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(RESEARCH ARTICLE)

Cucumber (*Cucumis sativus*) and tomato (*Solanum lycopersicum*) juice effective to reduce blood pressure

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Abstract

The fruits contain potassium, magnesium, phosphorus and lycopene can maintain blood pressure. This study aims to determine the effectiveness of cucumber and tomato juice on blood pressure. This study was a quasi-experimental with a pre-posttest design without control. The sampling used quota sampling was 36 respondents, divided into cucumber juice group was 18 respondents, and tomato juice group was 18 respondents. The research instrument used observation sheets and digital sphygmomanometers. Each group received juice every day in 7 days. Statistical tests using Shapiro-Wilk. The mean pre-posttest systolic and diastolic blood pressure in the cucumber juice group was 115.50-115.39 mmHg and 79.39-77.28 mmHg. The mean pre-posttest systolic and diastolic blood pressure in the tomato juice group was 110.67-109.78 mmHg and 77.39-73.61 mmHg. P-value pre-posttest systolic and diastolic blood pressure in cucumber juice group were 0.000 and 0.000. P-value pre-posttest systolic and diastolic blood pressure in tomato juice group were 0.000 and 0.000. P-value of the posttest systolic and diastolic blood pressure tests among two groups were 0.734 and 0.674. Giving cucumber juice and tomato juice is effective in helping to reduce systolic and diastolic blood pressure. There is no difference in effectiveness between cucumber juice and tomato juice.

Keywords: Cucumber; Tomato; Blood Pressure

1. Introduction

Blood pressure is a very important factor in the circulatory system. There are two types of blood pressure abnormalities, namely hypertension or high blood pressure and hypotension or low blood pressure. Hypertension is a condition where blood pressure is more than 140/90 mmHg. While hypotension is a condition where blood pressure is lower than 90/60 mmHg or blood pressure is low enough to cause symptoms such as dizziness and fainting [1].

World Health Organization (WHO) explained that hypertension is one of the factors of global death and is estimated to have caused 9.4 million deaths in 2010. Hypertension is estimated to contribute 12.8% of deaths worldwide. The prevalence of hypertension is highest in Africa (46%) and lowest in America (35%). High-income countries have lower prevalence compared to low-income countries [2]. Although orthostatic hypotension can occur in all age groups, it is reported more often in older adults, especially those who are sick. In the United States, orthostatic hypotension is 30% of older adults and up to 70% of residents of nursing homes. The incidence of orthostatic hypotension occurs in 47-58% of patients with Parkinson's disease, 13-32% of those with hypertension, 16-25% of those with diabetes mellitus and 24% of those with carotid artery stenosis [3].

The prevalence of hypertension in Indonesia continues to increase in number. In 2007, the prevalence of hypertension was 7.6% and increased to 9.5% in 2013. The number of hypertension sufferers in Yogyakarta is the third highest after

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East Nusa Tenggara and South Kalimantan [4]. While, the prevalence of hypotension is generally estimated to be 5% to 34% and usually increases at the age of 17-19 years [3].

Some ways in managing blood pressure are maintaining ideal body weight, reducing sodium (*sodium intake*), limiting alcohol consumption, eating enough K and Ca sources from the diet, avoiding smoking, reducing stress, and therapeutic massage. Management of blood pressure disorders is pursued by non-pharmacological. The non-pharmacological treatment uses traditional plants or fruits [5]. One way to control blood pressure is to be able to consume cucumber juice and tomato juice. Consuming cucumbers can reduce blood pressure and is very good for people with hypertension, containing potassium which is the primary intracellular electrolyte. Cucumbers also have a diuretic nature due to their high water content which helps reduce blood pressure [6].

