

Effectiveness of banana juice (*Musa acuminata* Linn.) on blood pressure, blood sugar levels, and low-density lipoprotein in elderly

¹Fitri, Y., ¹Suryana, S., ^{1*}Ahmad, A., ¹Hendra, A., ¹Fitrianingsih, E., ¹Arnizam and ²Yunianto, A.E.

¹Department of Nutrition, Aceh Health Polytechnic, Ministry of Health, Aceh Besar, 23352, Indonesia

²Department of Chemistry, Faculty of Health Science, Siliwangi University, Tasikmalaya 46115, Indonesia

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Abstract

The prevalence of hypertension in the elderly is increasing, but the use of functional food as treatment is still limited. Bananas contain nutrients and bioactive components as a prevention and treatment for various degenerative diseases. This study aims to determine the effectiveness of banana juice (*Musa acuminata* Linn.) on blood pressure, blood sugar levels, and low-density lipoprotein in the elderly. A quasi-experimental pre-post-test design with two groups consisting of sixteen elderly (eight elderly were given peeled banana juice and eight others were given unpeeled banana juice) for seven days as much as 300 mL each morning with the composition of 100 g of banana and 200 mL of water every day. Systolic and diastolic blood pressures were measured using a sphygmomanometer, while blood sugar levels and low-density lipoprotein (LDL) were measured by the spectrophotometric method. The data were analysed using dependent and independent t-test at 95% confidence level. The results of this study showed that both unpeeled and peeled banana juice (*Musa acuminata* Linn.) can reduce systolic and diastolic blood pressure respectively ($p = 0.02$ and $p = 0.04$) and ($p = 0.00$ and $p = 0.00$). However, the treatments were not significantly in terms of the blood sugar levels ($p = 0.19$ and $p = 0.59$), and the LDL levels ($p = 0.58$ and $p = 0.09$). Consuming banana juice (*Musa acuminata* Linn.) is effective in lowering blood pressure in the elderly, to prevent degenerative diseases.

1. Introduction

According to World Health Organization (WHO) data in 2013, an estimated 17 million people died every year from cardiovascular disease, and around 9.4 million due to complications of hypertension (WHO, 2013). The prevalence of hypertension in Indonesia is increasing every year. In Aceh Province, hypertension is ranked as the 10th cause of death (>1.5%) (RISKESDAS, 2013). Based on the 2018 RISKESDAS data, the prevalence of hypertension in Indonesia reaches 34.1% at the age above 18 years and 55.2% at the age 55-64 years (Balitbangkes, 2018).

Increasing cholesterol levels is a factor that can improve blood pressure. In the elderly, increased cholesterol is very dangerous to their health. Enhancement of blood pressure is closely related to sodium and potassium intake. People with high sodium intake have higher blood pressure compared to low ones. Hence, sodium intake is the cause of hypertension, a disease that occurs as the consequence of high blood

pressure that leads to various complications and some other diseases such as heart disease, stroke, and kidney failure (Sacks *et al.*, 2001, Juraschek *et al.*, 2017; Di Palo and Barone, 2020).

Hypertension and hypercholesterolemia can be controlled by consuming bananas (herbal treatments). Eating fruits and vegetables help lower blood pressure (Anindyah and Farmawati, 2015). Banana fruit can be processed into various food ingredients and also drinks such as juice. Selection of juice therapy is a form or method of healing by drinking fruit juice that has some benefits. Juice therapy can restore blood and blood vessel function and does not cause side effects unlike drugs reducing synthetic blood pressure that can irritate the kidneys. The water content in juices can reduce cholesterol and uncontrolled blood pressure and is known for removing fat in urine (Adi, 2018).

Giving bananas to the elderly can significantly reduce blood pressure (Chrisanto, 2017; Pramono *et al.*, 2017; Yulianti and Prameswari, 2019). Some important

*Corresponding author.

Email: aripinahmad@poltekkesaceh.ac.id

components in bananas are angiotensin-converting enzyme (ACE) inhibitors. This enzyme causes contraction of the muscles surrounding blood vessels, effectively narrowing vessels and increasing blood pressure. Potassium contained in bananas can control blood pressure in the body (Megia, 2008). Potassium reduces the effect of sodium on the body. Hence, eating bananas will lower blood pressure due to their high potassium content and also help in reducing thirst as well as muscle weakness due to potassium deficiency. A large banana contains 3.5 g of fibre, or 14% of a day's fibre needs (Dalimartha, 2011).

