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# The Effect of Mung Bean (*Phaseolus radiatus* L.) Beverage with Red Ginger (*Zingiber officinale* var. *rubrum*) Addition on Total Cholesterol Levels in Female Hypercholesterolemia Patients at Gunung Sari Ilir Public Health Center

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**ARTICLES**

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**ABSTRACT**

This study aims to analyze the effect of administering a mung bean beverage supplemented with red ginger on total cholesterol levels in female patients with hypercholesterolemia. The study utilized a quasi-experimental design with a non-equivalent control group approach. A total of 30 respondents were divided into two groups: treatment and control. The treatment group received the mung bean beverage with red ginger (250 ml) every morning for 14 days, while the control group received no intervention. Total cholesterol levels were examined using the Point of Care Testing (POCT) method before and after the intervention. Statistical analysis was performed using the paired t-test and the independent t-test. The results showed a significant decrease in total cholesterol levels in the treatment group from 240.33 ± 24.84 mg/dL to 207.07 ± 31.24 mg/dL (p = 0.000), with a mean difference of 33.27 mg/dL. Conversely, the control group experienced an increase in total cholesterol levels from 246.47 ± 28.65 mg/dL to 256.53 ± 27.51 mg/dL (p = 0.083). The independent t-test showed a significant difference between the two groups post-intervention (p = 0.000). The consumption of mung bean beverage with the addition of red ginger is effective in lowering total cholesterol levels in female patients with hypercholesterolemia. This intervention has the potential to be developed as a local food-based nutritional strategy for controlling dyslipidemia in primary health care

**Key Messages:**

- The combination of mung bean and red ginger beverage has been proven effective in significantly lowering total cholesterol levels in female patients with hypercholesterolemia. This local food-based intervention has the potential to become a simple, affordable, and practical nutritional strategy for controlling dyslipidemia in primary healthcare services.

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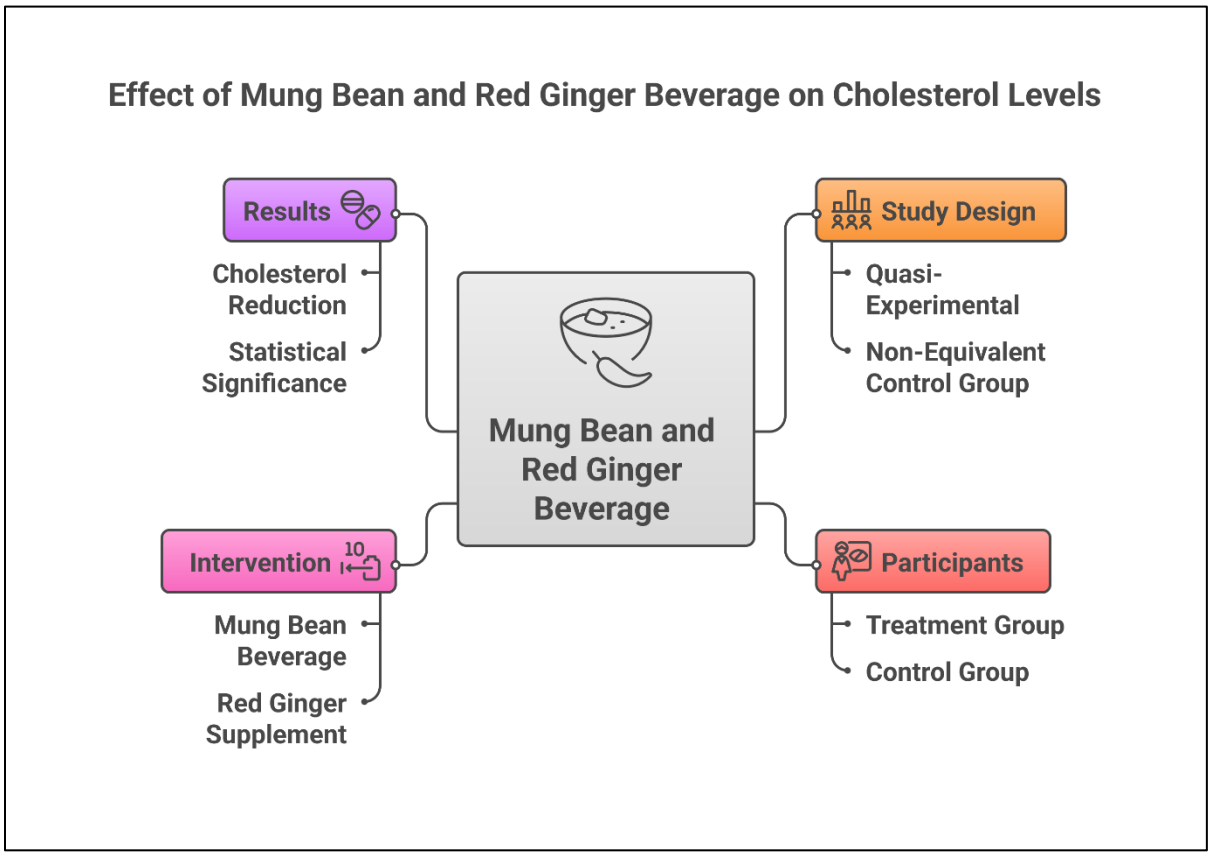
## GRAPHICAL ABSTRACT