In addition to cucumbers, tomatoes are perfect for hypertension sufferers because they contain potassium and lycopene. The content of potassium and lycopene in tomatoes can reduce blood pressure by inhibiting the release of renin increasing the excretion of sodium and water while lycopene is the most potent antioxidant among other antioxidants. Lycopene also plays a role in reducing LDL and as an anti-atherosclerosis by protecting endothelial vessels from damage, reducing the inflammatory response, and inhibiting the proliferation of smooth muscle cells [7]. Lycopene content in tomatoes which is the highest antioxidant can prevent lipid oxidation from preventing cardiovascular diseases such as hypertension [8]. Cucumber and tomatoes have good prices and are easy to get in everyday life. During this study, the researchers aimed to determine the effectiveness of non-pharmacological treatment using cucumber and tomato juice on blood pressure.

2. Material and methods

2.1. Study Design

This research was a quasi-experimental study with pretest-posttest without control. Respondents were divided into two groups that were equally treated, namely given cucumber juice and tomato juice (figure 1).

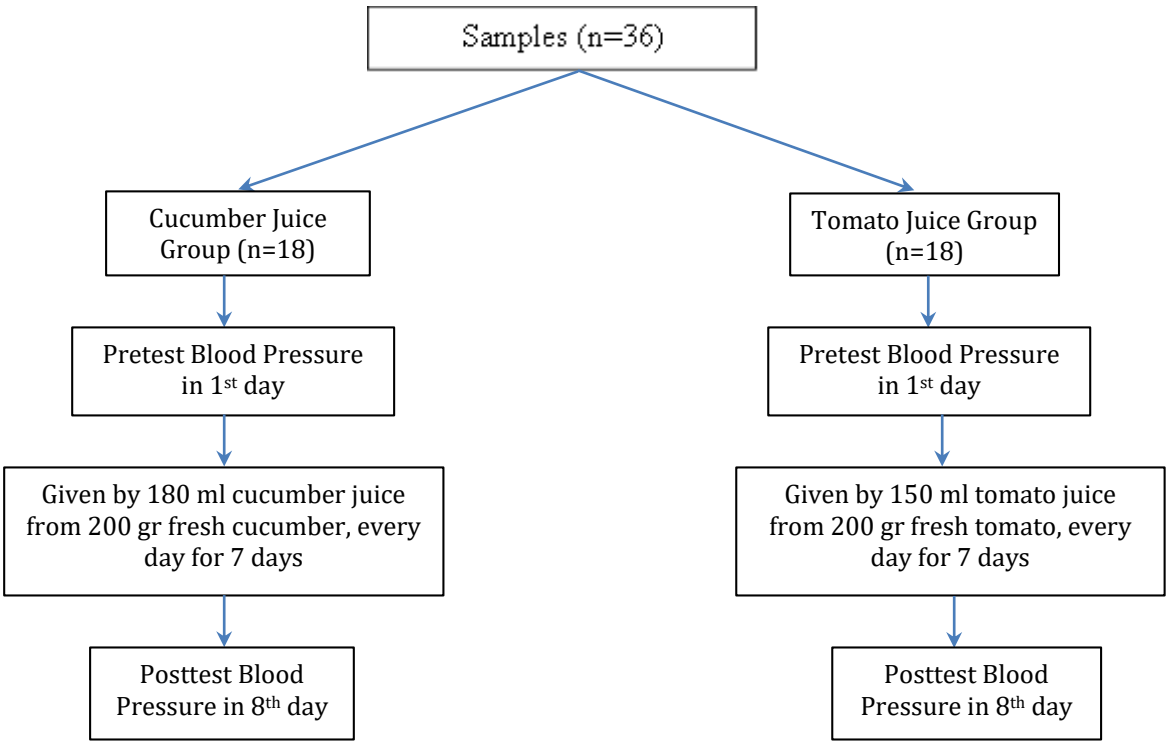

Figure 1 Study framework

2.2. Participants in the study

The populations were 138 students of Nutrition Sciences Program at Universitas Respati Yogyakarta. The samples were students who fit the inclusion and exclusion criteria. Inclusion criteria were willing to become a respondent by signing

informed consent, age 19-23 years old, normal body mass index, not taking blood pressure medication, not smoking, and not consuming alcohol. Exclusion criteria were allergic to consume cucumbers and tomatoes, had a history of gastritis, and a condition of pain. The sample can be calculated using the formula:

(t-1) (r - 1)=15

which t = many treatment groups and r = number of replications.

