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The Effect of Giving "Semundu" Juice with a Combination of Probiotics on Blood Pressure in Pre-Hypertension Patients

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ABSTRACT

Hypertension is a medical condition characterized by elevated blood pressure beyond normal limits. Management strategies for hypertension can be pharmacological or non-pharmacological. This study aims to evaluate the effect of administering "semundu" juice combined with yogurt on reducing blood pressure in individuals with hypertension in the Jembatan Kecil Health Center area, Bengkulu City, in 2024. A total of 28 participants with high blood pressure were randomly assigned to one of four groups: P0 (control group receiving educational leaflets), P1 (200g watermelon juice, 100g cucumber, and 20ml honey), P2 (100g Ambon banana, yogurt), and P3 (200g watermelon juice, 100g cucumber, 20ml honey, and yogurt). The Kruskal-Wallis test results indicated that the administration of "semundu" juice combined with probiotics significantly affected both systolic and diastolic blood pressure, as evidenced by a p-value of less than 0.05. All treatment groups demonstrated a reduction in blood pressure, with significant differences observed between the groups: P0 vs. P3 (p-value < 0.02), P1 vs. P3 (p-value < 0.034), and P2 vs. P3 (p-value < 0.01). These findings suggest that "semundu" juice combined with probiotics has a notable impact on lowering blood pressure in individuals with hypertension.

1. Introduction

Hypertension is characterized by an elevation in blood pressure beyond normal limits, often leading to other conditions such as stroke, which can significantly diminish one's quality of life across physical, psychological, social, and environmental domains (Pebrian *et al.*, 2020). A diagnosis of hypertension is made when systolic blood pressure is ≥140 mmHg or diastolic blood pressure is ≥90 mmHg (Pebriani *et al.*, 2023). Known as the silent killer, hypertension often remains undetected until complications arise (Oktaviani *et al.*, 2022).

In Indonesia, 63 million individuals over the age of 18 suffer from hypertension (Riskesdas, 2018). In Bengkulu Province, the number of hypertension cases in 2019 was 342,000, with Bengkulu City accounting for 60,000 of these cases (Bengkulu Provincial Health Office, 2019). Contributing factors to hypertension include aging, inadequate intake of fruits and vegetables, lack of physical activity, high sodium food consumption, and smoking (Achmad Syaid *et al.*, 2023). Hypertension management can be pharmacological or non-pharmacological (Gustomi & Nadhifah, 2021). Non-pharmacological approaches include the intake of potassium-rich foods such as watermelon and cucumber, along with the addition of honey and probiotics.

Watermelon, high in potassium, aids cardiac function and normalizes blood pressure. It contains citrulline, an amino acid that lowers blood pressure, and carotenoids that prevent arterial and venous hardening, thereby reducing blood pressure (Sari *et al.*, 2022). Cucumbers possess hypotensive properties due to their water and potassium content, which helps remove sodium and dilate blood vessels, thus reducing blood pressure (Christine *et al.*, 2021). Honey, a traditional remedy, lowers blood pressure due to its phytochemical content. Probiotics, found in fermented foods like yogurt, release proteins during fermentation that can lower blood pressure, such as isoleucine-proline-proline (IPP) and valine-proline-proline (VPP) (Roja *et al.*, 2022).

Research indicates that administering 20 ml of honey twice daily for seven days can reduce blood pressure in the elderly from 158/95 mmHg to 138/90 mmHg (Kharisma & Puspasari, 2023). Building on this and other non-pharmacological strategies, further research is needed to evaluate the effect of "semundu" juice (a blend of watermelon, cucumber, and honey/ Semangka, Mentimun dan Madu) combined with yogurt on blood pressure in pre-hypertensive patients in the Jembatan Kecil Health Center area, Bengkulu City, in 2024.

2. Methods

2.1 Site location

The research was carried out in the working area of the Jembatan Kecil Health Center, Bengkulu City. The research period was carried out for 1 week from 29 April 2024 - 30 May 2024.

2.2 Research tools and materials

The research utilized various tools including scales, measuring cups, pans, stirring spoons, thermometers, blenders, gas stoves, filters, and 200 ml small bottles. The ingredients used in the study were Ambon bananas, cow's milk, cucumber, honey, watermelon, and plain yogurt.

