International Journal of Pharmacy and Biological Sciences-IJPBS™ (2019) 9 (3): 895-906
Online ISSN: 2230-7605, Print ISSN: 2321-3272
Research Article | Biological Sciences | Open Access | MCI Approved
UGC Approved Journal

A Mini-Review on the Highly Important Effective Medicinal Plants Possessing Insulin Mimetic Activity in Ethnobotanical Evidence of India

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Received: 16 Mar 2019 / Accepted: 18 Apr 2019 / Published online: 1 Jul 2019
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Abstract
The vast ethnobotanical survey is found in India since the past. The values of ethnobotany have been realized over the centuries, which support the indigenous system of medicine in the healthcare sector. There are several methods of ethnobotanical research, which gives the relevant information about the medicinal plants based on the literature, herbarium, and field studies. Some plants have been reported for its active principle responsible for the treatment of disease. The detailed studies on the ethnobotanical aspects in India provide the number of ways to promote the traditional herbal medicinal plants for the benefit of the public. Diabetes mellitus is an endocrine disorder, which affects the majority of the population around the globe. Modern therapeutics are utilized to cure Non-Insulin Dependent Diabetic Mellitus, like dietary modification, oral hypoglycaemic agents, and insulin, which have their own limitations. As an exemplary source of medicine, plants have been used since ancient times. In last few decades, some of the plants have been used for the anti-diabetic activity. This review paper, Insulin mimetic, ethno-botany, Medicinal Plants, and traditional medicine were used as key words to search in Web of Science, PubMed, Scopus, EBSCO and EMBASE to select the relevant articles. Hence the findings emphasis on the ethnobotanical studies on various antidiabetic medicinal plants found in India and its biodiversity conservation approaches have been highlighted.

Keywords
Ethnobotany, Medicinal plants, Diabetes Mellitus, Insulin Mimetic Property, India.

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1. INTRODUCTION

1.1 Traditional Medicine

India is known for its heritage of herbal medicine. The ethnic and tribal people living in remote forest area depend widely on the indigenous system of medicine. The ethnobotany reveals the historical and present details about the plant's application for human disease, species conservation, and sustainable use of resources (Rahul Jitin, 2013). These studies are revealing the importance of locally available plants and their discovery of novel drugs (Uprety Yadav et al., 2010; Bharat Bhushan and Mukesh Kumar., 2013). Exclusively countries like India, China, Burma etc, use the complementary and alternative medicine to treat the various ailments. Traditional medicine is the highly affordable source

to the world's poorest patients. According to National Medicinal Plants Board and Botanical Survey of India (BSI), Govt. of India, nearly 18,000 flowering plants species was found to be flowering plants, of which 7500 species found to be used in Ayurveda, Unani, Siddha, and Homoeopathy medicine (Perumal samy and Ignacimuthu, 1998). Among these 800 plants were having the ethnobotanical information which is highly used for its insulin mimetic activity.

1.2 Diabetes Mellitus and Oral Hypoglycemic Agents

Diabetes mellitus (DM) is a well know common endocrine metabolic disorder found predominant around the world. It is characterized by chronic hyperglycemia, with changes in carbohydrates, protein, fat metabolism that results in the alteration of insulin secretion, insulin action or both. According to WHO, nearly 180 million people worldwide is estimated to have DM disorder and also expected to be 7th leading disease which will cause death in 2030 (WHO, 2004; Patel, M et al., 1986). The highest is found in the developing countries, especially in India, the rate of commonness of diabetes is estimated to be 2-5 % (Verma, et al., 1986; Rao et al., 1989). It was observed from history that, in early 700-200 BC, DM was categorized into two types; one is as genetic disorder and other results from dietary behaviour. (Oubre, et al., 1997; Deb, et al., 2006) Also few other complications are linked with diabetes like retinopathy, polyuria, polydipsia, weakness, kidney disease, neuropathy, heart disease etc, which lead to fatal for the individual, even in the working population. (Donga et al., 2010; Matsuda et al., 2002) Diabetes mellitus is a metabolic disorder of multiple disease and characterized with hypoglycaemic with higher variations in carbohydrates, fat, and protein metabolism which alters the insulin secretion (high or low periodically), insulin action or both the conditions. (Shah et al., 1997) Insulin and oral hypoglycemic agents like alpha-glucosidase inhibitors, sulfonylureas, biguanides and glinides were used as monotherapy or in combination to reduce the sugar level. These oral antidiabetic agents have serious of adverse side effects; managing diabetes without side effects is still a challenge. (Shane-McWhorter., 2001).

