The effect of *Dayak* onion brewed water in reducing blood pressure and mean arterial pressure (MAP) in hypertensive patients

Diah Setiani, Rahmawati Shoufiah, Hesti Prawita Widiastuti, Indah Nur Imamah, Rivan Firdaus, Frana Andrianur

Department of Nursing, East Kalimantan Ministry of Health Polytechnic, Samarinda, Indonesia

Correspondence: Diah Setiani, Department of Nursing, East Kalimantan Ministry of Health Polytechnic, Samarinda, Indonesia.
E-mail: diah.dee.oc@gmail.com

Key words: allicin; blood pressure; *Dayak* onion; hypertension; MAP.

Contributions: DS, conceptualization, data curation, formal analysis, methodology, validation, visualization, writing – original draft, review & editing; final approval of the version to be published funding acquisition. RS, conceptualization, investigation, methodology, validation, and writing – original draft, review & editing; HPW, conceptualization, methodology, formal analysis, validation, and writing – original draft, review & editing; ini, methodology, visualization, writing – review & editing; SS resources, investigation, and writing –review & editing; RF, formal analysis, validation, writing – review & editing; FA, resources, investigation, and writing –review & editing.

Conflict of interest: the authors declare no conflict of interest.

Ethics approval and consent to participate: the research has received ethical approval from the Health Research Ethics Commission, Poltekkes Kemenkes Kalimantan Timur, based on ethical certificate No. LB.02.01/7.1/3320/2022. During the research, the researcher pays attention to the ethical principles of information to consent, respect for human rights, beneficence, and non-maleficence.

Patient consent for publication: written informed consent was obtained for anonymized patient information to be published in this article.

Funding: this research did not receive external funding.

Availability of data and materials: all data generated or analyzed during this study are included in this published article.

Received: 12 September 2023.
Accepted: 6 November 2023.
Early access: 21 November 2023.

This work is licensed under a Creative Commons Attribution 4.0 License (by-nc 4.0).

©Copyright: the Author(s), 2023
Licensee PAGEPress, Italy
Healthcare in Low-resource Settings 2023; 11:11776
doi:10.4081/hls.2023.11776

Publisher's note: all claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article or claim that may be made by its manufacturer is not guaranteed or endorsed by the publisher.

Abstract

The World Health Organization (WHO) estimated that 1.28 billion adults aged 30-79 years worldwide suffered from hypertension. *Dayak* onion is an herbal plant found in Indonesia, particularly in Kalimantan and traditionally used to treat hypertension. The purpose of this study was to determine the effect of *Dayak* onion steeping water on the reduction of systolic-diastolic blood pressure and mean arterial pressure (MAP) in hypertensive patients. This study employed a quasi-experimental research design with a time series approach, utilizing a pre-post-test design with a control group. The sample included two groups (intervention and control), totaling 30 participants. The independent variable was the steeping of *Dayak* onion bulbs, while the dependent variables were blood pressure values and MAP. The instruments used were Standard Operating Procedures (SPO) *Dayak* onion herb, SPO blood pressure measurement, SPO calculation of MAP, and a digital sphygmomanometer. Data analysis was performed using paired t-tests. The results of the paired t-test statistical analysis of systolic-diastolic values and MAP in each group revealed significant findings. In the intervention group, a significant result was obtained in the pre-post test difference test, with a $p<0.05$ from day 1 to day 3 assessments. This suggests that *Dayak* onion steeping water had an effect on systolic-diastolic and MAP values in the intervention group. In contrast, the pre-post test in the control group yielded a $p<0.05$ for systolic values on days 2 and 3, diastolic values on days 1 and 3, and MAP values on days 1, 2, and 3. This indicates differences in systolic-diastolic and MAP values in the pre-post assessments, although these differences were not evenly distributed across every day. The study found that *Dayak* onion steeping water had an effect on systolic-diastolic and MAP values in the intervention group. Thus, the use of *Dayak* onion steeping water, containing allicin, can be considered an approach for controlling hypertension in the realm of complementary and alternative medicine, utilizing natural ingredients for herbal therapy.

