INTERNATIONAL RESEARCH JOURNAL OF PHARMACY

www.irjponline.com ISSN 2230 – 8407

Review Article

MEDICINAL PLANTS USED AS AN ANTIDIABETIC DRUG IN PHARMACEUTICAL INDUSTRY AND THEIR CONSERVATION: AN OVERVIEW

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Article Received on: 16/08/12 Revised on: 14/09/12 Approved for publication: 12/10/12

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ABSTRACT

This article attempts to review the literature and the emerging policy issues on Antidiabetic plants for pharmaceutical usage. Also provides a brief review of different plants using in the traditional system for the treatment of diabetes since ancient times. Plants such as *Allium cepa, Anacardium occidentale, Andrographis paniculata, Momordica charantia, Azadirachta indica, Brassica oleracea, Cinnamomum tamala and Withania somnifera* are commonly using as remedy for diabetes. There is an increasing demand for the herbal medicines for diabetic ailments and many plant drugs from Ayurvedic system are being explored. The biological activities from various clinical and preclinical studies have been included. Some of the acclaimed valuation works done in the last few years have been considered for this purpose. Conservation of biodiversity based on the benefits of medicinal plants and the traditional knowledge can be considered as good starting point for effective conservation of Antidiabetic plants, which requires accurate and up-to date information on the status of medicinal plant populations, detailed area-specific study, landscape valuation, extent and nature of plant use by local communities.

Keyword: Medicinal plants, Pharmaceutical usage, Antidiabetic activity, Conservation

INTRODUCTION

Globally, sales of herbal medicines are growing by about 10% annually. Over 25% of our common medicines contain at least some compounds obtained from plants. In less developed countries the World Health Organization estimates that 75-80% of the people rely on plant based medicines for primary health care. The use of traditional medicine has increased in developed countries also, mainly due to the failure of modern medicine to provide effective treatment for chronic diseases and emergence of multi drug resistant Bacteria and Parasites. The adverse effect of chemical drugs, questioning of the approaches and assumptions of allopathic medicine, their increase in costs and greater public access to information on traditional has also lead to an increase in interest in alternative treatment [1]

Diabetes mellitus (DM) is a metabolic disorder initially characterized by a loss of glucose homeostasis with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action, or both [2-3]. Without enough insulin, the cells of the body cannot absorb sufficient glucose from the blood; hence blood glucose levels increase, which is termed as hyperglycemia. If the glucose level in the blood remains high over a long period of time, this can result in longterm damage to organs, such as the kidneys, liver, eyes, nerves, heart and blood vessels. Complications in some of these organs can lead to death [4]. The metabolic dysregulation associated with DM causes secondary pathophysiologic changes in multiple organ system that imposes a tremendous burden on the individual with Diabetes and on health system. DM is the leading cause of end-stage renal disease, nontraumatic lower extremity amputation and adult blind. Antidiabetic medication seeks to maintain a normal glucose level.

It has been estimated that the global burden of type 2 Diabetes mellitus (T2DM) for 2010 would be 285 million people (2010) which is projected to increase to 438 million in 2030; a 65 % increase [5]. Similarly, for India this increase is estimated to be 58%, from 51 million people in 2010 to 87 million in 2030 [5]. The impacts of T2DM are considerable: as a lifelong disease, it increases morbidity and mortality and decreases the quality of life [6]. At the same time, the disease and its complications cause a heavy economic burden for diabetic patients themselves, their families and society. A better understanding about the cause of a predisposition of Indians to get T2DM is necessary for future planning of healthcare, policy and delivery in order to ensure that the burdens of disease are addressed[6].