Procedure for making juice: Weighing materials: Weighing materials that are ready to be weighed using a scale according to the specified weight. Ingredients are weighed according to the specified amounts, namely (watermelon 200 g, cucumber 100 g, honey 20 ml). Process for making fruit juice: Clean the watermelon from the skin and cut into cubes. Peel the cucumber then wash and cut into cubes. Then put the watermelon and cucumber into a blender. Then mix in 20 ml of honey. Blend all the ingredients until smooth and become juice.

2.3 Research design

This study employed an experimental approach using a Randomized Group Design (RBD). The research included four treatment groups: P0 (control group receiving education through leaflets), P1 (200 g watermelon juice, 100 g cucumber, and 20 ml honey), P2 (banana Ambon yogurt), and P3 (200 g watermelon juice, 100 g cucumber, 20 ml honey, and yogurt).

2.4 Experimental Design and sampling technic

This research is an experimental study utilizing a randomized block design (RBD) with four treatment combinations. The treatments are as follows: P0 involves the provision of educational media leaflets three times over seven consecutive days; P1 involves administering 200 ml of "semundu" juice daily for seven consecutive days; P2 involves providing 200 ml of banana yogurt daily for seven consecutive days; and P3 involves administering a combination of 200 ml of "semundu" juice and banana yogurt daily for seven consecutive days. All treatments are given once a day, every morning after eating. The sample collection technique used is purposive sampling, with a total of 28 participants diagnosed with hypertension. The sample size was determined using the Federer (1991) formula:

$$(k-1)\ (r-1) \geq 15$$

Information:
k= number of samples searched
r = number of treatments
This research included four treatment groups (r = 4), consisting of one control group and three treatment groups, resulting in an n value of 6. Using the Federer formula, the calculated sample size was 6 respondents per group, indicating the minimum number of respondents needed. Additionally, accounting for potential dropout, the sample size was adjusted to 7 respondents per group. Consequently, the total number of respondents in the study was 28.

3. Results and Dicussion

3.1 Results

3.1.1 Univariate analysis

Univariate analysis was used to see the characteristics of respondents based on age, gender, and whether there was a family history of disease, and to see a picture of blood pressure before and after the semundu juice and yoghurt combination which is presented in table 1.

Table 1. Characteristics of gender, family history of disease

Variabel	n	Frequency %
Gender		
Man	5	17,9
Woman	23	82,1
Family History of Disease		
There is	1	3,6
There isn't any	27	96,4

Table 1 shows the characteristics of respondents' gender and family history of illness. The gender of the majority of respondents was female, namely 23 people (82.1%) and for family history of illness, the majority of respondents had no family history, namely 27 people (96.4%).

3.1.2 Bivariate analysis

Based on Table 2, the results of the Kruskall Wallis test showed that there was an effect of giving "semundu" juice with a combination of probiotics. It was found that systolic and diastolic blood pressure after each treatment was given showed a significant effect on systolic and diastolic blood pressure after being given the intervention, which was marked by a p-value (< 0.05).

Table 2. Effect of administering "Semundu" juice before and after on systolic and diastolic blood pressure in pre-hypertensive patients.

Treatment	Variable	Blood pressure before tretment (mmHg)			Blood pressure after tretment (mmHg)		
		Mean±SD	Min± Max	P-value	Mean±SD	Min± Max	P-Value
P0	Systolic	137.429 ± 2.299	135 ± 140	0.124	128.00± 2.646	123±130	0.015
	Diastolic	86.29 ± 2.628	84 ± 90	0.241	81±2.449	79±85	0.006
P1	Systolic	140.571 ± 2.636	137 ± 145	0.124	127.14±1.345	125 ± 129	0.015
	Diastolic	84.43 ± 2.699	82 ± 90	0.241	81.43± 3.910	79 ±90	0.006
P2	Systolic	139.143 ± 2.4785	132 ± 142	0.124	126.71 ± 1.704	124 ±129	0.015
	Diastolic	85.86 ± 2.268	83 ± 89	0.241	79.14±1.069	78±80	0.006
P3	Systolic	139.143 ± 1.215	137 ± 140	0.124	122.71 ± 4.192	115±127	0.015
	Diastolic	86.71 ± 2.059	84 ± 89	0.241	84.71±2.498	81 ± 89	0.006

Table 3. Systolic post hoc test

Treatment variable	n	P-value
0-1	7	1.00
0-2	7	0.149
0-3	7	0.02
1-2	7	0.149
1-3	7	0.034
2-3	7	0.01

To determine the average difference for each treatment, the post hoc test was continued. Based on the post hoc test, it shows that there are differences in groups (0-3) with a p-value of 0.02, (1-3) with a p-value of 0.034, and (2-3) with a p-value of 0.01.

