



## Review Article

### A REVIEW ON PROMISING ANTI-DIABETIC MEDICINAL PLANTS FOR TREATMENT OF DIABETES MELLITUS

Mule V. S.<sup>1,2\*</sup>, Naikwade N. S.<sup>1</sup>

<sup>1</sup>Department of Pharmacology, Appasaheb Birnale College of Pharmacy, Sangli, Maharashtra, India

<sup>2</sup>Department of Pharmacology, Yashwantrao Bhonsale College of Pharmacy, Sawantwadi, Maharashtra, India

\*Corresponding Author Email: vsmule.tkcp@gmail.com

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#### ABSTRACT

Diabetes mellitus (DM) is a chronic disorder associated with abnormally high blood glucose level. Two main types are type 1 (Insulin Dependent) and type 2 (Non-Insulin) Dependent DM. As diabetes mellitus is seventh leading cause of deaths worldwide by 2030, it's very much important to search for new drugs including plant oriented products for treatment of diabetes. In present study we elaborated different medicinal plants having Anti-diabetic potential. As natural products are considered to be less toxic & found to have minimum side effects it will be the one of the good source of medicines for treatment of diabetes mellitus. In India traditionally many natural plant drugs are used for treating many disorders including DM. Recently many plants Anti-diabetic potential was studied scientifically. Anti-diabetic potential of all these plants were carried out by using different inducers like streptozotocin & alloxan. The present study highlights plants with Anti-diabetic potential, its extraction, method used etc.

**Keywords:** Diabetes Mellitus, Anti-diabetic Activity, Hypoglycemic Activity, Medicinal Plants

#### INTRODUCTION

Diabetes Mellitus (DM) is disorder of carbohydrate metabolism which is generally characterized by inadequate secretion of insulin or development of insulin resistance. The disorder is characterized by excessive increase in blood sugar level, excessive urine production, increase in thirst, hunger. There are two main types of diabetes mellitus; type 1 and type 2 diabetes mellitus. Type 1 which is also called as insulin dependent diabetes is an autoimmune disorder leading to destruction of pancreatic beta cells which declines the secretion of insulin.<sup>1</sup> A person suffering from type 1 diabetes requires to administer insulin on regular basis to control the sugar level. Type 2 diabetes also called as non-insulin dependent diabetes is much more common type which is affecting the glucose regulation by increasing the glucose resistance. If increase in blood sugar level persists for longer period of time it may cause the damage to kidney, eyes, neurons, heart etc. Such organ damage may reduce the blood supply and may cause the diabetic ulcer and infections. The data suggests that near about 1.5 million deaths worldwide in 2012 were caused by increase in blood sugar level. Diabetes is considered as eighth leading cause of death in 2012. Currently 400 million peoples are living with diabetes worldwide.<sup>2</sup>

The traditional medicine system consist of plant or plant product as single plant or combination of plants. This natural plant oriented drugs were found to be very effective as it was used since many years. Additionally these natural plant oriented drugs were considered less toxic and free from side effects when compared to synthetic drugs. As the modern allopathic drugs are having many side effect the WHO also suggest to find out the new plant oriented drugs as alternatives to present drugs. The allopathic drugs available today are having many side effects and these are the costlier drugs so there is huge need to find out the cost effective natural plant oriented drugs. As natural plants products are the templates for the development of new molecule the huge research is going on the natural plants oriented drugs for treatment of DM.<sup>3</sup> The present review explains some of the medicinal plants such as *Chloroxylon swietenia*, *Melanthera scandens*, *Alternanthera sessilis*, *Atriplex halimus*, *Tabernaemontana divaricata*, *Cynodon dactylon (L.) pers*, *Gongronema latifolium*, *Physalis peruviana L* and part of the plant used, method of extraction, model used for Anti-diabetic activity evaluation etc. Plants like *ficus lacor* Bunch- ham claimed to have Anti-diabetic potential but scientifically it's not proved. Some important medicinal plants for DM are explained below in table 1.

**Table 1: Medicinal plants with anti-diabetic activity**

Plant Name	Family	Part Used	Extract	Method	Activity	Ref.
<i>Ocimum tenuiflorum</i> L.	Lamiaceae	Leaves	Hexane, methanol	Streptozotocin	Antihyperglycemic	4
<i>Chloroxylon swietenia</i>	-	Bark	Methanol, Aqueous	Streptozotocin	Antidiabetic	5
<i>Morinda tinctoria</i>	Rubiaceae	Fruits	Chloroform, Methanol	Vitro inhibitory, glucose diffusion	Antidiabetic	6
<i>Melanthera scandens</i>	Asteraceae	Leaf	Ethanol	Alloxan	Hypolipidemic	7
<i>Vernonia amygdalina</i>	Asteraceae	Leaves	Aqueous	Alloxan monohydrate	Antidiabetic	8

