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A Review on select Indian medicinal plants having AntiDiabetic potential

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ABSTRACT:
Diabetes, commonly Type 2 diabetes, is one of the major health problems in India affecting various sections of people in the society. The explosive prevalence may be due to changes in nature and nurture. The management modalities include pharmacologic and dietary interventions along with life style modifications. The use of insulin and oral antidiabetic have limited acceptance in the traditional Indian society. Medicinal plants play an important role as an alternative because of effectiveness, lower costs, minimum side effects and wider acceptability. This paper reviews anti-diabetic potentials of ten common medicinal plants of Indian origin in Kharagpur 1 Block.

Key words: Diabetes, antidiabetic drugs, medicinal plants.

INTRODUCTION

Diabetes mellitus (DM) is a metabolic disease characterized by hyperglycemia, dyslipidemia, and disorders in metabolism and those results from defects in insulin secretion and/or insulin action. Persisting hyperglycemia and insulinaemia are the important factors in the development and progression of micro and macrovascular complications which includes neuropathy, nephropathy, cardiovascular and cerebrovascular diseases [1], [2].

DM may be fatal and is the world's fourth leading cause of death [3]. The prevalence of diabetes is increasing worldwide; affecting 230 million people of which 30 million are in India. It has been estimated that by the year 2025, the global prevalence of diabetes would increase ~ 350 million [4]. Reasons for this rise are multi-factorial. Increase in sedentary lifestyle, consumption of energy rich diet, obesity and higher life span are to be blamed [5].

IDDM (Type 1) is related to insulin deficiency caused by autoimmune mediated destruction of pancreatic beta-cells where as NIDDM (Type 2) is characterized by abnormal insulin secretion associated with varying degrees of insulin resistance and relative insulin deficiency, arising from multifactorial influences including genetic [6], [7]. In Type 2 accounts for 80-90% of diabetic population. The underlying objective of all diabetic treatment and management is to maintain an adequate homeostasis.

The available management strategies for DM include dietary modifications and the use of insulin and/or oral hypoglycemic drugs (e.g. sulfonylurea, biguanide and thiazolidinedione etc). The use of currently available drugs results in various side effects and hence there is a need for an alternative and optimised strategy. Further, Indian subcontinent lacks in the implementation of health promotive and preventive approaches and hence it is being felt that the optimized treatment for both kind of diabetes may be the one that is being traditionally accepted. Plants sources are the fundamental of many available drugs. Ethno botanical information on medicinal plants report about 800 common plants that are being used in the treatment of DM. However, only a small number of them have been studied thoroughly [8].

Majority of herb-based medicines are evaluated to be cost-effective on being compared with synthetic agents/drugs [9], [10]. The recommendation of a WHO Expert Committee is further exploration of active anti-hyperglycemic agents from plant sources [11]. The present review on common medicinal plants with antidiabetic potentials in Kharagpur 1 Block focuses on the scientific names/ families, different extracts with therapeutic applications, routes of administration, active principles being isolated and efficacy of the principles in animal models (Table 1).

Acacia arabica

Acacia arabica, commonly known as *babul*, belongs to the family of Mimosaceae. It is an evergreen tree found in the dry and arid parts of Indian subcontinent. The bark of the plant is known to have anti-diabetic potentials. Administration of powdered seeds of babul in doses of 2, 3 and 4 g/kg body-weight to normal and alloxan-diabetic rabbits showed significant hypoglycemic activities. It was being argued that the effects might be due to augmentation of release of insulin from pancreatic cells [12].

Aqueous methanolic extract of pods when administered at a dose of 400mg/kg body weight in alloxan induced diabetic rabbits significantly reduced the blood glucose, total cholesterol, triglyceride and low-density lipid level [43]. *Carter* [13] and *Kumar* [14] reported that the presence of tannins and particularly polyphenols in the extract caused reduction in the blood sugar level [44], [45].

