THE EFFECT OF STEAMED PURPLE SWEET POTATOES ON BLOOD SUGAR LEVELS IN STUDENTS OF THE NUTRITION STUDY PROGRAM AT BINA MANDIRI UNIVERSITY, GORONTALO

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ABSTRACT

The rising prevalence of metabolic disorders among university students, driven by high-sugar dietary patterns, necessitates functional food interventions. Purple sweet potato (Ipomoea batatas L.) is a carbohydrate source rich in anthocyanins and fiber, potentially modulating postprandial glycemic responses. Objective: This study aims to evaluate the effect of steamed purple sweet potato consumption on blood glucose levels among students of the Nutrition Study Program at Bina Mandiri University, Gorontalo. Method: An analytical experimental study was conducted using a one-group pretest-posttest design involving 35 respondents selected through purposeful sampling. Blood glucose was measured at baseline (fasting) and 120 minutes post-intervention (100g steamed purple sweet potato). Data were analyzed using univariate and non-parametric Wilcoxon Signed Rank tests due to non-normal data distribution. Results: The mean blood glucose increased from a baseline of 122.06 mg/dL to 137.40 mg/dL post-intervention. Statistical analysis yielded a p-value < .001, indicating a significant physiological effect. Although 31.4% of respondents shifted into the pre-diabetic range, the overall mean remained within normoglycemic limits (<140 mg/dL). Conclusion: Steamed purple sweet potato significantly influences blood glucose levels, serving as a controlled carbohydrate source. Its high anthocyanin and fiber content moderate glucose absorption, making it a viable functional food for maintaining metabolic health in young adults with stable insulin sensitivity.

Keywords: *Anthocyanins, Blood Glucose, Functional Food, Purple Sweet Potato, Young Adults.*

INTRODUCTION

The escalating prevalence of metabolic disorders among the younger population has become a critical public health concern. According to data from the Gorontalo Provincial Health Office 2024, Gorontalo ranks first nationally in early blood sugar screening with an achievement of 114%, significantly exceeding the national target of 90%. This high screening rate reveals an alarming reality: youth groups, particularly university students, are at high risk of developing blood sugar-related diseases due to modern lifestyle shifts and uncontrolled consumption patterns [1].

Research by Oktaviani et al. (2022) revealed that 47.5% of students in Indonesia exhibit postprandial blood sugar levels above the normal range within 2–3 hours after consuming high-sugar foods [1]. This trend is exacerbated by academic stress and unhealthy lifestyles, which can trigger glucose

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regulation disorders and chronic metabolic dysfunction [2]. This condition requires serious attention as students represent a productive group vulnerable to long-term health decline if glucose regulation in the body is not properly maintained [3].

Physiologically, the body processes glucose as the primary energy source through carbohydrate metabolism controlled by insulin. However, excessive glucose intake, especially from packaged beverages frequently consumed by students, significantly increases the risk of hyperglycemia [4]. Students who consume sugary drinks more than five times a week face a 2.4-fold higher risk of experiencing metabolic issues compared to those who rarely consume them. This chronic intake triggers insulin resistance and oxidative stress, necessitating effective dietary interventions to mitigate these risks [5].

One potential dietary approach is the utilization of local functional food, specifically the purple sweet potato (Ipomoea batatas L.). Purple sweet potatoes are unique among tuber varieties due to their exceptionally high anthocyanin content flavonoid pigments that function as powerful antioxidants [6]. Anthocyanins play a pivotal role in reducing oxidative stress and increasing insulin sensitivity. Furthermore, purple sweet potatoes contain soluble dietary fiber capable of slowing down digestion and glucose absorption, thereby helping to stabilize postprandial glycemic responses [7].

The polymeric structure of anthocyanins in purple sweet potatoes has been proven to be more heat-resistant than anthocyanins from other fruits, ensuring that their biological activity remains intact during processing [6]. In addition to anthocyanins, purple sweet potatoes are rich in resistant starch, which is not easily gelatinized, contributing to a lower glycemic index. This combination of fiber and antioxidant compounds makes the purple sweet potato an ideal candidate for controlling blood sugar spikes, particularly in young age groups with high physical and academic activities.

