



Review Article

Cardioprotective effects of ginger (*Zingiber officinale*)

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ABSTRACT

Ginger is the rhizome of the plant *zingiber officinale*. In ayurveda, it is referred as “vishwabheshaja” which means the universal medicine, can be given to anyone living in this world and it would be suited to all. In addition to its culinary use ginger also possess medicinal property by bioactive components present in them. Ginger can be used in its fresh, dried, powdered, oil and syrup forms. Ginger is an herbal remedy and reported to possess strong anti-diabetic, anti-inflammatory, anti-oxidant, anti-microbial and other activities. The present review is conducted to evaluate cardioprotective effect of ginger. Ginger was found effective in combating cardiovascular disease such as hypertension, obesity, atherosclerosis by changing lipid profile.

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1. Introduction

Herbs and plants are used as a source of therapeutic compounds in traditional medicinal system since ancient time. Medicinal plants play an important role in ethno medicine and pharmaceutical markets.¹ The rhizome of ginger has been used as a spice & traditional medicine.² Ginger is an herbaceous perennial plant with thick tuberous rhizome. Plant can grow up to 30 to 100 cm (1-3 ft) tall. Leaves are lance-shaped, bright green colored covered by sheathing base.³ Rhizomes are pale yellow, thick, aromatic and grow underground. Flowering spikes sprout directly from the rhizome. Cultivated in both tropical and subtropical countries like India, China, Bangladesh, Taiwan, Jamaica, Nigeria. Ginger has got medicinal value from the abundant chemical constituents present in them.⁴ Chemical analysis of ginger showed above 400 different compounds, among them are carbohydrates (50-70%), lipids (3-8%), terpenes & phenolic compounds are major

constituents.⁵ Gingerols, shogaols, paradols are major phenolic compounds whereas quercetin, zinger one, gingerenone-A, and dehydro gingerdione are some of the other phenolic compounds.⁶⁻⁸ α -curcumin, β -bisabolene, zingiberene, α -farnesene, and β -sesquiphellandrene are several terpene compounds.⁹ The plant is reported for analgesic activity, anticancer, anti-diabetic activity, antiemetic, antimicrobial, anti-inflammatory activity, antioxidant activity and neuroprotective activity.¹⁰ The present review is focused on cardio protective effect of *zingiber officinale*.

1.1. Taxonomy

1. Kingdom: Plantae
2. Division: Magnoliophyta
3. Order: Zingiberales
4. Family: Zingiberaceae
5. Genus: Zingiber
6. Species: *Z officinale*

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1.2. Vernacular names of ginger¹¹

Language	Name
Assami	Adakesa
Bengali	Ada
Gujarati	Adhu(Fresh), Sunth, Shuntya(Dried)
Hindi	Adrak (Fresh), Sonth (Dried)
Kannada	Hasishunti
Kashmiri	Adrak
Malayalam	Inji
Manipuri	Sing
Marathi	Sunth, Shuntya(Dried), Alha(Fresh)
Oriya	Ada, Adrak
Sanskrit	Aadrak
Tamil	Ingee
Telugu	Allam
Urd and Punjabi	Adrak

1.3. CVD

Cardiovascular diseases have been considered to be a leading cause of premature death and in 2008 17.3 million people died from CVD. Age, diabetes, dietary factors, dyslipidemia, hypertension, lack of physical activity, obesity, sedentary life style, sex and Smoking are risk factors responsible for premature deaths due to CVD.¹² A series of studies has shown that bioactive components of ginger namely gingerol and shogaol give protection against cardiovascular diseases.¹³

1.4. Hypotensive effect

Hypertension is the condition in which blood pressure is equal or more than 140/139 mm Hg. Hypertension can be managed by antihypertensive medications, modifying life style and through alternative herbal therapy such as ginger.¹⁴ Study of Ghayur and Gilani, 2005 reported that the crude extract of ginger (0.3-3 mg/kg) alleviated arterial blood pressure in anesthetized rats. In guinea pig paired atria crude extract of ginger exhibited cardio-depressant activity on the rate and force of spontaneous contraction.¹⁵ Study of Sathyanand et al., 2013 on hypertensive patients stated that ginger was effective in relieving high blood pressure by blocking calcium channels of organ and arterial walls, which induce smooth muscle contraction.¹⁶ Study of Shaban et al., 2017 on hypertensive patients reduced systolic and diastolic blood pressure in two study groups who took ginger while control group (took only anti-hypertensive drugs) had the signs and symptoms of hypertension in both pre and post study.¹⁴ Study conducted on obese women improved TC/HDL and LDL/HDL ratios and decreased triglycerides on administration of ginger capsules.¹⁷

