Review Article

Exhaustive Review of Diabetes Mellitus Type 1 and Type 2 Control by Intake of Fruits in Diet

ABSTRACT

A class of illnesses known as diabetes mellitus impact how our bodies utilize glucose or blood sugar. It serves as a significant source of energy for the cells that comprise our muscles and tissues thatare essential to our health. It's also the primary energy source for our brain. Each kind of diabetes has a different underlying aetiology. Type 1 and type 2 diabetes are one typesof chronic diabetes diseases. Prediabetes and gestational diabetes are two diabetes disorders that may be treated. When our blood sugar levels are greater than usual but not high enough to be diagnosed with diabetes. Unless the right steps are taken to stop the progression, prediabetes frequently precedes diabetes. People with type 2 diabetes can still benefit from fruits but only if they avoid ones with high sugar and carbohydrate content which might raise blood glucose levels. To manage diabetes 2, they need to include fruits with a low Glycemic Index. Cherries, prunes, grapefruit, dried apricots, raisins, peaches, apples, pears, strawberries, plums, guava, orange, grapes, papaya, banana, kiwi, pineapple, figs and mango are among the fruits that have a low glycemic index focus is the prime object of this review manuscript.

Keywords: Diabetes Mellitus, Diet, Fruits, Insulin, Type 1, Type 2

1. Introduction

Diabetes is a condition of the metabolism of carbohydrates in which the body does not utilize the sugars found in meals as it should. It is typified by elevated blood glucose levels and glycosuria brought on by insulin resistance and malfunctioning beta cells in the pancreas [1]. The body uses glucose or sugar, typically produced when part of the food is broken down as fuel. Insulin is a hormone that permits glucose to enter cells after the blood carries it. Insulin cannot be used correctly by diabetics or they generate too little or none at all [2]. The metabolism of lipids and proteins is also changed in severe stages of diabetes. Numerous elements including age, sedentary lifestyle, sex, food, obesity, socioeconomic level, genetics and hypertension, among others [2]. Reduced β-cell mass, decreased insulin secretion and a course of progressive insulin resistance in the liver and peripheral tissues are related to the aetiology of type 2 diabetes, whereas abnormalities in insulin secretion cause type 1 diabetes. Hyperglycemia, glycosuria, hyperlipidemia and atherosclerosis are all consequences of altered protein, fat and carbohydrate metabolism brought on by diabetes mellitus [3]. Long-term harm, organ failure and destruction are linked to hyperglycemia brought on by diabetes [4]. A variety of conditions including fatty changes, liver cirrhosis and cancer can affect the liver one of these organs [5]. An essential component of lipid and glucose balance the liver is an organ independent of insulin. Furthermore, research has demonstrated that tissue damage brought on by diabetes may [6, 18, 19]. A greater amount of study has been conducted on the delayed sequelae of diabetes which include nephropathy, retinopathy, cardiovascular problems, neuropathy, screen ulcers, high blood pressure and weight gain [7, 20, 21]. The number of diabetes patients being referred to physicians is experiencing a substantial increase. Diabetes currently afflicts over 140 million individuals in Western countries and this figure is projected to rise to 300 million by the year 2025 [8, 20]. Artificial medications are employed to reduce the onset of diabetes but are accompanied by adverse reactions [23]. The search for natural components that work well has

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become more popular these days because of this problem and their expensive price. Herbal remedies have been the subject of numerous investigations in recent years and these substances have been suggested as treatments for several incurable illnesses, including cancer, neurological disorders, cardiovascular disease and atherosclerosis. Medicinal plants with antioxidant activity can combat these diseases which include many modifications, including shifts in redox state. These plants have long been recognized as a beneficial source of health promotion [3, 4, 9]. Diabetes patients employed traditional medicine and medicinal herbs before anti-diabetic medications and insulin were discovered. There are various ways that plants might influence blood sugar levels [5, 10]. A portion of them might possess insulin kinase while others might suppress the activity of insulinase and still others might promote the regeneration of pancreatic β-cells. Plant fiber may also obstruct the absorption of carbs hence influencing blood sugar levels [6].

2.0. Symptoms

While the symptoms of the two forms of diabetes are similar differ in severity. In type 1 diabetes, symptoms appear more frequently and develop more quickly. Polyurea, polydipsia, polyphagia, weight loss, tiredness, cramps, constipation, hazy eyesight and candidiasis are some of the symptoms. Patients with type 1 diabetes for an extended period are at risk for both macrovascular illness (heart, peripheral vascular, and coronary artery disorders) and microvascular problems [6, 11]. Similar symptoms but a sneakier start characterize type 2 diabetes. The majority of instances are discovered accidentally or as a result of difficulties. Large artery atherosclerosis which is frequently linked to obesity, hypertension and hyperlipidemia is a significant risk factor for type 2 diabetes. End-stage renal disease and cardiovascular problems account for the majority of type 2 diabetes deaths. There are regional variations in the severity of these issues as well as their [6, 12]

2.1. Types Of Diabetes

2.1.1. Type 1 diabetes

Type 1 diabetes sometimes referred to as insulin-dependent diabetes (IDD), is less prevalent than type-2 diabetes and typically manifests during childhood. The prevalence of type 1 diabetes is about 5–10%. Type 1 diabetes prevents the synthesis of insulin. Beta cells which are located in the pancreas produce insulin. There is a possibility of the elimination of beta cells. Multiple factors can lead to the demise of beta cells [5-6, 13]. Most persons with type 1 diabetes have an immune system malfunction however, certain individuals have a hereditary predisposition to the condition. The body's immune cells erroneously target and eliminate beta cells instead of fulfilling their intended function. Glucose rises in the blood and the pancreas is unable to make insulin without beta cells. Cell membranes restrict the entry of sugar in the absence of insulin. Diabetes type 1 symptoms appear quickly and are characterized by a multifunctional system [5-6, 14].

