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Glycemic Response of Selected Fruits among Type 2 Diabetic Patients in Ibadan, Nigeria

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Abstract

Type 2 diabetes mellitus (T2DM) requires careful dietary management to control postprandial blood glucose levels. This study assessed the glycemic response of selected fruits among individuals with T2DM in Ibadan, Nigeria. An experimental design was employed involving adult diabetic patients attending a tertiary hospital. Participants consumed five selected fruits (banana, pineapple, orange, watermelon, and pawpaw), each standardized to provide 50 g of available carbohydrate, as well as a reference glucose solution. Capillary blood glucose levels were measured at baseline and at 30, 60, 90, and 120 minutes post-consumption. Glycemic response indices, including peak postprandial blood glucose (PPBG), mean incremental blood glucose (MIBG), and 2-hour postprandial blood glucose (2hPBG), were calculated. Results showed that all fruits elicited increases in blood glucose levels, with peak responses occurring at 30 minutes. Pineapple and watermelon produced higher glycemic responses, with MIBG values of 90.30 ± 25.54 mg/dL and 102.43 ± 108.62 mg/dL, respectively, while pawpaw (31.28 ± 14.03 mg/dL) and banana (39.69 ± 34.76 mg/dL) showed lower responses. Similar patterns were observed across the study periods. In conclusion, selected fruits differ in their glycemic impact among individuals with T2DM. Fruits such as pawpaw and banana may be more suitable for glycemic control, while pineapple and watermelon should be consumed in moderation. These findings provide useful evidence for guiding dietary recommendations and improving glycemic management among diabetic patients.

Keywords: Postprandial glycemia, Dietary management, Carbohydrate metabolism, Fruit Consumption, Blood glucose monitoring

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Introduction

Type 2 diabetes mellitus (T2DM) is a major global public health concern, characterized by chronic hyperglycemia resulting from insulin resistance and impaired insulin secretion (Goyal et al., 2023). The prevalence of T2DM has increased rapidly over the past few decades, particularly in low- and middle-income countries, including Nigeria (Olamoyegun et al., 2024). Poor glycemic control is associated with serious complications such as cardiovascular disease, neuropathy, nephropathy, and retinopathy, which significantly reduce quality of life and increase mortality (Yahaya et al., 2023). Effective dietary management remains a cornerstone in the prevention and control of T2DM, with particular emphasis on regulating postprandial blood glucose levels (Marume et al., 2025).

Postprandial glycemic response refers to the change in blood glucose concentration following the consumption of food, especially carbohydrate-containing meals (Kaur et al., 2020). In individuals with T2DM, postprandial hyperglycemia is often more pronounced due to delayed insulin response and reduced glucose uptake by peripheral tissues (Joshi et al., 2025). Studies have shown that controlling postprandial glucose excursions is critical for overall glycemic control and can reduce the risk of long-term complications (Joshi et al., 2025). As a result, considerable attention has been given to understanding how different foods influence glycemic response.

Fruits are widely recommended as part of a healthy diet due to their rich content of vitamins, minerals, dietary fiber, and bioactive compounds (Dhalaria et al., 2020). They are also associated with reduced risk of chronic diseases, including cardiovascular disease and certain cancers (Aune et al., 2017). However, fruits contain natural sugars such as fructose and glucose, which can influence blood glucose levels, especially in individuals with diabetes (Park, 2021). This has led to ongoing debate regarding the appropriate quantity and type of fruits that can be safely consumed by individuals with T2DM (Halvorsen et al., 2021).

The glycemic response to fruits is influenced by several factors, including carbohydrate content, fiber composition, ripeness, and food matrix (Murillo et al., 2022). Fruits with higher fiber content and lower available carbohydrate tend to produce lower glycemic responses (Murillo et al., 2022). In addition, the presence of bioactive compounds such as polyphenols and organic acids in fruits has been shown to modulate glucose absorption and improve insulin sensitivity (Aryaeian et al., 2017).

