

Analysis of Glycemic Index and Nutritional Content in White Bread Enriched with Arrowroot Flour

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Abstract: This study explores the nutritional and glycemic impact of incorporating arrowroot tuber flour in bread production as a step toward managing type 2 diabetes. In alignment with Sustainable Development Goal 2, the research leverages local food resources—specifically arrowroot tuber flour—to enhance food security and address the growing prevalence of diabetes. The study delves into the effectiveness of dietary interventions, emphasizing the glycemic index (GI) and glycemic load (GL) in weight loss maintenance and diabetes prevention. Arrowroot tuber, recognized for its low-GI and high fiber content, emerges as a potential substitute for high-GI white bread in response to Indonesia's increasing diabetes prevalence. Employing an experimental approach, wheat flour is substituted with arrowroot flour at different levels, revealing that a 30% substitution exhibits optimal nutritional attributes, including reduced fat content and increased dietary fiber. Glycemic index testing indicates that arrowroot tuber bread, especially at the 30% substitution level, has a lower glycemic impact, making it suitable for individuals with diabetes. The discussion emphasizes the well-rounded nutritional profile of arrowroot tuber bread, which is rich in carbohydrates, dietary fiber, and essential minerals, aligning with recommendations for heart health, weight management, and bone health. The study concludes that arrowroot tuber flour is a promising low-GI substitute in bread production, with the 30% substitution level recommended for optimal sensory appeal and glycemic impact. Further research is encouraged to explore additional health benefits, emphasizing its potential role in diabetes management and overall well-being.

Keywords: Arrowroot tuber flour, nutritional content, Glycemic index.

1. Introduction

A more hopeful future for all people can be achieved by implementing the Sustainable Development Goals (SDGs), which provide a thorough framework for sustainable development. Goal 2 of the Sustainable Development Agenda, sometimes known as "Zero Hunger," seeks to end world hunger by 2030 by ensuring everyone has access to nutritious food, promoting sustainable farming practices, and reducing food waste (United Nations, n.d.). To achieve this goal, it is crucial to make strategic use of the local food resources, particularly in countries like Indonesia, which benefit from tropical abundance.

As a tropical location, Indonesia possesses a diverse range of crops, which presents a chance to improve food security by using abundant indigenous production. By establishing an ample and varied array of local food sources, the foundation is laid for progressing toward a state of overall wellness. Access to sufficient and nourishing food enhances individuals' physical and mental well-being, fostering a suitable atmosphere for a superior quality of life.

Comorbidities, or other health problems, are common in people with type 2 diabetes, with cardiovascular disease (CVD) being one

of the most prevalent (Chatterjee et al., 2017). The risk of acquiring type 2 diabetes can be significantly reduced through lifestyle modifications that help with weight management and increase glucose homeostasis (Merlotti et al., 2014). Extensive research has shown that several dietary methods can effectively promote weight loss (WL) and reduce the risk of diabetes (Johnston et al., 2014; Ley et al., 2014). Rapid weight loss (WL) can occur with low-energy diets (LED) that include full or partial meal replacements, as seen in studies like PREvention of diabetes through lifestyle Intervention and population studies in Europe and around the world (PREVIEW) (Gudzune et al., 2015; Christensen et al., 2018). Rapid weight loss is not without problems; one of the biggest is maintaining the weight individuals lose (Hall & Kahan, 2018). Both weight loss maintenance (WLM) and diabetes prevention may be affected by dietary composition, particularly the ratio of macronutrients to total calories consumed (Ebbeling et al., 2018; Huntriss et al., 2018). Individuals should pay attention to the quantity and quality of carbohydrate intake (Reynolds et al., 2019). There is a discussion on the relative merits of two glycemic assessment tools: the glycemic index (GI) (Wolever, 2013) and the glycemic load (GL) (Monro & Shaw, 2008), which take into account both the quality and quantity of carbohydrates.