1.3 Plant as a source for Insulin Mimetic Activity

Since olden times, plants have been used as the source in traditional medicine, either directly or indirectly for curing the different ailments. From the ethnobotanical study it was identified, nearly 800 plants may possess the antidiabetic activity (Saxena, and Vikram, 2004; Alarcon-Aguilara et al., 1998). Based on the ethno-pharmacological perspective, it is important to understand the disease at an interface of biomedical and local or traditional treatment. A wide array of plants has been presently used as an antidiabetic agent based on the active principles demonstrating the application on Non-Insulin Dependent Diabetic Mellitus (NIDDM) (Bailey and Day, 1989; Ivorra et al., 1988). The secondary metabolites derived from plants include alkaloids, glycosides, galactomannan, polysaccharides, peptidoglycans, guanidine, steroids, glycopeptides, terpenoids, amino acids, carbohydrates, and inorganic compounds. Even after the discovery of metformin (Biguanide) - is a derivative of the natural product, galegine a guanidine isolated from Galega officinalis L. used to relieve the intense urination in diabetic patients (Marles, and Farnsworth, 1995). Thus plants act as a potential source for antidiabetic drugs among the practitioners, since the active principles are curative in nature, well defined, also vary tremendously in their active principles, quality and safety. In modern era, it is important to note that the further development of such active components, will act as lead molecules in to the treatment of various disorders. (Lee A. Witters., 2001; Rang and Dale, 1991) In most of the studies, have not explained about the impact on the plants on the course of DM. This review emphasizes the information on plants in the international literature and highlights the ethno-pharmacological, phytochemical application which is mostly used. Since there was a paucity of the literature published about the plant related research, this article will give a detailed idea for the future pharmacognosist or ethnobotanist.

1.4 Antidiabetic potential from plant origin- A Review

Developing a lead candidate from the natural source is a challenging role for the scientist and researchers. To design and develop a drug, it is important to check the following factors like the easy availability, compatible formulation, less or no side effects and less cost for the rural areas. Several valuable reviews on the ethnobotanical use of plants around the globe are available, but many are found to be specific based on the region, monographs etc. the most commonly families amaranthaceae, pinanceae, sterculiaceae, rosaceae, liliaceae, leguninosae, Annonaceae, compositae, oxalidaceae, meliaceae, chenopodiaceae, bixacease, lauraceae, Rutaceae, umbelliferae, myrtaceae etc. (Arumugam, et al., 2013) The list of hypoglycaemic plants with their scientific name, family, plant part used for the preparation, pharmacological study, and their active principles is tabulated in Table No. 1

Table 1 List of Plants having Insulin Mimetic Activity

Scientific name	Vernacular name	Family	Plant's Part Used	Phytochemical component	Reference
Abies pindrow Royle	Pindrow Fir, West Himalayan Fir	*Pinaceae*	Entire plant	Volatile oil	Xiang et al., 2013
Abroma augusta Linn	Devil's cotton	*Malvaceae*	Roots & Leaves	Fixed oils, Alkaloid	Halim, 2003
Acacia Arabica	Babul, Kikar, Gum Arabic tree	*Leguminosae*	Seed	Arabin	Wadood et al., 1989
Achyranthus aspera L	Chaff flower, devil's horsewhip, apamarga Kanta chaulai	*Amaranthaceae*	Entire plant	Triterpenoid saponins- possess oleanolic ass a glycone. Achyranthine, betaine, pentatriaontane	Akhtar, and Iqbal., 1991
Acacia arabica	Indian Gum, Babul	*Fabaceae*	Seed	Gum	Singh et al., 1975
Amaranthus spinosus L	Spiny amaranth, pigweed, thorny amaranth	*Amaranthaceae*	Stem	Alkaloids, Terpenes, sesqueterinoids	Sangameswaran and Jayakar, 2008.
Anacardium occidentale L	Kaju	*Anacardiaceae*	Entire plant	Flavonols, terpenoids, caumarin, phenolic compounds, essential oils	Kamtchouing, et al., 1998
Andrographis paniculata	Kirayat, siriyaa Nangai. Kalamegha	*Acanthaceae*	Whole plant	Diterpenoid lactone –andrographolide	Yu, et al., 2003
Annona squamosa	Sharifa, sugar apples	*Annonaceae*	Leaves, seed, bark	Acetogenin- squamosin B, annonin, squamosamide, reticulatain- 2, isosquamosin	Annie shirwaikar et al., 2004
Agrimony eupatoria L	Church steeples, sticklewort.	*Rosaceae*	Leaves	Flavonoids, apigenin, triterpene – euscapic acid, tormentic acid.	Watkins et al., 2012
Agele marmelose	Bael, siruphal, Holy Fruit tree, golden apple	*Rutaceae*	Leaves, fruits, roots	Aeglemarmelosine, coumarins, alkaloids	Laphookhieo et al., 2011
Allium cepa	Pyaj, onion	*Amaryllidaceae*	Tuber, leaves	Polyphenolic, essential nutrients	Augusti., 1973a
Allium sativum	Lahasun, garlic	*Amaryllidaceae*	Bulb	Allin, ajoene, saponins, flavonoids	Augusti, and Mathew, 1973b
Aloe vera or Aloe barbadensis	Ghee kunwar, kumar panthu	*Liliaceae*	Steam roasted, Juice of leaves	Barbaloin, isobarbaloin resin, Polysaccrides, flavonoids	Ajabnoor, 1990
Artemisia pallens wall	Davana	*Compositae*	Aerial parts	Essential oils, davanone	Subramoniam et al., 1996
Areca catechu	Supari, betalnut, pinang palm	*Piperaceae*	Leaf & Seed	Alkaloid, Arecaidine, Arecaidine	Chempakam, 1993

