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Effect of ginger kombucha consumption on blood pressure in patients with essential hypertension

Pengaruh konsumsi kombucha jahe terhadap tekanan darah pada pasien dengan hipertensi esensial

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Abstract

Essential hypertension remains a major global public health problem that requires effective non-pharmacological management strategies. Fermented functional beverages rich in antioxidants, such as ginger kombucha, have been proposed as potential complementary interventions for blood-pressure control. This study aimed to evaluate the effects of ginger kombucha consumption on blood pressure in patients with essential hypertension. A quasi-experimental pretest–posttest control group design was conducted involving 62 patients with hypertension at Medan Adventist Hospital, Indonesia, in April 2025. Participants were allocated to an intervention group (n = 31), which consumed 200 mL ginger kombucha twice daily for 14 days, and a control group (n = 31), which received no intervention. Blood pressure was measured using a standardized digital sphygmomanometer. Data were analyzed using paired and independent *t-tests*. The intervention group demonstrated a significant reduction in both systolic and diastolic blood pressure, with mean decreases of 16.2 mmHg and 10.1 mmHg, respectively ($p < 0.001$), whereas the changes in the control group were not statistically significant. Between-group comparisons showed significantly greater reductions in blood pressure in the intervention group ($p < 0.05$), indicating a clinically meaningful effect over a short period. In conclusion, ginger kombucha consumption significantly reduced blood pressure in patients with essential hypertension and may serve as a complementary non-pharmacological strategy for hypertension management. Ethical approval was obtained prior to data collection, and all the participants provided written informed consent.

Keywords: Blood pressure, fermented beverages, hypertension, kombucha, ginger (*Zingiber officinale*)

Abstrak

Hipertensi esensial tetap menjadi masalah kesehatan masyarakat global yang besar dan membutuhkan strategi manajemen non-farmakologis yang efektif. Minuman fungsional fermentasi yang kaya antioksidan, seperti kombucha jahe, telah diusulkan sebagai intervensi komplementer potensial. Studi ini bertujuan untuk mengevaluasi efek konsumsi kombucha jahe terhadap tekanan darah pada pasien dengan hipertensi esensial. Desain kelompok kontrol pra-uji-pasca-uji kuasi-eksperimental dilakukan yang melibatkan 62 pasien hipertensi di Rumah Sakit Advent Medan, Indonesia, pada April 2025. Partisipan dialokasikan ke dalam kelompok intervensi (n = 31), yang mengonsumsi 200 ml kombucha jahe dua kali sehari selama 14 hari, dan kelompok kontrol (n = 31), yang tidak menerima intervensi. Tekanan darah diukur menggunakan sphygmomanometer digital standar. Data dianalisis menggunakan uji t berpasangan dan uji t independen. Kelompok intervensi menunjukkan penurunan tekanan darah sistolik dan diastolik yang signifikan dengan

penurunan rata-rata masing-masing 16.2 mmHg dan 10.1 mmHg ($p < 0.001$), sedangkan perubahan pada kelompok kontrol tidak signifikan secara statistik. Perbandingan antar kelompok menunjukkan penurunan tekanan darah yang jauh lebih besar pada kelompok intervensi ($p < 0.05$), yang mengindikasikan efek klinis yang besar dalam periode intervensi yang singkat. Studi ini menyimpulkan bahwa konsumsi kombucha jahe secara signifikan menurunkan tekanan darah pada pasien dengan hipertensi esensial dan dapat berfungsi sebagai strategi non-farmakologis komplementer. Persetujuan etik untuk studi ini diperoleh sebelum pengumpulan data, dan semua peserta memberikan informed consent.

Kata Kunci: Hipertensi, jahe (*Zingiber officinale*), kombucha, minuman fermentasi, tekanan darah

Introduction

Hypertension remains one of the most prevalent non-communicable diseases worldwide and is a major contributor to cardiovascular morbidity and mortality. The World Health Organization estimates that more than 1.28 billion adults worldwide are affected by hypertension, with a substantial proportion remaining undiagnosed or inadequately controlled (Pandit et al., 2023). In Indonesia, the prevalence of hypertension among adults aged ≥18 years has reached 34.1%, making it a leading public health concern and a significant burden on the healthcare system (Febianti et al., 2022). The asymptomatic nature of hypertension often delays diagnosis and treatment, thereby increasing the risk of complications such as stroke, coronary heart disease and renal failure (Pandit et al., 2023).

