

FIGHTING DIABETES: THE ROLE OF HERBS

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ABSTRACT

Sixty percent of people worldwide utilize traditional medicines made from medicinal plants. Particularly in India, this article focuses on Indian herbal medications and plants used to treat diabetes. Diabetes is a serious human condition that affects people from all walks of life in many nations. In India, particularly in the cities, it is turning out to be a

serious health issue. Although there are several ways to lessen the negative effects of

diabetes and its secondary issues, herbal formulations are recommended because they are less expensive and have less side effects. The list includes herbal medications used to treat diabetes as well as medicinal plants with known antidiabetic and related therapeutic effects. Trigonella foenum graecum, Withania somnifera, Phyllanthus amarus, Pterocarpus marsupium, Tinospora cordifolia, Momordica charantia, Ocimum sanctum, Eugenia

jambolana, and Allium sativum are a few of them. Since free radical damage is one of the etiologic factors linked to the development of diabetes and its consequences, an antidiabetic molecule with antioxidant qualities would be more advantageous.

Consequently, details regarding the antioxidant properties of these therapeutic herbs are also provided.^[1,2,3,4]

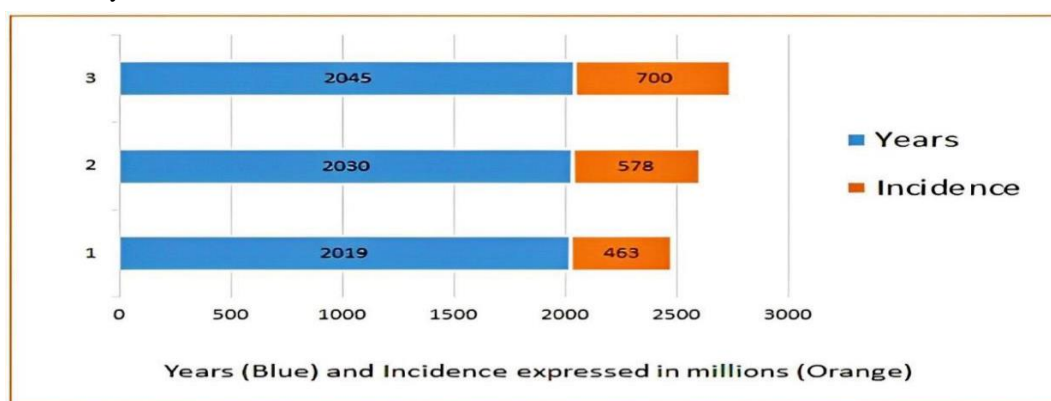
Keywords: medicinal plant, India, antidiabetic, antioxidant, diabetes

1. INTRODUCTION

Defects in insulin secretion and/or activity may be part of the etiology of diabetes mellitus

(DM), a metabolic disease that causes chronic hyperglycemia. According to estimates, one in three Americans will get diabetes at some point in their lives. Type 2 diabetic mellitus (T2DM) is the most prevalent type of DM, accounting for over 90% of cases.^[5,6] T2DM is

mostly caused by the body's tissues not responding to insulin or producing enough of it. According to numerous scientific research, diabetes lowers human quality of life by increasing the risk of serious complications like stroke, amputation, renal failure, and blindness, which can result in high morbidity and early death. According to the International Diabetes Federation (IDF), there were about 463 million adults with diabetes in 2019, as shown in [\[Figure 1\]](#). By 2030, that number is expected to rise to 578 million, and by 2045, it will reach 700 million.^[7,8,9]



Projection of an increased incidence of diabetes patients worldwide [\[Figure 1\]](#)

The last few decades have seen improvements in DM treatment methods. Anti-diabetic medications, however, can cause severe side effects such liver and renal problems and hypoglycemia coma. The use of medicinal plants in food products is advised by the World Health Organization (WHO) to treat diabetes mellitus.^[10,11] In underdeveloped nations, medicinal plants are used by at least four billion people to treat metabolic illnesses including diabetes mellitus. Thus, vitamins, medicinal herbs, and other vital components with anti-hypoglycemic qualities continue to be crucial for diabetic treatment. Through pre-clinical and clinical trials, scientific publications demonstrated that important

components, vitamins, and medicinal plants have been successfully employed to lower blood sugar levels.^[12,13,14]

