Antidiabetic Potential of Indigenous Plants; a Review

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Abstract:
The current study's objective is to assess numerous medicinal plants with anti diabetic properties. One of the most prevalent non-communicable illnesses in the world is diabetes mellitus. That's the fourth-leading causes of mortality in the world's most industrialized nations, and they have significantly increased that is widespread in many emerging industrialized and underdeveloped countries. The danger that this poses danger to be eliminated by the year 2100. Plants have historically been a prime source of medicine. The use of plants in the treatment of diseases was referenced in Ayurveda and other Indian literature. Numerous diseases. Less than 1% of an estimated 250000 higher plants have been examined. The advantages of medicinal plants with hypoglycemic effects in the treatment of diabetes mellitus have been supported by several investigations. These plants' properties may prevent diabetes problems from occurring and treat metabolic anomalies. Extremely few in relation to diabetes mellitus pharmacologically. There are few systematic investigations on herbs used in traditional medicine to treat diabetes mellitus.

Keyword: Diabetes mellitus, Ayurveda, Medicinal plants, Hypoglycemic.
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1. INTRODUCTION

Diabetes mellitus is a frequent and widespread condition that affects people in both industrialized and developing nations. This illness is thought to afflict 25% of the world's population.[1] Diabetes mellitus is brought on by improper glucose metabolism, which is connected to low blood insulin levels or insulin resistance in the target organs. Even though oral hypoglycemic medicines have made significant progress in the treatment of diabetes, research for novel medications is still ongoing due to the drawbacks of the synthetic pharmaceuticals now on the market.[2,3] Even though they have been praised for their healing abilities in the ancient systems of medicine, the herbal medications with anti diabetic action have not yet been commercially developed as contemporary medications.[4] Obese people are more likely to develop type 2 diabetes, which is also linked to hypertension and dyslipidemia. Therefore, the goal of the therapy is to decrease insulin resistance and to increase insulin secretion.[5,6] Diabetes is a metabolic illness in which the body does not effectively generate or use the hormone insulin, which is needed to turn sugar, carbohydrates, and other foods into energy. The hallmark of diabetes mellitus is persistently elevated blood glucose levels.[7,8] The human body uses insulin and glucagon to keep blood glucose levels within a fairly small range. Glucagon instructs the liver to release glucose from its cells into the blood so that it may be used as power.[9] Low rates of glucose absorption into muscles and adipose tissue due to type 1 diabetes' inability to produce insulin have an adverse effect on health.[10,11] In impoverished nations where the expense of conventional medications is a burden on the populace, traditional medicine (herbal) is utilized to treat diabetes.[12] Although hypoglycemic medicines derived from both natural and synthetic sources have been developed, diabetes and its related consequences remain a serious medical issue.[13] It has been discovered that several native Indian medicinal herbs can help people control their diabetes. The fact that medicinal herbs are widely available and have few adverse effects is one of their many benefits. Many of the pharmaceuticals that are now on the market have been made either directly or indirectly from plants, which have historically been an excellent source of medicines.[14]

Plants Having Anti-Diabetic Properties

Recently, certain medicinal plants have been utilized ephemerally as anti-diabetic and anti-hyperlipidemic medicines and have been reported to be helpful in diabetes globally.[15] Diabetes and its consequences remained a serious medical issue despite the availability of proven anti diabetic medications on the pharmaceutical market. These plants' anti hyperglycemic benefits are related to their capacity to improve pancreatic function by increasing insulin secretion, to restrict glucose absorption in the intestine, or to facilitate metabolites in insulin-dependent activities.[16,17] More than 400 plant species with hypoglycemic activity have been documented in literature; yet, it is still appealing to look for novel anti-diabetic medications made from natural plants since they include compounds with alternative and secure effects on diabetes mellitus. Glycosides, alkaloids, terpenoids, flavonoids, cartenoids, and other compounds found in the majority of plants are usually thought to have anti diabetic effects.[18]