Plant extracts have become a source of hope as a wide group of medicinal plant preparations are available that have been used over the centuries almost exclusively on the basis of empirical evidence. Hence, it has become necessary to revisit the medicinal plant dependent traditional medicine system. From current research reports, it is obvious that extract from various plant parts are screened for properties like Anti-inflammatory, Anti-microbial, Analgesic, Anti-convalescent, hypoglycemic, hypotensive and similar effects in animal models reflecting the disease conditions and their symptoms for which such plants are often used in folk-medicine. In a few cases, efforts are made to isolate active principles. It has been argued that the isolation of active principles is not an essential condition for herbal medicine and that it is best to determine efficiency and other effects using each plant preparation the way it is employed as herbal remedy. With one example we can say how research is booming on medicinal plants. One famous journal called "Tropical Journal of Pharmaceutical Research" has reported that over 60% of papers submitted to us for publication (Especially from Africa and Asia) are work on Medicinal plants. Not only in this, many other journals also feature works specially phytochemistry work on medicinal plants [7].

According to an all India Ethno biological survey carried out by the Ministry of Environment & Forests, Government of India, there are over 8000 species of plants being used by the people of India. Figure 1 represents the plant in various systems of medicine and the overlap of plant used across the medical systems [8].Figure 2 showed populations using

traditional medicine for primary health care and complementary and alternative medicines in developed countries. Medicinal plants used by various traditional communities is depicted in Figure3.

About 10% of the over 2, 50,000 plant species have been extensively screened in laboratories to determine their therapeutic potential. Approximately 120 plant-based prescription drugs are on the market, and these drugs come from only 95 different species of plants. National Cancer Research Institute has expanded its testing program for natural products and drug companies send out botanists to collect plants in the major rain forests of Asia, Africa and the Amazon. Many of our drugs come from tropical plants. 25% of the world's plants are found in the tropical Amazon alone [9]. Standardization of the plant material is not required when used by the rural communities for their primary health care but regardless of whether the medicinal plants is to be used by the local communities or by industry, a systematic approach is required for a plant identified from traditional medicine, as is done in modern medicine. It is necessary to focus on all aspects of medicinal plant research: from cultivation, ethano-pharmacology, utilization, isolation and identification of active constituents of efficient evaluation, pharmacology, safety, standardization, formulation and clinical evaluation. Animal toxicity studies are required to establish the potentiality of the medicines.

Though many medicinal plants are commonly available in the wild uncontrolled collection and sale at large quantities of plant material from the forest can lead to destruction of many forest plants especially the endemic species that have a restricted geographical distribution. For example, medicinal plants like Curcuma caesia, Rauwolfia serpentine were reported to occur abundantly [10] in central India. So that the cultivation of medicinal plants would seem as a commercially attractive option to companies because they have greater control over supply of the plant material and it is easier to control post-harvest treatment. Moreover, cultivation can reduce the dependence on the collection of plants from wild and thus have the potential to save wild populations and conserve their genetic diversity.

With all these background of importance of medicinal plants in Antidiabetic drug discovery, provoked the setting up of many Multinational Pharmaceutical companies and Domestic manufacturers of medicines. They are contributing a significant economic growth of the Global medicinal plant sector. They are using the medicinal plant significantly and exploiting them commercially

Distribution of Medicinal Plants

Macro analysis of the distribution of medicinal plants show that they are distributed across diverse habitats and landscape elements. Around 70% of India's medicinal plants are found in tropical areas mostly in the various forest types spread across the Western and Eastern Ghats, the Vindhyas, Chotta Nagpur plateau, Aravalis & Himalayas. Although less the 30% of the medicinal plants are found in the temperate and alpine areas and higher altitudes they include species of high medicinal value. Macro studies show that a larger percentage of the known medicinal plant occur in the dry and most deciduous vegetation as compared to the evergreen or temperate habitats. Analysis of habits of medicinal plants indicate that they are distributed across various habitats. One third is trees and equal portion shrubs and the remaining one third herbs, grasses and climbers. A very small proportion of the meidicinal plants are lower plants like lichens, fern algae, etc. Majority of the medicinal plants are higher flowering plants.

Of the 386 families and 2200 genera in which medicinal plants are recorded, the families Asteraceae, Euphorbiacae, Laminaceae, Fabaceae, Rubiaceae, Poaceae, Acanthaceae, Rosaceae and Apiaceae share the larger proportion of medicinal plant species with the highest number of species (419) falling under Asteraceae [8].

