



**ASPARAGUS RACEMOSUS, BERBERIS ARISTATA: ANTI DIABETIC PLANTS BEING  
USED IN TRADITIONAL MEDICINES OF SIKKIM (INDIA)**

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**ABSTRACT**

In one survey study the World Health Organization showed that about 80% of the world population are using medicinal plants as medicines for their primary healthcare. People use medicinal plants as drugs due to easy access, less cost, least side effects and above all natural. Currently about 20,000 plants are being used for treatment of different diseases. One such disease is diabetes. In many parts of the world people take medicinal plants in the form of traditional medicine to keep diabetes under control. In Sikkim (India) also lot of diabetics especially village dwellers use medicinal plants in diabetes through traditional medicine. In this article efforts were taken to discuss such two medicinal plants (*Asparagus racemosus* and *Berberis aristata*) in terms of their botanical description, vernacular names, classification, traditional use specially in Sikkim, content of bioactive compounds, pharmacological properties and above all anti-diabetic activity.

**KEYWORDS:** Diabetes, traditional medicine, use of medicinal plants, *Asparagus racemosus*, *Berberis aristata*.

**INTRODUCTION**

According to World Health Organization (WHO), diabetes mellitus is a metabolic disorder of multiple etiology characterized by chronic hyperglycemia (high levels of glucose in blood) with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action or both. Insulin is the hormone released from beta cells of pancreas and controls blood glucose levels by signalling liver, muscle and fat cells to take glucose from blood to generate energy.<sup>[1-2]</sup>

Diabetes mellitus is mainly of two types. Type 1- Insulin dependent diabetes mellitus (IDDM) also referred to as juvenile diabetes and known to affect only 5% of the diabetic population. In this case body makes little or even no insulin and the patient therefore requires insulin daily to survive. Type 2- Non-insulin dependent diabetes mellitus (NIDDM) usually develops in adults over the age of 40. In this case body is incapable of responding to insulin. However, diabetes may develop during pregnancy and, if so, it is known as gestational diabetes.<sup>[3-4]</sup>

Diabetes mellitus has characteristic symptoms like thirst, polyuria, blurred vision and loss of weight resulting long-term damage, dysfunction and failure of various organs such as, eyes, kidneys, nerves, heart, liver and veins. Disturbance in these organs can lead to death. An

estimated 1.6 million deaths were directly caused by diabetes globally in 2016 and nearly 1 million Indians die due to diabetes every year.

As of 2017 there are about 72.96 million cases of diabetes in adult population of India. A May 2019 study has found that about one in every two Indians living with diabetes is unaware of their conditions. Another study suggests that by 2022 India will have maximum number of diabetic patients and will become the 'Diabetes capital of the world'. As per estimation of the International Diabetes Federation, India will have 134.3 million living with diabetes in 2045. There are drugs to treat diabetes. Common drugs are, Currently accessible treatment for diabetes is with sulfonylureas, metformin, glucosidase inhibitors, troglitazone etc. But these drugs in long term use are reported to produce serious adverse side effects such as liver problems, lactic acidosis and diarrhea. So, research is going on to search for new anti-diabetic compounds and extended even in the field of medicinal plants.<sup>[5-6]</sup> Many medicinal plants are now known to possess anti diabetic activity. Few examples are, *Abutilon indicum*, *Ficus racemose*, *Gynocardia odorata*, *Ipomoea batatas*, *Litsea cubeba*, *Momordica charantia* etc. These plants are being used in treatment of diabetes through traditional medicine in different countries of the world.

In the present article such two medicinal plants viz. *Asparagus racemosus* and *Berberis aristata*, being used in traditional medicine of Sikkim for treatment of diabetes, are discussed.

### *Asparagus racemosus*

#### Botanical description

*Asparagus racemosus* (*A. racemosus*), locally known as Shatavari, is distributed throughout Australia, Sri Lanka, Africa, Java, Southern parts of China and north east part of India specially in Sikkim, but it is mainly cultivated in India. The plant is a woody climber growing to 1-2 m in height prefers to take root in gravelly, rocky soils high up in piedmont plains, at 1300-1400 m elevation. Leaves are like pine needles, small and uniform, and shiny green. Flowers are white and have small spikes. Fruits are blackish purple like globular shapes. Roots are silvery white or ash-color externally and white internally. Roots are smooth when fresh but wrinkles upon drying.<sup>[7]</sup>



*Asparagus racemosus*

#### Vernacular names

*A. racemosus* has different vernacular names viz.