<i>Azadirachta excelsa</i>	Meliaceae	Leaves	Ethanol	Alloxan monohydrate	Antidiabetic	9
<i>Ficus glomerata</i>		Leaves	Ethanol	Alloxan	Hypoglycemic	10
<i>Bambusa vulgaris</i>	Poaceae	Leaves	Petroleum ether	Streptozotocin	Antidiabetic	11
<i>Chloroxylon swietenia</i>	-	Bark	Methanol	Streptozotocin	Antidiabetic	12
<i>Terminalia catappa</i> Linn.	Combretaceae	Leaf	Aqueous	Alloxan	Antidiabetic	13
<i>Andrographis paniculata</i>	Acanthaceae	Leaf	Water	High fat diet & streptozotocin	Antidiabetic	14
<i>Alternanthera sessilis</i>	Amaranthaceae	Aerial parts	Ethanol	Streptozotocin	Antidiabetic	15
<i>Atriplex halimus</i> L.	Chenopodiaceae	Leaf	Aqueous	Streptozotocin	Antidiabetic	16
<i>Tabernaemontana divaricata</i> (L.)	Apocynaceae	Leaves	Methanol	Alloxan	Antidiabetic	17
<i>Cynodon dactylon</i> (L.)	Poaceae	Leaves	Methanol, Water	Alloxan	Antidiabetic	18
<i>Hippophae rhamnoides</i> L.	-	Leaves	Methanol, aqueous	Alpha glucosidase inhibitory	Antidiabetic	19
<i>Gongronema latifolium</i>	Asclepidaceae	Leaves	Aqueous, Methanol	Alloxan	Antidiabetic	20
<i>Barleria montana</i>	Acanthaceae	Aerial parts	Methanol	Streptozotocin	Antidiabetic	21
<i>Physalis peruviana</i> L.	Solanaceae	Leaf	Aqueous		Antidiabetic	22
<i>Strychnoshenningsii gilg</i>	Loganiaceae	Stem, bark	Aqueous	streptozotocin, nicotinamide	Antidiabetic	23
<i>Tridax procumbens</i> (Linn.)	Asteraceae	Whole plant	Ethanol	Streptozotocin	Antidiabetic	24
<i>Tinospora bakis</i> (T. Bakis)	Rubiaceae	Fruits	Aqueous	Streptozotocin	Antidiabetic	25
<i>Pistacia lentiscus</i>	Anacardiaceae	Leaf, fruit	Ethanol	Streptozotocin	Antidiabetic	26
<i>Urena lobata</i>	-	Leaf	Water and ethanol	Dipeptidyl peptidase IV activity	Antidiabetic	27
<i>Leucaena leucocephala</i>	Fabaceae	Seed	Ethanol	Streptozotocin	Antidiabetic	28
<i>Anthocleista vogelii</i> (Planch)	Gentianaceae	Stem, bark	Methanol	Alloxan	Hypoglycemic	29
<i>Cynodon dactylon</i> Pers.	Poaceae	Aerial parts	Ethanol	Alloxan	Antidiabetic	30
<i>Swertia corymbosa</i> (Grieb.)	-	Aerial parts	-	Inhibition of glucosidase	Antidiabetic	31
<i>Nypa fruticans</i> wurmb. Vinegar	-	Aerial parts	Acetate and water	Streptozotocin	Antidiabetic and antioxidant	32
<i>Sweetenia mahagoni</i>	-	Seed	Ethanol, aqueous	Alpha glucosidase & streptozotocin	Alpha-glucosidase inhibition	33
<i>Clitoria ternatea</i>	Fabaceae	Aerial parts	Petroleum ether, ethanol	Streptozotocin	Antidiabetic, antihyperlipidemic	34
<i>Combretum lanceolatum</i>	Combretaceae	Flowers	Ethanol	Streptozotocin	Antidiabetic	35
<i>Cassia fistula</i> Linn.	Leguminosae	Flowers	Acetone, ethanol, aqueous	Alloxan	Hypoglycemic	36

## ANTI-DIABETIC EFFECT OF MEDICINAL PLANTS EXTRACTS

### *Chloroxylon swietenia*

In present study Anti-diabetic potential of the *Chloroxylon swietenia* bark extracts was evaluated in streptozotocin induced diabetic rats. The diabetes was induced by intra-peritoneal injection of streptozotocin at the dose of 50 mg/kg of body weight. Methanolic and aqueous extracts were prepared by soxhlation and maceration method respectively. Results revealed the improvement in the blood glucose level when compared with standard drug glibenclamide and diabetic control group.<sup>5</sup>