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A recent meta-analysis of four RCTs found no significant difference between low-GI and high-GI diets in preventing weight gain. Nevertheless, this finding showed a lot of variation (Van & Mariman, 2019). In addition to influencing glucose regulation, the dietary glycemic index (GI) and glycemic load (GL) are strong predictors of type 2 diabetes incidence worldwide, as demonstrated by a recent meta-analysis of prospective cohort studies (Livesey et al., 2019). Sloth et al. (2009), Walilko et al. (2021), and Liu et al. (2021) were among the few clinical trials that examined the effects of GI and GL on WLM and glycemic status; however, most of these trials only lasted a year or less. This suggests that the studies may not have lasted long enough to capture the full trajectory of disease development. Additionally, few observational studies have examined the effects of WLM on glycemic status in the long run, especially after weight reduction caused by dietary changes.

For individuals with prediabetes, type 1 diabetes, or type 2 diabetes, it is difficult to maintain their blood sugar levels after eating without medical or lifestyle interventions. Foods are ranked by glycemic index (GI), a concept first proposed by Jenkins et al. (1981), which determines the effect their carbohydrate content has on postprandial blood glucose levels compared to glucose or white bread. According to Abiche et al. (2017), the glycemic load quantifies the amount certain food raises postprandial blood glucose levels. One low-GI food that has been shown to reduce postprandial rises in blood glucose levels is fructose (Evans et al., 2017). Furthermore, it has been shown to affect glucose regulation positively (Evans et al., 2017). According to a recent network meta-analysis of 56 trials, various dietary approaches can successfully reduce glycated hemoglobin (HbA1c) and fasting blood glucose (FBG) levels compared with a control diet (Schwingshackl et al., 2018). Another meta-analysis of 18 studies compared low- and high-glycemic-index (GI) diets and retrieved consistent results (Wang et al., 2015).

According to Higdon et al. (2022), the glycemic index (GI) measures the effect of foods on blood glucose levels. Meanwhile, Augustin et al. (2015) indicated that the glycemic load (GL) is calculated by multiplying the GI by the entire amount of carbohydrates that are available in a certain food. The glycemic index (GI) is a system for classifying foods. A glycemic index (GI) of 70 or above indicates that the meal is rich in quickly digested carbohydrates. Meals with a low GI have carbohydrates that break down more slowly and a glycemic index (GI) of 55 or lower. The post-meal spikes in blood glucose levels are lessened by consuming these low-GI foods (Higdon et al., 2022). The glycemic index (GI) of foods classified as intermediate-GI ranges from 56 to 69, positioned between low-GI (≤ 55) and high-GI (≥ 70) categories. Blood glucose levels rise more quickly after consuming meals with a higher glycemic index (GI) than those with a lower GI (Higdon et al., 2022).

About 400 million people across the globe are severely affected by type 2 diabetes, a chronic metabolic condition (Saedi et al., 2019). Both Saedi (2019) and Kaiser (2108) predicted that the incidence of type 2 diabetes will continue to climb in the coming decades unless strong and immediate action is taken. Considering

the association between type 2 diabetes and cardiovascular disease—the leading cause of death in Western countries—the detrimental implications are further amplified (Dokken, 2008; Xu, 2020). Maximizing research on lifestyle and nutritional therapies for populations at risk is critical to successfully tackle the rising incidence of type 2 diabetes. The enormous societal burden of this disease makes this imperative (Wang et al., 2025).

Lowered insulin sensitivity and secretion—hallmarks of type 2 diabetes onset—may be caused as much, if not more, by postprandial glycemia as by fasting blood glucose (Monnier et al., 2003; Blaak et al., 2012). People at risk for developing type 2 diabetes sometimes see a loss of control over postprandial glucose levels before there are disturbances in fasting indices (Monnier et al., 2007). In order to reduce the global burden of disease, it is important to deploy measures that lower postprandial glucose elevations. It is widely recognized that the glycemic index (GI) of carbohydrate-containing foods significantly influences blood sugar levels following a meal, a concept introduced over forty years ago (Jenkins et al., 1981). While other dietary components that promote good health may be more important, there is still disagreement about the significance and practicality of the glycemic index (GI) in individuals without diabetes (Vega et al., 2018). This is particularly true when considering a healthy eating pattern (HEP) (Sacks et al., 2014). The question of whether glucose and insulin responses to diverse carbohydrate diets in non-diabetic individuals become less variable over time due to compensatory mechanisms remains unanswered (Nazare, 2010).

