Review Article

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LESS KNOWN MEDICINAL PLANTS OF ASSAM AND ODISHA USED FOR TREATING DIABETES WITH SPECIAL REFERENCE TO CHARAKA

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ABSTRACT

Lifestyle disorders are diseases that appear to increase in frequency as countries like India become more industrialized and people live longer. They can include Alzheimer's disease, arthritis, atherosclerosis, asthma, some kinds of cancer, chronic obstructive pulmonary disease (COPD), type II diabetes, heart disease, metabolic syndrome, chronic renal failure, osteoporosis, stroke, depression and obesity. Diabetes mellitus is one of the common metabolic disorders acquiring around 2.8% of the world's population and is anticipated to cross 5.4% by the year 2025. Its percentage is in Assam 4.2 and Odisha 4.6 of the total population of state. Since long back herbal medicines have been the highly esteemed source of medicine therefore, they have become a growing part of modern, high-tech medicine. In view of the above aspects the present paper provides profiles of ten species of antidiabetic medicinal plants of Assam and Odisha state having their references in age old classical treatises like Charaka Samihita. The antidiabetic medicinal plants discussed are *Calotropis procera*, *Calotropis gigantea*, *Cassia fistula*, *Hemidesmus indicus*, *Cleodendrum serratum*, *Punica granatum*, *Woodfodia fruticosa*, *Cynodon dactylon*, *Fagonia cretica* and *Gmelina arborea*.

Keywords: Antidiabetic, Assam, Odisha, Charaka Samihita.

INTRODUCTION

In modern era, there is an increasing incidence of diseases such as diabetes, hypertension, cardio vascular diseases, behavioural problems, high cholesterol, and obesity affecting even the younger people.

Diabetes mellitus is one of the oldest diseases known to mankind and has been known since ages and the sweetness of diabetic urine has been mentioned in Ayurveda by Sushruta. Presently 2.8% of the population suffers from diabetes throughout the world and it may cross 5.4% by 2025. Diabetes mellitus is a systemic metabolic disease characterized by hyperglycemia hyperlipidemia, hyperaminoacidemia and hypoinsulinaemia it leads to decrease in both insulin secretion and insulin action. It is caused by the abnormality of carbohydrate metabolism which is linked to low blood insulin level or insensitivity of target organs to insulin¹. The management of diabetes is a global problem until now and successful treatment is not yet discovered. The modern antidiabetic drugs produce undesirable and side effects. Plant materials which are being used as traditional medicine for the treatment of diabetes are considered one of the good sources for a new drug or a lead to make a new drug. Plant extract or different folk plant preparations are being prescribed by the traditional practitioners and also accepted by the users for diabetes like for any other diseases in many countries especially in third world countries. Now-a days more than 400 plants are being used in different forms for hypoglycaemic effects all the claims practitioners or users are neither baseless nor absolutely².

Therefore, the present study is carried out to collect the available data on some of the less known antidiabetic medicinal plants of Assam and Odisha state.

DISCUSSION

The present study is carried out to document the medicinal plants being used by the traditional healers of different places and steps were taken to locate for the sustainability of those species.

In present study ten species of antidiabetic medicinal plants from Assam and Odisha namely *Calotropis procera*, *Calotropis gigantea*, *Cassia fistula*, *Hemidesmus indicus*, *Cleodendrum serratum*, *Punica granatum*, *Woodfodia fruticosa*, *Cynodon dactylon*, *Fagonia cretica* and *Gmelina arborea* have been reported looking to their use in various life style disorders especially in diabetes. However, efforts have been taken to evaluate those plants with their potency/effectiveness both from clinical point of view and having references in classical texts especially in Charaka Samihita.

Calotropis procera (Aiton) W.T.Aiton

Synonym: *Calotropis procera* Aiton

Sanskrit name: Arka (Charaka)

Calotropis procera is a species of flowering plant in the family Asclepiadaceae and is native to North Africa, Tropical Africa, Western Asia, South Asia, and Indochina. This plant is found abundantly in Assam and Odisha state of India.