Azadirachta indica	Neem	*Meliaceae*	Leaves	Nimbidin, nimbin, nimbidol, nimbosterol	Chattopadhyay, 1996
Ambrosia artemisifolia L	Bitterweed, Blackweed, annual ragweed	*Asteraceae*	Aerial plant	Sesquiterpene, psilostachyin, B, C	Tunali et al., 1998
Annacardium Occidentale	Cashew	*Anacardiaceae*	Bark	Anacardic acids, cardol, cardanol	Jaiswal, et al., 2016
Beta vulgaris	Chukkander, garden beet	*Chenopodiaceae*	Leaves, Root extract	Betalain betanin, indicaxanthin	Manisha Modak et al., 2007
Bidens pilosa	Black jack, beggar-ticks, cobbler's pegs	*Compositae*	Ariel plant	Polyacetylenic glycoside	Ubillas, et al., 2000
Biophytum sensitivum	Lajjalu, Laksmana	*Oxalidaceae*	Leaf	Amentoflabone, cupressuflavone, isoorientin	Puri and Baral., 1998
Bixa Orellana	Annotta	*Bixaceae*	Entire plant	Oleo-resin	Russel et al., 2005
Boerhavia diffusa L	Purnarnava	*Nyctaginaceae*	Leaves and entire plant	Alkaloid punarnavaine, punarnavoside	Amarnath Satheesh, and Pari, 2004
Brassica junceae	Rai	*Cruciferae*	Leaves & seed	Isothiocyanate glycoside singrin, protein, fixed oil	Grover, et al., 2003
Caesalpinia bonducella	Kantkarej, kantikaranja	*Leguminose*	Seed kernels	Fatty oils	Sharma et al., 1997
Carum carvi linn	Shia jir	*Umbelliferae*	Fruits	Resin, carvone, fixed oils	Eddouks et al., 2004
Cajanus cajan	Tuvar, reg gram or pigeon pea	*Fabaceae*	Seed, plant	Amino acids, protein	Amalraj, and Ignacimuthu, 1998a
Capparis decidua	Kurel, Kerda, pinju caper plant	*Capparaceae*	Flower, leaves	Glycoside	Yadav et al., 1997
Camellia sinesis	Green tea –chai	*Theaceace*	Leaves	Polyphenolic compounds	Lia Ardiana., et al., 2018
Capsicum frutescens linn	Mirch	*Solanaceae*	Entire plant	Volatile oils, resin, carvone, fixed oils	Talan et al., 2001
Cassia alata	Ringworm senna	*Caesalpiniaceae*	Flower	Saponins, glycosides	Palanichamy et al., 1988
Cantharanthus roseus	Sadabahar, Madagascar periwinkle	*Apocynaceace*	Leaves , twigs, flower	Indole alkaloid, vincristine, vinblastin	Singh et al., 2001
Cirtullus colocynthis	Badi indrayan, makkal, bitter apple, vine of Sodom, wild gourd	*Cucurbitaceae*	Leaves	Micronutrients, minerals	Batol Barghamdi et al., 2016

