Effectiveness of Insulin plant in Management of Diabetes Mellitus
Yonis Ismed

1 Faculty of Medicine, Universitas Sriwijaya, Palembang, Indonesia

ARTICLE INFO

Keywords:
Diabetes Mellitus
Insulin Plant
Hyperlycemic Effects

Corresponding author:
Yonis Ismed

E-mail address:
yonisismed@gmail.com

All authors have reviewed and approved the final version of the manuscript.

https://doi.org/10.37275/ehi.v3i1.45

1. Introduction

Diabetes mellitus (DM) is defined as disease or chronic metabolism abnormalities with multiple causes, characterized by high level of blood sugar, carbohydrate, lipid, protein metabolism problem as a result of insulin function deficiency. Insulin function deficiency is caused by abnormalities in production of insulin by beta langerhans or inability of cells to respond adequately to insulin.\(^1\)\(^2\) Diabetes mellitus is still a significant problem all over the world. It is estimated 8.3% of the world population (382 million) has the disease and projected to be 10% (592 million) in 2035. Diabetes mellitus has caused mortality in more than 5 million people.\(^3\)\(^4\)

Diabetes management aim is to correct insulin deficiency or resistant to reduce complication related to the disease and prevent further decline of β- pancreatic cells. One way to achieve this is by using oral hypoglycemic agent (eg metformin, gliburide, chlorpropamide, etc and insulin although some drugs still has unpleasant side effects and costly price. World Health Organisation stated research on alternative diabetic agent originated from plant is an important for management of this disease. Plant sources diabetic agent also shown to have fewer side effects than conventional ones with reduced blood glucose.\(^5\)

One of conventional diabetic drugs, metformin, also originated from Europe traditional plant, Galega officinalis, which is rich in guanidine, later found able to decrease blood sugar. Metformin success drove scientist to find another potential plant as antihyperglycemic agent. One of medicinal plant with this potential and also found in Indonesia is insulin plant or also called yacon (Smallanthus sonchifolius.) Rich in caffeic acid and chlorogenic acid, this plant is able to decrease blood sugar. Enhedryin and sesquiterpenic lactone in the leaves is also effective in decreasing postprandial glucose in diabetic animal...
Therefore it is important to know the effectiveness, safety and role of insulin plant in diabetes mellitus. This review aims to summarize and organize current literature on effectiveness and role of insulin plant in patient with diabetes mellitus.

**Insulin plant**

Insulin plant, also called yacon (*Smallanthus sonchifolius*) is a crop native from Peru, Ecuador, Colombia and Argentina. The plant begins to be cultivated outside its native country such as Japan, Europe and United States due to the potential harbored. In Indonesia, the plant has been cultivated since 2006 in Bandung and Yogyakarta. The plant could also be found in Jambi, at Jabung Barat Regency. Generally, the crop could optimally grow at highland at 24-30°C.

Insulin plant has old and big green leaves, gives rise to stems about 1,5-3 m high and has roots for food storage. The plant comes from plantae kingdom, Magnoliophyta division, Magnoliopsida class, Asterales order, Asteraceae family, Smallanthus genus and Smallanthus sonchifolius species.

![Figure 1. A) Insulin plant; B) Roots of insulin plant; C) Cross section of insulin plant roots](image)

Insulin plant roots water content is >70% and the rest is dry matter such as fructooligosaccharides. Fructooligosaccharids made up 6.4%-70% if the dry matter depending on the crop and location. Insulin plant, just like other plant, have high carbohydrate, lipid, protein, fiber and water content. Insulin plant also has compounds such as oxalic acid, carotenoids, sesquiterpene lactones, flavonoids and high content of phenolic compounds. Caffeic acid, gallic acid, rosmarinic acid, ferulic acid, chlorogenic acid and quercetin were also shown to be high in this plant and these substances may cause the antioxidant and antidiabetic activity. In addition, the flavonoids and sesquiterpene lactones have also been associated with a hypoglycemic effect.

**Potential as antidiabetic agent**

Studies evaluating potential of insulin plant as antidiabetic agent commonly has streptozotocin induced diabetic rats (D-STZ) as the subject. Insulin plant is given to the diabetic rats in form of extract, either from roots or leaves. One of the research evaluating the effect on insulin leaves extract is done by Klinsman (2018) which found improvement in dysmetabolism and cardiomyopathy related to DM in form of glycemia decrease by 63.9%, increase of insulin concentration by 49.3%, decrease of triacylglycerol and free fatty acid, amelioration of pancreatic islet cells, increase of antioxidant enzyme activity and repair of cardiac tissue. According to this, Genta (2010) evaluate five organic extracts and pure crystalline enhedryn from insulin plant leaves with normoglycemic, hyperglycemic and D-STZ rats. Methanol, buthanol and chloroform extract has hypoglycemic activity on 50,10 and 20 mg/kg dosage. Daily administration of extract for 8 weeks cause controlled blood sugar and increase of insulin. Phytochemical analysis from most active fraction,
buthanol extract, show caffeiic, chlorogenic and three dicaffeoilquinic acid as the significant component. Furthermore, Enhedrin, major sesquiterpene lactone from insulin leaves able to decrease postprandial glucose and found to be useful in diabetes. Russo (2015) elucidates the mechanism of the effect by methanol extract from insulin plant may have inhibitory activity to alpha amylase and alpha glucosidase enzyme, thereby able to decrease blood glucose and may be useful in hyperlycemia due to diabetes.