2.1.2. Type 2 diabetes

About 90–95% of diabetics have type-2 or non-insulin dependent diabetes (NIDD) which is more frequent than adult-onset type-1 diabetes. Insulin resistance a condition in which the body cells do not respond to insulin or the pancreas does not produce enough insulin is the cause of type 2 diabetes [5-6]. Diabetes type 2 symptoms appear gradually. Many persons with type 2 diabetes are unaware of their condition until they visit their doctor due to a health issue. The patient may have high blood glucose levels for seven to ten years before being diagnosed with type 2 diabetes. Even if the blood contains an abundance of insulin in this form the cells are not receptive to it. Because glucose enters cells more difficultly and backs up in the bloodstream [5-6]. Most persons with Type 2 diabetes are older adults, overweight and have a blood relative who has the condition. Type-2 diabetes typically affects people over 40 while it frequently affects people from South Asia and the African Caribbean before 40. Short-term symptoms of uncontrolled diabetes include thirst, weariness, frequent urination and impaired eyesight [5-6, 15]. Over an extended period, people may experience heart illness, kidney issues, visual

impairments, nerve damage and further challenges. Insulin injections, diet, exercise and medication are used to treat it. For most people, reducing weight and upping physical activity will help postpone or even prevent Type 2 diabetes. Diabetes that is not under control can cause kidney failure, stroke, heart disease and blindness among other health problems. On the other hand, with appropriate testing, treatment and lifestyle type 2 diabetics are controlled [5-6, 14].

2.1.3. Gestational diabetes

Certain pregnant women develop gestational diabetes, which is the third kind of diabetes. This type of diabetes will have similar symptoms and therapy to that of Type 2 diabetes. It normally disappears after childbirth [6]. The quantity and kind of carbohydrates we eat during the day should be the main emphasis of our diet plan. However, it's also critical to eat things we enjoy. want to eat enough to feel full and prevent overindulging and making bad decisions. These foods can help control blood sugar levels and improve overall health and happiness which is shown in Table 1.

Table 1. Ingredients of diet in different foods

Foods	Ingredients of diet	~~Reference~~
Nuts	Nuts reduce insulin resistance, inflammation and cholesterol because they are high in unsaturated fats, proteins and a variety of vitamins and minerals. A study found that to lower high blood sugar and fat (triglycerides) we should consume at least 50 grams of almonds, cashews, chestnuts, walnuts or pistachios each day.	[6, 7]
Banana	A study from University College Dublin in Ireland suggests that resistant starch which is present in foods like potatoes, bananas, grains, and legumes may improve gastrointestinal health, help regulate blood sugar levels and increase feelings of fullness. This type of starch is regarded as dietary fiber since it is not broken down in the small intestine.	[7, 8]
Amla	The Indian gooseberry tree yields amla which has long been used as a traditional treatment for high blood sugar. Additionally, it has a	[7]

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	mineral called chromium which controls how carbohydrates are metabolized and improves our body's sensitivity to insulin.	
Greens	Leafy greens are rich in minerals such as vitamin A and magnesium, as well as fiber. Blood sugar can be lowered with the use of these foods. consuming 1.35 portions in place of. A 14 percent lower incidence of type 2 diabetes is linked to eating two servings of leafy greens each day.	[7, 11]
Garlic	Garlic may be able to assist with blood sugar regulation. Consuming garlic is said to reduce fasting blood glucose or blood sugar levels that occur when you haven't eaten. Studies of a similar nature indicate that onions may also benefit blood sugar levels.	[7, 8]

3.0. Diabetes Treatment

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3.1. Insulin treatment in diabetes mellitus

The introduction of insulin to treat diabetes has saved an estimated 5 million years of life for patients with type 1 diabetes during the year 2000 [8] The manufacturing, formulation and administration of insulin preparations as well as the creation of insulin treatment regimens that sustain long-term normo-glycemia with minimal risk of hypoglycemia have advanced significantly in recent years [9,10]. In both type 1 and type 2 diabetes, the goal of preventing or delaying the development of chronic microvascular problems has been well demonstrated during the past ten years. Regrettably, glycemic control is consistently worse in patients using insulin than in people receiving other therapy [11,12]. It is widely acknowledged that the only significant factor limiting the dosage of insulin is hypoglycemia, making insulin the most effective glucose-lowering medication. In contrast to all oral medications which have a finite maximum impact, the dose of insulin causes increasingly more side effects. The goal of insulin therapy should be to emulate nature which has remarkable efficacy in preventing hypoglycemia in between meals and minimizing postprandial hyperglycemia [13]. However, pharmacological issues make insulin therapy more difficult. First effective portal insulin concentration is only

