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The potential of pisang raja as a functional food in reducing BMI and fat percent in hypertension patients

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ABSTRAK

Latar Belakang: *Pangan fungsional merupakan satu atau lebih komponen makanan dengan nutrisi penting untuk pertumbuhan atau perkembangan tubuh. Pisang merupakan contoh pangan fungsional dengan kandungan kalium, serat dan pati resisten yang dapat membantu terapi pasien hipertensi.*
Tujuan: *Penelitian ini bertujuan untuk mengetahui pengaruh pisang raja terhadap IMT dan persen lemak tubuh dengan intervensi pemberian buah pisang yang berbeda.*
Metode: *Penelitian ini menggunakan metode pre-post test with control group dengan subjek penderita hipertensi yang mengikuti posbindu dan bertempat tinggal di Kabupaten Klaten. Subjek dibagi menjadi empat kelompok yaitu K-(edukasi diet rendah garam), K+(obat amlodipin dan edukasi diet rendah garam), I1(pisang raja 1buah dan edukasi diet rendah garam), dan I2(pisang raja 2buah dan edukasi diet rendah garam), penelitian selama 14 hari. Data dianalisis menggunakan uji Paired t tes untuk mengetetahui pengaruh sebelum dan sesudah intervensi dan uji one way ANOVA untuk mengetahui perbedaan antar kelompok, dan dikatakan signifikan apabila p<0,05.*
Hasil: *Setelah 14 hari, terjadi penurunan IMT secara signifikan pada kelompok K+, I1 dan I2. Pada kelompok K+ dan I2 setelah 14 hari mengalami penurunan persen lemak tubuh secara signifikan*
Kesimpulan: *Pemberian pisang raja sebanyak 1x per hari atau 2x per hari dapat menurunkan IMT secara signifikan. Pemberian pisang raja sebanyak 1x per hari tidak dapat menurunkan persen lemak tubuh secara signifikan dan pemberikan pisang raja sebanyak 2x per hari dapat menurunkan persen lemak tubuh secara signifikan.*

KATA KUNCI*: pangan fungsional; hipertensi; indeks massa tubuh; persen lemak tubuh.*

ABSTRACT

Background: *Functional food is one or more food components with important nutrients for body growth or development. Bananas are an example of a functional food containing potassium, fiber and resistant starch which can help treat hypertension patients.*
Objectives: *This study aims to determine the effect of plantains on BMI and body fat percentage by providing different banana interventions.*
Methods: *This study used a pre-post test with control group method with subjects suffering from hypertension who attended posbindu and lived in Klaten Regency. Subjects were divided into four groups, namely K-(low salt diet education), K+(amlodipin and low salt diet education), I1(1pisang raja and low salt diet education), and I2(2pisang raja and low salt diet education), research for 14 days. Data were analyzed using the Paired t test to determine the effect before and after the intervension and the one way ANOVA test to determine difference between groups, and were said to be significant if p<0,05.*
Results: *After 14 days, there was a significant decrease in BMI in the K+, I1 and I2 groups. In the K+ and I2 groups after 14 days their body fat percentage decreased significantly*
Conclusions: *Giving a pisang raja 1x per day or 2x per day can reduce BMI significantly. Giving a pisang raja 1x per day cannot reduce body far percentage significantly and giving a banana 2x per day can reduce body fat percentage significantly..*

KEYWORD*:* *functional food; hypertension; body mass index; body fat percent.*

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INTRODUCTION

The evolution of society, technology, and overall welfare has ushered in a shift in daily activities and lifestyles, leading to a decline in quality of life. This shift has also contributed to the rise in several degenerative diseases, including hypertension, diabetes, and others. Addressing and managing these ailments is crucial, and one effective approach is altering dietary habits through the consumption of functional foods. Functional food refers to food items containing one or more essential nutrients vital for bodily growth and development. Beyond mere sustenance, these foods also incorporate bioactive components that offer physiological benefits without causing harm to the body. Despite the numerous benefits of functional food, there remains a lack of awareness and understanding among the populace in Indonesia. Therefore, it is imperative to foster knowledge and awareness within the community regarding the consumption of functional food. Moreover, in presenting functional food, careful attention should be paid to factors such as taste, texture, color, and other sensory aspects to ensure continued appeal and palatability when consumed (1–3).