Introduction

An estimated 1.28 billion adults aged 30-79 years worldwide suffer from hypertension, with the majority (two-thirds) residing in low- and middle-income countries. Approximately 46% of adults with hypertension are unaware of their condition, and less than half (42%) receive a diagnosis and treatment. Only about 1 in 5 adults (21%) with hypertension have their blood pressure under control. Hypertension, often referred to as the silent killer, can wreak havoc if left uncontrolled, targeting vital organs and leading to heart attacks, strokes, kidney disorders, and even blindness.[1] Hypertension induces endothelial dysfunction, exacerbates the atherosclerotic process, and contributes to the instability of

Non-commercial use only

atherosclerotic plaques. While hypertension is typically asymptomatic and can go unnoticed, some patients may report symptoms such as dizziness, headaches, nosebleeds, chest pain, and palpitations.[2–4] Hypertension stands as the leading cause of premature death worldwide, and one of the global targets for non-communicable diseases is to reduce its prevalence by 33% between 2010 and 2030.[5] Hypertension is more prevalent among men, older adults, and those who are overweight or obese. In Indonesia, the prevalence of hypertension rose from 25.8% in 2013 to 34.1% in 2018. In 2018, the number of individuals with hypertension in Indonesia reached 63.3 million, accounting for 34.11% of the population. The hypertension rate in Indonesia reached 63.3 million, 34.11% of the population, in 2018.[6] In East Kalimantan Province, the prevalence of hypertension per district, based on a doctor's diagnosis in the population aged over 18 years, according to Riskesdas data from 2018, shows the following statistics for hypertension sufferers: Paser Regency 9.70%, West Kutai Regency 11.33%, Kutai Kartanegara Regency 10.14%, East Kutai Regency 8.12%, Berau Regency 9.75%, North Penajam Paser Regency 8.49%, Mahakam Ulu Regency 13.77%, Balikpapan City 12.66%, Samarinda City 11.19%, Bontang City 9.23%. West Kutai Regency, based on Riskesdas 2018 data, has the highest prevalence of hypertension per district in East Kalimantan. Notably, in Barong Tongkok District, the incidence of hypertension is relatively high, with data from the Barong Tongkok Health Center indicating that, as of October 2021, 561 people, comprising 190 men and 371 women in the age group of 15-59 years, have been diagnosed with hypertension.[7]

Hypertension, defined as persistent systolic blood pressure (SBP) of at least 130 mm Hg or diastolic blood pressure (DBP) of at least 80 mm Hg,[8] affects approximately 116 million adults in the US and more than 1 billion adults worldwide. It is associated with an increased risk of cardiovascular disease (CVD) events, including coronary heart disease, heart failure, and stroke, as well as a higher risk of mortality.[9,10] The global prevalence of hypertension poses a significant public health challenge due to the frequency of the condition and its associated risks of cardiovascular and kidney diseases. The treatment of hypertension includes both pharmacological and non-pharmacological approaches. Pharmacological therapy involves various classes of drugs, such as angiotensin-converting enzyme inhibitors, calcium channel blockers, diuretics, beta-blockers, alpha-blockers, and angiotensin II and insulin receptor antagonists. Non-pharmacological therapy focuses on implementing a healthy lifestyle. Antihypertensive treatment aims to prevent the onset of related diseases by effectively controlling high blood pressure.[11] Antihypertensive treatment aims to prevent these diseases by controlling high blood pressure.[12] The availability, cost, and adverse effects of conventional hypertension medications limit effective treatment. Due to these limitations, some patients, particularly in developing countries, turn to complementary and alternative medicine for treatment.[13] Effective management of hypertensive patients is a crucial strategy to prevent the increase in morbidity and mortalit.[14] Unfortunately, there is a lack of recommendations for complementary therapy in hypertension treatment guidelines.[15] It is well-known that many hypertensive patients seek complementary and alternative medicine.[16] Complementary and alternative medicine therapies are typically divided into four main domains. They involve the utilization of natural compounds like probiotics, prebiotics, and dietary supplements to strengthen and promote healing in the human body. In this context,[17] natural compounds contained in plants, such as herbs, play a significant role. Natural plant products have been employed throughout human history for various purposes. Today, herbal products are used to address a wide range of health issues and conditions, including allergies, arthritis, migraines, fatigue, wound healing, burns, digestive problems, skin infections, genetic disorders, and even cancer.[18]

