



Incorporation of selected fruits (Apples, Berries, Guavas, Pears and Avocado) in Type II Diabetic mellitus management

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ABSTRACT

Fruits are wealthy in fibre, antioxidants, and phytochemicals that have benefits of healthy effects. Consumption of fruits with a low glycemic index and high fiber content has been recommended for the primary prevention of many chronic diseases, including Type 2 Diabetes mellitus. This review revealed that the fruits such as, berries, Apples, Guavas, Pears and Avocado takes major role in the management of Type 2 Diabetic mellitus.

Keywords: diabetic mellitus, Type2DM, Glycemic Index

INTRODUCTION

Diabetes mellitus is a metabolic disorder caused by interruption of carbohydrate metabolism. Hyperglycaemia, its main feature is determined by the deficiency of insulin secretion or a resistance of the tissues to the action of this hormone. According to the American Diabetes Association (ADA), DM can be diagnosed with fasting plasma glucose (FPG) levels of 126 mg/dL (7.0 mmol/L) or higher, or an HbA1c level of 6.5% or higher.

Insulin is a hormone secreted by the pancreas that aids glucose enter into cells to be used for energy. A. Poznyak et al., 2020 explained insulin resistance in diabetes, either the pancreas doesn't synthesis enough insulin, or the body's cells don't respond normally to insulin. As a result, glucose accumulated in the bloodstream, leading to high blood sugar levels.

Types of Diabetes

Popoviciu MS et al., 2023 highlighted the autoimmune disease associated with diabetic mellitus in their review, the body's immune system mistakenly attacks and destroys the beta cells in the islets of Langerhans. The loss of beta cells leads to a severe lack of insulin, resulting in a build-up of glucose in the bloodstream (hyperglycemia) and leads to Type 1 diabetes.

Type-1 diabetes or childhood diabetes or Insulin Dependent Diabetes is quite common than type-2 diabetes. People bout 5 to 10% only with type-1 diabetes. Lot of factors can destroy the beta cells. Some people are genetic tendency toward type-1 diabetes. Before the age of 40 Type 1 diabetes usually appears. It requires insulin therapy for their whole life, typically through injections or an insulin pump. Type 1 diabetes treated by insulin injections and diet, and regular exercise is also

recommended.

Type-2 diabetes

Galicia-Garcia U et al., 2020 analysed and summarised the data based on the molecular mechanisms and pathways implicated in insulin metabolism leading to T2DM and insulin resistance. Type-2 DM also called as non-insulin-dependent (NIDDM) diabetes. It is more common than type-1 diabetes adult-onset, about 90 to 95% of the people with diabetes have this type. In type-2 diabetes, either the pancreatic β -cells does not make enough insulin, or the body cells do not respond to insulin (insulin resistance) Symptoms of type-2 diabetes develop slowly. Lot of people with type-2 diabetes does not know they have it until they go to the doctor for a complication. In the mean the time type-2 diabetes is diagnosed, the patients have high blood glucose levels for 7 to 10 years. In this condition, there may be plenty of insulin in the bloodstream, but the cells are resistant to it. Glucose cannot easily absorbed into the cells, and it stored already in the bloodstream. Most of the Type-2 diabetic patients are older adults, overweight, and have a blood relative who has the disease. Typically develops in adulthood, but increasingly affects children and adolescents due to factors like obesity(Priyanka Garg et al., 2022) and lack of physical activity. It can be managed through lifestyle changes (diet and exercise), medications to improve insulin sensitivity or increase insulin production, and sometimes insulin therapy, approximately 90% of people living with type2 diabetes.

Gestational diabetes

The third type of diabetes, called gestational diabetes, occurs in some pregnant women. The symptoms and treatment will similar that of the Type-2 diabetic mellitus. It usually disappears after childbirth.

Factors control Type 2 Diabetic mellitus

Glycemic Index

In the clinical terms, the glycemic index (GI) is a ranking of carbohydrates based on how quickly they raise blood sugar levels after consumption, with pure glucose (sugar) assigned a value of 100.

Foods with a high GI cause a rapid and significant rise in blood sugar, while low-GI foods cause a slower and more gradual increase. Foods with a GI of 70 or higher are considered high, 56-69 are medium, and 55 or lower are low. Low-GI Diet helps to improve blood sugar regulation and management in people with diabetes. Managing blood sugar levels is crucial, and the GI can be a helpful tool for making food choices that minimize blood sugar spikes and crashes. Choosing low level Glycaemic Index foods can help stabilize the level of blood sugar and improve long term blood glucose control (HbA1c) in individuals with type 2 diabetic.

