

Exploring the Pharmacological Significance of Ginger: A Literature-Based Review

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ABSTRACT:

Ginger (*Zingiber officinale*) is one of the most renowned and useful medical plants famous for its therapeutic and pharmacological properties. This literature review aims to summarize and highlight the potential of ginger and its bioactive components such as shagols, gingerols, gingerdiones and zingerone. The data is being collected from different researches, scientific studies and data bases and by the clinical controlled trials available on the databases like Google Scholar, PubMed and eCommons. This review actually highlights the important pharmacological properties of lowering blood pressure, lowering triglycerides (LDL and increasing HDL), antioxidant activity, inhibition or blockage of calcium channels, mediating inflammation and improvement of lipid metabolism. Overall, this review actually highlights the potency of ginger to be a promising candidate for future drug development in pharmaceuticals due to its characteristics. Furthermore, this article also summarizes the important characteristics of ginger which promises the further exploration of its bioactive components.

KEYWORDS: *Zingiber Officinale*, Ginger, bioactive components, antioxidant activity.

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INTRODUCTION:

Ginger (*Zingiber officinale*) is an aromatic and medicinal plant which is widely used as a spice and as a traditional medicine and for remedies in various parts of the world. It is a rich, herbaceous and a perennial plant generally attaining a height of about 1 meter. The leaves of ginger plant are lanceolate and

bright green, while the flowers are pale yellow with purple margins. Ginger belongs to the family of ZINGIBERACEAE which also encompasses other notable and essential spices such as turmeric, cardamom and galangal [1, 2].

Ginger is indigenous to Maritime Southeast Asia, firstly domesticated by Austronesian

peoples (coastal Asian communities). It was among the earliest Asian spices exported to Europe finding use in ancient Greek and Roman civilizations. The fresh rhizome of ginger has approximately 79% of H₂O, 2% protein, 18% carbohydrates, 1% fat, and energy about 89kcal (333kJ) for 100 gram. It also offers Moderate amount of potassium, magnesium, manganese and some other micro nutrients are also present. It is safe to have ginger in a normal quantity, overdose can cause gastro intestinal issues. It is recognized safe by FDA (GRAS). Ginger is a complex compound containing about 400 compounds. The major bio active components of ginger includes Gingerols, (pungent compound), Shagols (can be formed from Gingerols via heating or any other physical process), Zingerone (formed by Gingerols during drying, lesser pungent compound, also contributes to aroma), Sesquiterpenes (beta-bisabolene, zingiberene). These compounds aid in different biological properties of ginger like anti-microbial, anti-inflammatory, antioxidant, cardio protective etc. Because of its versatile and wide class properties it does not have many medicinal properties but also has a versatile use worldwide for example in beverages, candy, sodas, teas, wines, pickles, medicines (modern and traditional both). Due to the interest of the modern world differently in research, the importance of ginger and its properties have also increased. The scientific revolution has actually discovered its role in managing different diseases like nausea, metabolic disorders and cardio protective issues. This makes ginger an important compound not only in culinary uses but also in pharmaceuticals[3], aiding in the relief of serious diseases.



CHARACTERISITC PROPERTIES OF GINGER:

1. Vasodilant and vasorelaxant property:

Ginger has been identified as a potent natural vasodilator having a direct impact on vascular smooth muscles and blood pressure regulation. This VASODILENT or VASORELAXANT PROPERTY is actually due to its bioactive components such as gingerols, Shagols and Zingerone. They actually work by modulating the calcium channel's activity, nitric oxide signaling and endothelial function. Some investigations have also shown that ginger can act by blocking the calcium channels (voltage dependent) by mimicking the calcium channel's working mechanism like verapamil thereby reducing resistance in vessels and pressure in arteries. Other researches and studies have also shown that ginger is potent enough to increase the activity of eNOS endothelial nitric oxide synthase via ERK 1/2 phosphorylation which leads to greater production of NO nitric oxide thus causing relaxation in smooth muscles[4-6]

Additionally 6-gingerol (another bioactive component of ginger) is potent enough to ease abnormal constriction of vessels in diabetes patients by restoring NO-cGMP signaling. These properties of ginger actually

contribute to improved compliance of vessels, reduced peripheral resistance and cardio protective benefits.