This review article lists various medicinal plants with anti-diabetic properties and explains how they work. Some of the important anti-diabetic potential herbal plants are -

Catharanthus roseus (Apocynaceae)

Catharanthus roseus, commonly known as bright eyes, Cape periwinkle, graveyard plant, Madagascar periwinkle, old maid, pink periwinkle, rose periwinkle, is a perennial species of flowering plant in the family Apocynaceae. It is native and endemic to Madagascar, but grown elsewhere as an ornamental and medicinal plant.[19]An investigation was done to see how well Vincarosea methanolic whole plant extracts controlled blood sugar levels in diabetic rats for 14 days after alloxan induction. In comparison to whole plant extract at low dose (300 mg/kg), the methanolic whole plant extract at high dose (500 mg/kg) significantly reduced hyperglycemia in diabetic rats. The methanolic extracts also shown improvement in body weight, lipid profile, and pancreatic -cell regeneration in diabetic rats. The repair of the pancreas by methanolic Vincarosea extracts is supported by histopathological investigations as a potential mechanism of their antidiabetic effect.[20]

Fig.1 Catharanthus roseus

Barleriaprionitis (Acanthacea)

It is found as native in Maharashtra and in some places in Chhattisgarh, it is commonly known as vajradanti in india. It has been practically proved that these plant have multiple medicinal property.[21] The anti-diabetic properties of the leaf and root of B. prionitis were examined in an alcoholic extract. Six groups consisting of six albino rats were formed from the animals. All the rats had various treatments involving vehicle, alcoholic extract of leaves, and alcoholic extract of roots of B. prionitis Linn (200 mg/kg) for 14 days in three groups to induce diabetes (150 mg/kg b.w., i.p.). Animals in the experiment displayed an acceptable but insignificant anti-diabetic response to the alcohol-based extract of the roots. According to the study, B. prionitis' alcoholic leaf extract could be included in the list of herbal remedies that are helpful for treating diabetes mellitus.[22]

Fig.2 Barleriaprionitis

Panax ginseng Linn. (Asian ginseng, Araliaceae)

In many Asian nations, root has been clinically utilized to treat type II diabetes. P. ginseng has reportedly been used therapeutically for the management of type II diabetes, according to historical documents. Clinical investigations both in vitro as well as in vivo animal research back up the idea that this plant's roots have antihyperglycemic properties. Other ingredients have a clear pharmacological impact on energy metabolism, and ginsenoside plays a significant role in their antihyperglycemic action.[23, 24]

Fig.3 Panax ginseng Linn**.**

Berberis vulgaris

It is a deciduous shrub growing up to 4 metres high, B. vulgaris is a member of the Berberidaceae family and is used traditionally as medicine .Berberis vulgaris has hypoglycemic effects in streptozotocin-induced diabetic rats. The findings showed that saponins and water extract have a substantial hypoglycemic effect. The levels of serum triglycerides and cholesterol dramatically increased.[25, 26]

Fig.4 Berberis vulgaris

Brideliandellensis Beille.(Euphorbiaceae)

Diabetes is treated in Cameroon with a medicinal herb. In rats that had been given alloxan to cause diabetes, the water and methanol extract of the leaf of the related species B. ferruginea was shown to be an effective hypoglycemic agent. In STZ (streptozotocin) type I and type II diabetic rats at various postprandial phases, the research of the glucose-lowering effects of the ethanol extract and fractions of B. ndellensis stem bark was carried out, and a substantial drop in blood glucose level was noted. The extract works by stimulating islet cells, and to do this, it needs active cells.[27]

Fig. 5 BrideliandellensisBeille

Cocciniaindica Wight &Arn. (Cucurbitaceae)