Bananas are readily available and serve as a functional food with numerous benefits for the body. Their high potassium content can aid in managing hypertension by regulating blood pressure levels. Blood presure serves as one of the indicators for hypertension, alongside factors such as excessive body weight and a high percentage of body fat, which are also significant risk factors (6–8). Previous research suggests that consuming 300 grams of banana mas daily for seven days has been shown to have a positive effect on blood pressure among individuals with mild hypertension (4). Bananas are not only rich in potassium but also contain inulin and resistant starch, which can contribute to reducing body weight and body fat percentage. These components stimulate the growth of beneficial bacteria in the digestive tract, aiding in hunger suppression. Previous studies have demonstrated that administering banana fruit extract for five days resulted in a decrease in body weight (5).

Hypertension is a non-communicable disease known as the silent killer, because hypertension sufferers rarely feel symptoms in their bodies. According to the World Health Organization (WHO), 41.28 million adults have hypertension and it is estimated that 46% of hypertension sufferers are not aware that they have this condition. According to World Health Organization (WHO) 2019, hypertension is characterized by a recurrent increase in systolic blood pressure ≥ 140 mmHg and diastolic blood pressure ≤ 90 mmHg. In Indonesia, hypertension prevalence is on the rise, affecting around 260 thousand people, which accounts for 34.1% of the population. Hypertension is also one of the main causes of mortality and morbidity in Indonesia(6,9). Obesity or excessive body weight significantly increases the risk of hypertension, with individuals carrying excess weight being 5-6 times more likely to develop hypertension compared to those with a normal body weight (9–11). The greater body mass index increases the body's work in supplying oxygen and food to body tissues, causing an increase in the work of the heart in pumping blood. (12–14). Considering the risk factors for hypertension outlined, it's evident that many of these are attributable to personal habits. Thus, it becomes imperative to prioritize self-care to both prevent and manage hypertension (15).

Numerous researchers have investigated the impact of bananas on blood pressure. However, studies focusing on the association between banana consumption and a reduction in Body Mass Index (BMI) and body fat percentage, particularly through various feeding interventions, are scarce. Remember this, the researcher aims to examine the effects of pisang raja on BMI and body fat percentage using diverse banana feeding methods. The outcomes of this research can serve as valuable reference material, potentially informing the selection of combination therapies for hypertensive patients.

MATERIALS AND METHODS

This research used a quasi experimental design method with a pre-post test with control group method conducted in three sub-districts with the highest hypertension data in Klaten Regency and was conducted from November to December 2023. Sample selection using Multistage Sampling technique. The subjects of this research were hypertensive patients who lived in the Bayat, Juwiring and Wedi sub-districts, Klaten Regency and attended the Integrated Development Post (Posbindu).

In this study, researchers selected a sample of women aged 45-60 years who took part in Posbindu. This is in accordance with the Indonesian Ministry of Health's program to carry out disease screening and prevention by establishing Posbindu. Based on previous research, most of the visits were women aged over 50 years. In addition, this study selected samples with the criteria of overweight or obese nutritional status (BMI ≥ 23) and body fat percentage ≥ 25%, because according to previous research, one of the risk factors for hypertension is obesity. Subjects had systolic blood pressure (≥ 120-159 mmHg) and diastolic blood pressure (≥ 80-99 mmHg), willing to follow research procedures with evidence of agreeing and filling out an informed consent form. The research comprised 52 subjects allocated into four groups: group K- (negative control, receiving no intervention), group K+ (positive control, administered amlodipine 5mg/day for 14 days), group I1 (intervention one, consuming one pisang raja daily for 14 days, taken in the morning before breakfast), and group I2 (intervention two, consuming two pisang raja daily for 14 days, taken in the morning before breakfast and in the evening before dinner). All participants received education on adhering to a low-sodium diet, with each pisang raja weighing between 90-110 grams (16,17).

Statistical analysis was conducted to assess changes in BMI and percent body fat before and after the pisang raja intervention. The Paired Samples T Test was employed for normally distributed data, while the Wilcoxon test was utilized for non-normally distributed data. Then the statistical analysis used to determine differences in BMI and percent body fat between research groups using the One Way ANOVA test. If the data is normal, continue with the Tukey post hoc test and if the data is not normal, carry out the Krusikal Wallis Test Statistical data analysis was conducted using SPSS version 26, with significance set at $p \leq 0.05$. Furthermore, this research received approval from the Research

Ethics Committee of the Faculty of Medicine, Sebelas Maret University, under protocol number 213/UN27.06.11/KEP/EC/2023. Permission was granted to perform the procedures on the research subjects.

