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Recent Advances in Herbal Medicine for Diabetes Management: A Review

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ABSTRACT:

Diabetes is becoming more common globally and affects people from all works of life. While modern medicines are effective, many individuals now prefer natural remedies due to fewer side effects and long-term safety. In India and other traditional cultures, herbal medicines have been trusted for generations to control sugar levels. This review highlights the role of commonly herbs such as bitter melon, fenugreek, cinnamon, berberine and jamun seeds in diabetes management. It also talks about new research and improvements in herbal diabetes from 2020 to 2024. These herbal remedies have not only demonstrated hypoglycemic effects in clinical trials but also show promise in protecting pancreatic cells. The goal of this paper is to give a clear understanding of herbal medicines and how they can help in Diabetes care along with proper guidance.

KEYWORDS: Diabetic Mellitus, Herbal Medicines, traditional Medicines.

INTRODUCTION:

Diabetes is no longer something that we read about here and there – it's everywhere. Almost every household these days has a member with the condition. In 2021 international Diabetes federation reported that over 530 million adults suffered from Diabetes; the number is estimated to be 640 million by 2030. The World Health Organization (WHO) has listed 21,000 plants, which are used for medicinal purposes around the world. Among them, more than 400 plants are available for the treatment of diabetes. There are many herbal remedies suggested for Diabetes and diabetic complications. Medicinal plants form the main ingredients of these formulations. Some drugs trigger undesirable side effects like upset stomach, diarrhea, dizziness, weight gain and low blood sugar. Some herbs like *Gymnema Sylvestre* (gurmar) can cause low blood sugar levels when combined with Diabetes medications. Others, like Ginseng may cause headaches, sleep disturbances. While, Bitter Melon can cause side effects like upset stomach and diarrhea. A detail of medicinal plants with antidiabetic and related beneficial effects is given below.

PREVALENCE OF DIABETES IN INDIA:

Diabetes has become an epidemic in India. As of 2023, over 101 million adults (aged 20-79) are living with Diabetes, representing approximately 11-11.5% of the population. India contributes to about 26% of the world's diabetes burden – one in four adults with diabetes globally is Indian. Recent data shows that nearly 30% of those with Diabetes remain undiagnosed and untreated, creating serious risks of complications. The trend is rising rapidly – up 44% in just four years – and the count is projected to reach 156 million by 2050. This increase is primarily due to sedentary lifestyle, unhealthy diets, urban population and other related factor

As shown in *Figure 1*, the number of diabetes cases around the world has been going up rapidly, and according to *Figure 2*, the number of diabetic adults in India is projected to reach 156.7 million by 2050, which is a big jump from 32.7 million in 2000. This rise is mostly because of unhealthy eating habits, poor lifestyle, and less physical activity.

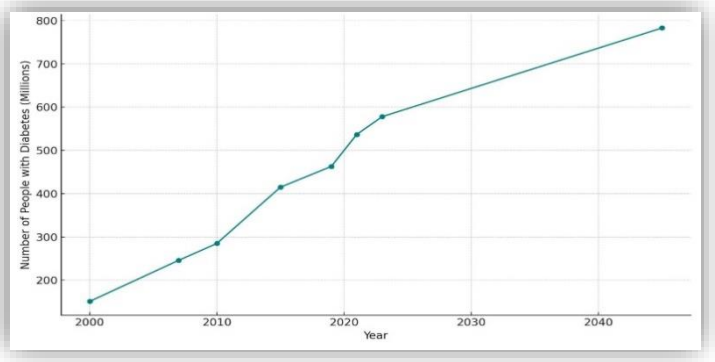

Figure 1: Global Diabetes Prevalence (in millions)
Source: Available at: https://diabetesatlas.org

Figure 2: Number Of Adults (20-79 years) With Diabetes in India

2000	**32.7 million**
2011	**61.3 million**
2024	**89.8 million**
2050	**156.7 million**

Source: Available at: https://diabetesatlas.org .

TRADITIONAL vs MODERN USE:

1.Traditional Use: Traditional systems of medicine such as Ayurveda, Unani, Siddha and other indigenous practices have long utilized herbal remedies to manage diabetes symptoms. Various system of medicine which are practiced traditionally in India are known as indigenous systems of medicine. Many plants like Gymnema sylvestre, Momordica Charantia, and Trigonella Foenum-graecum have shown hypoglycemic activity and are used in traditional medicine for Diabetes management.