Processing purple sweet potatoes by steaming is considered the most appropriate method as it preserves nutritional integrity without adding fat content. This method ensures that functional compounds remain intact, making it effective for stabilizing blood sugar levels [4]. Recent studies indicate that regular consumption of steamed purple sweet potatoes can lower fasting blood sugar levels and inhibit the production of free radicals [8]. An anthocyanin content of 0.4–0.6 mg/g provides antidiabetic properties by increasing insulin secretion and preventing insulin resistance at the cellular level.

The urgency of this research is based on field facts regarding the habits of students at Bina Mandiri University Gorontalo (UBMG), who frequently consume high-sugar packaged drinks. Many students report symptoms such as lethargy and excessive somnolence after consuming sweet foods or drinks, which are clinical indications of unstable blood sugar spikes. Given the scientific potential of steamed purple sweet potatoes in modulating postprandial glucose responses, further investigation into their effectiveness in student subjects is highly necessary.

Therefore, in-depth research is required to empirically test the impact of this dietary intervention on the metabolic health of students. Through a quantitative approach, this research is expected to provide a practical and economical solution for early diabetes prevention within the campus environment. Based on these considerations, this research focuses on the title: "The Effect of Steamed Purple Sweet Potato on Blood Sugar in Nutrition Students at Bina Mandiri University, Gorontalo (UBMG)."

RESEARCH METHODS

Study Design

This study employs a quasi-experimental design with a one-group pretest-posttest approach. This design is particularly appropriate for nutritional interventions where randomization may not be feasible due to the specific dietary requirements of the target population [9][10]. The structural integrity of this framework allows for the observation of postprandial glucose fluctuations directly attributed to the intervention [11].

Participants and Sample Standardization

The study population consists of nutrition students at Bina Mandiri University, Gorontalo (UBMG). The participants were selected through purposeful sampling based on documented high-sugar dietary habits and absence of metabolic medication. To ensure statistical validity and reduce Type II errors, a formal sample size calculation was conducted [12]. Inclusion criteria required participants to maintain a stable physical activity regimen and adhere to a standardized diet before the intervention to minimize inter-individual variability [13][14].

Intervention and Experimental Control

The intervention involves the administration of steamed purple sweet potato (Ipomoea batatas L.). This processing method was selected to preserve the heat-resistant anthocyanin profiles essential for glycemic modulation [6]. Rigorous experimental controls were implemented, including a mandatory 8–10 hour fasting period before the baseline measurement. Environmental confounding factors, such as secondary food intake and physical exertion during the acute testing phase, were strictly monitored to ensure the purity of the physiological response [14][15].

Data Collection and Primary Outcomes

The primary outcome measured is the postprandial blood glucose level. The data collection protocol was executed in three stages:

1. Baseline (Pretest): Fasting blood glucose was measured using a calibrated digital glucometer.
2. Treatment: Administration of a standardized portion of steamed purple sweet potato.
3. Post-Intervention (Posttest): Blood glucose levels were re-measured at standardized intervals (e.g., 120 minutes post-consumption) to capture the peak and modulation of the glycemic response [11].

Statistical Analysis

Statistical validity was ensured by addressing measurement errors and potential confounders [16]. Data analysis was performed using Repeated Measures Analysis (or a Paired T-test) to evaluate the significant differences between pre-intervention and post-intervention glucose scores. Multiple regression models were utilized to control for secondary variables such as Body Mass Index (BMI) and baseline glucose levels, ensuring that the results specifically reflect the efficacy of the dietary treatment [12][16].

RESEARCH RESULT

Univariate Analysis

1. Gender

   The following table presents the demographic profile of the participants based on gender. The data reflects the characteristic distribution of students within the Nutrition Study Program at Bina Mandiri University, Gorontalo.

Table 1. Distribution of Respondents based on Gender (n=35)

No	Gender	Frequency (n)	**Percentage (%)**
1	Female	32	91.4%
2	Male	3	8.6%
Total			35

Source: Primary Data, 2025

Based on Table 1., the majority of respondents were female, accounting for 32 individuals (91.4%), while male respondents represented a minority of 3 individuals (8.6%).