Cinnamomum zeylanicum	Dalchini	*Lauraceae*	Bark	Tannin, mannitol	Verspohl, et al., 2005
Coccinia indica	Bimb, kanturi, ivy gauard	*Cucurbitaceae*	Fruits	Triterpines, Alkaloid, flavonoid, β-carotene	Hossain, et al., 1992
Cryptolepis sanguniolenta	Anatmul	*Asclepidaceae*	Entire plant	cryptolepine	Newman Osafo et al., 2017
Eclipta alba lin	Bhringraj	*Compositae*	Entire plant	Ecliptin alkaloid	Ananthi et al., 2003
Embellica offcinalis	Amla	*Euphorbiaceae*	Fruits	Vitamin C, tannin	Rao et al., 2005
Enicostemma littorale	Chhota chirayata	*Gentianaceae*	Entire plant	Swertiamarine glycoside	Maroo et al., 2003
Eucalyptus globulus	Safeda	*Myrtaceae*	Leaves	Essential oil, cineol	Gray, and Flatt, 1998.
Euphrasia offcinale	Eyebright	*Scrophulariaceae*	Leaves , bark	Alkaloids	Porchenzhian et al., 2000
Eugenia jambolana	Jamun	*Myrtaceae*	Leaves, kernel, bark	Protein, fibre, nutrients	Sharma et al., 2003
Eugenia uniflora	Pitanga, Surinam cherry	*Myrtaceae*	Leaves	Resins. Vitamin A.	Arai, et al., 1999
Ficus bengalenesis	Indian banyan tree, bur	*Moraceae*	Bark	Tannin	Cherian and Augusti, 1993
Ficus religinosa	Peepal	*Moraceae*	Entire plant	Tannin	Chandrasekar et al., 2010
Gymnema sylvestre	Gudmar, merasingi, periploca of the woods	*Asclepiadaceae*	Leaves	Gymnemic acid, quercital	Gholap and Kar., 2003
Gentiana Olivieri	-	*Gentianaceae*	Flowers	Iso-orentin C-glycoside	Sezik et al., 2005
Glycerrhiza glabra linn	Mulethi	*Leguminosae*	Root	Triterpenoid, saponins, glycerrhizin	Swanston-flatt, et al., 1990
Helicteres isora linn	Indian screw tree	*Sterculiaceae*	Root	Saponins, tannin, ligin	Chakrabarti et al., 2002
Hibiscus rosasinesis	Gudhal, jasson, shoe flower	*Malvaceae*	Flower, entire plant	Vitamin C, B, fats	Sachdewa and Khemani., 1999
Ipomoea batatas	Sakkargand, mitha alu, sweet potato, kumara	*Convolvulaceae*	Tubers	Provitamin A, Vitamin B_6, micronutrients	Kusano and Abe 2000
Lupinus albus linn	Turmass	*Fabaceae*	Seed	Alkaloid, fatty oil, asparagine	Tsiodras., et al., 1999
Lagerstroemia speciosa	Jarul, pride of India	*Lyrthraceae*	Leaves	Corosolic acid, masilinic acid	Kakuda et al., 1996
Mangifera indica	Aam, amb, mango	*Anacardiaceae*	Leaf	Mangiferin	Aderibigbe, et al., 1999
Memecylon umbellatum	Anjani, Ali, Iron wood,	*Melastomataceae*	Leaf	Glucoside, dye	Amalraj, and Ignacinuthu, 1998.