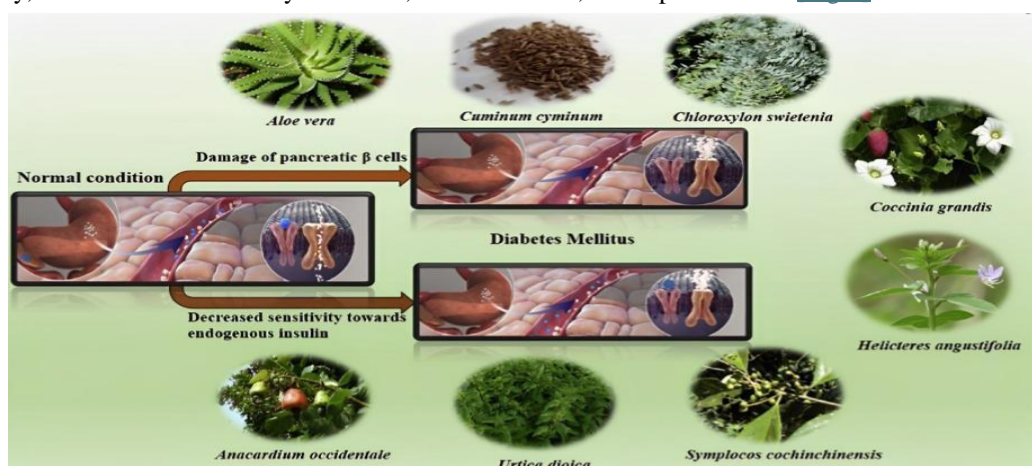
Zinc intake, for instance, has been shown to control insulin receptors and increase insulin activity. Garlic has been shown in a

study to protect adult albino rats from diabetic retinopathy. Based on variations in chemical structure, several phytochemicals with anti-diabetic qualities found in medicinal plants have been identified and categorized into primary groups. Alkaloids, aromatic acids, carotenoids, coumarins, flavonoids, glycosides, organic acids, phenols and phenolics, phytosterols, protease inhibitors, saponins steroids.[15,16,17]

Clinical overview of diabetic mellitus:

Diabetes Mellitus Type I (T1DM) and Type II (T2DM) are the two forms of diabetes, which is a chronic illness marked by hyperglycemia. A reduced amount of insulin is supplied to the circulation in type 1 diabetes due to damage to the pancreatic β -cells. Patients will require the use of exogenous insulin in order to survive. Conversely, type 2 diabetes has been seen in 85% of diabetic individuals, which leads to peripheral insulin resistance and,

consequently, reduced insulin sensitivity to the liver, skeletal muscles, and adipose tissues. [Fig 2][19,20,21]



Condition to develop diabetic mellitus disease and herbal approaches in the improvement of insulin secretion or improvement in insulin resistivity of the body cells.





Gestational diabetes mellitus is another type of diabetes that can occur in pregnant women who have never been diagnosed with the disease. Age, obesity, physical inactivity, population expansion, and urbanization are some of the factors that can cause a constant rise in the number of diabetic patients. The prevalence of diabetes in adults globally was projected to be around 171 million in 2000, but by 2014, it has risen to 422 million, or almost one in eleven individuals. The world's diabetes prevalence is predicted to double to around 366 million people by 2030 as a result of demographic shifts among those over 65 and, most significantly, the sedentary lifestyles adopted by those living in urban areas worldwide. Untreated diabetes can result in severe, life-threatening consequences such as diabetic ketoacidosis and coma because of the abnormally high blood glucose levels.[22,23,24] Additional terrible effects of diabetes include vascular issues, which can lead to both macrovascular and microvascular illnesses because high glucose levels damage the vessels. Microvascular problems can result in blindness, neuropathy, and other conditions, whereas macrovascular problems can cause cardiovascular problems. Lower limb amputations, depression, sexual dysfunction, and dementia are further consequences of long-term diabetes.[25,26]