Bengali: *Shatamuli* Gujarati: *Satawari* Hindi: *Satavari*, *Shatawar* or *Satmuli* Kannada: *Majjigegadde* or *Aheruballi* Kumaon: *Kairuwa* Madhya Pradesh: *Narbodh* or *atmooli* Malayalam: *Chatavali* Marathi: *Shatavari* or *Shatmuli* Nepali: *Kurilo* Rajasthan: *Norkanto* or *Satawar* Sanskrit: *Satavari* Tamil: *Shimaishadavari* or *Inli-chedi* Telegu: *Toala-gaddalu* or *Pilli-gaddalu*.<sup>[8]</sup>

#### Classification<sup>[9]</sup>

Kingdom: *Plantae* Clade: *Angiosperms* Order: *Asparagales* Family: *Asparagaceae*. Sub family: *Asparagoideae* Genus: *Asparagus* Species: *Asparagus racemosus*.

#### Traditional use

*A. racemosus* has many traditional uses. In Ayurveda the plant is used to increase longevity, impart immunity, prevent ageing, improve mental function, vigor and add vitality to the body. It is also used in inflammation, neuropathy, nervous disorders, dyspepsia, tumors,

hepatopathy and in cases of threatened abortion. Roots of the plant are used in bronchitis, hyperacidity, diarrhoea, dysentery, cough, and certain infectious diseases. In Unani and Siddha system of medicine *A. racemosus* is used in treatments of chronic fevers, excessive heat, stomach ulcers, epilepsy, kidney disorder and liver cancer. It is used to increase milk secretion in nursing mothers and regulate sexual behaviors. The plant is also used as immune stimulant and antioxidant. The plant has anti-dyspepsia & anti-tussive effects.<sup>[10]</sup>

In Sikkim *A. racemosus* is used as traditional medicine in diabetes. Folk healers of Sikkim prescribe decoction of tender shoots (25ml) of the plant to the diabetic patients once daily for 6-8 weeks. By this treatment, the folk healers claimed, blood sugar of the diabetic patients can be kept under control.<sup>[11]</sup>

#### Bioactive compounds

*A. racemosus* contains many bioactive compounds like, Saponins, immunoside, asparagine A, isoflavones-8-methoxy-5, 6, 4-trihydroxy isoflavone-7-O-beta-D-glucopyranoside, racemosol, dihydrophenanthrene, racemofuran, polysaccharides, mucilage, glycosides of quercetin, rutin and hyperoside, sitosterol, 4, 6-dihydroxy-2-O (-2-hydroxy isobutyl) benzaldehyde and undecanyl cetanoate, kaepfrol, essential fatty acids like gamma linoleinic acids, vitamin A, diosgenin, quercetin 3-glucourbnides and trace minerals e.g. zinc, copper, manganese, cobalt, zinc, magnesium, calcium, potassium, selenium etc.<sup>[12]</sup>

#### Pharmacological activity

*A. racemosus* has several pharmacological activities such as, antimicrobial, antidiabetic, anticancer, antidepressant, antiurolithiatic, antioxidant, antiinflammatory, anti HIV, antidyspepsia, antiepileptic, antiulcer, antistress, anti diarrhoeal, antiplasmodial, antitussive, analgesic, adaptogenic, galactogogue, diuretic, lipid lowering, cardioprotective, hepatoprotective, immunostimulant, immunomodulatory etc.<sup>[13]</sup>

#### Anti-Diabetic activity of *Asparagus racemosus*

Anti-diabetic activity of *A. racemosus* was studied in experimental animals. In diabetic rats and rabbits root extract of *A. racemosus* was administered. Results showed that the root extract could reduce blood glucose level in the animals. Insulinotropic pathways was studied and it was found that root extract caused a wide ranging stimulatory effect on physiological insulinotropic pathways.<sup>[14]</sup>

Insulin secretory action of extracts of *A. racemosus* root in perfused pancreas, isolated islets and clonal pancreatic beta-cells was studied by Hannan *et al.* Results showed that chloroform, hexane and ethyl acetate extracts of *A. racemosus* evoked significant increase in insulin release but aqueous and butanol extracts showed less prominent effects on insulin release, especially at lower glucose concentration.<sup>[15]</sup>