The plant is a very promising source of anticancerous, ascaricidal, schizonticidal, anti-microbial, anthelmintic, insecticidal, anti-inflammatory, anti-diarrhoeal, larvicidal with many other beneficial properties. The plant contains many active compounds like calotropin, alotropagenin, calotoxin, calactin, uscharin, amyrin, amyrin esters, uscharidin, coroglaucigenin, frugoside, corotoxigenin, calotropagenin and voruscharine used in many therapeutic applications. The plant is used in folk medicine for the treatment of leprosy, elephantiasis, fever, menorrhagia, malaria and snake bite³.

Antidiabetic activities

Dry latex of *Calotropis procera* had anti-hyperglycaemic effects in alloxan-induced diabetes in rats and showed antidiabetic effects as comparable to the standard antidiabetic drug glibenclamide⁴. Hydroalcoholic extract of the leaves of *C. procera* (300 and 600mg/kg/day) reduced significantly the level of blood glucose and improved metabolic status of the streptozotocin-induced diabetic rats and ameliorated the oral tolerance glucose test⁵. Petroleum ether, methanol and aqueous extracts of *Calotropis procera* roots at the dose of 250 mg/kg, b. wt. for 15 days had anti-hyperglycemic effect in streptozotocin-induced diabetes in Male Wistar Albino rats and the activities were compared to that effect produced by a standard antidiabetic agent, glibenclamide 500µg/kg⁶. Ethanolic extract of *Calotropis procera* fruits at the dose of 250 and 500mg/kg, b. wt. had antidiabetic effects in alloxan induced diabetic rats⁷.

Calotropis Gigantea (L.) W.T.Aiton

Synonym: *Asclepias gigantea* L., *Calotropis gigantea* (L.) R. Br. ex Schult., *Madorius giganteus* (L.) Kuntze, *Periploca cochinchinensis* Lour., *Streptocaulon cochinchinense* (Lour.) G. Don.

Sanskrit name: Alarka (Charaka)

Calotropis gigantea is a species of *Calotropis* native to Cambodia, Indonesia, Malaysia, Philippines, Thailand, Sri Lanka, India, China, Pakistan, Nepal, and tropical Africa. In India the plant is found abundantly in Assam and Odisha state.

Calotropis gigantea is used as a traditional medicine to treat common disease such as fevers, rheumatism, indigestion, cough, cold, eczema, asthma, elephantiasis, nausea, vomiting and diarrhoea. According to Ayurveda, the dried whole plant is a good tonic, expectorant, depurative and anthelmintic. In ancient ayurvedic medicine the plant *Calotropis gigantea* is known as "Sweta Arka". Various phytochemicals are present in *Calotropis gigantea* especially in the leaves. Usharin, gigantol, calcium oxalate, alpha and beta-calotropenol, beta-amyrin, fatty acids (both saturated and unsaturated), hydrocarbons, acetates and the benzoates, a mixture of tetracyclic triterpene compounds, terols, giganteol and gigantol are also found to be present. Cardenolide calotropin, α-amyrin, β-amyrin, taraxasterol, β-sitosterol, α-amyrin methylbutazone, β-amyrin methylbutazone, α-amyrin acetate, β-amyrin acetate, taraxasteryl acetate, lupeol acetate B, gigantursenyl acetate A, gigantursenyl acetate B, flavonol glycoside, akundarol, uscharidin, calotropin, frugoside, calotroposides A to G are responsible for many of its activities⁸.

Antidiabetic activities

Methanolic extract of *Calotropis gigantea* seeds showed antidiabetic activity on streptozotocin induced diabetic rats⁹. Chloroform extract of *Calotropis gigantea* leaf and flower in the doses of 10, 20 and 50mg/kg, orally showed a significant reduction in serum glucose levels in streptozotocin-induced diabetic rats¹⁰. Chloroform extract of *Calotropis gigantea* flowers administered orally at the doses of 100 and 200 mg/kg for 21 consecutive days showed moderate anti-diabetic activity in

alloxan-induced hyperglycemia in Wistar albino rats¹¹. Ethanolic, chloroform and n-butano fractions of *C. gigantea* leaf extract possesses significant antidiabetic and antioxidant activity in Streptozotocin-induced diabetic rats¹².

Cassia fistula L.