Economic Burden of Diabetes in India

Despite Diabetes being a life-long disorder and is expensive to manage and treat for the large proportion of subjects in developing societies, there is lack of data on its economic burden in India. In the Indian context the financial burden is often shared by relatives of the patients [11]. The health care budget of the government in India is a meager 2% [12] compared to 14% to defense [13]. The total amount needed for India to treat T2DM is estimated to around 2.2 billion USD[11]. In India the direct medical cost to identify one subject with insulin glucose tolerance is INR 5,278 [14].

In the Indian context these costs are prohibitive: 75.5% of the Indian population is earning less than $2 per day and 41.6% less than $1.25 per day[15]. Kumar et al.[16] analyzed the community based data available from the middle and high income groups in Delhi (DEDICOM survey) to determine the direct cost of ambulatory Diabetes care, to evaluate the socio-demographic associates of spending, and to ascertain the relationship of spending with the delivered quality of Diabetes care. They concluded that a majority of Diabetes patients spend a significant proportion of their family income on Diabetes related expenditure (~Rs. 6000 i.e. ~US$ 150) per year. The cost is higher for subjects with longer duration since diagnosis, those with higher education or income, those with co-morbidities and those requiring oral hypoglycemic agents or insulin. In developing countries like India, the brunt of Diabetes and cardiovascular disease occurs among the economically productive age group (20-45 year olds) (WHO 2006). Diabetes mellitus is responsible for 1157 thousand years of life lost due to the disease, and for 2263 thousand DALYs during 2004 [17-18].

India has about 45000 plant species and among them, several thousands have been claimed to possess medicinal properties. Research conducted in last few decades on plants mentioned in ancient literature or used traditionally for Diabetes have shown anti-diabetic property. Grover et al. [19] reported 45 plants and their products (active, natural principles and crude extracts) that have been mentioned/used in the Indian traditional system of medicine and have showed experimental or clinical anti-diabetic activity. Indian plants which are most effective and the most commonly studied in relation to Diabetes and their complications are: *Allium cepa, Allium sativum, Aloe vera, Cajanus cajan, Coccinia indica, Caesalpinia bonducella, Ficus bengalenesis, Gymnema sylvestre, Momordica charantia, Ocimum sanctum, Pterocarpus marsupium, Swertia chirayita, Syzigium cumini, Tinospora cordifolia and Trigonella foenum graecum. Among these we have evaluated M. charantia, Eugenia jambolana, Mucuna pruriens, T. cordifolia, T. foenum graecum, O. sanctum, P. marsupium, Murraya koenigii* and *Brassica juncea*. All plants have shown varying degree of hypoglycemic and anti-hyperglycemic activity [19].

Many kinds of natural products, such as terpenoids, alkaloids, flavonoids, phenolics, and some others, have shown antidiabetic potential. Particularly, schulzeines A, B, and C, radicamines A and B, 2,5-imino-1,2,5-trideoxy-L-glucitol, beta-homofuconojirimycin, myrciacitrin IV,

dehydrotrametenolic acid, corosolic acid (Glucosol), 4-(alpha-rhamnopyranosyl)ellagic acid, and 1,2,3,4,6-pentagalloylglucose have shown significant antidiabetic activities as reported by Jung et al.[20]. Among active medicinal herbs, *Momordica charantia* L. (Cucurbitaceae), *Pterocarpus marsupium* Roxb. (Leguminoceae), and *Trigonella foenum graecum* L. (Leguminosae) have been reported as beneficial for treatment of type 2 Diabetes.

Active hypoglycemic constituents from plants

Many active compounds have been isolated from the plant and herb species of India. These active principles are dietary fibres, alkaloids, flavonoids, saponins, amino acids, steroids, peptides and others. These have produced potent hypoglycemic, anti-hyperglycemic and glucose suppressive activities[21]. The above effects achieved by either insulin release from pancreatic ß-cells, inhibited glucose absorption in gut,stimulated glycogenesis in liver or increased glucose utilization by the body [10,22].These compounds also exhibited their antioxidant, hypolipidemic, anticataract activities, restored enzymaticfunctions, repair and regeneration of pancreatic islets and the alleviation of liver and renal damage [23] .Some active constituentshave been obtained from plants possess insulin like activity and couldbe provide alternate for insulin therapy.

