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REVIEW ARTICLE

Evaluation of Medicinal Plants to Defeat Diabetes and Related Complications-Review

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ABSTRACT

Diabetes is one of the major health problems around the globe in recent time, its increasing prevalence and high cost of treatment in the world is a cause of concern and is posing a continuous threat to human health since decades. The number of diabetic patients is expected to increase from 371 million from 2012 to 552 million by 2030, if no urgent action is taken. Uncontrolled hyperglycemia in both type 1 and type 2 diabetes lead to the development of both acute and long term complications. There has been a need and desire for a natural, more effective and economically feasible alternative to synthetic anti-diabetic drugs due to their high cost, side effects and failure in achieving ideal results. Nature gives us an array of tools including medicinal plants to beat diabetes, its complications and the underlying causes that lead to diabetes. In recent years, there has been a resurgence of interest in medicinal plants which are believed to be natural origin for bioactive compounds and antioxidants which attracted a great treaty of attention, to control life threatening disease like diabetes in which oxidative dent has been implicated.Interest in natural products research is strong and can be attributed to several factors, including unmet therapeutic requirements, the remarkable diversity of both chemical structures and biological activities of naturally occurring secondary metabolites and improved techniques to isolate, purify and structurally characterize these active constituents.

Keywords: Diabetes, medicinal plants, antioxidants, bioactive compounds,synthetic drugs.

INTRODUCTION

Diabetes is the most common metabolic disorder affecting populations in all geographical regions of the world. It is believed to be one of the most dangerous and life threatening diseases in the world today, involving the pancreas, (Verbrugge*et al*., 1989).It is common to all parts of the world (Anonymous, 2007)and isaffecting the citizen of both developed and developing countries.

Diabetes can simply be put forth in words as a group of metabolic diseases where the person suffers from above-normal levels of blood glucose, either due to inadequate production of insulin, total insensitivity of the cells in the body to respond to it, or complete inability to produce it. The pancreas is responsible for making insulin in the body **(Fig1)**.

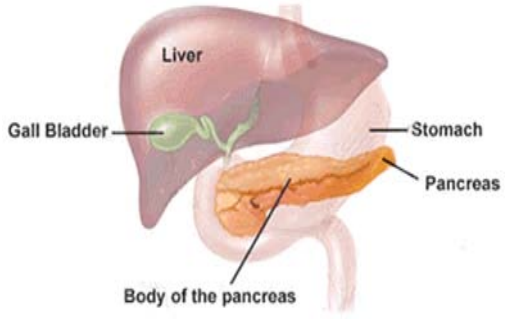

Fig1: The pancreas is responsible for making insulin

Diabetes is a metabolic disorder characterized by hyperglycemia with impairment of carbohydrate, fat and protein metabolism, (Alberti *et al*., 1998)**.** Diabetes is one of the major health problems around the globe in recent time. Asia and Africa are the most viable areas where the disease is

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feared to raise 2-3 folds. The prevalence of diabetes is influenced by genetic, ethnic and socioeconomic factors. Its increasing prevalence and high cost of treatment in the world is a cause of concern (Kanter*et al*., 2003) and is posing a continuous threat to human health since decades. The countries with largest number of diabetes patients will be India, China and U.S.A by 2030. It is estimated that every 5th person will be an Indian. The diabetic capital of the world (SaikatNeogi, HindustanTimes New Delhi, Sept. 03, 2007) India having the highest number of diabetic patients in the world posing enormous health problems in the country.

The International Diabetes Federation (IDF) estimates that the number of diabetic patients is expected to increase from 366 million in 2011 to 552 million by 2030, Brussels, 14th Nov. 2011.In India the Chennai based diabetes research center says over 50% cases of diabetes in rural India and about 30% in urban areas go undiagnosed. In 2012, IDF estimates that 371 million people have diabetes worldwide and updated the evidence of the growing burden of diabetes and impaired glucose tolerance as summarized in **(Table 1 & 2)**.(IDF Diabetes Atlas 5th edition, 2012 updates).

