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Effectiveness of Antioxidant Compounds in Minaserua Herbal Drink from Bima as a Functional Food on Blood Pressure and Cholesterol Levels

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Abstract

Hypertension and hypercholesterolemia are major risk factors for degenerative diseases with increasing prevalence. Minaserua, a traditional herbal drink from Bima made from black glutinous rice, ginger, turmeric, clove, Javanese chili, black pepper, palm sugar, and coconut milk, is rich in bioactive compounds and potentially reduces blood pressure and cholesterol levels. This study employed a pre-post control group design. Participants were divided into an experimental group, receiving Minaserua daily for 2–4 weeks, and a control group, receiving no intervention. Blood pressure and cholesterol levels were measured before and after the intervention. Antioxidant activity was analyzed using the DPPH spectrophotometric method. Statistical analysis was performed using paired t-tests and independent t-tests. Minaserua exhibited strong antioxidant activity with an IC-50 of 41.30 mg/ml. The experimental group showed significant reductions in total cholesterol, LDL, triglycerides, and significant increases in HDL ($p < 0.05$), along with significant decreases in systolic and diastolic blood pressure ($p < 0.05$). The control group showed no significant changes, except for a marginal increase in HDL. Minaserua herbal drink effectively improves lipid profiles and lowers blood pressure, supporting its potential as a functional food for preventing hypertension and hypercholesterolemia.

Keywords: Minaserua; antioxidant; functional food; blood pressure; cholesterol.

Abbreviation: ACE: Angiotensin-Converting Enzyme, AOAC: Association of Official Analytical Chemists, DPPH: 2,2-Diphenyl-1-Picrylhydrazyl, HDL: High-Density Lipoprotein, IC_{50}: Half Maximal Inhibitory Concentration, LDL: Low-Density Lipoprotein, NO: Nitric Oxide, TG: Triglyceride.

INTRODUCTION

Cardiovascular disease remains a leading cause of global morbidity and mortality, with hypertension and dyslipidemia (including high cholesterol) as key risk factors. Hypertension is defined as systolic blood pressure exceeding 140 mmHg and diastolic blood pressure exceeding 90 mmHg (Peltzer & Pengpid, 2018). According to data from the 2023 Indonesian Health Survey (SKI), the prevalence of hypertension in the population aged 18 years and older in Indonesia is 30.8% (Kemenkes RI, 2024). Meanwhile, hypercholesterolemia is a lipid metabolism disorder characterized by elevated total blood cholesterol levels, exceeding the standard limit of 240 milligrams per deciliter (mg/dL). Cholesterol in the blood is carried by lipoproteins, which are divided into three classes: Low-Density Lipoprotein (LDL), High-Density Lipoprotein (HDL), and Triglycerides (TG). The prevalence of cholesterol worldwide is around 45%, in Southeast Asia, around 30%, and in Indonesia, 35% (Maramy et al., 2024). If not properly managed, both conditions can lead to serious complications such as coronary heart disease, stroke, and kidney failure (Law *et al*., 2023).

Preventive approaches through functional foods are gaining increasing attention due to the potential of bioactive plant compounds to reduce oxidative stress and improve lipid profiles and vascular function. Recent meta-studies and reviews suggest that the mixture of phytochemicals (phenolics, flavonoids, and other compounds) in herbal ingredients may contribute to lowering blood pressure and improving lipid parameters (Maramy et al., 2024). Minasarua (often written as "Mina Sarua") is a traditional drink of the Mbojo people (Bima, West Nusa Tenggara) made from a combination of sticky rice tape (tape ketan/black sticky rice), spices such as ginger, turmeric, pepper, cinnamon, cloves, and brown sugar (blondo). The use of these spices is traditionally believed to have a warming effect and promote well-being; the spice composition is also reported to be rich in

antioxidants, which supports the drink's potential as a functional food. Several studies have examined Minasarua formulations, demonstrating compositional variability and a relationship between composition and antioxidant activity (Verawati *et al*., 2023).

