Project On

A Review on Natural Remedies for Diabetes: A Review of Bangladesh's Anti-diabetic Plants at Kishoreganj

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APPROVAL

This project, titled "Natural Remedies for Diabetes: A Review of Bangladesh’s Anti-diabetic Plants at Kishoreganj," submitted to the Department of Pharmacy, Faculty of Health & Life Sciences at Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the Bachelor of Pharmacy degree. It has also been approved in terms of its style and content.

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ABSTRACT

Diabetes mellitus has emerged as a significant global health challenge, with increasing prevalence in Bangladesh. This review investigates the traditional anti-diabetic plants utilized in Kishoreganj, Bangladesh, highlighting their pharmacological potential. A systematic analysis of various indigenous plants reveals that species such as Momordica charantia (bitter melon), Trigonella foenum-graecum (fenugreek), and Azadirachta indica (neem) possess bioactive compounds that exhibit blood glucose-lowering effects, enhance insulin sensitivity, and exhibit antioxidant properties. The paper underscores the importance of integrating these natural remedies into diabetes management while addressing the need for further scientific validation through clinical trials. Additionally, the review emphasizes the cultural significance and sustainable harvesting of these plants, advocating for their conservation as part of traditional medicine. Overall, this study provides a foundation for future research on the therapeutic application of indigenous plants in diabetes care, promoting a holistic approach to health in Bangladesh.

Keywords: Antidiabetic, Pharmacological, Hyperglycemia, Drug.

DECLARATION

I hereby declare that I am conducting this project study under the supervision of Ms. Aklima Akter, Assistant Professor, Department of Pharmacy, Faculty of Health & Life Sciences, Daffodil International University, in partial fulfillment of the requirements for the Bachelor of Pharmacy degree (B. Pharm). I affirm that this project is my original work and that neither this project nor any part of it has been submitted for the award of a Bachelor's degree or any other degree elsewhere.

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Introduction

1.1. Diabetes

Diabetes mellitus, a chronic metabolic disorder characterized by hyperglycemia, has emerged as a substantial global health issue. Although conventional treatments, including insulin and oral hypoglycemic agents, continue to be the primary method of managing diabetes, there is a growing interest in natural remedies, particularly in regions like Bangladesh, where a diverse array of medicinal plants presents the potential for alternative forms of treatment [1]. Bangladesh has a lengthy history of utilizing traditional remedies to manage a variety of maladies, including diabetes, due to its abundance of plant biodiversity. Recent research has concentrated on the identification and validation of the anti-diabetic properties of local plants that are used in folk medicine. This has resulted in optimistic findings that have the potential to complement or enhance current therapeutic options. Hypoglycemic activity has been demonstrated in numerous plants that are frequently encountered in Bangladesh, indicating the potential to enhance insulin sensitivity and reduce blood glucose levels [2]. Momordica charantia (bitter melon), Azadirachta indica (neem), Swertia chirata, and Trigonella foenum-graecum (fenugreek) are notable examples of these. These plants have been extensively employed in traditional medicinal practices and have been recognized by science for their anti-diabetic properties [3]. For instance, Momordica charantia contains bioactive compounds that enhance glucose uptake and mimic insulin, while Azadirachta indica has demonstrated the potential to improve insulin secretion and reduce insulin resistance [4].

Fig 01: Diabetic Symbol.

The pharmacological efficacy of these plants is frequently attributed to their extensive phytochemical content, which encompasses alkaloids, flavonoids, saponins, and tannins [5]. These compounds demonstrate a variety of mechanisms of action, including the regulation of carbohydrate metabolism, the inhibition of glucose absorption in the intestine, and the enhancement of pancreatic β-cell function [6]. Additionally, these plants are rich in antioxidants, which may aid in the reduction of the oxidative stress that is linked to diabetes and its complications [7].

Additional research, notably clinical trials, is required to verify the safety and efficacy of these botanicals in human populations, despite their promising therapeutic potential [8-11]. However, the incorporation of these natural remedies into conventional diabetes treatment strategies could provide a more comprehensive approach to managing this intricate condition, particularly in resource-limited settings such as Bangladesh. This methodology would not only advance sustainable healthcare solutions but also encourage the preservation of biodiversity and traditional knowledge [12].

1.2. History of Diabetes

The condition of diabetes has been documented in ancient Egyptian medical texts, with the earliest known mention of the condition dating back thousands of years. A condition characterized by excessive thirst and frequent urination—symptoms that we now recognize as classic indicators of diabetes—is described in the Ebers Papyrus, a document dating back to approximately 1550 BCE. Nevertheless, this condition was not well understood in ancient times, and treatments were rudimentary, frequently involving herbal remedies or dietary modifications [13].

The term "diabetes" is derived from the Greek word "siphon," which denotes the excessive excretion of urination, a critical symptom of the disease. Around the first century CE, the Greek physician Aretaeus of Cappadocia was the first to employ the term "diabetes" to characterize this condition. He observed that individuals with diabetes experienced an insatiable thirst and an insatiable urge to excrete. Thomas Willis later devised the comprehensive term "diabetes mellitus"

in the 17th century, incorporating the Latin word mellitus, which means "honeyed" or "sweet." This was due to the fact that the urine of individuals with diabetes was frequently pleasant to the taste, a finding that had been made in Indian and Chinese medical traditions even earlier [14-15]. In ancient India, physicians observed that insects were drawn to the urine of diabetic patients, which prompted them to name the condition Madhumeha, which translates to "honey urine."

For centuries, diabetes was not fully comprehended. The pancreas' function in diabetes was not unveiled by medical science until the late 19th century. Paul Langerhans, a German medical student, identified the islets of Langerhans in the pancreas in 1869. These islets were subsequently associated with insulin production. This discovery was crucial; however, the genuine innovation occurred in the early 20th century. Canadian researchers Frederick Banting and Charles Best, along with biochemist James Collip, effectively isolated insulin from the pancreas of canines in 1921. Insulin is a hormone that is essential for the regulation of blood sugar. It was this discovery that transformed the management of diabetes. In 1922, insulin was first administered to a human patient, thereby transforming a fatal condition into one that could be effectively managed through injections [16].