It included various system being practiced throughout the world such as:

1) Ayurveda- Indian System of Medicine
2) Siddha
3) Unani
4) Homeopathic System of Medicine

1) AYURVEDA- INDIAN SYSTEM OF MEDICINE

Ayurveda is an ancient system of health-care, both physical and mental, literally means, the 'science of life'. Health in Ayurveda has been defined as a well-balanced metabolism plus a happy state of being. In Ayurveda treatment is done by helpful use of drugs, diets and practices. Medicinal plants, the different parts and their therapeutic effects are described in vedas. The principal objectives of Ayurveda include maintenance and promotion of health, prevention of disease and cure of sickness. Commonly used Ayurvedic plants, their active components, and mechanism of action are provided below how these plants are worked in lowering blood sugar levels. Some examples include:

- Aloe vera: inhibits protein glycation
- Areca catechu: promotes insulin secretion by regenerating β-cells.
- Camellia sinesis: reduces gluconeogenesis absorption.
- Cornus officinallis: decreases glucose absorption.

2) SIDDHA

Siddha is extensively practiced in the southern parts of Tamil Nadu and in the neighboring states. Siddha is an ancient system of medicine. Siddha medicine is essentially a psychosomatic system of medicine. Unlike Ayurveda, importance is given more to minerals and metals rather than herbs in pharmaceutics. Nilavembu, Vettiver, and chandraprabha Vati are examples used in diabetic treatment.

Over the last few years, siddha medicine has gained more attention for its natural and effective ways to help manage Diabetes. While this traditional system has been used for centuries, recent studies from (2020-2024) have shown how some of its remedies really work in today's world. Here are few important highlights (Table 1)

S. No.	Title of the Study	Year	Key Focus
1	Pharmacokinetic profile on gallic acid in Madhumega chooranam	2023	Bioactive compound analysis in Siddha drug
2	Evaluation of anti-diabetic activity of Oorithal Thamarai Chooranam in type 2 diabetic patients	2022	Clinical study on Siddha formulation efficacy
3	Standardization and therapeutic evaluation of Athiyadhi Kashayam	2020	Drug standardization and patient outcomes

Table 1 shows recent research exploring the efficacy and bioactive components of Siddha formulations in managing diabetes.

3) UNANI

The root of this system goes deep to the times of the well-known Greek philosopher Hippocrates who is credited with it. Aristole Golden (384 322 BC) Greek Philosopher "Father of nature history" made valuable contributions to it. This system of Greek origin was further carried to Persia (Iran), where it has been improved by Arabian physicians. The Unani system of medicine aims at treating the cause of disease and not its system.

Unani system emphasizes the balance of bodily humors (Akhlat). It uses herbs such as Jamun, Neem and Tukhm-e-kasni for their hypoglycemic properties.

Diabetes mellitus has long been treated with Qurs-E-Ziabetus Sada, a traditional Unani medication. It is a traditional herbal formulation commonly used for managing diabetes, particularly in regions where traditional medicine is an integral part of the healthcare system. Qurs-E-Ziabetus Sada are valued for their effectiveness in managing blood sugar levels and supporting overall health.

4) HOMEOPATHIC SYSTEM OF MEDICINE

Homeopathy, the ancient and holistic healing system, has gained significant popularity in recent years as people seek natural and effective alternatives for various health conditions.

Homeopathic Remedies for Diabetes:

i) Bitter Melon (Momocardia Charantia): Bitter Melon is recognized for its blood sugar lowering properties and is frequently used in Homeopathic preparation to maintain glucose levels.

ii) Syzygium Jambolanum: This remedy is derived from the seeds of the Jambolan tree and is effective in managing excessive thirst, hunger and frequent urination associated with Diabetes.

iii) Gymnema (Gymnema Sylvestre) is a plant that may lower sugar levels in the blood and urine in people with type 2 diabetes.

iv) Uranium nitricum and phosphoric acid are a common Homeopathic remedy for people who have to pee too much due to diabetes (polydipsia). Honeybee (Apis mellifica) help to improve urine flow and help your body release extra fluid from the tissues.

2.Modern Use:

In recent years, modern medicine has made big improvements in treating Diabetes, especially type 2 diabetes. New types of medicines like GLP-1 receptor agonists and SGLT2 inhibitors, and technologies such as continuous glucose monitors (CGM) and automatic insulin delivery system have changed how Diabetes is managed. These treatments help control blood sugar levels better, also support weight loss, protect the heart and improve the overall quality of life for patients.