### *Melanthera scandens*

*Melanthera scandens* is a perennial herb belonging to family Asteraceae. The leaves of the plants were extracted with methanol and its fractions were prepared. The extracts were evaluated in terms of Anti-diabetic and hypoglycemic activity by using alloxan monohydrate as inducer of diabetes. With given acute

dose the extracts shown significant reduction in blood glucose level in alloxan induced diabetic rats. The extracts were also found to have beneficial effects on lipid profile in diabetes by reducing serum total cholesterol, triglyceride, LDL and VLDL levels.<sup>7</sup>

### *Alternanthera sessilis*

The study was designed to evaluate the Anti-diabetic properties of this plant by measuring the plasma blood glucose level in streptozotocin induced diabetic rats. The powdered plant material was extracted by using ethanol as solvent. The model was designed to evaluate Anti-diabetic activity for 10 days. The result showed the significant improvement in diabetes on 10<sup>th</sup> day when compared with other groups.<sup>15</sup>

### *Atriplex halimus*

*Atriplex* is a popular folk remedy for treatment of heart related disorders and diabetes mellitus. In present study the Anti-diabetic potential was evaluated in streptozotocin induced diabetic rats.

The result suggested the significant reduction in blood sugar level. [16]

#### ***Tabernaemontana divaricate***

*Tabernaemontana divaricata* is a common ornamental plant belongs to Apocynaceae family, commonly known as Tagar. The plant extract was used for many pharmacological activities like antioxidant, anti-infection, anti-ulcer, analgesia etc. The present study was undertaken to evaluate the plant for its hypoglycemic effect by using its methanolic extract. The experimental design involves total five groups with five animals (swiss albino mice) in each group. The diabetes was induced by using alloxan as inducer. The results revealed that the blood sugar level was reduced in both positive and test control groups. From results it was cleared that the extracts shows antihyperglycemic activity which is comparable with standard drug in alloxan induced diabetic rats.<sup>17</sup>

#### ***Cynodon dactylon (L.) pers***

The plant *Cynodon dactylon* commonly known as Doob belongs to family Poaceae. The extract of plant was evaluated for diuretic, anti-emetic and purifying properties. The present study was taken to evaluate its Anti-diabetic potential using albino rats. The leaves of the plant were extracted with chloroform, ethanol and methanol in a Soxhlet apparatus. The extracts were subjected to different preliminary phytochemical tests. The experimental animal used for study purpose was wistar albino rats which are divided in to seven groups with five animals in each group. The study was performed for 21 days after induction of diabetes by alloxan. The results showed the significant reduction in blood glucose level at the end of 21 days when compared with diabetic control group. The effect was also significant on lipid profile after administration of different extracts for 21 days. Both petroleum ether & methanol extracts reduced the blood cholesterol & triglyceride level significantly when compared with diabetic control group.<sup>18</sup>

#### ***Gongronema latifolium***

*Gongronema latifolium* a plant commonly known as Utazi commonly used by the Nigerian peoples for controlling diabetes. The present study was undertaken to ascertain the fractions endowed with the hypoglycemic effect. In present study two extracts were used ethanolic & aqueous extracts. Methanolic extract was further fractionated by hexane, chloroform and methanol. Alloxan monohydrate was injected intraperitoneally. The diabetic rats were divided in to five different groups with six rats in each group. The effect of aqueous extract on glycemic rats indicates the gradual decrease in blood glucose level from 0 to 32 hrs. The methanolic extract exhibited significant ( $p < 0.05$ ) reduction in blood glucose level. The methanol fraction showed significant reduction in blood glucose level while results were found to be non-significant in hexane & chloroform fraction.<sup>20</sup>

#### ***Physalis peruviana L.***

*Physalis peruviana* L. is a plant commonly found in South America & cultivated in South Africa. The plant was used traditionally for treating malaria, cancer, leukemia, malaria, asthma, hepatitis & diabetes. The present study was undertaken to evaluate the Anti-diabetic potential by using guinea pig as experimental animal. The extract was prepared as decoction in water as 10% solution. Guinea pig of both sex were used for study purpose. After 04 gm/kg of glucose load administration the blood glucose level was measured after every 30 minutes up to 180 minutes. The result showed that the plant extract shows the

significant reduction in blood glucose level when compared with both control & reference at respective dose.<sup>22</sup>