Since that time, diabetes research has continued to advance, with the introduction of new treatments such as synthetic insulin, oral medications, and, most recently, continuous glucose monitoring and insulin devices, which provide improved management options for individuals with diabetes. Diabetes continues to be a global health issue, affecting millions of individuals worldwide, despite these advancements.

1.3. Types of Diabetes

- Type 1 diabetes.
- Type 2 diabetes.
- Gestational diabetes.
- Maturity onset diabetes of the young (MODY).
- Neonatal Diabetes

- Wolfram Syndrome
- Alström Syndrome
- Latent Autoimmune Diabetes in Adults (LADA)

Type 1 diabetes

Type 1 diabetes, also referred to as insulin-dependent diabetes or juvenile diabetes, is a chronic autoimmune condition in which the body's immune system inadvertently targets and eliminates the insulin-producing beta cells in the pancreas. Consequently, the body generates minimal to no insulin, the hormone responsible for regulating blood sugar levels. Hyperglycemia is the result of the inability of glucose to enter cells for energy utilization in the absence of insulin [17]. In contrast to Type 2 diabetes, which is frequently associated with lifestyle factors such as diet and physical activity, Type 1 diabetes typically manifests during childhood, adolescent, or early adulthood. It is believed that the autoimmune response is initiated by a combination of genetic predisposition and environmental stimuli, such as viral infections, although the precise cause is not entirely understood. At present, there is no known method to prevent Type 1 diabetes. The symptoms of T1D frequently manifest abruptly and may include excessive thirst, frequent urination, extreme appetite, fatigue, unexplained weight loss, and impaired vision. The condition can result in severe complications, including diabetic ketoacidosis (DKA), which can be life-threatening, if left untreated [18]. Type 1 diabetes is typically managed through lifelong insulin therapy, which is administered through injections or an insulin device. In order to maintain their blood glucose levels within a target range and modify their insulin dosing as necessary, individuals with T1D must conduct routine blood glucose monitoring [19-23]. A healthy diet, regular physical activity, and meticulous monitoring of blood sugar fluctuations are all essential components of managing the condition, in addition to insulin therapy [24].

Advancements in continuous glucose monitoring technology and insulin delivery systems have enhanced the quality of life for individuals with Type 1 diabetes, despite the fact that it remains a lifelong challenge [25]. Research is ongoing to identify potential cures, such as pancreatic islet cell transplantation and immunotherapy, which provide optimism for the future.

Type 2 diabetes

Millions of individuals worldwide are affected by prevalent form of the disease. It transpires when the body develops insulin resistance or when the pancreas fails to produce an adequate amount of insulin to effectively regulate blood sugar. Subsequently, hyperglycemia develops as a consequence of glucose accumulation in the circulation. In contrast to Type 1 diabetes, which is an autoimmune condition, Type 2 diabetes is significantly influenced by lifestyle factors, including obesity, physical inactivity, and a poor diet. However, genetics also significantly influence an individual's likelihood of developing the condition [26]. Type 2 diabetes is typically diagnosed in adults over the age of 45, but it is now being diagnosed in younger individuals, including children, as a result of the increasing prevalence of obesity. Fatigue, impaired vision, frequent urination, and slow-healing wounds are among the most prevalent symptoms. Nevertheless, a significant number of individuals with Type 2 diabetes may not exhibit any discernible symptoms, which can result in a delay in the diagnosis and management of the condition [27-30].

The management of Type 2 diabetes frequently commences with lifestyle modifications, including the adoption of a nutritious diet, the increase of physical activity, and the loss of weight [31]. Oral medications, such as metformin, are frequently prescribed to assist in the regulation of blood sugar levels. Insulin therapy may be necessary if these treatments are inadequate. If left uncontrolled, Type 2 diabetes can result in severe complications, including kidney failure, nerve damage, and heart disease. However, it is a condition that can be managed. Many individuals with Type 2 diabetes can lead healthy, active lives with the assistance of early diagnosis, appropriate treatment, and lifestyle modifications [32].

Gestational Diabetes

Gestational diabetes is a form of diabetes that develops during pregnancy, typically during the second or third trimester. Elevated blood sugar levels are the result of the body's inability to produce sufficient insulin to accommodate the heightened demands of pregnancy [33]. Although gestational diabetes typically subsides following childbirth, it elevates the likelihood of complications for both the mother and the infant. Screening, which is typically conducted between the 24th and 28th weeks of pregnancy, is essential for women with gestational diabetes, as they

may not exhibit any discernible symptoms [34]. Obesity, a familial history of diabetes, previous gestational diabetes, and certain ethnic origins are all risk factors [35]. Gestational diabetes can result in complications, including preeclampsia, a condition marked by elevated blood pressure and an elevated risk of cesarean delivery, if left untreated. After birth, the infant is at risk of hypoglycemia, precipitous birth, and excessive birth weight (macrosomia) [36-38].

The management of gestational diabetes entails the monitoring of blood sugar levels, the adoption of a healthy diet, the participation in regular physical activity, and the occasional administration of insulin or other medications as necessary. In order to guarantee a healthy pregnancy and delivery, it is imperative to conduct rigorous surveillance of both the mother and the infant. It is crucial to conduct post-pregnancy follow-up for women who develop gestational diabetes, as they are at an elevated risk of developing Type 2 diabetes in the future. Nevertheless, the majority of women with gestational diabetes are able to have healthy pregnancies and infants with the assistance of appropriate care and management [39].