Table 1: Countries/territories with number of people with diabetes

S.No	Country/Territory	2011 (Millions)	2012 (Millions)
1	China	90.0	92.3
2	India	61.3	63.0
3	United states of America	23.7	24.1
4	Russian Federation	12.6	12.7
5	Mexico	10.3	10.6
6	Egypt	7.3	7.5
7	Indonesia	7.3	7.6

Table 2: Prevalence of Diabetes and IGT (20-79 years)

Diabetes prevalence	2011	2030
Global prevalence	8.3 %	9.9 %
Comparative prevalence	8.5 %	8.9 %
Number of people with diabetes	366 million	552 million
Impaired glucose tolerance (IGT)		
Global prevalence	6.4 %	7.1 %
Comparative prevalence	6.5 %	6.7 %
Number of people with IGT	280 million	398 million

Diabetes is characterized by derangements in carbohydrate, protein and fat metabolism triggered by the absolute or relative inadequacy of insulin secretion and / or insulin action (Balkau*et al*., 2000). Insulin, a hormone that is produced by the pancreas and lets glucose – the body's fuel – enter cells.It informs the body's cells that the individual is properly fed, causing liver and muscle cells to take in glucose. The glucose is stored in the form of glycogen, which is used as energy. Glycogen causes fat cells to take in blood lipids and turn them into triglycerides, which play an important role in metabolism, using fat sources for energy. The effect of insulin on glucose uptake and metabolism is shown in **(Fig 2).**

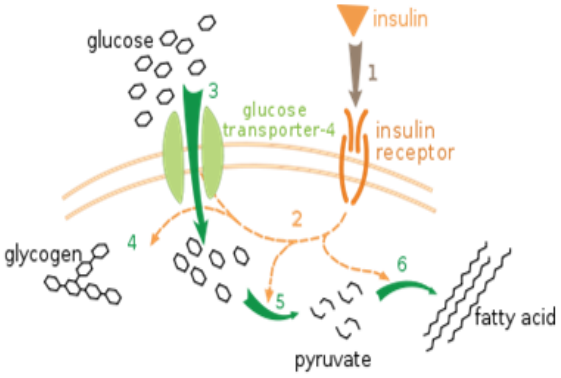

Fig 2: Effect of insulin on glucose uptake and metabolism

Insulin being the prime hormone regulating blood glucose levels, the solution to treat the disease translates into creating a bodily system more receptive to the hormone or activating it to produce insulin depending on the type of diabetes. The disease is associated with a significant burden to society and patients because most cases require lifelong treatment with insulin as well as access to day-to-day monitoring and treatment of complications.

Diabetes can be classified into three major categories: type 1 diabetes, type 2 diabetes and gestational diabetes (Velho &Froguel, 2002)**.** Diabetes, whether of type I or type II category, is primarily characterized by either lack of insulin or its action (due to any cause whatsoever) which starts with derangement of carbohydrate metabolism to eventually entangle derangement of protein and lipid metabolism as well.

Diabetes complications can develop, because of badly managed blood-glucose level in diabetes. Uncontrolled hyperglycemia in both type 1 and type 2 diabetes lead to the development of both acute and long term complications (Weiss &Sumpio, 2006). Hyperglycemic condition over a period of time develops diabetic complications such as nephropathy, retinopathy, neuropathy and cardiomyopathy(Arky RA, (1982).

Currently, diabetes is controlled and managed by a combination of diet restriction, weight reduction programs and oral hypoglycemic synthetic drugs (Evans and Rushakoff, 2007).Anti-diabetic drugs like Sulphonylurea (by increasing the insulin production from beta cells of langerhans in

pancreas) and biguanides (by working like insulin) play a critical role in treatment of diabetes, but due to failures in achieving ideal results, increasing side effects and high cost, there has always been a need and desire for a natural, more effective and economically feasible alternative with fewer side effects. Various synthetic anti-diabetic drugs with their mechanism, site of action and side effects are shown in (**Table 3**) (G.B. Kavishankar*et al*., 2011).

However, current anti-diabetic medications have toxic side effectsincluding, but not limited to, nausea, diarrhea, and hypoglycemia at higher doses, liver problems, lactic acidosis and weight gain (Evans and Rushakoff, 2007).These side effects prompt patients to stop taking these anti-diabetic medications. Furthermore, despite the intensive use of current anti-diabetic agents, many (more than 50%) type 2 diabetic patients still exhibit poor glycemic control and some (18%) develop serious complications within six years of diagnosis Clearly, there is a need for new anti-diabetic agents. Therefore, much effort has been devoted to the search and development of optimal therapeutic regimens for the management of diabetes (Achaya and Shrivastava, 2008).