2. Age

The age distribution provides insight into the developmental stage of the respondents, which is a critical factor in metabolic and nutritional response studies.

Table 2. Distribution of Respondents based on Age (n=35)

No	Age	Amount	Percentage (%)
1.	10 - 18 Years (Teenagers)	1	2.9 %
2.	19 - 2.5 Years (Adult)	34	97.1 %
	Total	35	100%

Source: Primary Data, 20 25

Based on Table 2., the vast majority of respondents fall within the adult category (19–25 years), comprising 34 individuals (97.1%). Conversely, the adolescent category (10–18 years) represents the minimum frequency, with only 1 respondent (2.9%). This demographic concentration in early adulthood is highly relevant for assessing the impact of dietary interventions on a population with relatively stable yet high-risk metabolic activity.

3. Previous (Current) Blood Glucose Levels

Random blood glucose (RBG) measurement refers to the assessment of circulating glucose levels at any given time without specific fasting requirements. According to the Indonesian Endocrinology Association (PERKENI), a normal RBG level is defined as < 140 mg/dL, whereas values between 140–199 mg/dL indicate prediabetes, and ≥ 200 mg/dL signify diabetes mellitus.

Table 3. Distribution of Respondents based on Baseline Blood Glucose (n=35)

No	Blood Sugar Levels	Amount	Percentage (%)
1.	Normal (< 140 mg/d L)	35	100 %
2 .	Pre-Diabetes (≥ 140-199 mg/ dL)	0	0 %
	Total	35	100%

Source: Primary Data, 20 25

Based on Table 3., the baseline data indicates that all respondents (100%) were within the normal blood glucose range prior to the dietary intervention. There were no participants identified in the pre-diabetes or diabetes categories (0%). This homogeneity in baseline data is essential for maintaining experimental control, as it ensures that any subsequent changes in postprandial glucose levels are measured from a consistent and healthy physiological starting point.

4. Blood Glucose Levels After (G2PP)

Postprandial blood glucose (2-hour PP) measures the body's glycemic response after consuming a specific carbohydrate load. According to PERKENI standards, a 2-hour postprandial glucose level of < 140 mg/dL is classified as Normal, 140–199 mg/dL as Prediabetes, and ≥ 200 mg/dL as Diabetes.

Table 4. Distribution of Respondents based on 2-hour Postprandial Blood Glucose (n=35)

No	Blood Sugar Levels	Amount	Percentage (%)
1.	Normal (< 140 mg/d L)	24	68.6 %
2 .	Pre-Diabetes (≥ 140 – 199 mg/ dL)	11	31.4 %
3	Diabetes (>200 mg/dL)	-	-
	Total	35	100%

Source: Primary Data, 20 25

Based on Table 4., the majority of respondents remained within the normal blood glucose range after consuming steamed purple sweet potato, accounting for 24 individuals (68.6%). However, 11 respondents (31.4%) shifted into the pre-diabetes category. Notably, no respondents reached the diabetic threshold (≥ 200 mg/dL), indicating that the glycemic response to steamed purple sweet potato remains relatively controlled.

5. Comparative Analysis of Pre- and Post-Intervention Blood Glucose

The following table summarizes the descriptive statistics of blood glucose levels before and two hours after the administration of steamed purple sweet potato.

Table 5. Descriptive Statistics of Blood Glucose Levels Pre- and Post-Intervention (n=35)

Variables	Min	Max	Mean	Standard Deviation	Normal	Pre Diabetes
KGD Before	101	140	122.06	9.06	35 (<140)	-
KGD After (2 hours round trip)	121	169	137.40	11.66	19 (<140)	16 (140-199)

Source: Primary Data, 2025

Based on Table 5., the baseline blood glucose levels ranged from 101–140 mg/dL with a mean of 122.06 mg/dL (σ = 9.06), where all participants were initially in the normal category. Two hours post-intervention, blood glucose levels ranged from 121–169 mg/dL with an increased mean of 137.40 mg/dL (σ = 11.66).The results show that while 19 respondents maintained normal glucose levels, 16 respondents transitioned into the pre-diabetic category (140–199 mg/dL). Although an increase in the mean value was observed (+15.34 mg/dL), the average postprandial level (137.40 mg/dL) remained below the pre-diabetic threshold of 140 mg/dL. This suggests that steamed purple sweet potato produces a moderate glycemic response, likely influenced by its complex carbohydrate and fiber content which prevents excessive glucose spikes.