Latent Autoimmune Diabetes in Adults (LADA)

Latent Autoimmune Diabetes in Adults (LADA) is a type of diabetes that exhibits characteristics of both Type 1 and Type 2 diabetes. This autoimmune condition, which is frequently referred to as "Type 1.5 diabetes," is characterized by a progressive progression in which the immune system targets the insulin-producing beta cells in the pancreas [40]. In contrast to Type 1 diabetes, which develops rapidly and is frequently diagnosed during childhood or adolescence, LADA typically manifests in maturity and advances at a slower pace. LADA is frequently misdiagnosed as Type 2 diabetes at the outset, as it is most prevalent in adults over the age of 30 and may not necessitate urgent insulin treatment. Nevertheless, the body's capacity to produce insulin diminishes over time, and patients eventually require insulin therapy to regulate their blood glucose levels, as LADA is autoimmune in nature. Oral medications that are efficacious for Type 2 diabetes are typically insufficient for the management of LADA. The precise origin of LADA is not well understood; however, it is believed to be influenced by genetic and environmental factors that are similar to those that induce Type 1 diabetes. Excessive thirst, frequent urination, fatigue, and unexplained weight loss are symptoms of LADA, which are similar to other forms of diabetes [41]. The

diagnosis of LADA entails the testing of specific autoantibodies, including glutamic acid decarboxylase antibodies (GADAs), which are typically present in individuals with autoimmune diabetes. In order to prevent complications associated with uncontrolled blood sugar levels and preserve remaining beta cell function, it is crucial to recognize LADA early and administer appropriate treatment.

1.4. Diabetes Symptoms

The symptoms of diabetes are contingent upon the type of diabetes and the severity of the elevated blood sugar levels. Nevertheless, certain symptoms are consistent across various varieties of the condition. The primary symptoms consist of:

- **Polyuria (frequent urination):** Excess glucose in the urine is a result of elevated blood sugar levels, which results in frequent urination by removing additional water from the body.
- **Increased thirst and fluid ingestion (polydipsia):** The body becomes dehydrated as a consequence of frequent urination.
- **Polyphagia (increased appetite):** The body's cells are unable to access glucose for energy, resulting in a constant sense of hunger, despite elevated blood sugar.
- **Unexplained weight loss:** Despite the fact that individuals with diabetes may consume more food due to appetite, their bodies are unable to effectively convert the calories. Consequently, they experience weight loss despite consuming an adequate or increased amount of food.
- **Fatigue:** Persistent fatigue and a lack of energy result from the body's inability to efficiently convert glucose into energy.

- **Blurred vision:** The lenses of the eyes can be affected by high blood sugar, resulting in edema and indistinct vision.
- **Slow-healing wounds:** Diabetes can impede blood circulation and diminish the immune system, leading to the delay in the mending of injuries and infections.
- **Tingling or paralysis:** Prolonged high blood sugar levels can result in nerve damage (diabetic neuropathy), which can cause tingling, numbness, or pain, particularly in the hands and feet.

1.5. Diabetes Causes

The immune system, which is typically responsible for safeguarding the body from infections, mistakenly assaults and destroys the insulin-producing beta cells in the pancreas, resulting in the development of type 1 diabetes. A severe reduction or complete absence of insulin, which is essential for the regulation of blood sugar levels, is the result of this autoimmune reaction. According to scientists, the development of Type 1 diabetes may be precipitated by a combination of genetic predisposition and environmental factors, including viral infections [42]. The objective of ongoing research, such as the TrialNet study, is to identify these catalysts in order to prevent or cure the disease.

Overeating, physical inactivity, and excess body weight are all closely associated with the prevalence of Type 2 diabetes. Individuals with Type 2 diabetes, particularly those who are obese, frequently experience insulin resistance. In this condition, the distribution of body fat is a significant factor, as an elevated. Body Mass Index (BMI) tables are a useful tool for evaluating your weight in relation to your height, which can be used to evaluate your risk of developing Type 2 diabete [43].

Insulin resistance

The initial indication the development a consequence, the body necessitates an increased amount of insulin to facilitate the flow of glucose into the cells. In order to satisfy this increased demand, the pancreas increases insulin production. Nevertheless, the pancreas may experience difficulty in maintaining its production of insulin as time progresses. This imbalance 2 diabetes.

Genes and familys history

Like Type 1 diabetes, certain genetic factors Type 2 diabetes. This condition tends to run in families and is more prevalent among specific racial and ethnic groups, including:

✓ Black Americans

✓ Native Alaskans

✓ American Indians

✓ Asian Americans

✓ Hispanics/Latinos

✓ Native Hawaiians

✓ Caribbean Islanders

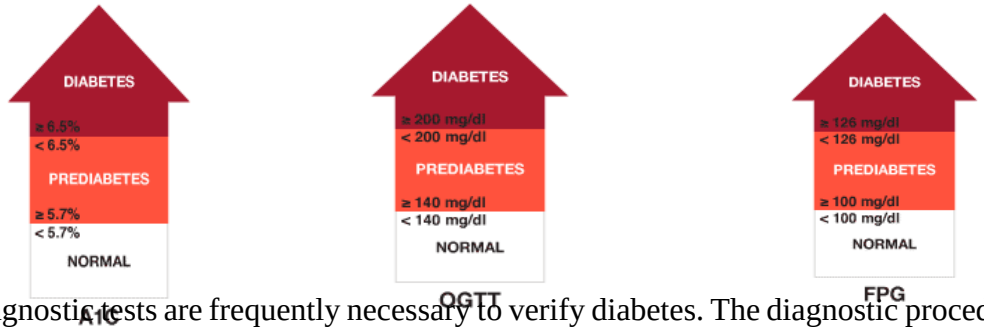
In addition to genetic predisposition, these genes may also contribute to a higherng Type 2 diabetes.

Insulin resistance

Insulin resistance is a natural occurrence in late pregnancy as a result of the influence of placental hormones. Nevertheless, certain expectant mothers are unable to compensate for this insulin resistance due to a deficiency of insulin production in their pancreas, resulting in gestational diabetes. Gestational diabetes is linked to weight gain, similar a certain degree of insulin resistance.

Furthermore, the development of gestational diabetes can be exacerbated by extensive food consumption during pregnancy [44-46].

1.6. Diagnosis



Multiple diagnostic tests are frequently necessary to verify diabetes. The diagnostic procedure may be prolonged by an additional day as a result of the use of multiple methods to assure accuracy. These procedures Occasionally, a single positive test may be adequate to diagnose diabetes if your physician determines that your blood glucose level is exceedingly high or if you exhibit the typical symptoms of elevated blood glucose.

