



A review on Herbal Anti-Diabetic Formulations and their Importance in Health Sector

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ABSTRACT

Diabetes mellitus, a chronic metabolic disorder characterized by high blood sugar, is rising globally and can lead to severe complications like heart disease, kidney damage, and nerve disorders. Alongside conventional treatments, herbal remedies are gaining attention for their affordability and minimal side effects. This review explores the role of traditional herbs and commercial formulations in managing diabetes, combining scientific evidence with traditional knowledge. Key herbs like fenugreek (*Trigonella foenum-graecum*), bitter melon (*Momordica charantia*), gymnema (*Gymnema sylvestre*), and cinnamon (*Cinnamomum verum*) show promising anti-diabetic effects. They work by boosting insulin secretion, reducing glucose absorption, and combating oxidative stress. Commercial herbal blends often combine these for enhanced benefits. However, challenges remain in standardization and clinical validation. While herbal remedies offer a natural approach to glycemic control, further research is needed to integrate them effectively into modern healthcare. Bridging traditional wisdom with scientific validation could provide safer, complementary options for diabetes management.

Keywords: Diabetes mellitus, Anti-diabetic properties, Natural plants,
Herbal preparations, phytochemicals, glycemic control.

INTRODUCTION

The practice of using herbs for therapeutic purposes has been around for centuries. India boasts a long-standing tradition of harnessing the power

of herbs for medicinal purposes, deeply rooted in its cultural and spiritual traditions. The knowledge about the healing power of herbs was obtained from indigenous people. The earliest references to medicinal plants in India can be traced back to the



Vedas, particularly the Rigveda and Atharvaveda, dating from around 1500 to 500 BCE. During the period of 1000 BCE, these ancient texts, including the Charaka Samhita, Sushruta Samhita, and Ashtanga Hridaya, were key sources of knowledge on medicinal plants in India. An in-detail information of the use of various herb for various ailments is provided in these texts. Approximately 60% of the world's population uses medicines derived from herbs or medicinal plants. The use of these is well established because of their safety and effectiveness in recent years, the use of herbs has grown exponentially by virtue of their natural origin and minimal side effects. During the colonial period (18th-20th Centuries) there was a slight decline in use of traditional practices because of improved western medicine. Herbs has a vast range of importance in medicine as they provide natural alternative for synthetic medicine, diverse healing properties, can prevent and treat the illness, easily accessible, less or no side effects etc. Herbal medicines target the root cause of diseases through various mechanisms, which may lead to a complete cure¹.

Diabetes

Diabetes has a history that stretches back to ancient times. Diabetes is known as “madhu-meha”, which madhu means “honey” and medha means “pass through urine “. Diabetes is a chronic metabolic condition where impaired insulin function disrupts blood sugar balance, leading to sustained hyperglycemia and long-term health challenges. This condition arises from either reduced insulin secretion, insulin resistance, or a combination of these factors. Insulin is a pancreatic hormone secreted from beta cells of pancreas which is involved in managing blood glucose levels, by regulating the reuptake of glucose by most of the cells. Due to insufficient insulin secretion, uptake and utilisation of glucose is minimised².

Diabetes causes problems with how the body handles carbohydrates, fats and proteins, it results in metabolic dysfunction Long-term diabetes can lead to both microvascular and macrovascular complications, which affect multiple body organs and leads to disruption of their normal functioning.

1. Microvascular – that affects smaller blood vessels. Includes Retinopathy (eye) progresses to blindness, Nephropathy(kidney) on progression renal failure, Neuropathy(nerve)

2. Macrovascular – which impacts large blood vessels and includes conditions such as heart disease and peripheral artery disease.

Elevated blood glucose levels, or hyperglycemia, are the main indicator for diagnosing diabetes³.

Different types of diabetes

The two primary types of diabetes are diabetes insipidus and diabetes mellitus.

Diabetes insipidus

Diabetes insipidus is commonly due to either inadequate vasopressin production or the kidneys' impaired response to this hormone. It is the curable form. It is characterised by excessive thirst and more dilute urine. It can be treated with hormone replacement or by increasing kidney response.