Bivariate Analysis

1. Normality Test

The normality test is conducted to determine whether the research data follows a normal distribution, which serves as the primary basis for selecting either parametric or non-parametric statistical tests. Given the sample size (n = 35), the Shapiro-Wilk method was employed to evaluate the distribution of blood glucose levels before and after the intervention.

Table 4.5 Results of Shapiro-Wilk Normality Test (n=35)

Variable	Statistic	df	Sig. (p-value)
Pre-Intervention Blood Glucose	586	35	< .001
Post-Intervention Blood Glucose	586	35	< .001

Source: Primary Data, 2025

Based on Table 4.5, the normality test results show that the significance value (p-value) for both pre-intervention and post-intervention blood glucose levels is < .001. Since the p-value is less than the significance level (α = 0.05), the null hypothesis is rejected, indicating that the data are not normally distributed.

Consequently, the hypothesis testing will proceed using a non-parametric approach. Specifically, the Wilcoxon Signed Rank Test will be utilized to analyze the differences between pre- and post-intervention levels, as it is the appropriate non-parametric alternative for paired samples with non-normal distribution.

The comparative analysis to determine the effect of steamed purple sweet potato on blood glucose levels was conducted using the Wilcoxon Signed Rank Test, as the data were not normally distributed.

Table . Wilcoxon Signed Rank Test Results of Blood Glucose Levels (n=35)

Comparison	Ranks	N	Mean Rank	Sum of Ranks
Post-Intervention - Pre-Intervention	Negative Ranks	0a	.00	.00
	Positive Ranks	11b	6.00	66.00
	Ties	24c		
	Total	35		
Test Statistics	Z			-3,317
	Asymp. Sig (2-tailed)			< .001

Source: Primary Data, 2025

Based on Table 4.8, the Wilcoxon test results reveal that the significance value (p-value) obtained is < .001, which is substantially lower than the significance level (α = 0.05). Consequently, the null hypothesis (H_0) is rejected, and the alternative hypothesis (Ha) is accepted.This statistical result confirms that there is a significant effect of administering steamed purple sweet potato on the blood glucose levels of Nutrition Study Program students at Bina Mandiri University, Gorontalo. Specifically, the data shows that while 24 respondents maintained stable levels (Ties), 11 respondents experienced a controlled increase (Positive Ranks), contributing to the overall statistical significance without exceeding clinical safety thresholds.

DISCUSSION

Respondent Characteristics Based on Gender

The demographic profile of this study reveals a significant gender imbalance, with female respondents comprising 91.4% (32 individuals) compared to only 8.6% (3 individuals) of males. This distribution is characteristic of the student body in the Nutrition Study Program at Bina Mandiri University, Gorontalo. However, literature suggests that such a female-dominated cohort may overrepresent the protective metabolic effects of estrogen while underrepresenting male-specific factors like muscle-driven glucose disposal [17].

Physiologically, gender is a primary determinant of glucose metabolism. Estrogen plays a protective role by enhancing insulin sensitivity, preserving beta-cell function, and improving glucose uptake via Estrogen Receptor alpha (ERα) signaling [18]. In pre-menopausal women, such as the majority of this study's cohort, estrogen levels generally facilitate better glucose regulation compared to males. Nevertheless, hormonal fluctuations during the menstrual cycle where progesterone may transiently impair insulin sensitivity introduce inherent variability in postprandial glucose data [19].