Anti-diabetic natural products

Diabetes is a widespread metabolic disease that affects around 41 million Indians and rightfully making it the 'Diabetic Capital of the World'. Several remedies are used since ages for the treatment of Diabetes and similar disorders. The best example may used as a household remedy for the treatment of Diabetes. Charantin, a steroidal saponin isolated from this plant is reported to have an insulin-like activity responsible for its hypoglycemic effect [24] . Besides charantin stimulates the release of insulin and blocks glucose formation in the bloodstream, suggesting its beneficial effects in non-insulin-dependent Diabetes [25] *Gymnema sylvestre*(gurmar), is another plant that has been used traditionally for the treatment of Diabetes. Gymnemic acid IV, obtained from leaves of *Gymnema sylvestre* has been reported to show strong hypoglycemic activity in animals models of Diabetes comparable to glibenclamide [26] Andrographolide, a diterpenoid lactone, isolated from *Andrographis paniculata* has been found to exhibit significant hypoglycemic activity [27] . Table 1 depicted some medicinal plants with their Anti diabetic and other beneficial activities [28] .

Pathophysiology of Diabetes Mellitus

Diabetes mellitus is divided into 2 main types: type I (insulin -dependent Diabetes mellitus or IDDM) and type II (non -insulin -dependent Diabetes mellitus or NIDDM). IDDM occurs due to insulin insufficiency because the body does not generate any insulin and patients entirely depend on an exogenous supply of insulin. IDDM is more pronounced in children and young adults [29]. It causes severe damage to the pancreatic β-cells. It is categorized as autoimmune (immune mediated) Diabetes (type 1A) or idiopathic Diabetes with β -cell destruction (type 1B), although the precise description of the later is still unknown [30]. Patients suffering from NIDDM are unable to respond to insulin and can be treated with exercise, diet management and medication. Mostly, its onset is in adulthood, largely occurring in obese people over 40 years of age. NIDDM is the most widespread type. It indicates a condition with disturbed carbohydrate and fat metabolism. Hypertension, hyperlipidemia, hyperinsulinemia and atherosclerosis are often allied with Diabetes. Both the types demonstrate some frequent symptoms like high blood sugar levels, unusual thirst, extreme hunger, frequent urination, extreme weakness, blurred vision etc.

Although the pathophysiology of Diabetes is not entirely understood, many studies indicate the participation of free radicals in the pathogenesis of Diabetes [31] and its complications [32-34]. Free radicals are proficient enough of damaging cellular molecules, proteins, lipids and DNA, leading to alternation of cell functions. In fact, the abnormalities in lipids and proteins are one of the key reasons for the development of diabetic complications. During Diabetes, free radicals oxidize the lipoproteins, and various irregularities of lipoprotein metabolism also occur in very low-density lipoprotein (VLDL), low-density lipoprotein (LDL) and high-density lipoprotein (HDL) in Diabetes [35]. Different extracellular proteins are also modified into glycoprotein due to high blood glucose, which is associated with severe diabetic complications [36] . Reactive oxygen species (ROS) are being reported to be formed in different tissues in Diabetes [37-38] by various sources such as the nonenzymatic glycosylation reaction,[10] the electron transport chain in mitochondria [40] and membrane -bound NADPH oxidase [41-42] ROS are also involved in the progression of insulin resistance as well as pancreatic β-cell dysfunction [43]. Also, advanced glycation end products (AGEs) are produced by non -enzymatic glycosylation of proteins, which tends to mount up on long -lived molecules in tissues creating abnormalities in cell and tissue functions [44-45]. AGEs also play a role in improved vascular permeability in both micro- and macro-vascular structures by sticking to specific macrophage receptors, which leads to free radical production and endothelial dysfunction. AGEs, produced on nucleic acids, may also lead to altered gene expression and mutation. In Diabetes, oxidative stress coexists along with decrease in the antioxidant status, which can lead to the detrimental effects due to free radicals [46]. Vitamins C and E, the natural antioxidants, have been reported to decrease the oxidative stress in experimental Diabetes [47]. Numerous plant products have been reported to have a significant antioxidant activity, which may be of some benefit in Diabetes [48,20] .

