



**Daffodil**  
*International*  
**University**

**Project On**

A Review on Natural Treatment of Type-2 Diabetes

**Submitted To**

The Department of Pharmacy,  
Faculty of Allied Health Sciences,  
Daffodil International University

In the partial fulfillment of the requirements for the degree of Bachelor of Pharmacy

**Submitted By**

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Batch: 20<sup>th</sup>

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## APPROVAL

This project, A review on Natural Treatment of Type-2 Diabetes, submitted to the Department of Pharmacy, Faculty of Allied Health Sciences, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of Bachelor of Pharmacy and approved as to its style and contents.

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**ABSTRACT**

Type 2 diabetes is a disorder that affects the body's capacity to regulate and use sugar as fuel. As a result of this chronic condition, too much sugar is continually running through the body. Over time, high blood sugar levels may cause problems with the cardiovascular, nervous, and immunological systems. This study's objective is to examine natural treatments for Type-2 Diabetes. The examination is preceded with a literature study. For this research, around 125 publications are evaluated. Several websites were used to prepare this investigation's literature search. All data was gathered between 1984 and 2022. After reviewing all the data, It was discovered that now a days natural treatment is used more all over the world beside the allopathic. Type 2 diabetes patients, aloe vera gel may work as a safe antihyperglycemic and antihypercholesterolemic drug without having a substantial impact on other normal blood lipid levels or liver/kidney function, according to clinical research. According to a study, aloe vera was administered to rabbits to observe its impact on fasting blood glucose levels. Diabetes is a severe, perhaps fatal, condition that has to be closely monitored in order to be adequately controlled with medicine and lifestyle changes. Type 2 diabetes may be reversed or managed by adopting healthy lifestyle changes such as eating a well-balanced diet, exercising often, and losing weight.

**Keywords:** Antidiabetic, Pharmacological, Diabetes, Drug.

## DECLARATION

I, at this moment, announce that I am carrying out this project study under the supervision of "Dr. Mohammed Shafikur Rahman," Associate Professor, Department of Pharmacy, Faculty of Allied Health Sciences, Daffodil International University, Impartial Compliance with the Bachelor of Pharmacy Degree Requirement (B. Pharm). This project, I declare, is my original work. I also state that neither this project nor any part thereof has been submitted for the Bachelor's award or any degree elsewhere.

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I place on record my sincere thank you to **Professor Dr. Abu Naser Zafar Ullah**, Dean, and Faculty of Allied Health Sciences of Daffodil International University, for the continuous encouragement.

I am also grateful to my research supervisor **Dr. Mohammed Shafikur Rahman**, Associate Professor, Department of Pharmacy, Daffodil International University. I am incredibly thankful and indebted to him for sharing his expertise and sincere and valuable guidance and encouragement extended to me.

I take this opportunity to thank all Department faculty members for their help and support. I also thank my parents for their unceasing encouragement, support, and attention. I am also grateful to my partner, who supported me through this venture.

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**Author**

Sirajum Munira

***DEDICATION***

*I dedicate this work to my parents and my teachers and my friends.*

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# *Introduction*



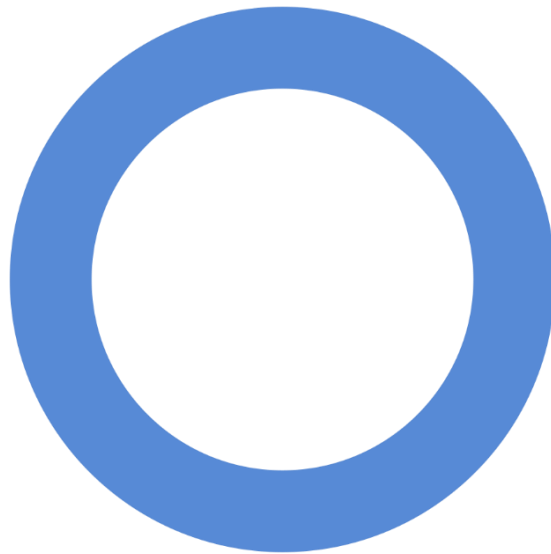
## Diabetes

Diabetes, often known as diabetes mellitus, is a spectrum of metabolic illnesses that are defined by chronic hyperglycemia. Diabetes is the most prevalent form of diabetes (high blood sugar). Among the symptoms that you may experience are extreme thirst, hunger, and urination. Diabetes that is not under control may result in a number of significant consequences [01]. A hyperosmolar hyperglycemic condition, diabetic ketoacidosis, or even mortality might be among the acute consequences [02]. The results may be catastrophic in the long run, leading to illnesses such as coronary heart disease, stroke, chronic renal disease, foot ulcers, nerve damage, eye damage, and cognitive impairment. Diabetes is caused by an insufficient production of insulin in the pancreas as well as an improper response of body cells to insulin. [03] Insulin is a hormone that facilitates the transport of glucose into cells so that it may be used as a source of fuel. [04] Diabetes mellitus types 1, 2, and 3 are the most prevalent forms of the illness. Type 1 diabetes is the most severe kind.

- Beta cells in the pancreas are damaged in type 1 diabetes, resulting in insulin deficiency. Formerly known as juvenile Diabetic or insulin-dependent diabetes mellitus, this form of the disease is now just called Diabetes. The reduction of beta cells is a symptom of an autoimmune response, the root cause of this issue. [05] Until now, the cause of this autoimmune response has been unknown. Although adults are not immune to developing type 1 diabetes, it mostly affects children and teenagers. [06]
- Insulin resistance, also known as the inability of cells to react appropriately to insulin, is the fundamental cause of type 2 diabetes. As the condition worsens, it is possible that a deficiency in insulin may become noticeable. [07] Formerly referred to as "non-insulin-dependent diabetes mellitus" or "adult-onset diabetes," this kind of diabetes is now more often recognized as "type 2 diabetes." The elderly were historically the group most likely to be diagnosed with type 2 diabetes; nevertheless, rising rates of obesity among adolescents have led to a rise in the prevalence of the illness in younger people. [08] Lack of physical activity and being overweight are two significant causes of this condition.
- Women who have never been diagnosed with diabetes but who get pregnant have an increased risk of developing gestational diabetes, which is defined by consistently high levels of blood sugar. Women whose diabetes was brought on by pregnancy often see a

return to normalcy in their blood sugar levels not long after giving birth. On the other hand, mothers who have experienced gestational diabetes are more likely to acquire type 2 diabetes after giving birth to their children. [09]

Insulin must be administered by injections subcutaneously in order to control type 1 diabetes. Following a diet that is balanced, participating in regular physical exercise, obtaining and maintaining a healthy body weight, and avoiding the use of tobacco products are all important components of both the prevention of type 2 diabetes and the management of the disease. Oral antidiabetic medications may be used to treat type 2 diabetes as a treatment option, either in conjunction with insulin therapy or on their own. [10] It is crucial for those who have the illness to maintain proper levels of foot and eye care as well as to keep their blood pressure under control. Oral use of insulin and some other medications might cause blood sugar levels to drop (hypoglycemia). [11] Surgical weight reduction may be an effective treatment option for type 2 diabetes in patients who are obese and meet the criteria for the condition. [12]



**Fig 01: Diabetes symbol** [Courtesy; google]

Diabetes that was diagnosed during pregnancy often goes away following the delivery of the baby. Diabetes was estimated to affect 8.8% of the world's adult population, which equated to around 463 million individuals in 2019. Type 2 diabetes is responsible for around 90 percent of all cases of diabetes. The incidence rates for men and women are not significantly different from one another. [15] The current state of the market is indicating that interest rates will continue to climb

for the foreseeable future. If a person has diabetes, their risk of passing away at a young age is at least two times higher than average. Diabetes was the cause of death for over 4.2 million people worldwide in 2019. Because of this, it comes in at number seven on the list of worldwide killers, where it rates quite high. [15-16] It was estimated that diabetes-related medical treatment will cost a total of 727 billion US dollars to provide over the globe in the year 2017. In 2017, the cost of diabetes-related medical treatment in the United States was a startling 327 billion dollars. [17] The medical costs associated with diabetes are sometimes 1.5 to 2 times higher than the average cost. [18]