In recent decades, the rising prevalence of hypertension has been closely linked to lifestyle changes, including excessive sodium intake, physical inactivity, and increased psychosocial stress. Consequently, contemporary hypertension management emphasizes not only pharmacological therapy but also lifestyle modifications and nutritional interventions. From a nursing and public health perspective, non-pharmacological approaches are essential components of long-term blood pressure control, as they promote patient autonomy, self-management, and sustained adherence to healthy behaviors (Bulto et al., 2024). Nurses play a pivotal role in delivering health education, facilitating dietary changes, and supporting community-based interventions aimed at reducing the risk of cardiovascular disease.

Dietary patterns rich in antioxidants and bioactive compounds are consistently associated with improved blood pressure regulation. Evidence from nutritional epidemiology indicates that polyphenols and flavonoids derived from plant-based foods and beverages contribute to vascular health by enhancing endothelial function and reducing oxidative stress (Harahap et al., 2024). Fermented beverages have received increasing attention because of their enhanced antioxidant bioavailability and probiotics, which may further support cardiovascular health (Niu et al., 2025).

Kombucha is a fermented tea beverage produced through the activity of a symbiotic culture of bacteria and yeast (SCOBY), resulting in a drink rich in polyphenols, organic acids, vitamins, and probiotic microorganisms. Several experimental and clinical studies have suggested that kombucha consumption may improve cardiometabolic parameters, including lipid profiles and blood pressure, primarily through its antioxidant and anti-inflammatory properties (Chou et al., 2024; Fraiz et al., 2024). However, most evidence regarding the antihypertensive effects of kombucha is derived from in vitro and animal studies, with relatively few clinical trials conducted on hypertensive populations (Pramono et al., 2024).

The incorporation of ginger (*Zingiber officinale*) into kombucha fermentation may further enhance its functionality. Ginger contains bioactive compounds, such as gingerols and shogaols, which have been associated with vasodilation and blood pressure reduction in both experimental and clinical studies (Hasani et al., 2019; Mao et al., 2019). Although ginger supplementation alone has demonstrated antihypertensive potential, clinical investigations examining the combined effects of ginger and kombucha as a fermented functional beverage remain limited, particularly among patients with essential hypertension.

Recent studies on fermented beverages similar to kombucha, including fermented teas

and probiotic drinks, have reported modest yet clinically meaningful reductions in systolic and diastolic blood pressure in human participants (Fraiz et al., 2024; Wanyo et al., 2025). However, research specifically evaluating ginger-enriched kombucha using controlled clinical designs remains scarce. Moreover, few studies have examined such interventions within a nursing or community health framework, where feasibility, safety, and patient adherence are critical (Kristinawati et al., 2023; Rezaldi et al., 2022).

The dosage of ginger kombucha used in this study (200 mL consumed twice daily) was selected based on evidence from the functional beverage literature indicating that daily intakes ranging from 150 to 250 mL are generally safe and sufficient to deliver biologically active levels of polyphenols, organic acids, and probiotics without causing adverse gastrointestinal effects (Fraiz et al., 2024; Khamidah & Antarlina, 2020). Dividing the total intake into two daily servings was intended to maintain a more consistent exposure to bioactive compounds throughout the day, thereby supporting optimal physiological effects of the treatment.

Taken together, these considerations highlight an important research gap regarding the clinical effectiveness of ginger kombucha consumption in patients with essential hypertension, particularly within the context of non-pharmacological nursing interventions. Therefore, this study aimed to determine the effectiveness of ginger kombucha consumption over a 14-day intervention period in reducing systolic and diastolic blood pressure in patients with essential hypertension.

Methods

Study Design

This study employed a quasi-experimental pretest–posttest control-group design. This design was selected because full randomization was not feasible in the outpatient clinical setting, while still allowing comparison of blood pressure changes between the intervention and control groups before and after the intervention. Data collection was conducted in April 2025 at the Medan Adventist Hospital in North Sumatra, Indonesia.

Participants

The study population comprised patients diagnosed with essential hypertension who received outpatient care at Medan Adventist Hospital. A purposive sampling technique was used to ensure that the participants met the predefined clinical and safety criteria relevant to the intervention. This sampling approach was chosen to minimize potential confounding factors, such as unstable pharmacological therapy, comorbid conditions, and concurrent use of herbal products, which could influence the blood pressure outcomes.

