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Effect of Soy Milk and Red Ginger Combination on Serum Cholesterol in Hypercholesterolemic Patients

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ABSTRACT

Cardiovascular diseases (CVDs) are the leading cause of death globally, responsible for over 17.9 million deaths annually according to the World Health Organization. In Indonesia, hypercholesterolemia remains a major CVD risk factor, affecting approximately 35.9% of the population. Although statins are effective in lowering cholesterol, they are associated with adverse effects such as myopathy and memory disturbances in older adults. Therefore, natural alternatives such as soy milk and red ginger, both widely available and rich in bioactive compounds, warrant further investigation. Soy protein is linked to a 3–5% reduction in LDL cholesterol, while red ginger contains phenolic antioxidants, particularly gingerol, with hypocholesterolemic and anti-atherogenic properties through HMG-CoA reductase inhibition. This study aimed to determine the effect of soy milk combined with red ginger on serum cholesterol levels in hypercholesterolemic patients. A pretest–posttest control group design was conducted with 30 participants selected through purposive sampling. The intervention group received 25 g soy in 500 mL soy milk combined with 3 g of red ginger powder daily for 14 days, while the control group received calorie-free syrup. Mean cholesterol levels in the intervention group significantly decreased from 223.2 ± 8.7 mg/dL to 184.0 ± 7.9 mg/dL, representing a 17.5% reduction. In contrast, the control group showed no significant change (217.9 ± 9.4 mg/dL to 216.4 ± 8.8 mg/dL). Statistical analysis confirmed a significant reduction in the intervention group ($p < 0.001$). In conclusion, the combination of soy milk and red ginger demonstrated a significant cholesterol-lowering effect within a short intervention period, highlighting its potential as an accessible, safe, and non-pharmacological option for primary healthcare strategies to manage hypercholesterolemia.

Keywords:
Cardiovascular diseases; Hypercholesterolemia; Zingiber officinale; Soy milk; Natural cholesterol-lowering agents

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1. Introduction

Cardiovascular disease (CVD) remains the leading cause of death worldwide, accounting for more than 17 million deaths annually according to the World Health Organization (WHO) [2]. In Indonesia, the prevalence of hypercholesterolemia as a major CVD risk factor reaches 35.9% of the population [1]. Surveillance from the Non-Communicable Disease Integrated Guidance Post (Posbindu PTM) further indicates prevalence rates of 48% in men and 54.3% in women, with the highest rates (58.7%) among individuals aged over 60 years [2]. Local data from the Pekanbaru City Health

Profile in 2016 also recorded 2,811 cases of coronary heart disease (CHD), with hypercholesterolemia identified as one of the major risk factors [3].

Various strategies have been proposed to manage elevated cholesterol levels, including pharmacological and non-pharmacological approaches. Statins are widely prescribed as first-line pharmacological agents, acting through competitive inhibition of HMG-CoA reductase, the key enzyme in cholesterol biosynthesis [4]. Despite their effectiveness, statins are associated with several side effects, such as myopathy (including myalgia, myositis, and rhabdomyolysis), an increased incidence of type 2 diabetes, and reversible memory impairment, particularly in patients over 50 years of age [5].

Non-pharmacological interventions for hypercholesterolemia include physical activity, smoking cessation, diets rich in unsaturated fatty acids and fiber, and the use of herbal medicine [6]. Soy (*Glycine max*), which can be processed into soy milk, is considered a functional food with cholesterol-lowering benefits due to its high protein content available at relatively low cost [7]. Soy protein has been associated with a 3–5% reduction in LDL cholesterol, with several studies reporting that daily intake of around 25 g of soy protein can reduce LDL cholesterol by approximately 5 mg/dL [8]. Similarly, red ginger (*Zingiber officinale* var. *rubrum*) contains phenolic antioxidants such as gingerol, which exhibit hypocholesterolemic and anti-atherogenic properties by inhibiting HMG-CoA reductase and reducing cholesterol biosynthesis [7].

Given that both soy milk and red ginger are abundant in Indonesia and have demonstrated lipid-lowering potential, their combination represents a promising natural approach to managing hypercholesterolemia. To our knowledge, this study is among the first in Indonesia to evaluate the combined effect of soy milk and red ginger on serum cholesterol levels in hypercholesterolemic patients. The findings are expected to provide an empirical basis for developing accessible, safe, and non-pharmacological strategies for improving cardiovascular health in the community.

