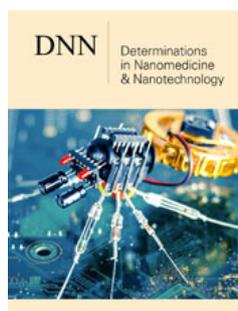


Silver Nanoparticle of *Pterocarpus Marsupium* Demonstrating Antidiabetic Activity in Rats

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Abstract

Pterocarpus marsupium is an important medicinal plant belonging to the family of Fabaceae. *Pterocarpus marsupium* bark and wood have been used as an antidiabetic remedy and it is popular in traditional medicine. The green synthesis of nanoparticles has an advantage when it combined with the silver to gives silver nanoparticles. Green synthesized nanoparticles are very effective, less toxic, low in cost and safe to the environment. *Pterocarpus marsupium* silver nanoparticles are effective against an antidiabetic activity without using any chemical reagent as stabilizing agent. The antidiabetic assay for *Pterocarpus marsupium* green synthesized silver nanoparticle involves both *invitro* and *in vivo* approaches. This review is to address the existing evidence on antidiabetic effect in rats using green synthesized silver nanoparticles of *Pterocarpus marsupium*.

Keyword: *Pterocarpus marsupium*; Green synthesis; Silver nanoparticle; Antidiabetic activity

Introduction

Diabetes mellitus is a major health problem worldwide. Diabetes mellitus is a metabolic disorder in which the body does not produce enough respond normally to insulin, causing blood sugar levels to be abnormal which leads to the serious damage to blood vessels, heart, kidney, eyes and nerves. About 463 million people worldwide have diabetes, it is predicted that by 2045 it may afflict up to 700 million people. In India, currently 77 million individuals have diabetes, and it was expected to double in 2045. Increased blood sugar level gives rise to many complications like diabetes retinopathy, depression, hypertension, hyperlipidemia, Alzheimer's disease, hearing impairment etc., Adults with diabetes have increased risk of heart attack and strokes. In pregnancy, increases the risk of fetal death and other severe complications [1,2]. The Nanoparticle is a small particle and dimensions to be in the range of 1 to 100 nanometers. Being nanosized, it shows improved bioavailability and increases solubility, and these structures penetrate in the tissue system, and ensures an action at the targeted location in the body. Among the wide range of metal nanoparticles, silver nanoparticles were the most popular, due to their unique physical, a chemical, and biological properties. Nowadays, the nanoparticles are synthesized by the green method are getting popular. Green synthesized nanoparticles have advantages such as eco-friendly, non-toxic and cost effective etc. Of the concern, there are some disadvantages such as the green method of nanoparticles being synthesized with the help of plants and its parts [3].

Medicinal Plants with Antidiabetic Potential

In the last few years medicinal plants are used in the world for treatment of diabetes. Some Indian medicinal plants which are most commonly tested for antidiabetic activity and experimentally evaluated. They include, *Allium cepa*, *Alluvium sativum*, *Aegle marmelos*, *Aloe vera*, *Andrographis paniculata*, *Azadirachta indica*, *Brassica juncea*, *Buddleja rapa*, *Cassia auriculata*, *Catharanthus roseus*, *Cajanus cajan*, *Citrus sinensis*, *Coccinia indica*, *Caesalpinia bonducella*, *Curcuma longa*, *Eugenia jambolana*, *Ficus bengalensis*, *Gymnema sylvestre*, *Momordica charantia*, *Mucuna pruriens*, *Murraya koeingii*, *Ocimum sativum*, *Pterocarpus marsupium*, *Swertia chiraytia*, *Syzigium cumini*, *Tinospora cordifolia*, *Trigonella foenum graceum* etc., Since herbal drugs have fewer side effects than synthetic allopathic drugs, the World Health Organization (WHO) advised to use traditional plants for the treatment

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of diabetes. Majority of people were benefited with traditional medicines in the management of diabetes [4-6].

Utilization of Nanotechnology in Medicinal Plant

The utility of the nanotechnology in the medicinal field is known as a nanomedicine. The Nanotechnology has the ability to target certain tissues and organs, individual cells and it systematically reduces side effects and increases the therapeutic index of drug molecules. Phytoconstituents which are present in the plant crude extract have enormous functionalities. The researchers have planned to explore mechanisms of a metal ion uptake and the reduction by plants. So, the green synthesized metal-based nanoparticle using medicinal plants has emerged [7].

Pterocarpus Marsupium

Pterocarpus marsupium belongs to the family Fabaceae also known as Malabar kino, Indian kino tree. It is the medicinal plant most widely used in the ayurvedic system of medicine to control antidiabetic effect. Various parts of Indian kino tree are used to treat antidiabetic diseases such as seeds, roots, heartwood, bark, leaves etc., The bark and heartwood of *Pterocarpus marsupium* is very effective in hypoglycemic activity and it was very popular in traditional medicine. Some studies for antidiabetic activity have conducted and reported the mechanism of action such as β -cell generation in the pancreas, insulin release, insulin like activities (increase in glucose uptake, increase in glycogen synthesis, increase in activity of oxidase enzyme) inhibition of amylase and glucosidase, increased expression of glucose transporter etc., Many studies were focused on pterostilbene and (-) epicatechin which were responsible for the antidiabetic effect of *Pterocarpus marsupium* heartwood and bark. The antidiabetic assay for the *Pterocarpus marsupium* involves both *invitro* and *in vivo* approaches [8,9].