The calculation results obtained a sample of 16 people plus the anticipation of drop out of 10% so that the number of samples becomes 18 groups. The research site was conducted on April 26-May 3, 2019. The sampling technique used in this study was using the method of *Quota Sampling*.

2.3. Instruments

Cucumber and tomato juice were made using a juicer by standard operating procedures that have been made previously. Blood pressure was measured using a *digital sphygmomanometer* Omron brand. Blood pressure measurements were by standard operational procedures. The measurement results were recorded on the observation sheet.

Figure 2 Instruments

2.4. Intervention and data collection

The first group received an intervention in the form of giving cucumber juice. Cucumber juice was made from 200 grams of cucumber that has been cleaned and then mashed using a juicer obtained 180 ml of cucumber juice. The juice was given once a day in the morning (07.00-09.00 am) for seven consecutive days. The second group got tomato juice. Tomato juice was made from 200 grams of tomatoes that have been cleaned and then mashed using a juicer obtained 150 ml of tomato juice. The juice was given once a day in the morning (07.00-09.00 am) for seven consecutive days. Samples were measured blood pressure at pretest and posttest. Blood pressure was measured in the left arm, in a sitting position after resting for 5 minutes. Pretest blood pressure was measured on the first day before being given cucumber juice and tomato juice. Posted blood pressure was measured on the eighth day (one day after treatment was completed) at 07.00-09.00 am.

Figure 3 Juice Preparation

2.5. Data analysis

This study used normality test with the *Shapiro Wilk test*. The result of normality data, *pretest-posttest* of systolic blood pressure among cucumber/tomato groups were 0.054 and 0.501/0.675 and 0.432. The *pretest-posttest* of diastolic blood pressure among cucumber/tomato groups were 0.491 and 0.945/0.056 and 0.092. The normality test results of cucumber juice and tomato juice were generally distributed so that the statistical tests used in this study were *Paired T-Test* and *Independent T-Test*.

2.6. Ethical consideration

The study permission obtained from the Head of the Nutrition Science Programme of Universitas Respati Yogyakarta. Informed consent was signed to all respondents before the data collection.

3. Results

3.1. Characteristics of respondents

Table 1 Characteristics of respondents

Category	Cucumber juice group		Tomato juice group	
	f	%	f	%
Age (year)				
21	16	88.9	16	88.9
22	2	11.1	2	11.1
Total	18	100.0	18	100.0
Gender				
Female	15	88.3	17	94.4
Male	3	11.7	1	5.6
Total	18	100.0	18	100.0

Table 1 known that the majority of respondents in both groups were 22 years old, as many as 16 people (88.9%). In the group of cucumber juice and tomato juice, the majority were female, namely 15 people (88.3%) and 17 people (94.4%).

3.2. Pretest and posttest blood pressure

Table 2 shows that the mean systolic and diastolic pretest-posttest blood pressure in both groups decreased. In the cucumber juice group, the mean systolic blood pressure decreased from 115.50 mmHg to 111.39 mmHg. In diastolic blood pressure, decreased from 79.39 mmHg to 77.28 mmHg. In the tomato juice group showed similar results, the mean systolic pressure decreased from 110.67 mmHg to 109.78 mmHg. While the mean diastolic pressure decreased from 77.39 mmHg to 73.61 mmHg.