Diabetes mellitus

It is the incurable form. It is defined as a chronic metabolic disorder associated with elevated blood sugar levels (hyperglycaemia), resulting from impaired insulin secretion, insulin resistance, or both⁴.

Based on its etiology and pathogenesis, diabetes mellitus is primarily classified into four types. This classification aids in clinical assessment of the disorder.

TYPE – 1:

It is often referred to as 1ADM or Insulin Dependent Diabetes (IDDM) or Juvenile diabetes. This occurrence is seen in approximately 5 to 10 % population.

Type 1 diabetes is an autoimmune disorder, indicated by the destruction of beta cells of pancreas which is T-cell mediated and results in insulin deficiency. The progression of this disorder is marked by the rate at which immune system destroys the beta cells. A mix of genetic predisposition and environmental conditions affects this.

There are 3 instances related to type 1 diabetes, include:

1. Occurs in children and adolescents, a sudden destruction of beta cells leads to Diabetic ketoacidosis (DKA), the earliest detectable

- clinical presentation of the disorder.
2. Hyperglycemia in this context appears exclusively under physiological stress or as a result of other disease condition which is marked by a gradual or slight increase in blood glucose levels.
 3. In case of adults, beta cells will secrete only a certain amount of insulin that is merely sufficient to avoid ketoacidosis temporarily. Due to subsequent ketoacidosis, and progressive insulin deficiency it becomes insulin dependent diabetes.

T1DM is characterised by several immune markers, i.e, antibodies That includes:

1. Glutamic acid decarboxylase autoantibodies [GAD65] - GADAs
2. Islet cell autoantibodies [ICA512] – ICAs
3. Insulin autoantibodies – IAAs
4. Autoantibody to islet specific zinc transporters – ZnT8
5. Autoantibodies to Tyrosine phosphatases – IA-2 AND IN-2 ALFA

Any of these antibodies can be utilized for detection.

The occurrence of IAAs in infants and young children without previous insulin therapy indicate type 1DM. these play an inhibitory role in patients undergoing insulin therapy by interfering with insulin function.

Late beta cell destruction leads to conversion of type 1 to type 2 DM. Latent Autoimmune Diabetes in Adults (LADA) is a distinct subtype of diabetes that progresses gradually in adulthood. The presence of Glutamic Acid Decarboxylase Antibodies (GADAs) is a crucial and highly specific marker for diagnosing LADA, while Islet Cell Antibodies (ICAs) also contribute significantly to its identification.

For juvenile DM IA-2 and IA-2 ALFA, IAAs, ZnT8 act as markers.

Idiopathic diabetes

Alternatively designated as ICA-negative or Type-1B diabetes. It features severe but varying degree of insulin deficiency [insulinopenia]⁵.

Type 2

It is often referred to as non-insulin

dependent DM [NIDDM] or Adult-onset DM. 90-95% of the generally occurred diabetes is of this type.

It is marked by Islet β Cell Impairment and resistance to insulin. Insulin Receptor Desensitization is occurred because of various cellular pathway destruction. It leads to decreased sensitivity of cells or tissues towards insulin. This triggers beta cells to secrete insulin, which upon progression may leads to dysfunction of beta cells.

Type 2 diabetes mellitus (T2DM) progresses gradually and often remains asymptomatic for many years. The common symptoms associated with T2DM are Unintentional body mass reduction, Linear growth deceleration, Loss of visual acuity sharpness, Compensatory fluid craving, Pathologic urinary volume increase etc.

The main important risk factor associated with T2DM is Obesity which is defined by increased body fat which results in development of insulin resistance⁶.