## INTRODUCTION

Hypercholesterolemia is defined as a total cholesterol level of ≥ 200 mg/dL (1). According to the American Heart Association (AHA), hypercholesterolemia is a condition where total cholesterol and LDL levels in the blood exceed normal limits. High blood cholesterol levels are a major cause of atherosclerosis and/or atherosclerosis-related diseases, such as coronary heart disease, ischemic cerebrovascular disease, and peripheral vascular disease (2). Hypercholesterolemia is the second leading physiological risk factor for cardiovascular disease (CVD) after high blood pressure (3). High cholesterol was estimated to cause 3.5 million deaths and 81.4 million disability-adjusted life years (DALYs) in LMICs in 2019 (4).

Globally, the prevalence of hypercholesterolemia continues to rise. The WHO (5), reported that approximately 39% of adults aged 25 and older have elevated cholesterol levels, with a higher proportion in women compared to men. At the national level, the 2018 Basic Health Research (*Riskesdas*) reported that the prevalence of hypercholesterolemia in Indonesia reached 28.8% in the population aged ≥15 years, with a higher prevalence in women (31.0%) compared to men (26.4%) (6). Meanwhile, the results of the 2023 Indonesian Health Survey (*SKI*) showed that the proportion of the population aged ≥15 years with total cholesterol (TC) levels >200 mg/dl remains quite high, at 13.8% in women. Furthermore, the proportion of other abnormal lipid levels was also reported, namely LDL ≥130 mg/dl at 7.0%, triglycerides (TG) ≥150 mg/dl at 18.6%, and low HDL (<40 mg/dl) at 26.3%. Specifically, in East Kalimantan Province, the prevalence of hypercholesterolemia was recorded to be higher than the national average, reaching 46.8% (7). Meanwhile, the latest screening data from 2024 at the Gunung Sari Ilir Public Health Center (*Puskesmas*), Balikpapan City, East Kalimantan, indicated that hypercholesterolemia ranks as the second highest Non-Communicable Disease (NCD). The prevalence in women reached 69.8%, compared to 30.7% in men, and showed an increase from 38% in the first quarter to 43.71% in the fourth quarter (Productive Age NCD Screening Data, Gunung Sari Ilir Public Health Center, 2024).

The impact of hypercholesterolemia includes not only an increased risk of mortality due to cardiovascular disease but also a significant economic burden on the health system and community



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productivity (8). Therefore, intervention strategies that are affordable, accessible, and community-based are crucial.

In the context of functional food, mung bean (*Phaseolus radiatus* L.) possesses hypocholesterolemic potential. Animal studies (hamsters) have shown that the consumption of both cooked and germinated mung beans can lower total cholesterol and non-HDL levels, as well as increase cholesterol excretion through the mechanism of increased CYP7A1 enzyme expression (9). Additionally, mung bean intake has been proven to improve lipid profiles and oxidative stress in hyperlipidemic animal models (10) (11).