Research on Minasarua formulation and optimization suggests that the ratio and combination of spices (ginger, turmeric, Javanese chili, pepper, black sticky rice tape, and blondo) influence Minasarua's total phenols, total flavonoids, anthocyanins, and antioxidant activity. Several optimization studies have reported increased antioxidant activity after formula adjustments. However, despite evidence of in vitro antioxidant activity, direct evidence on the effects of Minasarua consumption on clinical parameters, such as blood pressure and cholesterol levels, in humans (or animal models) remains very limited or has not been widely published. Therefore, experimental research is needed to link Minasarua's antioxidant content with tangible physiological effects, including lowering blood pressure and reducing LDL-cholesterol (Maramy *et al*., 2024).

Previous research on the antihypertensive and hypolipidemic effects of traditional spice mixtures or herbal medicines has shown promising results, both in animal models and in limited human clinical trials, providing a strong scientific basis for exploring Minasarua as a functional food(Cicero et al., 2021). This traditional beverage contains various bioactive compounds, including flavonoids, polyphenols, and essential oils, which are known to play a role in antioxidant and anti-inflammatory mechanisms, as well as modulating lipid metabolism and blood pressure. In addition to its potential health benefits, developing Minaserua as a functional product also has a socio-economic dimension, supporting the preservation of local wisdom while increasing economic value for the Bima community, particularly if this product can be formulated, standardized, and scientifically evaluated within a modern functional food framework (Verawati *et al*., 2023).

The increasing prevalence of hypertension and hypercholesterolemia, along with their close association with cardiovascular diseases, underscores the urgent need for preventive and therapeutic approaches based on natural products. Although various studies have confirmed the antioxidant potential of traditional herbal ingredients, scientific evidence on the direct physiological effects of locally formulated herbal drinks such as Minaserua remains limited. Considering its rich composition of antioxidant compounds including flavonoids, phenolics, and anthocyanins Minaserua is believed to have the potential to improve lipid metabolism and regulate blood pressure. Therefore, this study was conducted to analyze the antioxidant activity and bioactive compound content of the Minaserua herbal drink using the DPPH spectrophotometric method and to evaluate its effectiveness in lowering blood pressure and cholesterol levels through experimental intervention in humans.

MATERIALS AND METHODS

This research was conducted in two main stages: laboratory analysis and experimental testing. The laboratory analysis used the DPPH (spectrophotometric) method to measure the antioxidant activity and bioactive compound content of Minaserua herbal drink. The DPPH (2,2-diphenyl-1-picrylhydrazyl) method is widely used in plant extract and herbal drink research due to its simplicity, speed, and sensitivity to free radical scavenging activity (Kingori et al., 2024). According to recent research, the DPPH method has been simplified without reducing measurement accuracy, and can be validated according to AOAC guidelines (Aklimah & Ekayanti, 2022). The next stage employed a pre-post control group experimental design, where the sample was divided into two groups: an experimental group that received Minaserua herbal drink daily for 14 days (2 weeks) and a control group that received no intervention. Blood pressure and cholesterol levels were measured before (pre) and after (post) the intervention to assess the changes that occurred. Because the results of the normality test indicated that the data were not normally distributed, statistical analysis was performed using the non-parametric Wilcoxon signed-rank test, an alternative to the paired t-test for paired data with non-normal distributions (Indra Ruswadi et al., 2023). This test is commonly used in health intervention research to analyze significant changes between pre- and post-values in the same group.

