



Total Carbohydrate Content Test of Banana Kepok (*Musa Paradisiaca* L.) On different steaming processes as an alternative energy source

Sri Nurindah Bakari^{1*}, Sunarto Kadir², Ulfa Aulia³

^{1,2,3}Universitas Negeri Gorontalo, Gorontalo, Indonesia

*Corresponding e-mail: srinurindah2@gmail.com

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ABSTRACT

Banana (*Musa paradisiaca* L.) is one of the local foods that has a high carbohydrate content and has the potential to be developed as an alternative energy source. Carbohydrates act as the main source of energy for the body. However, processing processes such as steaming can affect the carbohydrate content due to changes in starch structure during gelatinization and reshaping starch structure. The formulation of the problem in this study includes what is the difference in carbohydrate content in 2 variations of steaming time, as well as the most optimal steaming time in maintaining carbohydrate content. This study aims to analyze the effect of steaming time on the total carbohydrate content of kepok bananas and assess its potential as an alternative energy source. This study also fills a research gap related to the effect of specific steaming duration on carbohydrate stability in local foods.

The research uses a laboratory experiment design with a post-test only design. The sample was in the form of physiologically ripe kepok bananas steamed at a temperature of $\pm 100^{\circ}\text{C}$ with a time variation of 30 and 35 minutes. Carbohydrate content analysis was conducted using the Luff-Schoorl method (SNI 01-2891-1992) and tested with Mann-Whitney ($\alpha=0.05$).

The results showed average carbohydrate content of 36.66% (30 minutes) and 35.85% (35 minutes). The statistical test showed a value of $p = 0.05$ which was at the limit of significance, thus showing a tendency for difference but not statistically strong enough. It was concluded that 30-minute steaming tended to better maintain carbohydrate levels, although further research with larger samples is needed.

INTRODUCTION

Energy is an essential component that the human body needs to carry out metabolic processes and daily physical activity. The main source of energy comes from macronutrients, namely carbohydrates, fats, and proteins, with carbohydrates as the main source of energy because they are easily converted into glucose for the needs of cells [1]. The energy needed by the body comes from the metabolism of nutrients, especially carbohydrates and fats as the main source of energy [2]. Carbohydrates themselves are the most efficient primary source of energy because they can be quickly metabolized into glucose to meet the energy needs of cells [3]. Each individual's energy needs vary depending on age, gender, body composition, and level of physical activity, so energy fulfillment through the consumption of a balanced nutritious diet is very important [4].

Nutrition problems in Indonesia are still a complex public health issue, one of which is caused by the lack of diversity in food consumption [5]. Energy sources in Indonesia are still dominated by rice as the main staple food. High dependence on one type of food can cause vulnerability in the event of production or distribution disruptions [6].

Food consumption is an important factor that determines health status, both undernutrition and overnutrition which has an impact on morbidity and mortality [7]. Unhealthy eating habits have been shown to contribute to various diseases, such as obesity, anemia, and *Stroke* [8]. Therefore, efforts to diversify food are needed as a strategy to support national food security through the use of local food resources that have high nutritional value [9]. Diversification of food based on local sources is an important strategy in reducing dependence on one staple food commodity [10].

One of the local foods that has the potential to be developed as an alternative energy source is kepok bananas (*Musa paradisiaca L.*). Kepok bananas are included in the group of processed bananas (*plantain*) which has a relatively high starch and carbohydrate content [11]. Bananas are one of the highest-production horticultural commodities in Indonesia and have the potential as an alternative energy source [12]. In addition, kepok bananas also contain fiber, vitamins, and minerals that are beneficial for health [13], and has a relatively low glycemic index so it can be a healthier choice of energy sources [14]. Kepok bananas also contain quite high fiber and contribute to meeting daily fiber needs [15]. The potassium content in bananas also plays a role in helping maintain blood pressure and cardiovascular health [16].

Based on the data of the Hope Food Pattern (PPH), the fruit consumption of the Indonesian people still does not meet the recommendations set by the World Health Organization (WHO), which is a minimum of 65 kg/capita/year [17]. In Gorontalo Province itself, banana consumption is still relatively low [18].

However, the carbohydrate content in food can change due to the processing process, especially heating such as steaming. This process can lead to changes in starch structure through gelatinization and hydrolysis that have an impact on a decrease or change in carbohydrate availability [19]. The length of steaming time is one of the factors that plays an important role in determining the change in nutritional content. The variation in steaming time in bananas has an effect on the sugar content and chemical characteristics of the product, which suggests that the heating duration plays a role in changes in the carbohydrate components [4].

Some studies suggest that the heating process, such as steaming, can affect the starch structure and the amount of carbohydrates in bananas. Research by Karunaratna (2024) [20] It shows that heat treatment, including steaming, can decrease the content of resistant starches due to gelatinization and reorganization of starch structures, which has an impact on changes in the digestibility of carbohydrates. In addition, Prachayawarakorn (2016) [21] It shows that the steaming time affects the physicochemical characteristics of bananas, including moisture content, dissolved sugars, and texture, which indirectly affects energy availability.