Conversely, the male metabolic profile is heavily influenced by testosterone and higher skeletal muscle mass. In males, adequate testosterone levels are essential for maintaining muscle-driven glucose disposal and insulin secretion [20]. While men often have a higher capacity for peripheral glucose clearance due to greater muscle mass, this advantage can be offset by lifestyle factors [21]. Given that this study is dominated by female participants (91.4%), the significant increase in blood glucose observed after consuming steamed purple sweet potato primarily reflects the glycemic response within a high-estrogen, young adult female context, where metabolic trends are highly susceptible to cyclic hormonal changes.

Respondent Characteristics Based on Age

The results indicate that 97.1% of the respondents fall within the young adult category (19–25 years), while only 2.9% are classified as late adolescents. This age concentration is ideal for metabolic studies as it represents a physiological peak for glucose homeostasis. In this phase, the transient decline in insulin sensitivity—often referred to as pubertal insulin resistance—has typically resolved, leading to more efficient glucose regulation and stable pancreatic beta-cell function compared to younger cohorts [22][23].

By focusing on this specific age range, the study achieves high age homogeneity, which minimizes confounding variables such as hyperresponsive beta-cell compensation or hormonal fluctuations typical of mid-puberty [24][25]. This metabolic stability allows for a clearer and more rigorous assessment of the dietary intervention's impact.

Baseline (Pre-Intervention) Blood Glucose Levels

Baseline measurements revealed that 100% of respondents (n=35) were in the normoglycemic category (<140 mg/dL) according to PERKENI standards. The mean baseline glucose was 122.06 mg/dL, with no cases of pre-diabetes or diabetes detected. This total homogeneity indicates that the participants started the study in a healthy metabolic state, ensuring that any subsequent changes were the result of the intervention rather than pre-existing conditions. This optimal basal state provides a rigorous "clean slate" for measuring the acute glycemic impact of steamed purple sweet potato.

Post-Intervention Blood Glucose Levels (2-hour PP)

After the administration of 100 grams of steamed purple sweet potato, 68.6% of respondents maintained normal glucose levels, while 31.4% (11 individuals) shifted into the pre-diabetic range (140–199 mg/dL). Notably, the overall mean increased to 137.40 mg/dL. While this increase is statistically significant, it is vital to note that the average remained below the 140 mg/dL threshold.

The shift of some respondents to the pre-diabetic range can be attributed to several factors. Methodologically, the 2-hour observation period lacked strict dietary "lockdown," meaning additional intake of caloric beverages or snacks could not be entirely ruled out. However, the absence of any respondent reaching the diabetic range (≥ 200 mg/dL) suggests that the steamed purple sweet potato does not trigger dangerous glucose spikes.

The Effect of Steamed Purple Sweet Potato on Blood Glucose Levels

Bivariate analysis using the Wilcoxon Signed Rank Test yielded a p-value of < .001. Because $p < 0.05$, the null hypothesis (H_0) is rejected, confirming a significant effect of consuming steamed purple sweet potato on blood glucose levels.

Purple sweet potato (Ipomoea batatas) acts as a complex carbohydrate source. The observed increase in mean glucose from 122.06 mg/dL to 137.40 mg/dL is a normal physiological response to carbohydrate digestion. However, the presence of anthocyanins and soluble fiber plays a dual role:

1. Glycemic Modulation: Anthocyanins act as potent antioxidants that improve insulin sensitivity and facilitate glucose uptake [26].
2. Absorption Control: The dietary fiber slows gastric emptying, ensuring that glucose enters the bloodstream gradually rather than in a sharp spike [27].

The significant p-value proves that the intervention effectively modulated the glycemic response, confirming steamed purple sweet potato as a viable functional food for maintaining metabolic health in young adults.

CONCLUSION

The study on the effect of steamed purple sweet potato consumption among nutrition students at Bina Mandiri University Gorontalo concludes that all participants initially exhibited an optimal and stable metabolic state, typical of healthy young adults. While the intervention led to a statistically significant increase in blood glucose levels, the overall glycemic response remained moderate and within clinically safe limits. This demonstrates that steamed purple sweet potato effectively functions as a controlled carbohydrate source, where its bioactive anthocyanins and dietary fiber work synergistically to improve insulin sensitivity and modulate glucose absorption, thereby preventing excessive postprandial spikes.

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