Procedure for making Minaserua herbal drink:

a. Prepare the ingredients (main ingredients: black glutinous rice, coconut milk, spices: ginger, cloves, Javanese chili, turmeric).
b. Wash the glutinous rice, then steam it until cooked (about 30-40 minutes)
c. Once cooked, remove from heat and let cool to room temperature.
d. Grind the fermented cassava yeast into a powder.
e. Ferment the glutinous rice: (Sprinkle the ground yeast into the cooled glutinous rice and stir well. Then store in a closed container in a warm and cool place for 2-3 days to ferment until the glutinous rice becomes soft and has a distinctive aroma.)
f. Prepare the herbal solution: Grate the coconut and squeeze out the coconut milk, grate the ginger, turmeric, pepper, and Javanese chili until smooth. Boil the coconut milk with the finely ground spices in 2 liters of water until it comes to a boil. Add the brown sugar and stir until completely dissolved. Then strain the solution to separate the pulp from the spices.

g. Mix the herbs: Mix the fermented glutinous rice into the prepared herbal solution. Filtered, then stir until evenly mixed

Figure 1. Minaserua Herbal Drink.

Laboratory test procedures

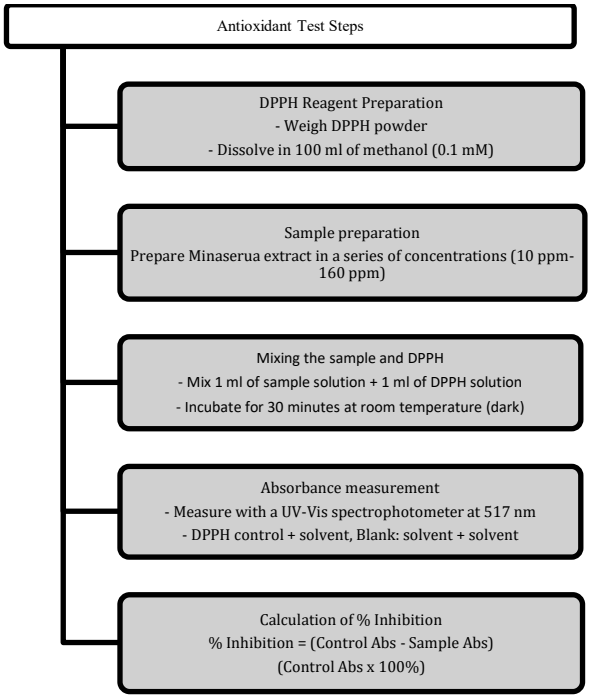

Figure 2. Antioxidant test flow using the DPPH-Spectrophotometry method.

This study involved 84 subjects aged 25–60 years who had a history of hypertension and elevated cholesterol levels. The subjects were divided into two groups: an experimental group consisting of 42 participants who received the Minaserua herbal drink, and a control group of 42 participants who were given a placebo in the form of plain or similar water. The intervention was carried out for 14–28 days with a consumption frequency of 1–2 times per day, with an adult serving size of 150–200 ml (equivalent to one medium glass**).** During the intervention period, daily monitoring was conducted to assess adherence as well as measurements of blood pressure (systolic and diastolic), reductions in total cholesterol, LDL, and triglycerides, and increases in HDL levels. Statistical analysis included paired t-tests to evaluate changes within each group and independent t-tests to compare differences between the two groups.

RESULTS AND DISCUSSION

Results Laboratory Test Results

This study aimed to determine the antioxidant compounds contained in the Minaserua herbal drink and to examine the effectiveness of administering Minaserua herbal drink, a traditional beverage from Bima, in reducing blood pressure and cholesterol levels (Verawati et al., 2023). Based on laboratory test data using the DPPH method, the results showed an increase in % inhibition along with the increase in sample concentration, with the following results:

Based on laboratory test data using the DPPH method, the % inhibition as the sample concentration increases, with the following results:

Table 1. Results of the antioxidant analysis test table.

No.	Sample Code	Concentration (C, mg/mL)	Sample Absorbance	DPPH Absorbance	% Inhibition	IC_{50} (mg/mL)
1	S1.1	16.11	0.531	0.694	23.49	
2	S1.2	32.21	0.429	0.694	38.18	
3	S1.3	48.32	0.287	0.694	58.65	41.30
4	S1.4	64.43	0.152	0.694	78.10	
5	S1.5	80.53	0.078	0.694	88.76	

Based on the results of the antioxidant activity test using the DPPH method on Minaserua samples, it was found that the percentage of inhibition increased with increasing solution concentration, with the highest inhibition value of 88.76% achieved at a concentration of 80.53 mg/mL. The IC_{50} value obtained of 41.30 mg/ml indicates that Minaserua has moderate to vigorous antioxidant activity. These results indicate that Minaserua has the potential to be a herbal drink with the ability to capture free radicals, so it can support efforts to prevent degenerative diseases related to oxidative stress.