achieved at the cost of hyper-insulinemia in the systemic circulation because subcutaneous insulin injection sites drain into the peripheral circulation rather than the portal circulation. The second factor is the pharmacokinetic and pharmacodynamic characteristics of therapeutic insulin preparations [14]. For instance, long-acting insulin preparations do not offer the consistent, low concentrations needed in between meals while short-acting insulins are absorbed too slowly and last too long to resemble the typical prandial peaks [14]. Furthermore, it is impossible to forecast how a given insulin dose would drop blood glucose because subcutaneous insulin absorption varies greatly. Once more the injection site is crucial; it should be closer to the abdomen than the thigh, inject more deeply, intramuscularly, warm the area beforehand or use local massage [14] Some of the shortcomings have been addressed by the development of insulin analogues have an alteration in the amino acid sequence of human insulin which changes the rate of insulin absorption or some other structural change like being linked to a fatty acid chain that alters the insulin time action curve [15]. Regular insulin is modified to result in the various short-acting insulin analogies: insulin lispro (Humalog), insulin aspart (Novolog) and insulin glulisine (Apidra); intermediate (Isophane, Lente) long-acting analogues: insulin glargine and insulin detemir [16].

Many insulin preparations are available and are grouped according to their duration of action: a rapid-acting formulation to cover meals and intermediate and longer-acting preparations to provide steady basal levels between meals and overnight. Insulin is prepared either from humans, porcine or bovine or a mixture of bovine and porcine in Table 2.Nowadays, human insulin (Humulin, Novolin) is produced using recombinant DNA technology and is widely accessible [16]. Because the amino acid sequences of human, porcine and bovine insulins differ, so do their physicochemical characteristics. In aqueous solutions, human insulin dissolves more readily than pig insulin does. To increase its stability, it is administered at a pH of neutral. For almost all patients with type 1 diabetes and many with type 2 diabetes insulin is the cornerstone of their

care. Insulin can be injected intravenously (IV) or intramuscularly (IM) although the subcutaneous (SC) method is recommended for long-term therapy [16].

3.2. Short and rapid-acting insulin preparations

Exhibit the quickest initiation of effects but the briefest duration. It is recommended to administer short-acting insulin approximately 30 to 45 minutes before meals [16]. Regular insulin can also be administered intravenously or intramuscularly. Following intravenous (IV) administration blood glucose concentration rapidly decreases within 30-45 minutes (5-15 minutes for lispro, aspart and glulisine insulins) and reaches its maximum level between 1.5 to 4 hours (30-90 minutes for lispro, aspart and glulisine). The duration of its effect lasts for 5-8 hours (2-5 hours for lispro, aspart and glulisine) [17]. Intravenous administration of insulin is beneficial for patients experiencing ketoacidosis or undergoing surgery, labour and delivery or critical care. Regular insulin is found in a solution for injection in the form of a hexamer. To be effectively absorbed into the bloodstream the insulin hexamer must break apart into dimers or monomers [18]. The duration of regular insulin is determined by the dissociation process which typically takes 30-60 minutes. This process also influences the beginning and the shape of the time-action curve. Contrary to ordinary insulin the insulin analogues (Lispro, Aspart and Glulisine) rapidly separate into individual units immediately after being injected. This feature results in fast absorption and a shorter duration of action compared to normal insulin. Lispro has two distinct benefits compared to ordinary insulin: firstly, it decreases the occurrence of hypoglycemia by 20% to 30% secondly, it moderately but considerably enhances glucose management as measured by haemoglobin A1c, by 0.3% to 0.5% [19]. Aspart insulin and Glulisine insulins share similarities with Lispro. Various inhalable preparations of quick-acting human regular insulin in the form of dry powder or liquid suspension are accessible. These preparations exhibit a similar initiation and peak action time as rapid-acting insulin but have a more prolonged duration of action compared to existing rapid-acting insulin analogues [20].

3.3. Intermediate-acting insulin

Subcutaneous injection of intermediate-acting insulin preparations results in an onset of action of around 1-2 hours, reaching its maximum effect at 6-12 hours, and lasting for 18-24 hours in Table 2. Intermediate-acting insulins are designed to break down more slowly when injected under the skin resulting in a significantly extended period of action [21]. The two most commonly utilized formulations are neutral protamine Hagedorn (NPH) insulin which is an isophane insulin suspension and lente insulin which is an insulin zinc suspension. NPH insulin is a solution of insulin that is combined with zinc and protamine in a phosphate buffer resulting in a suspension [21]. Lente insulin is a combination of ultralente and semilente insulins that are crystalline and amorphous respectively. It is formulated in an acetate buffer to reduce the solubility of insulin. NPH and lente insulins share comparable pharmacokinetic and pharmacodynamic characteristics in terms of their ability to reduce glucose levels. These insulins reach their maximum effect 4-6 hours after being injected subcutaneously and gradually diminish over 18-24 hours. Consequently, injecting these insulins either separately or in a premixed solution before the evening meal increases the risk of nocturnal hypoglycemia [22]. Therefore, it is recommended to provide intermediate-acting insulin preparations after bedtime to assist in stabilizing fasting blood glucose, especially in type 2 DM. The injections are either administered once (in the elderly) or twice a day. The implementation of intermediate-acting insulin formulations led to a decrease in the frequency of administering numerous injections of standard insulin. Regular and NPH insulin can be combined in a single syringe [22]. When NPH insulin is mixed with regular insulin it does not inhibit the action of regular insulin. In contrast, when lente insulin is mixed with regular insulin part of the lente insulin may form a complex with protamine or ZN^{2+} after several hours which delays the absorption of the fast-acting insulin [22].