Besides the fruit, bananas' skin also has benefits in lowering blood pressure. Research conducted by Sutanto (2010) proved that Banana skin could decrease blood pressure in adult women. Bananas also contain flavonoids and tannins. Flavonoid compounds contained in bananas play a role in preventing the occurrence of glucose metabolism, fat and irregular proteins. Tannin can reduce the absorption of food extracts including glucose in the small intestine, consequently, it can inhibit sugar intake and has hypoglycaemic activity by increasing glycogenesis (Ramayulis, 2013).

Furthermore, flavonoids contained in banana peels are quercetin, carotenoids, phenolic compounds, and biogenic amines, as angiotensin-converting ACE inhibitor enzymes (Pereira and Maraschin, 2015; Dong *et al.*, 2016). In addition to lowering blood pressure, banana peels also play a role in reducing cholesterol levels. The study conducted by Hamisah (2014) found that the administration of banana peel extract in white rats can reduce total blood cholesterol levels.

Indonesia has the largest production of bananas, in 2011 alone 811,909 tons were produced. While in Aceh Province, bananas reached 28,100 tons, which ranked second under pineapple. In Aceh Besar District, the commodities of bananas are the second after Pidie District (Rahmawati, 2013). Based on these explanations, this study investigated the effects of banana juice to reduce blood pressure, blood sugar levels, and LDL levels in the elderly.

2. Materials and methods

This study used a quasi-experimental pre-post-test design, to analyse the effectiveness of giving banana juice on cholesterol (LDL) and blood pressure levels in the elderly in the *Rumoh Seujahtra Geunaseh Sayang* nursing house at Banda Aceh city. This study was conducted on sixteen elderly adults (eight were given banana juice with its peel and eight were given banana juice without its peel). These treatments were administrated for 7 days whereby 300 mL of banana

juice (100 banana and 200 mL water) was given to the participants every morning. The selection of samples was based on the inclusion criteria: Willing to be participants (men or women are allowed), the patients are conscious and able to talk, and neither drink nor eat other fruits which can affect blood pressure.

This study has received ethical approval from the Ethics Commission of the Faculty of Nursing, University of Sumatera Utara, Indonesia number: 977/IV/SP/2016, and each sample is asked to be approved as a sample by giving juice and blood tests.

2.1 Data collection and measure

The data collected includes the characteristic subject, namely age and gender by an interviewed method using a structured questionnaire. Then blood sugar levels and low-density lipoprotein levels were measured using the spectrophotometric method. Blood pressure data were collected using a sphygmomanometer before and after the intervention.

2.2 Interventions

The type of banana used as an intervention in this study is *Pisang Ayam (Musa acuminata* Linn.). The interventions were categorized into two groups; banana juice with skin (first group) and banana juice without skin (second group). The banana juice is given once a day for 7 days. A total of 100 g of fresh bananas were dissolved in 200 mL water without the addition of sugar. Peeled banana juice was also given once a day for 7 days. The 100 g of fresh banana with 10 g of banana peel were dissolved in 200 mL water and then blended without adding sugar.

2.3 Data processing and analysis

Data were analysed using Microsoft excel and IBM SPSS v21.0. Univariate analysis was carried out to analyze the distribution frequency of cholesterol levels and blood pressure of hypertension patients before and after consuming banana juice. While Analysis of bivariate was used to analyse the effect between the variables using the dependent t

-Test at 95% level confidence.

3. Results and discussion

3.1 Characteristics of subject

The result showed (Table 1) sixteen samples that consist of both elderly males and females with an average age of 60-90. Nearly three-quarters of the study subjects were women in both groups, but according to age, most (87.5%) of the unpeeled banana juice intervention group were over 70 years of age. On the

other hand, unpeeled banana juice was more dominant (62.5%) for the elderly aged between 60-70 years.

Table 1. Characteristics of subject

Category	Peeled Banana Juice		Unpeeled Banana Juice	
	n	%	n	%
Sex				
Women	5	62.5	5	62.5
Men	3	37.5	3	37.5
Age (years)				
≥ 60 - 70	1	12.5	5	62.5
≥ 70	7	87.5	3	37.5

3.2 Effect of banana juice on systolic and diastolic pressure

Consumption of fruit either raw or processed into juice can reduce the risk of cardiovascular disease, especially blood pressure (Griep *et al.*, 2013). Most of the world's population, especially in developing countries, consumes bananas in meeting their nutritional needs (Singh *et al.*, 2018). Banana is a herbaceous plant that is often found by people in the tropics (Kumar *et al.*, 2012).