Result analisis data

Univariate Analysis

a. Responden criteria based on gender, age based on (Intervensi)

Table 2. Distribution of respondents by age and gender.

Gender	Elderly(>60 year)	Productive (25-60)	Total
Male	2 (4,76%)	14 (33,33%)	16
Female	4 (9,52%)	22 (52,38%)	26
Total	6	36	42

Based on the analysis of the distribution Table of respondents by gender and age category, among the total 42 respondents, the majority were in the productive age group (15-64 years), comprising 36 people (85.71%), while the elderly group numbered six people (14.29%). When viewed by gender, female respondents dominated, comprising 26 individuals (61.90%), including 22 respondents in the productive age group (52.38%) and four elderly respondents (9.25%). Meanwhile, male respondents numbered 16 people (38.10%), consisting of 14 productive respondents (33.33%) and two elderly respondents (4.76%). Overall, these results indicate that most of the study respondents were women of productive age.

b. Respondent criteria based on gender, age based on (control)

Table 3. Distribution of respondents based on age and gender of control group respondents.

Gender	Elderly(>60 year)	Produktif (15-59)	Total
Male	4 (9,5%)	8 (19,0%)	12
Female	17 (40,5%)	13 (31,0%)	30
Total	21	21	42

Based on the distribution table of respondents by gender and age, it is evident that the majority of respondents were women, with the highest percentage in the productive age group (52.38%), while productive men accounted for 33.33%. This indicates that the productive age group comprised the majority of respondents (85.72%), while the elderly group accounted for 14.28%.

Analysis Bivariate

a. Intervention Group

Table 2. Wilcoxon data analysis results (intervention group).

Variable	Change	Z	P-value	Conclusion
Total Cholesterol	Significant	-5.672	0.000	Significant change
HDL	Significant	-5.770	0.000	Significant change
LDL	Significant	-5.679	0.000	Significant change
Triglycerides (TG)	Significant	-5.677	0.000	Significant change
Systolic Blood Pressure	Significant	-5.705	0.000	Significant change
Diastolic Blood Pressure	Significant	-5.669	0.000	Significant change

The analysis of the intervention group revealed that administering the treatment resulted in a significant improvement in cardiovascular health indicators. There were notable reductions in total cholesterol, LDL, and triglyceride levels, accompanied by a significant increase in HDL concentration ($p < 0.05$), indicating an enhanced lipid profile. Additionally, both systolic and diastolic blood pressures showed significant decreases ($p < 0.05$), suggesting improved vascular function. Collectively, these findings confirm that the treatment had a substantial positive impact on the participants' lipid metabolism and blood pressure, thereby contributing to overall cardiovascular health improvement.

Based on the results of the Wilcoxon test, the intervention significantly reduced the average systolic and diastolic blood pressure, as well as total cholesterol, LDL, and triglyceride levels, while significantly increasing HDL levels.

b. Control Group

Table 3. Wilcoxon data analysis results (control group).

Variable	Change	Z	P-value	Conclusion
Total Cholesterol	Not significant	-0.617	0.537	No significant change
HDL	Slight increase	-2.000	0.046	Marginally significant change
LDL	Not significant	-1.947	0.052	No significant change
Triglycerides (TG)	Not significant	-1.414	0.157	No significant change
Systolic Blood Pressure	Not significant	-1.342	0.180	No significant change
Diastolic Blood Pressure	Not significant	-1.342	0.180	No significant change