3.4. Long-acting insulin preparations

Ultralente insulin also known as extended insulin zinc suspension and protamine zinc insulin suspension is classified as a long-acting insulin. They exhibit a delayed onset and a prolonged generally steady peak of action. Still, ultralente as a form of long-acting insulin is given in Table 2. While a certain amount of insulin remains in the body for 24 hours after injection it is insufficient to adequately satisfy the basal or background insulin needs [24]. Ultralente insulin exhibits a comparable start and peak to intermediate-acting insulin however slightly delayed or extended. Ultralente has a duration that surpasses intermediate insulin but falls short of insulin glargine in terms of length. In most situations, it is taken twice daily (early morning and at bedtime) or in a regimen where ultralente is provided at breakfast to supply basal insulin throughout the day and evening and NPH is given at bedtime to inhibit hepatic glucose production overnight. Nowadays this regimen of adding ultralente is less typically employed with other longacting insulin formulations accessible. Protamine zinc insulin is now obsolete due to its highly erratic and protracted duration of effect, and it is no longer accessible in the United States [24]. Insulin glargine (Lantus) is now the only available insulin that fulfils the majority of the criteria for long-acting insulin. Insulin glargine is produced via recombinant DNA technology which leads to alterations in the amino acid composition of conventional insulin giving it the designation of an insulin analogue. Glargine is a transparent solution with a pH value of 4.0 [25].

Its acidic pH means that it cannot be combined with the short-acting insulin preparations that are now on the market such as lispro or normal insulin which are made to have a neutral pH. When injected through the skin it has an extended flat activity profile lasting almost 24 hours and thus provides acceptable baseline levels when given once daily. In comparison to NPH insulin glargine administered at bedtime results in fewer overnight hypoglycemia episodes and a less fluctuating fasting glucose concentration in both adults and children [26]. It is recommended to provide rapid-acting insulin with the meal instead of dividing the insulin glargine into two

injections since some individuals do not have adequate basal insulin coverage as shown by a rise in blood glucose shortly before the next glargine dose. In circumstances where glucose management is satisfactory but seems to have diminishing basal insulin coverage, then it is beneficial to split the insulin glargine. Insulin glargine is not licensed for use in pregnancy and there is inadequate data on pregnancy to provide a suggestion for clinical application at this moment [27].

Acrylated insulin is produced when a saturated fatty acid is added to an e amino acid. Insulin detemir is a readily available analogue of insulin. Unlike conventional insulin, insulin detemir lacks threonine at position B30 and contains a fatty acyl chain connected at position B29 of the lysine amino acid [28-29]. The presence of a fatty acyl side chain in the substance causes a delay in the metabolism and elimination from the bloodstream following a subcutaneous injection. As a result, the duration of its effects is greater than that of the intermediate substance, but not as long as insulin glargine [30]. The clinical classification of insulin detemir as either a prolonged-intermediate-acting insulin which typically requires two injections per day and has a moderate peak or long-acting insulin which usually requires one injection per day with a minimal peak will ultimately depend on future clinical trials and clinical experience [30].

Table 2. Insulin preparation and its properties

Type	**Properties (action in hours)**			~~**Reference**~~
Rapid	Onset	Peak	Duration	[31-32].
Regular soluble (Crystalline)	0.5-0.7	1.5-4	5-8	[31-32].
Lispro *Intermediate*	0.25	0.5-1.5	2-5	[31-32].
NPH (isophane)	1-2	6-12	18-24	[31-32].
Lente Slow	1-2	6-12	18-24	[31-32].
Ultralente	4-6	16-18	20-36	[31-32].
Protamine zinc	4-6	14-20	24-36	[31-32].
Glargine	2-5	5-24	18-24	[31-32].

3.5. Premixed insulin

Premixed insulin was created to enhance convenience and simplicity for patients when it comes to ordering and adjusting their dosage as well as to facilitate the process for physicians. Currently, premixed insulin is offered in various combinations of short-acting or rapid-acting insulin (soluble insulin) to intermediate-acting insulin (NPH or a protamine solution) [31-32]. The majority of insulin currently used consists of premixed formulations, primarily in ratios of 30/70 (soluble/NPH). However, these formulations are gradually being supplemented by newer combinations of rapid-acting analogues (such as lispro or aspart) with protamine-retarded counterparts [33]. Examples of these combinations include lispro/neutral protamine lispro in ratios of 25/75, 50/50 and 75/25 as well as aspart/neutral protamine aspart in ratios of 30/70, 50/50 and 70/30. Traditional premixed insulin formulations are administered twice a day before breakfast and the evening meal. Although widely favoured several experts argue that a predetermined ratio of short to intermediate insulin does not permit precise adjustment of each insulin component to match self-monitoring blood glucose (SMBG) patterns [34]. Currently, there have been no direct evaluations comparing the use of premixed insulin to the practice of individually mixing and modifying each insulin. Empirical evidence has demonstrated that premixed insulin is unsuitable for individuals with type 1 diabetes as it necessitates frequent modifications to attain optimal blood sugar regulation. Conversely, in the case of type 2 diabetes, the advantages of simplicity and the capacity to easily make adjustments for both patients and healthcare providers may be more important than the drawback of not being able to precisely alter the doses. Rapid-acting insulin analogues are progressively replacing normal insulin because of superior postprandial glucose management reduced hypoglycemia and more convenience for patients at the time of insulin injections [34].