Meanwhile, red ginger (*Zingiber officinale* var. *rubrum*) is known to contain phenolic compounds and gingerol, which are influential in lowering blood lipids. A 2025 study showed that a combination of red ginger extract and Klanceng honey was effective in lowering cholesterol levels by up to 4% lower than the control, while simultaneously improving blood glucose and viscosity. These findings confirm the potential of red ginger as a natural complementary therapy for hypercholesterolemia control (12). A clinical trial in Indonesia also reported that the administration of red ginger powder at 3 g/day for 30 days significantly lowered total cholesterol levels (average decrease of 57.5 mg/dL, $p = 0.000$) in dyslipidemia patients (13).

Red ginger and mung bean are local foods with potential as functional interventions in the control of hypercholesterolemia. Red ginger contains gingerol, shogaol, paradol, zingerone, flavonoids, and polyphenols, which possess antioxidant properties and support protection against dyslipidemia. Meanwhile, mung beans are rich in vegetable protein, fiber, unsaturated fatty acids, as well as phytosterols and flavonoids, which can lower cholesterol by inhibiting its absorption in the intestine and increasing the excretion of bile acids. The combination of bioactive contents from both ingredients has the potential to become an alternative nutritional intervention based on local food that is inexpensive, easily obtained, and relevant for primary health care (14).

Despite promising individual effects, a significant gap exists in understanding the synergistic efficacy of a combined mung bean and red ginger beverage formulation specifically tailored for and tested in a community-based primary healthcare setting for hypercholesterolemic women. Local data from the Gunung Sari Ilir Public Health Center showing a high prevalence of hypercholesterolemia in women provides a strong basis for conducting this research. This local burden is likely exacerbated by high-fat diets and limited access to conventional medication, making a community-based, functional food approach particularly pertinent. In other words, the combination of mung bean and red ginger beverages has the potential to be a practical, locally based food intervention that can be implemented at the primary healthcare level in Indonesia. Based on the above, this study aims to assess the effect of administering a mung bean beverage with the addition of red ginger on total cholesterol levels in female hypercholesterolemia patients in the working area of Gunung Sari Ilir Public Health Center. These findings are expected to provide scientific evidence to support public nutrition policies in Indonesia and inform the management of hypercholesterolemia using local foods.

## METHODS

This study was conducted at the Gunung Sari Ilir Public Health Center, Gunung Sari Ilir Village, Central Balikpapan District, Balikpapan City, from June 18 to July 3, 2025, with an intervention duration of 14 days. The type of research used was a quasi-experiment with a non-equivalent control group design. In this design, an initial measurement (pretest) of total cholesterol levels was performed before the intervention, followed by the administration of the treatment, and then a re-measurement (posttest) after the intervention. The control group was not given the treatment, while the treatment group received a mung bean beverage with the addition of red ginger amounting to 250 ml every morning for 14 days.

The study population comprised all female hypercholesterolemia patients registered at the Gunung Sari Ilir Public Health Center. The study sample was determined using the Lemeshow formula, with a minimum of 30 respondents. The sampling technique used was purposive sampling, with inclusion criteria: (1) women aged 20–50 years; (2) having total cholesterol levels ≥ 200 mg/dl; (3) not currently consuming drugs or herbs that could affect cholesterol levels; and (4) willing to consume the mung bean beverage with the addition of red ginger for 14 days. The exclusion criteria included: (1) currently pregnant



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or breastfeeding; (2) currently under medical care related to heart and vascular disease, diabetes mellitus, hypertension, kidney failure, or gout; and (3) having a history of gastric acid disease or digestive disorders.

The independent variable in this study was the administration of the mung bean beverage with the addition of red ginger, while the dependent variable was the respondents' total cholesterol levels. The beverage was made from 25 grams of mung bean powder, 3 grams of red ginger powder, and 2.5 grams of corn sugar dissolved in mineral water to reach 250 ml. The beverage was administered once a day in the morning for 14 consecutive days.

Primary data were obtained from laboratory examination results of respondents' total cholesterol levels using the Point of Care Testing (POCT) method after the respondents had fasted for a minimum of 10 hours. Blood samples were taken by laboratory personnel using standard procedures, including preparing tools and materials, washing hands, wearing gloves, sterilizing the blood collection area with an alcohol swab, drawing blood using a pen blood lancet, dripping blood onto the test stick, and waiting for the results. The research instruments used included a cholesterol measuring device (POCT), blood lancets, pen blood lancet, alcohol swabs, wound plasters, masks, and disposable gloves. All procedures were carried out according to laboratory SOPs to ensure the validity of the examination results.