Table 3: Synthetic drugs and their side effects

Agent	Mechanisms	Site of action	Advantages	Side effects
Sulphonylureas	Stimulating insulin productionby inhibiting the K-ATPchannel	Pancreatic beta cells	Effective and inexpensive	Hypoglycemia and weight gain.
Metformin	Decreases insulin resistance	Liver	Weight lossDoes not causeHypoglycemia	Nausea and diarrhea. Hypoglycemia occurs when combined with sulfonylurea or insulin
Thiazolidinediones	Reduce insulin resistance by activating PPAR-γ	GI – Tract	Low risk	Increased liver enzymes, weightgain,edema, mild anemia.
α-glucosidase inhibitors	Reduces intestinal glucose Absorption	Fat , muscle	Decreases postprandial plasma triglyceride	Diarrhea, abdominal pain, flatulence;Serum levels of transaminases increases at doses.

Plants still remain a major source for drug discovery inspite of the development of synthetic molecules. Consequently, the uses of traditional plant extract in the treatment of various diseases have been flourished (Fabricant & Farnsworth, 2001). According to the World Health Organization (WHO), more than 150 plants are known to be used for the treatment of diabetes and the study of hypoglycemic plants is then encouraged (Marles& Farnsworth, 1995).

World health organization (WHO) has recommended the evaluation of traditional plant treatments for diabetes as they are effective, non-toxic, with less or no side effect and are considered to be excellent candidates for oral therapy(Day C, 1998). Recently there are many medicinal plants possessing experimental and clinical antidiabetic activity that have been used in traditional systems of medicine (Mankil *et al*., 2006). Most of the world population particularly in developing countries still depends on traditional medicines (Shukla and Sinclair, 2009; Yi and Wetzstein, 2010).

Free radicals like super oxide anion radicals (O_2) hydroxyl radicals (OH) and non-free-radical species such as H_2O_2 andsinglet oxygen (O_2) are highly unstable. When the amount of these free radicals exceed in the body, they readily attack and induce oxidative damage to various biomolecules including proteins, lipids, lipoproteins and DNA. This oxidative damage is decisive etiological factor concerned in quite a lot of chronic human diseases such as diabetes, cancer, atherosclerosis, arthritis, and neurodegenerative diseases. Based on the lack of effective therapies for most chronic diseases, the expediency of antioxidants in protection against these diseases is defensible. Thus there is the need of antioxidant of natural origin because that can protect the human body from diabetes and other diseases as well. In recent years one of the areas, which attracted a great treaty of attention, is antioxidant in the control of life threatening disease in which oxidative dent has been implicated. For estimating the anti-oxidative potential of chemical components, some rapid, simple and inexpensive experimental approaches were used. Most of them require a spectrophotometric measurement and a certain reaction time in order to obtain reproducible results.

Use of Medicinal Plants in Diabetes:

Medicinal plants have been used since ancient times to treat and manage diabetes in traditional medical systems of many cultures throughout the

world. Various medicinal plants used for the treatment of diabetes are shown in (**Table 4**). Currently, medicinal plants continue to play an important role in the management of diabetes, especially in developing countries, where many people do not have access to conventional anti-diabetic therapies. In recent years, there has been a resurgence of interest in medicinal plants with hypoglycemic potential in these countries. This renewed interest in herbal anti-diabetic remedies in developed countries is believed to be motivated by several factors, including, the side effects, high secondary failure rates and the cost of conventional synthetic anti-diabetic remedies. Opportunities for multidisciplinary research that joins the forces of natural products phytochemistry, analytical chemistry, biotechnology and pharmacology to exploit the vast diversity of chemical structures and biological activities of natural products.The medicinal value of these plants lies in bioactive phytochemical constituents that produce definite physiological action on the human body (Akinmoladun *et al.*, 2007).

The usage of herbal medicine has amplified dramatically for various diseases amongst general people over last few years not only because of their easy accessibility without prescription, low cost and appointment to the health care specialists and more with the belief that natural remedies have less or no lethal effects as compared to synthetic medicines (Ashraf Rizwan *et.al*. 2011)**.**

Interest in natural products research is strong and can be attributed to several factors, including unmet therapeutic requirements, the remarkable diversity of bothchemical structures and biological activities of naturally occurring secondary metabolites and improved techniques to isolate, purify and structurally characterize these active constituents.In recent years phytochemistry has again become a field of active interest. Photochemistry research is the backbone of herbal industry. For promoting use of herbals in modern medicine, phytochemistry should be envisaged for:Isolation, purification and characterization of new bioactive phyto-constituents: Use of newly isolated phyto-constituents as “lead” compound for the synthetic design of analogues with either improved therapeutic activity or reduced toxicity: Conservation of lead bioactive phyto-constituents into medicinally important drugs.