The The analysis of the control group revealed that the placebo administration did not produce any significant effects on participants' lipid profiles or blood pressure. Total cholesterol, LDL, and triglyceride levels showed no significant changes before and after treatment ($p > 0.05$), while HDL levels exhibited a marginally significant increase ($p = 0.046$). Similarly, both systolic and diastolic blood pressures remained relatively stable, with p-values greater than 0.05, indicating no statistically significant difference. Overall, these results suggest that the placebo intervention had no measurable impact on lipid metabolism or blood pressure regulation, confirming that the observed improvements in the intervention group were likely attributable to the active treatment rather than external factors

Discussion of Results

The antioxidant activity test using the DPPH method aims to evaluate the ability of compounds in minasarerua samples to reduce free radicals. Based on the test results, the percentage of inhibition increases with increasing sample concentration. At a concentration of 16.11 mg/mL, the percentage of inhibition is only 23.49%, whereas at the highest concentration (80.5 mg/mL), the inhibition reaches 88.76%. This indicates that the antioxidant activity of minaserua is concentration-dependent, where the higher the concentration of the extract, the greater its ability to capture free radicals (Cicero *et al*., 2021).

The IC_{50} value of Minaserua was 41.30 mg/ml, indicating extreme general antioxidant activity. Thus, Minaserua can be categorized as having quite good antioxidant activity. This antioxidant activity is likely contributed to by the content of bioactive compounds, such as anthocyanins, flavonoids, and other phenolic compounds, commonly found in spices and pigmented plants (Prior *et al*., 2005). These compounds work by donating hydrogen atoms to neutralize DPPH free radicals, thereby reducing oxidative stress. These results support Minaserua's potential as a natural herbal drink with antioxidant activity that is beneficial for health, particularly in preventing degenerative diseases associated with free radicals, such as hypertension, diabetes, and cardiovascular disease (Li *et al*., 2024).

The effectiveness of this antioxidant is directly related to the intervention results in respondents, where there was a significant decrease in total cholesterol, LDL, and triglyceride levels, as well as an increase in HDL. Furthermore, systolic and diastolic blood pressure also experienced a significant decrease. These findings are in line with a recent study of the antioxidant activity of minaserua measured in vitro (DPPH); IC_{50} = 41.30 MG/ML; maximum inhibition 88.76%), indicating significant and concentration-dependent radical scavenging ability. The IC_{50} value is within the range, indicating relatively strong activity when compared with various commercial plant extracts; however, it should be emphasized that comparisons of IC_{50} between studies must take into account differences in extraction methods, solvents, initial DPPH concentrations, and units of measurement (mg/ml) (Gulcin & Alwasel, 2023).

This strengthens the evidence that antioxidant effects not only occur in vitro but also have a positive impact on cardiovascular health. This effect aligns with previous research, which shows that consuming antioxidant-rich foods can improve lipid profiles and enhance endothelial function by increasing nitric oxide (NO) bioavailability (Ruhdiana & Sandi, 2023).

Phenolic and flavonoid compounds in minaserua can neutralize free radicals and reduce lipid peroxidation, thereby inhibiting the formation of oxidized LDL (ox-LDL), which contributes to the development of atherosclerotic plaque. Reduction of ox-LDL reduces the vascular inflammatory process and may slow or alleviate endothelial dysfunction associated with increased blood pressure and poor lipid profiles. Literature support: review of the protective effects of polyphenols on endothelium and atherogenesis (Iqbal et al., 2023).

Several flavonoids are known to modulate the expression and stability of the LDL receptor (LDLR), and enzymes regulating cholesterol metabolism can increase LDLR expression, thereby enhancing LDL clearance from plasma. This may provide a direct molecular pathway for reducing total and LDL cholesterol after consuming these beneficial compounds. Recent molecular evidence suggests that flavonoids alter LDLR regulation through several transcriptional/post-translational mechanisms (Bjune et al., 2024).