High-GI foods can lead to rapid fluctuations in blood sugar, which can be harmful for people with diabetes. Greenwood DC et al., (2013) findings are consistent with, and contribute to, a growing body of evidence for the protective associations with low dietary GI and GL observational studies of Bridget A Gayer (2019) and Rizliya Visvanathan (2021) states that Apples, Pears, Oranges, Berries, and Grapefruit are naturally low in GI due to their fiber and fructose. Guava has a low glycemic index (GI) of 12-24, making it a good choice. The glycemic index (GI) of Avocado is 40 and also considered as a low glycemic fruit.

Fiber content in DM diet

Rich Fiber content nutrition food plays a major role in Type 2 DM management. Intake of high fiber preferably of the soluble type, for T2DM patients. Intake in the forms of both dietary and

supplementary are useful. 25 to 40 gram of fiber per day. For a fiber-rich fruit boost, consider raspberries, blackberries, apples (with skin), pears, avocados, and guavas. Manish Kumar Singh et al., 2025 studied and demonstrated that individual hexose sugars, especially fructose, significantly influence the GI. These results suggested that the ratio of carbohydrates and fiber may give a more accurate and reliable calculation for determining the GI than traditional methods. The scope of further research is to investigate the specific contribution of dietary fiber components, fruit texture, micronutrients, vitamins, genetic predispositions, gut microbiota, and the body's physiological status to understand the deeper mechanism of GI regulation.

Role of fruits in diabetes management

Fruits can be a valuable part of a diabetic diet, offering essential nutrients and fiber that can help manage blood sugar levels, but portion control and choosing fruits with lower glycemic index are important. Fruits contains vitamins, minerals, and antioxidants, which are beneficial for overall health.

The fiber in fruits helps slow down the absorption of sugar into the bloodstream, preventing rapid spikes in blood sugar levels.

Berries are a good source of dietary fiber, Berries like blueberries, raspberries, strawberries, and blackberries are good choices due to their high fiber and antioxidant content.

Apples and Pears are also good sources of fiber and can be enjoyed in moderation.

Citrus Fruits like Oranges, grapefruits, and lemons are relatively low in sugar and provide vitamin C. Avoid drinking large amounts of citrus fruit juice, as it lacks fiber and can cause a rapid rise in blood sugar levels.

Fruits like mangoes, pineapples, and dates are naturally high in sugar and should be consumed in moderation. While fruit juice can be a source of vitamins, it often lacks the fiber found in whole fruits and can lead to rapid blood sugar spikes. Dried fruits are concentrated sources of sugar and should be eaten in smaller portions.

Role of berries in type 2 DM

Blueberries contains polyphenols, which include the bioactive compound (anthocyanin). Stull AJ (2016) indicated that epidemiological evidence as incorporating blueberries into the diet may reduce the risk of developing type 2 diabetes. Blueberries and cranberries, can be a beneficial part of a type 2 diabetes diet due to their low glycemic index, high fiber content, and rich source of antioxidants, potentially aiding in blood sugar control

Specific Berries and Their Benefits:

Blueberries: Rich in anthocyanins, which have anti-inflammatory and antioxidant properties.

Cranberries: Contain compounds that may help reduce inflammation and improve blood sugar control.

Raspberries and Strawberries: Also low in sugar and high in fiber, making them good choices for people with diabetes. (Jaakko Mursu et al., 2014)

Incorporating Berries into a Diabetes Diet

The GI of Blueberries is 53 , GI of Blackberries is 28, Raspberries followed by 25, GI is 40 for Strawberries.

Choose Whole Berries: Opt for whole, fresh berries rather than juices or dried berries, as they retain more fiber and nutrients.

Eat in Moderation: While berries are healthy, they still contain natural sugars, so it's important to consume them in moderation as part of a balanced diet.

Combine with Other Healthy Foods: Pair berries with other diabetes-friendly foods, such as yogurt, nuts, or whole grains, to create a balanced meal or snack.

Role of Apples

Apples are a good choice for people with diabetes due to their low glycemic index (GI) and high fiber content, which helps to prevent blood sugar spikes. As per USDA, approximately 200 gram of single medium sized apple provides 104 calories and 27 g of carbohydrates. In medium sized apple 4g fiber and vitamin C. Apples has relatively low on both GI and GL scales, hence it's impact on blood sugar is minimal. The GI of an apple typically ranges from 32 to 38, considered low, and the fiber helps slow down sugar absorption, they cause a relatively slow and gradual rise in blood sugar levels compared to foods with a higher GI.