Medicinal plants produce bioactive compounds used mainly for medicinal purposes. These compounds either act on different systems of animals including man, and/or act through interfering in the metabolism of microbes infecting them. In a way the bioactive compounds from medicinal plants play a determining role in regulating host-microbe interaction in favour of the host. So the identification of bioactive compound in plants, their isolation, purification and characterization of active ingredients in crude extracts by various analytical methods is important. The medicinal properties of plants could be based on the antioxidant properties of the phytochemicals in them.

In India, the ayurvedic system has described a large number of such medicines based on plants or plant product and the determination of their morphological and pharmacological or pharmacognostical characters can provide a better understanding of their active principles and mode of action. However a large number of tropical plants have not been studied in detail for their chemical constituents, pharmacological properties of the extracts, and their pharmacognostical characterization.

Advances in biotechnology, Pharmacology, botanical science bioassay technology and in chemical methodology should provide new means for making cost effective natural products, the commercial processing of even rare plants and the chemicals they produce. These technologies will extend and enhance the usefulness of plants as renewable resources of valuable chemicals. In the future, biologically active plant-derived compounds can be expected to play an increasingly significant role in treating life threatening diseases including diabetes.

Table 4: Medicinal plants used for the treatment of diabetes

Name of the plant	Disease	Refrence(s)
Panaxquinquefolius	glycemic control in type 2 diabetes through increasing post-prandial insulin levels	Mucaloet *al*., 2012
Annona squamosal	Lowers blood glucose level	Gupta *et al*, 2005
Aloe vera	Maintains glucose homeostasis by adjustingthe carbohydrate metabolizing enzymes	Rajasekaran*et al*, 2004
Andrographispaniculata	Prevents glucose absorption from gut. (Diabetestreatment)	Yu BC *et al*, 2003
Casearіaesculenta	reduction in blood glucoselevel and an increase in the activity of liverhexokinase, resulting in potent hypoglycemicactivity	Prakasam*et al*, 2002
Aeglemarmelos	Increases utilization of glucose; strong antioxidant activity, accounting for the hypoglycemic potential	Sachdewa*et al*., 2001
Withaniasomnifera	Beta cell rejuvenation, regeneration,and stimulation.	Andallu*et al*., 2000

DISCUSSION

Nature has been source of medicinal plants for thousands of years and a large number of modern drugs have been isolated from natural sources. Medicinal plants have been described, natural ways to lower sugar in blood. They have been used more and more to complement or sometimes even replace conventional diabetic drugs.Medicinal plants have immense ability to synthesize aromatic materials mainly secondary metabolites and bioactive chemical constituents, thus serves as the source of various modern pharmaceuticals.

Traditional Medicines derived from medicinal plants are used by about 60% of the world's population. Though there are various approaches to reduce the ill effects of diabetes and its secondary complications, herbal formulations are preferred due to lesser side effects and low cost. One of the etiologic factors implicated in the development of diabetes and its complications is the damage induced by free radicals and hence an anti-diabetic compound with antioxidant properties would be more beneficial.

CONCLUSION

Undoubtedly plants have many molecules, which have yet to be discovered. From the beginning of the 20th century, the subject had developed mainly on botanical side being concerned with history, identification, collection and evaluation of medicinal plants. This has open many research opportunities to biotechnologists and pharmacognosists ranging from characterizing biologically active principles, designing suitable analytical methods for quality control and standardization of plant based anti-diabetic drugs.

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REFRENCES

1. Acharya, D., and Shrivastava, K., (2008). Indigenous Herbal Medicines: Tribal Formulations and Traditional Herbal Practices, Aavishkar Publishers Distributor, Jaipur- India.ISBN 9788179102527. pp 440.
2. Akinmoladun AC, Ibukun EO, Afor E, Obuotor EM, Farombi EO (2007). Phytochemical constituent and antioxidant activity of extract from the leaves of *Ocimumgratissimum.* Sci. Res. Essay. 2: 163-166.
3. Alberti KG, Zimmet PZ.(1998) New diagnostic criteria and classification of diabetes-again? Diabetic medicine 1998; 15: 535-536.
4. Andulla B and Radhika B (2000) .Hypoglycemic, diuretic and hypocholesterolemic effect ofwinter cherry *(WithaniasomniferaDunal*) root. *Indian Journal of Experimental Biology*. 38, 607-609Anonymous (2007).*Diabetes mellitus statiatics*, American Heart Association, 18(1).
5. Arky RA. Clinical correlates of metabolic derangements of Diabetes Mellitus, "Complications of diabetes mellitus". In: kozak, G.P. (Ed.). Philadelphia; W.B. Saunders 19.
6. Ashraf, Rizwan et.al.(2011) Plant (Garlic) Supplement with standard Antidiabetic agent provides better Diabetic control in Type-II Diabetes patients. Pakistan Journal of Pharmaceutical sciences.24(4), pp.565-570.
7. Balkau B, Charles M. A and Eschwège, E. (2000) Discussion épidémiologique des nouveaux critères du diabète. Mt Endocrinologie2**:**229-34. 82: 16-20p.