Complementary and alternative medicine therapies are typically divided into four main domains. They involve the utilization of natural compounds like probiotics, prebiotics, and dietary supplements to strengthen and promote healing in the human body. In this context, natural compounds contained in plants, such as herbs, play a significant role. Natural plant products have been employed throughout human history for various purposes. Today, herbal products are used to address a wide range of health issues and conditions, including allergies, arthritis, migraines, fatigue, wound healing, burns, digestive problems, skin infections, genetic disorders, and even cancer.[19]

Dayak onion plants are commonly found in Kalimantan, particularly in East Kalimantan, within the West Kutai Regency. The most frequently used part of this plant is its tubers. This plant contains a wide array of phytochemical compounds, including alkaloids, glycosides, flavonoids, phenolics, and steroids. Through the isolation of compounds from *Dayak* onion bulbs, 15 compounds were identified, including (2S) dihydroeleuterinol-8-O-α-D-glucopyranosida, dihydroeleuterinol, eleuterinol, eleuterinosidaA, (-)-hongkonin, eleuterin, isoeleuterin, (2S) dihydroeleuterinol-8-O-α-D-glucopyranosida, dihydroeleuterinol, eleuterinol, eleuterinosidaA, (-)-hongkonin, eleuterin, isoeleuterin, eleutocidaC, eleuterinosidaC, eleuterinosidaB, THE-7-acetyl-3,6-dihydroxy-8-methyltetralon, leutocideA, leutocideB, and eleuterinosideD. Among these compounds, eleuterol, eleuterin, and isoeleuterin have demonstrated potential as antihypertensive agents.[20]

According to a study conducted by Swandari & Nuryanto in 2018 on the anti-inflammatory activity of EC50 Results, E. Bulbosa extract exhibited potential anti-inflammatory properties, with effectiveness nearly equaling half the concentration of indomethacin. Other studies have supported this finding, indicating that components in *Dayak* onion extract, specifically eleutherine and isoeleutherine, displayed anti-inflammatory activity by inhibiting carrageenan-induced leg edema. The mechanism of action for E. Bulbosa extract's anti-inflammatory effects is believed to be related to its flavonoid content. One significant mechanism for anti-inflammatory activity involves the inhibition of enzymes that produce eicosanoids (phospholipase A2, cyclooxygenase, and lipoxygenase), leading to reduced levels of prostanoids and leukotrienes. Other potential anti-inflammatory mechanisms may include the inhibition of histamine release, phosphodiesterase, protein kinase, and transcriptase activation.[21]

Based on several empirical reviews regarding the efficacy and compounds found in *Dayak* onions, researchers have become interested in understanding the impact of steeping *Dayak* onions on reducing blood pressure and mean arterial pressure in hypertensive patients. This study serves as a means of exploring complementary therapies and alternative medicine, employing natural ingredients rooted in the local wisdom of Kalimantan for herbal therapy management. The purpose of this study was to determine the effect of Dayak onion steeping water on the reduction of systolic-diastolic blood pressure and mean arterial pressure (MAP) in hypertensive patients.