Table 4. Post hoc gameshowell post diastolic test

Treatment variable	n	P-value
0-1	7	0.869
0-2	7	0.708
0-3	7	0.072
1-0	7	0.869
1-2	7	0.952
1-3	7	0.114
2-0	7	0.708
2-1	7	0.952
2-3	7	0.169
3-1	7	0.114
3-2	7	0.169

To determine the differences between each treatment, the gameshowell post hoc test was continued. Based on the Post hoc Gameshowl test, it shows that there are no significant differences between treatment groups (p-value > 0.05).

Table 5. Relationship between sodium and potassium intake and blood pressure

	Variable	N	r	p-velue
Sodium Intake	Systolic pre-treatment	28	0.131	0.507
	Diastolic pre-treatment	28	0.191	0.331
	Systolic post-treatment	28	0.442	0.018
	Diastolic post-treatment	28	0.107	0.588
Potassium Intake	Systolic pre-treatment	28	0.059	0.767
	Diastolic pre-treatment	28	0.298	0.123
	Systolic post-treatment	28	0.348	0.172
	Diastolic post-treatment	28	0.070	0.380

Based on Table 5, it shows that after carrying out the Spearmen rho sodium and potassium test, there is a significant influence of sodium intake on post-systolic blood pressure which is marked by 0.018. and there is no significant effect on systolic and post-diastolic potassium and sodium intake as indicated by a p-value <0.05.

3.2 Discussion

3.2.1 Blood pressure before being given "Semundu" juice with a combination of probiotics in pre-hypertensive patients

The data analysis in Table 2 shows the blood pressure of respondents before treatment: the control group had an average blood pressure of 137/86 mmHg, treatment group 1 had 140/84 mmHg, treatment group 2 had 139/85 mmHg, and treatment group 3 had 139/85 mmHg. According to the guidelines from the European Society of Hypertension-European Society of Cardiology (ESH-ESC) (2018), these values fall within the prehypertension category. Prehypertension is defined as a systolic blood pressure of 120–139 mmHg or a diastolic blood pressure of 80–89 mmHg. Individuals with prehypertension are at an increased risk of developing hypertension. For instance, a blood pressure reading of 110/85 mmHg or 130/79 mmHg would classify an individual as at risk for hypertension (Ramadhan *et al.*, 2024).

As people age, the likelihood of developing hypertension increases due to physiological changes such as increased peripheral resistance, heightened sympathetic nerve activity, and reduced elasticity of large blood vessels, leading to higher systolic blood pressure. After the age of 40, arterial walls thicken due to collagen buildup in the muscle layers, causing blood vessels to narrow and stiffen (Amanda & Martini, 2018).

To mitigate the risk of prehypertension, it is crucial to adopt a healthy lifestyle and consume appropriate foods. Age and lifestyle factors are significant contributors to prehypertension among respondents. Lifestyle modifications are necessary to lower the risk of progressing to hypertension, including adopting healthy eating habits, increasing physical activity, reducing alcohol consumption, and quitting smoking. Additionally, genetic factors, age, and gender also significantly influence the risk of developing this condition (Ramadhan *et al.*, 2024).

3.2.2 Blood pressure after being given "Semundu" juice with a combination of probiotics in pre-hypertensive patients

Table 2 illustrates a reduction in blood pressure following the administration of "Semundu" juice combined with probiotics. The average systolic blood pressure of pre-hypertension patients in the intervention group decreased by 11.43 mmHg, and diastolic blood pressure decreased by 2.38 mmHg. In contrast, the control group, which received only educational leaflets, showed a reduction in systolic blood pressure by 10.95 mmHg and diastolic blood pressure by 0.96 mmHg. Sodium and potassium intake of respondents in the P0, P1, P2, and P3 groups was monitored using 24-hour food recall three times over the seven-day intervention period, with blood pressure measurements taken twice (before and after the intervention). The observed decrease in blood pressure is attributed to the intervention rather than dietary changes.

The potassium content in cucumbers in "Semundu" juice can lower systolic and diastolic blood pressure by inhibiting renin release, thereby increasing the excretion of sodium and water. Renin catalyzes the conversion of angiotensinogen to angiotensin I (Japlely *et al.*, 2024). This is supported by Nurleli's (2020) research, which demonstrated the effectiveness of cucumber and watermelon juice in reducing blood pressure in elderly hypertensive patients. Similarly, Japlely *et al.* (2024) found that cucumber and watermelon juice effectively lowered both systolic and diastolic blood pressure in hypertension patients.