### **History of Diabetes**

An Egyptian literature dated to about 1500 BCE spoke to diabetic illness for the first time, describing it as "too much emptying of the urine"[19]. This was the first time the disease was ever documented. [20] The Ebers papyrus contains instructions on what beverages are appropriate to consume under a variety of circumstances. [21] It is generally agreed upon that type 1 diabetes was the very first manifestation of the condition to be identified and recorded. Nearly about the same time, medical professionals in India identified the same condition and designated it by the term madhumeha, which may be translated to mean "honey urine." They noticed that ants were attracted to the urine as a side effect, which was interesting. According to popular belief, the Greek physician Apollonius of Memphis is the one who first used the phrase "diabetes," which literally means "to pass through." The phrase was not used for the first time that is recorded until the year 230 BCE. During the period of the Roman Empire, becoming sick was an extremely uncommon event, thus it's reasonable to conclude that people seldom became sick. Galen said that over the whole of his professional career, he had only seen two instances similar to this one. It is conceivable that this is the product of previous lifestyle and dietary decisions, or it is possible that the clinical indications weren't noticed until the illness had already progressed. Both of these possibilities are feasible. Galen referred to the condition as "diarrhea of the urine" to characterize it (diarrhea urinosa). Aretaeus of Cappadocia's book is the earliest surviving source on the condition of Diabetes. It was the first time the ailment was discussed in writing form (2nd or early 3rd century C.E.). By doing so, he mirrored the theories of the so-called "Pneumatic School," which held that exposure to damp and cold circumstances contributed to the beginning and spread of the illness. He also echoed the beliefs of the "Pneumatic School." He postulated that Diabetes

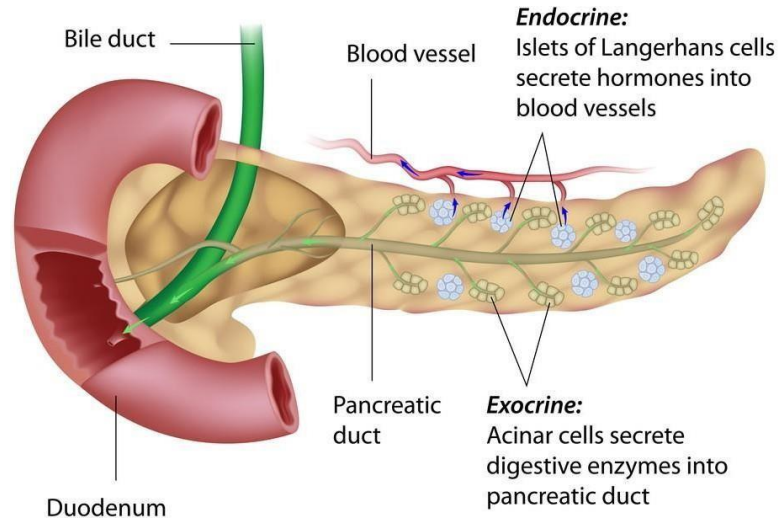
was associated with a number of other illnesses and disorders, and he went on to address how to differentiate the symptoms of Diabetes from those of other ailments, such as snakebite, which also cause an increase in thirst. After the publication of the Latin translation of his work in Venice in the year 1552, his body of work began to gain widespread recognition across the Western world. [22] Sushruta and Charaka, two Indian doctors, made the first discovery that there are two unique kinds of diabetes, each of which should be treated as their own illness some time between 400 and 500 CE. One kind of diabetes is associated with being young, whereas the other form is associated with being overweight. Insulin was first developed and perfected in 1921 and 1922, respectively, in Canada by Frederick Banting and Charles Herbert Best. As a direct consequence of this, a successful therapy for diabetes, which had been on the market since the beginning of the 20th century, was at last able to get off the ground. After that, in the 1940s, a long-acting form of insulin called NPH was developed as a response to the diabetes pandemic.

### **Etymology**

In Ancient Greek, the term diabetes meant "a passing through; a siphon," and the Latin name for the illness derives from the Greek phrase that was first used to describe the condition. [23] Aretaeus of Cappadocia, a Greek physician who practiced in the 1st century C.E., is credited with giving the condition its current term, urolithiasis, which literally translates to "excessive discharge of urine." [24-25] The root  $\nu$  of the Greek word diabainein, which means "to pass through," comes from the prefix dia-, which means "through," and the verb mainaino, which means "to go." The English translation of the Greek term is "to go through." 1425 is the year that is credited as being the first time the term "diabetes" was used in a medical setting. The origin of the modern English term "mellitus" may be traced back to the ancient Latin word "mellitus," which meant "mellite" (i.e., sweetened with honey; [26] honey-sweet [27]). Mel, which is the Latin word for honey, is the origin of the medical term Mellitus. This name is formed from the Latin terms for sweetness (Mel) and pleasantness (Mel), together with the suffix -tus (equivalent to the English -site). Thomas Willis, in 1675, added the suffix "mellitus" to the word "diabetes" to denote the illness. This was done because persons with diabetes often have urine that has a sweet taste (glycosuria). Ancient cultures such as the Greeks, Chinese, Egyptians, Indians, and Persians all noticed that urine had a particularly pleasant taste, nearly similar to the sweetness of sugar. [28]

## **Pathophysiology**

The hormone insulin regulates how much glucose is taken up from the blood into most cells, with the exception of smooth muscle, which is controlled by insulin's interaction with IGF-1. Because of this, insulin insufficiency or insulin receptor insensitivity plays a crucial role in the development of all types of diabetes. [29] The three primary ways that glucose enters the body are via the digestion and absorption of food, the breakdown of glycogen in the liver (also known as glycogenolysis) (glycogen is a storage form of glucose), and the process of gluconeogenesis (the production of glucose from non-carbohydrate substrates). [30] Insulin controls blood sugar levels fairly accurately. Insulin's roles include blocking glucose from being released from glycogen, increasing its storage as glycogen, and speeding the movement of glucose into fat and muscle cells. Insulin also plays a role in maintaining normal blood sugar levels. [31] The beta cells (-cells) in the islets of Langerhans of the pancreas secrete insulin in response to an increase in blood glucose levels, which often occurs after eating. Insulin is required by about two-thirds of all cells in the body in order for those cells to be able to use glucose from the blood for energy, conversion into other molecules, or storage. When there is a decrease in the amount of sugar in the blood, beta cells produce less insulin, and the rate at which glycogen is converted into glucose slows down. The hormone glucagon, which has an effect that is opposite to that of insulin, is essential to the control of this process. There are many factors that may inhibit cells from taking up glucose, including a lack of insulin, insulin resistance, or faulty insulin; [32] correspondingly, these factors hinder glucose from being stored in the liver and muscles. Hyperglycemia, often known as excessive blood sugar, is one of the consequences of this condition. Other consequences include reduced protein synthesis and metabolic acidosis (when insulin is completely absent). When the kidneys reach their glucose reabsorption threshold, the body starts excreting the sugar as urine, and this process continues until the kidneys reach their next threshold (glycosuria). This condition causes polyuria (excessive urination) as well as a loss of fluid because the osmotic pressure of the urine rises while the kidney's ability to reabsorb water declines. A decrease in blood volume prompts the body to draw water from other sources, leading to dehydration as well as an increase in the need to drink (polydipsia). Because your cells aren't receiving the glucose they need, an additional benefit of eating more than is required is that it may cause you to put on weight (polyphagia). [33]



**Fig 02: Beta cells** [Courtesy; google]

## The signs of Diabetes

The onset of Diabetes is accompanied by blood sugar increases.

### General signs

Diabetes's typical signs and symptoms include:

- ✓ increased appetite
- ✓ more hunger for food, weight loss
- ✓ urinary frequency hazy vision
- ✓ severe weariness, non-healing wounds

### The signs in males

Men with Diabetes may exhibit the following symptoms in addition to the common ones:

- ✓ Less sexual interactions cause erectile dysfunction (E.D.)
- ✓ weak muscle power

### Signs in women

Diabetes in women may cause symptoms like:

- ✓ vulvar aridity
- ✓ infections of the urinary tract
- ✓ Candida infections
- ✓ itching, dry skin [34-35]

## Why does Diabetes develop?

No of the kind; having too much glucose flowing in your circulation is what causes Diabetes. However, depending on the kind of Diabetes you have, there are several causes for elevated blood glucose levels.[36]

- **Causes of Type 1 diabetes:** The cells in your pancreas that are responsible for producing insulin are attacked and killed by your body. Without insulin, glucose levels in your circulation rise, as glucose is unable to enter your cells and therefore builds up. The patient's genes may also have a role in their condition in certain cases. A reaction from the immune system might potentially be triggered by a virus.
- **Type 2 diabetes and prediabetes cause:** Insulin is unable to do its function properly in your body because the cells restrict it from allowing glucose to enter the cells. You have reached a point when the cells in your body are resistant to the effects of insulin. Your pancreas is not able to keep up with the need to create enough insulin to overcome this resistance. Your blood glucose levels rise as a result of this change.
- **Gestational Diabetes:** During pregnancy, the placenta will secrete hormones that will make your cells more resistant to the effects of insulin. These hormones will be released into your bloodstream. Your pancreas does not produce enough insulin to overcome this resistance because of its limited production. Your blood still has an excessive amount of glucose in it. [37-38]

## Type of Diabetes

- a. Type 1 diabetes.
- b. Type 2 diabetes.
- c. Gestational Diabetes.
- d. Maturity onset diabetes of the young (MODY)
- e. Neonatal Diabetes.