In the year 2016 (Manzano M et al.,) study states that polyphenols and phytochemicals in the skin of the apple could improve insulin resistance in animal models. In 2017 (Toshihiko Shoji et al.) review indicates that several animal models shows limited number of human studies reported that polyphenols inhibit hyperglycemia and improve insulin sensitivity and acute insulin secretion. Apples do not cause spikes in blood sugar levels due to 27 grams of carbohydrates in 200g of an apple. The fiber in apples, especially in the skin, helps slow down the absorption of sugar, which can help prevent blood sugar spikes. Apples are also a good source of antioxidants like quercetin, which may improve insulin sensitivity.

While apples are a healthy choice, moderation is important, as with any food when managing diabetes. It is advisable to consume apples in their raw form to maximize their benefits, as cooking or processing may slightly increase their glycemic index.

Guava: Guava fruits are tropical and subtropical trees that are rich in nutritious, delicious, and given the title as "superfood" by nutritionist. It is rich in fiber and vitamin C, low fat, and free from cholesterol. Guava has 112 calories and 23 grams of carbohydrates in a full 1-cup servings. Carbohydrates are mostly natural sugar (14.7 grams), and 9 grams of fiber. But it does not have starch content. The GI of guava found it to be around 33 for people with type 2 diabetes and 31 for healthy peoples, with no major difference between the two groups. Based upon these findings dietician suggested that guava fruit without peel was more Seffective on minimising the blood sugar level. Yukun Jiao et al., 2017 demonstrated the anti-hyperglycaemic activity, anti-hyperlipidemic effects, and protective effects on the pancreas and liver of guava fruit polysaccharides (GP-1, GP-3, GP-4) in T2DM rats. Studies carried out on the influence of GPs on other signalling pathways

Benefits of Pears in Diabetes

Xiao-Fei Guo et al. 2017, demonstrated that the intake of apples and pears was linked to an 18% decrease in the risk of type 2 DM. According to dose-response analysis, each additional pear and apple consumed per week corresponded with a 3% decrease in the risk of type 2 DM. Pears do not lead to a quick surge in blood sugar levels like several other fruits or foods. The fiber found in pears aids in slowing the rate at which sugar enters the bloodstream, which can assist in stabilizing blood sugar levels. Rich in antioxidants, pears can help safeguard against cellular damage and lower the risk of chronic diseases, including diabetes. Pears provide a good source of vitamins (C and K),

potassium, and various essential nutrients.

Reduce Type 2 Diabetes Risk:

Certain studies indicate that the consumption of pears and apples may correlate with a lower risk of developing type 2 diabetes due to their minimal levels of available carbohydrates (M. L. Dreher, 2021). Integrating fragrant and juicy peaches into your diabetes-friendly diet is an excellent way to utilize them during the warmer months. Combine peach slices with low-fat buttermilk, crushed ice, and a sprinkle of ginger or cinnamon to create a straightforward smoothie that is suitable for individuals with diabetes.

A wonderful way to include apricots in the diabetic meal plan is by using them as a main sweet summer fruit. Think about adding some chopped fresh apricots to a salad or mixing them into either hot or cold cereal. If you can resist the urge to eat them straight away, try layering berries with plain non fat yogurt in a parfait. It makes a fantastic dessert or brunch option for diabetes. Store pears at room temperature until they ripen and are ready for consumption (at which time they can be placed in the refrigerator). Here's a delightful idea: slice a pear and include the pieces in your next green salad.

Steer clear of fruit juices and opt for whole fruits instead, as they contain more fiber and create a greater sense of fullness. When buying canned fruit juices, it is critical to check the label for the terms 'unsweetened extra-light or no sugar added' if required. Avoid eating fruits that have been frozen or preserved in a heavy syrup.

Apples in a Diabetes-Friendly Diet:

Inoue Y et al. , (2022) researched and found that apples are effective at managing Postprandial Blood Glucose Levels in individuals with Normal Glucose Tolerance compared to those with Impaired Glucose Tolerance. Consuming apples alongside protein and healthy fats can help slow sugar absorption and avert spikes in blood sugar. The skins of apples are nutrient-rich, providing additional fiber and antioxidants beneficial for heart health; however, it is advisable to avoid peeling them.