The results of this study (Table 2) showed the average systolic blood pressure of patients before consuming unpeeled banana juice is 156.63 mmHg and the diastolic is 88.75 mmHg, while after the intervention the average systolic and diastolic blood pressure decreased to 135.25 mmHg and 67.25 mmHg. The same

result also occurred in the peeled banana juice, there was a decrease in the systolic pressure from 163.25 mmHg to 132.25 mmHg, and diastolic pressure from 86.88 mmHg to 74.38 mmHg. The statistical test results showed that both treatments decreased systolic and diastolic blood pressure significantly ($p < 0.05$). The results of this study indicate that banana juice is effective in reducing blood pressure in the elderly. The results (Table 3) showed that there was no difference between giving unpeeled banana juice and peeled banana juice in reducing blood pressure for both systolic and diastolic ($p > 0.05$), meaning that both interventions had the same effect.

The results of this study indicate that the provision of fruits such as bananas in this study can be an alternative for the prevention and management of hypertension in the elderly. Both types of banana juices have shown almost no difference in lowering blood pressure, yet the nutritional content in unpeeled banana juice is much higher than in peeled banana juice (Sutanto, 2010). However, a study conducted by Kasron (2012) showed that banana without peel has higher potassium than bananas with their peel. A hundred grams of it contains 435 mg of potassium. Thus, both peeled and unpeeled bananas could be an alternative to increasing potassium intake, especially in the elderly. This study proved that bananas are better consumed by processing them in various ways, one of which is juiced. This juice therapy can be used as an antidote to hypertension because the potassium in bananas has the effect of lowering blood

Table 2. The averages blood pressure, blood sugar levels, and low-density lipoprotein (LDL) levels before and after giving banana juice intervention[#]

Variable	Unpeeled banana juice		Peeled banana juice	
	Mean±SD	p-value	Mean±SD	p-value
Systolic				
Before	156.63±8.85		163.25±11.56	
After	135.25±11.49	0.00*	132.25±18.29	0.00*
Mean different	21.37±12.68		31.00±21.85	
Diastolic				
Before	88.75±12.55		86.88±10.45	
After	67.25±7.63	0.04*	74.38±8.53	0.00*
Mean different	21.50±14.63		10.37±12.75	
Blood sugar levels				
Before	195.13±153.55		97.63±29.52	
After	156.00±86.16	0.19	92.75±29.09	0.59
Mean different	39.12±77.22		4.87±24.97	
LDL levels				
Before	203.25±52.14		212.63±49.49	
After	208.63±45.79	0.580	180.75±20.02	0.098
Mean different	-5.37±26.29		31.87±47.19	

SD: standard deviation, LDL: low-density lipoprotein

[#]Dependent t-test.

*significant at $p < 0.05$.

pressure and does not give any detrimental side effects (Tangkilian *et al.*, 2013; Adi, 2018)

Banana juice will greatly help overcome complex bonds in releasing minerals making them easily absorbed by the body. Juice is better to be consumed immediately to maintain its freshness and provide better benefits. Juice is also a healing complement to herbal therapy. Based on a study conducted by Sutanto (2011), 60 g of banana peel dissolved in 250 mL water was effective to reduce blood pressure in adult women.

3.3 Effect of banana juice on blood sugar levels

The results of this study also showed (Table 2) that on average, there was a decrease in blood sugar levels in elderly subjects who were given banana juice. In the unpeeled banana juice group, there was a decrease in the mean blood sugar from 195.13 g/dL to 156.00 g/dL. The same results also occurred in the banana juice peeled group, from 97.63 g/dL to 92.75 g/dL. However, this decrease was not statistically significant ($p>0.05$). The results also showed (Table 3) that there was no difference in the effect of banana juice between giving unpeeled banana juice and peeled banana juice ($p>0.05$).