The rise in non-communicable diseases is closely linked to the advancing complexity of global society, expanding populations, and increasing life expectancy. A suboptimal diet is the primary factor contributing to the increasing prevalence of non-communicable diseases. Changes in sedentary lifestyle patterns are gradually spreading throughout society, affecting daily eating habits, nutritional apathy, and increased fast food consumption (Sudaryati et al., 2017).

According to the October 2023 Susenas findings reported in the Indonesia Health Profile 2024, the highest average proportion of monthly per capita spending was allocated to food and beverages (13.5%), while the lowest was spent on tubers (0.4%). The rising expenditure on processed food is worrisome due to its association with degenerative illnesses. Unhealthy eating patterns contribute to the development of degenerative diseases, such as diabetes mellitus (DM), which is a significant public health concern. Notably, Indonesia has the highest prevalence of DM cases. According to the International Diabetes Federation (IDF) 2019 report, Indonesia ranked seventh in terms of diabetes prevalence, with 10.7 million individuals affected. This ranking places Indonesia after China, India, the United States, Brazil, Mexico, and Russia.

Based on the Indonesia Health Survey (SKI) conducted in 2023, the prevalence of diabetes mellitus (DM) increased from 6.9% in 2018 to 10.9% among a total population of 275 million. Efforts to reduce the occurrence of DM involve regulating appropriate dietary choices, namely those low in glucose. Consuming foods

with a low glycemic index (GI) helps reduce the symptoms and effects of diabetes.

Indonesians regularly consume bread as a fundamental and essential part of their diet. Nevertheless, specialists advise against diabetics consuming white bread due to its elevated glycemic index (GI) content. To resolve this problem, one can substitute the primary component of flour with alternative substances that have a low GI. Arrowroot tubers have been identified as a suitable replacement for wheat (Sudaryati et al., 2017).

Mature arrowroot tubers are rich in dietary fiber, and a significant portion of the starch content is extracted to produce arrowroot flour, which serves as a valuable source of carbohydrates. In addition, combining arrowroot tubers, which contain starch, with wheat flour might produce white bread. The addition of arrowroot starch to wheat flour has been demonstrated to enhance the stability of gels. It can be used to regulate the thickening characteristics of starch in commercial products (Sudaryati et al., 2017). Arrowroot flour is believed to have the potential to serve as a component in various food preparations, including cookies, biscuits, cakes, sweets, and more (Malki et al., 2023). The production of white bread is currently seeing growth within the field of food and culinary technology. Wheat flour, derived from wheat, is the primary ingredient for bread making. However, wheat cultivation is not practiced in Indonesia. Hence, based on research findings, it is anticipated that wheat flour can be replaced or combined with arrowroot flour cultivated in Indonesia (Sudaryati et al., 2017). Prior research indicates that arrowroot tubers can serve as a functional food due to their positive impact on health. Hence, this study aims to demonstrate that arrowroot flour can be used as an additive to wheat flour in bread, enhancing its nutritional value.

2. Methods

This study used an experimental method employing a Completely Randomized Design (CRD) with a single factor—specifically bread—and three treatments, including arrowroot tubers. The investigation was carried out between September and October 2017, with students from the Faculty of Public Health at the Universitas Sumatera Utara as participants.

The selection of materials and equipment was centered on their high quality, ensuring that the ingredients were in excellent condition, free from spoilage, and properly packaged. The ingredients for producing arrowroot bread were comparable to those typically employed in its standard preparation, including arrowroot flour.

The study encompassed multiple phases, including the preparation of conventional arrowroot bread and arrowroot tuber bread, evaluation of their acceptability, and comparison of their nutritional composition. The production of arrowroot tuber bread involves a series of procedures, including the combination of materials, the manipulation of the dough through kneading, rolling, and shaping, the subsequent resting period, and finally, the baking process.

The acceptance testing was performed through an organoleptic evaluation by a panel of 30 individuals, all of whom were students

from the Faculty of Public Health at the Universitas Sumatera Utara. Their assessments were conducted using a three-point hedonic scale and focused on specific characteristics of the product's appeal and flavor.