The concept of glycemic index (GI) has been widely used to classify carbohydrate-containing foods based on their effect on blood glucose levels (Nicholls 2022). Many fruits are generally classified as low to moderate GI foods, suggesting that they may be suitable for individuals with diabetes when consumed in appropriate portions. However, glycemic index values alone may not fully reflect the actual physiological response in individuals with T2DM, as factors such as portion size and individual metabolic differences also play significant roles (Kaur et al., 2020). Therefore, direct assessment of postprandial glycemic response provides more practical and clinically relevant information.

Several studies have investigated the glycemic response to fruits in both healthy individuals and those with diabetes. Some findings suggest that fruits such as citrus fruits produce relatively low glycemic responses, while others such as watermelon and pineapple may elicit higher responses (Ansari et al., 2024). In a study conducted among individuals with T2DM, significant differences were observed in the postprandial glycemic response to commonly consumed fruits, indicating that not all fruits have the same metabolic effects (Crummett & Grosso, 2022). Similarly, other studies have shown that the form of fruit consumption, whether whole, blended, or juiced, can also influence glycemic response (Crummett & Grosso, 2022).

Despite these findings, there remains inconsistency in the literature regarding the glycemic impact of different fruits. Some studies report minimal differences in glycemic response among fruits, while others demonstrate significant variation (Crummett & Grosso, 2022). These discrepancies may be due to differences in study design, population characteristics, portion sizes, and methods of glucose measurement. In addition, there is limited data on the glycemic response to tropical fruits commonly consumed in African settings, particularly among individuals with T2DM.

In Nigeria, fruits such as banana, pineapple, orange, watermelon, and pawpaw (papaya) are commonly consumed due to their availability and affordability. These fruits contribute significantly to daily nutrient intake but also vary in their sugar composition and fiber content. Previous studies in Nigeria have examined the glycemic response to selected fruits; however, many of these studies were conducted among healthy individuals or did not standardize carbohydrate portions (Ninikanwa et al., 2020). Furthermore, there is limited evidence on how these fruits affect glycemic response in individuals living with T2DM under controlled conditions.

Understanding the glycemic response to commonly consumed fruits is important for providing evidence-based dietary recommendations for individuals with diabetes. Accurate information can help healthcare professionals guide patients in making appropriate food choices that support glycemic control without unnecessarily restricting fruit intake. It also addresses common misconceptions among patients who may avoid fruits entirely due to fear of increasing blood glucose levels (Kaur et al., 2020).

In addition, environmental and seasonal variations may influence the nutrient composition of fruits, which could subsequently affect their glycemic impact (Oduneye et al., 2025). However, limited studies have explored how such variations influence glycemic responses among individuals with type 2 diabetes. Given the increasing burden of T2DM in Nigeria and the importance of dietary management, there is a need for context-specific research that evaluates the glycemic effects of locally available foods. Therefore, this study aims to assess the glycemic response of selected fruits among individuals with type 2 diabetes mellitus in Ibadan, Nigeria, while considering variations observed during different periods of fruit availability.

Materials and Methods

Study Design

This study employed an experimental design to assess the glycemic response of selected fruits among individuals with type 2 diabetes mellitus (T2DM).

Study Area and Participants

The study was conducted at the diabetic clinic of Ring Road State Hospital, Ibadan, Oyo State, Nigeria. The participants consisted of adult patients diagnosed with type 2 diabetes mellitus who attended routine clinic visits and consented to participate in the study.

Sample Size and Sampling Technique

The sample size was determined using Cochran's formula, yielding a minimum of 67 participants. After adjusting for a 10% attrition rate, 75 participants were recruited. Of these, 43 participants completed the first phase (rainy season), while 40 completed the second phase of the study (dry season). For consistency in analysis, only the 40 participants who completed both phases were included in the final data analysis. Participants were recruited using a purposive sampling technique based on predefined eligibility criteria.

Fruit Selection and Preparation

Five commonly consumed fruits, banana, pineapple, orange, watermelon, and pawpaw, were selected for the study. Fresh samples were purchased from a local market in Ibadan. Fruits were washed, peeled where necessary, and prepared into edible portions. Each fruit serving was standardized to provide 50 g of available carbohydrate based on the carbohydrate content per 100 g edible portion. The required quantities were weighed using a digital scale.