Fasting Plasma Glucose

Fasting blood glucose testing is conducted after the patient has fasted, meaning they have refrained from consuming any food or drink (except water) for at least eight hours before the test. This test is typically done in the morning before breakfast. If an individual's fasting blood glucose level is 126 mg/dl or higher, they are diagnosed with diabetes mellitus.

Fasting Plasma Glucose (FPG) Levels:

Normal: less than 100 mg/dl

Prediabetes: 100 mg/dl to 125 mg/dl

Diabetes: 126 mg/dl or higher

Oral Glucose Tolerance Test (OGTT)

The Oral Glucose Tolerance Test measures levels both before and after consuming a specific sugary drink. This test helps physicians assess how efficiently your body metabolizes sugar. After fasting for two hours and consuming the drink, level of 200 mg/dl or higher is diagnostic of diabetes.

Oral Glucose Tolerance Test (OGTT) Levels:

Normal: less than 140 mg/dl

Prediabetes: 140 to 199 mg/dl

Diabetes: 200 mg/dl or higher

Random (also called Casual) Plasma Glucose Test

If there are severe indications of diaetes, a blood test may be administered. If blood levels exceed 200 mg/dL, diabetes may be diagnosed [47-49].

1.7. Diabetes Treatments

It is crucial for diabetes patients to adhere to their medication regimens without exception. It is essential that diabetics do not ignore their condition, as this could lead to severe repercussions. Potential complications include blindness, the necessity of amputation of digits or feet, mortality (particularly from cardiovascular disease). Your risk of developing a diabetic complication can be significantly reduced by adhering to the prescribed dosage of your diabetes medication. The treatment consists of dietary and physical activity modifications, as well as pharmaceuticals (if necessary). There are numerous management options for diabetes, including insulin, medications, and other injectable remedies. Insulin infusions are the permanent requirement for individuals with type 1 diabetes. Although a substantial number of individuals with type 2 diabetes are capable of managing their blood ultimately require insulin [50].

Endocrine Connection

- Each diabetes subtype has its own set of treatment options. Type 1 diabetes is diagnosed when the pancreas ceases to produce insulin. Children and adolescents are particularly susceptible, although individuals of any age are susceptible. Insulin is required by individuals with type 1 diabetes to sustain their existence.
- Ty the only one. Insulin resistance develops in individuals with type 2 diabetes, as insulin production decreases. Adults, particularly those who are obese, are disproportionately affected. Nevertheless, the elderly are not the only group that is more susceptible to developing type 2 diabetes.
- Gestational diabetes is tes that exclusively manifests during pregnancy. Fortunately, the majority of women report that their symptoms subside following the delivery of their child. Women who have experienced gestational diabetes are at an increased risk of developing type 2 diabetes in their later years. Al the technical phrases and names; however, it is important to be aware [51-52].

1.8. Plants

The majority of the energy needs of Plantae members are satisfied by sunlight. There was a time when all organisms that did not belong to the animal domain were regarded to be part of the vegetation realm. Nevertheless, the definition of Plantae does not currently include the archaea, bacteria, and specific algae and prokaryotes.. Viridiplantae, a subgroup of plants, is a sister group to Glaucophyta (land plants) and encompasses green phytoplankton and Embryophyta. apable of producing flowers, fruit, and spores; however, they are unable to develop normally as a result of their lack of chlorophyll and photosynthesis. Sexual reproduction and generational alternation are indispensable attributes of plant life, regardless of the prevalence of asexual reproduction in plants. Approximately 260.000 to 290.000 of the 320,000 plant species that are currently known produce viable seed [53]. Green plants are responsible vegetables have been cultivated by humans for generations, as they are essential components of a nutritious diet. Since ancient times, plants have

been employed for a wide range of purposes, including sustenance, medicine, fiber for garments, and paper. The study of plants and nvironment is referred to as botany, a branch of biology [54].

1.9. Medicinal plants

Traditional medical practices have prioritized the identification and utilization of therapeutic plants, which are frequently referred to as medicinal herbs, since ancient times. A wide range of compounds are produced by plants for value of the hundreds of plant species that possess medicinal properties was US$2.2 billion in 2012 [56]. It was anticipated that the global market for plant extracts and pharmaceuticals would be valued in the billions of dollars by 2017. The World Health Organization (WHO) has established a network to encourage the responsible and salutary use of traditional medicine in specific countries, as a result of the lack of adequate regulation. Medicinal plants are particularly concerned about over-collection in order to satisfy commercial demand, in addition to systemic challenges such as habitat loss and climate change.

1.9.1. Some Medicinal plants in Bangladesh

Tulsi

In traditional Ayurvedic medicine, Tulsi, also known as Holy Basil (Ocimum sanctum), is a highly regarded medicinal plant. It is widely recognized for its numerous health advantages, such as its capacity to enhance immunity, alleviate tension, and address respiratory ailments. Potent bioactive compounds, including eugenol, rosmarinic acid, and flavonoids, are present in tulsi, which contribute to its antimicrobial, antioxidant, and anti-inflammatory properties. Frequently ingested as a tea or in supplement form, tulsi is also incorporated into hygiene and wellness products due to its exceptional natural medicinal properties. It is of cultural and spiritual significance in numerous regions of India, in addition to its medical significance.

Fig 02: Tulsi.

Ginger

Ginger (Zingiber officinale) is a medicinal plant that is widely recognized for its potent therapeutic properties. For centuries, it has been employed in traditional medicine to alleviate a variety of afflictions, such as inflammation, vertigo, and digestive issues. Ginger's active compounds, including gingerol and shogaol, offer antimicrobial, antioxidant, and anti-inflammatory properties. Ginger is frequently ingested as a spice, tea, or supplement to alleviate vertigo, promote digestion, and alleviate the discomfort associated with arthritis. It has become a fundamental component of both culinary and medicinal practices worldwide due to its adaptability and efficacy.

Fig 03: Ginger.

Indian bael

The Aegle marmelos tree, commonly known as bael, Bengal quince, golden apple, stone apple, and wood apple, is an endangered species native to India and Southeast Asia. This tree is

recognized for its unique fruit and various medicinal properties. Due to its declining numbers, conservation efforts are essential to preserve this valuable species and its ecological significance.