Gaps in Diabetes Mellitus Research

Gaps in research can never be completely fulfilled for any country or for any disease. Despite the increase of new Diabetes research programmes in India they are far from adequate to address the emerging demand (corresponding increase in disease burden) [49,18]. The major Diabetes related research gaps are as follows:

1. Lack of large scale health surveillance; to make accurate prediction of prevalence, incidence and related death rates is the major research gap for Diabetes in India. Most of the aforementioned efforts in Diabetes in India are regionalized or localized and cannot be easily generalized to the entire Indian population. Moreover, north Indian populations are highly neglected in all different kind of T2DM related research efforts. Therefore, to measure the scale of the problem there is a need of reliable population-based epidemiological studies in Diabetes in the context of its existing and potential economic impact.

2. Inadequate diabetic health care prevention is apparent for the majority of people in India both in the primary and secondary care level. There is a need to establish evidence based services for effective prevention, diagnosis and care of T2DM, along with the need to evaluate these health systems in India.

3. Evaluation and audit of adherence to the national guidelines for T2DM are required to ensure appropriate care is provided, and if not, how this may be improved.

4. Need of increased awareness of T2DM: Awareness programs like MARG and CHETNA may not be sufficient in the light of T2DM burden in India because of low coverage. An awareness programme may develop means for the self-management of Diabetes could be of value to lower resource settings, if account were taken of the relevant social and economic settings.

5. Immediate need of well integrated translational research designs to explore the research that takes Diabetes' main causative factors and tests practical interventions against them which, if proven, might be adopted. This also includes infrastructure and equipment support for research on genetic markers for type 2 Diabetes in the non-obese Indian population, although this has been catered by "ICMR Advanced Centre for Genomics of Type 2 Diabetes" but this may not be sufficient.

Conservation of Medicinal Plant Resources in India

***In Situ* conservation**

It will be necessary, based on an understanding that where medicinal plants are currently distributed, to develop novel programmes for their in-situ conservation and to designate specific genetic reserves. This intervention also applies to timber species as well as wild relative of crops, and current government activities relating to protected areas may need to be modified in order to accommodate these species. The implementation of Joint Forest Management Scheme in these areas could be a logical approach to use, given the viability of medicinal plants for generating income as well as rehabilitating degraded lands. Due to their position as the major stewards of the resource base women and tribal groups, especially, should be given some control over these lands.

The project adopted should encompass existing initiatives introduced by organizations such as FRLHT, Bangalore and UTTHAN, Allahabad etc. In addition, these in-situ conservation areas should be made to serve several functions such as the provision of education and awareness building, as well as training for sustainable harvesting methods.

***Ex-situ* Conservation**

Several medicinal plants are already threatened, rare, or endangered. In addition, the "precautionary principle" applies to those where status is currently unknown and to segments of germpools. There is an immediate need to consolidate and finally link the existing herbal gardens and gene banks as well as reference specimens in herbaria to ensure that the 540 species of importance in the major classical systems, as well as those supplied to the international market, are protected in ex-situ reserves. This requires strategic planning since the range of germplasm obtained for each species must be representative. Plant collections need to evolve from being species reference collections to being genetic resources collections.