In another study modulatory role of *A. racemosus* on glucose homeostasis in aged rats was noted. Results showed, supplementation of *A. racemosus* root extract to aged In rats restored the age associated altered activity of enzymes and plasma parameters.<sup>[16]</sup>

Hannan *et al.* investigated effects of ethanol extracts of *A. racemosus* roots on glucose homeostasis in diabetic rats. They also studied the effects on insulin action in 3T3 adipocytes. They noted that when root extract of *A. racemosus* was administered orally together with glucose, the extract improved glucose tolerance in normal as well as in diabetic rats. The extract also significantly suppressed postprandial hyperglycaemia after sucrose ingestion and reversibly increased unabsorbed sucrose content throughout the gut and inhibited significantly the absorption of glucose during *in situ* gut perfusion with glucose. Further, the extract enhanced glucose transport and insulin action in 3T3-L1 adipocytes. Authors observed that daily administration of *A. racemosus* to type 2 diabetic rats for 28 days decreased serum glucose and increased pancreatic insulin, plasma insulin, liver glycogen and total oxidant status. Authors commented, these findings indicate that anti hyperglycaemic activity of *A. racemosus* is partly mediated by inhibition of carbohydrate digestion and absorption, together with enhancement of insulin secretion and action in the peripheral tissue. *A. racemosus*, therefore, may be useful as a source of novel antidiabetic compounds or a dietary adjunct for the management of diabetes.<sup>[17]</sup>

Antidiabetic effect of *A. racemosus* on alloxan- induced diabetic rats was studied by Mamun *et al.* Diabetes was induced in male Wister albino rats by the administration of single intra-peritoneal injection of alloxan monohydrate (120 mg/kg b.w.). Ethanol extract of *A. racemosus* was given to rats for 2 weeks. Gliclazide and Pioglitazone, known anti diabetic drugs, were also given to separate groups of diabetic rats. After 2 weeks biochemical parameters such as serum total cholesterol, triglyceride, low density lipoprotein, high density lipoprotein, very low density lipoprotein. glutamate oxaloacetate transaminases, serum glutamate pyruvate transaminases and total protein were estimated. Results showed that alloxan treatment caused persistent hyperglycemia, hyperlipidemia and liver dysfunction in rats. Treatment with *A. racemosus* extract at different doses improved hyperglycemia significantly by reducing blood glucose levels in rats which was comparable to that of glucose-lowering activity of the anti diabetic drugs. Treatment with *A. racemosus* markedly reduced amounts of total cholesterol, triglyceride, low density lipoprotein, very low density lipoprotein. glutamate oxaloacetate transaminases, serum glutamate pyruvate transaminases but increased high density lipoprotein when compared to disease control rats. Results were comparable to that of gliclazide treated rats and

pioglitazone treated rats indicated improvement in diabetic status.<sup>[18]</sup>

Vadivelan *et al.* studied antidiabetic potential of *A. racemosus* leaf extracts through inhibition of  $\alpha$ -amylase and  $\alpha$ -glucosidase. Root of the *A. racemosus* was extracted separately with chloroform, ethyl acetate, n-hexane, methanol and water and the extracts were evaluated for  $\alpha$ -amylase and  $\alpha$ -glucosidase inhibitory activity. Results showed that ethyl acetate and aqueous extracts exerted  $\alpha$ -amylase and  $\alpha$ -glucosidase inhibitory activity though the activity was less than that of acarbose, a known  $\alpha$ -amylase and  $\alpha$ -glucosidase inhibitor. On analysis it revealed that the extracts contained saponins, amino acids, flavonoids, tannins and phenolic, protein as the major phytochemical constituents. It was told that Type – 2 diabetes mellitus is characterized by postprandial hyperglycemia. One of the therapeutic approaches is to reduce postprandial hyperglycemia. This can be done by inhibiting carbohydrate splitting enzymes like  $\alpha$ -amylase and  $\alpha$ -glucosidase. Acarbose, one  $\alpha$ -amylase and  $\alpha$ -glucosidase inhibitor, has already been included in the list of drugs of Type - 2 diabetes mellitus. As *A. racemosus* exerted  $\alpha$ -amylase and  $\alpha$ -glucosidase inhibitory activity, the plant may be used to control postprandial hyperglycemia *vis-à-vis* Type-2 mellitus.<sup>[19]</sup>

#### ***Berberis aristata***

##### **Botanical description**

*Berberis aristata* (*B. aristata*), commonly known as 'Daruharidra', is an erect spiny shrub.