Data collected through laboratory examinations were then processed through the stages of editing, coding, entry, and cleaning. Data analysis began with a normality test using Shapiro-Wilk because the sample size was <50 people. Univariate analysis was used to describe the distribution of total cholesterol levels in the form of mean values and standard deviations. Bivariate analysis was conducted to determine the difference in total cholesterol levels between before and after the intervention. The statistical tests used were the paired t-test to assess pretest–posttest differences within each group, and the independent t-test to compare differences between the treatment and control groups.

This study has obtained ethical approval from the Research Ethics Commission of the Health Polytechnic of the Ministry of Health Gorontalo with protocol code DP.04.03/KEPK/294/2025, and all procedures were carried out in accordance with applicable research ethics principles and standards. Additionally, this study also obtained permission for data collection and implementation from the Balikpapan City Health Office and the Gunung Sari Ilir Public Health Center.

## RESULTS

Table 1 shows that the majority of respondents in both groups were in late adulthood (30–59 years), namely 73.3% in the experimental group and 80.0% in the control group. The highest level of education was Senior High School (SMA), with a proportion of 80.0% in the experimental group and 66.7% in the control group. In general, the characteristics of respondents in both groups were relatively comparable, making them suitable for comparison to assess the effect of the intervention.

**Table 1. Characteristics of Respondents in the Working Area of Gunung Sari Ilir Public Health Center**

| Characteristic | Experiment | | Control | |
|---|---|---|---|---|
| | n | % | n | % |
| **Age** | | | | |
| Early Adulthood (20-29 y) | 4 | 26.7 | 3 | 20.0 |
| Late Adulthood (30-59 y) | 11 | 73.3 | 12 | 80.0 |
| **Education** | | | | |
| Senior High School | 12 | 80.0 | 10 | 66.7 |
| Diploma | 2 | 13.3 | 4 | 26.7 |
| Bachelor's | 1 | 6.7 | 1 | 6.7 |
| **Total** | **15** | **100** | **15** | **100** |

Table 2 shows that in the experimental group, there was a decrease in the mean total cholesterol level from 240.33 mg/dL before the intervention to 207.07 mg/dL after the intervention, with a value range of 167–276 mg/dL. This indicates an improvement in the lipid profile of patients after being given the intervention of consuming mung bean beverage with the addition of red ginger. Conversely, in the control group which was not given the mung bean beverage with red ginger addition, there was an increase in the



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mean total cholesterol level from 246.47 mg/dL to 256.53 mg/dL. The range of cholesterol levels in the control group also tended to be higher post-research, namely 215–302 mg/dL.

**Table 2. Mean Pre and Post Total Cholesterol Levels in Experimental and Control Groups of Female Hypercholesterolemia Patients at Gunung Sari Ilir Public Health Center**

| Group | Mean (mg/dL) | Standard Deviation (mg/dL) | Minimum-Maximum (mg/dL) |
|---|---|---|---|
| **Experiment** | | | |
| Total Cholesterol Pre | 240.33 | 24.844 | 210-289 |
| Total Cholesterol Post | 207.07 | 31.244 | 167-276 |
| **Control** | | | |
| Total Cholesterol Pre | 246.47 | 28.645 | 263-291 |
| Total Cholesterol Post | 256.53 | 27.508 | 215-302 |

Table 3 shows the results of the paired t-test analysis. In the experimental group, the mean total cholesterol level before intervention was 240.33 ± 24.844 mg/dL, and after intervention, it decreased to 207.07 ± 31.244 mg/dL. This decrease showed a mean difference of 33.267 mg/dL with a standard deviation of 11.367 mg/dL. The statistical test showed a p-value = 0.000 ($p < 0.05$), so it can be concluded that there is a significant difference between total cholesterol levels before and after the intervention in the experimental group. Meanwhile, in the control group, the mean total cholesterol level before the study was 246.47 ± 28.645 mg/dL, increasing to 256.53 ± 27.508 mg/dL after the study. This increase showed a mean difference of 10.067 mg/dL with a standard deviation of 8.844 mg/dL. However, the statistical test results showed a p-value = 0.083 ($p > 0.05$), so the increase was not statistically significant.