For conservation of Biodiversity it is proposed to lay out medicinal plant conservation areas (MPCA) at 200 sites in side covering relatively undisturbed forests of different vegetation types. The key activity of medicinal plants conservation area model will include the following:-

i) Selection of sites that cover the range of forest types, altitudes, areas of known species

Richness and medicinal plants presence. Sites having red listed species population should also be considered. Attempt should be made to capture the wild populations of entire medicinal plants of the country.

ii) Forest areas (within Protected areas) with high Biodiversity or sites traditionally valued for medicinal plants diversity or sites with the presence of known red-listed medicinal species, are specially identified.

iii) Detailed botanical study of each site should be completed aiming documentation of all plant taxa occuring in MPCA with herbarium records, systematic estimation of plant population and regeneration, distribution patterns, association, micro habitat and cultural information related to the plants collected.

iv) Each site should be about 500 ha in area for which "Management Plan should" be formulated.

v) Taking efficient measures to protect sites from fire and other biotic pressure.

vi) Locating breeding populations of red listed species and economically viable species and at a subsequent stage developed a suitable species recovery programme for critically endangered species and enrichment planting programme for economically valuable species.

vii) Building and strengthening community institutions for long term management of the

sites.

viii) Training of wildlife staff and others for in-situ conservation of medicinal plants.

Table 1: List of medicinal plants with Anti-diabetic and other beneficial activities [28]

Sl.No.	Name of the plant	Medical used
1	*Abrus precatorius*	Anti - Diabetic , Purgative, Aphrodisiac, Emetic, Sore throat
2	*Acacia Arabica*	Anti - Diabetic , Cough, Chronic diarrhea, Dysentery, Passive hemorrhages
3	*Balanites aegyptia* Planch	Anti - Diabetic, Purgative, Anthelmintic, Coughs, Burns, Useful in snake bites
4	*Barleria lupulina*	Anti - Diabetic, Kidney disorders, CNS activity
5	*Catharanthus roseus* Linn	Anti - Diabetic, Anti cancer, Diarrhoea, Vermifuge, Toothache
6	*Capparis sepiaria*	Anti - Diabetic, Hepatoprotective
7	*Datura quercifolia*	Anti - Diabetic, Anodyne, Hypnotic, Narcotic, Anti spasmodic, Hallucinogenic
8	*Datura metel*	Anti - Diabetic, Anti septic, Anti spasmodic, Counter irritant, Narcotic
9	*Eleutherococcus senticosus*	Anti - Diabetic, Anti stress, Fatigue, Adaptogenetic
10	*Eragrostis bipinnata actinum*	Anti - Diabetic, Hepatoprotective
11	*Euphorbia prostrata*	Anti - Diabetic, Anti inflammatory, Anti microbial
12	*Eupatorium odoratum*	Anti-diabetic, antioxidant, antiviral, antiinflammatory and anticancer
13	*Ferula asa-foetida*	Anti - Diabetic, Anti periodic, Expectorant, Cardio tonic, Anti spasmodic, Alterative, Deobstruent
14	*Galega officinalis*	Anti - Diabetic, Galactagogic, Diuretic, Diaphoretic
15	*Gymnema yavanense*	Anti - Diabetic, Laxative, Stimulant, Stomachic, Diuretic
16	*Hedyotis biflora*	Anti - Diabetic, Anti tumor, Fever, Gastric irritation, Nervous depression
17	*Hoodia tacarrora*	Anti - Diabetic, Anti oxidant, Hypertension, Stomaches
18	*Ichnocarpus frutescens*	Anti - Diabetic, Anti tumor, Anti oxidant, Hepatoprotective
19	*Indigofera arrecta Hochst*	Anti - Diabetic , Anti bacterial

20	*Jacobinia suberecta*	Anti - Diabetic, Effective in HIV
21	*Jugla ns mandshurica*	Anti - Diabetic, Cough, Allergy, Acute gastritis, lithangiuria
22	*Kalanchoe crenata*	Anti - Diabetic, Protects from cardio vascular complications
23	*Konjac mannan*	Anti - Diabetic, Obesity disorders, Promotes intestinal motility
24	*Laportea ovalifolia*	Anti - Diabetic, Hypolipidaemic, Analgesic effect
25	*Larrea tridentate*	Anti - Diabetic, Rheumatic disease, Venereal infections, Urinary infections, Cancer
26	*Moll nia roxburghianum*	Anti - Diabetic, Anti inflammatory
27	*Mangifera indica*	Anti - Diabetic, Immunomodulatory, Anti oxidant, Diaphoretic Astringent
28	*Nelumbo nucifera gaertn*	Anti - Diabetic, Diuretic, Piles, Leprosy, Vomiting, Dysentery