Data analysis was conducted using statistical tests, including the Bartlett test, ANOVA, and the Kruskal-Wallis test. The examination used a descriptive percentage analysis method to ascertain the nutritional composition of arrowroot tuber bread. ANOVA and Kruskal-Wallis tests were performed to assess variations in the sensory quality of arrowroot tuber bread at different concentrations with a significance level of 95% ($\alpha = 0.05$).

3. Results

Analysis of the Nutritional Content of Arrowroot Tuber Bread

Various treatments incorporated the inclusion of arrowroot flour with differing nutritional compositions. The nutritional content of arrowroot tuber bread is presented in Table 1.

Table 1. Nutritional Analysis of Arrowroot Tuber Bread with 10%, 20% and 30% Arrowroot Flour Substitution

Parameter	Result		
	10%	20%	30%
Moisture Content	35,5	34,5	32,7
Ash Content	0,82	0,84	1,14
Protein	7,13	6,67	6,78
Fat	8,28	8,41	6,36
Carbohydrates	39,6	44,6	46,6

The nutritional analysis was conducted on bread made from arrowroot tuber, in which 10% of the wheat flour was substituted with arrowroot flour. The findings indicate that this replacement resulted in a bread composition of 35.5% moisture, 0.82% ash, 7.13% protein, 8.28% fat, 39.6% carbohydrates, and 0.76% dietary fiber. These values offer valuable information regarding the nutritional characteristics of the bread under these specific conditions. A further nutritional evaluation was carried out on bread prepared with arrowroot tuber, in which 20% of the wheat flour was replaced by arrowroot flour. The bread produced under these circumstances displayed clear nutritional attributes, with moisture at 34.5%, ash at 0.84%, protein at 6.67%, fat at 8.41%, carbohydrates at 44.6%, and dietary fiber at 2.27%. These results illustrate how modifying the ratio of arrowroot flour can lead to different nutritional characteristics. The nutritional composition of bread made from arrowroot tuber was further evaluated with 30% of the wheat flour substituted with arrowroot flour. The replacement had a discernible effect on the nutritional composition of the bread. The bread had 32.7% moisture, 1.14% ash, 6.78% protein, 6.36% fat, 46.6% carbohydrate, and 6.33% dietary fiber. The results demonstrate the unique nutritional composition of the bread when a greater proportion of arrowroot flour is used.

The tables present a complete perspective on how changing the proportion of arrowroot and wheat flour in bread-making affects its nutritional composition. This provides useful information for assessing the dietary advantages of bread made from arrowroot tuber.

Glycemic Index of Arrowroot Tuber Bread

The arrowroot tuber bread was compared to standard pure glucose—the reference food—to conduct the Glycemic Index (GI)

assessment. Several carbohydrate testing methods were used to establish the available carbohydrate content of the test food, which was then used to make this comparison. All chemicals that the body breaks down, absorbs, and processes are considered available carbohydrates (Vaidya et al., 2014). The gastrointestinal analysis results of arrowroot tuber bread are presented in Table 2.

Table 2. Descriptive Analysis of Blood Glucose Response to Arrowroot Bread Concentration

Arrowroot Bread Concentration	Blood Glucose Response	Min	Max	Mean	SD
10% Arrowroot Bread	0	84	107	90.40	14.638
	15	97	154	117.60	21.130
	30	98	145	113.70	19.085
	45	96	140	106.70	13.141
20% Arrowroot Bread	0	85	106	84.50	9.217
	15	96	153	127.10	19.678
	30	93	183	126.40	26.834
	45	69	147	107.10	20.851
30% Arrowroot Bread	0	85	101	83.00	9.752
	15	100	151	120.70	18.613
	30	98	133	114.30	14.322
	45	93	140	111.20	15.296

The glycemic index (GI) of arrowroot tuber bread was the highest, as shown in Table 2. The Glycemic Index is a helpful tool for evaluating the quantity and quality of carbohydrate sources to control blood sugar levels. Carbohydrates affect blood glucose levels differently because of the different rates at which they are digested and absorbed. Meals with a low glycemic index (GI) are suitable for people with diabetes to control their blood sugar levels, as they do not produce large spikes in blood glucose levels. The Glycemic Index is a method for categorizing foods into three levels: High, Medium, and Low. Studies suggest that consuming meals with a high glycemic index (GI) (<55) or a medium GI (55–75) can lead to rapid insulin release and increased insulin resistance (Siagin, 2004; Franz, 2012). According to Siagian (2004) and Franz (2012), several factors can influence the glycemic index (GI), including the amylose-to-amylopectin ratio, fiber content, resistant starch, fat content, protein content, the presence of anti-nutrient compounds, and cooking methods.