Synonym: *Bactrylobium fistula* Willd.; *Cassia bonplandiana* DC.; *Cassia excelsa* Kunth; *Cassia fistuloides* Collad.; *Cassia rhombifolia* Roxb.; *Cathartocarpus excelsus* G. Don.; *Cathartocarpus fistula* Pers.; *Cathartocarpus fistuloides* (Collad.) G. Don.; *Cathartocarpus rhombifolius* G. Don.
Sanskrit name: Aragvadhya (Charaka)

Cassia fistula L. is known as the golden shower tree and by other names, is a flowering plant in the family Caesalpiniaceae. The species is native to the Indian subcontinent and adjacent regions of Southeast Asia, found abundantly in Assam and Odisha state of India. In traditional medicine, the plant is used for the treatment of hematemesis, pruritis, intestinal disorder, leucoderma, diabetes, constipation etc¹³. Various phytochemicals viz. rhein, volatile oil, waxy, lupeol, β-sitosterol and hexacosanol, fistulin, kaempferol etc. are present in the plant¹⁴.

Antidiabetic activities

Hexane extract of *Cassia fistula* stem bark at the doses of 0.15, 0.30, 0.45g/kg body weight for 30 days suppressed the elevated blood glucose levels in Streptozotocin diabetic rats. The hypoglycemic effect produced by the extract was better than that of standard hypoglycemic drug glibenclamide¹⁵. Daily oral administration of the total alcoholic extract and its ethyl acetate fraction of the bark of *Cassia fistula* in alloxan induced diabetic rats for 14 days exhibited significant reduction in blood glucose levels and also found effective in restoring the blood lipids to normal levels. The activity of the extracts was found comparable with standard drug glibenclamide¹⁶. Methanolic extract of the bark and leaves of *Cassia fistula* at the dose 500mg/kg body weight exhibited significant antihyperglycemic and antilipidemic activity than at low dose of 250mg/kg in Streptozotocin-nicotinamide-induced diabetes mellitus in rats¹⁷.

Hemidesmus indicus (L.) R.Br.

Synonym: *Periploca indica*

Sanskrit name: Anantamul (Charaka)

Hemidesmus indicus is a species of plant that is found over the greater part of India, from the upper Gangetic plain eastwards to Assam and in some places in central, western and South India.

Hemidesmus indicus is widely used in Ayurveda for treatment of various disease conditions. It is used as a tonic, demulcent, diaphoretic, diuretic and blood purifier. The therapeutic action of the herb is due to presence of major chemical constituents like coumarinonolignoids hemidesmine and hemidesmin¹⁸.

Antidiabetic activities

Ethanol root extract of *Hemidesmus indicus* had significant dose dependent antidiabetic effect as demonstrated in gut perfusion and six segment methods on Long Evans rats. In the gut perfusion study the glucose absorption in control rats vs. rats fed with 250 mg/kg and 500 mg/kg extracts were observed at 5, 10, 15, 20, 25 and 30 minutes and the significant change of intestinal glucose absorption was found throughout the experimental time which was 34.96 vs. 29 vs 37.97, 34.29 vs. 28.04 vs. 37.99, 39.69 vs. 42.85 vs. 38.29, 35.69 vs. 30.32 vs. 36.45, 36.98 vs. 30.44 vs. 35.92 and 34.82 vs. 19.44 vs. 30.77mmol/L respectively. The change of intestinal glucose absorption was found significant with 250mg/kg than 500mg/kg

root extract of *Hemidesmus indicus*. The six segment study was performed to assess the amount of glucose remaining in the six different positions of the GIT at 30, 60, 180 and 360 minutes. The data revealed that the 500mg/kg root extract of *Hemidesmus indicus* had gradually reduced the glucose absorption in GIT compared to control throughout the experimental time¹⁹. Aqueous extract of *Hemidesmus indicus* roots at a dosage of 500mg/kg/day exhibited significant antidiabetic activity on streptozotocin-induced diabetic rats²⁰. Administration of *Hemidesmus indicus* roots (40mg/g body weight/day) for four weeks showed significant hypoglycemic effect in Alloxan induced diabetic rats²¹. *Hemidesmus indicus* root extract showed significant antidiabetic activity in alloxan induced diabetic rats at the single dose of 250 or 1000mg/kg²².