29	*Nepeta cllaris*	Anti - Diabetic, Insect repellents
30	*Ocimum gratissimum*	Anti - Diabetic, Rheumatism, Ejaculation
31	*Ocimum sanctum*	Anti - Diabetic, Anti spasmodic, Analgestic, Hypotensive, Febrifuge, Adoptogenic, Anti inflammatory
32	*Phragmites vallatoria*	Anti - Diabetic, Wound healing, Rheumatoid arthritis
33	*Pterocarpus marsupium*	Anti - Diabetic, Astringent, Diarrhea, Pyrosis, Syphilis, Cholera Dysentery
34	*Quercus infectoria*	Anti - Diabetic, Astringent, Eczema, Dysentery, Haemorrhages, Diarrhea
35	*Quercus robur*	Anti Diabetic, Bach, Haemostatic, Decongestant, Astringent
36	*Rauwolfia serpentina*	Anti - Diabetic, Anti hypertensive, Hypnotic, Sedativ e
37	*Rehmanniaglu tinosa*	Anti - Diabetic, Diuretic, Anemia, Promotes healing, Anti inflammatory Liver disorders
38	*Saccharum officinarum*	Anti - Diabetic, Anti septic, Preservative, Demulcent, Laxative, Diuretic
39	*Salacinia oreosperma*	Anti - Diabetic, Anti human immuno deficiency virus
40	*Talinum cuneifolium*	Anti - Diabetic, Aphrodisiac
41	*Tamarindus indica*	Anti - Diabetic, Laxative, Refrigerant, Digestive
42	*Trigonella foenum-graecum*	Diabetic, Carminative, Anti tumor, Restorative, Laxative Hypotensive, Diuretic
43	*Urginea indica*	Anti - Diabetic, Asthma, Rheumatism, Dropsy, Cardio tonic
44	*Urtica dioica*	Anti - Diabetic, Anti asthmatic, Haemostatic, Diuretic, Astringent Galactogogue, Anti dandruff
45	*Vaccinium myrtillus*	Anti - Diabetic, Antiseptic, Astringent, Diuretic, Kidney disorders Ophthalmic
46	*Vinca rosea*	Anti - Diabetic, Anti tumor, Diuretic, Malaria fever
47	*Withania coagulans*	Anti - Diabetic, Anti-helmintic
48	*Withania somnifera*	Anti - Diabetic, Aphrodisiac, Diuretic, Nervine sedative, Immuno modulator, Adaptogenic
49	*Xanthium pungens*	Anti - Diabetic, Anti microbial
50	*Xanthium strumarium*	Anti - Diabetic, Anodyne, Anti -bacterial, Anti-fungal, Antiperiodic, Anti -spasmodic, Diuretic
51	*Zingiber zerumbet*	Anti-Diabetic, Anti- helmintic, Antitumor, Anti-Bacterial, Anti-inflammatory
52	*Ziziphus mauritiana*	Anti-Diabetic, Anti diarrheal, Anti- microbial, Anti - viral

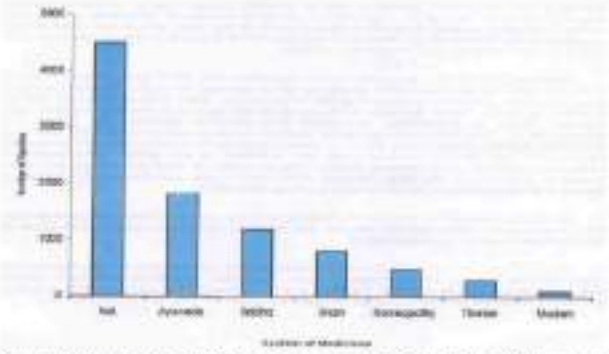


Figure 1: Plants being used by various system of medicines (Government of India, Planning Commission, 2000)