Momordica cymbalania	Kadavanchi, athalaki	*Cucurbitaceae*	Fruit , seed	Isoproterenol	Rao et al., 1999
Momordica charantia	Karela, bitter gourd	*Cucurbitaceae*	Fruit, pulp, seed, leaf-whole plant	Momordicine alkaloid, ascorbic acid	Chaturvedi, et al., 2004
Morus alba	Shetnut, tut, white mulberry	*Moraceae*	Leaves	Alkaloids	Asano et al., 1994
Musa sapientum	Kela, banana, tundan	*Musaceae*	Fresh flowers	Carbohydrates	Pari, and Umamaheswari, 2000.
Mucuna pruriens	Kabach, cowitch, Bengal velvet bean cowage	*Fabaceae*	Seed	L-Dopa, Mucunain, dimethyltryptamine- noxide	Akhtar, et al., 1990
Murraya koeingii	Kurry patta, curry leaf	*Rutaceae*	Leaves	Mahanimbine, Girnimbine, undecalactone. 2- methyl-3- methyl carbazole	Arulselvan, et al., 2006
Nelumbo neucifera	Kamal, lotus	*Nymphaeaceae*	Rhizome	Nuciferin, nornuciferin	Mukherjee, et al., 1997
Ocimum sanctum	Tulsi, holy basil	*Labiatae*	Leaf	Phenol, aldehyde, alkaloid, tannin, vitamin C	Chatopadhyay., 1993.
Olea europia	Olive	*Oleacea*	Leaves	Oleuropeoside	Gonzalez., 1992
Panax ginseng	Pannag	*Araliaceae*	Root & entire plant	Glycans, panaxans	Oshima, et al., 1985
Punica granatum	Anar	*Punicaceae*	Seed	Protein, tannin, gallic acid, pelletierine	Ashish K. Das et al., 2001
Picrorrhiza kurroa royale	Katuka	*Scrophuariaceae*	Entire plant	Picrorrhizin, kutkin	Joy and Kuttan, 1999
Phyllanthus amarus	Bhui amala	*Euphorbiaceae*	Entire plant	alkaloid	Srividya and Periwal,1995
Pterocarpus marsupium	Vijayasar, bijasal, indian Malabar	*Fabaceae*	Wood	Pterostilbene	Chakravarthy et al., 1980
Salacia reticulata	Vairi, pitica	*Celastraceae*	Root bark	Kotalanol, salacinol	Yoshikawa et al., 1998
Salacia oblonga	Ponkoranti	*Celastraceae*	Root bark	Kotalanol, salacinol , kotalagenin 16-acetate	Matsuda et al., 1999
Swertia chirayita	Chirata	*Gentianaceae*	Whole plant	Swerchirin, zanthone mangiferin, gentianine	Saxena et al., 1996
Syzigium cumini	Eugenia jambolana, Jamblang, black berry	*Myrtaceae*	Dry leaves	Protein, fibre	Mahapatra, et al., 1985
Trigonella foenum graecum	Methi, mutti, fenugreek	*Fabaceae*	Seeds	Saponins, proteins, 4-hydroxyisoleucine	Ajabnoor, and Tilmisany, 1988.

Tinospora cordifolia	Amarta, guduci	*Menispermaceae*	Root	Berberinne, starch	Noor, and Ashcroft., 1989
Termamnus labialis	Mashoni	*Fabaceae*	Aerial parts	Caumarin-fraxidin	Fort et al., 2000
Urtifca dioica	Bichhu booti	*Urticaceae*	Leaves	Fatty oils	Bigan Farzami et al., 2003
Withania somnifera	Ashwagandha	*Solanaceae*	Root	Withanine, somnine, withaferine, withanolides	Andallu et al., 2000
Xanthium struarium	Chhota gokhru	*Compositae*	Fruits	Phenolic compounds, caffeic acid	Hsu et al., 2000
Zingiber officinale	Adrak	*Zingiberaceae*	Rhizome	Sesquiterpene	Akhani, et al., 2004
Zizyphus sativa	Pitni-ber	*Rhamnaceae*	Leaves	tannin	Anand, et al., 1989

2. CONCLUSION

Due to the modern health care system in developing countries such as India, is still suffering to reach the healthcare goals. From an ethno pharmacological perspective, this review would be interesting to analyse the phytoconstituents highly responsible for the anti-diabetic activity. It is important that during the ethnobotanical survey, discarding of plastic and other waste should be prohibited, thus shape the ways to protect the endangered species or rare species. The healthcare professionals should look into the monitor and educate the public, in order to avoid the sedentary way of life. Strict rules should be implemented to control the sale of plants in the market, which will avoid people for auto-consumption. The production of medicinal plants should be done with quality that could be affordable for the poor families. These initiatives should be promoted during the training and education programmes for the patients suffering from diabetes, physicians, and healthcare professionals to ensure the safety of the public. India is rich in plant biodiversity, still lacks the training for physicians and pharmacist in Ayurvedic and Siddha medicine. Also the presence of such resources would lead to the new class of drugs having significant antidiabetic activity. The conservation of ethnobotanical resources and wild crops should be considered for the future breeding programmes.

The isolation of active principle is highly important level in R & D for developing the novel phytomedicine. The quality control will help the healthcare professionals to follow the authenticated samples for the public use. Another unresolved issue is the intellectual property of these species. Since these phytomedicines are commercialized into the market, the government and other institution can develop the ways to sustainable use of plants bearing antidiabetic activity. More investigation should be carried to explain the mechanism of action of active principle obtained from plants with antidiabetic effect. The toxic side effects of the plants should also be focused for the better living of the public.

CONFLICTS OF INTEREST

The Author declared no competing interests.

ETHICAL CONSIDERATION

Ethical issues (Fabrication of Table data, Plagiarism) have been completely noticed by the author through the institution committee and turn-tin software.

FUNDING

This review paper is supported by VIT University, INDIA to use the digital resources of the University.

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