Include Guava in a Diabetic Diet:

Consume guava as a complete fruit, since it maintains its fiber content. Blend guava with other low-GI fruits, a protein source, and a little yogurt to create a nutritious and satisfying smoothie. In 2017, Yukun Jiao et al. fractionated the guava polysaccharides obtained through water extraction and ethanol precipitation, naming them GP-1, GP-2, GP-3, and GP-4. Subsequently, the PMP-HPLC method was employed for identifying the monosaccharide composition. They reported that the anti-hyperglycemic activity, anti-hyperlipidemic effects, and protective impacts on the pancreas and liver of guava fruit polysaccharides (GP-1, GP-3, GP-4) were observed in T2DM rats.

Fermented pears enhance gut health and improve insulin sensitivity.

In individuals with diabetes, gastrointestinal dysfunction and bacterial infections are frequently observed as they disrupt normal metabolic regulation. The most prevalent chronic bacterial infection in humans is caused by *Helicobacter pylori*, which is found in nearly half of the global population. *H. pylori* is a micro-aerophilic, Gram-negative, slow-growing, spiral-shaped organism linked to various stomach-related diseases, including chronic atrophic gastritis and peptic ulceration. This study evaluated the phenolic-linked functionality of two pear cultivars (Bartlett and Starkrimson) with excellent bioactive properties for potential management of type 2 diabetes and hypertension. Dipayan Sarkar et al. (2015) explored the inhibition of *H. pylori* and the proliferation of *Bifidobacterium longum*, a beneficial probiotic with lactic acid bacteria-like characteristics, through

the fermentation of whole pear juice from the same cultivars using *L. helveticus*.

Incorporate avocado into the DM diet.

Avocado is an alternative to mayonnaise and sugary creamy items in the diabetic mellitus diet. The high fiber and healthy fats in avocados can assist in making you feel full and satisfied, which can contribute to weight management, a crucial aspect of diabetes care. MacKenzie K Senn et al. (2024) investigated the connections between habitual avocado intake (i. e. , for over 12 weeks, the duration of previous intervention studies) and average glucose levels, reporting that each average daily half-cup serving of avocado correlates with HbA1c values approximately 5 mmol/mol lower in Hispanic/Latino adults. They suggested that avocados play a significant role in a diet designed to support glucose homeostasis and are sensitive to an individual's overall glycemic status and metabolic functioning in those with type 2 DM.

RESULTS AND DISCUSSION

Muraki et al., 2013 reported that the presence of heterogeneity in the associations between fruit consumption of normal and risk of type 2 diabetic individuals. The intake of whole fruits, particularly apple, grapes and blueberries are significantly associated with a lower risk of type 2 diabetes, whereas consumption of fruit juice is associated with a high risk.

Ines Ellouze et al., 2023, reviewed and concluded that diabetic of an individuals should consume fresh, and in few cases, dried fruit rather than juices, pulps, pomaces, and other fruit by-products. It also important to take in their diet with fruit and fruit products consumed on any given day for these types of DM individuals . It is easiest mode to intake the calorified dense fruit as juice in higher volumes than their fresh whole food forms, which leads to a higher daily total energy intake. This study revealed the existing evidence on the supposed negative impact of juice consumption in metabolic disorders remains scarce, in addition to conflicting findings. This issues are due to the lack of routine or randomizer clinical trials that were appropriately adjusted for potential confounding variables, including intake of total energy and the levels of physical activity , which are associated with the development of T2DM.

Ali et al.,(2024) concluded in their review pointed out the difference in the connections between specific fruits and the likelihood of developing type 2 diabetes. Highly intake of some whole fruits particularly blueberries, grapes, and apples are strongly connected to a reduced risk of developing type 2 diabetes. Conversely, higher consumption of fruit juice was connected with an elevated risk.

CONCLUSION

Nutritional content of berries rich in fiber, vitamins and antioxidants, and also have a lower glycemic index level. Apples consists of soluble fiber and it can help regulate blood suga level. Pears contains high amount of fiber content and slow-digesting sugars, so pears contribute to steady blood sugar levels. The presence of fiber in fruits can reduce the absorption of high amount of sugar into the bloodstream which can cause a immediately rise in blood sugar levels. Fruits which has high fiber content like apples due to their skin on, it leads to lower glycemic index. Some tropical fruits like pineapple, papaya, and mango tend to be higher in natural sugars and have a higher glycemic index compared to other fruits. While intake these fruits may lead to more significant hike in blood sugar levels.

Fruits has broad spectrum of choices that harmonize with the regulation of blood sugar level. Unique combination of nutrients and glycemic index shows the impact on the management of Type 2 Diabetic mellitus with proper life style.

New studies have pointed out the potential for conversion of non secretion β islet cells into insulin secretion β -cells to replenish β -cell mass as a means to treated diabetes. This review addressing the future research on control of type2 diabetic mellitus with the mentioned fruits.

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