#### ***Berberis aristata***

ranging between 2 and 3 meters in height. Bark of the plant is yellow to brown from outside and deep yellow from inside. Leaves are simple spiny, lanceolate, toothed and leathery. Flowers are stalked, yellow and complete. Fruits are globose to ovoid. Seeds are 2 to 5 in number, varying in colour from yellow to pink. *B. aristata* is distributed throughout the Himalayas, Sri Lanka and Nilgiri hills. The plant is found in plenty in mountainous parts of North India specially in Sikkim and Nepal.<sup>[20]</sup>

**Vernacular names**<sup>[21]</sup>

Bengali: *Daruharidra* English: *Indian berberry* Gujrati: *Daruharidra*, *daruhuladur* Hindi: *Daruhaldi*, *darhald* Kannada: *Maradarishana*, *maradarishina*, *daruhaladi* Malayalam: *Maramannal*, *maramanjil* Marathi: *Daruhalad* Oriya: *Daruharidra*, *daruhalidi* Punjabi: *Sumalu* Sanskrit: *Katamkateri*, *dirvi* Tamil: *Gangeti*, *varatiu manjal* Telugu: *Manupasupu* Urdu: *Darhald*.

**Classification**<sup>[22]</sup>

Kingdom: *Plantae* Division: *Magnoliophyta* Class: *Magnoliopsida* Order: *Ranunculales* Family: *Berberidaceae* Genus: *Berberis* Species: *aristata*.

**Traditional use**

*B. aristata* is used traditionally in menorrhagia, diarrhea, inflammation, skin disease, allergies, metabolic disorders, jaundice, wound healing, bleeding piles, infection of eyes and as laxative. In Ayurveda decoction of leaves of *B. aristata* is prepared. This is known as 'Rashut'. Rashut is used in the treatment of eye and ear infections, menorrhagia, diarrhoea, skin diseases, cholera, jaundice as well as urinary tract infection. Decoction of the root is used in washing the infected wounds and ulcers. It is also used for healing and promoting cicatrization.<sup>[23]</sup>

In Sikkim *B. aristata* is used as traditional medicine in diabetes. Folk healers of Sikkim prescribe root bark extract (5–10ml) of the plant to the diabetic patients twice (after breakfast and dinner) daily for 1–2 weeks daily. By this treatment, the folk healers claimed, blood sugar of the diabetic patients remained under normal range.<sup>[11]</sup>

**Bioactive compounds**

*B. aristata* contains protoberberine and bis isoquinoline type of alkaloid. The major alkaloid found in root of the plant is berberine. Other alkaloids are pseudoberberine chloride, 1-Omethyl pakistanine, pseudopalmitine chloride, dihydrokarachine, taximaline, pakistanine, oxyberberine, aromoline, dehydrocaroline, jatrorrhizine, oxycanthine, epiberberine, palmitine, columbamine, karachine etc.<sup>[24]</sup>

**Pharmacological activity**

*B. aristata* showed many pharmacological activities like antioxidant, anticancer, antidepressant, antibacterial, antifungal, anti-inflammatory, antipyretic, analgesic, hypoglycaemic, hepatoprotective, immunomodulatory etc.<sup>[25]</sup>

**Anti-Diabetic activity of *Berberis aristata***

*B. aristata* has been analyzed for *in vitro* antioxidant and antidiabetic properties. The plant was found effective against the inhibition of free radicals and the inhibition of alpha amylase and alpha glycosidase enzymes. Acetone extract of the plant was found more effective against the diabetes and also the antioxidant power than that of water extract.<sup>[26]</sup> Hypoglycemic effects of *B.*

*aristata* extract was studied for its effects on glucose adsorption capacity, *in vitro* glucose diffusion and amylolysis kinetics as well as glucose transport across the yeast cells. It was observed that the plant extract adsorbed glucose and the adsorption of glucose increased remarkably with an increase in glucose concentration. The plant extract also promoted glucose uptake by the yeast cells. Authors concluded that the results of the study verified the hypoglycemic activity of *B. aristata*.<sup>[27]</sup>

