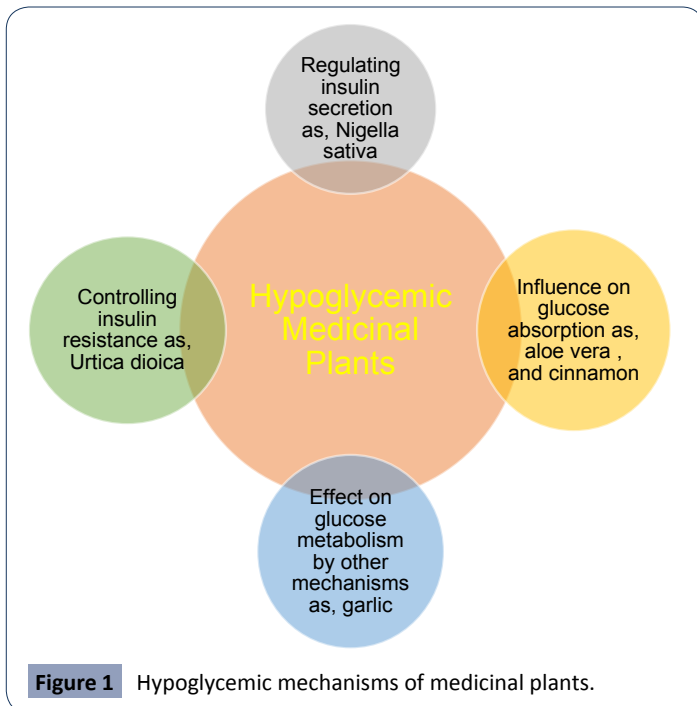
although they are effective ways to reduce the level of diabetes in the blood, but they have multiple side effects, including what causes weight gain, or fatigue of the liver cells, fatigue of the pancreas, high blood acidity [4].

All this was the reason for the trend towards an integrated pharmacy in the plant kingdom, in the interest of scientists to reduce the side effects and at the same time use safe methods of treatment. Medicinal plants are distinguished by the presence of secondary metabolites, which are phytochemical compounds such as alkalis, phenolic acid, phenol, and tannin. These compounds have medicinal properties such as antioxidant, anti-bacterial and anti-fungal properties, and some of them have proven effective as a blood sugar-lowering agent [5].

Herbaceous plants may affect glucose levels through 3 mechanisms, **Figure 1**.

Regulating insulin secretion

As insulin secretion is one of the most important causes of diabetes, research has proven that there are some herbal plants that have the ability to improve blood sugar levels by regulating insulin secretion, and trying to protect beta cells from damage, as is the case when eating cumin seeds, and *Nigella sativa* [6].



Controlling insulin resistance

Most people with type 2 diabetes have insulin resistance. Some herbal plants have the ability to boost insulin sensitivity, such as *Urtica dioica* [7].

Influence on glucose absorption

α -glucosidase increases the rates of digestion of carbohydrates and then increases the rate of absorption of sugar, raising the glucose in the blood. There are some herbal plants that work to inhibit the action of α -glucosidase and the α -amylase enzyme, and then affect glucose absorption and impede its movement and reduce blood sugar levels, such as cinnamon, green tea, aloe vera, and basil [8].

Effect on glucose metabolism by other mechanisms

By re-repairing damaged pancreatic cells, increasing insulin sensitivity, increasing the efficiency of oxidative properties. As high glucose for a long time may cause a rise in ROS rates, and this may be accompanied by damage to many vital tissues, so the containment of some herbal plants on antioxidant compounds that stimulate the pancreatic cells, increasing insulin sensitivity. Among the most important plants that play this role is garlic extract, which stimulates the secretion of insulin from beta cells and thus affects the reduction of blood sugar levels [9]. Among the most famous of these medicinal plants.