Commonly utilized in sub-Saharan Africa and Southeast Asia for the conventional treatment of diabetic mellitus. Hypoglycemic action may be seen in pectin that was extracted from C. indicafruit . An alcoholic plant extract was shown to be effective in lowering blood sugar levels. This extract was then fractionated further to assess its biochemical characteristics' effects on diabetes, with the results pointing to toluene as an active fraction. These principles' precise effects may be a result of their ability to repair damaged cells caused by alloxan.[28, 29]

Fig.6 Cocciniaindica

Cocculushirsutus Linn. (Menispermaceae)

Roots, also known as patala-garudi, are bitter, acrid, laxative, demulcent, antiperiodic in fever, tonic, and diuretic. All around India, but particularly in arid areas, the plant flourishes. It resembles the plant path and is a straggly shrub with gently vile-lous juvenile portions. In mice that had been given alloxan to cause diabetes, Badole et al. showed that an aqueous extract of Cocculushirsutus (L) Diels leaves had antihyperglycemic properties. The aqueous extract of C. hirsutus's antihyperglycemic potential may be brought on by diabetic mice having lower blood glucose levels and greater glucose tolerance. Additionally, the extract stops weight loss.[30,31]

Fig.7 Cocculushirsutus Linn

Centauriumerythrea (Gentianaceae)

Centauriumerythraea is a species of flowering plant in the gentian family known by the common names common centaury and European centaury. A single intraperitoneal dosage of STZ (65 mg/kg) was used to cause diabetes. MDA in the tissue was used to gauge oxidative stress. the estimation of pancreatic antioxidant enzymes such as glutathione peroxidase (GPx), catalase, and superoxide dismutase (SOD).

When diabetic rats were treated, there was a noticeable decrease in the total amount of pancreas tissue TBARS compared to normal animals.[32] The pancreatic antioxidant defense enzymes SOD, CAT, GPx, and GST had considerably higher activity levels in the diabetic-treated mice.[33]

Fig.8 Centauriumerythrea

9.Alangiumlamarckii(Cornaceae)

It is native to india.Sage Leaved Alangium is a tall thorny tree. It grows to a height of about 3 to 10 meters. The bark is ash coloured, rough and faintly fissured.The ethanol extract of Alangiumlamarckii (A. lamarckii) has anti-diabetic properties. For these investigations, alcoholic leaf extract of 250 and 500 mg/kg body weight was used. In STZnicotinamide-induced diabetic rats, A. lamarckii exhibits considerable antidiabetic action.[34]

Fig. 9 Alangiumlamarckii

10.Ficushispida Linn. (Moraceae)

In Chhattisgarh it is commonly known doomer. India is home to several of these little trees. Numerous researchers have documented a decrease in blood sugar of various substances derived from F. bengalensis.[35]According to research on the hypoglycemic effects of F. bengalensis Linn. (bark) in both healthy and diabetic albino rats, the water-soluble portion of the extract of alcohol of Ficushispida considerably lowers fasting blood glucose levels in both healthy and diabetic rats who have been given alloxan. Ficushispida peel extract has a direct peripheral effect on cells, however if administered along with insulin, a pharmacological interaction may ensue.[36]

Fig.10 Ficushispida

11 Bougainvilleaspectabilis Linn. (Nyctaginaceae)

In Chhattisgarh it is commonly as kagajflower and is a well-known decorative plant that is frequently planted in Indian gardens. Native to South America, the genus Bougainvillaea includes blooming plants that may be found from Brazil through southern Argentina and farther west to Peru. The conventional plant has the ability to treat diabetes. In streptozotocin-induced type I diabetic albino rats, the blood glucose reducing ability of BougainvillaeaspectabilisWilld leaf extract was observed.[37] The ethanolic extract of the leaves possesses antihyperglycemic properties, which are most likely brought about by higher insulin sensitivity and increased glucose absorption through accelerated glycogenesis in the liver.[38]