HERBS AS ANTIDIABETICS





Numerous medicinal plants have been recorded as being used to cure diabetes in Ayurveda and other ancient medical systems. Active ingredients originating from plants include a variety of chemical substances that have demonstrated a consistent level of activity and may be used to treat diabetes. According to Rao et al. (2010), these include triterpenes, terpenoids, steroids, gum, polysaccharides, peptidoglycans, hypoglycans, guanidine, alkaloids, glycosides, carbohydrates, glycopeptides, amino acids, and inorganic ions. Usually, a combination of bioactive components produces the intended biological reaction. Both within the same species and among various plant sections, the relative quantity of active components can change.[27] The active ingredients found in medicinal plants have been shown to have a variety of properties, including the ability to promote the release of insulin from beta cells, regenerate pancreatic beta cells, exhibit insulin-like effects, combat insulin resistance, and decrease glucose uptake, absorption, and utilization (Wadkar et al., 2008). The use of herbal medications as an antidiabetic remedy is growing in popularity because of its perceived efficacy, lower clinical side effects, and affordable price (Patel et al., 2012). [28]


The active ingredients and mode of action of a few antidiabetic plants are listed in [table no.1]

List of some antidiabetic herbs and their mode of action:[Table 1][29,30]

Sr No.	Botanical name and Family	Part of plant Used	Active constitutions	Mode of action
1	Acacia arabica (Indian Gum) Fabaceae 	Seed and bark	Polyphenols, Tannis	Initiate insulin release from pancreatic beta cells (Patil et al., 2011 ji).
2.	Aegle marmelos (Bel, Golden Apple) Rutaceae 	Leaf	Again , marmelosin	Increases either the glucose utilization or Directly stimulates insulin release from pancreatic beta cells (Arumugama, et al., 2008, Yaheya et al., 2009).
3.	Allium cepa (onion) Alliaceae 	Bulb	Allylpropyl disulphide, S-methyl cysteine sulphoxide	Stimulates insulin secretion and also increases HMG CoA reductase activity and liver hexokinase activity (Thomson et al., 2007, Tripathi et al., 2012).
4.	Allium sativum (Garlic) Alliaceae 	Bulb	Allyl propyl disulphide, allicin	Control the blood glucose and lipids in serum as well as in tissues and altered the activities of liver hexokinase, glucose 6- phosphatase and HMG CoA reductase (Ozougwu et al., 2011).
5.	Aloe barbadensis (Aloe vera) Liliaceae	Leaf	Alloin and barbaloin	Stimulates synthesis and/or release of insulin from the beta cells of the islets of Langerhans of pancreas and also the action of hepatic gluconeogenesis/ glucogenolysis (Jafri et al., 2011)

				
6.	Andrographis paniculata (Kalmegh)	Whole plant	Andrographolide, diterpenoid lactone,	Prevents glucose absorption from the gut wall
	Acanthaceae 		and kalmeghin	(Nalamolu et al., 2006).
7.	Annona squamosa (Custard apple, sugar apple) Annonaceae 	Fruit	Liriodenine, moupinamide	Promotes the insulin release from the pancreatic beta cells, increases the consumption of glucose in the muscles and prevents the glucose output from the liver (Kaleem et al., 2008).
8	Artemisia pallens Asteraceae 	Leaf and flower	Germacranolide	Increases the peripheral glucose utilization or inhibits the glucose reabsorption in the proximal tubule (Donga et al., 2011).
9.	Azadirachta indica (Neem) Meliaceae	Leaf flower	Azadirachtin and Nimbin	Regenerate the pancreas beta
		and seed		cells (Khosla et al., 2000).

10.	<p><i>Bauhinia candicans</i> Leguminosae</p> 	Leaf	Astragalin, kaempferitrin	Increases peripheral metabolism of glucose (Fuentes et al., 2004).
11.	<p><i>Beta vulgaris</i> (Beet root) Amaranthaceae</p> 	Root	Phenolics, Betacyanins	Decreases the nonenzymatic glycosylation of skin proteins and blood glucose (Yoshikawa et al., 1996).
12.	<p><i>Biophytum sensitivum</i> (Sikerpud) Oxalidaceae</p> 	Entire plant	Unknown	Stimulates the synthesis/release of insulin from the beta cells (Ananda et al., 2012).
13.	<p><i>Boerhavia diffusa</i> Nyctaginaceae</p> 	Whole plant	Punarnavine and ursolic acid	Improves the glucose tolerance (Patel et al, 2012).
14.	<p><i>Brassica nigra</i> (Mustard) Brassicaceae</p>	Whole Plant	Isorhamnetin diglucoside. Isothiocynate, Sinigrin	Increases the activity of glycogen synthetase, decreases the glycogenolysis and gluconeogenesis by decreasing the activity of glycogen phosphorylase and gluconeogenic enzymes (Anand et al., 2009).