Aegle marmelos

Aegle marmelos belongs to the family Rutaceae and is commonly known as *bael* [46]. It is a medium-sized, deciduous, fruit bearing tree found in dry forests in hills and plains of Southern and Central India. The various parts of this plant mainly leave and fruits are used for the treatment of various diseases. Aqueous extract of *A.marmelos* leaf have insulin like actions and restore blood sugar and body weight to normal levels in experimentally induced diabetic rats [47], [48], [53]. It was reported that the intraperitoneal administration of methanolic extract of the callus powder of leaf extract of *A. marmelos* was as potent as the leaf extract in streptozotocin (STZ) diabetic rabbits [49]. Oxidative stress had significant effects in the causation of diabetes and other diabetes related complications in human beings [50]. Methanolic extract (100 mg/kg by wt) of *Aegle marmelos* effectively reduced the oxidative stress induced by alloxan and produced a reduction in blood sugar up to 54% on 12th day [15]. Lipid peroxidation is one of the characteristic features of diabetes. In the plasma of streptozotocin (STZ) induced diabetic rats there were an elevated level of lipid peroxides which was brought down by *A. marmelos* leaf extract [51]. *Narendra* [16] isolated alkaloid Aegeline 2 from the leaves of *A.marmelos* and that might elicit reduction in blood glucose, total cholesterol, plasma triglyceride and free fatty acids with an increase in high density cholesterol. Phytochemical analysis had shown the presence of coumarins such as marmelosin, alloimperatorin in *Aegle marmelos* fruits [52]. *Shani et al*. [42] investigated the efficacy of coumarins as hypoglycemic agents in diabetic rats. It had been reported that the water extract of fruit, given at a dose of 250 mg kg−1, was more effective than glibenclamide [53]. Isolation of a variety of α-glucosidase inhibitors such as phenylethyl cinnamides viz. anhydromarmeline, aegelinosides A and B were isolated from the leaves of *A. marmelos* [17].

Andrographis paniculata

Andrographis paniculata commonly known as *Kalmegh* belongs to the family of Acanthaceae. It grows throughout India and grows well in moist and shaded places but prefers sunny atmosphere. In *Ayurveda*, the roots and leaves of the herb *Andrographis paniculata* have extensively been used to treat various ailments like poor digestion, hepatitis, diabetes, liver dysfunctions etc. Oral administration of the ethanolic extract (leaf) at different doses (0.1, 0.2, and 0.4 g/body weight) reduced the serum glucose level in a dose dependent manner in STZ-diabetic rats. Its hypoglycemic effect might be attributed at least in part to increased glucose metabolism [54]. The ethanolic extract of the aerial parts of *A. paniculata* was reported to have anti-hyperglycemic and anti-oxidant effects in normal and STZ-diabetic rats on oral administration. *Zhang* and *Tan* [18] in their findings predicted the use of ethanolic extract of aerial parts to reduce oxidative stress which was one of the causes of diabetes. The aqueous extract of *A. paniculata* was found to have almost identical anti-hyperglycemic effect when compared to that of ethanolic extract by lowering the blood glucose level [55]. Rao [56] supported the traditional usage of the chloroform extract of roots of *A. paniculata* for the control of diabetes by significantly inhibiting the induction of albuminuria, proteinemia and uremia. Unlike andrographolide (most abundant) other medicinally active phytochemicals isolated from the leaves of *A. paniculata* are diterpenoids viz. deoxyandrographolide, -19ß-D-glucoside, and neo-andrographolide [19], [20]. Studies on structure-activity relationships of andrographolide analogues and their pharmacological activities indicated that 14-deoxy-11, 12-didehydroandrographolide obtained from andrographolides of *Andrographis paniculata* inhibited α glucosidase stronger than andrographolide itself [57] and that probably might play an important role in exerting the anti-diabetic activity.

Azadirachta indica

Azadirachta indica known as *neem*, an indigenous tree belonging to the family of Meliaceae, is native to India growing in tropical and sub tropical regions. Neem leaf extracts and seeds are used as an active ingredient for an effective cure for diabetes. Neem leaf extracts improve the blood circulation by dilating the blood vessels and is also helpful in reducing the need for hypoglycemic drugs. Oral administration of petroleum ether extracts of kernel (2 g/kg, body .wt.) and husk (0.9 g/kg, body wt.) of neem for 28 days prevented the oxidative stress; thus reported to manage STZ induced diabetes [21]. It was reported that neem kernel powder alone or in combination with glibenclamide significantly reduced the levels of serum lipids, lipoproteins and enzymes which were actually raised in alloxan diabetic rabbits [58]. Its anti-hyperlipaemic effect can represent a protective mechanism against the development of atherosclerosis whose incidence is vastly increased in diabetes [59].Thus neem powder in combination with glibenclamide might play an important role for the prevention or management of diabetes induced atherosclerosis in DM patients. Hypoglycemic activity of petroleum ether extract of neem seed on alloxan treated rats was also reported [60]. The effect could be attributed to several mechanisms such as increased peripheral glucose utilization, increased release of insulin and or inhibition of the proximal tubular re-absorption mechanism for glucose in the kidney [61]. Water extract of neem leaves (200mg/kg body wt) when administered to alloxan diabetic rats once a day for 8 weeks resulted in lowering of blood glucose and reduction in serum lipids [22]. It was suggested that *A.*