Gestational Diabetes

GDM is described as diabetes during pregnancy and typically disappears after child birth. This happens when the body fails to generate enough insulin to control blood glucose levels effectively during pregnancy. Hormones produced during 2nd or 3rd trimester or 24-28 weeks of pregnancy leads to insulin resistance. If it is not properly detected, it may lead to complications in both mother and baby [elevated risk of T2DM]. (7)

Other types

Monogenic Diabetes Pathogenesis

Maturity onset diabetes of young [MODY] resulting from specific cell mutation. This leads to defects in beta cell functions and impairs insulin secretion. It occurs before age of 25. This does not have any autoantibodies. It is diagnosed by genetic testing by identifying mutation in specific gene such as, HNF1A, HNF4A, GCK.

Neonatal diabetes- it is rare and is diagnosed in infants younger than 6 months It can be either permanent or temporary. It occurs because of mutation of genes such as, KCNJ11, ABCC8, INS that affects insulin production or pancreatic development⁸.

Biological source	Part used	Chemical constituent	Type of extract	Effect	Reference
Acacia arabica (Mimosaceae)	Bark, roots	Quercetin	Chloroform extract	Reduces blood glucose levels, stimulates insulin secretion	14
Allium cepa (Liliaceae)	Skin, bulb	Alliin	Ethanolic extract	Decreases fasting glycemia and augments insulin secretion and sensitivity.	15
Allium sativa (Liliaceae)	Skin, bulb	Allicin	Aqueous extract	Lowers blood sugar, boosts insulin production and effectiveness, and helps manage cholesterol and triglyceride levels, promoting overall metabolic health	16
Aloe barbadensis (Liliaceae)	Leaf	Aloin	Methanolic extract	Exerts antihyperglycemic effects by stimulating insulin secretion, improving glucose tolerance, and mitigating oxidative stress.	17
Andrographis paniculata (Acanthaceae)	Leaves	Andrographolide	Ethanolic extract	lowers blood glucose levels because of its antioxidant properties	18
Azadirachta indica (meliaceae)	Leaves, root, bark	Nimbin	Alcoholic extract	Reduces blood glucose levels, improves β -cell function	19
Momordica charantia (cucurbitaceae)	Fruit	Vicine	Aqueous, ethanolic extract	Lowers blood sugar, boosts insulin production, and slows down glucose absorption in the intestines.	20
Panax ginseng (Araliaceae)	Roots	Ginsenoside Rg2	Methanolic extract	Repairs and rejuvenates insulin-producing cells in the pancreas, and enhances the body's ability to absorb glucose	21
Oscimum	Leaves	Eugenol	Methanolic	Slows down carb	22

sanctum (Lamiaceae)			extract	digestion and absorption, and blocks the enzyme that breaks down sugars.	
Mangifera indica (Anacardiaceae)	Fruit peel	Mangiferin	Methanolic extract	Lowers morning blood sugar levels and enhances body's response to glucose.	23
Tinospora cardifolia (menispermaceae)	leaves	Syringin	Ethanolic extract	Reduces blood sugar levels, and triggers the production and release of insulin, helping to regulate glucose metabolism, inhibits gluconeogenesis	24
Aegle marmelous (Rutaceae)	leaves	Marmelosin	Ethanolic extract	Attenuates plasma glycemia, mitigates insulin resistance, and diminishes HbA1c levels.	25
Trigonella foenum-graecum (Fabaceae)	Seeds, leaves	Galacto- mannan	Ethanolic extract	Dampens alfa- glucosidase and aldose reductase activity, boost insulin sensitivity	26
Scoparia dulcis (Scrophulariaceae)	Leaves	scopadulcic acid A and B, scoparic acid inhibition	methanol extract	Insulin secretagogue activity, alfa- glucosidase	27
Amellin Senna occidentalis (Fabaceae)	Whole plant (seed, root, leaf)	Apigenin Chrysolein Bianthraquinone Chrysophenol	Ethanol and water extract	Lowers glyated hemoglobin levels, raise insulin levels, suppress nitric oxide	28
Justicia adhatoda (Acanthaceae)	Leaves	Vasicinone Epitaraxerol Astragalin	Ethanolic extract	enhancing insulin secretion and enhancing glucose uptake by cells	29
Eugenia jambolana (Myrtaceae)	Leaves, seed	Ellagic acid	Hot water extract	inhibits alfa-amylase, alfa-glucosidase, and glucose-6- phosphatase activity	30
phyllanthus amarus (Phyllanthaceae)	Whole plant	Ursolic acid	Ethanolic extract	Enhances glucose tolerance, protects against insulin resistance, and reduces liver sugar production.	31
Pterocarpus	Heartwood	Marsupin	Aqueous and	Boosts insulin	32