2. Method

Study Design and Participants

This study employed a pretest–posttest control group design and was conducted at the Garuda Public Health Center, Pekanbaru, Riau. Participants were selected using purposive sampling, involving individuals diagnosed with hypercholesterolemia in the working area of the health center. A total of 30 participants were enrolled and assigned to either the intervention or the control group. To minimize expectation bias, participants were not informed of the specific contents of their assigned beverages, and the study objectives were explained only in general terms. Although full double-blinding was not feasible due to the distinct sensory characteristics of ginger, both groups remained unaware of treatment allocation.

Intervention and Plant Materials

The intervention group received 25 g soy protein in 500 mL soy milk combined with 3 g of red ginger (*Zingiber officinale* var. *rubrum*) powder daily for 14 consecutive days. The dose of soy protein was determined based on meta-analyses showing that 25 g/day significantly reduces circulating LDL and total cholesterol [8], and clinical studies confirming that this dosage provides superior lipid-lowering effects compared to lower doses [11]. The duration of 14 days was adopted from earlier research demonstrating significant cholesterol reductions following short-term soy milk consumption [9].

The dose of red ginger was selected based on previous findings in dyslipidemic women, in which ginger administration led to significant reductions in total cholesterol [12]. A recent systematic review and meta-analysis further confirmed that ginger supplementation at doses around 3 g/day effectively lowers LDL and total cholesterol [13]. The control group received calorie-free syrup as a placebo.

Taxonomic identification of soy and red ginger was verified and deposited at the Faculty of Mathematics and Natural Sciences, Riau University (No. 167/UN19.5.1.13-4.1/EP/2021). Both soy milk and red ginger powder were prepared and processed at the Herbal Medicine Laboratory, Abdurrab University.

Outcome Measurement

Serum total cholesterol levels were measured at baseline (pretest) and after the 14-day intervention (posttest) using a blood cholesterol test meter device.

Statistical Analysis

Data were presented as mean, minimum, maximum, and standard deviation. Statistical analyses were performed using SPSS version 20 (IBM, Chicago, USA). The Shapiro–Wilk test was applied to assess normality, while Levene's test was used to evaluate homogeneity of variance. Differences within groups were analyzed using paired sample t-tests, and differences between groups were tested with independent sample t-tests. A p-value < 0.05 was considered statistically significant.

Ethical Clearance

This study obtained ethical approval from the Ethics Committee of Abdurrab University (No. 233/KEP-UNIVRAB/VI/2024). All participants provided informed consent prior to enrollment, and the study was conducted in accordance with the Declaration of Helsinki.

3. Results and Discussions

Participant Characteristics

The characteristics of respondents based on age distribution are presented in **Table 1**. All participants in the intervention group were aged 46–55 years, with a mean age of 50.4 ± 3.27 years. In contrast, the control group consisted of two age categories: 35–45 years (n = 4; mean 41.0 ± 1.41 years) and 46–55 years (n = 6; mean 50.67 ± 2.33 years). This slight imbalance in age distribution between groups may have influenced cholesterol outcomes and should be considered when interpreting the results. Previous evidence has shown that hypercholesterolemia is more prevalent among older adults, with studies reporting a significantly higher prevalence in elderly populations compared to younger individuals (64.0% vs. 23.7%) [10]. This is consistent with biological mechanisms suggesting that aging is associated with reduced LDL receptor activity, increased body mass index (BMI), and hormonal changes, all of which contribute to higher cholesterol levels [6],[10].

Table 1. Characteristics of respondents based on age

Groups	Age (years)	N	Mean	Std. Deviation
Intervention	35–45	–	–	–
	46–55	10	50.4	3.27
Control	35–45	4	41.0	1.41
	46–55	6	50.67	2.33

Pretest and Posttest Cholesterol Levels

The mean serum cholesterol levels of participants in both groups before and after the 14-day intervention are shown in **Figure 1**. In the intervention group, the mean cholesterol level decreased markedly from 223.20 ± 8.7 mg/dL at baseline to 184.00 ± 7.9 mg/dL after treatment with soy milk and red ginger. This represents a mean reduction of 39.2 mg/dL, equivalent to approximately 17.5%. In contrast, the control group, which received calorie-free syrup, showed no meaningful change, with mean cholesterol levels of 217.90 ± 9.4 mg/dL at baseline and 216.40 ± 8.8 mg/dL after the intervention.