- f. Wolfram Syndrome.
- g. Alström Syndrome.
- h. Latent Autoimmune Diabetes in Adults (LADA)

### **Type one Diabetes**

Diabetes type 1, sometimes known as juvenile diabetes, is an autoimmune illness in which the body's immune system erroneously assaults the body's own insulin-producing cells. Type 1 diabetes, or T1D, is frequently referred to as juvenile diabetes (beta cells). Insulin is a peptide hormone that is involved in both the creation of glucose-based cellular energy as well as the regulation of blood sugar levels. Insulin is essential for cellular energy generation. Before beginning therapy, there is a normal rise in the amount of sugar in the blood. An increase in the amount of urine that is produced, increased thirst, and increased appetite are all symptoms of high blood sugar. More severe effects of high blood sugar include weight loss and decreased vision. A person may also have double vision, excessive tiredness, and a slow recovery from wounds, among other symptoms. In most cases, the development of symptoms occurs in a few of weeks. Experts think that both hereditary and environmental variables play a role in the development of type 1 diabetes; nevertheless, they have not yet been able to identify the specific origin of this kind of diabetes. The immune system's effort to destroy insulin-producing beta cells in the pancreas is central to the process. These cells are located in the pancreas. A diagnosis of diabetes may be made by testing the patient's blood sugar or their glycated hemoglobin (HbA1C). Testing for autoantibodies is the procedure that has shown to be the most accurate in identifying type 1 diabetes from type 2 diabetes. At this point, there is no way to stop someone from developing type 1 diabetes. Treatment with insulin is now required in order to live. Diabetes may be treated with either injections given under the skin or with an insulin pump. Alterations to one's diet as well as their regular exercise program are essential components of diabetes treatment [39]. If the condition is not controlled properly, there is an increased chance of diabetes-related complications. Two of the complications that may arise quickly from diabetes are ketoacidosis and nonketotic hyperosmolar coma. Diabetes may lead to a number of long-term consequences, including heart disease, stroke, kidney failure, foot ulcers, and even loss of eyesight. Because insulin reduces blood sugar, an excessive amount of it might cause complications related to low blood sugar. Type 1 diabetes may account for as little as 5–10% of all occurrences of diabetes. Nobody really knows

how many people all throughout the globe are being impacted by this. On the other hand, it is anticipated that over 80,000 young people will be given a diagnosis every single year. It is projected that one million to three million people in the United States might be impacted by this [40]. In East Asia and Latin America, the annual rate of new cases is around one per one hundred thousand, but in Scandinavia and Kuwait, the rate is closer to thirty per one hundred thousand. [41] In the majority of instances, the first signs and symptoms of the condition appear in younger individuals.

### **Gestational Diabetes**

It is possible for a woman who does not ordinarily have high blood sugar levels to develop gestational diabetes if she has high blood sugar levels during her pregnancy. Even though the majority of women who have gestational diabetes are not aware that they have the condition, it is associated to a number of significant complications, such as preeclampsia, depression, and the need for a C-section delivery. Jaundice, being born larger than expected for their gestational age, and having postnatal hypoglycemia are all conditions that are more likely to occur in infants whose mothers had gestational diabetes that was not well managed. If diabetes is not treated, there is a possibility that the baby may not be born alive. Children face a much greater danger of developing type 2 diabetes and obesity in the long run. Insulin resistance or a decrease in insulin production may both lead to gestational diabetes. Gestational diabetes is more common in women who are overweight. If a person is overweight, if they have a family history of diabetes, if they suffer from polycystic ovarian syndrome, or if they have already had diabetes during pregnancy, then they have an increased chance of acquiring type 2 diabetes. Bloodwork provides a wealth of information about a patient. Screening should be performed on pregnant women between the ages of 24 and 28 who have a low risk. If your doctor considers that you have a higher than average risk of complications during pregnancy, he or she may suggest that you start prenatal testing as soon as the very first appointment. Before attempting to conceive a child, it is important to ensure that your weight is at a healthy level and that you are receiving sufficient amounts of regular exercise. This will help reduce the likelihood that you will have any issues throughout your pregnancy. Gestational diabetes may be managed by following a diabetic diet, engaging in regular physical activity, using oral drugs (such as metformin), and, in very unusual circumstances, receiving insulin injections. Altering one's diet and the amount of physical activity they get may probably

assist the majority of women [42] maintain their blood sugar under control. Those who are afflicted are urged to keep a close eye on their blood glucose levels every four hours. It is not feasible to place an adequate amount of importance on the benefits of nursing. As a result, it is strongly suggested that new mothers get started as soon as they can. It is estimated that gestational diabetes will affect between 3 and 9 percent of all pregnancies. This kind of thing often takes place during the third trimester of a pregnancy. It only affects 1% of those under the age of 20, whereas it strikes 13% of people 44 and over. Some of the most vulnerable members in society are members of ethnic minorities, namely Asians, Native Americans, Indigenous Australians, and Pacific Islanders. After delivery, glucose levels returned to normal in almost ninety percent of pregnant women whose glucose levels had increased during pregnancy. Despite this, women have a higher risk of developing type 2 diabetes [43].

### **Maturity onset diabetes of the young (MODY)**

Diabetes mellitus type 2 is inherited by a defective autosomal dominant gene or genes that interfere with insulin synthesis. This kind of diabetes, also known as maturity-onset diabetes of the young, is caused by type 2 diabetes mellitus (MODY). MODY is often referred to as monogenic diabetes [44], in contrast to the more prevalent forms of diabetes (especially types 1 and 2), which have more intricate combinations of causes, including a large number of genes and a variety of environmental factors. MODY 2 and MODY 3 are the forms of MODY that are seen most often. [45] Robert Tattersall and Stefan Fajans were the first to describe the disease that is now known as young-onset or adult-onset diabetes. Their key study was published in the journal *Diabetes* in 1975 and received a lot of attention at the time. [46]

### **Neonatal Diabetes**

Neonatal diabetes mellitus causes an infant's body to be unable to produce or make use of insulin, both of which are symptoms of the condition (NDM). A single gene is responsible for the development of non-insulin-dependent diabetes mellitus, often known as NDM. This kind of diabetes typically manifests itself during the first six months of a person's life. Because they do not produce enough insulin, infants tend to have a larger accumulation of glucose in their blood. This condition affects the newborns of just one baby out of every 100,000 to 500,000 overall. [47] NDM is sometimes misinterpreted as type 1 diabetes, which is a far more common form of

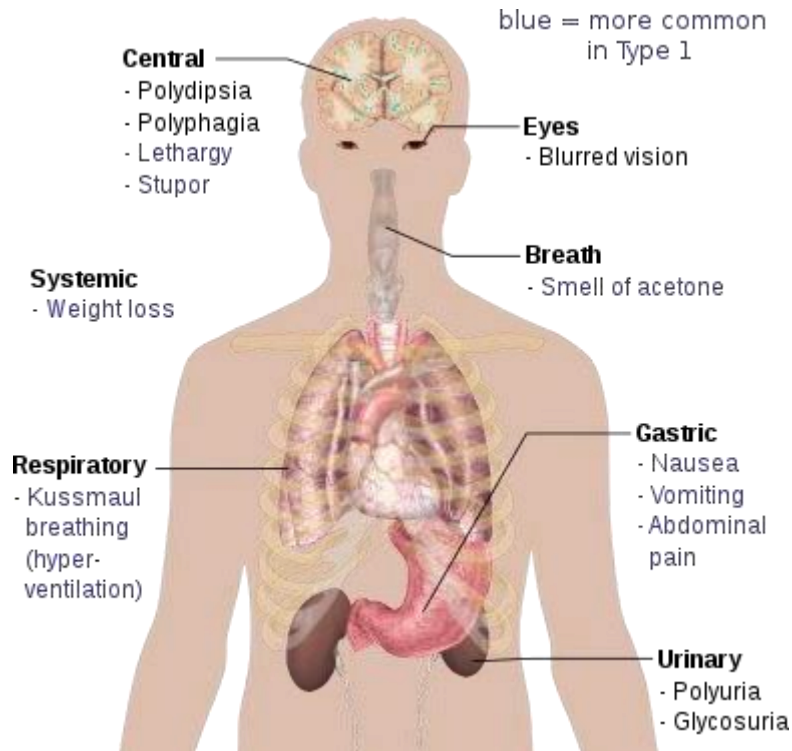
diabetes. On the other hand, type 1 diabetes does not often manifest itself until beyond the first six months of a person's existence. The second kind of NDM is referred to as "permanent neonatal diabetes mellitus," and it remains with the patient for the remainder of their life. A disease known as transitory neonatal diabetes mellitus may occasionally develop in neonates and then disappear for a period of time before reappearing (TNDM). [1] Researchers have identified the genes that are to blame for NDM. There is a possibility that the development of NDM might be brought on by alpha-cell dysfunction, beta-cell dysfunction, or accelerated beta-cell dysfunction [48,49]. Diabetes that is caused by a monogenic defect may be passed on from parents to children and even grandchildren. The manner in which each NDM-related gene is passed on to their offspring is unique.