Consuming 10% arrowroot tuber bread caused a rise in blood glucose levels from 93.7 mg/dL at T.0' to 118.2 mg/dL at T.45'. The measurement indicated a significant increase of 19.8 mg/dL in blood glucose levels, marking the highest point of elevation, with levels anticipated to decrease thereafter. Likewise, the ingestion of 20% arrowroot tuber bread, in addition to ordinary bread, resulted in a rise in blood glucose levels from 92.7 mg/dL at T.0' to 110.1 mg/dL at T.45'. The measurement showed a significant increase of 17.4 mg/dL in blood glucose levels, marking the peak elevation, after which the levels are expected to decline in the following minutes. When 30% arrowroot tuber bread was consumed, blood glucose levels increased from 96.1 mg/dL at T.0' to 114.6 mg/dL at T.45'. The measurement showed a significant rise of 18.5 mg/dL, marking the highest increase, followed by an anticipated decline in blood glucose levels in the subsequent minutes.

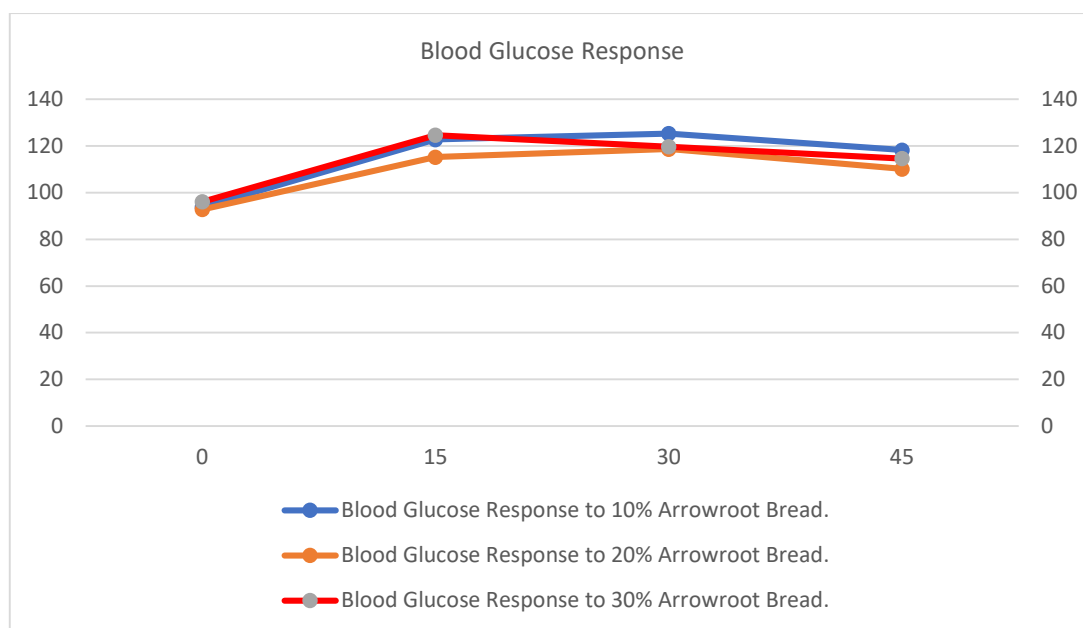


Figure 1. Blood Glucose Response to Arrowroot Bread

4. Discussion

Composition and Quality of Arrowroot Tuber Bread

Arrowroot tuber bread is a sugar-free bread made from eggless dough. Sugar is solely employed in the process of bread-making to accelerate fermentation (Sawettanun & Ogawa, 2022). Arrowroot tuber bread is renowned for its tender, fluffy consistency, airy texture, and subtle flavor. It is commonly eaten by individuals from the middle and upper socioeconomic strata as a convenient choice for breakfast. The main constituents of arrowroot tuber bread are wheat flour and arrowroot tuber flour, which provide substantial amounts of starch, carbohydrates, and protein. Various replacements using arrowroot tuber flour result in different nutritional compositions. For instance, when a mixture of 10% arrowroot tuber flour and 90% wheat flour is used to make bread, it yields precise nutritional values, including 35.5% moisture, 0.82% ash, 7.13% protein, 8.28% fat, 39.6% carbohydrate, and 0.76% dietary fiber. On the other hand, when using a combination of 20% arrowroot tuber flour and 80% wheat flour, the resulting nutritional composition differs, with 34.5% moisture, 0.84% ash, 6.67% protein content, 8.41% fat content, 44.6% carbohydrate content, and 2.27% dietary fiber. By making additional modifications, namely using a combination of 30% arrowroot tuber flour and 70% wheat flour, the resulting nutritional analysis reveals the following percentages: 32.7% moisture, 1.14% ash, 6.78% protein, 6.36% fat, 46.6% carbohydrate, and 6.33% dietary fiber.