2. Osteoblast protective

Ginger (*zingiber officinale*) exhibits outstanding properties of osteo protective mainly due to its phenolic bioactive components such as 6-gingerol and 10-gingerol. These bioactive components play a vital role in the maintenance of bone integrity by maintaining a perfect balance in bone formation and bone deformation. Studies have also showed and demonstrated that ginger extract have the potency for osteoblast differentiation and mineralization mainly through the upregulation of osteogenic markers as ALP (alkaline phosphatase), and RUNX2 while simultaneously suppressing the activity of osteoclast RANKL induced bone resorption. The antioxidant and anti-inflammatory properties also aids to bone preservation by reducing oxidative stress and inhibiting pro inflammatory mediators like TNF - alpha, IL-1beta and COX -2 which are actually accelerator of osteoclastic process. Furthermore 6-gingerol has been reported to mitigate estrogen deficiency related bone loss and improves bone mineral density in experimental process of osteoporosis[7].

3. Antifibrotic

Ginger (*zingiber officinale*) and its bioactive components of 6-gingerol and related other components actually showed significant anti fibrotic potential across various experimental models. These components work by limiting the fibrinogen cascade. They down regulate pro FIBROTIC mediators such as TGF -beta, alpha -SMA and collagen type I while suppressing INFLAMMATION via indicators of

NF -kB, TLR4 and reducing gene expression of pro inflammatory cytokines. Additionally, ginger also has the capability to enhance anti-oxidant defenses (that includes SOD, GSH lowering MDA) to combat oxidative stress that promotes fibrotic tissue deposition[8, 9].

4. Cardio protective

Ginger has been discovered to have remarkable triglyceride lowering properties, marking it as a natural agent with strong cardiovascular implications. In the patients of peritoneal dialysis which are actually very much prone to cardio vascular diseases, supplementation of ginger have shown a significant decrease in serum glycerides levels over 15 percent in over ten weeks. The bioactive components of ginger such as gingerols and Shagols are actually the main contributor towards lipid regulation action. They actually inhibit hepatic lipogenesis, increases or enhances lipolysis and improves clearance of fat from blood through the upregulation of lipoprotein lipase activity. Such mechanisms reduces the accumulation of lipoprotein rich in triglycerides thereby lowering the risk of atherosclerosis and vascular complications. Ginger and its bioactive components actually showed an impact in lowering the HDL and LDL components but this effect is not directly be attributed[10, 11].

5. Lowers calcium levels

Researches have showed that 6 - GIN (6 gingerols) have a significant impact on L type calcium channels. The results also showed that ginger have protective effects on heart by reducing the entry of calcium in cells. 6-Gingerol works directly on heart cells to lower calcium levels inside them. This

seems to protect the heart, especially during stress or poor blood flow. It makes the heart cells contract less strongly, which could help in certain heart conditions[12, 13].

6. Anti inflammatory and BP lowering:

Ginger has been around in medicine for years. Researches have showed that ginger has things in it that fight swelling, lower fats in the blood and protect against long term illness. Heart disease is still a big problem today. Research shows ginger might lower cholesterol, help with blood pressure and slow down blocked arteries. This review looks at things like gingerol and shogaol and how they might protect heart. Researches have also showed that ginger also has an impact on the type 2 diabetes mellitus patients administration of these herbal medicines including ginger as supplementary remedies could affect BP and sICAM-1 concentrations, influencing anthropometric measures, BP and endothelial function. Ginger exhibits anti-hypertensive and lipid lowering potential showing its cardio protective properties. Its bioactive components 6 gingerols and other constituents exhibits remarkable properties that lowers lipid profile, these compounds works by relaxing endothelia lining, modulation of vascular tone and reduction in the synthesis of LDL cholesterol while maintaining hemostasis of lipid. Ginger has the potency to lower the inflammation levels in body. Researches have done this experiment on a group pf women with HIIT with placebo groups when it was combined with HIIT. Women who trained and took ginger saw better fitness results, lost more fat, and had lower levels of one inflammation marker linked to heart disease. However, ginger can play an important role in lowering inflammation and supporting metabolism, which may enhance the effects of exercise.

The results showed that resistance training is a very effective way to improve cardiovascular health, and combining it with ginger can provide extra benefits[5, 6, 14].