Polyphenols/anthocyanins can increase nitric oxide (NO) production by endothelial cells, reduce endothelial oxidative stress, and decrease inflammatory adhesion, resulting in improved vasodilation and lower blood pressure. Several ongoing studies and reviews report improvements in vascular parameters (flow-mediated siltation, vasorelaxation) after polyphenol/anthocyanin supplementation (Laudani et al., 2023). Other studies also suggest that anthocyanins can improve endothelial function and potentially lower cholesterol and hypertension (Kiptiyah et al., 2017).

Plant extracts often show ACE-inhibitory activity in vitro (capable of inhibiting angiotensin-converting enzyme) and modulate cholesterol metabolism enzymes (HMG-CoA pathway for cholesterol-bile conversion). The in vitro ACE-inhibitory activity of some herbal extracts suggests a direct antihypertensive pathway (Mahmud et al., 2024). Polyphenols also reduce systemic inflammatory markers (CRP, IL-6) that play a role in dyslipidemia and hypertension. Furthermore, some polyphenols modulate the gut microbiota, which influences lipid metabolism. These combined effects may translate in vitro antioxidant activity into in vivo metabolic effects (Iqbal et al., 2023).

Several plant extracts also exhibit ACE-inhibiting activity in vitro, providing an additional antihypertensive pathway. The combination of antioxidant, anti-inflammatory, metabolic modulation, and vasoactive

enzyme effects explains how the administration of the Minaserua herbal drink can rapidly reduce cardiometabolic parameters in early intervention trials. These findings are consistent with recent literature on the benefits of polyphenols on cardiovascular health. DPPH data and interim clinical results from the Minaserua herbal drink study support them (Bayani et al., 2024).

DISCUSSION

The results of the study showed that the herbal drink Minaserua exhibits significant antioxidant activity, as determined by the DPPH test, with an IC_{50} value of 41.30 mg/mL. This value indicates that Minaserua is classified as having vigorous antioxidant activity, because the concentration required to inhibit 50% of free radicals is relatively low. This high antioxidant activity is most likely influenced by the flavonoids, phenolics, and anthocyanins contained in the basic ingredients of Minaserua, as also from the results of research by (Verawati *et a*l., 2023).

The antioxidant efficacy was directly related to the intervention outcomes in the respondents. There was a significant decrease in total cholesterol, LDL cholesterol, and triglycerides, accompanied by an increase in HDL cholesterol. Furthermore, systolic and diastolic blood pressure also decreased significantly. These findings align with recent research indicating that consuming beverages or functional foods rich in flavonoids and phenolic compounds can improve lipid profiles and lower blood pressure by enhancing endogenous antioxidant capacity and promoting endothelial function (Tumilaar *et al*., 2023).

Thus, this study not only confirms the antioxidant activity of minaserua but also demonstrates its biological link to improved cardiovascular health. Further research is needed to explore the bioavailability of the active compounds and conduct long-term clinical trials to strengthen minaserua's potential as a functional food based on local wisdom (Duan *et al*., 2025).

CONCLUSIONS

Based on the research results in the document, it can be concluded that Minaserua herbal drink has potent antioxidant activity with an IC_{50} value of 41.30 mg/mL, indicating a good ability to capture free radicals. This antioxidant activity is believed to originate from the content of anthocyanins, flavonoids, and phenolic compounds found in its constituent ingredients, including black sticky rice, ginger, turmeric, and other spices. The results of intervention trials in humans showed that consuming Minaserua for 14 days significantly reduced systolic and diastolic blood pressure, reduced total cholesterol, LDL, and triglyceride levels, and increased HDL levels ($p < 0.05$). Statistical analysis using the Wilcoxon signed-rank test confirmed that these changes were significant, while the control group showed no significant changes. These findings support that Minaserua's antioxidant effects not only occur in vitro but also provide real cardiovascular benefits in vivo, through mechanisms such as increased nitric oxide (NO) bioavailability, inhibition of the ACE enzyme, reduced lipid peroxidation, and modulation of cholesterol metabolism. Thus, Minaserua has the potential to be developed as a functional food based on local wisdom, which can help improve heart and blood vessel health and prevent degenerative diseases related to oxidative stress.

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