***Caesalpinia bonducella* (L.) Fleming**

Synonym: *Caesalpinia bonduc* (L.) Roxb.; *Caesalpinia crista* auct. Amer.; *Guilandina bonduc* L.; *Guilandina bonducella* L.
Sanskrit name: Latakaranjah (Charaka)

Caesalpinia bonduc, commonly known as Gray Nicker, is a species of flowering plant in the senna family Caesalpiniaceae. It is a prickly shrub widely distributed all over the world especially in India, Sri Lanka and Andaman and Nicobar Islands, in India specially found in tropical regions. In Indian traditional plant medicine, it has been considered as an important remedy for the treatment of several diseases. It is popular in indigenous system of medicine like Ayurveda, Siddha, Unani and Homoeopathy. The plant has been reported to possess anxiolytic, antinociceptive, anti-diarrhoeal, antidiabetic, adaptogenic, anthelmintic, antiestrogenic, anti-inflammatory, antimalarial, antimicrobial, antifungal, antispasmodic, anti-oxidant, antiproliferative, antipsoriatic, antitumor, larvacidal, muscle contractile, hepatoprotective, anticonvulsant and antifilarial activities. Phytochemical analysis of *Caesalpinia bonduc* (L.) has revealed the presence of alkaloids, flavo-noids, glycosides, saponins, tannins and triterpenoids²³.

Antidiabetic activities

Antidiabetic activity of *Caesalpinia bonducella* seed extracts was observed in rats²⁴. Aqueous extracts of seed kernel powder of *Caesalpinia bonducella* at the dose of 500mg/kg bodyweight showed antidiabetic activity in alloxan induced diabetic rats after 4 hrs of administration²⁵. Crude ethanolic extract of *Caesalpinia bonducella* at the dose of 500mg/kg bodyweight exhibited statistically significant hypoglycemic and anti-hyperglycemic activities in normal and alloxan induced diabetic albino mice, respectively²⁶. Hydro-alcoholic extracts of *Caesalpinia bonduc* (L.) Roxb. seeds at the doses of 250mg and 500mg /kg of b.wt. significantly lowered fasting blood glucose level in alloxan induced diabetic rats²⁷.

***Punica granatum* L.**

Synonym: *Punica florida* Salisb.; *Punica grandiflora* hort. ex Steud.; *Punica nana* L.; *Punica spinosa* Lam.
Sanskrit name: Dadima (Charaka)

Punica granatum, is a fruit bearing shrub or small tree belonging to family Lythraceae, cultivated throughout the Mediterranean region, as far north as the Himalayas, in Southeast Asia, and in California and Arizona in the United States. In the past decade, numerous studies on the antioxidant, anticarcinogenic, and anti-inflammatory properties of pomegranate constituents have been published, focusing on treatment and prevention of cancer, cardiovascular disease, diabetes, dental conditions, erectile dysfunction, bacterial

infections and antibiotic resistance, and ultraviolet radiation-induced skin damage. Other potential applications include infant brain ischemia, male infertility, Alzheimer's disease, arthritis, and obesity. Extracts of all parts of the fruit appear to have therapeutic properties, and some studies reported the medicinal benefit of bark, roots, and leaves of the tree as well. Current research seems to indicate the most therapeutically beneficial pomegranate constituents are ellagic acid, ellagitannins (including punicalagins), punicic acid, flavonoids, anthocyanidins, anthocyanins, and estrogenic flavonols and flavones²⁸.

Antidiabetic activities

Antidiabetic effects of flowers of *Punica granatum* were demonstrated in alloxan-induced rats^{29, 30,31,32,33}. Antidiabetic effects of the pomegranate fruit peel/rind and pomegranate juice was also observed^{34, 35, 36}.

***Woodfordia fruticosa* (L.) Kurz**

Synonym: *Woodfordia floribunda*

Sanskrit name: Dhataki (Charaka)

Woodfordia fruticosa is a species of plant in the Lythraceae family commonly occurring throughout North India, ascending to an altitude of 1,500 m. in the Himalayas, but rather scarce in South India. The dried flowers are credited with stimulant and astringent properties. It is commonly used in the treatment of various diseases like diarrhoea, dysentery, fever, headache, haemorrhoids, herpes, internal hemorrhage, leucorrhoea, liver disorders, menorrhagia, ulcer and wounds etc. It has many pharmacological activities like antimicrobial, hepatoprotective, cardio protective, antiulcer, immunomodulatory, anti-fertility, antitumor; wound healing, analgesic, anti-inflammatory, antibacterial and anti-hyperglycemic³⁷. Phytochemical screening revealed that phytoconstituents tannin, terpenoids, saponins and flavonoids are present in the extracts of *Woodfordia fruticosa* leaves and barks³⁸.