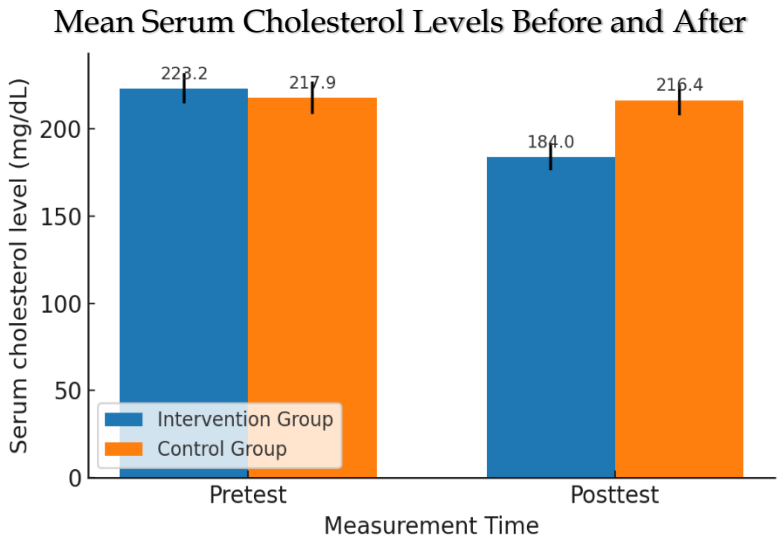

Figure 1. Mean serum cholesterol levels in intervention and control groups before and after the 14-day intervention (mean ± SD)

These findings indicate that short-term supplementation with soy milk and red ginger resulted in a clinically relevant reduction in serum cholesterol. This observation aligns with previous studies reporting that both soy protein and red ginger individually have cholesterol-lowering effects [8],[12],[13].

Statistical Analysis of Cholesterol Reduction

Before conducting comparative analyses, data normality and homogeneity were tested. The Shapiro–Wilk test results showed that all variables had $p > 0.05$, indicating normally distributed data, while Levene's test confirmed homogeneous variance across groups. The results of the normality test are presented in **Table 2**.

Table 2. Shapiro–Wilk normality test of cholesterol levels

Groups	Test Time	Sig.	Interpretation
Intervention	Pretest	0.176	Normal distribution
	Posttest	0.560	Normal distribution
Control	Pretest	0.800	Normal distribution
	Posttest	0.299	Normal distribution

A paired sample t-test was performed to compare pretest and posttest values within each group. In the intervention group, cholesterol levels decreased significantly from 223.20 mg/dL to 184.00 mg/dL (mean difference = 39.20 mg/dL, 95% CI: 26.90–51.50, $p < 0.001$). In contrast, the control group showed no significant change, with cholesterol levels decreasing only from 217.90 mg/dL to 216.40 mg/dL (mean difference = 1.50 mg/dL, 95% CI: –5.72–8.72, $p = 0.649$). Results are shown in **Table 3**.

Table 3. Paired sample t-test of pretest and posttest cholesterol levels

Group	N	Pretest (mg/dL)	Posttest (mg/dL)	Mean Difference	t-value	Sig.	95% CI of Difference
Intervention	10	223.20	184.00	39.20	7.211	<0.001	26.90 – 51.50
Control	10	217.90	216.40	1.50	0.470	0.649	–5.72 – 8.72

An independent samples t-test was then conducted to compare posttest values between groups. The intervention group had a significantly lower mean cholesterol level (184.00 mg/dL) compared to the control group (216.40 mg/dL), with a mean difference of –32.40 mg/dL (95% CI: –56.99 to –21.41, $p < 0.001$). These findings confirm that the combined administration of soy milk and red ginger produced a significant cholesterol-lowering effect compared to placebo. Results are presented in **Table 4**.

Table 4. Independent samples t-test of posttest cholesterol levels

Group	N	Mean (mg/dL)	Mean Difference	t-value	Sig.	95% CI of Difference
Intervention	10	184.00	–32.40	4.629	<0.001	–56.99 – –21.41
Control	10	216.40		0.212	0.834	–13.34 – 16.34

These results clearly demonstrate that the intervention with soy milk and red ginger led to a statistically and clinically significant reduction in cholesterol levels, whereas the control group experienced no meaningful change. This aligns with prior evidence suggesting that both soy protein and red ginger possess lipid-lowering properties [8],[11],[12].

This study demonstrated that daily consumption of 25 g soy protein in soy milk combined with 3 g of red ginger powder for 14 days significantly reduced total cholesterol levels in hypercholesterolemic patients, with a mean reduction of 39.2 mg/dL (17.5%). In contrast, the control group receiving calorie-free syrup did not experience significant changes. These findings suggest that even short-term dietary interventions with functional foods can yield measurable lipid-lowering effects.

