

REVIEW

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# Ginger (*Zingiber officinale*), as anti-hypercholesterolemia to prevent metabolic syndrome: Systematic Literature Review

Beta Melani<sup>1,\*</sup> and Suci Nar Vikasari<sup>2</sup>

## ABSTRACT

**Background:** One of the symptoms of metabolic syndrome is an increase in cholesterol levels in the blood. Red Ginger (*Zingiber officinale*) is an herbal plant that has several active compounds that can help improve lipid levels in the blood. The community uses red ginger because it is easy to grow and/or procure at a reasonable cost. Red ginger has the potential to be used in herbal formulations to help people avoid metabolic syndrome.

**Aim:** This systematic study was conducted to examine the potential of ginger as an anti-hypercholesterolemia to prevent metabolic syndrome based on preclinical and clinical study.

**Methods:** The study was conducted on Indonesian-language articles through the Google Scholar Indonesia database. The inclusion criteria used were articles in Indonesian, preclinical and clinical experimental research, and complete articles that were accessible free of charge.

**Results:** The results of the study show that the anti-cholesterol effect of ginger has been proven both preclinically and clinically. To reduce blood cholesterol levels, ginger can be used combine with other herbs. Some of the active ingredients in ginger are phenolic compounds, including gingerols and shogaols. The suspected mechanism of action is to affect the HMG-CoA reductase enzyme by inhibiting the oxidation pathway and as antiinflammation.

**Conclusion:** Ginger has the potential to prevent metabolic syndrome by reducing cholesterol levels in the blood.

**Keywords:** Ginger, *Zingiber officinale*, hypercholesterolemia, metabolic syndrome

## BACKGROUND

Metabolic syndrome is a symptom of a disease include elevated blood pressure, elevated blood sugar levels, obesity and dyslipidemia. The occurrence of metabolic syndrome is generally due to lifestyle changes, one of which is unhealthy eating patterns such as eating sweet, salty, fatty foods, animal side dishes with preservatives and excessive use of flavourings<sup>1</sup>. Metabolic syndrome can lead to stroke, various heart diseases and diabetes mellitus<sup>2</sup>. One of the most common dyslipidemias is hypercholesterolemia. The definition of hypercholesterolemia is an increase in cholesterol in the blood due to abnormalities in the level of lipoproteins (particles that carry cholesterol into the bloodstream) which in the long term accelerates the occurrence of atherosclerosis<sup>3</sup>.

Ginger (*Zingiber officinale*), is a plant whose rhizomes are often used as spices and as raw materials for traditional medicine. The rhizome is in the form of fingers that bulge in the middle segments. The dominant spicy taste felt from ginger is caused by a ketone compound called zingeron<sup>4</sup>. Ginger rhizome in Indonesia is

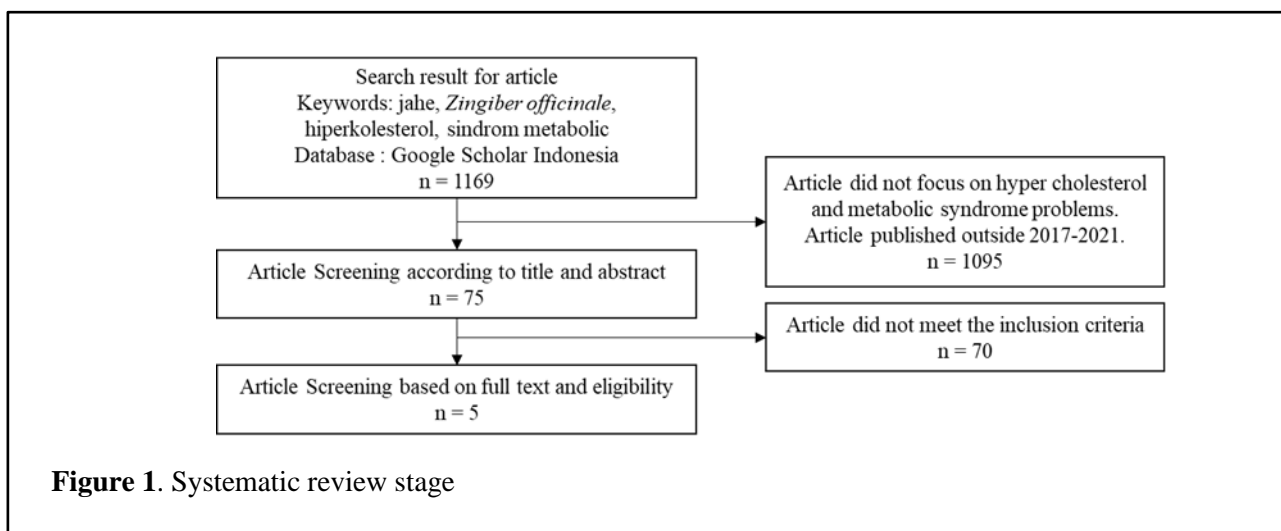
\*Correspondence: betamelaningadilan@gmail.com