1.5. Prevention of obesity

Imbalance between energy intake and expenditure leads to excessive energy storage as triglycerides in adipose tissue known as obesity; it can cause many serious health problems.¹⁸ Ginger has shown the most significant anti-obesity effects in in-vitro and in-vivo studies. Administration of aqueous extract of ginger to high fat fed rats decreased triglyceride and low-density lipoprotein and increased high density lipoprotein.¹⁹ Study conducted by Sayed et al. reported that rat received ginger water decreased body weight, mRNA expression of sterol regulatory element-binding protein 1 (SREBP-1c) in liver and adipose tissues were down regulated, while those of adiponectin, hepatic carnitine palmitoyltransferase1 (CPT-1), acetyl-coA-oxidase (ACO), Glucose transporter 2 (GLUT-2), and pyruvate kinase (PK) were upregulated.²⁰ Furthermore, ginger decreased elevated serum lipase activity, high density lipoprotein & increased total cholesterol excretion in rats.²¹ Ginger capsules improved TC/HDL and LDL/HDL ratios and attenuated triglyceride and low-density lipoprotein in the study conducted on obese women.¹⁷

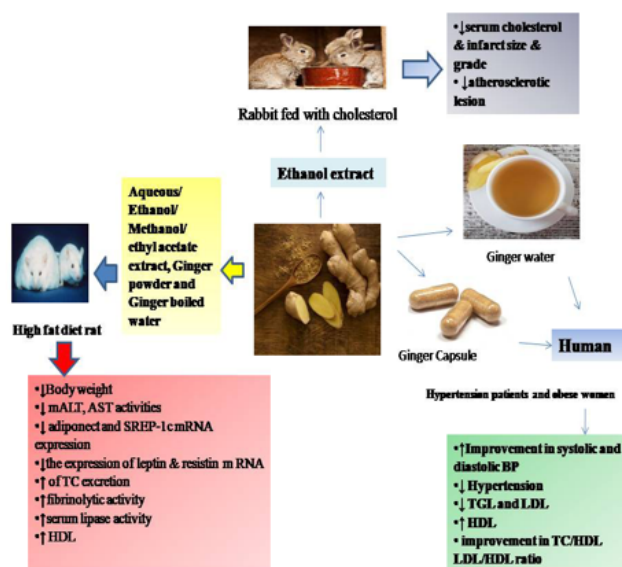


Fig. 1: Diagram depicting the cardio-protective effect of ginger

1.6. Prevention of atherosclerosis

Atherosclerosis is build-up of low-density lipoprotein, cholesterol on the inner wall of an artery and vascular inflammation leading to interruption of blood flow.^{22,23} The effect of dry ginger powder (0.1g/kg body weight) was studied on experimentally induced atherosclerosis in rabbit for 75 days. This significantly decreased serum cholesterol, atherosclerotic lesion, infarct size and grade.²⁴ Verma et al., 2004 conducted study on Indian albino rabbits' administration of ginger powder (0.1 g/kg body

Table 1: Study design and demographic description of cardio protective effect of *Z. officinale* with high quality evidence