Materials and Methods

The research design used was a Quasi-Experimental approach

OPEN ACCESS

with a time series method and a pre-post-test design that included a control group. The sample consisted of two groups, the intervention and control groups, each comprising 30 participants. The inclusion criteria for the sample were respondents aged 35-59 years, not currently taking antihypertensive drugs, and not experiencing crisis conditions or hypertensive emergencies. In this study, the independent variable was the steeping of *Dayak* onion bulbs, while the dependent variables were systolic, diastolic, and mean arterial pressure (MAP) values. The instruments utilized included standard operating procedures (SPO) for the preparation of *Dayak* onion ingredients in the intervention group, SPO for blood pressure measurements, and SPO for calculating MAP. Digital sphygmomanometers were used for blood pressure measurements. Data analysis for this study was conducted using paired t-tests. The research received ethical approval from the Health Research Ethics Commission at Poltekkes Kemenkes Kalimantan Timur, based on ethical certificate No. LB.02.01/7.1/3320/2022. Throughout the research, the researcher adhered to ethical principles such as obtaining informed consent, respecting human rights, promoting beneficence, and ensuring non-maleficence.

Results

Characteristics of respondents

Table 1 shows that in the intervention group, the majority of respondents were aged 36-45 years, comprising 8 people (53.3%), whereas in the control group, most fell into the 46-55 age range, totaling 12 people (66.7%). As for gender, the majority in both groups were women; in the intervention group, there were 10 people (66.7%), and in the control group, there were 8 people (44.4%). Concerning the history of hypertension drug usage, the majority in the intervention group took captopril, accounting for 9 people (60.0%), while in the control group, almost all used amlodipine, with 14 people (77.8%).

Table 2. shows that systolic-diastolic blood pressure in the intervention group decreased. This is evident in the systolic mean of the intervention group on day 1, where the pre-post values were (163.33-154.27). After the administration of *Dayak* onion steeping water as an intervention, the systolic mean on day 3 also decreased, with pre-post values of (142.93-139.80). Similarly, the diastolic values of respondents decreased after they were given *Dayak* onion steeping water, with a mean pre-post change from (116.87-101.73) on day 1, and on day 3, the change was from (89.93-

Table 1. Characteristics of respondents.

Characteristics of respondents	Intervention group		Control group	
	Frequency	%	Frequency	%
Age				
36-45 years	8	53.3	3	16.7
46-55 years old	7	38.9	12	66.7
Gender				
Man	5	33.3	7	38.9
Woman	10	66.7	8	44.4
History of antihypertensive drugs taken				
Amlodipine	6	40.0	14	77.8
Captopril	9	60.0	1	5.6
Total	15	100	15	100

Table 2. Blood pressure: systolic and diastolic, and MAP in both groups (intervention and control).

Day	Measurement	Variable	Intervention group				Control group			
			Min	Max	Mean	SD	Min	Max	Mean	SD
1	Pre	Systolic	153	173	163.33	5.108	155	173	164.07	4.773
		Diastolic	104	127	116.87	7.661	102	124	112.93	6.552
		MAP	211	236	221.77	6.695	207	235	220.53	7.267
	Post	Systolic	144	164	154.27	5.175	145	160	154.60	3.719
		Diastolic	90	114	101.73	7.196	90	119	103.13	6.770
		MAP	191	220	205.13	7.413	195	215	206.37	4.835
2	Pre	Systolic	140	161	150.27	5.861	143	156	151.73	3.195
		Diastolic	88	110	96.27	6.029	83	102	93.67	5.434
		MAP	191	220	205.13	7.531	191	205	198.57	4.590
	Post	Systolic	138	153	145.47	4.207	139	150	145.07	3.615
		Diastolic	85	103	92.00	4.472	80	92	85.80	3.448
		MAP	185	213	198.40	5.377	181	195	187.97	4.704
3	Pre	Systolic	137	150	142.93	3.936	137	146	142.13	3.067
		Diastolic	84	99	89.93	3.788	81	88	83.73	2.120
		MAP	180	196	187.90	4.789	179	189	184.00	3.665
	Post	Systolic	135	145	139.80	3.121	134	140	136.47	1.846
		Diastolic	82	93	86.73	3.515	78	84	80.80	1.424
		MAP	176	189	183.17	3.488	174	180	176.93	1.954

Non-commercial use only

86.73). Regarding the MAP value, the intervention group also experienced a decrease after receiving the intervention of *Dayak* onion steeping water. The mean MAP on day 1 changed from (221.77-205.13) pre-post, and after the intervention, the mean MAP on day 3 changed from (187.90-183.17).