indica besides controlling the blood sugar might also be helpful in preventing or delaying the onset of disease [62]. Combined extracts of *A. indica and Vernonia amygdalina* showed maximum therapeutic effect with minimum side effects than individual treatments [63]. Administration of chloroform extracts of neem on murine diabetic model revealed that it can be used as a herbal medicine for diabetes [23].

Cinnamomum zeylanicum

Cinnamomum zeylanicum, commonly known as Cinnamon, belongs to the family Lauraceae and is native to Sri Lanka. It is being cultivated in IIT Campus of Kharagpur in many houses. It is derived from the dried bark of trees. There are several varieties of *Cinnamomum*, of which two main with varying characteristics are *Cinnamomum cassia* and *Cinnamomum zeylanicum*. The most important secondary metabolites of *Cinnamomum* include volatile oils with different aroma characteristics and composition. Major components present in stem bark oil and root bark oil are cinnamaldehyde, cinnamic acid and camphor [24], [25].Oral administration of cinnamaldehyde isolated from *Cinnamomum zeylanicum* at different doses (5, 10 and 20 mg/kg) for 45 days in STZ induced male diabetic rats reduced the plasma glucose concentration in dose dependent manner [64]. It was also reported that p-methoxy cinnamic acid, a cinnamic acid derivative decreased plasma glucose concentration in a dose dependent manner in both normal and diabetic rats. The reduction in plasma glucose level was achieved by increase in insulin secretion; increase in glycolysis and by inhibiting gluconeogenesis [65]. It was reported that Cinnamon bark by its insulin potentiating factor increased the activity of glucose metabolism three folds in rat epididymal fat cells [26] Administration of Cinnamon capsules at different doses (1, 3, 6 g) to diabetic individuals for 40 days reduced the mean fasting serum glucose levels. It was suggested that 1-3g was optimum for the treatment of Type 2 diabetes [66]. Intake of cinnamon not only reduced serum glucose but also reduced triglyceride, LDL cholesterol, and total cholesterol in people with Type 2 diabetes [67], [68]. In vitro testing of anti-hyperglycemic activity of a natural product from the stem bark of *Cinnamomum zeylanicum* had been carried out and was found that cinnamtannin B1 also known as A-type proanthocyanidine increased glucose consumption up to 32% in 3T3-L1 adipocyte cell line [69]. Administration of aqueous extract of *Cinnamomum cassia* at different doses (50, 100, 150 and 200 mg/kg) for 6 weeks to Type 2 diabetic mice showed dose-dependent decrease in plasma glucose level. In addition, serum insulin levels and HDL–cholesterol levels were significantly higher and the concentration of triglyceride and total cholesterol were significantly lower after 6 weeks of the administration. These results suggest that cinnamon extract has a regulatory role in blood biochemistry by improving insulin sensitivity and metabolic regulations [70].

Gymnema sylvestre

Popularly known as *gurmar*, belonging to the family of Asclepiadaceae is an herb commonly found in the tropical forests of Southern India and Central India. The leaves and the stems are considered to have medicinal value. Though the anti-diabetic effect of *G. sylvestre* leaves were documented 70 years ago; the blood glucose lowering effect were there when residual pancreatic function existed suggesting a direct effect on the pancreas [71], [72]. It was reported that during an oral glucose tolerance test in diabetic animal administration of dried leaves of *G.sylvestre* reduced blood glucose and increased serum insulin levels. The study was also supported by similar results with aqueous leaf extract in human volunteers where normalization of glycosylated hemoglobin and glycosylated plasma proteins occurred [73]. It helped to restore homeostasis through increased serum insulin levels by repair/regeneration of the islets of Langerhans. Oral administration of varying doses (50, 100, 200 and 500 mg/kg) of aqueous extract of the leaves to STZ diabetic rats and IDDM patients showed dose-dependent decrease in fasting blood glucose, glycosylated haemoglobin (HbA1c), glycosylated plasma protein and insulin requirements [74], [28] Hence it was speculated that *G. sylvestre* leaf extract also acts through enhancement of insulin secretion. However, no effects of *G. sylvestre* leaves extract (120 mg/kg/day PO) for 7 days on insulin resistance in STZ diabetic rats was reported [75]. Anti-hyperglycemic action of active components such as saponins and triterpene glycosides (gymnemic acids I-IV and gymnemasaponin V) obtained from methanolic extracts of *gurmar* leaves was investigated and it was reported that gymnemic acid IV because of its insulin releasing capacity was the main component responsible for the antidiabetic activity [27]. These compounds were assumed to be either wholly or partly responsible for the observed anti-hyperglycemic activities.