Model	Extract	Dose	Parameters	Result	References
High fat diet fed albino rats	Ginger boiled water	125 mg/kg /day for 2 weeks	Biochemical analysis of blood samples Histological examination of liver	↓ in ALT , AST activities & in TGs and TC levels	Emam et al., (2019)
High fat diet fed male albino rats	Aqueous extract	250 & 500 mg/kg body wt/day for 12 weeks	plasma analysis Liver lipid analysis Fecal analysis	Both doses of ginger attenuated TC,TG & LDL ↑ of TC excretion in mice & it is dose dependent	Bekkouch et al., (2019)
Male wistar rats	Ginger water	25-50% in their drinking water for 30 days	Biochemical analysis of TC & TAG Gene expression analysis	↓serum TC & TAG ↓regulate SREBP-1c Mrna expression ↓the expression of leptin & resistin m RNA ↑Adiponectin in m RNA expression compared to control ↑GLUT-2m RNA , CPT-1m RNA, ACO m RNA	Sayed et al., (2019)
Patients with hypertension	Ginger water	Ginger water one time/day for 10 months	Questionnaire Physiological measurement of blood pressure	Improvement in systolic & diastolic BP by 1 month ↓hypertension	Shaban et al., (2017)
Male rabbit fed high cholesterol	Ethanollic extract	0.1g/kg body wt /day for 75 days	Enzymatic assays of blood samples Microscopic measurement of atherosclerotic lesions	↓serum cholesterol & infarct size & grade ↓atherosclerotic lesion	Rouhi-Boroujeni et al., (2016)
Wister rats	Ginger powder	*20 & 40 mg/kg body wt ginger or garlic/day *10 mg of garlic + 10 mg of ginger/kg body wt/day *20 mg of garlic+ 20 mg ginger/kg body weight /day For 4 weeks	Lipid profile analysis BP recorded by micro dynamometer	↓Serum TC,TG & LDL in all doses ↓Diastolic blood pressure in all single & combined doses of garlic+ginger Single doses of ginger reduced pulse pressure	Tende et al., (2015)
High fat diet fed albino rats	Ginger powder	5% ginger powder along with high fat diet for 4 weeks	Body weight Peroxisomal enzyme analysis Biochemical analysis of lipid profile	↓Body weight ↓TG,LDL No change in bilirubin & pancreatic lipase activity ↑serum lipase activity	Mahmoud and Elnour.,(2013)
Male wistar albino rats	Ethnoli extract	200,400 & 2000 mg/kg bd wt/day for 4 weeks	Measurement of mean arterial blood pressure Assessment of oxidative stress	Attenuated left ventricular weight to body weight & left ventricular wall thickness ↓Mean arterial blood pressure, protein content, RNA concentrate ,collagen content, CK-MB & LDH level	Rohini et al., (2013)
Doxorubicin induced male albino rats	Ethanollic extract of ginger	200 mg/kg body wt/day 4weeks before & 2 weeks concurrent with doxorubicin	ECG Blood sample analysis	↓mortality % ginger & vitamin E provided protection from DOX-induced cardiac injury	Galal et al.,(2013)
Vanaspathi fed long Evans rats	Ginger extract	300 mg/kg/day for 49 days	Lipid profile Histopathological study – liver & aorta	Prevented the rise in TC, LDL, TG levels ↑HDL level	Paul et al.,(2012)

Table 1 Cont...

Cisplatin-induced albino rats	Ethanol extract of ginger	0.5 & 1 g/kg body wt/day for 10 days	Blood serum analysis Histological examination	Reduction in AST,ALT & TSB Protection against cisplatin-induced hepatic & cardiac damage ↓LDH & CK levels	Attyah and Ismail.,(2012)
Alloxan induced diabetic rats	Ginger juice/ extract	4 ml/kg body wt /day for 6 weeks	Enzymatic calorimetric method-cholesterol LDL,VLDL & HDL	↓plasma cholesterol, LDL& TG ↑HDL level	Elshater et al., (2009)
Fructose-induced rats	Methanol & ethyl acetate extract	250 mg/kg body wt/day for 3 weeks	Lipid profile Body weight	↓in the elevated lipid levels & body weight	Kadnur and Goyal.,(2005)
Albino rabbits fed with cholesterol	Ginger powder	0.1 g/kg body wt for 75 days	Lipid profile Body weight	↓in the lipid peroxidation ↑fibrinolytic activity ↓LDL, TG & TC	Verma et al., (2004)
High fat fed rats	Aqueous extract	35 & 70 mg/kg body wt/day	Lipid profile	↓TGL & LDL ↑HDL Higher doses had a stronger reducing effect than the lower doses	Murugaiah et al., (1999)
Obese women(18-45 years)	Ginger capsule	1 g/day (2 tablets of 500 mg) for 12 weeks	Lipid profile	↓TGL & LDL ↑HDL Improvement in TC/HDL & LDL/HDL ratios	Attari et al., (2015)
Patients with type 2 diabetes (30-70years)	Ginger capsule	800 mg capsule before lunch & dinner for 12 weeks	Recording international physical activity questionnaire (IPAQ-S) Anthropometry Lipid profile	↓TG & TC	Arablou et al., (2014)

weight) for 75 day decreased lipid peroxidation and enhanced fibrinolytic activity. These distinct properties prevent development of atherosclerosis.^{25–36}

2. Conclusion

Ginger is used as a spice, flavoring agent, food and medicines. Pharmacological screenings of *Zingiber officinale* revealed its curative properties. The present review is based on current and past research done on the cardioprotective effect of ginger. Ginger was found helpful in management and restoration of hypertension, obesity, atherosclerosis and hypolipidemia.

3. Source of Funding

None.

4. Conflict of Interest

None.

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