The inclusion criteria were as follows: patients aged 40–70 years, diagnosed with mild-to-moderate essential hypertension, receiving stable antihypertensive therapy or lifestyle management, not consuming herbal supplements or other fermented beverages, and willing to participate and provide written informed consent. The exclusion criteria were as follows: secondary hypertension, unstable medication regimens, known allergy to ginger or tea, and severe gastrointestinal disorders or chronic illnesses that could affect the study outcomes.

A total of 62 eligible participants were enrolled in this study. Following recruitment, participants were allocated to the intervention and control groups using a simple quasi-random assignment based on the order of enrollment (odd–even sequence) to reduce allocation bias. Each group consisted of 31 participants each. This allocation method was applied after purposive sampling and, therefore, did not represent full randomization.

Instrument

Blood pressure measurements were obtained using a validated automated digital sphygmomanometer (Omron HEM-7130) that was clinically validated according to international standards. As this device is a technical measurement instrument, internal consistency reliability testing (e.g., Cronbach's α) was not applicable; instead, the device's validated accuracy and routine calibration were relied upon.

Outcome assessors were blinded to the group allocation to minimize measurement bias. Blood pressure was measured at baseline (Day 1) and after the intervention period (Day 14). All measurements were conducted in the morning between 7:00 and 9:00 a.m., following at least 10 min of seated rest. Participants were instructed to avoid caffeine intake, smoking, and strenuous physical activity for at least 30 min prior to the measurement. Two measurements were taken at

five-minute intervals, and the average value was used for statistical analysis.

Intervention

The intervention involved ginger kombucha prepared from fermented black tea using a symbiotic culture of bacteria and yeast (SCOBY). Fresh ginger extract (10% w/v) was added before fermentation. The fermentation process was conducted under hygienic conditions for 10 d at room temperature (25–28 °C).

Quality and safety assessments were performed before consumption. The final product had a pH of 2.8–3.2, indicating adequate fermentation. Microbial safety was ensured by visual inspection for contamination and adherence to standard hygiene protocols during preparation. The alcohol content was estimated to be below 0.5%, in accordance with the non-alcoholic beverage standards for kombucha products.

Participants in the intervention group consumed 200 mL ginger kombucha twice daily (morning and evening) for 14 consecutive days. This dosage was based on previous functional beverage studies indicating that daily intakes of 150–250 mL are safe and sufficient to deliver biologically active compounds without any adverse effects. The research team and nursing staff supervised the consumption of the test food to ensure compliance and participant safety. The control group did not receive kombucha or placebo interventions.

Data Collection

The principal investigator conducted data collection with the assistance of two trained research assistants. Demographic and clinical data, including age, sex, duration of hypertension, and body mass index (BMI), were collected at the baseline. Blood pressure data were recorded using standardized observation sheets adapted from the World Health Organization's Blood Pressure Measurement Protocol (2020).

Data Analysis

Data were analyzed using SPSS version 26.0. Descriptive statistics were used to summarize the participants' characteristics. Prior to inferential analysis, the assumptions of normality were assessed using the Shapiro–Wilk test, and the homogeneity of variances was evaluated using Levene's test.

Paired *t-tests* were used to compare pre- and post-intervention blood pressure values within each group, while independent *t-tests* were applied to compare mean changes in blood pressure between groups. Statistical significance was set at $p < 0.05$. Effect sizes (Cohen's *d*) were calculated for between-group comparisons to enhance clinical interpretation.

Ethical Considerations

This study was approved by the Health Research Ethics Committee of STIKes Artha (approval number: 207/KEP-SARTHA/III/2025). Written informed consent was obtained from all participants before data collection. Participants were informed about the study objectives, procedures, potential risks, and their right to withdraw from the study at any time, without consequences.

Result and Discussion

A total of 62 participants completed the study, with 31 participants in the intervention group and 31 in the control group. Baseline characteristics, including sex, age, educational level, duration of hypertension, and body mass index (BMI), were comparable between the groups. Statistical analysis revealed no significant differences in baseline characteristics ($p > 0.05$), indicating that the groups were homogeneous and appropriate for comparison (Table 1).

Following the 14-day intervention period, changes in both systolic and diastolic blood pressure were observed in the two groups. In the intervention group, the mean systolic blood pressure decreased from 152.3 ± 10.6 mmHg to 136.1 ± 9.2 mmHg, while the mean diastolic blood pressure decreased from 94.1 ± 7.5 mmHg to 84.0 ± 6.1 mmHg. In contrast, the control group exhibited smaller and nonsignificant changes in blood pressure (Table 2). Within-group analysis using paired *t-tests* demonstrated statistically significant reductions in both systolic and diastolic blood pressure in the intervention group ($p < 0.001$). No statistically significant changes were observed in the control group ($p > 0.05$).