## **Type two Diabetes**

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Diabetes type 2, formerly known as adult-onset diabetes, is a form of the metabolic illness that is characterized by poor glucose homeostasis, insulin resistance, and inadequate insulin secretion. Type 2 diabetes was once known as adult-onset diabetes. People may find themselves experiencing an increase in thirst, an increase in the need to urinate, and a loss of weight for no apparent reason. There is a possibility of experiencing adverse effects such as wounds that may not heal, an increase in appetite, and tiredness. The majority of symptoms take their time making their appearance. A high blood sugar level may have serious long-term repercussions, such as an increased risk of cardiovascular disease, stroke, and diabetic retinopathy, all of which can lead to eyesight loss, renal failure, and in the most extreme instances, amputations owing to reduced blood circulation in the limbs. [50] Although ketoacidosis is not very prevalent, a rapid development of the disease known as hyperosmolar hyperglycemia is always a possibility. Being overweight and not getting enough exercise are the two primary risk factors that are associated with having type 2 diabetes the most often. There are certain individuals who are more likely to get an illness due to their family history. Over ninety percent of those who are diagnosed with diabetes have type 2 diabetes.

## Natural Treatment of Type-2 Diabetes



**Fig 03: Type 2 diabetes** [Courtesy; google]

Diabetes type 1 and other kinds of diabetes are included in the ten percent of all instances of diabetes that are not associated with pregnancy or type 2. Insulin's ability to control blood sugar levels is hindered when beta cells in the pancreas are lost owing to an autoimmune disease. This makes insulin less effective overall. [51-52] A battery of blood tests, including the fasting plasma glucose test, the oral glucose tolerance test, and the glycated hemoglobin test, are required to diagnose diabetes (A1C). You may reduce or eliminate your risk of having type 2 diabetes by keeping a healthy weight, engaging in regular physical activity, and eating appropriately (high in fruits and vegetables and low in sugar and saturated fats). Altering one's diet and engaging in physical activity are both components of the therapy. When other methods of controlling glucose levels are not adequate, metformin is often utilized. Injections of insulin could be required for a lot of different people. [53] If you use insulin, you need to check your blood sugar levels more often than if you take oral medicine; however, people who take oral medication may not. If a

person has diabetes and is very obese, bariatric surgery may be able to help improve their condition. Since the 1960s, there has been a discernible rise in the frequency of occurrence of both obesity and type 2 diabetes. From 1985 to 2015, the number of people throughout the globe who were diagnosed with the illness climbed from 30 million to 392 million. Despite the fact that symptoms don't often appear until middle age or later in life, a growing number of people in their younger years are being diagnosed with type 2 diabetes. [54] People who have diabetes of the type 2 kind often have a life expectancy that is 10 years shorter than average. Diabetes was one of the earliest medical conditions to be written about and recorded. An Egyptian record dating back to about 1500 BCE has the first mention of it that is now available. [55] In the 1920s, researchers discovered that insulin was an essential component in the treatment and management of diabetes. [56]

### **History Type 2 diabetes**

One of the first diseases to be recorded was diabetes, which was described as "too much emptying of the urine" in an Egyptian text that was written about 1500 BCE. This was one of the earliest known instances of the disease. It is believed that type 1 diabetes was present in the first patients who reported having the condition. In about the same time period, medical professionals in India identified the illness and gave it the term madhumeha, which may be literally translated as "honey urine." They also noticed that ants were drawn to the urine for some reason. Around 230 BCE, a Greek physician by the name of Apollonius Memphites was the first person to use the term "diabetes," which literally translates to "to pass through." Galen, a physician who worked during the time of the Roman empire and practiced medicine, said that throughout the course of his career, he had only seen two patients who were affected by the illness. [57] In the years between 400 and 500 AD, two Indian physicians named Sushruta and Charaka were the first to differentiate between type 1 diabetes and type 2 diabetes. It was formerly believed that type 1 diabetes was more frequent in younger individuals, whereas type 2 diabetes was supposed to be more common in persons who were overweight. It wasn't until the early part of the 20th century that a treatment that was really successful was developed. Insulin was first discovered by Frederick Banting and Charles Best, two Canadians, in 1921 and 1922 respectively. Following this, in the 1940s, a long-acting form of NPH insulin was created as a solution to the issue in order to combat diabetes. In the year 1916, Elliot Joslin proposed the concept that diabetes patients would benefit from going without food for

lengthy periods of time as a treatment option. This conclusion has been confirmed by further research, and at this point, the most effective therapy for type 2 diabetes is to achieve and maintain a healthy weight. [58]

### **Pathophysiology of Type 2 diabetes**

The failure of beta cells, which leads to insulin resistance and type 2 diabetes. Insulin resistance is a condition in which cells are unable to react normally to the presence of insulin. Adipose tissue, liver, and muscles are the tissues most likely to be affected by insulin resistance. The release of glucose by the liver is stifled by insulin. Because of insulin resistance, glucose is released in an abnormal manner by the liver. While some persons have a lower risk of beta cell malfunction and a higher risk of insulin resistance, others have a lower risk of beta cell dysfunction and a higher risk of insulin resistance. Increased breakdown of fat cells, resistance to the hormone incretin, high blood levels of glucagon, renal retention of salt and water, and poor regulation of metabolism by the central nervous system are all potential contributing factors in the development of type 2 diabetes and insulin resistance. [59] Insulin resistance is a risk factor for developing diabetes, although not everyone who has it goes on to get the disease. Beta cells expand during the early stages of insulin resistance as a compensatory mechanism for insulin insensitivity. When a person develops type 2 diabetes, they experience a loss of around fifty percent of their beta cells. Apoptosis occurs in beta cells upon activation of FOXO1 by fatty acids. Insulin resistance brought on by obesity and type 2 diabetes have unclear causes. The lipid metabolism of the liver and muscle cells, as well as the creation of ATP, may contribute to insulin resistance. According to recent findings, the hypothalamus is involved in insulin resistance. The chance of developing diabetes is raised by the DUSP8 gene. A neural signaling protein that is produced in the hypothalamus by this gene. Infusions of hypothalamic leptin into diabetic rats reduces both blood glucose levels and insulin resistance. The hormone leptin stimulates cells in the hypothalamus, which in turn helps to control blood sugar levels. [60] Therefore, hypothalamus and pancreatic endocrine cells may be responsible for the development of type 2 diabetes. Glucose levels in the blood are regulated by autonomic nerve projections from cells in the hypothalamus. The autonomic innervation of the liver as well as the muscles enhances glucose absorption. Patients with diabetes have improper glucose regulation in their autonomic nervous system. Leptin-sensitive neurons that regulate glucose become resistant with age and when people eat diets rich in fat. Food consumption,



obesity, and blood glucose levels are not under control when neurons are resistant to leptin. [61-62] The riddle that is type 2 diabetes includes the mystery of where this insensitivity to leptin came from in the body. Even in severely diabetic animals, a single intrahypothalamic infusion of FGF1 is sufficient to restore blood glucose levels for an extended period of time in diabetic rats. [63] Diabetes may be cured by activating astrocytes. The hypothalamic astrocytes that are the target of FGF1 are the ones that produce Fatty Acid Binding Protein 7 (FABP7). This protein has an effect on leptin-sensitive neurons and modulates the activity of those neurons. As a result, malfunction in FABP7+ astrocytes might be the root cause of leptin and insulin resistance associated with aging and high-fat diets. As they age, FABP7+ astrocytes produce cytoplasmic granules, which originate from the degeneration of mitochondria. This mitochondrial degeneration is caused by an increased consumption of fatty acids as well as enhanced mitochondrial oxidation. [64-65] It is possible that pathological mitochondrial degeneration in these cells may affect their normal functioning, which will in turn disturb the hypothalamus region's ability to regulate blood glucose levels.

### **Signs and symptoms of Type 2 diabetes**

Diabetes is characterized by a number of telltale symptoms, the most prominent of which are polyuria, polydipsia, polyphagia, and weight loss. At the time of diagnosis, extremely common presenting symptoms include blurred vision, itching, peripheral neuropathy, recurrent vaginal infections, and tiredness. Another symptom that may present itself is an inability to taste things. [66] However, a significant number of individuals do not exhibit any symptoms in the early stages and are instead discovered via the use of regular tests. Some people diagnosed with type 2 diabetes may have a condition known as hyperosmolar hyperglycemic state (a condition of very high blood sugar associated with a decreased level of consciousness and low blood pressure).