It's worth noting that systolic-diastolic blood pressure in the control group also decreased. This is evident in the systolic mean on day 1, where the pre-post values were (164.07-154.60), and on day 3, the values were (142.13-136.47). Similarly, the diastolic values changed, with the mean pre-post values being (112.93-103.13) on day 1, and on day 3, the values were (83.73-80.80). The MAP values of respondents in the control group also showed a decrease. The mean MAP on day 1 had pre-post values of (220.53-206.37), and on day 3, the values were (184.00-176.93).

Table 3. Based the results of paired t-test statistical tests on systolic-diastolic values and MAP in the pre-post test intervention group. A p-value of 0.000 ($\alpha<0.05$) was obtained, which was observed from day 1 to day 3. This indicates that there are significant differences in systolic-diastolic values and MAP before and after the intervention in the intervention group.

Similarly, the paired t-test statistical test results for systolic, diastolic, and MAP values in the pre-post test control group yielded a p-value of $< \alpha$ (0.05) for systolic values on days 2 and 3, diastolic values on days 1 and 3, and MAP values on days 1, 2, and 3. This also indicates significant differences, reflecting a notable decrease in systolic-diastolic values and MAP in the control group. However, the decline in values was not evenly distributed on days 1, 2, or 3. In contrast to the intervention group, which experienced a consistent decrease in values on days 1, 2, and 3, it becomes evident that there is an effect of *Dayak* onion steeping water (Eleutherine Palmifolia) on systolic-diastolic and MAP values in the intervention group.

Discussion

The results of paired t-tests on systolic-diastolic values and MAP for each group displayed significant outcomes. In the intervention group, a significant result was obtained in the pre-post test difference analysis, with a p-value of < 0.05 from day 1 to the day 3 assessment. This indicates that there was an effect of *Dayak* onion steeping water on systolic-diastolic and MAP values in the intervention group.

In the pre-post test for the control group, significant $p<0.05$ were obtained for systolic values on days 2 and 3, diastolic values on days 1 and 3, and MAP values on days 1, 2, and 3. This indicates that there are differences in systolic-diastolic values and MAP in the pre-post values, although these differences are not evenly distributed every day.

Dayak onion bulbs contain active compounds that are potent in combating various diseases, including their effectiveness as antihypertensive agents. These active compounds belong to the triterpenoid group, quinones, and naphthoquinones, along with the presence of allicin and alkaloids.[22] Allicin is believed to reduce blood viscosity, thereby leading to a reduction in blood pressure.[23] This plant contains nearly all phytochemical content, including alkaloids, glycosides, flavonoids, phenolics, and steroids. Through the isolation of compounds from *Dayak* onion bulbs, 15 compounds were identified, namely (2S) dihydroeleuterinol-8-O-α-D-glucopyranosida, dihydroeleuterinol, eleuterinol, eleuterinosidaA, (-)-hongkonin, eleuterin, isoeleuterin, (2S) dihydroeleuterinol-8-O-α-D-glucopyranosida, dihydroeleuterinol, eleuterinol, eleuterinosidaA, (-)-hongkonin, eleuterin, isoeleuterin, eleutocidaC, eleuterinosidaC, eleuterinosidaB, THE-7-acetyl-3,6-dihydroxy-8-methyltetralon, leutocideA, leutocideB, and eleuterinosideD.[20] The activity of eleuterol, eleuterin, and isoeleuterin has the potential to act as antihypertensive agents.[24] *Dayak* onion tea has an effect on reducing blood pressure in hypertensive patients, with a p-value of 0.001 for systolic value and a p-value of 0.002 for diastolic value. In other words, *Dayak* onion tea has an impact on blood pressure.[25] The administration of 100% *Dayak* onion tea resulted in a significant decrease in high blood pressure. The analysis yielded a p-value of 0.000 ($p < 0.05$) for the respondents' blood pressure, indicating that *Dayak* onion tea has a noticeable effect on reducing blood pressure in the elderly.[26]