<sup>1</sup>Kompetensi Keahlian Farmasi, Sekolah Menengah Kejuruan Bandung Barat, Bandung, Indonesia  
Full list of author information is available at the end of the article

used traditionally to treat swelling, irritation, vomiting, flu, as a laxative, stimulant, laxative menstruation, and laxative saliva<sup>5,6</sup>. Several pharmacological activities were observed, including antiemetic, anti-inflammatory, analgesic effect, reducing osteoarthritis, antioxidant, anticancer, antithrombotic, hypolipidemic and hypoglycemic effects, cardiovascular, antineoplastic, anti-infective, hepatoprotective and immunomodulatory effects.<sup>4</sup> Ginger rhizome contains essential oils not less than 0.70% v/w. Ginger essential oil contains monoterpenes ( $\beta$ -phellandren, camphene, cineol, geraniol, curcumene, citral, terpineol, borneol) and sesquiterpenes ( $\alpha$ -zingiberen, -sesquiphellandren, -bisabolen, -farnesen, ar-curcumene), zingiberolene. The main chemical constituents contained in ginger rhizome are (6,8, and 10)-gingerol, (6,8 and 10)-shogaol, paradol, methyl gingerol, gingerdiol, dehydrogingerdion, gingerdion<sup>7</sup>. This compound belongs to the group of phenolic compounds. Shogaol is formed from gingerol that has undergone changes due to temperature. Ginger rhizome also contains water, carbohydrates, protein, fat, minerals, and fiber<sup>7</sup>. It is known that there are several types of ginger, including small ginger, red ginger and elephant ginger. The different types of ginger cause differences in the content of phenolic compounds<sup>8</sup>. Red ginger compounds, such as gingerols, are used to treat test animals fed high-fat diets<sup>9</sup>, so this study research is aimed at assessing the potential of ginger as an anti-hypercholesterolemic for the prevention of metabolic syndrome.

## METHODS

This literature review was conducted using the Google Scholar Indonesia database which was published in 2017-2021. The keywords used are ginger, *Zingiber officinale*, hypercholesterolemia and metabolic syndrome. The inclusion criteria used were articles in Indonesian, preclinical and clinical experimental research, and complete articles that were accessible free of charge. The inclusion criteria used were articles in Indonesian, preclinical and clinical experimental research, and complete articles that were accessible free of charge. Inclusion criteria was the results of the study did not provide complete data and the article was in the form of a review. The next step was to present in the form of a table containing the title of the article, author, year and research results.



## RESULTS

In this study, the articles found with the keywords ginger, *Zingiber officinale*, hypercholesterolemia and metabolic syndrome from the Google Scholar database were 1,169 articles. After screening based on titles and

abstracts, 75 articles were obtained, and according to the inclusion criteria, a study was conducted on preclinical and clinical studies of red ginger in Indonesia, and the results showed that there were 5 articles that met these criteria to be analyzed. The articles analyzed can be seen in Table 1.