Table 2 Systolic blood pressure and diastole cucumber juice

Groups groups	**Pretest-posttest blood pressure (mmHg)**			
	Minimum	Maximum	Mean	SD*
Cucumber juice				
Systolic	90-102	131- 120	115.50-111.39	13.161-5.304
Diastolic	52-63	97-91	79.39-77.28	10.749-6.875
Tomato juice				
Systolic	90-91	134-131	110.67-109.78	11.616-8.055
Diastolic	52-66	88-87	77.39-73.61	9.543-6.705

*SD = Standard Deviation

3.3. Effects of cucumber and tomato juice to blood pressure

Table 3 Effect of cucumber juice and tomato juice on blood pressure

Group	**Blood pressure (mmHg)**		**p-*value***
	Mean	Difference Mean	
Cucumber juice			
Systole			
Pretest	115.50	- 4.11	0.000*
Posttest	111.39		
Diastole			
Pretest	79.39	- 2.11	0.000*
Posttest	77.28		
Tomato juice			
Systole			
Pretest	110.67	-0.89	0.000*
Posttest	109.78		
Diastole			
Pretest	77.39	-3.78	0.000*
Posttest	73.61		

*Paired T-Test

Table 3 shows that the group of cucumber juice and tomato juice, mean systolic blood pressure pretest-posttest decreased by 4.11 mmHg and 0.89 mmHg. The mean of diastolic blood pressure pretest-posttest in the cucumber and tomato juice groups decreased by 2.11 mmHg and 3.78 mmHg. The results of the *paired t-test for* systolic and diastolic blood pressure in both groups showed a p-value of 0.000, meaning cucumber juice and tomato juice was effective in reducing systolic and diastolic blood pressure in college students.

Table 4 Differences in effectiveness of cucumber juice and tomato juice on systolic and diastolic blood pressure

Blood pressure	Difference in mean	Difference among group	P-value
Systole			
Cucumber juice	4.11	3.22	0.734*
Tomato juice	0.89		
Diastole			
Cucumber juice	2.11	1.67	0.674*
Tomato juice	3.78		

*Independent T-Test

Table 4 shows the difference in systole blood pressure between the cucumber juice and tomato juice group was 3.22 mmHg and the cucumber juice group showed a decrease in systolic blood pressure more than tomato juice. While the difference in diastolic blood pressure reduction between the two groups was 1.67 mmHg, the tomato juice group showed a decrease in diastole blood pressure more than cucumber juice. The results of the independent *T-Test* on systolic and diastolic blood pressure between the two groups obtained p-values of 0.734 and 0.674, meaning that there was no significant difference between cucumber juice and tomato juice in reducing the blood pressure of systolic and diastolic in college students.

4. Discussion

Classification of blood pressure for adults, namely hypotension, is a state of systolic arterial pressure <90 mmHg, or diastolic pressure <60 mmHg. Normal systolic blood pressure <120 mmHg and diastolic <80 mmHg, prehypertension systolic blood pressure 120-139 mmHg and diastolic 80-90 mmHg, first-degree hypertension systolic blood pressure 140-159 mmHg and diastolic 90-99 mmHg, second-degree hypertension systolic blood pressure ≥160 mmHg and diastolic ≥100 mmHg [9]. Based on table 2, the majority of respondents are included in the normal category. However, the maximum value of systolic blood pressure in the *pretest* cucumber juice group and the pretest-posttest tomato juice group is in the category of prehypertension.

Table 3 shows that the average blood pressure has decreased. Statistically shows the influence of cucumber juice on blood pressure (p=0.000). The results of this study indicate the influence of cucumber juice administration on blood pressure in patients with hypertension. Based on the results of research conducted by previous researchers, there was a significant effect of cucumber juice on systolic and diastolic blood pressure [10], [11], [12]. Cucumber (*Cucumis sativus L.)* can help lower blood pressure. Cucumber juice contains Calories, Carbohydrates, Water, Protein, Sugar, Fiber, Fat, Vitamin C, Vitamin K, Vitamin B1 (Thiamine), Vitamin B2 (Riboflavin), Vitamin B3 (Niacin), Vitamin B5 (Panthothenic acid), Vitamin B9 (Folate), Calcium, Iron, Magnesium, Phosphorus, Kalium (Potassium), Sodium, and Zinc [13].