7. Anti oxidant

Ginger is not just a spice but a healing plant that has been trusted for generations. This study found that how much light ginger gets can change the healthy compounds inside it. Halia Bara (wild ginger) ginger seemed to benefit the most from low light for flavonoids, but high light for phenolics. The leaves had more of these compounds than the rhizomes. Antioxidant levels followed the flavonoids closely, with the highest activity in Halia Bara (wild ginger) leaves at low light. Even the rhizomes, especially under low light, showed strong antioxidant power. This proves that ginger is more than just flavor – it's a real health booster. Diseases such as diabetes, high blood pressure, Alzheimer's, Parkinson's, and Atherosclerosis have become so common these days because of life style factors. A big cause of these diseases is oxidative stress (too many harmful free radicals) and inflammation. Oxidative stress triggers inflammatory chemicals and reduces antioxidant defenses in body. This harms DNA, proteins, and carbohydrates causing disturbance in normal functioning of cells leading to diseases. Ginger has the potency to fight against oxidative stress due to its bioactive components such as 6-gingerol and 6-shagols which are essential to reduce the level of oxidative stress and inflammation in the body.

Ginger along with turmeric has the potential to maintain the antioxidant activity and level of oxidative stress in the body. It has also the capability to maintain the higher NOS-2 and ICAM-1 and heart and liver markers LEVELS

in the body. Using deep fried stuff can risk the health and can make the condition worsen especially when the oil once reheated is used again and again. Ginger and turmeric in the oil before heating can help protect against it. They keep antioxidant systems active, lower inflammation, improve organ function, and stop blood pressure from going too high. This study looked at how ginger extract can prevent early steps of CVD. The problem starts when LDL gets stuck and oxidized in blood vessel walls, causing inflammation and foam cells. Some parts of ginger extract, especially fractions D and E, were strong antioxidants. This means they could stop LDL oxidation and foam cell formation. More research is needed to know exactly which molecules do this and how. Ginger could be a natural option to prevent atherosclerosis[15, 16].

8. Fat lowering (anti lipidemic)

In this article, researchers wanted to analyze the effect of ginger on blocked arteries caused by high cholesterol, to see if ginger could help lower it. They performed a test on albino mice with high cholesterol and poor lipid profiles. They measured fats in the blood, fats deposited in the artery walls, bad cholesterol, and antioxidant power. The test resulted in reduced bad cholesterol and total cholesterol, triglycerides, and other fats in the walls of arteries by the effect of high doses of ginger. Ginger also helps as an antioxidant because it neutralizes the harmful free radicals in the DPPH test, showing strong radical scavenging activity. Additionally, ginger improves the condition of artery tissues, making them less damaged by atherosclerosis, and may have the potential to slow down the progression of such heart-related conditions. Ginger has been identified as one of the essential lipid lowering agent.

The goal of this work was to check if ginger extract can help when high fat levels cause heart damage. Rats with Triton WR-1339 developed high bad fats, low good fats, hormone changes, and higher heart injury markers. Their antioxidant system was weaker and oxidative stress was higher. After three weeks of ginger treatment their fats dropped, heart markers improved, hormones balanced, and antioxidant enzymes went up. Oxidative stress went down. Ginger extract worked as a natural heart protector. This study is about how two plants rhizomes ginger (*Zingiber officinale*) and turmeric (*Curcuma longa*) affect heart rate in rats with high cholesterol. They fed rats with high cholesterol diet for 14 days. This caused bad effects such as , higher arginase activity (enzyme related to blood vessels problems) ,higher atherogenic index (risk score for heart diseases) , more oxidative stress , more bad fats in blood, low good cholesterol. They came to the conclusion that giving ginger or turmeric(2 or 3 percent in diet) reversed these effects like lowered arginase activity and atherogenic index , reduced total cholesterol, triglycerides and LDL-C , reduced oxidative stress in liver and higher HDL-C. All in all ginger and turmeric can help prevent high cholesterol damage, improve fat balance, reduce oxidative stress and may protect against heart diseases[17, 18].

Ginger has been identified as the lipid lowering substance in humans and animals . In this article, researchers wanted to analyze the effect of ginger on blocked arteries caused by high cholesterol, to see if ginger could help lower it. They performed a test on albino mice with high cholesterol and poor lipid profiles. They measured fats in the blood, fats deposited in the artery walls, bad cholesterol, and antioxidant power. The test