The reduction in blood pressure can be attributed to several components in watermelon, including vitamins A, B6, and C, potassium, lycopene, and flavonoids, which initiate reactions by activating arginine and stimulating optimal Human Growth Hormone (HGH) production. This promotes muscle health and minimizes fat accumulation in the body and blood vessels. This study builds on previous research, such as Umrah *et al.* (2022), which found that watermelon juice effectively lowers blood pressure in hypertensive patients as a non-pharmaceutical therapy. Pardede (2019) also reported a decrease in blood pressure following watermelon juice intervention.

In addition to watermelon, cucumber is a key ingredient in the juice. The potassium in cucumbers can reduce renin secretion, thereby inhibiting the Renin-Angiotensin System, which reduces the production of angiotensin I and II and subsequently decreases blood vessel vasoconstriction (Carolin *et al.*, 2023).

3.2.3 The Effect of Providing Leaflet Media Education and Providing Semundu Juice with a combination of probiotics on Blood Pressure

The results of the post hoc tests revealed significant differences among the treatment groups: group 0 versus group 3 (p-value = 0.02), group 1 versus group 3 (p-value = 0.034), and group 2 versus group 3 (p-value = 0.01), indicating that the intervention led to significant differences in blood pressure outcomes across the groups (see Table 3).

The treatment used in this study was informed by previous research, including Umrah et al. (2022), who demonstrated the effectiveness of watermelon juice in lowering blood pressure in hypertensive patients as a non-pharmaceutical therapy. This aligns with Pardede (2019), who also reported a reduction in blood pressure following watermelon juice intervention. The decrease in blood pressure is attributed to various components in watermelon, including vitamins A, B6, and C, potassium, lycopene, and flavonoids, which initiate reactions by activating arginine and stimulating optimal Human Growth Hormone (HGH) production, promoting muscle health and minimizing fat accumulation in the body and blood vessels.

Blood pressure decreased following the administration of "Semundu" juice combined with probiotics. The average systolic blood pressure of pre-hypertension patients in the intervention groups decreased as follows: control group (127/81 mmHg), treatment group 1 (127/82 mmHg), treatment group 2 (127/80 mmHg), and treatment group 3 (122/82 mmHg).

Analysis of 24-hour food recall data before and after the intervention showed no influence from the food consumed by respondents on sodium and potassium intake. However, the "Semundu" juice intervention did influence blood pressure. The Spearman rho test revealed a significant effect of sodium intake on post-intervention systolic blood pressure (p-value = 0.018), while there was no significant effect on post-intervention potassium and sodium intake, as indicated by a p-value < 0.05.

The potassium in cucumbers in "Semundu" juice can lower systolic and diastolic blood pressure by inhibiting renin release, which increases the excretion of sodium and water. Renin circulates in the blood and catalyzes the conversion of angiotensinogen to angiotensin I (Japlely *et al.*, 2024). This is supported by Nurleli (2020), who found that cucumber and watermelon juice effectively reduced blood pressure in elderly hypertensive patients, and by Japlely *et al.* (2024), who confirmed its efficacy in lowering both systolic and diastolic blood pressure in hypertensive individuals.

The Kruskal-Wallis test in this study showed a significant effect of the intervention on systolic blood pressure (p-value < 0.05) but no significant effect on diastolic blood pressure. Education plays a crucial role in increasing knowledge, both individually and in groups (Notoadmojo, 2014). Educational efforts include providing information, using media, and targeting specific educational goals (Khomsan, 2021). According to Supariasa (2014), nutrition education aims to improve nutritional status by modifying eating behaviors. The success of educational interventions depends on factors related to the extension, target audience, and the extension process.

3.2.4 The effect of giving semundu juice

The research findings on the use of Semundu juice across three treatments indicated the following: For treatment P1, analysis using the Kruskal-Wallis test revealed that both systolic and diastolic blood pressure showed significant differences post-treatment, with a p-value < 0.05. For treatment P2, the results showed a significant difference in systolic blood pressure (p-value = 0.017, which is < 0.05), but no significant difference in diastolic blood pressure (p-value = 0.066, which is > 0.05). In the P3 intervention group, both systolic and diastolic pressures exhibited significant differences after treatment, with a p-value of 0.03 (< 0.05).