Experimental Feeding Protocol

Each participant underwent a six-day testing period. On Days 1 to 5, participants consumed one fruit per day (pawpaw, banana, pineapple, orange, and watermelon), while on Day 6, a reference meal consisting of 50 g glucose dissolved in 250 mL of water was administered. All tests were conducted after a 10–12-hour overnight fast. Capillary blood glucose levels were measured at baseline (0 minutes), and at 30, 60, 90, and 120 minutes after consumption of each test meal. Participants consumed each portion within 10–15 minutes and remained seated throughout the testing period. The study was conducted during two periods of fruit availability.

Outcome Measures

Glycemic response was assessed using the following parameters:

- Fasting Blood Glucose (FBG)
- Peak Postprandial Blood Glucose (PPBG)
- Mean Incremental Blood Glucose (MIBG)
- Two-hour Postprandial Blood Glucose (2hPBG)

Data Analysis

Data were analyzed using IBM SPSS version 25. Descriptive statistics, including mean and standard deviation, were used to summarize blood glucose values. Glycemic response indices, including mean incremental blood glucose (MIBG), peak postprandial blood glucose (PPBG), and two-hour postprandial blood glucose (2hPBG), were calculated for each fruit and compared with the reference glucose solution. Differences in glycemic responses were considered statistically significant at $p < 0.05$.

Ethical Considerations

Ethical approval was obtained from the Research Ethics Committee of Lead City University and the Oyo State Ministry of Health. Institutional approval was also obtained from Ring Road State Hospital, Ibadan. Written informed consent was obtained from all participants prior to data collection. Confidentiality was maintained, and participation was voluntary.

Results

The socio-demographic characteristics of the participants are presented in Table 1. A total of 40 participants completed the study. The majority were aged 61–70 years (42.5%), followed by those aged 51–60 years (25.0%). Females constituted a higher proportion (77.5%) compared to males (22.5%). Most participants had primary education (40.0%), while 27.5% had tertiary education. In terms of occupation, 27.5% were unemployed and 20.0% were retired. The largest proportion of participants (42.5%) earned between ₦50,001 and ₦100,000 monthly.

Table 1: Demographic Profile of Participants

Variables	Frequency (N = 40)	Percentage (%)
Age group		
31–40	2	5.0
41–50	4	10.0
51–60	10	25.0
61–70	17	42.5
71–80	7	17.5
Total	40	100.0
Sex		
Male	9	22.5
Female	31	77.5
Total	40	100.0
Marital status		
Single	11	27.5
Married	11	27.5
Separated/Divorced	18	45.0
Total	40	100.0
Educational level		
Primary	16	40.0
Tertiary	11	27.5
Non-formal	7	17.5
Secondary	6	15.0
Occupation		
Not Employed	11	27.5
Retired	8	20.0
Trader	7	17.5
Civil Servant	7	17.5
Artisan	7	17.5
Income		
50,001 – 100,000	17	42.5
< 20,000	11	27.5
> 100,000	6	15.0
20,000 – 50,000	6	15.0

The postprandial blood glucose responses of participants following the consumption of selected fruits during the rainy season are presented in Table 2. Fasting blood glucose values ranged from 140.77 ± 37.45 mg/dL (orange) to 171.63 ± 58.79 mg/dL (pineapple). All fruits elicited an increase in blood glucose levels, with peak values generally observed at 30 minutes post-consumption. Pineapple produced the highest peak postprandial blood glucose (261.93 ± 76.03 mg/dL), followed by watermelon (256.67 ± 134.86 mg/dL), while banana elicited the lowest response (194.21 ± 63.24 mg/dL). Blood glucose levels declined progressively after 60 minutes, approaching baseline values at 120 minutes.