Momordica charantia

Commonly known as *karela* or bitter gourd, belongs to the family of Cucurbitaceae and is used as traditional medicine for diabetes in India and Africa. The fruits, leaves and seeds of the plant have been used in India for a number of diseases. In experimental models following oral administration of the unripe fruits has showed to produce anti-hyperglycemic activity [76], [77], [78]. Oral administration of various extracts of fresh and dried fruits (using solvents like methanol, chloroform and water) of bitter melon on diabetic rats decreased the blood glucose level but the highest effect (48 percent) was reported in the aqueous extract of

fresh unripe whole fruits (dose of 20 mg/kg body weight) when compared to that of glibenclamide [29]. Alcoholic extract of whole fruit not only lowered the blood glucose level but maintained it low even after discontinuation of the extract for 15 days; thus showing improvement in islets of Langerhans [79]. It was reported that bitter gourd suppressed postprandial hyperglycemia by inhibition of alpha-glucosidase activity [80]. The fruit juice significantly increased the number of beta cells leading to regeneration of beta cells in diabetic rats [81]. Chronic treatment with aqueous fruit extract (200 mg/kg, orally) in alloxan diabetic rats caused a significant fall in plasma glucose levels of 64.33%, 66.96%, 69.7% and 70.53% at 1, 2, 3 and 4 months, and mean reduction of 15.37%, 18.68% and 22.86% in STZ mice at 40, 50 and 60 days, respectively [82]. Part of the antihyperglycemic effect of *Momordica charantia* was due to a decrease in insulin resistance because of the increase of GLUT4 protein content in the plasma membrane of the muscle [83]. Isolation of a polypeptide (p-insulin or v-insulin) from fruit and seeds of karela was reported and subcutaneous administration of it led to a significant fall in blood glucose in IDDM patients only [84], [85]. *Charantin*, a mixture of sitosterol and stigmastadienol glucosides was isolated from fruit of *karela* (0.01% yield) showed decrease in blood glucose concentration when administered to fasted normal rabbits orally or intravenously [86]. An alkaloid named vicine which was a pyrimidine nucleoside isolated from the seeds had been found to induce hypoglycemia in rats in an intraperitoneal dose (16g/kg body wt) [30], [31]. Isolation of three non-steroidal antidiabetic compounds (*Kakra* 1 b, 111 a and 111 b) from the fruit was reported but the structures of these compounds were not yet determined [32]. Experiments in rats showed that 2 important constituents of *M.charantia* i.e. oleanolic acid 3-O-glucuronide and momordin Ic exerted anti-hyperglycemic effect by inhibiting glucose transport at the brush border of the small intestine [33].

Ocimum sanctum

It is a small erect herb belonging to the family Lamiaceae. It is commonly known as *Tulsi*. It is a fragrant bushy plant found in semi tropical and tropical parts of India. The seeds, leaves and the roots of *Tulsi* have great medicinal value. Intra-peritoneal administration of 70% ethanolic extract of *tulsi* leaves caused a significant reduction of blood glucose in normal, glucose-fed hyperglycemic and streptozotocin-treated diabetic rats [87]. A diet containing leaf powder (1%) fed to normal and diabetic rats for 1 month brought about significant reduction in fasting blood glucose, uronic acid, total amino acids, total cholesterol, triglycerides and total lipid [88]. Results of a single-blind placebo-controlled trial indicated a significant decrease in blood glucose levels during the treatment of Type 2 diabetes with *Tulsi* leaves as compared to placebo [89]. Comparative study of *Trigonella foenum-graecum*, *Ocimum sanctum* and *Pterocarpus marsupium* in normal and alloxan treated diabetic rats suggested that leaf extract of *tulsi* had maximum hypoglycemic effect [90]. It is being rich in essential oils. Gas liquid chromatography of the essential oils obtained from the leaves had revealed the presence of eugenol (70%) as the major constituent [34]. It reduced raised blood sugar, triglyceride and cholesterol levels in blood serum [91]. It was also reported to contain alkaloids, glycosides, tannins and saponins [35] and a number of active substances which had not been identified belonging to the above groups. It may be said that the therapeutic effect of O. *sanctum* plants may be due to the presence of the above as well as a number of unidentified compounds.