### **Complications**

Diabetes type 2, a chronic illness, is associated with a reduction of around 10 years in a person's expected lifespan. This is due, in part, to the many unfavorable outcomes that can occur as a result of having diabetes, including a two- to fourfold increased risk of cardiovascular disease (including ischemic heart disease and stroke), a factor 20 increased risk of lower limb amputations, and an increased risk of having to be hospitalized. In the industrialized world, diabetes mellitus type 2 is the major cause of both nontraumatic blindness and renal failure, and it is growing increasingly



prevalent in other areas of the world as well. [67] An increasing prevalence of cognitive impairment and dementia has been connected to a number of diseases, including Alzheimer's and vascular dementia, amongst others. [68] Acanthosis nigricans, an abnormal darkening of the skin, sexual dysfunction, and recurring infections are a few of the other symptoms. In addition, there is a correlation between having type 2 diabetes and having a milder kind of hearing loss. [69]

### **Causes of Type 2 diabetes**

The majority of people who develop type 2 diabetes do so for one of two interconnected reasons:

Muscle cells, fat cells, and liver cells may all develop a resistance to insulin. Due to the abnormal interaction that these cells have with insulin, they are unable to take in an adequate amount of sugar. The pancreas is unable to generate enough amount of insulin to regulate the levels of glucose in the blood. It is not known for certain why this occurs; however, being overweight and leading an inactive lifestyle are major contributing factors.[70]

### **Risk factors**

Type 2 diabetes risk factors include the following:

**Weight.** Obesity or being overweight is a major risk.

**Fat distribution.** A higher risk is indicated if you store fat mostly in your belly rather than your hips and thighs. If you are a male with a waist measurement above 40 inches (101.6 cm) or a woman with a measurement over 35 inches, you have an increased chance of developing type 2 diabetes (88.9 centimeters).

**Inactivity.** Your risk increases the less active you are. Exercise aids in weight management, burns glucose as fuel and increases insulin sensitivity in your cells.

**Family history.** If your parent or sibling has type 2 diabetes, your chance of developing it also rises.

**Race and ethnicity.** Individuals of specific races and ethnicities, such as Black, Hispanic, Native Americans, Asians, and Pacific Islanders, are more prone than white people to acquire type 2 diabetes, while it is unknown why this is the case.

**Blood lipid levels.** Low levels of high-density lipoprotein (HDL) cholesterol, or the "good" cholesterol, and high levels of triglycerides are linked to an increased risk.

**Age.** Type 2 diabetes risk rises with age, particularly beyond the age of 45.

**Prediabetes.** When your blood sugar level is over normal but not high enough to be diagnosed as Diabetes, you have prediabetes. Prediabetes often develops into type 2 diabetes if left untreated. Pregnancy-related risks If you had gestational Diabetes while pregnant or had a baby that weighed more than 9 pounds, your chance of getting type 2 diabetes is higher (4 kilograms).

**Polycystic ovary syndrome.** Diabetes is more likely in those with the polycystic ovarian syndrome, a prevalent disorder marked by irregular menstrual cycles, excessive hair growth, and obesity.

**Areas of darkened skin, usually in the armpits and neck.** Insulin resistance is often indicated by this condition.

### Diagnosis

You can find out whether you have type 2 diabetes by having your doctor check your blood. Testing to confirm a diagnosis often takes place over the course of two days. However, if your blood sugar is really high or you're experiencing a wide range of symptoms, a single test can be sufficient. [71]

**A1c.** It is similar to taking an average of your blood glucose levels over the course of the preceding two or three months.

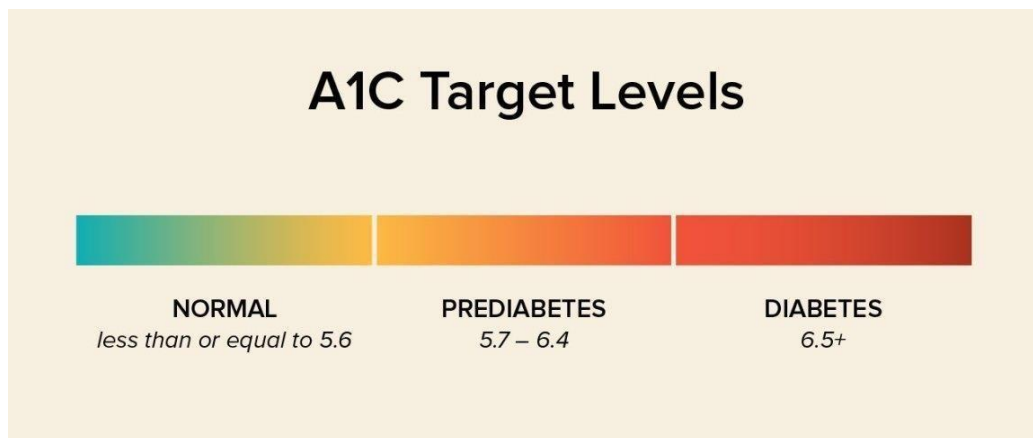


Fig 04 : A1c [Courtesy; google]

**Fasting plasma glucose.** A blood sugar test when the patient is fasting is another name for this. It takes your blood sugar reading with no food in your stomach. In the eight hours leading up to the exam, you won't be allowed to consume anything other than water, including food and drink.

**Oral glucose tolerance test (OGTT).** This measures your blood glucose before you drink anything sweet and then again two hours later to see how your body manages the sugar after you've consumed it. [72]

## Type 2 Diabetes Treatments and Medications

When diet and exercise alone are insufficient to maintain their blood sugar in a safe range, persons with type 2 diabetes sometimes turn to medications as their first line of treatment. There are several of them, and each one functions differently.

- Biguanides. The most widely prescribed medication for the treatment of Diabetes is included in this category, metformin. It instructs your liver to keep part of the glucose it produces.



**Fig 05: Metformin** [Courtesy; google]

- Sulfonylureas and meglitinides. Your pancreas is instructed to produce more insulin by these drugs.

- DPP-4 inhibitors prevent the body from metabolizing the hormones that tell your pancreas to start producing insulin. As a result, they are more effective when you need to reduce your blood sugar levels after eating.
- TZDs, glitazones, or thiazolidinediones. These drugs improve insulin efficiency. Your cells' level of insulin resistance is reduced, which reduces the amount of work your pancreas has to accomplish.
- Foods like bread, pasta, rice, potatoes, and maize that contain complex carbs take longer to digest when taken with alpha-glucosidase inhibitors. This prevents the spike in blood sugar that occurs after eating.
- Inhibitors of SGLT2 cause your kidneys to excrete excess sugar. Bile acid sequestrants can reduce blood sugar levels while lowering cholesterol.
- A temporary solution to a stressful scenario or because other medications are insufficient to manage their blood sugar may be insulin treatment. Insulin types are categorized based on how quickly they begin to operate and how long their effects remain. It's possible that you'll need to utilize several insulin types. Some types of insulin are pre-mixed.
- Surgery to reduce weight helps lose excess weight. And just doing that will help you manage your blood sugar. However, it also increases the number of incretins, a kind of hormone, in your stomach. These instruct the pancreas to produce insulin. You may be able to take less medicine over time. But not everyone will like it. Only males who are at least 100 pounds overweight and women who are at least 80 pounds overweight are often recommended weight reduction surgery by doctors.

## **Type 2 Diabetes Management**

To properly treat type 2 diabetes, you'll need to adapt your way of life.

**Loss of weight.** Your A1c levels and your risk for cardiovascular disease may both be decreased by losing between 5% and 10% of your body weight, or if you weigh 180 pounds, less than 20 pounds. Your need for diabetes, high blood pressure, and high cholesterol drugs may be reduced as a result. Losing weight may also assist with sleep apnea and the symptoms of sadness.

**Healthy diet.** There isn't a diabetic diet that works for everyone. To control your blood sugar and prevent diabetic complications, you must pay close attention to your intake of carbohydrates, fiber,

fat, and salt. Moreover, when and how much you eat matters. To plan your meals and snacks, consult your diabetes team or a trained dietitian.

**Physical exercise.** Your blood sugar is lowered by activity, including exercise and household duties. It improves insulin use by your cells. Additionally, it facilitates the use of glucose by your muscles. Check your blood sugar levels both before and after exercise.