4.0. Complications of insulin therapy

The two most frequent side effects of insulin are hypoglycemia and weight gain. Inappropriate dose mismatches between insulin peak delivery and food intake or the addition of factors that

increase insulin sensitivity (adrenal insufficiency, pituitary insufficiency) or that increase glucose uptake without insulin (exercise) can all result in hyperglycemia [35-36]. Episodic hypoglycemia episodes are more common the more vigorously euglycemia is attempted. In one clinical research (DCCT) the group receiving intensive insulin therapy experienced a three-fold increase in hypoglycemia responses compared to the group receiving conventional therapy. Hypoglycemia can occur less frequently and carries a lower risk when physiological insulin regimens are used in conjunction with education. Increased muscle fat and truncal mass result in weight gain which is an inevitable side effect of initiating insulin therapy for uncontrolled diabetes [37]. This is also because there are fewer energy losses from glycosuria. In this instance, physiological insulin regimes can limit weight gain by decreasing the demand for snacks in both adults and children due to improper insulinemia and hypoglycemia between meals. When insulin is initiated to treat type 2 diabetes metformin can help reduce weight gain [38-40], insulin allergy and resistance. Using human insulin or extremely pure forms of the hormone has resulted in a significant reduction in the prevalence of insulin resistance and allergic responses. Allergy responses were particularly common with bovine insulin [41]. The small amounts of aggregated or denatured insulin that are present in all preparations, the tiny amounts of contaminants, or the sensitivity to any of the components that go into making insulin (protamine, $Zn^{2+,}$ phenol etc.) are still the causes of these reactions [42-43]. Allergy reactions mediated by IgE were the most common although at present they are very uncommon. Although there are benefits to skin testing, many people respond well to intradermal insulin without suffering any negative side effects. Desensitization is a recommended treatment if the allergy continues and it works for 50% of people [44-45].

5.0. Some Fruits for a Diabetes-Friendly Diet

5.1. Berries from the refreshing treat and disease-fighting antioxidant

Feel free to indulge in your love of berries whether they're blueberries, strawberries or another kind. The American Diabetes Association claims that berries are a superfood for diabetics due to their high fiber and antioxidant content. The U.S. Department of Agriculture (USDA) reports that a cup of fresh blueberries contains 84 calories and 21 grams (g) of carbs. Try layering berries with plain nonfat yogurt in a parfait if you can resist the impulse to just pop them straight into your mouth. It provides a terrific dessert or brunch for diabetes as shown in Fig. 1. [46-47].