The cholesterol-lowering effect observed here is consistent with previous studies. Abdi et al. (2019) reported that 14 days of soy milk supplementation in hypercholesterolemic animal models led to a reduction of 46 mg/dL in cholesterol levels [9]. Similarly, a meta-analysis by Blanco Mejia et al. (2019) confirmed that soy protein at a daily intake of ~25 g significantly reduced circulating LDL cholesterol [8], while a clinical trial by Høie et al. (2005) showed that higher doses (25 g/day) were more effective than lower doses (15 g/day) in reducing LDL cholesterol [11]. With respect to red ginger, Sari and Rahayuningsih (2014) reported that daily administration of ginger drink reduced total cholesterol by 8.64% in dyslipidemic women [12]. More recently, Salih et al. (2023) demonstrated through a systematic review and meta-analysis that ginger supplementation at doses of approximately 3 g/day significantly lowered LDL and total cholesterol [13]. Together, these findings reinforce the consistency of the present results with established evidence.

The biochemical mechanisms underlying these effects are multifactorial. Soy protein and its isoflavones, particularly genistein and daidzein, are known to increase LDL receptor expression in the liver, thereby enhancing the clearance of circulating LDL cholesterol. They may also inhibit HMG-CoA reductase, the rate-limiting enzyme in

endogenous cholesterol synthesis, and reduce oxidative stress, thus improving lipid metabolism [8], [14], [15]. Red ginger contains phenolic compounds such as gingerol and shogaol, which exhibit hypocholesterolemic and anti-atherogenic properties. These compounds inhibit HMG-CoA reductase, reduce LDL oxidation through antioxidative activity, and stimulate bile acid synthesis via 7α-hydroxylase activation, promoting cholesterol excretion [12]. Emerging molecular docking studies suggest that soy phytosterols (e.g., β-sitosterol) and ginger bioactive compounds (e.g., 6-gingerol, 12-shogaol) may act through complementary pathways, resulting in synergistic lipid-lowering effects [14].

The reduction achieved in just 14 days is noteworthy, as many nutritional and herbal interventions typically require 4–8 weeks to reach maximal effects. This suggests that the combination of soy milk and red ginger may exert early, measurable effects on cholesterol metabolism. However, it is also possible that the full lipid-lowering potential was not achieved within this short duration, and longer interventions might yield even greater benefits. Importantly, no known pharmacological antagonism exists between soy isoflavones and gingerols, supporting their use in combination [7],[13].

This study has several limitations. The sample size was relatively small (n = 30), which may limit generalizability. The 14-day duration may have captured only initial effects rather than maximal cholesterol reduction. Although participants were not told which treatment they received, no formal blinding of sensory characteristics was implemented, and the distinct taste and aroma of ginger could have influenced perceptions. Furthermore, the study population was limited to a single community health center, which may restrict applicability to other populations. Future research should include larger, more diverse cohorts, longer intervention periods, and comprehensive lipid profiles (including LDL, HDL, and triglycerides) to validate and expand upon these findings.

Overall, this study provides evidence that soy milk combined with red ginger represents a promising, accessible, and non-pharmacological approach to managing hypercholesterolemia. Its synergistic effects on lipid metabolism could support broader applications in primary healthcare strategies aimed at reducing cardiovascular risk.

4. Conclusion

This study demonstrated that the combination of soy milk and red ginger significantly reduced total cholesterol levels in hypercholesterolemic patients within 14 days, with outcomes superior to the control group receiving a calorie-free placebo. The cholesterol-lowering effect is most likely attributable to synergistic mechanisms, including enhanced LDL receptor expression, inhibition of HMG-CoA reductase, reduction of oxidative stress, and stimulation of bile acid excretion. These complementary actions underline the potential of this combination as a safe, accessible, and non-pharmacological strategy for cholesterol management. While the short-term findings are promising, future research involving larger populations, longer intervention periods, and comprehensive lipid profiling is warranted to confirm and expand these results.

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Conflicts of Interest:

The authors declare that there is no conflict of interest regarding the publication of this paper.