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9.Bp lowering effect

Ginger and its active bio components such as gingerol, gingerdiol, gingerdione, betacarotene, capsaicin, caffeic acid and curcumin shows the potency to lower the blood pressure in the patients. This study was done to find out how the effect of ginger extracts on blood pressure and heart rate of humans. Researches worked on 60 participants where 22 were men and 38 were

women, they were divided into 3 groups: Control (drank distilled water), Experimental group 1 (took 100 mg/kg body weight ginger extract) and Experimental group 2 (took 50 mg/kg body weight ginger extract). Three measurements were taken: systolic blood pressure, diastolic blood pressure and heart rate. Readings were recorded before consumption, 2 hrs later and 4 hrs later. After 2 hrs there was drop in BP and heart rate in both ginger groups. After 4 hrs systolic BP was slightly increased but still lower than baseline while heart rate and diastolic BP didn't show significant drop as in the 2 hrs. It was observed that the effect depends on the dose, higher dose had higher effect. Ginger extract helps lower BP and heart rate temporarily and works better at high doses.

This study looks at how ginger helps with hypertension and hyperlipidemia, both of which increase risks of heart attack. It was done because modern medicines work but have side effects and it's better to prevent these problems than treat them later. They took 18 rats and split them into 3 groups: control (high fat diet), ginger group (high fat diet + ginger), garlic group (high fat diet + garlic). The doses of ginger and garlic were 500 mg per kg body weight for 7 weeks. Then they measured blood pressure and lipid profile before and after. The observed results showed that ginger reduces systolic blood pressure and lowers blood fats, ginger did not increase HDL-C. Ginger was better for lowering BP and garlic was slightly better for improving lipid profile. Ginger like garlic is a natural prevention from heart diseases[20].

Ginger and its bioactive components showed significant impact on the patients of arteriosclerosis. This study was done to examine the anti-atherosclerotic property of ginger. The double blinded randomized

placebo clinical trial .evaluated that 1600mg of ginger powder is potent enough to bring a change, one group of people were given with 1600mg of ginger powder in capsule form for 8 weeks and other groups was given with a placebo (having wheat flour) the results were checked after 8 weeks the patients who were taking ginger supplements showed significant drop in lipoprotein A (LpA) and high sensitivity C reactive protein (hs-CRP) indicating improvement in inflammation and lipid profiles , there was not much difference in total antioxidant capacity TAC , the findings confirmed that ginger exhibits prominent anti artheroscleritic properties.

In this article the researchers actually tried to find out the effect of ginger and garlic separate and both on the diastolic bp and, mean arterial pressure. The researchers looked at how ginger and garlic—by themselves and together—affect blood pressure and heart health in animals. First, they used Wister rats to see changes in cholesterol and blood fats. Next, they looked at heart rate and strength using a rabbit heart, and finally measured blood pressure in anesthetized cats. To carry out the experiment the rats were divided into 7 groups. They were given ginger and garlic separately and remaining groups were given with both garlic and ginger. The results showed that either ginger or garlic has lowered the blood pressure and mean arterial pressure but the group that had both showed optimistic results with noticeable change in lowering of bp, triglycerides, and LDL and increase HDL. The combined ginger + garlic dose also slowed down the heart rate and reduced contraction strength. Garlic alone (and when mixed with ginger) significantly lowered diastolic blood pressure and mean arterial pressure. Some doses of ginger by itself also lowered diastolic blood

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has soothing, cardio-depressant effect. In experiment on blood vessels ginger actively eased muscle tightening and promoted relaxation. This means that ginger helps reduce calcium entry in cells which is a process that allows blood vessels and muscles to unwind and function more smoothly. What's even more fascinating is that this calming effect doesn't depend on vessels inner lining. Ginger works directly where it's needed. Beyond the heart, its extracts also help in relaxing airways and uterine muscles, which explains why it has been used to ease asthma, menstrual pain, and high blood pressure. Altogether the study heart fully pictures ginger as a natural comforter. A plant that pumps the heart relaxes the body and restores body's natural balance[12].

CONCLUSION

This study shows ginger as a natural and powerful and a potent spice, which actively participates in making health better, in more than a single health functions, ginger and its bio active component such as gingerols, gingerdion, Shagols, 6-gingerols and other important bioactive components aiding the health and helping to prevent the harmful and chronic diseases such as blood pressure, diabetes mellitus, arteriosclerosis and others chronic diseases. Ginger has a potency to lower the bp lowering effect, lowering calcium levels easing contraction and causing relaxation, antifibrotic inhibiting fibrotic issues, lowering hypertension and causing an impactful lowering on triglycerides, antioxidant and blood pressure. All the studies and researches have proved ginger to be one of the best natural healer of all times.

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