Phyllanthus emblica

Commonly known as *amla*, belongs to the family of Euphorbiaceae. It grows well in the plains and sub-mountain regions all over the Indian sub-continent. All parts of the plant are considered to have medicinal value [92]. A polyphenol-rich fraction of ethyl acetate extract of *amla* when administered orally to streptozotocin treated rats relieved them from various oxidative stress indices of the serum and improved glucose metabolism [93]. Intraperitoneal administration of aqueous extract of fruit at a dose of 200mg/kg body weight significantly reduced blood sugar level in Type 2 diabetes and improved liver functioning in alloxan induced diabetic rats [36]. It contains large number of constituents in varying amounts falling in broad classes of alkaloids, benzenoid derivatives, diterpenes and triterpenes, furanolactones, flavonoids and sterols [37]. Flavonoids were responsible for decreasing the blood sugar level and showed significant hypoglycemic effect when administered to rats [94]. The fruit extract is said to have many pharmacologic uses and is said to have antidiabetic properties [95]. It also contains vitamin C, gallic acid and ellagic acid [38]. This plant can be used for further work to isolate bioactive constituent having anti-diabetic effect with lesser side effects.

Trigonella foenum graecum

Commonly known as fenugreek, belongs to the family of Papilionaceae. It is being used both as an herb and spice. It is extensively cultivated as a food crop in India in semi-arid regions. The leaves and seeds are considered to be important from medicinal point of view. Administration of coarsely ground fenugreek seeds improved severe diabetes in human subjects. This property was later confirmed in alloxan-diabetic rats, where the seed extract induced a significant hypoglycemic effect [96], [97]. A reduction in hyperglycemia was reported in diabetic dogs fed with fenugreek seeds [98], [99].

Table1: Summary of the reviewed medicinal plants having antidiabetic potential.

Scientific name (Family)	Common name	Parts used (extracts)	ROA	Animal model	Active constituent	Reference
Acacia arabica	Babul	Powdered seeds	-	Alloxan- rats	tannins,polyphenols	[12], [13], [14]
(Mimosaceae)		MeOH/ pods	-	Alloxan-rabbit		
Aegle marmelos	Bael	MeOH/ leaves	i.p	STZ-rabbit	anhydromarmeline (1), aegeline 2	[15], [16], [17]
(Rutaceae)		Aqu/ fruit	i.p	STZ-rats	aegelinosides A(7),B(8), coumarins	
Andrographis paniculata	Kalmegh	EtOH/ aerial parts	oral	STZ-rats	andrographolide	[18], [19], [20]
(Acanthaceae)						
Azadirachta indica	Neem	pet. ether/kernel	oral	STZ-rats	-	[21], [22], [23]
(Meliaceae)		Chl/neem seed oil	-	Alloxan rats		
		Aqu/leaves	-	Alloxan rats		
Cinnamomum zeylanicum	Cinnamon	Aqu/dried leaves	oral	STZ- rats	cinnamaldehyde,camphor,	[24], [25], [26]
(Lauraceae)		bark			cinnamic acid	
Gymnema sylvestre	Gurmar	Aqu/leaves	oral	STZ- rats	saponins,triterpene	[27], [28]
(Asclepiadaceae)				Human subjects	glycosides-Gymnemic acid	
Momordica charantia	Karela	Aqu/fresh unripe	oral	Diabetic rats	Charantin,vicine,p-insulin, momordin Ic	[29], [30], [31], [32], [33]
(Cucurbitaceae)		fruit & seeds	s.c	type 1&2 patients	oleanolic acid 3-O-glucuronide,	
Ocimum sanctum	Tulsi	70% EtOH/leaves	i.p.	STZ- rats	Eugenol, alkaloids, tannins,	[34], [35]
(Lamiaceae)					glycosides,saponins	
Phyllantus emblica	Amla	Ethyl acetate/fruit	oral	STZ- rats	alkaloids benzenoid derivatives , flavonoids,	[36], [37], [38]
(Euphorbiaceae)		Aqu/fruit	i.p.	Alloxan rats	diterpenes and triterpenes, sterol	
					furanolactones, gallic and ellagic acid	
Trigonella foenum graecum	Fenugreek	Aqu/leaves/seeds	oral	Alloxan diabetic dogs	Trigonelline, galactomannan	[39], [40], [41], [42]
(Papilionaceae)		MeOH/seeds, EtOH/leaves	i.p	Diabetic dogs /rats		