marsupium (Papilionoideae)			ethanol extract	efficiency, stimulates insulin production, and enhances glucose absorption.	
Gymnema Sylvestre (Apocynaceae)	Leaves	Gymnemic acid	Alcoholic extract	Stimulates the release of insulin, and slows down sugar absorption in the gut, helping to regulate blood sugar levels	33
Acorus calamus (acoraceae)	Rhizome	β Asarone	Methanolic extract	Insulin Sensitization and Release α -Glucosidase Inhibition	34
Costus igneus (costaceae)	Rhizome, leaf	Diosgenin	Ethanolic extract	presence of insulin- like proteins, which can mimic the action of insulin and help in lowering blood sugar levels	35
Jatropha curcas (Euphorbiaceae)	Leaves	Isoorientin	Ethanolic extract	Reduces cholesterol and triglycerides, improves glucose absorption, and regulates blood sugar control by inhibiting DPP-IV enzyme.	36
Embellica officinalis (Euphorbiaceae)	Fruit	ellagic acid	Aqueous extract	Enhancement of β cell Function	37
Cinnamomum zeylanicum (Lauraceae)	bark	Cinnamaldehyde	Ethanolic/met hanoli/acetone extract	Exerts quadruple antidiabetic effects: (1) improving insulin sensitivity, (2) suppressing carbohydrate- digesting enzymes, (3) inhibiting AGE generation, and (4) preventing protein glycation.	38
Stevia rebaudiana (Asteraceae)	leaves	Stevioside rebaudioside A	Aqueous extract	Reduces blood glucose levels and glycosylated hemoglobin (HbA1c), enhance insulin sensitivity	39
Zingiber officinalis (zingiberaceae)	Rhizome	Gingerol	Aqueous extract	Demonstrates triple metabolic benefits: (1) increased insulin production, (2)	40

Moringa oleifera (Moringaceae)	leaves	Kaempferol	Ethanolic extract	improved glucose metabolism, and (3) cholesterol-lowering effects. Targets key diabetic pathways by: increasing pancreatic β-cell insulin output, improving peripheral glucose uptake, and inhibiting AGE formation.	41
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Marketed formulation	Ingredients	Reference
Pancreatic tonic 180 cp	<i>Pterocarpus marsupium</i> , <i>Gymnema sylvestre</i> , <i>Momordica charantia</i> , <i>Syzygium cumini</i> , <i>Trigonella foenum graceum</i> , <i>Azadirachta indica</i> , <i>Ficus racemosa</i> , <i>Aegle marmelos</i> , <i>Cinnamomum tamala</i>	43
Syndrex	<i>Germinated Fenugreek seed extract</i>	44
Gurmar powder	<i>Gymnema sylvestre</i>	45
Adcaps	<i>Haldi, Jambuphal, Amla, Mamajov, Neem, Karela</i> , Vijaysar, Tejbal, Gulvel	46
Asanand	Ganasar, Arjuna, Lodhra, Karanja, Kanth, Shirish, Palash	47
Madhu Rishta churna	Fenugreek, Indian kino tree, bitter gourd	48
Dihar	<i>Syzygium cumini</i> , <i>Momordica charantia</i> , <i>Emblica officinalis</i> , <i>Gymnema sylvestre</i> , <i>Enicostemma</i> , <i>Azadirachta indica</i> , <i>Tinospora cordifolia</i> and <i>Curcuma longa</i>	49
Diabet	<i>Curcuma longa</i> , <i>Coscinium fenestratum</i> , <i>Strychnos potatorum</i> , <i>Phyllanthus reticulatus</i> . <i>Tamarindus indica</i> , <i>Tribulus terrestris</i>	50
Diasol	<i>Eugenia jambolana</i> , <i>Foenum graceum</i> , <i>Terminalia chebula</i> , <i>Quercus, infectoria</i> , <i>Cuminum cyminum</i> , <i>Taraxacum officinale</i> , <i>Emblica officinalis</i> , <i>Gymnea sylvestre</i> , <i>Phyllanthus nerui</i> and <i>Enicostemma littorale</i>	51
Diakyur	<i>Cassia javanica</i> , <i>Cassia auriculata</i> , <i>Salacia reticulate</i> , <i>Gymnema sylvestre</i> , <i>Mucuna pruriens</i> , <i>Syzygium jambolaum</i> , <i>Terminalia arjuna</i>	52
Diabecon	<i>Gymnema sylvestre</i> , <i>Pterocarpus marsupium</i> , <i>Tinospora cardifolia</i>	53
Okudiabet	<i>stachytarpheta angustifolia</i> , <i>Alstonia congensis</i>	54