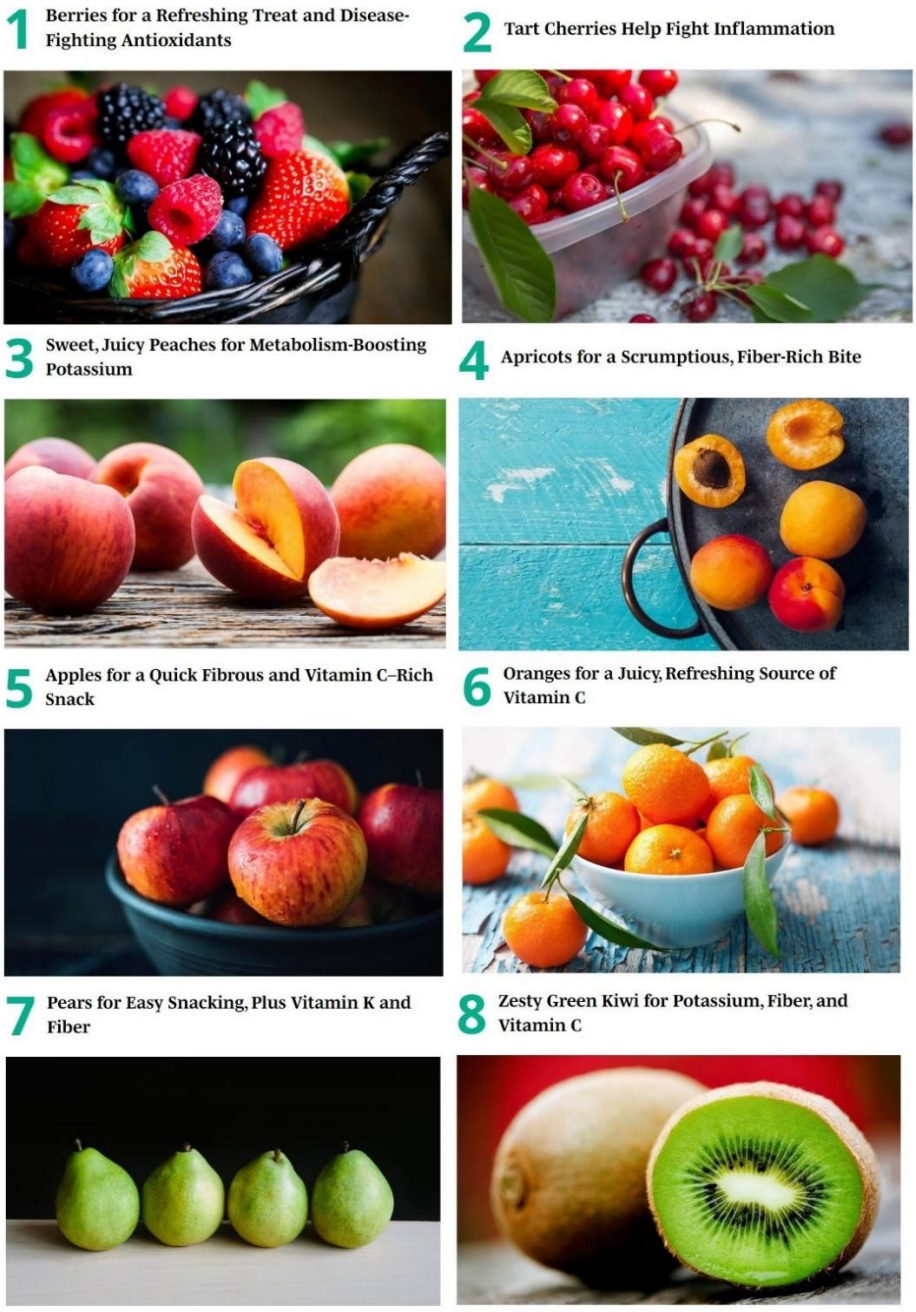

Fig. 1. Fruits for a diabetes-friendly diet

5.2. Tart cherries help fight inflammation

According to the USDA, a cup of cherries contains 52 calories and 12.5 g of carbohydrates. Cherries may have anti-inflammatory properties. According to a review that was published in Nutrients in March 2018 tart cherries are also a great source of antioxidants which may help prevent heart disease, cancer and other illnesses. Fresh, canned, frozen or dried fruits are available for purchase. To avoid a blood sugar surge, make sure to read the labels of canned and dried fruits because many of them include added sugar [46-47].

5.3. Sweet juicy peaches for metabolism-boosting potassium

Incorporating fragrant and luscious peaches into your diabetes-friendly diet is a great way to enjoy them during the warmer months. The USDA reports that one medium peach has 14 g of carbs and 59 calories. Furthermore, it contains 285 mg of potassium (six percent of the daily intake) and 10 mg of vitamin C or eleven percent of the DV for that nutrient. The fruit tastes great either way on its own or added to iced tea for a refreshing twist. Blend peach slices with low-fat buttermilk, crushed ice and a dash of ginger or cinnamon to make a simple smoothie that's perfect for those with diabetes [46-47].

5.4. Apricots for a scrumptious fibre-rich bite

A great way to incorporate apricots into your diabetic meal plan is to add them as a staple sweet summer fruit. According to the USDA one apricot contains just 17 calories and 4 g of carbs. 15% of your daily value (DV) of vitamin A or 134 micrograms (mcg) can be obtained from four fresh apricots. These juicy gems are a fantastic source of fiber as well. The dietary fiber content of four apricots is 3g or 10% of the DV. Consider adding some chopped fresh apricots to a salad or incorporating them into hot or cold cereal [46-47].

5.5. Apples for quick fibrous and vitamin C-rich snack

A daily apple could indeed fend off illnesses. As a terrific fruit option, medium-sized apples have only 95 calories and 25 grams of carbohydrates, so pack one in your purse or tote bag if you're on the run. In addition, apples have a good amount of fiber (4 g per medium fruit or 16 percent of your DV) and vitamin C (8.73 mg, or roughly 9 percent of the DV) in a midsize apple [46-47]. Apple skins are nutrient-dense with additional fiber and heart-protective antioxidants;

nevertheless, avoid peeling them, advises the Harvard T.H. Chan School of Public Health [46-47].

5.6. Orange for a juicy refreshing source of vitamin C

One medium orange has 70 milligrams of vitamin C, which equates to 78 percent of your daily requirement. According to the USDA, this light option has just 62 calories and 15 g of carbs. Additionally, one medium orange has 237 mg of potassium (5% of the DV) and 40 mcg of folate (10 percent of the DV), both of which may help stabilize blood pressure [46-47]. While you're savoring this delicious delight, keep in mind that grapefruit along with other citrus fruits is also an excellent option [46-47].

5.7. Pears for easy snacking plus vitamin K

Pears are a smart addition to your diabetic meal plan since they are a great source of fiber (one medium fruit has around 5.5 g or 20 percent of the DV) according to the USDA. Moreover, their texture and flavour enhance after picking, in contrast to most other fruits [46-47]. According to USA Pears keep your pears at room temperature until they are mature and ready to eat (at which point you can store them in the refrigerator). Here's a delightful treat, cut a pear into slices and add them to the next green salad [46-47].