Although some studies have examined the effect of processing on the carbohydrate content of bananas, most studies have only compared types of processing such as boiling and frying, and have not specifically examined variations in steaming times. In addition, research linking changes in carbohydrate levels to potential as an alternative energy source is still limited. Based on this, the formulation of this study is that there is a difference in the total carbohydrate content in kepok bananas due to variations in steaming time, where shorter steaming times tend to maintain higher carbohydrate content.

RESEARCH METHODS

This study method is a laboratory experiment to analyze the effect of variations in steaming time (30 and 35 minutes at $\pm 100^{\circ}\text{C}$) on the total carbohydrate content of kepok bananas (*Musa paradisiaca L.*). The analysis was carried out using *the Luff-Schoorl method* (SNI 01-2891-1992), and the data were analyzed descriptively as well as *the Mann-Whitney test* ($\alpha=0.05$).

RESULTS

Table 1 Analysis of the difference in total carbohydrate content of banana kepok with test *Mann-Whitney*

Steaming Time	Repetition 1 (%)	Repetition 2 (%)	Repetition 3 (%)	Average (%)	Sig.
30 minutes	36,72	36,65	36,60	36,66	0,05
35 minutes	35,82	35,80	35,91	35,85	

Source : Primary Data 2026

Based on the table, it can be seen that the total carbohydrate content of kepok bananas steamed for 30 minutes has an average of 36.66%, while in steaming for 35 minutes it is 35.85%. The results of statistical analysis using the Mann-Whitney test showed a value of $p = 0.05$, which showed a tendency to differ in carbohydrate content between the two steaming time treatments.

The results of the Mann-Whitney test showed a value of $p = 0.05$ which was at the limit of significance ($\alpha = 0.05$). This shows that the difference in carbohydrate content between 30-minute and 35-minute steaming is at the limit of significance. Descriptively, the average carbohydrate content in 30 minutes of steaming (36.66%) was higher than that of 35 minutes (35.85%), with a difference of 0.81%.

DISCUSSION

The results showed that the variation in steaming time had an effect on the total carbohydrate content of banana kepok. The carbohydrate content in steaming for 30 minutes is higher than steaming for 35 minutes. The decrease in carbohydrate content can occur due to changes in the starch structure during the heating process. When food is heated, starch granules undergo a gelatinization process, which is the development and breakdown of crystal structures that cause starch to be hydrolyzed more easily into simple sugars [22].

When viewed from the magnitude of the difference, steaming for 30 minutes showed a higher carbohydrate content compared to 35 minutes with a difference of 0.81%. Although this difference is not very large, these results show a tendency that shorter steaming times are better at maintaining carbohydrate levels. With a limited number of samples, these results still have limitations, but still provide a preliminary idea that variations in steaming time affect the carbohydrate content of banana kepok.

The longer the heating process lasts, the more likely it is that the starch will degrade into simpler components. In addition, some carbohydrate components can also dissolve in water during the heat treatment process, resulting in a measurable decrease in carbohydrate levels [23]. Previous research also by Prachayawarakorn (2016) [21] states that during the steaming process, the crystalline structure of the starch in bananas can be damaged, thus affecting the availability and digestibility of carbohydrates.

Despite the decrease in carbohydrate content during longer steaming, kepok bananas still have a high enough carbohydrate content so that they have the potential to be used as an alternative energy source. The carbohydrates in bananas are mostly complex starches that are gradually digested in the body, so they can provide more stable energy than simple sugars.

The results of this study show that steamed bananas have the potential to be a safer alternative energy source for people with diabetes mellitus, because the steaming process is able to retain complex carbohydrates and increase resistant starch so that glucose release takes place more slowly. This is in line with the research of Wardhani et al. (2024) [24] which states that steamed kepok bananas have a lower glycemic index and are relatively safe for diabetics, and are supported by Ruhdiana et al. (2023) [25] which shows that the fiber and resistant starch content in kepok bananas plays a role in significantly lowering blood glucose levels.

In addition, kepok bananas also contain dietary fiber, vitamins, and minerals that provide additional benefits for body health. Therefore, the use of kepok bananas as an alternative energy source can be one of the strategies in supporting food diversification based on local resources.

LIMITATIONS OF THE STUDY

The study has several limitations, such as the limited number of samples and the variation in steaming time that includes only two treatments. In addition, the analysis focused on total carbohydrate levels without examining the type of carbohydrate in more detail. Nevertheless, this study still provides an important preliminary picture of the effect of steaming time on the carbohydrate content of banana kepok.

CONCLUSION

Based on the results of the study, there was a difference in total carbohydrate content between 30-minute and 35-minute steaming, where 30-minute steaming showed a higher average value. However, the results of the statistical test ($p = 0.05$) were at the limit of significance, so the difference provided an early indication of the effect of steaming time on carbohydrate levels. In general, steaming with a shorter time tends to maintain carbohydrate levels better. In addition, steamed kepok bananas still have a high enough carbohydrate content so that they have the potential to be an alternative energy source based on

local food. This study has limitations, such as the limited number of samples and the variation in steaming time that is not wide. Therefore, further research with a more robust design is needed to reinforce these findings.

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