References

[1] W. A. Lestari and D. M. Utari, "Analysis of the dominant factor of hypercholesterolemia among 45–59-year-old elderly in the working area of Puskesmas Rangkapanjaya, Depok City, 2016," *Berita Kedokteran Masyarakat*, vol. 33, no. 6, p. 267, Jun. 2017. [Online]. Available: https://doi.org/10.22146/bkm.12293

[2] World Health Organization, "Cardiovascular diseases (CVDs)," *World Health Organization*, Geneva, 2025. [Online]. Available: https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)

[3] Ministry of Health Republic of Indonesia, *Indonesia Health Profile 2017*. Jakarta: Ministry of Health, 2017. [Online]. Available: https://pusdatin.kemkes.go.id/resources/download/pusdatin/profil-kesehatan-indonesia/Profil-Kesehatan-Indonesia-2017.pdf

[4] O. Sizar, S. Khare, P. Patel, and R. Talati, *Statin Medications*. Treasure Island, FL: StatPearls Publishing, 2025. [Online]. Available: https://www.ncbi.nlm.nih.gov/books/NBK430940/

[5] I. Simic and Z. Reiner, "Adverse effects of statins – myths and reality," *Current Pharmaceutical Design*, vol. 21, no. 9, pp. 1220–1226, Jan. 2015. [Online]. Available: https://doi.org/10.2174/1381612820666141013134447

[6] M. Ibrahim, E. Asuka, and I. Jialal, *Hypercholesterolemia*. Treasure Island, FL: StatPearls Publishing, 2023. [Online]. Available: https://www.ncbi.nlm.nih.gov/books/NBK459188/

[7] I. F. F. Benzie, *Herbal Medicine: Biomolecular and Clinical Aspects*, 2nd ed. Boca Raton, FL: Taylor & Francis, 2011. [Online]. Available: https://www.ncbi.nlm.nih.gov/books/NBK92770/

[8] S. Blanco Mejia, R. Messina, M. Li, S. Viguiliouk, D. Chiavaroli, and J. W. Kendall et al., "A meta-analysis of 46 studies identified by the FDA demonstrates that soy protein decreases circulating LDL and total cholesterol concentrations in adults," *Journal of Nutrition*, vol. 149, no. 6, pp. 968–981, Jun. 2019. [Online]. Available: https://doi.org/10.1093/jn/nxz020

[9] M. Andika, "Effect of soy milk consumption on total cholesterol in patients with hypercholesterolemia in the working area of Puskesmas Lubuk Buaya, Padang," *Menara Ilmu: Journal of Research and Scientific Studies, Universitas Muhammadiyah Sumatera Barat*, vol. 13, no. 3, Jan. 2019. [Online]. Available: https://doi.org/10.33559/mi.v13i3.1224

[10] A. Rosada, A. Weber, D. Wittfeld, U. Then Bergh, M. Kumric, and S. Demuth et al., "Hyperlipidemias in elderly patients: Results from the Berlin Aging Study II (BASE-II), a cross-sectional study," *Lipids in Health and Disease*, vol. 19, no. 1, p. 92, Dec. 2020. [Online]. Available: https://doi.org/10.1186/s12944-020-01277-9

[11] L. H. Høie, H.-J. Graubaum, A. Harde, J. Gruenwald, and K.-D. Wernecke, "Lipid-lowering effect of two dosages of a soy protein supplement in hypercholesterolemia," *Advances in Therapy*, vol. 22, no. 2, pp. 175–186, Mar. 2005. [Online]. Available: https://doi.org/10.1007/BF02849888

[12] R. P. Sari and H. M. Rahayuningsih, "Effect of red ginger (*Zingiber officinale* var. *Rubrum*) on total cholesterol levels of women with dyslipidemia," *Journal of*

Nutrition College, vol. 3, no. 4, pp. 798–806, Oct. 2014. [Online]. Available: https://doi.org/10.14710/jnc.v3i4.6883

[13] A. K. Salih, F. A. Mohamed, H. Osman, A. H. Ahmed, and K. Adam, "Effect of ginger (*Zingiber officinale*) intake on human serum lipid profile: Systematic review and meta-analysis," *Phytotherapy Research*, vol. 37, no. 6, pp. 2472–2483, Jun. 2023. [Online]. Available: https://doi.org/10.1002/ptr.7769

[14] Y. Purnomo, M. Taufiq, A. Wijaya, and R. Hakim, "Molecular docking of soybean (*Glycine max*) seed and ginger (*Zingiber officinale*) rhizome components as anti-diabetic through inhibition of dipeptidyl peptidase-4 (DPP-4) and alpha-glucosidase enzymes," *Tropical Journal of Natural Product Research*, vol. 5, no. 10, pp. 1735–1742, Oct. 2021. [Online]. Available: https://doi.org/10.26538/tjnpr/v5i10.7

[15] M. Ali Hamid, "Soy milk consumption in lowering blood cholesterol in clients with hypercholesterolemia," *Journals of Ners Community*, vol. 13, no. 1, pp. 97–105, Jul. 2022. [Online]. Available: https://doi.org/10.55129/jnerscommunity.v13i1.1657