Ingredients	Dosage form	Extract	Methodology	Outcome	Reference
<i>Costus igneus</i>	Transdermal patch	Ethanol and water	Transdermal	Lowers blood sugar levels probably after meals	59
<i>Momordica charantia</i> , <i>Trigonella foenum</i> , <i>Withania somnifera</i> , <i>Citrullus colocynthis</i> , <i>Momordica balsamina</i> , <i>Momordica dioica</i>	Liposomes	Hydroalcoholic	Encapsulation	2-fold increased efficacy	60
	Phytosomes	Methanolic extract	Phytosomes	Prolonged-Release Flavonoid Formulation Exhibiting Significant Glucose-Lowering Effects	61
<i>Gymnema sylvestre</i>	Niosomes	Alcoholic extract	Niosomes	Niosomes made the glucose-lowering effect stronger.	62
<i>Calophyllum tomentosum</i>	silver nanoparticles (AgNPs)	Aqueous extract	Nano formulation	Exhibits stronger blocking effects on digestive (gastric) glucosidase and DPP-IV than on pancreatic enzymes.	63
<i>Costus igneus</i>	Zinc oxide nanoparticles (ZnONPs)	Aqueous extract	Nano formulation	Displays concurrent β amylase/ α -glucosidase inhibitory and antioxidant activities relevant for diabetes management.	64
Mulberry leaf and <i>Pueraria lobata</i>	Selenium nanoparticles (SeNPs)	Ethanollic extract	Nano formulation	Significant hypoglycemic effects with	65

<i>Eclipta alba</i>	Gold nanoparticles (AuNPs)	methaolic extract	Nano formulation	decrease in blood sugar levels Anti-apoptotic potential of β -cell decreased cell damage	66
<i>Stevia rebaudiana</i>	Titanium dioxide nanoparticles (TiO ₂ NPs)	alcohol-aqueous (80:20) extract	Nano formulation	Triggers strong, sustained hypoglycemic effects.	67
<i>Polygonum salicifolium</i>	Platinum nanoparticles (PtNPs)	aqueous extract	Nano formulation	Remarkable suppression of alfa-glucosidase activity	68
<i>Costus speciosus</i>	Platinum-titanium oxide nanoparticles (Pt-TiO ₂ NPs)	Ethanollic extract	Nano formulation	Suitable alfa-amylase inhibition effect.	69

Diabetes Caused by Genetic Abnormalities in Insulin Action

This type of diabetes is rare and is caused by genetic mutations, these genetic mutations cause disruption of insulin function leading resistance to insulin followed by diabetes.

Type A Insulin Resistance

Mutations in insulin receptor gene (INSR) are commonly cause insulin resistance that leads to diabetes condition.

Leprechaunism (Donohue Syndrome)

It is also caused by mutations in insulin receptor gene (INSR). It is characterise by Growth retardation and failure to thrive, Severe hyperinsulinemia.