Particularly in allicin compounds, they exhibit vasodilator activity independent of nitric oxide synthesis, ATP-sensitive K(+) channels, activation of cyclooxygenase enzymes, or changes in bronchomotor tone in rat pulmonary blood vessels. Allicin is also believed to inhibit the renin-angiotensin system, which plays a crucial role in renovascular hypertension. This reduction in blood pressure occurs through the inhibition of angiotensin conversion enzyme (ACE) activity, while simultaneously enhancing the vasodilator effect. This decrease in ACE activity is observed in serum, aorta, heart, lungs, and kidneys.

Treatment with allicin results in decreased hypertension, improved kidney function, and reduced heart dysfunction. Allicin compounds reduce vascular reactivity to angiotensin II, AT1R overexpression, and morphometric parameters. Allicin also downregulates Keap1 and upregulates Nrf2 expression, leading to an increase in antioxidant enzymes and a reduction in oxidative stress. Therefore, allicin demonstrates antihypertensive, nephroprotective, cardioprotective,[27] and antioxidant effects through the downregulation of AT1R and Keap1 expression.[28] Simple extraction

Table 3. Blood pressure difference test: systolic and diastolic, MAP in both groups (intervention and control).

			Intervention group			Control group		
Day	Measurement	Variable	Mean	SD	p	Mean	SD	p
1	Pre -post	Systolic	9.067	2.789	0.000	9.467	4.596	0.104
		Diastolic	15.133	5.768	0.004	9.800	5.979	0.019
		MAP	16.633	4.608	0.000	14.167	6.307	0.048
2	Pre -post	Systolic	4.800	2.484	0.000	6.667	2.664	0.004
		Diastolic	4.267	2.187	0.000	7.867	5.343	0.210
		MAP	6.933	3.035	0.000	10.600	2.836	0.000
3	Pre -post	Systolic	3.133	1.356	0.000	5.667	2.225	0.004
		Diastolic	2.867	2.356	0.000	2.933	1.100	0.000
		MAP	4.733	1.954	0.000	7.067	2.456	0.001

OPEN ACCESS

methods of natural ingredients, such as onions containing allicin,[29] can reduce systolic and diastolic blood pressure.[30]

Allicin has a potent antihypertensive effect, and this effect is associated with its vasodilatory properties and the H2S mechanism. The vasorelaxant activities of allicin are, in part, dependent on the endothelium. Endothelium-dependent vasorelaxation by allicin is mediated by the NO-sGC-cGMP, PGI2-AC-cAMP, and EDHF pathways, with H2S production playing a role in the first two pathways, rather than the third one. Meanwhile, endothelium-independent vasodilation is primarily attributed to H2S production. Therefore, the current study suggests that allicin might serve as an alternative agent for reducing the incidence of cardiovascular disorders in the hypertensive population.[31] The effects of allicin, both direct and indirect through cytokine activation, can increase the quantity and proliferation of EPCs. This effect of allicin on EPC proliferation might explain the improvements in cardiovascular disease.[32]

Garlic and *Dayak* onions both contain various active components. The biological functions of garlic include antioxidant activity, anti-inflammatory activity, antimicrobial activity, immune system modulation, cardiovascular protection, antihypertensive activity, anti-hyperlipidemia activity, heart protection, other cardiovascular protective effects, anticancer activity, hepatoprotective activity, digestive system protection, anti-diabetic activity, anti-obesity activity, and renal protection.[33]

Providing hypertensive patients with *Dayak* onion bulb steeping water can reduce systolic-diastolic and MAP values. The simple extraction of *Dayak* onion bulbs through steeping in hot water makes it easier for patients to consume the active compounds they contain. Specifically, allicin, the active compound in *Dayak* onions, has a vascular vasodilator effect that can inhibit the renin-angiotensin system, which plays a role in raising blood pressure. Therefore, the provision of *Dayak* onion steeping water to hypertensive patients can serve as a management approach in the domain of both complementary and alternative medicine for controlling hypertension through the use of natural ingredients in herbal therapy.