Apple cider vinegar

Apple cider vinegar is one of the substances that reduce the rate of diabetes, as it works to regulate the rate of sugar if taken after meals. It also reduces the rate of fasting sugar if taken two tablespoons before bed. Apple cider vinegar must be taken diluted so as not to affect the enamel of the teeth. Although

apple cider vinegar is made from apples, a teaspoon of it contains 1 g of carbohydrates [10].

Research experiments have proven that vinegar has an effective role in reducing diabetes levels, especially after eating a meal that contains large amounts of carbohydrates. The first experience of the effect of vinegar on diabetes was in 1988, when a group of mice was given a solution of acetic acid (2%) after giving them a meal rich in carbohydrates, and a decrease in blood glucose levels was observed. The benefit of vinegar as a lowering of diabetes is due to its containment of some phytochemical compounds, especially polyphenols, which reduce sugar levels after eating, by means of slowing down the intestinal movement, which contributes to reducing the absorption of sugar, so its rate does not rise in the blood after eating, and it may inhibit the enzymes responsible for Digestion of carbohydrates, so it reduces the level of sugar in the blood after eating [11].

A scientific study applied to 317 people with type 2 diabetes proved that consuming a spoonful of apple cider vinegar with meals rich in carbohydrates led to a decrease in the rate of fasting and HBA1C [12].

Dietary fibers

Eating fiber reduces the absorption of carbohydrates, so it leads to a decrease in the level of sugar in the blood, and it also gives a feeling of fullness, so it reduces the amount of food and this contributes to the maintenance of blood sugar levels. It is recommended to eat 30 grams of fiber daily [13].

Scientific research has proven the ability of plants rich in fiber to reduce levels of sugar and insulin in the blood. The results found that consuming foods rich in fiber have the ability to reduce the level of sugar. In a study that was conducted on rats eating a mixture of guar gum (5%) and wheat bran (10%) occurred decrease in diabetes rates and improvement in renal impairment. This is due to the fiber's ability to activate the enzyme glutamine fructose-6-phosphate amidotransferase and lowering the renal content of heparin sulfate, thus lowering the blood sugar level [14].

Studies have also shown that people who eat foods rich in fiber have a lower sugar level compared to those who do not eat foods rich in thousands, as thousands reduce glucose absorption rates from the intestine, which contributes to not increasing it [15].

In a study conducted on dogs, it was found that dogs that were fed foods rich in fiber had a decrease in the level of sugar compared to the group that did not eat fiber [16].

One of the most important plants rich in fiber is fenugreek, where the seed content of fenugreek is 50-60% of the fiber. The effect of eating fenugreek has been studied on people with diabetes, it was noted that the cells' response to insulin improved, so there was a decrease in the level of sugar compared to people who did not take it [17].

Curcumin

It has an effective glucose-lowering and anti-inflammatory effect, as scientific research has proven that it increases insulin sensitivity, in addition to reducing TNF- α , hsCRP, and cytokines.

It also reduces insulin resistance and thus lowers the rate of diabetes and HBA1c [18].

In one study that was conducted on people with type 2 diabetes, they were given 250 mg curcuminoids/day for 9 months. All cases were cured compared to the group that took diabetes drugs, where only (16.4%) were cured. This is due to the fact that Curcumin rich with flavonoids, and poly phenols which have antidiabetic effects. It works to increase the efficiency of beta cells, reduce peptide C, and it increases sensitivity to insulin by reducing resistance to it [19].

Olea europaea L

Clinical trials have shown that people who took *Olea europaea L* leaf extract for 14 weeks had an improvement in fasting glucose levels, as well as decreased accumulation. Also, experiments on animals that were treated orally with *Olea europaea L* extract demonstrated the lack of digestion and absorption of carbohydrate in the intestine [20].

In a study to study the antidiabetic effect of olive leaf oleuropein extract that was administered to a group of diabetic mice for 4 weeks, a weight loss of 8 and 16 mg / kg was observed, in addition to a decrease in the level of glucose and cholesterol, and this is likely the reason for this. The olive leaf is rich in phenolic compounds and antioxidants that have an effective anti-diabetic effect [21].