Rabson-Mendenhall Syndrome

An uncommon genetic condition that causes severe resistance towards insulin. In this case the body is incapable to effectively utilize insulin, resulting in elevated blood sugar levels. It is also caused due to mutation in insulin receptor gene (INSR).

Lipodystrophy Syndromes

Mutations in different genes, including

AGPAT2, BSCL2 (seipin), and others causes this disease. A group of disorders distinguished by abnormal distribution of body fat, leading to insulin resistance⁹.

Methods to determine diabetes

Generally, the diabetes is diagnosed by

Medical history – based on symptoms and signs, any other medical complications, genetic history etc. and also determined by other tests that include as follows:

Fasting Plasma Glucose (FPG) Test

This test assesses blood glucose levels following a fast of at least 8 hours. It is commonly used because it is simple and cost-effective. Values meeting or exceeding 126 mg/dL (7.0 mmol/L) are diagnostic for diabetes.

A1C Test (HbA1C Test)

This test, known as hemoglobin A1C, assesses long-term glucose control by measuring average blood sugar over approximately 3 months. It is convenient as it does not require fasting. 6.5% hemoglobin A1C serves as the cutoff point for diagnosing diabetes. This test might not be accurate for individuals with certain types of anaemia or haemoglobin variants.

Random Plasma Glucose (RPG) Test

This test evaluates blood glucose levels at any time, without considering the timing of the last meal. It is useful when diabetes symptoms are present, and immediate testing is needed. A reading of 200 mg/dL+ (≥ 11.1 mmol/L) establishes diabetes diagnosis.

Oral Glucose Tolerance Test (OGTT)

In this test, blood glucose levels are measured both before and after drinking a glucose-containing sweet beverage. While chiefly employed for gestational diabetes diagnosis, this test sometimes detects type 2 diabetes. Results showing 200 mg/dL (11.1 mmol/L+) at the 2-hour mark confirm diabetes.

C-Peptide Test

C-peptide testing helps distinguish Type 1 from Type 2 diabetes. Low levels suggest Type 1 (autoimmune β -cell destruction), while normal/high levels align with Type 2 (insulin resistance)¹⁰.

Antibody Testing

Tests for autoantibodies, such as glutamic acid decarboxylase (GAD) antibodies, can help diagnose type 1 diabetes, especially in ambiguous cases. These antibodies are usually present in individuals with type 1 diabetes but not in those with type 2 diabetes.

Other tests may also include lipid profile test, kidney function test, blood urea, SGPT (serum glutamic pyruvic transaminase), serum vitamin B12 AND vit D¹¹.

Glucose Detection and Regulation

Beta cells detect glucose levels via glucose transporter proteins (GLUT2), which facilitate the entry of glucose into the cells. The entered glucose gets metabolised inside the cells and produce ATP, increased levels of ATP causes potassium channel closure and calcium channel opening. The increased influx of Ca^{2+} levels stimulates the release of insulin through exocytosis.

In other case hypothalamus detects glucose levels by specialised glucose sensing neurons and regulate it. It is also done by feedback mechanism¹².

Historical perspective of therapeutic use of natural plants

The therapeutic use of herbs has a long-standing history, with deep roots in traditional medicine systems worldwide. In India, herbal medicine is an integral part of the country's cultural and spiritual fabric, with origins tracing back to ancient times. Knowledge of the medicinal properties of herbs was passed down from indigenous communities and recorded in sacred texts such as the Vedas—especially the Rigveda and Atharvaveda—which date back to approximately 1500-500 BCE. As Indian medical traditions developed, foundational texts such as the Charaka Samhita, Sushruta Samhita, and Ashtanga Hridaya emerged as comprehensive compendiums, systematically documenting plant-based therapies for diverse diseases. An estimated three-fifths of the global population incorporates plant-based therapeutics into their primary healthcare regimens, largely due to trusted traditional safety profiles and therapeutic outcomes. In recent years, many people have started using herbal remedies because of their natural origins and minimal adverse effects compared to synthetic drugs. However, during the 18th-20th centuries, the popularity of traditional herbal practices decreased a bit with the rise of Western medicine. The restored interest in herbal medicine today is connected to the wide benefits they offer: they provide a natural alternative to synthetic pharmaceuticals, possess diverse healing properties, and are often more affordable and accessible. Furthermore, herbal remedies are generally considered safer, with fewer adverse effects. They work by targeting the root causes of diseases through various biological mechanisms, often aiming for long-term or even complete recovery of health issues¹³.