Conclusions

The results of statistical tests in the intervention group yielded significant values in the measurement of blood pressure values, including systolic-diastolic and MAP, on days 1 to 3. This indicates that there was an effect of Dayak onion steeping water on systolic-diastolic and MAP values in the intervention group. Therefore, providing Dayak onion steeping water to hypertensive patients can be employed as a management approach in the realm of both complementary and alternative medicine for ayakllingg hypertension through the use of natural ingredients as herbal therapies.

References

1. Israfil I, Kusnanto K, Yusuf A, Efendi F. The effect of health education intervention through mobile phone on hypertension patients: A systematic review. Med J Malaysia 2022;77:232-6.
2. Kalish LA, Buczynski B, Connell P, et al. Stop Hypertension with the Acupuncture Research Program (SHARP): Clinical trial design and screening results. Control Clin Trials 2004;25:76-103.
3. Makhfudli, Susanto J, Sairozi A, Ubudiyah M. Determinants of Hypertension in Outpatients in East Java, Indonesia. J Pak Med Assoc 2023;73:S113-7.
4. Escobar E. Hypertension and coronary heart disease. J Hum Hypertens 2002;16:S61-3.
5. WHO. Hypertension. WHO. 2023 Available from: https://www.who.int/news-room/fact-sheets/detail/ hypertension
6. Kusumaningrum T, Pratiwi IN, Wahyu N, et al. Factors associated with hypertension in women of childbearing age. The 13th International Nursing Conference 2021;73:109-12.
7. Kementerian Kesehatan RI Badan Penelitian dan Pengembangan Kesehatan. Hasil Utama RISKESDAS 2018. https://kesmas.kemkes.go.id/assets/upload/dir_519d41d8cd98f00/files/Hasil-riskesdas-2018_1274.pdf. 2018.
8. WHO. Hypertension. 2023 [cited 2023 Oct 30]. Available from: https://www.who.int/news-room/fact-sheets/detail/hypertension
9. Carey RM, Moran AE, Whelton PK. Treatment of Hypertension: A Review. JAMA 2022;328:1849-61.
10. Purnawan IN, Widati S, Wahyuni CU. A cross-sectional study: a hypertension screening model using digital tensimeter as the gold standard at public health centre in GianyarRegency, Bali Province, Indonesia. J Public Health Afr 2023;14:1-5.
11. Pristianty L, Priyandani Y, Rahem A. The correlation between knowledge, attitude and family support on compliance of outpatients with hypertension in a healthcare centre in Indonesia. Pharm Educ 2023;23:25-30.
12. Wijaya IN, Athiyah U, Fasich, et al. The association between drug therapy problems and blood pressure control of patients with hypertension in public health center setting. J Public Health Afr 2023;14:137-40.
13. Ali-Shtayeh MS, Jamous RM, Jamous RM, Salameh NMY. Complementary and alternative medicine (CAM) use among hypertensive patients in Palestine. Complement Ther Clin Pract 2013;19:256-63.
14. Afik A, Fikriana R. Self-care Experience in Hypertensive Patients. Bali Med J 2021;10:1398-402.
15. Pristianty L, Hingis ES, Priyandani Y, Rahem A. Relationship between knowledge and adherence to hypertension treatment. J Public Health Afr 2023;14:2502.
16. Ng JY, Gilotra K. Complementary medicine mention and recommendations are limited across hypertension guidelines: A systematic review. Complement Ther Med 2020;50:102374.
17. Hass DJ. Complementary and Alternative Medicine. In: Sleisenger and Fordtran's Gastrointestinal and Liver Disease. Elsevier; 2010. P. 2287-2299.e3.
18. Dada R, Sabharwal P, Sharma A, Henkel R. Use of herbal medicine as primary or supplementary treatments. In: Herbal Medicine in Andrology. Elsevier; 2021. P. 9-15.
19. Kamarudin AA, Sayuti NH, Saad N, Razak NAAb, Esa Nmohd. Eleutherine bulbosa (Mill.) Urb. Bulb: Review of the Pharmacological Activities and Its Prospects for Application. Int J Mol Sci 2021;22:6747.
20. Prayitno B, Mukti BH, Lagiono. Optimasi Potensi Bawang Dayak (Eleutherine Sp.) Sebagai Bahan Obat Alternatif. Jurnal Pendidikan Hayati 2018;3:149-58.
21. Swandari Paramita, Muhammad Khairul Nuryanto. Anti-inflammatory activity of bawang ayak (eleutherine bulbosa (mill. Urb.))Ethanol bulb extracts. J Vocat Health Stud 2018;51-5.
22. Chan JYY, Yuen ACY, Chan RYK, Chan SW. A Review of the Cardiovascular Benefits and Antioxidant Properties of Allicin. Phytother Res 2013;27:637-46.