Pterocarpus Marsupium *Invitro* Antidiabetic Activity

The *in vitro* antidiabetic assay includes both enzymatic assay and non-enzymatic assay. The enzymatic assay which includes carbohydrate digesting enzymes such as α -amylase, α -glucosidase, protein tyrosine phosphatase 1B, sucrase etc., The enzymatic action which mainly inhibits α -amylase and α -glucosidase. Those carbohydrates digesting enzymes work by controlling postprandial hyperglycemia. The delay of carbohydrate digestive enzymes shows better results in the management of type 2 diabetes mellitus. The *in vitro* non enzymatic glycosylation of Hemoglobin method is the important assay used to know control of diabetes. In an investigation *in vitro* approach of *Pterocarpus marsupium* showed better results in the mechanism of antidiabetic activity and some of them were successfully reported. They are as follows, [10,11].

Bark

In an investigation *in vitro* antidiabetic approach was performed with the aqueous extract of *Pterocarpus marsupium* roxb.in the dialysis membrane and showed better hypoglycemic activity by inhibiting the diffusion of glucose with the inhibition of α -amylase and β -glucosidase [12].

Heartwood and bark

In an investigation heartwood and bark of *Pterocarpus marsupium* has antidiabetic effect and it has a hypoglycemic effect, and it also has further protection in alleviating diabetic complications [13].

In vivo Antidiabetic Activity

The *in vivo* antidiabetic activity was performed by various methods such as acute toxicity studies, induction of diabetes to experimental animals etc. This approach was performed in the animal models like rodents (rats, mice), invertebrates, zebra fish etc. Some *in vivo* antidiabetic assay approaches were experimentally proven. They are as follows, [14]

1. **Seeds:** An investigation showed that ethanolic seed extract of *Pterocarpus marsupium* has potential antidiabetic effect in the gabapentin induced diabetic rats and it was concluded that effect was more similar to the standard drug metformin [15].
2. **Roots:** In an investigation showed that ethanolic roots extract of *Pterocarpus marsupium* has revealed the antihyperglycemic effect and it was determined by its statistically significant p value <0.001 in the streptozotocin induced diabetes rats [16].
3. **Leaves:** an investigation indicate that methanolic leaves extract of leaves of *Pterocarpus marsupium* has significant oral hypoglycemic activity with comparison of oral hypoglycemic effect of insulin secretagogue with glibenclamide, sulphonyl urea in alloxan induced diabetic albino rats. Finally, it was concluded that antidiabetic effect may be due to the increased insulin secretion [17].

Heartwood and bark

1. An investigation showed that ethanolic extract of *Pterocarpus marsupium* wood and bark and combined effect of wood and bark has antidiabetic effect were investigated in the Wistar albino rats. Finally, it was concluded by significant increase in plasma insulin p<0.001 [18].
2. An investigation showed that ethanolic heartwood extract of *Pterocarpus marsupium* has an antidiabetic effect and it improves the glycemic control and reduces the diabetic complications. It was concluded that phytoconstituents present in the heartwood such as phenolic-C-glycoside which is responsible for the antihyperglycemic activity [19].
3. An investigation showed that ethanolic heartwood extract of *Pterocarpus marsupium* has antidiabetic activity and it was evaluated in streptozotocin-nicotinamide induced type 2 diabetic rats. And it was concluded by significant (<0.005) reduction in the fasting blood glucose level in rats [20].

Green synthesized Silver Nanoparticle of *Pterocarpus Marsupium* *Invitro* Approach

An investigation showed that green synthesized silver nanoparticles of *Pterocarpus marsupium* is effective for antidiabetic effect, and they confirmed that nanoparticles were stable without

using any chemical reagent. Finally, antidiabetic activity was concluded by α -amylase inhibitory assay of silver nanoparticles with an IC50 value of 71.14% [21].

In vivo Approach

In an investigation showed that *Pterocarpus marsupium* silver nanoparticles were nontoxic and green synthesized silver nanoparticle of *Pterocarpus marsupium* has antihyperglycemic activity against streptozotocin-nicotinamide induced type 2 diabetes in rats. And it was concluded by *Pterocarpus marsupium* silver nanoparticle has more favorable reduction in lipid level in streptozotocin and nicotinamide - induced diabetic rats, compared with glibenclamide as well as regeneration of β -cells of pancreas [22].

Conclusion

This review reveals the investigations performed on different parts of Indian kino tree, *Pterocarpus marsupium* such as bark, heartwood, seed, root, leaves to control Diabetes mellitus. Diabetes mellitus is a group of metabolic disorders that leads to high blood sugar level due to defects in their insulin secretion. The International Diabetes Federation Atlas Ninth Edition, 2019 projects diabetes worldwide as approximately 463 million adults of the age 20-79 years and by 2045 this will rise to 700 million. At present, several groups of researchers concentrate on biomimetic approaches such as plant or plant leaf extracts, microorganisms and yeast to synthesize the metal nanoparticles called as "green chemical or phytochemical" approach as potential applications that might substantially improve quality of life for diabetics for which this work can be a lead to progress in this direction fruitfully.

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