				
15.	Bumelia storm	Root bark	Triterpenoids and steroids	Shows insulin secretagogue effect in pancreatic cells (Naik et

Formulated Herbal Drugs with antidiabetic properties^[31] : [Table 2](#)

Drug	Company	Ingredients
Diabecon	Himalaya	Gymnema sylvestre, Pterocarpus marsupium, Glycyrrhiza glabra, Casearia esculenta, Syzygium cumini, Asparagus racemosus, Boerhavia diffusa, Sphaeranthus indicus, Tinospora cordifolia, Swertia chirata, Tribulus terrestris, Phyllanthus amarus, Gmelina arborea, Gossypium herbaceum, Berberis aristata, Aloe vera, Triphala, Commiphora wightii, shilajeet, Momordica charantia, Piper nigrum, Ocimum sanctum, Abutilon indicum, Curcuma longa, Rumex maritimus
Diasulin		Officinalis, Gymnema sylvestre, Momordica charantia, Scoparia dulcis, Syzygium cumini, Tinospora cordifolia, Trigonella foenum graecum
Pancreatic tonic 180 cp	Ayurvedic herbal supplement	Pterocarpus marsupium, Gymnema sylvestre, Momordica charantia, Syzygium cumini, Trigonella foenum graceum, Azadirachta indica, Ficus racemosa, Aegle marmelos, Cinnamomum tamala
Ayurveda alternative herbal formula to Diabetes:	Chakrapani Ayurveda	Gurmar (Gymnema sylvestre) Karela (Momordica charantia) Pushkarmool (Inula racemosa) Jamun Gutli (Syzygium cumini) Neem (Azadirachta indica) Methika (Trigonella foenum graceum) Guduchi (Tinospora cordifolia)
Bitter gourd Powder	Garry and Sun natural Remedies	Bitter gourd (<i>Momordica charantia</i>)
Dia-care	Admark Herbals Limited	Sanjeevan Mool; Himej, Jambu beej, Kadu, Namejav, Neem chal.
Diabetes-Daily Care	Nature's Health Supply	Alpha Lipoic Acid, Cinnamon 4% Extract, Chromax, Vanadium, Fenugreek 50% extract, Gymnema sylvestre 25% extract Momordica 7% extract, Licorice Root 20% extract

Diabeta	Ayurvedic cure Ayurvedic Herbal Health Products	Gymnema sylvestre, Vinca rosea (Periwinkle), Curcuma longa (Turmeric), Azadirachta indica (Neem), Pterocarpus marsupium (Kino Tree), Momordica charantia (Bitter Gourd), Syzygiumcumini (Black Plum), Acacia arabica (Black Babhul), Tinospora cordifolia , Zingiber officinale (Ginger)
Diabecure	Nature beaute sante	Juglans regia, Berberis vulgaris, Erythrea centaurium, Millefolium, Taraxacum
Epinsulin	Swastik Formulations	vijaysar (<i>Pterocarpus marsupium</i>)
Gurmar powder	Garry and Sun natural Remedies	Gurmar(<i>Gymnema sylvestre</i>)

2. CONCLUSION

A vast array of botanicals have the ability to treat diabetes, according to Ayurveda. Many of them have not yet been investigated and validated by science, and just a small number have. The following plants have demonstrated varied degrees of hypoglycemic activity: Momordica charantia, Eugenia jambolana, Trigonella foenum graecum, Pterocarpus marsupium, Ocimum sanctum, Gymnema sylvestre, Allium sativum, and Ficus religiosa. According to reports, these plants may also help manage the difficulties associated with diabetes. Future research might focus on identifying, isolating, and purifying the bioactive substances found in these plants. Such studies' findings could serve as a springboard for the creation of possible medications to treat diabetes. Diabetes management may benefit from this review.^[41]

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