Cinnamon

Scientific research has proven that cinnamon has a great benefit in reducing blood sugar levels. Cinnamon is one of the most important spices that are used to control blood sugar levels, due to the fact that it is rich in phytochemical compounds such as flavonoids, terpenes, glycosides. Studies have shown that when rats ingested 300 mg per kilogram of cinnamon, a significant decrease in the rate of glucose after post prandial [22].

Aloe vera

Aloe vera leaves are used as anti-diabetes by increasing insulin secretion from the pancreas, and its antioxidant effect by reducing the level of MDA, and increasing the concentration of SOD and GSH. Experiments have shown that the main reason aloe vera acts as an anti-diabetic is that it contains Emodin and mannose-6-phosphate in Aloe vera, which act as anti-inflammatory and thus reduce inflammation to lower the level of diabetes. In addition, aloe vera works to inhibit the synthesis of pancreatic α -amylase. It is responsible for the breakdown of starch into glucose and then maintains blood sugar levels [23].

Resveratrol

Clinical trials have shown that resveratrol extract has a diabetes-lowering effect, as in one study on obese people who took 150 mg / dL – 1 of resveratrol for one month, there was a significant decrease in the rate of diabetes. In another study it was proved that people with type diabetes type II 250 mg/ day – 1 for 3 months, a significant decrease in cumulative glucose in addition to an increase in insulin sensitivity [24].

Ginseng

Scientific research has proven that taking American ginseng works to reduce fasting sugar and mycelium levels, as well as reducing the rate of glycosylated hemoglobin. Ginseng plays an effective role as an anti-diabetic by containing the compound Ginsenosides, known to have diabetes-lowering properties, as it enhances insulin sensitivity by reducing the rate of demand for it. Stimulates insulin activity by stimulating production of protein kinase B and insulin receptor substrate-1 by the pancreas [25].

The anti-diabetic effect of ginseng is because it contains a bioactive compound called triterpene β -glycoside that has the ability to regulate insulin excretion, glucose metabolism and absorption [26].

In one study, a number of people with diabetes were given 100 and 200 mg of ginseng every day for 8 weeks, a decrease in fasting sugar levels occurred in addition to the cumulative sugar [27].

In another study, diabetics were given 3-4.5 g of Korean red ginseng, and there was a decrease in the rate of HBA1C [28].

In addition, giving 1 gm of ginseng extract for 4 weeks before eating 40 minutes led to a decrease in fasting glucose [29,30].

Nigella sativa

It is one of the most important herbal plants that contain phytochemical metabolites that have effective advantages in treating many diseases. However, it proved to be a great advantage in the treatment of diabetes, especially type 2 diabetes, as it helped to raise insulin sensitivity and reduced blood sugar levels. Where a study was done on rats, where they were given 2 g / kg per kilogram of weight from an aqueous solution of *Nigella sativa* for a period of 6 weeks, as the results showed improvement in glucose efficiency and control of blood sugar level and also proved effective in reducing weight by the same mechanism that metformin works in.

Conclusion

Diabetes has many complications, including what affects the eye and may cause blindness, and some causes damage to the arteries, especially in the kidneys and heart, causing kidney failure and heart strokes, and may affect the bones causing their fragility.

In spite of the effectiveness of the tools used in treating diabetes, its undesirable side effects make those who use it in a state of anxiety and dissatisfaction, so the importance of medicinal plants appeared in that they may have the desired effect and have no side effects from the drugs. And due to the medicinal plants' richness with phenolic compounds, they make them the focus of attention of scientists and researchers to try to reach the machine that works these compounds, which contributes to finding safe ways to extract them to obtain new drugs for treating diabetes with the least possible side effects.

Declaration of conflicts of interest

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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