Table 2: Glycemic Response in Rainy Season

Fruit Administered	Fasting Blood Sugar (mg/dL)	30mins_PPBG (mg/dL)	60mins_PPBG (mg/dL)	90mins_PPBG (mg/dL)	120mins_PPBG (mg/dL)
Glucose Control	171.13 ± 66.27	224.14 ± 75.19	201.69 ± 70.53	186.12 ± 65.00	174.00 ± 63.00
Watermelon	154.24 ± 48.27	256.67 ± 134.86	174.93 ± 66.03	162.35 ± 62.65	164.78 ± 72.59
Orange	140.77 ± 37.45	222.73 ± 55.12	208.14 ± 65.50	182.93 ± 61.23	172.24 ± 63.47
Pineapple	171.63 ± 58.79	261.93 ± 76.03	241.98 ± 86.59	223.22 ± 87.38	198.03 ± 78.64
Pawpaw	166.77 ± 57.96	198.05 ± 63.81	192.74 ± 65.96	178.21 ± 63.58	175.29 ± 68.39
Banana	154.52 ± 59.48	194.21 ± 63.24	202.95 ± 67.97	203.59 ± 78.14	187.59 ± 74.84

As shown in Table 3, watermelon (102.43 ± 108.62 mg/dL), pineapple (90.30 ± 25.54 mg/dL), and orange (81.97 ± 26.32 mg/dL) produced higher mean incremental blood glucose (MIBG) values and were significantly different compared to the glucose control ($p < 0.05$). Pawpaw (31.28 ± 14.03 mg/dL) and banana (39.69 ± 34.76 mg/dL) elicited relatively lower glycemic responses.

Table 3: Blood Glucose Response Indices to Fruit Consumption during Rainy Season

Fruit	FBG	PPBG	MIBG	2hPBG
	(Mean ± SD)	(Mean ± SD)	(Mean ± SD)	(Mean ± SD)
Glucose Control	171.13 ± 66.27	224.14 ± 75.19	53.01 ± 18.73	174.00 ± 63.00
Watermelon	154.24 ± 48.27	256.67 ± 134.86	102.43 ± 108.62*	164.78 ± 72.59
Orange	140.77 ± 37.45	222.73 ± 55.12	81.97 ± 26.32*	172.24 ± 63.47
Pineapple	171.63 ± 58.79	261.93 ± 76.03	90.30 ± 25.54*	198.03 ± 78.64
Pawpaw	166.77 ± 57.96	198.05 ± 63.81	31.28 ± 14.03	175.29 ± 68.39
Banana	154.52 ± 59.48	194.21 ± 63.24	39.69 ± 34.76	187.59 ± 74.84

FBG – Fasting Blood Glucose, PPBG, Peak postprandial blood glucose; MIPG, Maximum increase in blood glucose; 2hPBG, Two-hour postprandial blood glucose; Significance of difference from glucose: *$p < 0.05$