The results of this study are in accordance with the results of Fitriani's (2012) study using Ambon banana to reduce blood sugar levels which showed no significant effect of Ambon banana skin extract on glucose levels in mice. Several studies have shown that banana juice provides a positive response to blood sugar levels (Dikshit *et al.*, 2012). The administration of stem of *Musa sapientum* Linn. 50 mg/kg for four weeks in streptozotocin-induced diabetic rats was effective to decrease fasting and postprandial plasma glucose (FPG, PPG) levels. In another's study conducted by Darvhekar *et al.* (2016) *Musa sapientum* Linn. (MS) bark juice significantly reduced the blood glucose level in the diabetic rats

As bananas are rich in vitamins and minerals, the compounds responsible for reducing glucose levels in blood were flavonoids, tannins, triterpenoids, and steroids. Flavonoids could prevent the regular metabolism of glucose, fat, and protein. Flavonoid glycosides were capable of acting as a hydroxyl catcher that could prevent diabetogenic action. Tannin could reduce the absorption of food essences including glucose in the intestine, inhibit sugar intake, and have activity hypoglycemic with improving glycogenesis (Kajmal *et al.*, 2010). According to Puraikalan (2018) the banana peel contains important nutrients such as protein (9.4-11.7%), fat (3.6-6.7%), and fibre (11.5-14.4%). Acetone extract of *Musa sapientum* Fruit Peel (MSPE) possesses anti-diabetic activity by improving insulin secretion,

decreasing blood glucose level and HbA1c (Murthy and Felicia, 2015).

The inactive effect of giving banana juice in this study can be caused by the short duration of administration. The 7 days of treatment that the existing bioactive components have not been able to have a significant effect. For this reason, it is necessary to carry out further trials through follow-up research with a longer intervention time and perhaps also on samples with different age characteristics. Furthermore, the samples were small due small population who meet the criteria. Some of these limitations are assumed to affect the insignificance of the effect of treatments.

3.4 Effect of banana juice on low-density lipoprotein levels

The results (Table 3) showed that the levels of low-density lipoprotein (LDL) in the unpeeled banana juice group increased slightly by 5.37 points from 208.63 g/dL to 208.63 g/dL. Meanwhile, peeled banana juice peels decreased by 31.87 points from 212.63 g/dL to 180.75 g/dL after treatment. The results of statistical tests showed that there was no significant difference in LDL levels before and after the intervention in the two groups ($p>0.05$). The results of the comparative analysis between unpeeled banana juice and peeled banana juice (Table 3) also did not show a significant difference in increasing HDL ($p>0.05$). These results indicate that giving banana juice for 7 days has not been effective in increasing LDL levels in the elderly.

Table 3. The effectiveness of banana juice on blood pressure, blood sugar levels, and low-density lipoprotein (LDL) levels after banana juice interventions[#]

Variable	Unpeeled banana juice	Peeled banana juice	p-value*
	Mean±SD	Mean±SD	
Systolic	135.25±11.45	132.25±18.21	0.70
Diastolic	67.25±7.62	74.37±8.53	0.10
Blood sugar levels	156.00±86.15	92.75±29.08	0.06
LDL levels	208.62±45.79	180.75±20.01	0.13

SD: standard deviation, LDL: low-density lipoprotein

[#]Dependent t-test.

*significant at $p<0.05$.

These results are different from a study where the administration of *Musa sapientum* Linn. has a positive effect on cholesterol levels. The results of the study by Dikshit *et al.* (2012) utilizing the stem of *Musa sapientum* Linn. exhibit antidiabetic and antihyperlipidemic effects. Another study reported by Hidayati (2015) showed there was a decrease in total cholesterol levels in mice that were fed bananas for 21 days.

There is no significant effect of cholesterol levels decrease in the samples. After some interviews with the samples, the researcher got the information that most menus served in the nursing house are fatty food. In this case, it is assumed that giving banana juice has no significant effect on the sample. This may be due to only 7 days of treatment causing no significant effect. Besides, the age of the sample (who are elderly) could be a factor causing the absence of a significant effect. Mostly, people in advanced age have a decrease in renin levels due to the reduction of nephrons caused by the ageing process. The older a person, the more sensitive the body will be to increase and decrease in sodium levels due to decreased metabolism (Boedhi and Darmojo, 2011).

4. Conclusion

Based on the results of this study, it can be concluded that giving banana juice *Musa acuminata* Linn. with and without its peel is effective in reducing systolic and diastolic blood pressure in the elderly. However, the treatment does not significantly reduce blood sugar levels and increase low-density lipoprotein levels in the elderly. However, banana juice can be an alternative intervention for the prevention and management of blood pressure, especially in the elderly. It is necessary to do further studies with a longer duration of administration and varying doses of juice to determine the effect of *Musa acuminata* Linn. juice on blood sugar levels and lipid profiles.

Conflict of interest

All authors declare they have no conflict of interest.

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