These studies emphasize the nutritional composition of arrowroot tuber bread, providing insight into its main characteristics. The bread's high carbohydrate content, especially from the arrowroot tuber flour, highlights its significance as a powerful energy source. Carbohydrates are essential macronutrients that power a range of body functions and are particularly helpful for delivering rapid and consistent energy. Furthermore, the significant amount of dietary fiber present in this bread is a crucial characteristic. Dietary fiber is well-known

for its advantageous effect on gastrointestinal health. It facilitates the maintenance of regular bowel motions, prevents constipation, and assists in weight management. Furthermore, dietary fiber plays a crucial role in controlling blood sugar levels, making arrowroot tuber bread an excellent nutritional choice for those with diabetes, thus emphasizing its relevance for this particular demographic.

In contrast, the bread's low-fat content is an appealing attribute. Low-fat diets are considered beneficial for cardiovascular health and appropriate for people seeking to control their weight. The steady protein content is also worth mentioning. Proteins play a crucial role in tissue repair, immune system function, overall growth and development, as well as the preservation and growth of muscles. Hence, a consistent protein level in arrowroot tuber bread enhances its appeal as a versatile dietary item.

Moreover, identifying crucial elements in the bread's ash content is important. These minerals are essential for a multitude of biological functions. Calcium, an essential mineral in arrowroot tuber bread, is renowned for preserving robust skeletal structure and dental health. This attribute suggests the potential advantages of bread made from arrowroot tuber, particularly for pregnant women with elevated calcium needs to promote the growth of the fetus and prevent maternal bone loss. Moreover, evidence indicates that consuming arrowroot tuber bread may aid in the prevention of illnesses such as osteoporosis, a progressive bone disorder characterized by reduced bone density. Hence, the inclusion of carbohydrates, dietary fiber, low-fat, stable protein, and critical minerals in arrowroot tuber bread highlights its potential as a nourishing and health-enhancing dietary option. When assessing the excellence of arrowroot tuber bread, it is essential to consider characteristics such as its texture, taste, color, and aroma. Optimal kneading of the dough for 25 minutes achieves maximum expansion and yields arrowroot tuber bread with substitutions of 10%, 20%, and 30% substitutions. The bread has a tender consistency with a mildly rough composition,

a tinge of brownish-yellow hue on the outer surface, and a slightly yellowish shade inside. It possesses a distinctively aromatic scent that is typical of well-baked bread and is free from any raw dough flavor. Damak et al. (2022) state that the use of wheat, yeast, and salt enhances the porosity and consistency of arrowroot tuber bread and contributes to its color development.