Fig 04: Indian bael.

Myrobalan

Terminalia chebula, commonly known as black myrobalan and chebulic myrobalan, is a tree species native to the subcontinent of India and Nepal. It is also found in southwest China, Sri Lanka, Malaysia, and Vietnam. This tree is valued for its fruit, which has been used in traditional medicine for centuries, and it plays a significant role in various herbal remedies due to its numerous health benefits. The conservation of Terminalia chebula is important not only for its medicinal properties but also for its ecological contributions in the regions where it is found.

Fig 05: Myrobalan.

Arjun tree

The Terminalia arjuna tree is a of the Terminalia genus. One of the two common English names for this plant is Arjuna or Arjun tree.

Fig 06: Arjun tree.

Golden shower tree

A member of the Fabaceae family, Cassia fistula is a flowering plant. typically achieved in late spring or early summer, when temperatures are high and humidity is low. blossoms. It thrives in arid, sunlit environments. This tree is capable of withstanding low salt concentrations and average drought, and it flourishes in full sun and well-drained soil. While it may be capable of withstanding a certain amount of frost, protracted exposure to frigid temperatures may be detrimental.

Fig 07: Golden shower tree.

Mangifera indica

The mango, a flowering plant species belonging to the Anacardiaceae family, is scientifically known as Mangifera indica. It is an enormous ontemporary mangoes are characterized by two distinct genetic divisions: the "Southeast Asian type" and the "Indian type."

Fig 08: Mangifera indica.

1.10. Antidiabetic plants at Kishoreganj

Kishoreganj is characterized by a diverse array of medicinal plants that have been traditionally employed to address diabetes, a burgeoning public health issue. In numerous studies, a variety of plants, including Momordica charantia (bitter melon), Azadirachta indica (neem), Syzygium

cumini (black plum), and Tinospora cordifolia (heart-leaved moonseed), have demonstrated promising anti-diabetic potential. It is hypothesized that these plants modulate blood glucose levels by increasing peripheral glucose utilization, inhibiting glucose absorption, or enhancing insulin secretion. For example, Momordica charantia has been discovered to contain bioactive compounds such as charantin and polypeptide-p, which have the ability to mimic insulin and reduce blood sugar levels [57]. Similarly, Syzygium cumini seeds are abundant in flavonoids and alkaloids that have hypoglycemic properties [58]. Bangladesh is a significant source of potential natural remedies for diabetes management due to the combination of modern scientific validation and indigenous knowledge of these medicinal plants [59].

1.10.1. Bombax ceiba

Numerous species in the Bombax genus are commonly known as cotton trees, with Bombax ceiba being one of the most recognized. This tree is also referred to Bombax ceiba is a deciduous tree, characterized by its tall, slender, and straight trunk, which sheds its leaves seasonally. In spring, it produces striking five-petaled red flowers before new leaves appear [60]. Once mature, the capsules of the tree contain white filaments resembling cotton. The trunk is adorned with spines, serving as a defense mechanism against herbivores. Although the substantial trunk may suggest potential for timber production, the wood is relatively soft and not suitable for practical use.

Fig 09: Bombax ceiba.

1.10.2. Bryophyllum pinnatum (Lam.) Oken

The Bryophyllum pinnatum (Lam.) Oken plant is treated for a variety of maladies, including inflammation, infections, anxiety, restlessness, and sleep difficulties [61]. Despite the widespread recognition concentration of flavonoids, the unprocessed extracts of B.P. have not yet been determined to have either beneficial or harmful effects.

Fig 10: Bryophyllum pinnatum (Lam.) Oken.

1.10.3. Caesalpinia

Caesalpinia is g plants that belongs to the Fabaceae family. Determining the exact number of species within this genus has been notoriously challenging, with estimates ranging from 70 to 165 depending on the source. The classification of certain species as Hoffmannseggia can influence their distribution. This genus includes trees and shrubs that thrive in tropical and subtropical regions. The genus was named in honor of the Italian botanist, physician, and philosopher Andrea Cesalpino (1519–1603), reflecting significant respect for his contributions to botany [62]. Additionally, both the Caesalpinaceae family and the Caesalpinioideae subfamily derive their names from this genus.

Fig 11: Caesalpinia.

1.10.4. Cocos nucifera L

The coconut palm (Cocos nucifera) is the only extant species in the palm family Arecaceae. The fruit. Botanically, however, the coconut fruit is classified as a drupe, not a nut. The name "coconut" originates from the Portuguese word for "head" or "skull," inspired by the three indentations on the shell that resemble facial features. As an iconic symbol of tropical regions, the coconut palm is commonly seen along coastlines and is widely used for various purposes, including food, fuel, cosmetics, traditional remedies, and construction materials.

In tropical and subtropical areas, coconut milk and the flesh of the mature seed are staple foods. What distinguishes coconuts from other fruits is the are important ingredients in the food and cosmetic industries. Coconut water can be consumed as a refreshing drink or fermented to produce palm wine or coconut vinegar. Additionally, the fibrous husk, hard shell, and long, pinnate leaves of the coconut palm are used to create a variety of products, adding to its versatile role in daily life and home décor [63-64].

Fig 12: Cocos nucifera L.

1.10.5. Aegle marmelos

Indian Bael, which has been traditionally employed for a variety of medicinal purposes, demonstrates significant anti-diabetic properties. Research indicates that the extract of Aegle marmelos leaves enhances insulin sensitivity and glucose metabolism, thereby reducing blood glucose levels [65]. The hypoglycemic properties of the plant are attributed to the presence of alkaloids, coumarins, and flavonoids [66].

Fig 13: Aegle marmelos.

1.10.6. Asparagus racemosus

Shatavari is recognized for its capacity to regulate glucose levels. The root extracts have been demonstrated to improve glycemic control by promoting pancreatic β-cell regeneration and enhancing insulin secretion [67]. In Ayurvedic medicine, this adaptogenic herb is highly regarded for its ability to manage diabetes and its associated complications.

Fig 14: Asparagus racemosus.