RESULTS AND DISCUSSIONS

Based on the results of statistical analysis of the effect of pisang raja feeding on BMI can be seen in Table 1. **Table 1** below.

Table 1. Effect of Plantain Feeding on Body Mass Index

Group	n	Before	After	∆ Mean ± SD $(kg/m)^2$	p
		Mean ± SD $(kg/m)^2$	Mean ± SD $(kg/m)^2$		
K-	13	29.39 ± 4.32	31.59 ± 5.09	2.19 ± 3.6	0.49*)
K+	13	31.50 ± 3.17	30.11 ± 2.46	-1.39 ± 1.40	0.004*)
I1	13	27.78 ± 3.02	26.37 ± 2.75	-1.40 ± 1.55	0.007*)
I2	13	29.47 ± 3.69	28.12 ± 4.37	-1.34 ± 1.51	0.008*)
p		0.038**)	0.006**)	0.00**)	

Description:
K-= Negative control (no hypertension medication and plantain)
K+= Positive control (hypertension drug)
I1= Intervention 1 (plantain 1 fruit)
I2= Intervention 2 (plantain 2 pieces)
p= probability value
n= number of research subjects
∆= difference in body weight before and after plantain fruit feeding
*) = *Paired T Test*
**) = *ANOVA test*

In groups K+, I1, and I2, a reduction in BMI was observed, whereas group K- did not exhibit such a decrease. Subsequent statistical analysis using the Paired T-test test revealed significant results in the K+ group, with p = 0.004 (p < 0.05), indicating a notable disparity in body mass index before and after the intervention. In group I1, the result was p=0.007 (p<0.05), meaning that there was a difference in BMI in group I1. The results of the Paired T Test in group I2 obtained the result of p=0.008 (p<0.05) which means that in group I2 there is a difference in BMI. The results of statistical tests on the 4 research groups obtained the mean difference before and after the intervention using the One Way Anova test with the result of p=0.00 (p<0.05) which means there is a difference in body mass index before and after the intervention.

The statistical analysis results illustrating the impact of banana consumption on body fat percentage are presented in **Table 2**.

Table 2: Effect of plantain feeding on body fat percentage

Group	n	Before	After	∆ Mean ± SD	p
		Mean ± SD (%)	Mean ± SD (%)	$(kg/m)^2$	
K-	13	36.91 ± 5.08	37.78 ± 3.57	0.84 ± 4.14	0.46*)
K+	13	39.15 ± 3.14	36.70 ± 2.78	-2.53 ± 1.66	0.00*)
I1	13	35.75 ± 4.19	33.95 ± 4.32	-1.84 ± 3.89	0.074**)
I2	13	37.83 ± 3.63	36.40 ± 3.61	-1.15 ± 1.99	0.025*)
p		0.639	0.238***)	0.027***)	

Description:
K-= Negative control (no hypertension medication and plantain)
K+= Positive control (hypertension drug)
I1= Intervention 1 (plantain 1 fruit)
I2= Intervention 2 (plantain 2 pieces)
p= probability value

n= number of research subjects
∆= difference in body weight before and after plantain fruit feeding
*) = *Paired T Test*
**) = *Wilcoxon test*
***) = *Anova test*

Groups K+, I1, and I2 witnessed a reduction in body fat percentage, whereas the K- group did not demonstrate such a decrease. However, the statistical analysis conducted before and after the intervention revealed significant results in the K+ group, with p=0.00 (p<0.05), indicating a notable difference in body fat percentage pre- and post-intervention. In group I1, the results obtained p=0.074 (p>0.05) which means there is no difference in percent body fat in group I1. The results of the Paired T Test in group I2 showed p=0.025 (p<0.05) which means that in group I2 there was a difference in body fat percent. The results of statistical tests on the 4 research groups obtained the mean difference before and after the intervention using the Anova test with the result of p=0.027 (p<0.05) which means group K+, I1 and I2 there is a difference in percent body fat before and after the intervention.