**Better sleep.** Your risk of developing type 2 diabetes is increased by inadequate sleep. A1c levels, tests physicians use to examine your average blood sugar levels over three months, might be affected by how much and how well you sleep. Therefore, getting more restful sleep may result in lower blood sugar levels.[73-74]

### **Medicinal plants**

Since the beginning of time, conventional medical procedures have been dependent on the identification and use of therapeutic plants, sometimes commonly referred to as medicinal herbs. Herbivorous mammals, herbivorous insects and fungi, and other herbivores are all potential victims of the hundreds of chemical compounds that plants produce in order to defend themselves. Clay tablets were left behind by the Sumerian society, which was at its peak about 3000 B.C., and they included a catalogue of hundreds of medicinal herbs, including opium. In the Ebers Papyrus, which was written in ancient Egypt circa 1550 BC, there is a description of more than eight hundred and fifty different plant medicines. Around the year 60 AD, the Greek physician Dioscorides, who had served in the Roman army, wrote the book *De materia medica* (On Medicine). This book featured more than a thousand distinct recipes for medicinal mixtures produced from over 600 distinct medicinal plants. [75] This book was used for the following 1500 years as the basis for pharmacopoeias all throughout the world. On occasion, ethnobotanical investigations are carried out as a part of drug discovery efforts. These studies have led to the discovery of hundreds of compounds that have pharmacological action. These often prescribed drugs include names like aspirin, digoxin, quinine, and opium, to name just a few examples. Alkaloids, glycosides, polyphenols, and terpenes are only few of the many types of compounds that may be found in plants; however, this list is not exhaustive. In places that have not been industrialized, the use of therapeutic plants is prevalent since the herbs are not only easily available but also relatively affordable. It was estimated that the global export value of the hundreds of

different kinds of plants that have medicinal properties was \$2.2 billion in 2012. [76] In 2017, it was estimated that the potential global market for botanical extracts and pharmaceuticals might be worth multiple hundreds of billions of dollars. In regions of the world in which the practice of traditional medicine is not subject to rigorous oversight, the World Health Organization (WHO) has established a network to encourage the responsible and prudent use of such practices. The botanical and herbal sector is often criticized for the prevalence of inefficient and unverified placebo and pseudoscience products, which is one of the most popular complaints against the industry. In addition to more widespread concerns such as climate change and the deterioration of habitats, one specific threat to medicinal plants is the excessive collecting of their parts to satisfy consumer demand. [77]

### **Characteristics of medicinal plants**

When utilized in the context of medicine, plants have numerous features treatment, in the following order:

- a. Synergistic medicine, in which the different components of plants interact with one another simultaneously such that the applications of those components could either complement or injure one another, or neutralize any possible detrimental effects that they may have. Assistance provided by the government medical system in the management of difficult cases components of the plants were shown to be effective against cancer and other disorders quite efficient.
- b. Preventive medicine - It has been established that the component is useful in plants that are defined by their ability to prevent the appearance of specific illnesses. Among these plants, the positive effects of the component have been demonstrated. This will help to contribute to a reduction in the consumption of the pharmaceutical treatments that will be administered once the condition has already been existing, thereby lessening the adverse effects that are caused by the synthetic treatment. This will be the case because this will help to contribute to a reduction in the consumption of the pharmaceutical treatments that will be administered once the condition has already been existent.

## **Medicinal Plants (Importance and Uses)**

Some of these plants contain qualities that make them excellent remedies, which is why they fall under the category of "medicinal plants." The term "medicinal plants" refers to a broad variety of plant species that are used in herbalism. These medicinal plants are regarded as rich resources of components that have the potential to be used in the production of new pharmaceuticals as well as the synthesis of those drugs. In addition to this, the role that these plants have had in the development of human civilizations throughout the whole world is pretty significant and has a significant amount of importance. In addition, a great number of plant species are considered to be significant providers of various nutrients; as a direct result of this, a great number of these plant species are advocated for the potential medical benefits they offer. This group of plants includes a wide variety of plants, including ginger, green tea, walnuts, and a few more. The components of aspirin and toothpaste that are considered to be active chemicals originate from a range of different plants, and their derivatives provide a large source of these components. These components also make up a considerable portion of toothpaste.

## **Alternative Medicine**

Today, the concept of utilizing plants as medicine is at the core of what has become a catchphrase in popular culture and is referred to as "Alternative Medicine." On the other hand, the conventional wisdom maintains that an individual should only consume pharmaceuticals that are readily available in tablet form. Even yet, the great majority of the pills and capsules that we use on a daily basis came from plant sources. This is true despite the fact that we utilize plant-based pills and capsules. The manufacturing of a large number of different pharmaceuticals begins with the extraction of therapeutic compounds from various plants. Compounds that are produced from plants are used in the manufacturing of a broad range of pharmaceutical goods, including laxatives, blood thinners, antibiotics, and antimalarial drugs. Vincristine, morphine, and morphine were all derived from their respective plants by utilizing periwinkle, yew, and foxglove respectively. In addition to it, morphine was used. [78]

## **Prospects of medicinal plants in Bangladesh**

In the book titled "Medicinal plants of Bangladesh—Chemical Constituents and Uses" (which was published in 1998) by Dr. Abdul Ghani, in-depth descriptions of the lives, habitats, and

pharmacological qualities of 449 medicinal plants unique to Bangladesh are provided (former Professor of Pharmacy at Jahangirnagar University and National Fellow of the Asiatic Society of Bangladesh). This book has been used as a reference by people who are educated in Western, Eastern, and alternative medical modalities, as well as by phytochemical researchers on the hunt for new therapeutically active chemical compounds in plants.

### **Bangladesh scenario**

Thanks to its subtropical environment, Bangladesh is home to a plethora of useful plants that may be used for medicinal purposes. By the early 1980s, local companies making herbal medicines (both Ayurvedic and Unani) could meet 80% of their demands from native woods, relying on imports for the other 20%. Things were not so great back then, but thankfully they have improved since then. Currently, just 20% of the demand in the local market is covered by medicinal herbs cultivated locally, while 80% is met by imports. According to the Bangladesh Agricultural Research Institute, the country is home to 722. (BARI). Only roughly 700 plants in Bangladesh are used for medicine, whereas India uses more than four times that number. About 255 of these plants are used by Ayurvedic and Unani pharmaceutical firms. Properly cultivating medicinal plants might have a significant impact on Bangladesh's economy. In addition to being cheap to produce and simple to manufacture, they may also be grown throughout the year. However, most actors in Bangladesh's value chain—including farmers—lack knowledge of the feasibility and profitability of medicinal plants. It wasn't until the 1990s that Bangladesh really began cultivating medicinal herbs for export; even then, much of the activity was concentrated in and around the Natore area. Due to consumer demand, the Bangladesh Forest Research Institute (BFRI) has started commercial production in the mountainous regions, where there was before no established farming practice. Institutionalizing modern production techniques and procedures, as well as establishing fruitful business ties, may quickly return Bangladesh to its golden period of medicinal plants. To facilitate the rapid growth of this important industry, the government should enact legislation providing institutional support for the growing, processing, storing, sorting, packaging, transporting, and selling of medicinal plants. The Department of Agricultural Extension under the Ministry of Agriculture provides farmers with occasional broad counsel, but they should do more to support the success of individual farmers and specialized markets. Collective good initiatives may be driven by academia, non-governmental organizations, or business.



## **Natural Products for the Treatment of Type 2 Diabetes Mellitus**

If diabetics don't get the therapy they need, it might lead to serious complications that reduce their quality of life and drive up their medical bills [79]. As a result of the ongoing spread of this condition around the world, it is anticipated that the number of people who are affected with it would reach 300 million by the year 2025. This syndrome is characterized by a high prevalence of microvascular and macrovascular disorders, the pathophysiological mechanisms behind which are intricate and not always well understood [80]. Hyperglycemia, or blood glucose levels that are persistently higher than normal, is the defining characteristic of type 2 diabetes, also known as T2DM. This condition occurs as a consequence of an insulin secretory malfunction that worsens over time against the backdrop of insulin resistance [81]. Type 2 diabetes is the most common form of the disease. It is the cause of 90–95 percent of all cases of diabetes in countries in the Western Hemisphere. It is not until the third decade of life that there is a discernible increase in the incidence of type 2 diabetes [82]. Chronic hyperglycemia is linked to long-term dysfunction and failure of a number of organs, in addition to other factors that increase the risk of cardiovascular disease, such as high blood pressure, being overweight or obese, having dyslipidemia, and leading unhealthy lifestyles (such as having an inadequate diet and being sedentary) [83-84]. (eyes, kidneys, nerves, heart, and blood vessels). Patients with type 2 diabetes account for between 5 and 10 percent of the total cost of the world's healthcare system [85]. This is mostly due to the higher rates of consultation and hospitalization, as well as longer rehospitalizations and more expensive treatments. If a patient has chronic difficulties, then the costs connected with their care will increase even higher [86]. Several studies have shown the financial efficacy of actions taken to prevent the occurrence of such problems [87]. Patients who have impaired glucose tolerance may be able to delay or even avoid developing type 2 diabetes by leading a more healthy lifestyle [88] or by using therapeutic medicines [88-90]. It has been determined that the simplest, most cost-effective, and safest approach of prevention is for an individual to make alterations to the manner in which they live their life. As was said before, type 2 diabetes is characterized by insulin resistance and, thus, a modest insulin insufficiency in the patients who have it. The course of this condition demonstrates a gradual shift in which alterations in the mass and function of pancreatic cells are preceded by a reduced responsiveness of peripheral organs to insulin (insulin resistance). At least in the beginning, these individuals may be able to