Nevertheless, kneading the dough for a duration of 40 minutes leads to an excessively elastic texture and an excessive amount of volume. Ye et al. (2023) assert that an excessive amount of mixing might harm the structure of gluten, result in excessive heat in the dough, and impede its development. The arrowroot tuber bread, when kneaded for 40 minutes, exhibits a slightly soft texture, a fine and slightly yellowish bread structure, a brown skin color, and a cream-colored interior. The texture of arrowroot tuber bread is distinctively tender, setting it apart from the moderately soft texture of conventional arrowroot tuber bread. This aligns with Fina's (2013) description of high-quality arrowroot tuber bread, characterized by a tender consistency and the ability to regain its initial form when compressed. Bread made from arrowroot tuber, when kneaded optimally, exhibits superior texture compared to bread that has been over-kneaded. There is no disparity in the arrangement. The arrowroot tuber bread has a brown exterior and a white interior.

Conventional white bread remains the most widely consumed bread type due to its appealing sensory attributes. Its primary ingredient, refined hard whole wheat flour, is inherently deficient in protein, dietary fiber, vitamins, minerals, fatty acids, and essential amino acids such as threonine, tryptophan, and lysine (Khoozani et al., 2020; Okafor et al., 2012). In contrast, arrowroot tuber bread presents a superior nutritional profile, with fiber content as high as 9.79–13.70% on a dry basis, enriched mineral composition, prebiotic potential, and immunomodulatory properties (Kumalasari et al., 2012), positioning it as a healthier alternative to traditional white bread.

Analyzing the Glycemic Index of Arrowroot Tuber Bread

The blood glucose values for both standard bread and the test food (arrowroot tuber bread) are represented on the X and Y axes, respectively. This leads to a curved shape for the specified food. The average glycemic reaction of the research subjects can be viewed on the curve, which is based on the measurements of glucose levels in the subjects.

- i. Arrowroot Tuber Bread 10%
Since the calculated F-value (6.87) is higher than the tabulated F-value (2.16), it can be concluded that H_1 is accepted and H_0 is rejected. This shows that patients are significantly affected by variations in the timing of consumption.
- ii. Arrowroot Tuber Bread 20%
By comparing the tabulated F-value (2.16) with the estimated F-value (5.18), it can be concluded that H_1 is accepted and H_0 is rejected. This indicates that the reactions are significantly affected by the differences in the timing of ingestion.

- iii. Arrowroot Tuber Bread 30%
Rejecting H_0 and accepting H_1 are possible outcomes when the estimated F-value (5.10) is greater than the tabulated F-value (2.16). This result indicates that the participants are significantly affected by fluctuations in the timing of consumption.
- iv. Glycemic Index of Arrowroot Tuber Bread
The current study illustrates that substituting a portion of wheat flour with arrowroot tuber flour in bread formulations significantly increases dietary fiber content while simultaneously reducing the glycemic index (GI) of the final product. Arrowroot tuber flour is recognized for its low GI classification, with a reported score of approximately 14 (Marsono, 2001), which is notably lower than that of wheat flour.

Numerous studies have underscored the advantages of low-GI foods in regulating postprandial blood glucose levels. Specifically, research on flour substitutions, including arrowroot, indicates their potential in eliciting lower glycemic responses compared to traditional wheat flour-based products. For instance, Lestari et al. (2017) demonstrated that the incorporation of arrowroot flour into staple foods resulted in enhanced glycemic control. Furthermore, investigations into arrowroot starch have revealed that its distinctive structural characteristics contribute to increased digestion resistance, facilitating a gradual release of glucose into the bloodstream (Tarique, 2021). To fully understand the implications of arrowroot flour in dietary applications, further research is warranted.

5. Conclusion

The research findings indicate that the use of arrowroot flour at varying concentrations (10%, 20%, and 30%) in the production of arrowroot tuber bread does not significantly impact flavor, aroma, color, and texture. Nevertheless, the panelists prefer the 30% substitute when it comes to sensory qualities. Carbohydrates are the main dietary element found in all varieties. Furthermore, the glycemic index tests revealed a notable disparity among the different versions, with the 30% substitution having the most influence. Arrowroot tuber bread, especially when substituted with 30%, is considered suitable for those with diabetes owing to its reduced glycemic index. Further investigation is advised to examine the possible advantages of arrowroot tuber bread, particularly its elevated calcium levels, which may support pregnant women and contribute to the prevention of osteoporosis.

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