Gilberto (2013) evaluates aqueous extract of insulin plant roots (YRAE) to four groups, control (C), group that received aqueous extract of insulin plant (Y), DM-type 1 without intervention (DM-1) and DM-type 1 managed with insulin plant extract (Y-DM1). It is reported there are significant decrease of water and food consumption in Y-DM1. YRAE consumption decrease glycemia, total cholesterol, VLDL, LDL and triacylglycerol significantly on diabetic rats. YRAE normalize ALT level on Y-DM1 that indicates its hepatoprotective effect. Another study by Habib (2011) on D-STZ rats found significant decrease of fasting plasma triacylglycerol and LDL with insulin plant roots diet oral supplement. Supplement consumption also has protective effect on triacylglycerol postprandial plasma peak and to pancreatic cells. Furtheremore, there are increase in GLP-1, one of the two incretine hormone, on groups given insulin plant roots supplement.

There also studies comparing effectiveness between roots and leaves extract to D-STZ rats. Both extract is found effective in preventing hyperglycemia. However, roots extract is more effective against normalisation of antioxidant enzyme function and decrease of reactive oxygen species (ROS) while leaves extract is ineffective. Therefore due to better benefit, roots extract is perhaps better than leaves extract.

Role of insulin plant is diabetes management isn’t only from antihyperglycemic effect or increase pof insulin secretion but also by increasing lipid metabolism, oxidative status and vascular endothelial function. Diabetic rats management with the plant extract has protective effect against nephropathy, complication cause by free radical. Furthermore, the roots and plant extract show high activity against free radical when measured in vitro. Antioxidant effect of insulin plant is related to the high level of phenolic compound on its roots and leaves. The leaves of insulin plant even have higher level of phenolic acid compared to its rooms.

Mechanism underlying insulin plant effect on reducing glucose lies on active compound on its leaves and roots. High level of phenol compound for example, can increase insulin receptor sensitivity and has an implication in treating diabetes melitus. Other research show phenolic extract from insulin plant could increase hepatic rats mRNA expression and cause decreased blood glucose. Decreased blood glucose could also be mediated by caffenonylquinic that inhibits α-glukosidase in the body.

Not only insulin-like effect, the plant also has other benefits. Other compound such as fenolic and caffenonylquinic, chlorogenic acid, polyphenol and tryptophan has antioxidant activity that prevent membrane cell damage and decrease reactive oxygen species which plays a role in DM complication such as nephropathy.

There are few studies evaluating consumption of insulin plant on human subjects. Only two studies has been done to the author knowledge. Scheid (2014) evaluate effect of daily consumption of freeze-dried powdered insulin plant for 9 weeks to glucose, lipid and bowel transit in geriatric patients and found significant decrease in glucose. Insulin plant is reported not to cause side effects to the bowel transit such as bloating, flatulence and abdominal discomfort. The plant is concluded safe for daily consumption and practical to use.

Genta (2010) reported significant decrease of body weight, waist circumference and body mass index on pre-menopause obese women who take insulin plant syrup for 120 days. Recommended syrup consumption not to cause unpleasant
gastrointestinal side effect is 0.14 g fructooligosaccharides/kg. Meanwhile, other research found no significant effect to the blood glucose (fasting blood sugar) and lipid serum, only show protective effect to LDL. Difference of the finding suggest different form of insulin plant can result to different effect. Rocio (2020) evaluates toxicogenetic effect of Smallanthus sonchifolius and found aqueous extract of the plant has sitotoxic, sitostatic and genotoxic effect. However, insulin plant is safe for consumption as 2% tea infusion (one tea bags/100 mL) maximum 250 ml/days.21

Several studies comparing insulin plant extract to traditional diabetic drugs. Otto (2020) research on Rattus norvegicus found insulint plant extract is just as effective as metformin in decreasing glucose.22 Supporting the findings, Dwitiyanti (2020) also found insulin extract from leaves is comparable to metformin in decreasing blood glucose and increase glycogen synthesis in the liver on hamster, thereby insulin plant has potential to manage hyperglycemia with high fatty diets.23

2. Conclusion

Diabetes still cause significant morbidity and mortality in the world. Administration of antidiabetic agents derived from plants is an important alternative for management of the disease. Insulin plants are natural crop that can be found in Indonesia and current literature shows many phytoconstituents of the plants such as flavonoids, caffeic acid, chlorogenic acid, phenolic compounds and sesquiterpenic lactones useful as antihyperglycemic and antioxidant. Further studies on the phytoconstituents responsible for the pharmacological activity of this plant still need to be done to make the treatment better and reliable with minimal side effects.

3. References

7. Agnia A. Efek ekstrak daun insulin (Smallantus sonchifolius) terhadap kadar glukosa darah, berat badan dan low density lipoprotein pada tikus yang diinduksi streptozotosin. UIN Syarif Hidayatullah. 2015.
Diabetic Rats after Yacon Leaf Extract Treatment. 2018; 2018.


20. Scheid MMA, Genaro PS, Moreno YMF, Pastore GM. Freeze-dried powdered yacon: effects of FOS on serum glucose, lipids and intestinal transit in the elderly. 2014;