survive without the need of insulin treatment. In some situations, losing weight, increasing physical activity, and/or using oral glucose-lowering drugs may be sufficient to keep their blood sugar levels under control [91]. Patients with extensive cell damage and, as a result, no residual insulin production are nonetheless need to take insulin in order to maintain their quality of life. The development of type 2 diabetes is preceded by impaired glucose tolerance, a condition in which the abnormalities described in type 2 diabetes are already present but to a lesser degree [92-93]. Hyperglycemia develops gradually, and in the early stages, it is often inadequate for the patient to identify any conventional indicators of the illness. As a result, type 2 diabetes typically remains untreated for many years in the majority of cases. Failure of cells has been identified as the key cause contributing to the development of type 2 diabetes. Insulin resistance and reduced function and mass of pancreatic cells generally coexist in the same individual. This normally leads to problems in the metabolism of carbohydrates, fats, and proteins in the target tissues of a diabetic patient. Although there are various pathogenic mechanisms involved in the development of type 2 diabetes (with the exception of the autoimmune destruction of cells, which does not take place), these two fundamental diseases often result in the same individual. Following a meal, insulin promotes the conversion of carbohydrates into lipids, which is a more efficient means of storing calories, and enhances the absorption of carbohydrates at locations that are used for storage. The contact that occurs between insulin and its receptor is what kicks off the signaling cascade that results in all of the aforementioned metabolic effects of insulin being exerted on the tissues that are targeted by insulin. Insulin resistance and decreased insulin activity may be attributed, in part, to a dysfunction in the operation of this transduction channel. The development of insulin resistance has been linked to a variety of causes, some of which include an accumulation of ectopic lipids, stress on the endoplasmic reticulum, the activation of the unfolded protein response, and generalized inflammation throughout the body. It's possible that the failure of multiple metabolic control components is what led to the development of these systems, which might then work together to govern insulin activity [94]. It is possible that a deterioration in the function of pancreatic cells is to blame when insulin production in response to a rise in blood glucose is not sufficient to meet the demand. This kind of deficit is referred to as a relative rather than an absolute shortfall. Symptoms of reduced cell function include a decreased sensitivity to glucose, loss of pulsatility and the biphasic nature of insulin secretion, and a reduction in cell mass. All of these symptoms may be attributed to insulin resistance. In the first illustration, the sensitivity of cells to

glucose decreases gradually from poor glucose tolerance to type 2 diabetes [96]. This occurs despite the fact that the normal sensitivity threshold has large individual differences that do not influence a person's ability to keep glucose homeostasis. [Citation needed] In the second scenario, a gradual decline in cell function is indicated by the biphasic profile and pulsatility of insulin secretion, which are hallmark markers of insulin secretion changes that occur early in type 2 diabetes. These changes are indicative of the fact that insulin secretion has been altered. Prior to the beginning of clinical symptoms, the development of  $\beta$ -cell secretory dysfunction may be contributed to by other factors, such as dyslipidemia, changes in hormone levels and cytokine function, and impairment of endothelial cells and vascular flow [97]. In the third and final scenario, maintaining a healthy amount of cell mass is essential to maintaining stable blood glucose levels and avoiding developing diabetes. The findings of clinical studies indicating an inadequate cell mass in type 2 diabetes due to an imbalance between the rate of cell renewal and apoptosis have been confirmed by the findings of autopsies performed on diabetic patients, which showed a decrease in cell mass of between 50 and 60 percent. This decrease is already apparent at the stage of impaired glucose tolerance [98]. According to these studies, mass loss is a stage that occurs early on and continues to proceed throughout the process of developing type 2 diabetes. Diabetes is characterized by consistently high blood sugar levels, which is medically referred to as hyperglycemia. This condition has a detrimental influence on insulin production as well as cell mass. This is because the processes of glycooxidation might cause glucotoxicity, which is the reason for this effect. According to the findings of study conducted by Sakura et al. [99], patients who have type 2 diabetes have an elevated expression of DNA damage in their islets that is brought on by oxidative stress. The formation of amyloid plaque in the brain's islets is another possible factor that contributes to the death of cells. The age-related process of fibrillary breakdown of amylin in granules is greatly accelerated by diabetes. It is possible that glycooxidative stress and amyloid deposition are to blame for the loss of cell function and mass that is associated with diabetes. This loss of cell function and mass is combined with higher endoplasmic reticulum stress in the impaired glucose tolerance condition. The activation of endoplasmic reticulum stress produced by functional overload of cells as a consequence of higher demand for the hormone in insulin-resistant circumstances may result in an increased rate of apoptosis. This may be the case if insulin resistance is present. The purpose of this piece is to provide a report on the most recent information that is available on phytotherapy as a treatment for type 2 diabetes. Novel

ethnopharmacological techniques, findings from current investigations of particular plants and isolated chemicals, and most significantly, results from recent clinical trials will get special focus throughout this research. [100]

## 1.7. Natural Home Remedies for Type 2 Diabetes

Type 2 diabetes, also known as diabetes mellitus, is the end result of a confluence of risk factors, the most prominent of which are inactivity, poor diet, emotional stress, sleep deprivation, environmental pollutants, and genetic predisposition. Type 1 diabetes, also known as diabetes vulgaris, is more commonly known as diabetes vulgaris. Patients diagnosed with type 2 diabetes often go to complementary and alternative medicine (CAM) to enhance the conventional therapy they are receiving. It is possible that using natural remedies and food as medication in conjunction with traditional diabetes treatment can provide favorable results. If you don't have the right knowledge or counsel, adding herbs, vitamins, or medications to your diet may have some positive effects, but it also carries the risk of causing a condition known as hypoglycemia, which is a hazardous drop in blood sugar.

### 1. Apple Cider Vinegar

It is believed that the primary component of apple cider vinegar, acetic acid, is responsible for many of the health benefits associated with using ACV. There are a few different approaches of using ACV that are supported by research. If you take two tablespoons before bed, your blood sugar levels in the morning when you haven't eaten may be lower. A meal that is strong in carbs may have its glycemic index lowered even more by eating one to two teaspoonsof apple cider vinegar along with it. I often recommend to patients that they either take apple cider vinegar on its own, just before a meal, or mix it with teas or salad dressings.



**Fig 06: Apple Cider Vinegar** [Courtesy; google]

## 2. Barley and fiber

Insulin and blood sugar levels may both be lowered by increasing fiber consumption. It is recommended that adults consume around 30 grams of fiber on a daily basis. The typical American only drinks between 6 and 8 grams, which is much below the recommended amount. Consuming veggies is the most effective way to attain your goal, despite the fact that you may obtain the same results by using fiber supplements such as Metamucil (psyllium husk). The consumption of barley, a kind of grain that is rich in fiber and protein, has been associated with lower levels of insulin, blood sugar, cholesterol, and inflammation in general. It is not always necessary to pre-soak barley before cooking it on the stovetop in less than fifteen minutes using just a little amount of water and a pinch of salt.

## 3. Chromium

Insufficient levels of the mineral chromium, which is most commonly found in brewer's yeast, can slow down the process of metabolizing glucose. There is evidence to suggest that chromium reduces both the A1c and total blood sugar levels. If you have a condition that affects your kidneys and you use this supplement, you should exercise extreme caution.

## 4. Zinc

Zinc deficiency is a common finding in those who suffer from diabetes. According to a number of studies, taking zinc supplements may bring about a reduction in both blood sugar and A1C levels, have an effect similar to that of an antioxidant, bring about a reduction in blood sugar, and even aid in the treatment of some complications linked with diabetes. Because large doses of zinc may inhibit the body from absorbing other minerals, including copper, it is important to ensure that you get the right amount by consulting with a professional.

## 5. Aloe Vera

It is commonly known that the sap of aloe vera plants has laxative qualities. Therefore, make sure you obtain the liquid that comes with the gel! The gelatinous fluid that can be found inside the leaves and is referred to as the gel is being used in an increasing number of applications. Make sure that any product you buy is free of both anthraquinones and aloin. This will save you from having to make unscheduled trips to the restroom.

## 6. Berberine

This is one of my all-time favorite botanicals, and it may be found in plants including Coptis, Oregon grape root, goldenseal, and barberry. The use of it has been supported by recent study for bringing down hba1c levels and blood sugar. Be cautious that using this herb while pregnant might cause standard medications to not work as intended.

## 7. Cinnamon

A delicacy that, in addition to being delicious, offers medical properties that lower cholesterol and blood sugar.



**Fig 07: Cinnamon** [Courtesy; google]

## 8. Fenugreek

In other parts of the world, a seed that is often used in the kitchen as a seasoning has been put to use medicinally for millennia in order to bring down levels of hba1c and cholesterol. This is a typical and harmless side effect, so there is no need to be frightened if you notice that your urine smells like maple syrup.