Example of Modern Medicines for Diabetes:

Medicine Type	Examples	Function
Insulin therapy	Regular, Rapid-acting. Long-acting	Helps keep blood sugar under control
Biguanides	Metformin	Decrease in liver glucose production
Sulfonylureas	Glimepiride, Gliclazide	It increases insulin secretion by the pancreas
DPP-4 inhibitors	Sitagliptin, Vildagliptin	Responsible for the degradation of incretins such as GLP1
GLP-1 receptor agonists	Liraglutide, Semaglutide	They slow gastric emptying, & stimulate insulin production

SGLT2 inhibitors	Dapagliflozin, Empagliflozin	Helps remove glucose via urine
Alpha-glucosidase Inhibitors	Acarbose	Slows carbohydrate digestion

MEDICINAL PLANTS & THEIR ANTI-DIABETIC PROPERTIES:

For centuries, many plants have been considered a fundamental source of potent antidiabetic drugs. In developing countries, particularly, medicinal plants are used to treat Diabetes to overcome the burden of the cost of conventional medicines to the population. Nowadays, treatments of diseases including Diabetes using medicinal plants are recommended because the plants contain phytoconstituents like flavonoids, saponins, alkaloids, terpenoids, and glycosides which may possess antidiabetic properties.

Here are some important herbs with proven antidiabetic properties:

Plant Name	Botanical Name	Image	Key Compounds	Antidiabetic Action
Momordica Charantia	Bitter Melon		Vicine, Charantin	Increase insulin secretion
Trigonella Foenum-graecum	Fenugreek		4-hydroxy-isoleucine	Slows glucose absorption
Cinnamomum Verum	Cinnamon		Cinnamalde-hyde	Enhance insulin sensitivity
Ocimum Sanctum	Tulsi		Eugenol	Regulates glucose metabolism
Gymnema Sylvestre	Gurmar		Gymnemic Acids	Reduces sugar cravings
Berberis Aristata	Daruharidra		Berberine	Improves insulin function

COMPERATIVE STUDY: Allopathic vs Herbal Medicine:

A German physician Samuel Hahnemann derived the word allopathy from two Greek terms, allos which means other, opposite, and pathos which depicts suffering. Allopathic treatment depends upon administering the medical agent which generates opposite effect as that of produced by the disease. Allopathy has possibilities of side effects, which is a major drawback here. There can be reactions to the components or side effects.

While, the use of herbal medicine as a treatment has significantly increased over the last decade. This is due to several factors, principal of which is that herbal medicine is a cheaper alternative with fewer undesired side effects. The term herbal medicine derived from the word herb, which originally refers to the dried and fresh flowering or leafy green part of plants. But nowadays, the term is been commonly used for all parts of plants such as leaf, root, bark, flower seed, resin etc. The following table provides a comparison used herbal and allopathic formulations for Diabetes.

Table 2: Allopathic antidiabetic drugs and their formulations

S.no.	Category	Name of drug	Brand name	Mode of action
1	Insulin	Regular insulin	Humulin R	Decreae glucose production and increase peripheral glucose uptake.
2	Biguanides	Metformin Phenformin	Glucophage DBI	Decrease insulin resistance.
3	Meglitinide	Repaglinide Nateglinide	Prandin Novonorm	Improve glycemic control.
4	Sulfonylurea 1st Generation agent 2nd generation agent	Tolbutamide Chlorpropamide Glipizide Glimepiride	Orinase Diabinese Glucotrol Amaryl	Block the ATP sensitive potassium channels.
5	Thiazolidinediones	Rosiglitazone Pioglitazone	Avandia Actos	Increase the insulin sensitivity.
6	Peptide analogs Injectable incretin mimetics GLP-1 Gastric inhibitory peptide analogs Injectable amylin analogues	Exenatide Sitagliptin Saxagliptin Linagliptin Pramlintide	Byetta Januvia Onglyza Trajenta Symlin	Increase incretin level which inhibit glucagon release and increases insulin secretion.
7	SGLT2 inhibitors	Canagliflozin	Invokana	Quick onset, lowers post prandial glucose

As shown in Table 2, various Allopathic antidiabetic drugs are commonly used such as insulin, metformin, and sulfonylureas, which works by decreasing insulin resistance, enhancing insulin secretion, or lowering glucose absorption.