5.8. Zesty green Kiwi for Potassium

A kiwi's zesty bright green fruit is hidden beneath its fuzzy brown peel which you may not be aware of if you haven't had one. One tasty, nutritious kiwi contains 5 percent of the daily value (DV) of potassium (215 mg), 71 percent of the daily value (64 mg) of vitamin C and 8 percent of the daily value (g) of fiber [46-47]. A single kiwi provides approximately 42 calories and 10 g of carbs, making it a wise inclusion in your diet for those with diabetes. Zespri Kiwifruit claims that kiwis are accessible all year round and can be stored in the fridge for as long as seven days [46-47].

6.0. Diabetic Meal Plan

Anyway, it is anticipated that a balanced diet with lots of fruits and vegetables and less processed food will lower the chance of developing several chronic degenerative diseases. Furthermore,

eating a diet high in whole foods facilitates better hunger control and typically keeps people from becoming overweight or obese. Conversely, a fast-food diet raises the risk of type II diabetes and obesity [48]. Meal plans for diabetics balance the calories from foods (carbs, proteins, and lipids) with each person's insulin dosage and amount of bodily activity. Foods including milk, fruits, vegetables, legumes, bread and grain, meat and fat are frequently consumed. Proteins, lipids and carbs are all present in these foods [49]. A meal plan should be designed so that 50–60% of daily calories come from carbohydrates, 15% through proteins, and the remaining portion is derived from lipids. Maintaining a regular daily schedule is crucial if insulin treatment is taken. The design of the plan will balance the peaks of insulin and carbohydrates. The World Health Organization (WHO) suggests consuming at least five to ten servings of fruits and vegetables each day [49].

6.1. Role of Fruits in Diabetes

An essential component of any person's basic diet should be fruits. Fruits supply the body with fiber, vitamins, and minerals that are necessary for a full, balanced diet, regardless of whether a person has type 2 diabetes or not. People with type-2 diabetes can still benefit from fruits but only if they avoid ones with high sugar and carbohydrate content which might raise blood glucose levels [50]. To manage diabetes 2, they ought to have fruits with a low Glycemic Index. Cherries, prunes, grapefruit, dried apricots, raisins, peaches, apples, pears, strawberries, plums, guava, orange, grapes, papaya, banana, kiwi, pineapple, figs and mango are among the fruits that have a low glycemic index. Despite watermelon having a high Glycemic Index, the glycemic load per food serving (120 g) is minimal, meaning it will not significantly impact blood glucose levels. Consequently, a standard portion, due to its higher water content, has few carbohydrates, resulting in a low glycemic load [50]. It is advisable to consume it in limited quantities. The consumption of these items is limited to their raw or cooked form or as juice, without any additional sugar. When purchasing fruits, consider acquiring them in smaller portions. Avoid

fruit juices and choose whole fruits instead as they have more fiber content and provide a greater feeling of satiety. When purchasing canned fruit juices, it is essential to examine the label for the terms 'unsweetened extra-light or no sugar added, if necessary. Avoid consuming fruits that have been preserved by freezing or canned in a dense syrup [51].

6.2. General Dietary Guideline

The contemporary approach to managing diabetes mostly entails making adjustments to the type and amount of food consumed by individuals with diabetes. Any form of diabetes regardless of weight status, age, gender or career is covered by the following rules as shown in Table 3 [52-61].

Table 3. General dietary guidelines for foods

Sl No.	Guideline	~~Reference~~
1	Most of the carbohydrates consumed should be in the form of starch (polysaccharides) such as maize, rice, beans, bread, potatoes etc.	[52, 61].
2	All refined sugars such as glucose, sucrose and their products (soft drinks, sweets, toffees, etc.) and honey should be avoided, except during severe illness or episodes of hypoglycemia. These foods contain simple sugar, which is easily absorbed causing a rapid rise in blood sugar.	[53, 62].
3	Non-nutritive sweeteners, e.g., Canderel, saccharine, NutraSweet and aspartame are suitable sugar substitutes for diabetic subjects.	[54, 59].
4	Animal fats such as butter, lard, egg yolk and other foods high in saturated fatty acids and cholesterol should be reduced to a minimum and replaced with vegetable oils, particularly polyunsaturated fats.	[55, 63].
5	Salt should be reduced whether hypertensive or not.	[56, 60].
6	Protein (fish, meat, beans, crab, crayfish, soybean, chicken, etc.) and salt are restricted for those with diabetic nephropathy.	[57].
7	Cigarette smoking should be avoided by diabetic patients. Alcohol should be taken only in moderation.	[58, 64].
8	The items allowed for free consumption include Water, green leafy vegetables, tomatoes, onions, cucumber, aubergine, peppers and vegetable salad without cream. Any brand of tea, coffee or drinks that contain very low or no calories.	[59].
9	For patients too ill to eat solid food a fluid or semi-solid diet should be substituted (papaya, soya bean, custard, etc.).	[52, 61].
10	Patients treated with insulin or certain oral hypoglycemic agents, e.g., sulfonylureas must be advised to eat regularly and often to prevent hypoglycemia 3 meals a day plus suitable snacks in between e.g., fresh	[60, 65].

	fruits.	
11	Small meals spaced over the day rather than 1 or 2 big meals help avoid post-pyramidal peaks in blood sugar.	[61, 66].