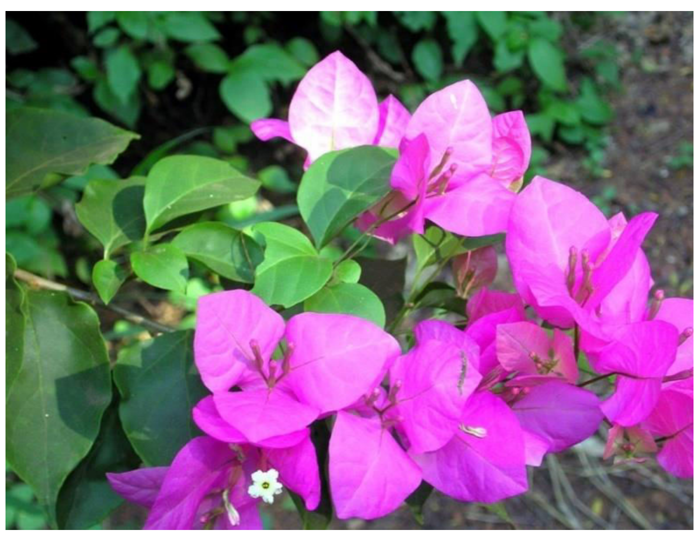

Fig.11Bougainvilleaspectabilis

12.TerminaliachebulaRetz.(Combretaceae)

is readily available in India and has been used extensively in Ayurveda to treat diabetes. Conventional medicine for the management of diabetes uses TRIPHALA, a herbal mixture including T. chebula. In streptozotocin-induced diabetic rats, the anti-diabetic and renoprotective properties of the chloroform-based extract of T. chebula Retz seeds were demonstrated. It has an effective renoprotective effect.[39]

Fig. 12 Terminaliachebula

13.Eugenia jambolana(Myrtaceae)

Ayurveda, an ancient Indian medical system, recommends Eugenia jambolana, also known as Jamun or Indian blackberry, for usage in DM. According to reports from both experimental models and clinical research, E. jambolana possesses hypoglycemic effects, which are in line with its purported anti-diabetic effect in conventional medicine.[40]

Fig. 13 Eugenia jambolana

14.Casearia esculenta Roxb. (Flacourtiaceae)

Is a plant having therapeutic characteristics that is also known in English as wild cowrie fruit. The plant, which is found in South India, is a shrub. C. esculenta is a well-known treatment for diabetes mellitus. Plants have been said to have hypoglycemic effects. Hypoglycemic components in the root extract of C. esculenta decreased blood sugar levels in test animals. In streptozotocin-induced diabetic rats, C. esculenta root extract influences protein metabolism and marker enzymes. According to the study, C. esculenta root extract may increase liver and kidney damage linked to streptozotocin-induced diabetes in rats as well as has an antihyperglycemic impact.[41]

Fig. 14 Casearia esculenta Roxb

15. **AnnonasquamosaLinn.(Annonaceae)**

It is generally known as shitaifal in Hindi and custard apple in English. It is raised all throughout India. The plant's seeds, leaves, and aerial portions all contain the pharmacologically active components. The herb has anti-diabetic and hypoglycemia properties, according to the research.[42] It works by raising pancreatic islet insulin levels, increasing muscle glucose uptake, and reducing liver glucose production. It has a large margin of safety. This plant's leaves can be used to make an extract that helps maintain healthy cholesterol and blood sugar levels.[43]

Fig. 15 Annonasquamosal

16. **Axonopuscompressus ,Poaceae (Gramineae)**

It is a species of grass. It is often used as a permanent pasture, groundcover.The plant's methanolic leaf extract has anti-diabetic properties. Alloxan was injected into the rats to cause diabetes. For these trials, 250, 500, and 1000 mg/kg bw of methanolic leaf extract were used. At all doses (250, 500, and 1000 mg/kg), methanolic leaf extract of Axonopuscompressus significantly decreased blood pressure (by 31.5%, 19.8%, and 24.5%).