Table 3: Herbal antidiabetic drugs and their formulations

S.no.	Plant species	Family	Name of Drug	Part Used	Mode of Action
1	Aegle marmelos	Rutaceae	Aegle Marmelosine	Leaves extracts	Improve functional state of pancreatic beta cells.
2	Allium cepa	Liliaceae	Dipropyl disulphide oxide	Dried powder	Stimulating the effects on glucose utilization.
3	Allium sativum	Liliaceae	Allypropyl disulphide oxide, allicin	Petroleum other extract of bulbs	Improve plasma lipid metabolism.
4	Aloe borbadensis	Asphodelaceae	Beta-sitosterol, campesterol	Leaf pulp extract	Improvement in impaired glucose tolerance.
5	Momordica charantia	Cucurbitaceae	Charantin, sterol	Fresh green leaves	Lowers the plasma apo beta-100 in mice fed with high fat diet.
6	Mangifera indicas	Anacardiaceae	Beta-carotene Alpha-carotene	Leaves extract	Reduction in the intestinal absorption of glucose.
7	Gymnema sylvestre	Apocynaceae	Dihydroxy gymnemic triacetate	Dried leaves	Increase the serum G peptide level which monitor the release of endogenous insulin.
8	Eugenia jambolana	Myrtaceae	Oleanolic acid, ellagic acid	Pulp of fruit	Inhibited insulin activity from liver and kidney

On the other hand, Table 3 presents various medicinal plants like Allium sativum, Momordica charantia, Eugenia jambolana etc, exhibit antidiabetic effects through multiple mechanisms such as improving insulin sensitivity or increasing glucose uptake.

RECENT HERBAL DRUG DEVELOPMENTS:

In recent years (2020-2024), the use of herbal medicines for managing Diabetes has gained strong scientific support. Earlier, these remedies were mostly based on tradition and belief, but now many are being tested in proper clinical trials. For example, an herbal mix called GlycaCare-II, which includes ingredients such as cinnamon, bitter melon, and jamun, was found to work just as well as metformin (a common diabetes medicine) in reducing blood sugar levels-without any major side effects.
Researchers are also using advanced tools like genomics and metabolomics to understand how herbs such as berberine, quercetin and EGCG helps the body improve insulin sensitivity and control sugar levels.

In India, there has been great interest in herbal drug combinations containing daruharidra (Berberis aristata), gudmar (Gymnema sylvestre), vijayasar, giloy, methi and majeestha for the fast improvement in blood sugar levels. Lifestyle plus BGR-34 was able to bring down fasting glucose in a pilot study from 254 to 124 mg/dL in very short times of 2 weeks.

Various other botanicals, such as fenugreek, bitter melon, cinnamon, aloe vera, and Gymnema sylvestre, have been on the upside of little but steady Diabetic effects that are natural. Fenugreek's soluble fiber directly affects carbohydrate absorption, and at the same time, Gymnema may be the source of reducing sugar cravings and increasing both insulin secretion and beta-cell regeneration.

- A 2022 meta-analysis found Azadirachta indica (Neem) significantly reduced HbA1c (by ~1-1.2 %), fasting glucose (~8 mg/dL), and insulin resistance in type 2 Diabetic individuals.
- A 2023 systematic review ranked six herbal remedies (including Cinnamon, Green tea, Berberis, Aloe) by effectiveness, showing substantial improvements in insulin sensitivity and glycemic control with good safety profiles.

All these findings show that herbal medicine is not just about tradition anymore-it's becoming a trusted part of modern diabetes care.

CONCLUSION:

Herbal remedies are gaining recognition for their role in Diabetes care. They not only offer safer alternatives but are also now backed by scientific research and growing global interest. Diabetes is one of the biggest health concerns today. Exploring safe, affordable, and effective treatments-especially through Herbal medicines-can help improve long-term care. The rise in Diabetes cases in India is alarming. With millions still undiagnosed, there is an urgent need for better awareness, early detection, support and preventive measures. A clear understanding of how Diabetes affects the body-especially insulin function and glucose metabolism-helps in managing the Diabetes more effectively and choosing suitable treatments. Various traditional remedies such as Ayurveda, Siddha, Unani and Homeopathy have been trusted for generations, and today, modern science is helping make them safer and more effective, and the good thing is that we don't have to choose between traditional and modern medicine. Actually, with some careful blending of the two aided by proper guidance and science. Herbal medicines are cheap, safe and effective range of care for Diabetes. Many medicinal plants like Bitter melon, Fenugreek, Tulsi, Gurmar, and Cinnamon have shown natural blood sugar lowering effects. Using them with proper guidance help support healthier Diabetes management in an affordable and safe way. While allopathic medicines are widely used and effective, herbal treatments are becoming more popular due to their natural origin and fewer side effects. From 2020-2024, herbal drugs have advanced significantly with clinical evidence and modern research tools supporting their role in blood sugar control-making them a valuable addition to modern Diabetic care.

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