**Table 1.** Summary of Selected Studies

No.	Researcher	Article title	Research result
1	Sunaryo, Rahmania, Dwitiyanti, Siska (2015) <sup>10</sup>	Antioxidant Activity of Combination between Ginger Extract ( <i>Zingiber officinale</i> Rosc.) with Zink Based on MDA, SOD and Catalase Measurements in Hypercholesterolemia and Hyperglycemia Mice with Streptozotocin as Inducer	Combination of ginger extract and Zinc (75 and 20 mg/kg bw) was able to reduce levels of malonyldialdehyde (MDA) and increase levels of superoksida dismutase (SOD) and catalase in animal models
2	Uthia, Dharma and Dewita (2016) <sup>11</sup>	The effect of mixture of ginger, garlic, wine vinegar, and honey on total cholesterol levels and histopathology of aorta heart vehicles in male white rats	The combination dosage of red ginger, garlic, apples, lemon and honey (0.162 g, 0.09 g, 1.8 g, 50 mL and 1.8 g for 200 g bw) for 28 days decrease in total cholesterol levels and may improve lumen area and lower scores damage to the blood vessels
3	Ifora, Dharma, Darma (2016) <sup>12</sup>	The effect of combination of ginger, garlic, apple, lemon and honey on total cholesterol levels and histopathology of aorta heart vehicles in male white rats	The combination dosage of red ginger, garlic, apples, lemon and honey (0.162 g, 0.09 g, 1.8 g, 50 mL and 1.8 g for 200 g bw) for 28 days decrease in total cholesterol levels may affect histopathologic aorta
4	Safitri and Agustin (2018) <sup>13</sup>	The effect of the administration of soybean and ginger milk on decreasing the cholesterol levels of Ngargoyoso Karanganyar citizens	Quasi experimental design, non-equivalent control group design, research by conducting examinations before and after being given treatment with soy milk and ginger and the presence of a control group. Giving 50 grams of red ginger, crushed and mixed with soy milk, reduces cholesterol levels in Ngargoyoso Karanganyar residents.
5	Mudrikatin (2020) <sup>14</sup>	The Influence of Red Ginger Extract in Menopause Climacterium Period of Total Cholesterols in Covid-19 Pandemic Period in East Java	The study design used a quasi-experimental design with a non-equivalent (pretest and posttest) control group design. Giving red ginger extract to women during menopause climacterium at a dose of 10 grams taken twice daily for 14 days can reduce total cholesterol levels by an average of 22 mg/dl.

## DISCUSSION

Based on the data, it was found that testing of ginger as an anti-hypercholesterolemia for metabolic syndrome has been carried out both preclinically and clinically. As an anti-hypercholesterolemia, ginger usually combine with other herbal plants. The use of herbal combinations has been carried out for generations and aims to increase the effect<sup>15</sup>. The use of a combination of ginger with other herbs has been proven to be safe and non-toxic. Toxic effects that need to be considered in acute administration are decreased movement activity, increased respiratory rate, urination and salivation. The urinary effect could be due to ginger having a potential diuretic effect<sup>16</sup>.

One of the causes of metabolic syndrome is obesity which is followed by an increase in fat metabolism. This causes an increase in the production of Reactive Oxygen Species (ROS) both in the circulation and in adipose cells<sup>17</sup>. The antioxidant effect of ginger is proven by its ability to reduce MDA levels, increase SOD and catalase levels in hypercholesterolemic and hyperglycemic test animals with streptozotocin inducers<sup>10</sup>.

The antioxidant effect of ginger is very strong and is related to the phenolic compounds it contains<sup>16</sup>. Several studies have suggested that flavonoid levels in the ginger can be used to reduce cholesterol levels by increasing the synthesis of bile acids<sup>18</sup>. The presence of 6-gingerol in the blood can trigger the production of low-density lipoprotein cholesterol (LDL-C) via triggering the production of C-reactive protein (CRP) and prostaglandins (PGE2). Niacin this content can help high-density lipoprotein cholesterol levels<sup>18</sup>.

Ginger is also known to have anti-inflammatory effects. Several components in ginger that have an anti-inflammatory impact also have an active influence on NF-kB and TNF- $\alpha$  expression. The presence of 6-gingerol and 6-paradol has a substantial anti-inflammatory impact. These anti-inflammatory components work by inhibiting the synthesis of TNF- $\alpha$ . It can impact the decrease in NF-kB activity, which is linked to other inflammatory cytokines and affects the action of the cyclooxygenase 2 enzyme, by decreasing TNF- $\alpha$  production. Prostaglandin synthesis can be affected by changes in the activity of these enzymes (PGE2). In this process, these components can also lower levels of acute phase proteins including C-reactive protein (CRP)<sup>18</sup>. Indirectly, the antioxidant effect of ginger will affect the reduction of inflammation. Inflammation itself is associated with the risk of developing metabolic syndrome, because there is a strong correlation between levels of the pro-inflammatory cytokine IL-18 in obese adolescents with metabolic syndrome<sup>19</sup>.

## CONCLUSION

Based on literature review, preclinic and clinical study show that ginger has the ability to prevent metabolic syndrome by lowering blood cholesterol levels.

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None

## CONFLICT OF INTEREST

The authors declare no conflict of interest regarding the publication of this article.

## AUTHORS' CONTRIBUTION

BM contributed to the systematic literature review and manuscript writing. SNV provided guidance during the manuscript writing process. All authors read and approved the final manuscript.

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## AUTHOR DETAILS

<sup>1</sup>Kompetensi Keahlian Farmasi, Sekolah Menengah Kejuruan Bandung Barat, Bandung, Indonesia

<sup>2</sup>Faculty of Pharmacy, Universitas Jenderal Achmad Yani, Cimahi, Indonesia

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