Between-group comparisons of mean blood pressure reductions indicated that the intervention group experienced significantly

greater decreases in both systolic and diastolic blood pressures than the control group. Independent *t-test* analysis showed statistically significant differences between the groups for both parameters ($p < 0.001$) (Table 3).

Table 1. Respondent characteristics (n = 62)

Characteristics	Intervention (n=31)		Control (n=31)		Total		p-value*
	n	%	n	%	n	%	
Gender							
Man	13	41.9	14	45.2	27	43.5	0.790
Woman	18	58.1	17	54.8	35	56.5	
Age (years)							
40–49	10	32.3	8	25.8	18	29.0	
50–59	13	41.9	11	35.5	24	38.7	0.714
≥60	8	25.8	12	38.7	20	32.3	
Last education							
Elementary–Middle School	7	22.6	8	25.8	15	24.2	
Senior High School	14	45.2	14	45.2	28	45.2	0.885
College	10	32.2	9	29.0	19	30.6	
Long-term hypertension							
<1 year	4	12.9	6	19.4	10	16.1	
1–5 year	18	58.1	14	45.2	32	51.6	0.641
>5 year	9	29.0	11	35.4	20	32.3	
BMI (Body Mass Index)							
Normal (18,5–24.9)	11	35.5	10	32.3	21	33.9	
Overweight (25–29.9)	14	45.2	15	48.4	29	46.8	0.790
Obesity (≥30)	6	19.3	6	19.3	12	19.3	

Values are presented as numbers (n) and percentages (%); p-values were obtained using the chi-square test

Table 2. Effectiveness of ginger kombucha drink in reducing blood pressure in patients with essential hypertension

Variables	Before (Mean ± SD)	After (Mean ± SD)	Δ (Mean Change)	p-value*
Systolic Pressure (mmHg)				
Intervention	152.3 ± 10.6	136.1 ± 9.2	−16.2	0.000
Control	151.8 ± 11.0	148.6 ± 10.5	−3.2	0.084
Diastolic Pressure (mmHg)				
Intervention	94.1 ± 7.5	84.0 ± 6.1	−10.1	0.000
Control	93.7 ± 7.2	91.5 ± 6.9	−2.2	0.092

* Paired t-test, significant if $p < 0.05$

Table 3. Comparison of blood pressure reduction between the intervention and control groups

Blood Pressure Parameters	Average Decrease in Intervention (Mean ± SD)	Average Decrease in Control (Mean ± SD)	p-value*
Systolic Pressure (mmHg)	16.2 ± 5.8	3.2 ± 4.9	0.000
Diastolic Pressure (mmHg)	10.1 ± 4.2	2.2 ± 3.7	0.000

* Independent t-test, significance $p < 0.05$

This study demonstrated that consumption of ginger kombucha for 14 days resulted in statistically and clinically significant reductions in systolic and diastolic blood pressure among patients with essential hypertension compared with that in the control group. A reduction exceeding 10 mmHg in systolic blood pressure is considered clinically

meaningful because it is associated with a substantial reduction in cardiovascular risk in hypertensive populations. These findings suggest that ginger kombucha may serve as a complementary non-pharmacological approach for short-term blood pressure management.

One of the strengths of this study is its controlled quasi-experimental design, use of standardized blood pressure measurement protocols, and inclusion of a clinical hypertensive population rather than relying on experimental or animal models. Additionally, the intervention was practical, well-tolerated, and feasible for implementation in nursing and community health settings. Nevertheless, several limitations of this study should be acknowledged. The relatively short intervention duration (14 days) limits the conclusions regarding long-term effectiveness and sustainability. Furthermore, biochemical markers such as antioxidant status, inflammatory mediators, or gut microbiota composition were not assessed, restricting the mechanistic interpretation. Potential confounding factors, including dietary intake, physical activity, and adherence to antihypertensive medication, were not controlled analytically and may have influenced blood pressure outcomes.

The substantial reduction in blood pressure observed over a short period may be explained by the combined effects of fermentation-enhanced bioavailability of polyphenols and the vasodilatory properties of ginger-derived compounds. Fermentation processes are known to enhance the absorption and biological activity of phenolic compounds, allowing for more rapid physiological effects than non-fermented products (Chou et al., 2024; Sari & Suharyanto, 2020). From a clinical perspective, early improvements in blood pressure are particularly relevant for patients with limited adherence to long-term lifestyle modifications, as short-term benefits may increase motivation and engagement in self-care.