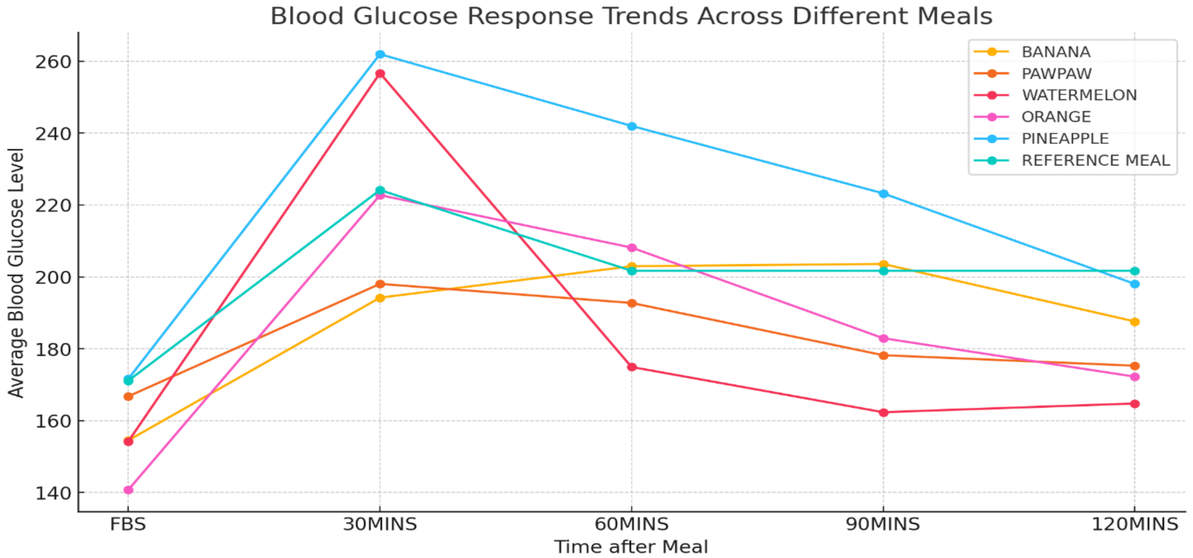

Figure 1: Blood Glucose Trends across Different Meals during Rainy Season.

Table 4 presents the glycemic responses following fruit consumption during the dry season. Fasting blood glucose values ranged from 142.95 ± 39.28 mg/dL (orange) to 163.51 ± 54.16 mg/dL (pineapple). Peak postprandial blood glucose levels were observed at 30 minutes for all fruits. Pineapple produced the highest peak value (255.97 ± 74.68 mg/dL), followed by watermelon (244.28 ± 125.13 mg/dL), while Banana recorded the lowest (191.80 ± 58.93 mg/dL) followed by Pawpaw (194.02 ± 63.76 mg/dL). A gradual decline in blood glucose levels was observed at subsequent time points.

Table 4: Glycemic Response in Dry Season

Fruit Administered	Fasting Blood Sugar (mg/dL)	30mins_PPBG (mg/dL)	60mins_PPBG (mg/dL)	90mins_PPBG (mg/dL)	120mins_PPBG (mg/dL)
Glucose Control	160.41 ± 66.70	212.17 ± 80.10	188.09 ± 70.43	184.77 ± 70.00	178.85 ± 68.50
Watermelon	152.10 ± 47.45	244.28 ± 125.13	177.09 ± 64.49	162.88 ± 59.59	162.90 ± 67.78
Orange	142.95 ± 39.28	225.87 ± 48.60	203.51 ± 60.83	180.49 ± 59.86	169.15 ± 61.88
Pineapple	163.51 ± 54.16	255.97 ± 74.68	231.09 ± 83.50	210.68 ± 83.76	187.40 ± 75.49
Pawpaw	160.22 ± 57.18	194.02 ± 63.76	189.08 ± 65.13	172.51 ± 60.44	168.62 ± 65.15
Banana	153.16 ± 53.43	191.80 ± 58.93	203.46 ± 64.76	200 ± 75.57	184.69 ± 69.26

As shown in Table 5, pineapple (92.46 ± 40.20 mg/dL), watermelon (92.17 ± 91.22 mg/dL), and orange (82.92 ± 26.53 mg/dL) exhibited higher mean incremental blood glucose values compared to pawpaw (33.80 ± 11.91 mg/dL) and banana (38.64 ± 34.22 mg/dL).

Table 5: Blood Glucose Response Indices to Fruit Consumption during Dry Season

Fruit	FBG (Mean ± SD)	PPBG (Mean ± SD)	MIBG (Mean ± SD)	2hPBG (Mean ± SD)
Glucose Control	160.41 ± 66.70	212.17 ± 80.10	51.76 ± 20.58	181.85 ± 68.50
Watermelon	152.10 ± 47.45	244.28 ± 125.13	92.17 ± 91.22	162.90 ± 67.78
Orange	142.95 ± 39.28	225.87 ± 48.60	82.92 ± 26.53	169.15 ± 61.88
Pineapple	163.51 ± 54.16	255.97 ± 74.68	92.46 ± 40.20	187.40 ± 75.49
Pawpaw	160.22 ± 57.18	194.02 ± 63.76	33.80 ± 11.91	168.62 ± 65.15
Banana	153.16 ± 53.43	191.80 ± 58.93	38.64 ± 34.22	184.75 ± 69.26