Non-commercial use only

23. Utami P, Mardiana L, Penulis PS T. Umbi Ajaib: Tumpas Penyakit. Nugroho S, Kusumaningtiyas P, W. B, P, editors. Jakarta: Penerbar Swadaya; 2013.
24. Lidiková J, Čeryová N, Tóth T, et al. Garlic (Allium sativum L.): Characterization of Bioactive Compounds and Related Health Benefits. In: Herbs and Spices - New Advances. IntechOpen; 2023.
25. Handayani S, Dewantari EM, My C, Fitria N, Kesehatan FI. Pengaruh Pemberian The Bawang Dayak Terhadap Penurunan Tekanan Darah Pada Penderita Hipertensi. Jurnal Perawat Indonesia 2021;5:724-30.
26. Tetty Junita Purba. Pengaruh Pemberian The Bawang Dayak Terhadap Penurunan Hipertensi Pada Lansia. BEST J 2021;5:393-8.
27. Salehi B, Zucca P, Orhan IE, et al. Allicin and health: A comprehensive review. Trends Food Sci Technol 2019;86:502-16.
28. García-Trejo EMA, Arellano-Buendía AS, Argüello-García R, et al. Effects of Allicin on Hypertension and Cardiac Function in Chronic Kidney Disease. Oxid Med Cell Longev 2016;2016:1-13.
29. Bhardwaj K, Verma M, Verma N, et al. Effect of long term supplementation of active garlic allicin in reducing blood pressure in hypertensive subjects. Int J Adv Med 2015;231-4.
30. Chan JYY, Tsui HT, Chung IYM, et al. Allicin protects rat cardiomyoblasts (H9c2 cells) from hydrogen peroxide-induced oxidative injury through inhibiting the generation of intracellular reactive oxygen species. Int J Food Sci Nutr 2014;65:868-73.
31. Cui T, Liu W, Chen S, et al. Antihypertensive effects of allicin on spontaneously hypertensive rats via vasorelaxation and hydrogen sulfide mechanisms. Biomed Pharmacother 2020;128:110240.
32. Putri AY, Pikir BS, Oktaviono YH, Alzahra F. Effects of Garlic Extract (allicin) on Proliferation of Endothelial Progenitor Cells (EPC) in Patients with Stable Coronary Artery Disease. In: IOP Conference Series: Earth and Environmental Science. 2020.
33. Shang A, Cao SY, Xu XY, et al. Bioactive Compounds and Biological Functions of Garlic (Allium sativum L.). Foods 2019;8:246.

Non-commercial use only