1.10.7. Allium sativum

Garlic has been acknowledged for its potential to combat diabetes for an extended period of time. It contains sulfur-containing compounds, such as allicin and S-allyl cysteine sulfoxide, which increase insulin sensitivity and decrease fasting blood glucose levels [68]. Furthermore, garlic contributes to the management of diabetes by reducing oxidative stress and inflammation.

Fig 15: Allium Sativum.

1.10.8. Achyranthes aspera

Commonly referred to as prickly chaff flower, Achyranthes aspera is extensively employed in traditional medicine. Research indicates that its extracts exhibit hypoglycemic activity, which is likely achieved by enhancing glucose assimilation in tissues and stimulating insulin secretion from the pancreas [69]. Additionally, the plant possesses antioxidant properties that safeguard β-cells from oxidative injury.

Fig 16: Achyranthes aspera.

1.10.9. Andrographis paniculata

Andrographis paniculata, or green chiretta, has been discovered to substantially reduce blood sugar levels. Andrographolide and other diterpenoid compounds are recognized for their glucose-lowering and insulin-mimetic properties [70]. The plant's antioxidant capacity also contributes to the prevention of diabetic complications.

Fig 17: Andrographis paniculata.

1.10.10. Azadirachta indica

Neem is renowned for its potent anti-diabetic properties. Insulin receptor sensitivity is improved and glucose absorption is stimulated by its leaves, seeds, and bark, which have been demonstrated to lower blood glucose levels [71]. The hypoglycemic and anti-inflammatory properties of neem are attributed to its flavonoids, triterpenoids, and glycosides.

Fig 18: Azadirachta indica.

1.10.11. Adiantum capillus-veneris

This fern species, which is also known as maidenhair fern, has been traditionally employed to treat a variety of afflictions, including diabetes. The precise mechanisms by which its aqueous extracts exert a hypoglycemic effect are still being investigated. Research indicates that the plant may improve insulin sensitivity [73].

Fig 19: Adiantum capillus-veneris.

1.10.12. Aloe barbadensis

For its anti-diabetic properties, aloe vera is frequently employed in both traditional and modern medicine. Glucomannan is present in the gel, which aids in the reduction of blood glucose levels. Furthermore, aloe has been discovered to enhance glucose metabolism and increase insulin sensitivity [74].

Fig 20: Aloe barbadensis.

1.10.13. Amaranthus spinosus

In animal models, the extracts of Amaranthus spinosus have exhibited substantial hypoglycemic effects. It is an effective anti-diabetic agent due to the presence of phenolic compounds and flavonoids, which enhance glucose utilization and reduce hyperglycemia [75].

Fig 21: Amaranthus spinosus.

1.10.14. Annona squamosa

Hypoglycemic effects have been reported in the leaves of the sugar apple tree, which are likely the result of the presence of alkaloids and flavonoids that assist in the regulation of glucose metabolism [76]. Its anti-diabetic properties are associated with the enhanced release of insulin and the inhibition of carbohydrate digestive enzymes.

Fig 22: Annona squamosa.

1.10.15. Argemone mexicana

Mexican prickly poppy has been traditionally employed for its medicinal properties, which include its ability to manage diabetes. The plant's alkaloids and flavonoids have been demonstrated to enhance insulin sensitivity and reduce blood sugar levels [77].

Fig 23: Argemone Mexicana.

1.10.16. Coccinia grandis

In Ayurveda, ivy gourd is traditionally employed to facilitate the treatment of diabetes. The plant's hypoglycemic activity is associated with its capacity to increase glucose uptake by peripheral tissues and enhance insulin secretion [78]. It is frequently prescribed for patients with mild to moderate diabetes.

Fig 24: Coccinia grandis.

1.11. Natural Remedies for Diabetes

Diabetes mellitus is a chronic metabolic disorder that is distinguished by elevated blood glucose levels, which can result in severe complications if left untreated. Many individuals resort to natural remedies that are derived from medicinal plants due to the potential adverse effects of modern medications [79]. There is potential for these plant-based treatments to regulate blood sugar levels, as they are abundant in bioactive compounds, including alkaloids, flavonoids, terpenoids, and polyphenols. Traditional diabetes management in Bangladesh has involved the use of a diverse array of medicinal plants, including Azadirachta indica (neem), Momordica charantia (bitter melon), and Syzygium cumini (black plum). These plants are effective alternatives or complementary therapies to synthetic medications, as evidenced by their ability to improve glucose uptake, reduce oxidative stress, and enhance insulin secretion.

For instance, Momordica charantia contains compounds such as charantin and polypeptide-p, which possess insulin-like properties and aid in the reduction of blood sugar levels [80]. In the same vein, Azadirachta indica has been discovered to enhance insulin receptor sensitivity and decrease hyperglycemia, while Syzygium cumini seeds are abundant in hypoglycemic agents [81].

Bangladesh provides a rich ethnobotanical heritage for the development of sustainable and accessible diabetes treatments by utilizing these natural resources.

2.1. G Arumugam1, P Manjula2, N Paari2 (2013) "A review: Anti diabetic medicinal plants used for diabetes mellitus" Journal of Acute Disease, Volume 2, Issue 3, 2013, Pages 196-200.

The article "A review: Anti-diabetic medicinal plants used for diabetes mellitus" by G. Arumugam, P. Manjula, and N. Paari (2013), which was published in the Journal of Acute Disease, provides a comprehensive analysis of the medicinal plants that have been traditionally employed to manage diabetes mellitus, a chronic and progressively more common metabolic disorder. The authors emphasize the global increase in diabetes cases and the increasing reliance on plant-based remedies as alternatives to synthetic medications, which is primarily due to their long history of use and low level of adverse effects. Momordica charantia (bitter melon), Trigonella foenum-graecum (fenugreek), Azadirachta indica (neem), and Allium sativum (garlic) are among the medicinal plants that are renowned for their anti-diabetic properties. The review provides a comprehensive examination of these plants. These plants have been demonstrated to reduce blood glucose levels through a variety of mechanisms, including the stimulation of insulin secretion, the enhancement of glucose absorption, the inhibition of carbohydrate digestion, and the provision of antioxidant defenses. The primary agents responsible for these effects are bioactive compounds, including alkaloids, flavonoids, saponins, and polyphenols. The paper underscores the promising therapeutic potential of these plants, but it also emphasizes the necessity of conducting more comprehensive clinical trials, standardizing plant extracts, and conducting safety assessments to completely determine their efficacy and safety in the management of diabetes. The authors conclude by urging for additional scientific investigation to isolate and assess the active compounds, thereby integrating traditional knowledge with contemporary medical science to create natural, effective diabetes treatments.