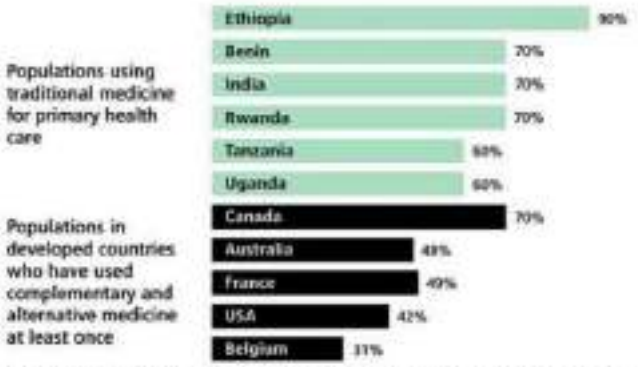


Figure 2: Populations using traditional medicine for primary health care and complementary and alternative medicines in developed countries

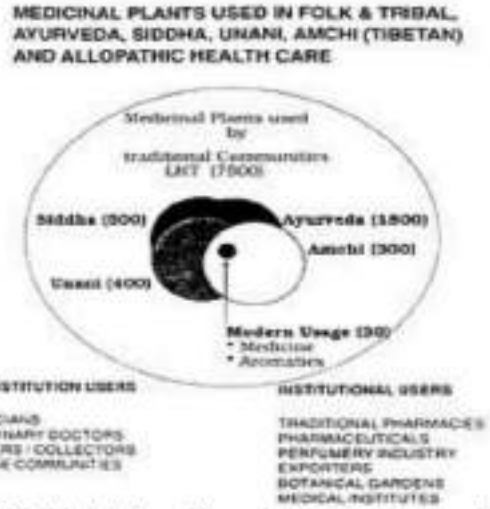


Figure 3 : Medicinal plants used by various traditional communities

CONCLUSION

The present deteriorating condition of the Antidiabetic plants need immediate attention not only for conservation but also for propagation. Countries can protect their Biodiversity in medicinal plants by working with industry towards monitoring and maintaining controlled non-destructive harvesting with habitat management.

Many pharmaceutical companies have already gone for artificial synthesis of plant extracted compounds. As useful plant compounds are often easy to synthesize, so that there is no dependency on plant collection or growers and collectors of forest medicinal plants as a source. But in some instances we don't know how to synthesize the desired compound, in other instances it is cheaper to collect from natural source. In such cases we can go through plant tissue culture for commercial production of plants. It's a better idea for conservation of medicinal plants.

Medicinal plants constitute a vast, undocumented and overexploited economic resource and they are the principal health care resource for the majority of the people. Communities and herbalists use medicinal plants in promoting and maintaining health of majority of population of most countries. Demand for herbal medicines has led to significant changes in traditional patterns of medicinal plants trade. Thus demand for medicinal plant is increasing in both developing and developed countries, and the bulk of the material trade is still from wild harvested sources on forest land and only a very small number of species are cultivated. The expanding trade in medicinal plants has serious implications on the survival of several plant species, with many under serious threats to become extinct. Investments are needed for the development of appropriate conversation, cultivation harvesting strategies, which will simultaneously meet the demand for low-cost and locally available medicines. At the same time, there must be immediate effort to ensure the conservation of diverse biological resources and the preservation and application of local cultural knowledge on the use of these resources. Due to increasing demand for the herbal drug for diabetic treatment, plant drugs from Ayurvedic system are being explored globally. This has resulted in many research studies with varied results, and hence there is a need to summarize them together. This review acts as a ready reference for biological activities of some Indian medicinal plants to the scientific community, in specific to researchers and students looking for sources of knowledge of medicinal plants and leads for new bioactive compounds. It is to be kept in mind that the reported activity may be shown by either the whole plant, or a part of the plant, or a particular extract, or isolated compounds.

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Source of support: Nil, Conflict of interest: None Declared

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