i.p: intraperitoneal, MeOH: methanol, EtOH: ethanol, STZ: streptozotocin, Aqu: aqueous, pet. ether: petroleum ether, Chl: chloroform, s.c: subcutaneous, ROA: Route of administration

Similar effects were reported in human volunteers given different doses of fenugreek 25g/day powder mixed in their diet (healthy volunteers); 100 g fenugreek/ day (Type 1 diabetics) and 15 g fenugreek/day (Type 2 diabetics) [100], [101]. One group of investigators had studied two fractions of the seed, namely the lipid extract, and the defatted seed material which contains fibres, saponins and proteins [98], [102]. It led to the conclusion that the active component was not in the lipid extract but in the defatted portion of the seeds, which brought about a decrease in hyperglycaemia in both normal and diabetic dogs. Oral administration of the aqueous and methanolic extract of fenugreek seeds is effective against diabetes only at the dose of 1 g/kg body weight. The presence of hypoglycemic activity in aqueous and methanolic extract indicates that the active agents are polar in nature [39].Oral administration of ethanolic fenugreek extract (0.1, 0.25, and 0.5 g/kg body weight) for 14 days decreased serum glucose level, total cholesterol and increased serum insulin in diabetic rats but not in normal rats when compared to the activity of glibenclamide [40].

The aqueous extract of fenugreek leaf when given to both healthy and alloxan-diabetic rats, produced a significant decrease in blood glucose level. However, an ethanolic extract of fenugreek leaf produced no reduction in blood glucose level in healthy rats but intra-peritoneal administration of 0.8 g/kg of the ethanolic leaf extract to diabetic rats produced a reduction of blood glucose concentration [103].The hypoglycemic effect of fenugreek was attributed to its major alkaloid, trigonelline which is a N-methyl derivative of the vitamin nicotinic acid [41], [42]. The presence of an orally active agent isolated from fenugreek seeds improved glucose tolerance for a period of one week in alloxan-treated rabbits. This was different and more potent than trigonelline and it was also reported to decrease fasting blood glucose in alloxan-recovered rabbits with an initial fasting blood glucose level of 180 mg/dl [104]. The Soluble Dietary Fibers (SDF) fraction of fenugreek seeds (major constituent is galactomannan) showed no effect on fasting blood glucose levels in type 2 diabetic rats. However, when fed simultaneously with glucose, it

showed a hypoglycemic effect in Type 2 diabetic rats [105], [106].

CONCLUSION

India is facing a diabetic explosion. The reason being multi-factorial, more emphasis lies in different steps to ensure adequate preventive and promotive aspects by exploring alternative therapies which are socio-culturally and socio-economically acceptable. Traditional medicine in the form of Ayurveda, folklore medicines, homeopathy, unani, siddha, yoga and holistic medicines are all being under active consideration and are in the process of further evaluation to find its value particularly in the rural Indian context. Modern reductionism and experimental approaches of Western classical medicine are being favoured to analyse the active components from the herbs and that may lead to loss of efficacy and synergism. The traditional holistic approaches are contrary to the Western concepts. Herbal medicine with its further amalgamation with the Western experimental science and Eastern holistic concept is gaining momentum to provide a comprehensive health care delivery system as a part of naturopathy. Adequate scientific exploration to enrich the therapeutic attributes of a particular herb by team of researchers of various domains will be welcomed not only in Indian sub-continent but also the globe as a whole. Hence, a description of various regional plants with its pharmacologic potentials is the need of the hour to start the holistic model.

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