Compared to the control group, the diabetic rats had higher glucose levels. A. compressus might have excellent antidiabetic qualities.[44]

Fig. 16 Axonopuscompressus

17 **Dioscoreadumetorum Pax. (Dioscoreaceae)**

It has a hypoglycemic impact and is traditionally used to treat diabetes. The scientific name for D. dumetorum Pax. is bitter yam. In Africa, it happens. Dioscoretine, an alkaloid found in an extract, has been said to have a hypoglycemic impact. Aqueous extract of the D. dumetorum tuber has been said to control hyperlipidemia, hypercholesterolemia, and hyperketonemia. The herb primarily treats diabetes problems by acting as a functioning hypoglycemic agent.[45]

Fig.17 Dioscoreadumetorum

18. **Coccinagrandis (Cucurbitaceae)**

It is commonly used in vegitale. It is known as kundru. It is a perennial, dioecious vine that can grow up to a length of 20 m. Plant has tuberous roots and climbs via simple tendrils. Leaves are green.Alcoholic extracts of the leaves of Cocciniagrandis (C. grandis) were tested for hypoglycemic action. Mice were given 600 mg/kg bw of an alcoholic extract intravenously. In healthy fasting rats, oral administration of an alcoholic extract of the leaves of C. grandis resulted in a considerable hypoglycemic effect.[46]

Fig. 18 Coccinagrandis

19. **Murrayakoenigii Linn. (Rutaceae)**

It is frequently referred to as "Curry patta" and is a popular seasoning in India. The water-based extract of the upper leaves of M. koenigii had a hypoglycemic effect in both normal and alloxan diabetes. When normal rats were fed this plant via oral ingestion for 60 days, the hypoglycemic effect of the plant led to an increase in hepatic glycogen concentration.[47] Various doses of M. koenigii leaves were reportedly given to diabetic rats to help regulate their condition, from mild diabetes to moderate, severe, and type I diabetes. It lowers the level of glucose in the blood and has been shown to improve carbohydrate metabolism.[48]

Fig.19Murrayakoenigii

20. **TerminaliacatappaLinn.(Combretaceae)**

is known as an Indian almond and can be found all throughout India's warmer regions. In alloxan-induced diabetic rats, the anti-diabetic efficacy of petroleum ether, methanol, and

aqueous T. catappa fruit extract on overnight glucose levels and serum biochemical measurements was investigated. At dose levels that were one-fifth of their lethal doses, all three extracts had a strong anti-diabetic effect.[49]
The extract might work by regenerating cells. -carotine may be responsible for the reduction of diabetic consequences such glycosylation in rats with alloxan-induced diabetes.[50]

Fig,20 Terminaliacatappa

Caesalpiniadigyna (Fabaceae)
Bergenin from the roots of Caesalpiniadigyna (C. digyna) has anti-diabetic properties. When compared to control rats, diabetic rats had significantly higher plasma total cholesterol (TC), triglycerides (TG), and LDL cholesterol levels, whereas HDL cholesterol levels had significantly lower values.[51]Bergenin (10 mg/kg; p.o.) administration resulted in a considerably higher lipid profile when compared to glibenclamide (10 mg/kg; p.o.). Antioxidant enzymes like SOD and Cat showed a decline in activity. Comparing diabetic rats to control rats, the amount of TBARS was considerably higher in the diabetic rats. Bergenin (10 mg/kg; p.o.) treatment significantly raised SOD and CAT levels while lowering TBARS levels. Bergenin has excellent anti-diabetic qualities.[52]

Fig. 21 Caesalpiniadigyna

22.**Chaenomelessinensis (Rosaceae)**

Chaenomelessinensis is deciduous. The dark-green, simple leaves are alternate.Fruits from Chaenomelessinensis (C. sinensis) (Thouin) Koehne have excellent anti-diabetic effects when extracted with ethyl acetate. Chaenomelessinensis is a member of the Rosaceae family. Anti-diabetic doses of 50 and 100 mg/kg body weight have been recorded.[53]