Antidiabetic activity of stem bark of *B. aristata* was studied by Semwal *et al.* in alloxan induced diabetic rats. Results showed that ethanolic extract of stem bark of the plant had significant hypoglycemic effect. It reduced blood glucose level 60.4% and 75.46 % at the doses of 25 mg/kg and 50 mg/kg respectively in diabetic rats.<sup>[28]</sup> In another study the authors observed anti diabetic activity of root extracts of *B. aristata* prepared by different solvents in alloxan-induced diabetic rats. Ethanol extract showed significant reduction of serum glucose level in diabetic rats as compared to diabetic control group. Cholesterol, triglycerides and high density lipoprotein levels were estimated. Results showed that cholesterol and triglyceride levels increased significantly in diabetic rats were decreased by the extract. The level of HDL cholesterol was significantly increased in the extract treated group. Oral glucose tolerance test was also done. Ethanol extract increased the glucose tolerance. Authors commented, *B. aristata* is very promising to develop phytomedicine for diabetes mellitus.<sup>[29]</sup> Singh and Kakkar studied antihyperglycemic and antioxidant effect of *B. aristata* root extract and its role in regulating carbohydrate metabolism in diabetic rats. Authors noted that plant root extract not only had antihyperglycemic and antioxidant effect but also could regulate carbohydrate metabolism in diabetic rats.<sup>[30]</sup> Pareek and Suthar studied antidiabetic activity of *B. aristata* root extract in streptozotocin induced diabetic rats. They found that oral application of extracts at doses of 100 and 200mg/kg body weight, significantly lowered plasma glucose levels in normal as well as diabetic rats. Metformin, a standard oral hypoglycaemic agent, was used in one group and it revealed that ethanolic extract *Berberis aristata* produced significant antihyperglycemic activity in diabetic rat which was comparable to metformin group.<sup>[31]</sup> Hypoglycemic effect of methanolic extract of *B. aristata* stem on normal and streptozotocin induced diabetic rats was studied by Upwar *et al.* Blood glucose and serum total cholesterol, triglyceride, HDL cholesterol levels in the animals were measured. Result showed that methanolic extract of *B. aristata* stem could reduce blood glucose, cholesterol and triglyceride levels which were found elevated during streptozotocin.

induced diabetes. *B. aristata* extract however increased HDL cholesterol level in the diabetic animals.<sup>[32]</sup> Gupta *et al.* studied blood glucose lowering potential of stem bark of *B. aristata* in alloxan-induced diabetic rats as well as its *in vitro* antioxidant property. It was observed

that methanolic extract of *B. aristata* stem bark exhibited significant antidiabetic activity in a dose dependent manner. The extract also had enough reducing power to manifest its antioxidant nature.<sup>[33]</sup>

Antidiabetic activity of *B. aristata* was studied on human subjects. Clinical trial was done with berberine, isolated from the plant, on 60 patients with type II diabetes mellitus. The patients varied in severity of this disorder. Oral doses were prescribed for 1-3 months, together with a therapeutic diet. It was observed that major symptoms of diabetes disappeared, patient strength improved, blood pressure and blood lipids of the patients were lowered. Fasting glycaemic levels in about 60% of patients were controlled.<sup>[34]</sup> Yin and colleagues have demonstrated scientific evidence for the use of berberine in human beings to treat type 2 diabetes mellitus.<sup>[35]</sup> Berberine has shown marked impact on carbohydrate and lipid metabolism. Recent preclinical and clinical

studies suggest that berberine has a strong impact on glucose homeostasis. In fact, berberine increases insulin receptor mRNA expression through kinase C dependent protein as promoter in cultured human liver cells and skeletal muscle.<sup>[36]</sup>

## CONCLUSION

It is expected that researchers will pay proper attention to validate scientific use of *Asparagus racemosus* and *Berberis aristata* in traditional medicine of Sikkim for diabetic patients and to proceed for isolation of antidiabetic compound(s) from the plants, characterize the isolated compounds by various spectroscopic experiments like IR (infrared), UV (ultraviolet), NMR (nuclear magnetic resonance), mass spectroscopy etc. and above all to undertake clinical trial to confirm anti diabetic activity of the isolated compounds in humans. In this way, natural antidiabetic compound(s) may be obtained from these plants which will replace the synthetic antidiabetic compounds and will act as “antidiabetic drugs” in future for greater interest of mankind.

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