Weight loss in overweight diabetes patients through reduction in portion sizes and calorie intake leads to improved insulin sensitivity hence optimizing the effectiveness of medication therapy. The energy balance is the basic idea underlying maintaining body weight [62-63]. This demographic should be motivated to sustain their present weight by adhering to consistent portion sizes, consuming a similar quantity of food daily eating at consistent intervals throughout the day adhering to a consistent medication schedule and engaging in regular exercise at a consistent interval. These patients should strive to select their daily meals from sources of carbs, vegetables, fruits and protein while restricting the use of fats [64-66].

6.3. Dietary Approach to Diabetes

A healthy weight and normal growth and development particularly during pregnancy and lactation are all supported by dietary treatment for diabetes which aims to attain ideal blood sugar levels and cholesterol concentrations as well as adequate calories. By addressing diabetes-related problems and preventing delays a balanced diet can enhance overall health in Table 4 [67-71]. Additionally, the patients have to make an effort to choose meals that are high in fruits, vegetables, carbohydrates and proteins and low in fats.

Table 4. Main food categories: include unlimited amounts of grains, legumes, fruits and vegetable

Food categories	Sources	~~Reference~~
Grains	Rice, high-fiber cereals, corn, oatmeal, wheat, millet, barley, rye.	[67-71].
Legumes	Beans, peas, lentils, nonfat soy products.	[67-71].
Fruits	All, except avocados, olives, pineapple and watermelon, bananas, apples, grapes, pears, peaches, oranges, melon, grapefruits, kiwi and barriers among others all a good choice.	[67-71].
Vegetables	All, except white potatoes. They include tomatoes, cucumbers, carrots, broccoli, cauliflowers, spinach, kale, cabbage, green, beans, sweet potatoes and artichokes.	[67-71].

Food has a significant role in both preventing and treating diabetes. However, as our understanding of the illness has grown, so too have nutritional strategies [67-68]. The conventional treatment of diabetes centres on reducing refined sugar intake and meals which release sugars upon digestion such as starches, bread, fruits and other foods that have high fat and protein content and low carbohydrate content [69]. Thus, diabetic specialists have been careful to restrict protein for individuals with compromised kidney function as well as lipids, particularly saturated fats that might increase cholesterol [70]. The revised strategy emphasizes fat more. Diabetes sufferers have issues with fat. Insulin's ability to transport glucose into cells will be hampered by a diet high in fat. On the other hand, cutting down on fat consumption and body fat improves insulin's function significantly. More recent treatment plans significantly cut back on meats, oils and high-fat dairy goods [71]. They also boost the number of fruits, vegetables, grains and legumes. Consume a diet rich in fruits and vegetables daily. Fruit juices are never as good as the actual fruit. Water is a better option than typical sodas and fruit drinks; low-calorie juices, tea and coffee are also excellent options. Consume lower GI meals, which will benefit your diabetes by preventing blood sugar spikes and maintaining control over your blood sugar levels [72]. Diabetes can be effectively prevented and reversed with food. Still, as our understanding of the illness has grown so too have nutritional strategies. Reducing refined sugar intake and meals like baked goods, fruits and carbohydrates that release sugar after digestion is the mainstay of conventional diabetic treatment. Reduced carbs could mean an unhealthy proportion of fat and protein in the diet. Thus, diabetic specialists have been careful to restrict protein for individuals with compromised kidney function as well as lipids, particularly saturated fats which might raise cholesterol [73-74]. The revised strategy emphasizes fat more. Diabetes sufferers have issues with fat. Insulin has a tougher job delivering glucose into cells with the higher fat content of a diet. On the other hand, cutting down on fat consumption and

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body fat improves insulin's function significantly. More recent treatment plans significantly cut back on meats, oils, and high-fat dairy goods. Grain, legume, fruit, and vegetable intake all rise together. According to the study, patients who were taking insulin or oral drugs were able to stop taking them after a few days if they followed an almost vegan dietary and physical activity regimen [75]. The majority of diabetic patients treated using this regimen maintained their improvements after two and three-year follow-ups. These small but effective dietary adjustments are effective [76].

Conclusion

Successful lifestyle changes such as weight loss counselling, adopting a nutritious diet just like the Mediterranean diet and increasing physical activity are the mainstays in the fight against type 2 diabetes. So, especially for those who are at high risk, the focus needs to be placed on encouraging a better lifestyle and figuring out ways to improve adherence as well as compliance with lifestyle changes. The Mediterranean food pattern has a preventive effect against type 2 diabetes, according to findings from clinical trials and epidemiological research assessing the pattern's impact on the onset and management of the disease. An essential part of caring for a diabetic patient is diet. Both the patient and the diabetic healthcare professional should be aware of the patient's fundamental dietary requirements. Even if the blood contains an abundance of insulin in this form, the cells are not receptive to it. Because it is difficult for glucose to enter cells it builds up in the blood. Short-term symptoms of uncontrolled diabetes include thirst, weariness, frequent urination and impaired eyesight. Over an extended period, people may experience heart illness, kidney issues, visual impairments, nerve damage and further challenges. Our research indicates that there is a notable variation in the connections between specific fruits and the likelihood of developing type 2 diabetes. Increased intake of some whole fruits specifically blueberries, grapes, and apples, was strongly linked to a reduced risk of developing

Comment [A8]: Use This review instead of our research

type 2 diabetes. Conversely, higher consumption of fruit juice was connected with an elevated risk.

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