Cucumber juice is effective in reducing systolic and diastolic blood pressure in respondents. Empirically there is a significant effect of giving cucumber juice on a decrease in blood pressure; this is possible because cucumbers contain kalium (potassium), magnesium, and phosphorus, where these minerals can effectively reduce blood pressure [14]. Potassium plays a role in maintaining the electrolyte stability of the body through the potassium-sodium pump. Potassium content in cucumber juice affects blood vessels; potassium has a natriuretic effect by inhibiting the release of renin-angiotensin, which can increase the excretion of sodium in water. This decrease in sodium excretion causes a decrease in plasma volume, cardiac output, and external pressure, so that blood pressure drops [15].

Based on Table 3 in the tomato juice group, the mean of systole and diastolic blood pressure decreased. Tomatoes (*Gycopersicum esculentum mill)* combine solanine alkaloids (0.007%), saponins, folic acid, malic acid, citric acid, bioflavonoids, proteins, fats, sugars (glucose, fructose), trigonous, choline, tomatoes, minerals (Ca, Mg, P, K, Na, Fe, Sulfur, chlorine), vitamins (B1, B2, B6, C, E, Lycopene, Niacin), Potassium, fibre, protein and histamine. Lycopene is a beta carotene yellow pigment in tomatoes, and solanine is efficacious as an antibiotic. It can reduce blood pressure by reducing sodium in urine and water in the same way as diuretics [13].

Potassium in tomato juice can reduce blood pressure by inhibiting the release of renin, resulting in increased excretion of sodium and water. Renin circulates in the blood and works by catalyzing the breakdown of angiotensin to angiotensin I. Angiotensin I changes its active form, angiotensin II with the help of Angiotensin-Converting Enzyme (ACE).

Angiotensin II has great potential to increase blood pressure; vasoconstrictor and can stimulate aldosterone secretion. Aldosterone increases blood pressure by sodium retention. Sodium and water retention is reduced in the presence of potassium, resulting in a decrease in plasma volume, cardiac output, peripheral pressure, and blood pressure [16]. These results are supported by previous studies which showed that increasing potassium consumption around 2100 mg (54 mmol) a day could reduce systolic [17], [18], [19].

Table 4 results of the *Independent T-Test* of systolic pressure and diastole pretest-posttest in the two groups showed that there was no difference in effectiveness between cucumber juice and tomato juice on blood pressure reduction (p=0.734 and p=0.674). This shows that cucumber juice and tomato juice are equally effective against reducing blood pressure, and there is no difference between the two. After being given cucumber juice and tomato juice, there was a decrease in blood pressure. Table 4 also shows that in the cucumber juice, the mean difference in systolic blood pressure was higher than 3.32 mmHg compared with tomato juice. That means cucumber juice more reduced systolic blood pressure. While, the mean difference in diastolic blood pressure of the tomato juice group was1.67 mmHg greater than cucumber juice. That means tomato juice more reduced diastolic blood pressure.

5. Conclusion

The results showed that the presence of cucumber juice and tomato juice is effective in reducing blood pressure, both systole and diastole. While between the two fruits, there is no difference in effectiveness in lowering blood pressure, between the two having the same results in lowering blood pressure, no one is better than the other. Both of these fruits are easily found in daily life. Based on the finding of the study, cucumber juice and tomato juice are expected to be used as a basis for non-pharmacological therapy for patients with hypertension. Further researchers are advised to continue the study in respondents with hypertension.

Compliance with ethical standards

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Disclosure of conflict of interest

There was no conflict of interest in this study.

Statement of informed consent

Informed consent was signed to all respondents before the data collection.

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