*FBG – Fasting Blood Glucose, PPBG, Peak postprandial blood glucose; MIPG, Maximum increase in blood glucose; 2hPBG, Two-hour postprandial blood glucose; Significance of difference from glucose: *p <0.05*

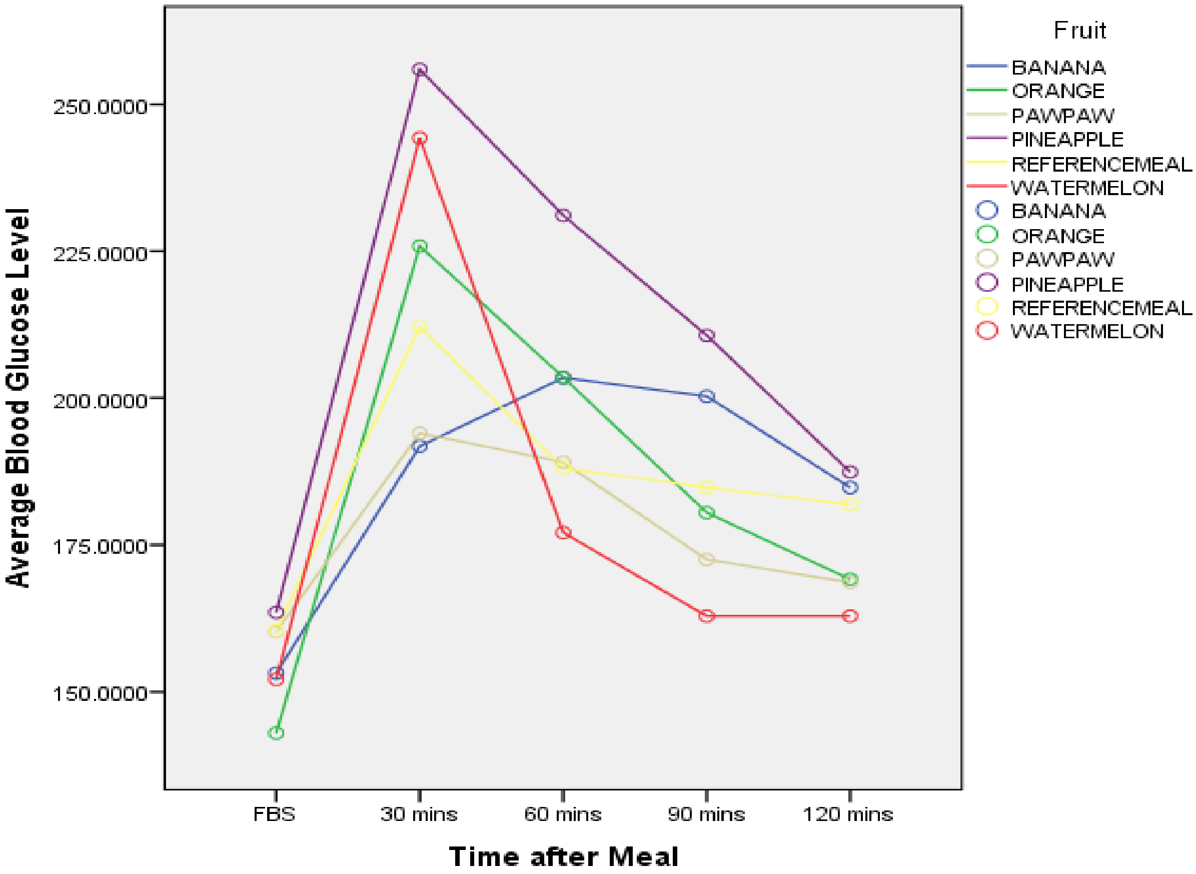

Figure 2: Blood Glucose Trends across Different Meals during Dry Season

Discussion

Fruit intake is widely acknowledged for its role in promoting health due to its rich composition of vitamins, fiber, antioxidants, and phytochemicals. However, among individuals living with type 2 diabetes mellitus (T2DM), fruit consumption patterns can be complex, often shaped by cultural beliefs, dietary misconceptions, access to nutrition education, economic factors, and individual glycemic concerns. This study assessed the glycemic response of selected fruits among individuals with type 2 diabetes mellitus in Ibadan, Nigeria. The findings demonstrate that different fruits elicit varying postprandial blood glucose responses, with consistent patterns observed across the study periods.