**Table 3. Comparison of Pre-Post Total Cholesterol in Experimental and Control Groups of Female Hypercholesterolemia Patients at Gunung Sari Ilir Public Health Center**

| Group | Cholesterol Level | Mean ± (SD) (mg/dL) | Mean Difference (mg/dL) | Standard Deviation (mg/dL) | p |
|---|---|---|---|---|---|
| **Experiment** | Pre | 240.33 ± 24.844 | 33.267 | 11.367 | 0.005 |
| | Post | 207.07 ± 31.244 | | | |
| **Control** | Pre | 246.47 ± 28.645 | 10.067 | 8.844 | 0.083 |
| | Post | 256.53 ± 27.508 | | | |

The results of the independent t-test analysis, presented in Table 4, indicate a significant difference in total cholesterol levels between the experimental and control groups. The mean total cholesterol level in the experimental group after intervention was 207.07 mg/dL, while in the control group it was 256.53 mg/dL, with a mean difference of 49.46 mg/dL (SD = 10.75). A p-value of 0.005 indicates a statistically significant difference. These findings indicate that administering a mung bean beverage with the addition of red ginger is effective in lowering total cholesterol levels in female patients with hypercholesterolemia.

**Table 4. The Effect of Administering Mung Bean Beverage with Red Ginger Addition on Total Cholesterol Levels in Female Hypercholesterolemia Patients in the Working Area of Gunung Sari Ilir Public Health Center**

| Total Cholesterol | Mean Post (mg/dL) Experiment | Mean Post (mg/dL) Control | Mean Difference (mg/dL) | Standard Deviation (mg/dL) | p |
|---|---|---|---|---|---|
| | 207.07 | 256.53 | 49.467 | 10.748 | 0.000 |

## DISCUSSION

The results of this study indicate that the administration of mung bean (*Phaseolus radiatus* L.) beverage with the addition of red ginger (*Zingiber officinale* var. *rubrum*) has a significant effect on reducing total cholesterol levels in female patients with hypercholesterolemia at Gunung Sari Ilir Public



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Health Center. In the experimental group, the mean total cholesterol level decreased from 240.33 ± 24.84 mg/dL to 207.07 ± 31.24 mg/dL, with a mean difference of 33.27 mg/dL (SD = 11.37) and a p-value = 0.005. These findings prove that this local food-based intervention has the potential as a non-pharmacological strategy in the management of hypercholesterolemia. Conversely, the control group actually experienced an increase in cholesterol levels (mean difference +10.07 mg/dL; p = 0.083), although not significant, indicating that the intervention has a tangible effect compared to the condition without treatment.

This research is supported by a study conducted by Hapsari & Rahayuningsih (15), where the administration of red ginger (*Zingiber officinale* var. *rubrum*) beverage at a dose of 3.2 ml/kg body weight for 21 days in women with dyslipidemia was proven to significantly lower LDL levels by 12.75%. These results indicate that the main bioactive compounds in red ginger, such as gingerol and shogaol, play a role in the hypolipidemic mechanism through increasing lipoprotein lipase enzyme activity and inhibiting cholesterol synthesis in the liver. Meanwhile, the results of the study by Sulistyaningsih & Mulyati (16) also reported that the administration of mung bean extract (*Phaseolus radiatus* L.) at 75 g/day for 14 days in hypercholesterolemia patients was able to significantly lower total cholesterol levels from 238.13 mg/dL to 217.00 mg/dL (p = 0.031).

The compounds found in ginger are volatile and non-volatile compounds. Volatile compounds consist of various terpenoid compounds, while non-volatile compounds consist of gingerol, shogaol, paradol, zingerone and their derivatives, as well as flavonoid and polyphenol compounds which have antioxidant effects that can prevent free radicals in the body. The main contents in ginger are gingerol and shogaol which are flavonoid compounds. The content of 6-gingerol, 8-gingerol, 10-gingerol, and 6-shogaol in red ginger is higher compared to elephant ginger, namely 18.03, 4.09, 4.61, and 1.36 mg/g respectively. The gingerol content in ginger has hypocholesterolemic and anti-atherogenic effects as well as suppression of HMG-CoA reductase enzyme activity, thereby reducing total cholesterol biosynthesis (14).