Antidiabetic activities

The ethanolic extract of *W. fruticosa* flowers (250 and 500mg/kg) significantly reduced fasting blood glucose level and increase insulin level after 21 days' treatment in streptozotocin diabetic rats³⁹. Aqueous extracts of leaves and stem barks of *Woodfordia fruticosa* at a dose of 200mg/ kg exhibited statistically significant antidiabetic activity in alloxan induced diabetic rats³⁸. Ethanolic and aqueous extract of *Woodfordia fruticosa* Linn (Kurz) flower extract at the doses of 100 and 200mg/kg showed dose-dependent antihyperglycaemic effect in streptozotocin induced diabetic rats⁴⁰.

***Cynodon dactylon* (L.) Pers.**

Sanskrit name: Durva (Charaka)

Cynodon dactylon, also known as *dūrvā* grass, *Dhoob*, Bermuda grass belongs to family Poaceae is originated in the Middle East. The grass is native to the Indian subcontinent and adjacent regions of Southeast Asia, found abundantly in Assam and Odisha state of India. *Cynodon dactylon* is been used as medicine for many diseases. It is believed to be beneficial to wounds, piles, eczema, urticaria, injuries, eye problems, skin rashes, constipation, indigestion, constipation, mental debility, diabetes, epilepsy, vaginal problems, menstrual problems, and gynecological problems. The expressed juice of plant act as astringent and is applied to bleeding cuts and wounds to stop bleeding. The paste made of the plant mixed with honey is used in epitaxis. Oral administration of the juice of the plant with honey 2-3 times a day for few days' effective treats

menorrhagia. A decoction of *Cynodon dactylon* mixed with sugar is useful in the problem of urine retention⁴¹. Phytochemical screening of *C. dactylon* revealed the presence of alkaloid, carbohydrates, saponins, tannins, terpene, glycosides, fixed oils⁴².

Antidiabetic activities

Petroleum ether, chloroform and methanol extracts of *Cynodon dactylon* showed anti-diabetic activity in alloxan-induced rats⁴². Aqueous extract of *Cynodon dactylon* had high antidiabetic potential along with significant hypoglycemic and hypolipidemic effect in streptozotocin induced diabetic rats⁴³. Ethanolic extract of *Cynodon dactylon* at the dose of 500mg/kg body weight given once daily for 14 days reduced the levels of serum glutamate oxaloacetate transaminase, serum glutamate pyruvate transaminase, alkaline phosphatase, creatinine and urine sugar significantly with increase in total protein and haemoglobin in hepatic complications in streptozotocin induced type 2 diabetic models⁴⁴.

Fagonia cretica L.

Sanskrit name: Durlabha (Charaka)

Fagonia cretica L., a member of the family Zygophyllaceae, is a small spiny undershrub mostly found in dry calcareous rocks throughout Pakistan. It is reputed to be a medicinal plant in scientific and folkloric literature, and its medicinal values are well documented. *Fagonia cretica* is astringent, febrifuge and prophylactic against small-pox. The plant is bitter and used for the treatment of fever, thirst, vomiting, dysentery, asthma, urinary discharges, liver trouble, typhoid, toothache, stomach troubles and skin diseases. Boiled residue of the plant in water is used to induce abortion. It is externally applied as a paste on tumors and other swellings of the neck⁴⁵.

Bioactivity guided isolation led to the identification of four known compounds from *Fagonia cretica*: quinovic acid, quinovic acid-3 β -O- β -D-glycopyranoside, quinovic acid-3 β -O- β -D-glucopyranosyl-(28 $\rightarrow$ 1)- β -D-glucopyranosyl ester and stigmasterol⁴⁶.