Fig. 22 Chaenomelessinensis

23. **Brassica juncea (Brassicaceae)**

In Tamilnadu, it is a widely used fragrance in a variety of foods. The Cruciferae family includes the traditional medicine plant B. juncea. In STZ-induced diabetic male albino rats, the strong hypoglycemic effect of B. juncea aqueous seed extract was studied. There have been reports of doses with hypoglycemic action of 250, 350, and 450 mg/kg.[54]

Fig. 23 Brassica juncea

24. **CosciniumfenestratumColebr.(Menispermaceae)**

In Sri Lanka and the Western Ghats, it is frequently referred to as a tree. The ancient, Ayurvedic, and Siddha schools of medicine have mostly used the plant for diabetic mellitus. In streptozotocin and nicotinamide-induced diabetic mice, this plant's alcohol stem extract enhances antioxidant state and controls metabolism. Alcoholic extract controls the homeostasis of glucose and reduces gluconeogenesis in C. fenestratum. The medication additionally strengthens cellular antioxidant defence.[55]

Fig. 24 CosciniumfenestratumColebr

Annona muricata Linn. (Annonaceae)

Referred to as soursop. It is a tiny, evergreen tree that reaches a height of 5 to 6 metres. The plant is evergreen and has young, rusty-hairy branches and leaves. Most of the hottest tropical regions in South and North America, including the Amazon, are home to Annona muricata.[56] The effects of aqueous leaf extract on pancreatic cells in diabetic rats treated with STZ (streptozotocin) were shown by the researchers in terms of immunohistochemistry and biochemistry. Leaf extract from A. muricata Linn. Significantly reduced the oxidative stress on the pancreatic cells of streptozotocin-treated diabetic mice. The medication enhanced the area of insulin-reactive □-cells and partially halted □-cell degeneration.[57]

Fig. 25 Annona muricata

Canavalia ensiformis DC. (Leguminosae)

It is commonly grown in the humid tropics of Africa and Asia and is a native of Central America and the West Indies. It is known as horse bean. According to reports, the seeds contain hypoglycemic and anti-hypercholesterolemic properties.[58] Its effectiveness as an active anti-diabetic herb was demonstrated by the impact of an aqueous extract of C. ensiformis seeds on hyperlipidemia and hyperketonemia in alloxan-induced diabetic rats. By taking an aqueous extract of C. ensiformis seeds orally, one can lower blood and urine sugar levels as well as the triacylglycerol, ketone bodies, and cholesterol that are increased in people with diabetes mellitus.[59]

Fig. 26 Canavalia ensiformis

Hypoxishemerocallidea Fisch. Mey. (Hypoxidaceae)

It is a perennial tuberous plant that was once known by the name H. rooperi. In South Africa, it is known as the "wonder plant," and studies have shown that it can treat adult-onset diabetes mellitus. The herb H. hemerocallidea can be utilised as a hypoglycemic drug and has the ability to treat adult-onset diabetes mellitus, as demonstrated by the methanolic extract's hypoglycemic action in normoglycemic and in streptozotocin-induced diabetic rats. It is still unclear how the herbal plant material works.[60]

Fig. 27 Hypoxishemerocallidea

Boerhaaviadiffusa Linn. (Nyctaginaceae)

Red hogweed is the popular name for a tiny perennial creeping plant that is extensively distributed throughout India.[61] For the treatment of diabetes, stress, dyspepsia, stomach discomfort, inflammation, jaundice, enlargement of the spleen, congestive heart failure, and bacterial infections, the root and the entire plant are utilised in Ayurvedic and Unani medicine in India. In rats with diabetes caused by alloxan, the plant's aqueous leaf extract has been investigated for its antidiabetic activity. The herb has antidiabetic effect, according to research on the chloroform extract of the plant's leaves in chronic treatment of streptozotocin-induced NIDDM (non insulin dependent diabetes mellitus) model diabetic mice. The plant primarily lowers blood sugar levels and improves insulin sensitivity.[62]