Previous studies have also reported that the administration of ginger extract was proven capable of significantly lowering plasma cholesterol levels and reducing the formation of atherosclerotic lesions. At high doses, ginger extract was reported to lower plasma cholesterol by up to 29%, lower LDL levels by up to 33%, and inhibit the process of LDL oxidation and aggregation(17). A recent meta-analysis review indicated that ginger consumption also improves the overall lipid profile, including triglycerides, total cholesterol, LDL, and HDL, depending on dosage and duration (18). Studies on animals also found that the administration of mung bean water to type 2 diabetic rat models for 8 weeks was proven to lower total cholesterol levels and atherogenic lipoprotein fractions (VLDL + LDL). This intervention was able to reduce oxidative stress, indicated by a decrease in malondialdehyde (MDA) levels as a biomarker of lipid peroxidation (19).

Biologically, the mechanism of cholesterol reduction in the intervention group can be explained through the bioactive content of both ingredients. Red ginger contains gingerol, shogaol, and phenolic compounds known to possess antioxidant activity and the ability to inhibit the HMG-CoA reductase enzyme, which is a key enzyme in cholesterol biosynthesis (20) (21). Additionally, ginger plays a role in increasing total plasma antioxidant capacity and reducing lipid peroxidation. This effect occurs through increased activity of endogenous antioxidant enzymes, such as superoxide dismutase, catalase, and glutathione peroxidase in the blood. Furthermore, ginger is able to reduce oxidative stress by scavenging superoxide ions and hydroxyl radicals. This antioxidant activity is primarily contributed by bioactive compounds such as gingerol, shogaol, and various phenolic ketone derivatives which play an important role in neutralizing free radicals (15).

Meanwhile, mung beans contribute through their content of soluble fiber, phytosterols, and isoflavones which play a role in binding bile acids in the intestine and increasing cholesterol excretion. Experimental studies on animals and humans have proven that mung bean consumption is capable of lowering blood cholesterol levels and improving lipid metabolism balance(22). Furthermore, recent research in Indonesia also shows that a combination of local foods is effective in lowering cholesterol: the administration of soy milk mixed with red ginger significantly lowered total cholesterol levels by approximately 39.2 mg/dL (17.5%) in 14 days (p < 0.001)(23). The combination of mung bean and red ginger in a single intervention provides a synergistic effect, namely cholesterol reduction through a dual



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mechanism: inhibition of cholesterol biosynthesis and increased cholesterol excretion. Another assumption regarding the increase in cholesterol levels in the control group due to a high-fat intake pattern (average 66.66 g/day exceeding the RDA) and a lack of management, both pharmacological and non-pharmacological, also reflects reasonable conditions in the field. This aligns with literature stating that a high-fat diet and sedentary lifestyle trigger an increase in cholesterol in general. Thus, the difference in trends between the intervention and control groups is not merely a statistical effect, but also a clinically important phenomenon to note. Theoretically, the success of the intervention is also explained by the activity of gingerol in red ginger which has antioxidant effects and modulates lipid enzymes such as HMG-CoA reductase and cholesterol 7α-hydroxylase, as well as fiber and bioactive components of mung beans which increase bile binding and cholesterol excretion; all support the significant decrease in total cholesterol levels in the intervention group.

## CONCLUSION

This study demonstrates that the administration of mung bean beverage with added red ginger has a significant effect in lowering total cholesterol levels in female patients with hypercholesterolemia. This positive effect is supported by the gingerol content in red ginger, which is capable of inhibiting cholesterol biosynthesis through the mechanism of HMG-CoA reductase enzyme inhibition, as well as isoflavone compounds, soluble fiber, and antioxidants in mung beans which play a role in improving lipid metabolism and enhancing cholesterol profile balance. These results strengthen the evidence that the utilization of local foods rich in bioactives can be used as an alternative functional intervention in efforts to prevent and control dyslipidemia in the community. For future follow-up, research with a larger sample size, longer intervention duration, and measurement of other biomarkers such as LDL, HDL, triglycerides, and inflammatory markers is needed to obtain a more comprehensive picture. Additionally, the development of product formulations based on red ginger and mung beans in the form of beverages or supplements can be an innovative strategy supporting non-communicable disease control programs at the basic health service level.

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## CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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