The results showed that all fruits led to an increase in postprandial blood glucose levels, with peak responses occurring at 30 minutes, followed by a gradual decline toward baseline at 120 minutes. This pattern is consistent with the physiological response to carbohydrate ingestion, where glucose absorption is rapid and peaks within the first hour (Dao et al., 2025). Similar findings have been reported in previous studies, indicating that postprandial glucose excursions typically reach maximum levels within 30–60 minutes after food intake (Engeroff et al., 2023).

Among the fruits studied, pineapple and watermelon consistently produced higher glycemic responses, while pawpaw and banana elicited lower responses. This variation can be attributed to differences in carbohydrate composition, fiber content, and the presence of bioactive compounds in the fruits. Fruits with higher simple sugar content and lower fiber tend to produce greater glycemic responses due to faster digestion and absorption (Singh et al., 2025). The relatively lower glycemic response observed with pawpaw and banana may be due to their fiber content and structural properties, which can slow gastric emptying and glucose absorption (Crummett & Grosso, 2022).

The observed differences in glycemic responses among the fruits may also be linked to their nutrient composition. Previous findings from this research (Oduneye et al., 2025) demonstrated variations in carbohydrate and reducing sugar contents of the selected fruits across periods of availability. Fruits with higher reducing sugar content, such as pineapple and watermelon, were associated with higher glycemic responses, while those with relatively lower sugar content demonstrated reduced glycemic impact. This supports existing evidence that the composition of carbohydrates and bioactive compounds in fruits plays a significant role in modulating postprandial glucose response (Dhalaria et al., 2020).

The higher glycemic responses observed for pineapple and watermelon are consistent with previous studies that have classified these fruits as having moderate to high glycemic potential (Oduneye et al., 2025). In contrast, fruits such as pawpaw have been reported to have a lower glycemic impact, making them more suitable for individuals with diabetes when consumed in controlled portions (Roy et al., 2022). These findings support existing evidence that not all fruits have the same metabolic effects and that fruit selection is important in dietary management of diabetes.

Although the study was conducted during two periods of fruit availability, similar glycemic response patterns were observed across both periods. However, slight variations in glycemic responses were noted, with some fruits showing marginally higher values in one period compared to the other. These differences may be related to variations in fruit composition due to environmental factors, ripeness, and storage conditions, which have been shown to influence sugar content and glycemic response (Crummett & Grosso, 2022).

The clinical implication of these findings is that individuals with type 2 diabetes can benefit from selecting fruits with lower glycemic responses, such as pawpaw and banana, as part of their dietary management. This is important in preventing excessive postprandial glucose excursions, which are associated with poor glycemic control and increased risk of complications (Kaur et al., 2020). At the same time, fruits with higher glycemic responses, such as pineapple and watermelon, may still be consumed in moderation and with appropriate portion control.

This study has some limitations. The relatively small sample size and participant attrition may limit the generalizability of the findings. In addition, individual variations in glucose metabolism and medication use were not controlled, which may have influenced glycemic responses. Despite these limitations, the study provides valuable insight into the glycemic effects of commonly consumed fruits in a real-world clinical setting.

Conclusion

In conclusion, this study demonstrated that selected fruits elicit varying glycemic responses among individuals with type 2 diabetes mellitus, with pineapple and watermelon producing higher postprandial blood glucose levels, while pawpaw and banana showed relatively lower responses. These findings indicate that not all fruits have the same glycemic impact and highlight the importance of fruit selection in dietary management of diabetes. Although slight variations were observed across periods of fruit availability, the overall glycemic patterns remained consistent. Therefore, incorporating lower glycemic fruits into the diet may support better glycemic control, while higher glycemic fruits should be consumed in moderation.

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