Fig. 28 Boerhaaviadiffusa

Albiziaodoratissima (Fabaceae)

In chhattisgarhindia it is commonly known as sirsa. Albiziaodoratissima, a member of the family Fabaceae, is a fast-growing, deciduous tree reaching 15 to 25 meter in height, and native to large parts of India.Effect of Albiziaodoratissima (A. odoratissima) methanolic bark extract on the prevention of diabetes in alloxan-induced diabetic mice. The animals were given methanolic extracts at doses of 250 and 500 mg/kg body weight. Alloxan-induced albino mice had significantly lower levels of blood cholesterol, triglycerides, SGOT, SGPT, alkaline phosphatase, and total proteins.[63]

Fig.29 Albiziaodoratissima

syzyguimcumini Linn. (Formerly Eugenia jam-bolana,Myrtaceae)

Plant has potential for lowering blood sugar. Numerous plant parts, including the fruit, seeds, bark, and tea made from leaves themselves have been used to cure diabetes throughout Asia. Researchers failed to find any blood glucose lowering effects with extracts or tea derived from plant leaves in normal rats, normal rats with STZ-induced diabetes, and normal volunteers despite reports of antihyperglycemic effects in leaves, seeds, fruits, and bark. Although tea made from S. cumini leaves doesn't have a hypoglycemic effect, its use in diabetes remains conceivable because of the possibility that its mode of action depends on particular abnormalities associated with the condition.[64]

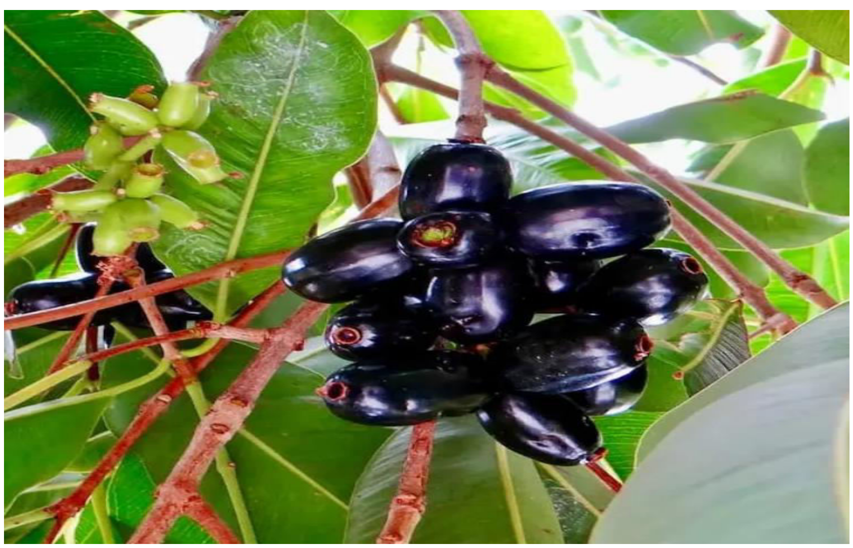

Fig.30 syzyguimcumini

Anacardiumoccidentale Linn. (Anacardiaceae)

Brazilian-born plant used as traditional medicine to cure diabetes mellitus in Cameroon and other countries in Africa. A. occidentale was discovered to have hypoglycemic and protecting properties. In streptozotocin-induced diabetic rats, the antihyperglycemic and renal protective effects of the leaves of this plant were reported. It lessens the functional and histological changes in the kidneys brought on by diabetes. A. occidentale's histological analysis considerably decreased the buildup of mucopolysaccharides in diabetic animals' kidneys, according to the research.[65]

Fig. 31 Anacardiumoccidentale

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