2.2. Qais, N., Jahan, S., & Shajib, M. S. (2018). A Review on Anti-diabetic Plants. Dhaka University Journal of Pharmaceutical Sciences, 17(1), 139–152.

The review examines the anti-diabetic properties of a variety of medicinal plants, including those that are frequently encountered in South Asia, particularly Bangladesh. The bioactive components

of plants such as Momordica charantia (bitter melon), Coccinia indica (ivy gourd), Syzygium cumini (black plum), and Trigonella foenum-graecum (fenugreek) are assessed for their ability to regulate blood glucose levels. The paper elucidates the mechanisms by which these plants function, including the promotion of insulin secretion, the enhancement of glucose uptake, the inhibition of carbohydrate absorption, and the improvement of lipid metabolisms. Furthermore, the review emphasizes the function of terpenoids, saponins, flavonoids, and polyphenols in the exertion of these therapeutic effects.

They underscore the significance of additional research to isolate bioactive compounds, conduct clinical trials, and guarantee the safety and efficacy of these herbal remedies, as well as the potential of these plants as complementary therapies for diabetes management. This paper emphasizes the necessity of a more robust integration of modern pharmacology and traditional knowledge in order to create plant-based therapies that could mitigate the global diabetes crisis.

2.3. DK Patel ,SK Prasad ,R Kumar ,S Hemalatha. (2012) "An overview on antidiabetic medicinal plants having insulin mimetic property" Asian Pacific Journal of Tropical Biomedicine. Volume 2, Issue 4, April 2012, Pages 320-330.

The authors underscore the escalating global prevalence of diabetes and the constraints of synthetic medications, such as their high costs and potential adverse effects, which have resulted in an increasing interest in plant-based remedies. The review identifies a variety of medicinal plants that are recognized for their insulin-like effects, including Momordica charantia (bitter melon), Pterocarpus marsupium (Indian kino tree), Trigonella foenum-graecum (fenugreek), and Coccinia indica (ivy gourd). Bioactive compounds, such as alkaloids, flavonoids, glycosides, and terpenoids, are present in these plants. These compounds have the potential to mimic insulin by promoting glucose absorption, improving insulin receptor sensitivity, and stimulating β-cell function. The paper investigates the various mechanisms by which these plants assist in the regulation of blood sugar levels, including the stimulation of insulin secretion, the activation of insulin signaling pathways, and the protection of pancreatic cells from oxidative stress.

The significance of these medicinal plants as promising alternatives or supplements to synthetic pharmaceuticals, particularly for type 2 diabetes, is underscored by the authors. Nevertheless, they also acknowledge that additional research, particularly clinical trials, is required to verify the safety and efficacy of these plants. The paper concludes by urging the scientific community to further investigate these insulin-mimetic plants in order to identify effective, natural, and affordable diabetes treatments.

Chapter Three:
Purpose of The Study

3. Purpose of the study

There are the following objectives of this investigation:

● To examine the diabetic situation in Bangladesh.

● To determine which plant possesses antidiabetic properties.

● To offer a comprehensive examination of the utilization of antidiabetic botanicals.

● To ascertain the proportion of antidiabetic plant components that are used to manage diabetes in Bangladesh.

● To establish a novel academic discipline.

Chapter Four:

Methodology

4.1. Introduction:

This study with a comprehensive literature, examining a total of 111 papers. The review provides a foundation for understanding the current research and findings related to the topic, guiding the direction of the study.

4.2. Research Design:

This exploration was conducted using various online platforms, including websites, to gather relevant literature. These resources provided access to a wide range of academic papers, research articles, and studies that form the basis of the literature review, ensuring a comprehensive and thorough examination of the topic.

4.3. Method of Data Analysis:

After gathering the data, all information was meticulously checked for consistency. Any missing or conflicting data was identified and discarded to ensure the reliability of the study. Data analysis was conducted using the updated version of Microsoft Excel. The data collected spans from 1980 to 2023, providing a comprehensive timeline for analysis and ensuring the inclusion of both historical and contemporary research findings.

4.4. Ethical Considerations

The investigation members were granted verbal authorization prior to the commencement of the information collection. The respondents' anonymity was maintained, and the study at any time.

Chapter Five:
Findings and Discussion

5.1. The parcentage of antidiabetic plant used to treat Diabetes in Bangladesh.

Traditional methods for treating hyperglycemia are frequently cost-effective, simpler, and employ locally accessible botanicals that are recognized for their hypoglycemic properties. Some of these herbal treatments have attracted substantial research interest as a result of their antidiabetic properties. Ficus The prospective antidiabetic properties of a variety of plant portions, such as leaves, fruits, flowers, roots, bark, rhizomes, bulbs, latex, and seeds, are examined in the review. The leaves are the most frequently utilized component, comprising 32% of the total utilization. The following components are listed in order of frequency: fruits (14%), whole plants (12%), roots (11%), seeds (11%), foliage (9%), stems (6%), flowers (3%), and rhizomes (1%).

Parts of plants used in the treatment of Diabetes	Botanicals used to cure Diabetes, in part
Leaf	33%
Fruit	13%
The whole plant	11%
The root	12%
The seed	12%
The bark	8%
The stem	7%
The flower	2%
The rhizome	1%

Table 01: The percentage of antidiabetic plant used to treat Diabetes in Bangladesh [84].

5.2. Usage as an effective diabetes treatment

Following an exhaustive, it was determined that a variety of plant components, such as, and, in certain instances, entire plants, are employed to manage diabetes. The majority of these plants are typically consumed in the morning and are frequently immersed in water before consumption contains a comprehensive inventory of these formulations.