Watermelon is considered an effective non-pharmacological therapy for hypertension, with 100 grams containing 112 mg of potassium, 10 mg of magnesium, 1 mg of sodium, and 7 mg of calcium. Cucumbers are also rich in potassium and magnesium. Potassium helps lower blood pressure by eliminating excess sodium in the blood, reducing the preload on the heart, while magnesium decreases the contractile strength of heart and skeletal muscles. Additionally, watermelon's high lycopene content offers antioxidant and diuretic effects, enhancing blood vessel flexibility and improving blood circulation (Sulung and Poluan, 2018).

The Semundu juice treatment also includes Ambon bananas. Research by Crisanto (2017) demonstrated that hypertensive individuals aged 60 who consumed one Ambon banana daily experienced a 10% reduction in blood pressure.

Yogurt and probiotics were incorporated into Semundu juice. According to Ayustaningwarno (2013), Lactobacillus casei in yogurt has a hypotensive effect, attributed to bioactive peptides produced from the breakdown of β-casein during fermentation. The most effective antihypertensive peptides are isoleucyl-prolyl-proline (IPP) and valyl-prolyl-proline (VPP), which inhibit the angiotensin-converting enzyme (ACE), leading to lower blood pressure. Probiotics can exert physiological effects when present in amounts of at least 106 cfu/g. Studies indicate that consuming 120 grams of yogurt daily significantly reduces systolic blood pressure within two weeks.

These findings, along with consistent results from prior research, suggest that Semundu juice can be a viable non-pharmacological alternative for lowering blood pressure, particularly when combined with lifestyle and dietary changes (Ayustaningwarno, 2013).

3.2.5 Relationship between potassium and sodium intake on blood pressure

In this study, the respondents' sodium and potassium intake was monitored using a 24-hour food recall conducted three times during the intervention. Table 4.7 shows that the Spearman rho test revealed a significant relationship between sodium intake and post-systolic blood pressure, with a p-value of 0.018. However, no significant relationship was found between sodium and potassium intake and post-systolic and diastolic blood pressure, indicated by a p-value of 0.17 (>0.05). These findings align with Nova et al. (2013), which identified relationships between fat intake, sodium intake, physical activity, and the incidence of hypertension. The observed difference in sodium levels is likely due to the administration of Semundu juice.

Sodium intake plays a critical role in the mechanism of increasing blood pressure by increasing plasma volume. Consuming salt (sodium) triggers thirst, leading to increased fluid intake, thereby elevating blood volume and forcing the heart to pump more vigorously, which raises blood pressure. Frequent consumption of high-salt foods, cholesterol-rich foods, seasonings (MSG), and dairy products can trigger hypertension (Astuti, 2017). High-salt and high-fat foods contribute to peripheral resistance and elevated blood pressure (CDCP, 2021).

Sodium (NaCl) is essential in regulating blood volume and pressure, muscle contractions, nerve cell transmission, and maintaining water, electrolyte balance, and the body's acid-alkaline levels. Excessive sodium intake leads to hypertonic conditions where water retention occurs, increasing blood volume (Whelton *et al.*, 2017).

The study also investigated potassium intake, which showed no significant relationship with systolic blood pressure (>0.05). This absence of a relationship could be due to insufficient potassium intake or methodological issues such as brief recall interviews, inadequate probing, and respondent memory factors.

Potassium, present in Semundu juice ingredients, should affect blood pressure when consumed in appropriate amounts. Potassium reduces renin secretion, inhibiting the Renin-Angiotensin System, which decreases angiotensin I and II levels, thereby reducing blood vessel vasoconstriction. This mechanism decreases sodium and water reabsorption in the kidneys, increases diuresis, and ultimately lowers blood pressure (Carolin *et al.*, 2023).

4. Conclusion

Before treatment, systolic blood pressure ranged from 134 mmHg to 145 mmHg, and diastolic blood pressure ranged from 82 mmHg to 90 mmHg. After treatment, systolic blood pressure ranged from 115 mmHg to 145 mmHg, and diastolic blood pressure ranged from 78 mmHg to 90 mmHg. There was no significant influence on systolic or diastolic blood pressure before treatment. However, after treatment, there was a significant reduction in both systolic and diastolic blood pressure, indicating that "semundu" juice effectively lowers blood pressure. Based on these findings, it is recommended that respondents educate themselves about hypertension and participate in educational activities about hypertension, as well as adopt a healthy lifestyle.

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