8. Brussels, WHO International Diabetes Federation IDF 14thNov 2011 release.
9. Day C, (1998)Traditional plant treatments for diabetes mellitus: Pharmaceutical foods. Brazilian Journal of Nutrition; 80: 203-208.
10. Evans, J.L &Rushakoff, R.J. (2007). Oral pharmacological agents for type 2 diabetes: sulfonylureas, meglitinides, metformin, thiazolidinediones, a-glucosidase inhibitors, and emerging approaches. In: Degroot L, Goldfine ID, Rushakoff RJ, eds. Endotext .com: Diabetes and Carbohydrate Metabolism. www.medtext.com:
11. Fabricant DS, Farnsworth NR. (2001).The value of plants used in traditional medicine for drug discovery. Environmental Health Perspective., 109: 69-75.
12. Gupta RK, Kesari AN, Murth PS, Chandra R, Tandon V, Watal G. (2005). Hypoglycemic and hypoglycemic effect of ethanolic extract of leaves of *Annonasquamosa*L. in experimental animals. *Journal of Ethnopharmacology*, 99, 75–81.
13. International Diabetes Federation (IDF)Diabetes Atlas 5th edition, 2012 updates.
14. Kanter M.,Meral I., Yener Z., Ozbek H.,DemirH.:partial regeneration/proliferation of beta-cells in theiselts of langerhans by *Nigella sativa* in streptozotocininduced diabetic rats.J.Exp.Med.;210:213-219,2003.
15. Marles RJ, Farnsworth NR. (1995).Antidiabetic plants and their active constituents. Phytomedicine., 2: 137-189.
16. Mankil J, Moonsoo P, Hyun CL, Yoon-Ho K, Eun SK, Sang KK.(2006)Antidiabetic agents from medicinal plants. Curr. Med. Chem; 13: 1203-1218.
17. Prakasam A, Sethupathy S, Pugalendi KV (2002). Antihyperglycaemic effect of *Casearia esculenta*root extracts in streptozotocin-induced diabetic rats. *Pharmazie*, 57, 758–760.
18. Rajasekaran S, Sivagnanam K, Ravi K, Subramanian S (2004). Hypoglycemic effect of *Aloe vera*gel on streptozotocin-induced diabetes in experimental rats. *Journal of Medicinal Food*, 7, 61–66.
19. Sachdewa A, Nigam R, Khemani LD. (2001). Hypoglycemic effect of *Hibiscus rosasinensis L*. leaf extract in glucose and streptozotocin induced hyperglycemic rats. *Indian Journal of Experimental Biology*, 39, 284–286.
20. SaikatNeogi, HindustanTimes New Delhi, Sept. 03, 2007.
21. Shukla S, Sinclair AJ (2009). Becoming a traditional medicinal plant healer: Divergent views of practicing and young healers on traditional medicinal plant knowledge skills in India. Ethnobot. Res. Appl 7: 39-51.
22. Velho, G., and Froguel P., (2002). Maturity-onset diabetes of the young (MODY), MODY genes and non-insulin-dependent diabetes mellitus. *Diabetes*; 23:34-43.
23. Verbrugge, L.M., J.M. Lepkowski and Y. Imanaka, (1989). Comorbidity and its impact on disability. Milbank Quar., 67: 450-84.
24. Weiss, J., and Sumpio, B., (2006). "Review of prevalence and outcome of vascular disease in patients with diabetes mellitus". *Eur J VascEndovascSurg*31 (2): 143–150.
25. Yi WG, Wetzstein HY.(2010).Biochemical, biological and histological evaluation of some culinary and medicinal herbs grown under greenhouse and field conditions. J. Sci. Food Agric. 90:1063-1070.
26. YuBC, Hung CR, Chen WC, Cheng JT (2003). Antihyperglycemic effect of andrographolide in streptozotocin-induced diabetic rats. *PlantaMedica*, 69; 1075–1079.