Plants Name	Family	The formulation used in local areas of Bangladesh
A. paniculata	Acanthaceae	Diabetes is often treated using drugs made from the whole plant. Before breakfast in the morning, 5 mg of the entire plant's crude paste extract is consumed.
A. conyzoides	Asteraceae	Two spoonfuls of the entire plant's macerated form are consumed each day.
S. chirata	Gentianaceae	Diabetes is treated using chirata root and a honey concoction. It is consumed in doses of 1-2 g every morning.
T. arjuna	Combretaceae	2 hours after eating, consume 3-6 g of Berks in powdered or macerated form with milk.
A.indica	Meliaceae	Two to three tablespoons of the water-based leaf extract paste should be consumed every day on an empty stomach.

Table 02: Usage as an effective diabetes treatments [85].

5.3. Hypoglycemic effects of *Plant.*

The aqueous extract of Andrographis paniculata was discovered to have the potential to inhibit glucose-induced hyperglycemia in studies involving normal rabbits. Nevertheless, an analysis of

numerous articles indicated that it did not have any impact on hyperglycemia induced by epinephrine. The fasting blood glucose levels were not substantially affected by the continuous administration of the extract over a six-week period. Nevertheless, numerous investigations Furthermore, the treatment of alloxan-induced diabetic rodents demonstrated a robust antidiabetic efficacy, as it was able to restore the impaired estrous cycle [86-87].

5.4. Diabetes and other functions.

The study's indicate that the leaves of tulsi (Ocimum sanctum) and neem (Azadirachta indica) may be effective in reducing blood pressure and alleviating symptoms in individuals with diabetes and hypertension. It is important to note that the anthropometric measurements of the participants did not differ significantly as a consequence of the addition of tulsi and neem leaf [90]. Additionally, it demonstrated traits that reduced hypolipidemia, total cholesterol, uric acid levels, and fasting blood sugar in hypoglycemic and diabetic rodents. The leaves are recognized for their multifaceted pharmacological effects, which and antimutagenic properties. Additionally, they have the potential to assist in the treatment of gastric ulcers and stimulate the immune system [91-92].

5.5. Medicinal plants of Bangladesh with antidiabetic activity and Probable mechanisms.

Table 3 below provides a summary of the bioactive components and prospective modes of action of a variety of antidiabetic medicinal plants in Bangladesh, as determined by research from numerous articles. This table offers a detailed analysis of the specific compounds present in these plants and delineates the potential mechanisms by which they may contribute to their antidiabetic properties. It also emphasizes their importance in traditional medicine and potential therapeutic applications.

Plant Name	Part of Plant Responsible	Effect on Diabetes
Bryophyllum pinnatum	Leaves	High concentration of flavonoids; effects on diabetes not fully established
Aegle marmelos	Leaves	Enhances insulin sensitivity, improves glucose metabolism, reduces blood glucose levels
Asparagus racemosus	Roots	Improves glycemic control, promotes pancreatic β-cell regeneration, enhances insulin secretion
Allium sativum	Bulbs (Garlic cloves)	Increases insulin sensitivity, decreases fasting blood glucose levels, reduces oxidative stress and inflammation
Achyranthes aspera	Whole plant (Extracts)	Enhances glucose assimilation, stimulates insulin secretion, provides antioxidant protection for β-cells
Andrographis paniculata	Whole plant (Extracts)	Lowers blood sugar levels, insulin-mimetic properties, prevents diabetic complications
Azadirachta indica	Leaves, seeds, bark	Lowers blood glucose levels, improves insulin receptor sensitivity, stimulates glucose absorption
Adiantum capillus-veneris	Aqueous extracts from the fern	Improves insulin sensitivity, exact mechanisms are still under investigation
Aloe barbadensis	Gel	Reduces blood glucose levels, enhances glucose metabolism, increases insulin sensitivity
Amaranthus spinosus	Whole plant (Extracts)	Exhibits hypoglycemic effects, enhances glucose utilization, reduces hyperglycemia
Annona squamosa	Leaves	Enhances insulin release, inhibits carbohydrate digestive enzymes, helps regulate glucose metabolism

Argemone mexicana	Whole plant (Extracts)	Enhances insulin sensitivity, reduces blood sugar levels
Coccinia grandis	Whole plant (Extracts)	Increases glucose uptake by tissues, enhances insulin secretion, used in Ayurveda for diabetes treatment

Table 03: Part of plant responsible for Anti diabetic effect [93].

5.6. Discussion

The plants mentioned exhibit diverse mechanisms of anti-diabetic activity, mainly through their ability to regulate glucose metabolism, enhance insulin sensitivity, or promote insulin secretion. Many of these plants, such as Aegle marmelos and Asparagus racemosus, work by improving insulin sensitivity and glucose uptake, making them effective in managing blood glucose levels. Allium sativum (garlic) and Azadirachta indica (neem) are particularly noted for reducing oxidative stress and inflammation, which are common complications in diabetes. Others, like Aloe barbadensis and Coccinia grandis, act by promoting glucose metabolism and increasing tissue uptake of glucose, providing a natural method for blood sugar regulation. Plants like Andrographis paniculata and Achyranthes aspera not only help in glucose management but also offer protection to pancreatic β-cells, supporting their regeneration and function. The variation in active plant parts—ranging from leaves, roots, and seeds to whole plant extracts—suggests that different compounds such as flavonoids, alkaloids, and glycosides are responsible for their effects, making these plants potential candidates for natural remedies in diabetes management.

Chapter Six:

Conclusion

6. Conclusion

The promising role of medicinal plants native to the Kishoreganj region in Bangladesh as potential treatments for diabetes. This region has a rich biodiversity with numerous plants traditionally used in folk medicine that have shown anti-diabetic properties in recent research. Compounds from plants such as Momordica charantia (bitter melon), Trigonella foenum-graecum (fenugreek), and Azadirachta indica (neem) are found to modulate blood glucose levels, improve insulin sensitivity, and reduce oxidative stress, which are critical in diabetes management.

Chapter Seven:

Reference:

7. Reference

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