Kombucha is widely recognized as a functional beverage because of its high antioxidant content derived from tea polyphenols, which increases during fermentation. These antioxidants contribute to improved endothelial function and reduced oxidative stress, both of which play central roles in blood pressure regulation (Khamidah & Antarlina, 2020; Mahardani & Yuanita, 2021). Rather than focusing extensively on molecular pathways, it is important to emphasize that reduced oxidative stress and improved vascular responsiveness are clinically relevant mechanisms that support blood pressure reduction in hypertensive individuals.

The addition of ginger further enhanced the functional properties of the kombucha. Gingerols and shogaols have been shown to promote vasodilation and reduce vascular resistance, contributing to the blood pressure–lowering effects observed in both experimental and clinical studies (Ekayanti & Nurfitriani, 2025; Mao et al., 2019). The findings of this study suggest a potential synergistic effect between fermented tea components and ginger; however, further controlled clinical trials are required to confirm this interaction.

The present findings are consistent with those of previous studies reporting the antihypertensive effects of fermented products and ginger-based interventions. Elkhtab et al. (2017) demonstrated that kombucha fermentation can generate angiotensin-converting enzyme (ACE) inhibitory peptides, while Bellassoued et al. (2015) and Rosa et al. (2021) reported enhanced antioxidant enzyme activity following kombucha consumption. However, most existing studies have focused on animal models or non-hypertensive populations. This study provides novel clinical evidence by evaluating ginger kombucha consumption in patients with essential hypertension.

Recent human studies involving fermented beverages have also reported modest reductions in blood pressure over relatively short intervention periods, supporting the plausibility of these findings (Fraiz et al., 2024; Wanyo et al., 2025). Nonetheless, variability in individual responses, as reflected by relatively large standard deviations, suggests that not all participants experienced the same degree of benefit, underscoring the need for personalized approaches to nutritional interventions.

The possibility of placebo effects or behavioral modifications during the intervention period should be considered. Participants in the intervention group may have become more attentive to health-related behaviors, such as dietary intake, salt consumption, and physical activity, which could have contributed to blood

pressure reduction. Although the outcome assessors were blinded, the participants were aware of the group allocation, which may have influenced their behavioral compliance. Additionally, although the participants were instructed to maintain their usual lifestyle and pharmacological therapy, variations in daily activities and dietary intake were not formally monitored, representing a potential source of bias.

From a nursing and public health perspective, these findings align with Pender's Health Promotion Model, which emphasizes empowerment, self-efficacy, and engagement in health-promoting behaviors. Ginger kombucha represents a simple, culturally acceptable, and low-cost intervention that may support patient participation in non-pharmacological hypertension management (Cardoso et al., 2022; Santos et al., 2025). However, the present findings should be interpreted as preliminary and are not intended to support the immediate incorporation into clinical practice guidelines.

Future studies should employ randomized controlled designs, longer intervention periods, and comprehensive control of lifestyle-related confounders to address these limitations. The inclusion of biochemical markers and gut microbiota analyses would further strengthen our understanding of the mechanisms underlying blood pressure reduction. Additionally, dose–response studies are needed to determine the optimal intake levels and long-term safety of ginger kombucha consumption.

Conclusion

This study demonstrates that 14 days of ginger kombucha consumption is associated with clinically meaningful reductions in both systolic and diastolic blood pressure among individuals with essential hypertension, suggesting its potential role as a complementary non-pharmacological intervention for short-term blood pressure control through combined antioxidant, anti-inflammatory, and probiotic effects that support vascular homeostasis.

However, these findings should be interpreted with caution due to the quasi-experimental design, short intervention duration, lack of analytical control over lifestyle factors such as diet, physical activity, and medication adherence, and the absence of biochemical and gut microbiota assessments, which limit the mechanistic interpretation and generalizability of the results. From a nursing and public health perspective, ginger kombucha is a feasible and low-cost option that can be incorporated into preventive and promotive health education programs. However, current evidence is insufficient to support its inclusion in formal clinical treatment guidelines.

Future studies employing randomized controlled designs, longer follow-up periods, comprehensive control of confounding variables, and dose–response analyses are warranted to determine the optimal intake, consistency of effect size, and long-term safety of ginger kombucha consumption in hypertensive populations.

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