#### ***Tridax procumbent (Linn.)***

Plant *Tridax procumbent* (Linn.) belongs to family Asteraceae. The scientific data suggest the use of plant for anti-inflammatory, hepatoprotective, wound healing, antimicrobial, antiseptic, hypotensive, and immunomodulatory properties. The present study was undertaken by author to investigate Anti-diabetic potential of the plant in streptozotocin induced insulin dependent diabetes mellitus. The ethanolic extract was prepared by using soxhlation method. The 21 days of study period was used to evaluate the Anti-diabetic activity during which the diabetic animals were given the dose of extract. The administration of extracts of whole plant to diabetic rats showed the significant reduction in blood glucose level when compared with normal control group. It was also found that the lipid profile of the diabetic animals not altered as it was protected by extracts.<sup>24</sup>

#### ***Tinospora bakis, Nauclea latifolia and Randia nilotica***

The objective of the present study was to evaluate the hypoglycemic activity of plants extract. The acute toxicity studies were performed according to OECD 423 guidelines. Dose of 400 mg/kg of different extracts were selected for study purpose. In streptozotocin induced diabetic rat model two types of studies were carried out acute and chronic study. In chronic study model the animals were treated for 14 days. The blood collected on 15<sup>th</sup> day was analysed for glucose, lipid profile, liver and kidney enzymes. Results of both acute and chronic study showed the significant hypoglycaemic potential of all plants extracts. The improvement in liver and kidney enzymes levels indicates the significant effect of plants to correct metabolic disturbances due to diabetes.<sup>25</sup>

#### ***Pistacia lentiscus***

The leaves and fruits of the plant *Pistacia lentiscus* were identified and its powder was prepared by electric mill. The leaf powder and fruits paste was macerated on mechanical shaker in ethanol as solvent. Further the extract was subjected to fractionation by ethyl acetate and water. Further the organic phase was subjected to chloroform and aqueous extraction. All the fractions were dried separately. In vitro Anti-diabetic activity was evaluated in streptozotocin induced diabetic rats. In vitro Anti-diabetic activity was evaluated by  $\alpha$ -amylase inhibitory assay. The extracts showed promising Anti-diabetic activity in streptozotocin induced diabetic rats which was comparable to standard drug glibenclamide. In the  $\alpha$ -amylase inhibitory assay method the dose dependent increase in inhibition of enzyme activity was observed which indicates the ability of plant extract to inhibit the conversion of starch to glucose.<sup>26</sup>

#### ***Leucaena leucocephala (Lam.)***

The plant belonging to the family Fabaceae was reported to be used for the stomach diseases, facilitate abortion and provide contraction. In this work the author evaluated the Anti-diabetic and antioxidant activity of plant extract in rats. The Anti-diabetic activity was evaluated in rats by using streptozotocin as inducer. The results showed that the insulin level was increased significantly in extract treated diabetic rats.<sup>28</sup>

#### ***Anthocleista vogelii (Planc.)***

The plant is common in tropical Africa and sudan and is also found in southern Nigeria belonging to family Gentianaceae. The

plant was commonly used for the treatment of diabetes and inflammatory conditions. The amylase inhibitory activity of the plant in vitro also suggest the Anti-diabetic potential of the plant. The present study was carried out to demonstrate the hypoglycaemic activity of the plant extract in alloxan induced diabetic rats. The methanolic extract of plant was prepared by maceration further it was subjected to the fractionation by different solvents with increasing polarity. The hypoglycaemic activity was evaluated in hypoglycaemic and diabetic rats. The result when compared with healthy rats reveals the hypoglycaemic effect of extract. The effect of different extract in alloxan induced diabetic rats was found to be significant when compared with standard drug glibenclamide.<sup>29</sup>

#### **Wertia corymbosa (Grieb.)**

The authenticated aerial parts of the plant *Swertia corymbosa* (Grieb.) was extracted and its active chemical constituents were isolated. The different activities of isolated active chemical constituents were carried out. The in vitro Anti-diabetic activity was carried out by inhibition assay for  $\alpha$ -glucosidase.<sup>31</sup>

#### **Nypa fruticans Wurm.**

*Nypa fruticans* Wurm. is an vinegar which is consumed by peoples commonly so the author undertaken the plant to investigate the Anti-diabetic potential of plant. The plant extract was prepared by using liquid – liquid extraction method. Anti-diabetic activity was carried out in streptozotocin induced diabetic rats by using metformin as standard drug. The sub-acute study indicates the significant Anti-diabetic effect of extract with respect to glucose and insulin level.<sup>32</sup>

#### **CONCLUSION**

In present review we elaborated the commonly used Anti-diabetic plants used traditionally for treating diabetes mellitus. Medicinal plants are widely used because of its easy availability and probable side effects with available allopathic medicines. In present review we focused on different medicinal plants having Anti-diabetic potential and method used for extraction and method used to evaluate its activity. This information may be useful for all researchers, academicians, scientists and health professionals who are working on plants & useful to treat diabetes mellitus.

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