## 9. Gymnema

Evidence supporting its therapeutic treatment is now catching up to its centuries-old use in India, revealing benefits for insulin levels, glucose metabolism, and as a supplement to increase the efficacy of conventional drugs. In India, the use of this herb dates back centuries. Because this herbal supplement interacts with your other prescriptions, you should be aware that you must monitor your blood sugar levels on a frequent basis or run the risk of developing hypoglycemia.



**Fig 08: Gymnema** [Courtesy; google]

## 10. Nopal

Have you ever seen nopales in the Mexican restaurant that is your favorite? Since they are currently on the market, you may buy them without hesitation, secure in the knowledge that you are selecting a nutritious option for your diet. Nopales are the pads of the prickly pear cactus, and when correctly cooked, they have a delicious flavor. For me, the best way to consume them is in the form of a salad or paired with eggs.





**Fig 09: Nopal** [Courtesy; google



*The goal of my studies*



## Natural Treatment of Type-2 Diabetes

Diabetes is a long-term (chronic) illness that affects how our body converts food into energy. The majority of the food we consume is converted by our body into sugar (glucose), which is then released into our circulation. Our pancreas releases insulin when our blood sugar levels rise.

My aim of this study is,

- To see the current condition of Diabetes and its treatment.
- To see which area people are mostly affected by Diabetes.
- To see which type of Diabetes is mostly affected people.
- To see the natural treatment of Type-2 Diabetes.
- To open a new area of higher studies.

# *Methodology*



**Introduction:**

A literature review leads the examination. Around 125 papers are reviewed for this study.

**Research Design:**

This exploration was planned through google scholar, PubMed, and many other websites to find literature.

**Method of Data Analysis:**

After an assortment of information, all information was checked for precision and internal consistency to deny missing or clashing data, and those were discarded. Information investigation was done through Microsoft's dominant refreshed rendition. All collected information is from 1984 to 2022.

**Ethical Considerations**

Before beginning the information assortment, educated verbal permission was taken from the investigation members. The obscurity of the respondents was kept private, and study subjects were educated that they could have the option to leave the program at any.

## *Result & Discussion*



***Pterocarpus marsupium* and other Epicatechin-containing Plants effects on Diabetes**

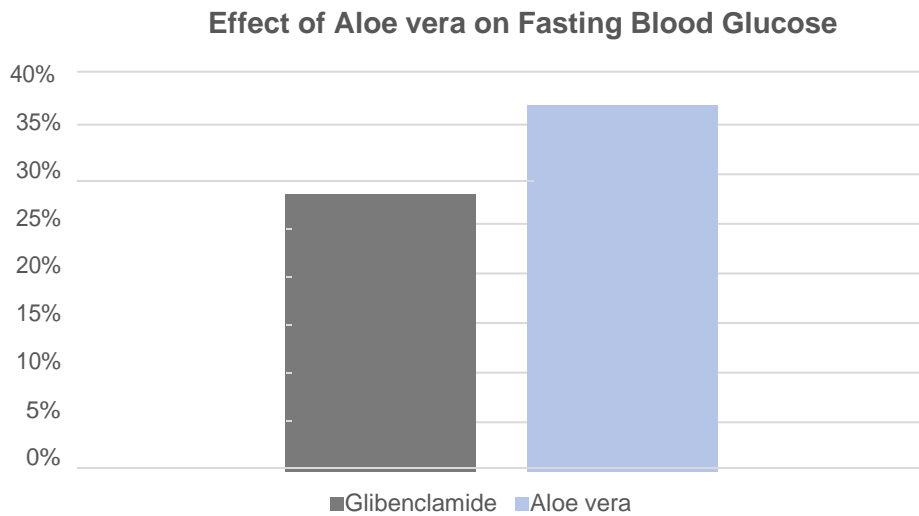
Pterocarpus at doses of 2-4 g daily was discovered to have significant glucose-lowering benefits in patients with mild type 2 diabetes in an open trial carried out at four centers in India. In the 12-week experiment, 97 patients were involved. Sixty-seven individuals completed the trial with satisfactory blood sugar control with 2 g (73%), 3 g (16%), and 4 g (10%) [101-102].

<b>Amount of <i>Pterocarpus marsupium</i></b>	<b>Blood Glucose control rate</b>
2g	73%
3g	16%
4g	10%

**Table 1: *Pterocarpus marsupium* and other Epicatechin-containing Plants effects on Diabetes**

**Effect of Aloe vera on fasting blood glucose levels (mg/dl) in control and experimental rabbits**

In type 2 diabetes patients, aloe vera gel may work as a safe antihyperglycemic and antihypercholesterolemic drug without having a substantial impact on other normal blood lipid levels or liver/kidney function, according to clinical research. According to a study, aloe vera was administered to rabbits to observe its impact on fasting blood glucose levels. Aloe vera's effect on blood glucose has decreased it by 28%, whereas the effect of glibenclamide has decreased it by 37% [103-104].



**Fig 10: Effect of Aloe vera on Fasting Blood Glucose**

### Bioactive chemicals for inflammatory Diabetes

Flavonoid-rich functional meals may reduce our risk of acquiring Diabetes. This concept is the cornerstone of phytotherapy, a treatment for Diabetes that alters immune function, especially in D.M. Some flavone family chemicals, including Apigenin and Diosmin, are mentioned in the review study [105-106].

Class	Compounds	Plant Sources	Mechanism of Actions
Flavone	Apigenin	Parsley Celery Rosemary Oregano Thyme Basil Coriander	<ul style="list-style-type: none"> <li>• Activation of ERK1/2</li> <li>• Attenuates the production of pro-inflammatory cytokines such as IL-6, IL-1<math>\beta</math>, and TNF-<math>\alpha</math></li> </ul>
	Diosmin	Lemon Orange Buddha's fingers	<ul style="list-style-type: none"> <li>• Deactivation of NF-<math>\kappa</math>B targets</li> <li>• Suppression of monocyte chemoattractant protein-1 (MCP-1), tumor necrosis factor (TNF-<math>\alpha</math>), and interleukins (IL-1<math>\beta</math> and 6)</li> </ul>

**Table 2: Bioactive chemicals for inflammatory Diabetes**



### **Effects of *Gymnema sylvestre* (Gurmar) on Diabetes**

Diabetes has traditionally been treated using *Gymnema Sylvestre*, a plant that is indigenous to the tropical woods of India. *Gymnema Sylvestre* first emerged on the American market a few years ago, with much fanfare as a "sugar blocker." 22 individuals with type 2 diabetes who were on oral hypoglycemic medications were also given 400 mg of *Gymnema Sylvestre* extract daily. Improved blood sugar regulation was seen in all patients. Twenty-one of the 22 patients were able to significantly lower their oral hypoglycemic treatment dose, and five patients were able to stop using oral medication and maintain blood sugar control with only the *Gymnema* extract. 67 *Gymnema Sylvestre* is thought to increase endogenous insulin synthesis [107-108].

### ***Allium sativum* (Amaryllidaceae) Effects on Diabetes**

This plant, which is more popularly known as garlic, is indigenous to Central Asia and northern Iran, although it is also regularly found in India. Its primary constituent is an essential oil, which is made up of various sulfide compounds, including trisulfides and disulfides. In the field of pharmacology, it is useful as an antibacterial, antifungal, antiparasitic, antiviral, antihypertensive, and antithrombotic agent, amongst others. According to the findings of a study, consideration of the plant should be given to diabetic Mellitus research that will take place in the future. Because when streptozotocin-induced diabetic rats were given dosages of 0.1, 0.25, and 0.5 g/kg of the compound [109-110].

**Bangladeshi medicinal herbs having antidiabetic efficacy and possible mechanisms.**

According to the findings of research found in a variety of journals [111], Bangladesh is home to a rich diversity of medicinal plants that may treat Diabetes. The bioactive components of these plants and the probable mechanisms by which they work are listed in Table 4 below.

<b>Botanical name (Common Name)</b>	<b>Bioactive constituent(s)</b>	<b>Probable mechanisms of action</b>
<i>Acacia catechu</i> (L.f.) Willd.	▪ Flavonoids	Encourage insulin production Encourage regrowth of Beta-cells
<i>Adhatoda vasica</i> Nees (Basak)	▪ Alkaloids	Reduce alpha-glucosidase activity
<i>Aegle marmelos</i>	▪ Tannins	Increase insulin secretion from pancreatic $\beta$ -cell. Regulate the activity of carbohydrate metabolizing enzymes

**Table 3: Bioactive constituent(s) and Probable mechanisms of action of medicinal plants**

## *Conclusion*



## Natural Treatment of Type-2 Diabetes

Diabetes is a severe, perhaps fatal, condition that has to be closely monitored in order to be adequately controlled with medicine and lifestyle changes. Type 2 diabetes may be reversed or managed by adopting healthy lifestyle changes such as eating a well-balanced diet, exercising often, and losing weight.

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