Antidiabetic activities

No information available regarding *in-vivo* antidiabetic activities of *Fagonia cretica*. However, *in-vitro* a crude extract of *Fagonia cretica* possessed good dipeptidyl peptidase-4 (DPP-4) inhibitory activity (IC₅₀ value: 38.1 μ g/ml) which was also present in its n-hexane, ethyl acetate or aqueous fractions⁴⁶.

Gmelina arborea Roxb.

Synonym: *Gmelina arborea* var. *canescens* Haines, *Gmelina arborea* var. *glaucescens* C.B. Clarke, *Gmelina rheedei* Hook., *Gmelina sinuate*.

Sanskrit name: Gambhari (Charaka)

Gmelina arborea locally known as Gamhar, Gamari, Kashmir tree, Malay beechwood is a fast-growing deciduous tree under the family Verbenaceae, occurring naturally throughout greater part of India at altitudes up to 1,500 meters. In India, *Gmelina arborea* occurs extensively from the Ravi eastwards in the sub-Himalayan tracts, common throughout Assam and adjoining areas of northern West Bengal, also in southern Bihar and Odisha. *Gmelina arborea* Roxb is a well-known medicinal plant in the Ayurveda. The roots, leaves, flowers, fruits and bark are used for treating different ailments in traditional medicine in the treatment of scorpion sting, snake-bites and diabetes. Various phytoconstituents like uteolin, indole alkaloids, and glycosides are present in different parts of the plant⁴⁷.

Antidiabetic activities

Aqueous extract of *Gmelina arborea* bark at a dose of 250 and 500mg/kg body wt. had antihyperglycemic activity against Streptozotocin-induced diabetes in rats, after single and subacute oral administration but it did not show significant glucose lowering effect in normoglycemic rats⁴⁷. Ethanolic extract of *G. arborea* bark at dose of 420mg/kg found to reduce the increase of blood sugar in streptozotocin induced diabetic rats due to the increased blood GSH levels reinforcing the role of GSH as free radical scavenger and in the repair of free radical caused biological damage⁴⁸. Aqueous extract of *Gmelina arborea* at the dose of 200mg/kg daily for 20 days had anti-diabetic activity in alloxan-induced diabetic rats⁴⁹.

Diabetes mellitus is one of the common metabolic disorders acquiring around 2.8% of the world's population and is anticipated to cross 5.4% by the year 2025. Its percentage is in Assam 4.2 and Odisha 4.6 of the total population of state. Since long back herbal medicines have been the highly esteemed source of medicine therefore, they have become a growing part of modern, high-tech medicine. Medicinal plants have the advantage of having no side-effects⁵⁰. In view of the above aspects the present paper provides profiles of 10 species of antidiabetic medicinal plants of Assam and Odisha state viz. *Calotropis procera*, *Calotropis gigantia*, *Cassia fistula*, *Hemidesmus indicus*, *Cleodendrum serratum*, *Punica granatum*, *Woodfordia fruticosa*, *Cynodon dactylon*, *Fagonia cretica* and *Gmelina arborea*. The plants have been used in ethnic medicinal practises for treating diabetes in both the states since time long back. Various pharmacological studies demonstrated antidiabetic activity of the plant due to presence of wide range of active principles.

Today the lifestyle disorders have created not only financial load rather devastating in general health issues in world scenario and probably this concept was well centrifuged by the scientists of earliest time and today the scientists are also investigating those concepts could be helpful for today's life. In the present study, it was focussed to locate such antidiabetic medicinal plants in view of diabetes become one of the most lifestyle disorders of today's world. It is hoped that if those natural plants are well preserved in its natural habitat and if proper documentation is being done on the traditional practises of these medicinal plants can be a great help for our civilization and we could be able to sustain/retain the lost glory/ hidden treasure of human being.

CONCLUSION

From the above study though not concluded but conclusion have been drawn on the basis of this study that several plants are still in existence and their potency related to combating various diseases are not only revalidated today rather they have got the references of effectiveness quite in the age of Charaka, Sushruta, Vagbhatta etc.

Nature has always provided the naturals which are being potentiated with the nature's gift. A plant is always a plant having its own identity and its use based on various experimentations and it is fact that from the primitive era the *sheeras* of Ayurveda have well documented the effectiveness of these nature gifted items and they have also prescribed in a simple natural way after going definitely a lot of experimental studies.

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