This research revealed a notable decrease in BMI among the K+, I1, and I2 groups following banana consumption. In this research, BMI (Body Mass Index) was calculated by dividing body weight in kilograms by height in meters squared. As per the Asia Pacific BMI criteria, a BMI measurement of ≥ 23 indicates a risk of obesity or, alternatively, being overweight. Obesity stands as an independent risk factor for hypertension, meaning that its occurrence can lead to hypertension even without other influencing risk factors. Numerous previous studies have investigated the association between obesity and the incidence of hypertension. The incidence of obesity gives an influence on the occurrence of hypertension 2.16 greater when compared to subjects who are not obese (8,18). The American Heart Association also reported that subjects who are overweight with an excess weight of 20% have a risk of hypertension 3-8 times greater than subjects who are not obese.

This research focused on pre-elderly subjects, whose lifestyle often reflects that of the elderly. As body weight increases, the levels of insulin and aldosterone in the plasma also rise. This elevated insulin level reduces sodium extraction in the glomeruli, consequently leading to increased insulin levels. Additionally, aldosterone retains sodium in the blood, the reby increasing blood volume (19). Therefore, to avoid or overcome the risk factors that cause hypertension, it is necessary to take care of yourself.

The JNC VII or JNC VIII guidelines advocate for pharmacological therapy, comprising medication usage, and non-pharmacological interventions, such as dietary adjustments and physical activity, to prevent and control hypertension. According to JNC VIII, pharmacological treatment is recommended for individuals aged <60 years when their systolic blood pressure is ≥ 140 mmHg or diastolic blood pressure is ≥ 90 mmHg. For individuals with systolic blood pressure < 140 mmHg and diastolic blood pressure < 90 mmHg, non-pharmacological interventions are essential to sustain blood pressure stability (20).

Bananas contribute to stabilizing blood pressure by aiding in weight management, thanks to their rich crude fiber content. This type of fiber comprises cellulose, lignin, and pentose, all of which play crucial roles in the digestive system. Fiber assists in maintaining proper hydration levels in the body and facilitating smoother bowel movements. Moreover, bananas contain pectin, which functions by creating a thick liquid that slows down stomach emptying, prolonging the digestion process (5,21). This is in line with previous research that mice given 6.6gr of banana fruit extract for 5 days experienced a decrease in body weight, namely with an average initial body weight of 32.23gr to 30.69gr. (22).

According to the outcomes from the research on banana consumption and body fat percentage, significant reductions were

observed in groups K+ and I2. This decline can be attributed to the fiber content found in bananas, which helps to stave off hunger. Fiber possesses the ability to retain water, thereby delaying gastric emptying and providing a sense of fullness for longer periods (5,23). Banana is also one of the food ingredients as a source of serotonin. Serotonin serves as a raw material to restrain appetite because the presence of serotonin can provide stimulation to Brown Adipose Tissue (BAT) to release energy. Appetite regulation stimulation is carried out by the hypothalamus by means of ∝-melanocyte-stimulating hormone (∝- MSH) released by anorexigenic proopiomelanocortin (POMC) neurons which is an endogenous ligand of melanocortin 4 receptor (MC4R) to restrain appetite (18,24).

As per PerKaBPOM (2016), fiber sources are deemed favorable if the fiber content in the food reaches 3 grams per 100 grams of food. Plantains stand out as an exemplary fruit in this regard, boasting a substantial fiber content of 5.2 grams per 100 grams of fruit (5). Moreover, bananas contain pectin, a compound capable of binding fat within the small intestine and digestive tract. Pectin also acts to bind bile salts, subsequently facilitating their elimination from the body through feces. Individuals who are obese typically have elevated levels of body fat. The fiber in bananas binds excess fat in the bodies of obese individuals, leading to a reduction in bile acid levels in the liver. This decrease prompts the liver to utilize cholesterol in the production of bile acids, the reby decreasing fat levels in the body. Consequently, this results in a reduction in overall body fat percentage (19,24). This is in line with previous research that rats given banana fruit extract 4.5gr/200gr b.w. rats and giving banana fruit extract 9gr/200gr b.w. rats for 3 weeks had a significant effect on reducing serum triglyceride levels (25).

CONCLUSIONS AND RECOMENDATION

Providing pisang raja once or twice daily can notably decrease BMI. However, offering plantains once daily did not lead to a significant reduction in body fat percentage, whereas providing them twice daily resulted in a significant decrease in body fat percentage.

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