Previous researches and its findings

Since ancient period, plant and plant extracts are used to prevent and treat diabetes. Numerous research has been carried out on various plants with antidiabetic properties. Some of them include-

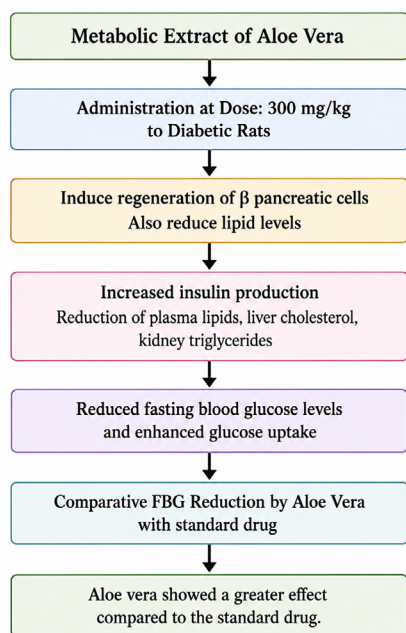
One of the examples of above-mentioned plants and its activity which was experimentally proved is described below (reference-17)

The antidiabetic activity of remaining

mentioned plants was proved based on experimentation in the same way.

Aloe Vera

The methanol-soluble fraction of Aloe leaves (300 mg/kg dose) validated its traditional use in diabetes management through measurable hypoglycemic effects. In diabetic rats, insulin production was increased by regenerating pancreatic beta cells. It also reduced the lipid levels in plasma, liver cholesterol and also kidney triglycerides. *Following overnight fasting, diabetes was induced in male albino rats via freshly prepared alloxan solution (150 mg/kg) delivered intravenously.* Treatment with Aloe vera lowered fasting blood glucose levels by 40.5% on day 7, 47.6% on day 14, and 65.5% on day 21. The standard reference drug showed reductions of 33.4%, 43.4%, and 76.0% at the same time points. It acts by repairing the damaged beta pancreatic cells to increase insulin production. It in turn also shows enhanced glucose uptake by cells.



Currently Marketed Plant-Based Therapeutic Formulations

Ayurveda, India's ancient healing system, uses different ways to prepare herbal medicines. These preparations include decoctions, infusions, tinctures, and powders. According to ancient texts like the Charaka Samhita and Sushruta Samhita, Ayurvedic medicines can be made in two ways: (a) using a single herb, or (b) using two or more herbs together. When multiple herbs are combined in one preparation, it is called a polyherbal formulation.⁴² Evidence-Based Polyherbal Formulations in Contemporary Therapeutics include-

Novel Formulations

To enhance the bioavailability and activity of the components many studies related to integration of novel technologies are made. Based on these many plants based nano particles are developed which show enhanced activity and also far better in controlling complications⁵⁸.

CONCLUSION

The integration of natural products into modern technology holds a significant role in development of novel therapies for many diseases like diabetes. This also aids to overcome the challenges associated with traditional systems, enabling the enhanced efficacy of the compound. All the existed conventional treatments only relieve but they often fail to treat the root cause of the disease. Further, there is a growing interest in plant-based treatments because of their safety, more effective alternatives for synthetic drugs, as they also have the potential to reduce complications.

Overall, combining traditional medicinal knowledge with modern drug development tools is likely to lead to more effective treatments for diabetes and other health challenges in the future, contributing significantly to global health.

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