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The multi characteristics values of ginger (*Zingiber officinale*) in human nutrition and disease prevention

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Abstract

Ginger is a flowering plant in the Zingiberaceae family (*Zingiber officinale* Roscoe). The most essential ingredient in our meal is ginger, which is utilized as a spice. One of the earliest recognized medicinal herbs, ginger has been used for centuries to treat a variety of human diseases. Sesquiterpenoids, monoterpenoids, essential volatile oils (1–5%), and non-volatile pungent chemicals such gingerols, shogaols, paradols, and zingerones are the primary components of ginger. Gingerol products can be use as antiparasitic, anti-microbial, radio protective, antiflarial and anti-cancer. Ginger regulates blood sugar levels using a variety of ways. Other suggested use for ginger includes the treatment of conditions like fever, indigestion, nausea, hypertension, dementia, and constipation. The antioxidant properties of ginger are enhanced by the presence of phenolic and flavonoid compounds. The antioxidant properties of ginger are enhanced by the presence of phenolic and flavonoid compounds.

Keywords: Ginger; Gingerols; Flavonoid; Component; Rhizome; Treatment; Medicine

1. Introduction

The ginger plant has been cultivated for a very long time, and it is believed to have started in China before spreading to India, South East Asia, West Africa, and the Caribbean [1]. Both as a spice and a traditional medicine, ginger is frequently utilized [2]. The plant's rhizome has been used for millennia for both culinary purposes and the treatment of a variety of illnesses, including arthritis, rheumatism, muscle aches, constipation, indigestion, vomiting, hypertension, dementia, and fever [3].

Additionally, recent research has highlighted the therapeutic effects of ginger on a variety of conditions, including osteoarthritis [4], musculoskeletal disorders [5], nausea and vomiting [6], motion sickness [7], migraine [5], cancer [8], Hyperlipidaemia and Hyperglycaemia. In addition, many illnesses, including cardiovascular disease, can be controlled with ginger [9]. The antioxidant properties of ginger are enhanced by the presence of phenolic and flavonoid compounds [10]. Many tribes use the fragrant Zingiberaceae plant as sweetmeats [11].

Ginger is frequently used as a seasoning and in foods like gingerbread and speculoos as well as drinks like gingerale. Its rhizomes contain several pungent compounds [12]. Gingerol is one of ginger's most potent flavorings. Shogaols and

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paradol can be produced by converting gingerol [13]. These modified forms engage in hepatoprotective functions [14]. Additionally, gingerol derivatives can be used as anti-parasitic, anti-microbial, radioprotective, anti-flavial, and anti-diabetic agents [15, 16, 17]

Figure 1 Ginger Rhizome

2. Taxonomical Classification of Ginger

Ginger is a member of Zingiberaceae family. Turmeric, cardamom, black cardamom, and grains of paradise are its related spices. The general name for ginger is Zingiber, which is derived from the Greek zingiberis and the Sanskrit word singabera for the spice [18]. The taxonomic position of ginger are as follows.

- Order: Zingiberales
- Family: Zingiberaceae
- Genus; *Zingiber*
- Species; *officinale*
- Greek: *Zingiber officinale*
- English: Common Ginger
- Spanish: Gengibre
- French: Gingembre
- Chinese: Jiang.
- Portuguese: Gengibre-comum
- Urdu .;Adrak

3. Botanical Description of Ginger

A flowering plant called ginger (*Zingiber officinale*) produces rhizomes, ginger roots, and ginger. It is a perennial herbaceous plant with annually leafy stems [11]. Ginger has leafy stems that reach a height of around one metre (three feet). The elongated, two-row, alternating leaves are 15 to 30 cm (6 to 12 inches) long and come from sheaths that cover the stem. The blooms occur in dense spikes that resemble cones and are made up of overlapping green bracts that may have yellow edges. These spikes are about 2.5 cm (1 inch) thick and 5 to 8 cm (2 to 3 inches) long. A single little yellow-green and purple blossom is enclosed by each bract. By the first week of May or June, the ginger season is over. Crop is ready for harvesting in 8 months. Ginger is collected in the sixth month for use as a fresh spice, and in the eighth month for use in processing. Crop is ready for harvesting in 8 months. Ginger is picked in the sixth month if it is to be used as a fresh spice, and in the eighth month if it is to be processed. Ginger should be harvested when the leaves turn yellow and are entirely dried. Rhizomes should be dug out and cleaned by being properly washed in water two to three times after harvesting. After that, let them to dry in the shade for two to three days [19].

3.1. Nutrient Composition

Fresh ginger contains 80.9% moisture, 2.3% protein, 0.9% fat, 1.2% minerals, 2.4% fiber and 12.3% carbohydrates. Ginger contains the minerals calcium, phosphorus, and iron. Additionally, it has nutrients like vitamin C, thiamine, riboflavin, and niacin [10]. Type, variety, agronomic circumstances, curing techniques, drying and storage conditions, as well as other factors, affect the composition [19].

3.2. Chemistry of Ginger

The chemical composition of ginger depends on different factors such as variety, agronomic and treatment storage conditions. The gingerols were shown to be the main active ingredients in fresh ginger rhizomes, and gingerol [5-hydroxy1-(4-hydroxy-3-methoxy phenyl) decan-3-one is the most prevalent component in the gingerol series [20]. 3-6% fatty oil, 9% protein, 60–70% carbs, 3-8% crude fiber, around 8% ash, 9–12% water, and 2-3% volatile oil are all present in the powdered rhizome

The volatile oil is mostly made up of mono and sesquiterpenes, as well as camphene, beta-phellandrene, curcumene, cineole, geranyl acetate, terphineol, terpenes, borneol, geraniol, limonene, and linalool. It also contains alpha-zingiberene (30–70%), beta-sesquiphellandrene [8]. Shogaol, a dehydrated form of gingerol, is a key pungent component in dried ginger powder up to biosynthesis3-5. Odorous compounds including gingerol, shogaol, zingerone, and paradol make up 4-7.5% of the dried powder that makes up oleoresin, which is extracted using acetone and ethanol. The oleoresin has also been found to contain zingiberol, the principal aroma contributing component as well as zingiberene, gingediol, diarylheptanoids, vitamins and phytosterols [19].

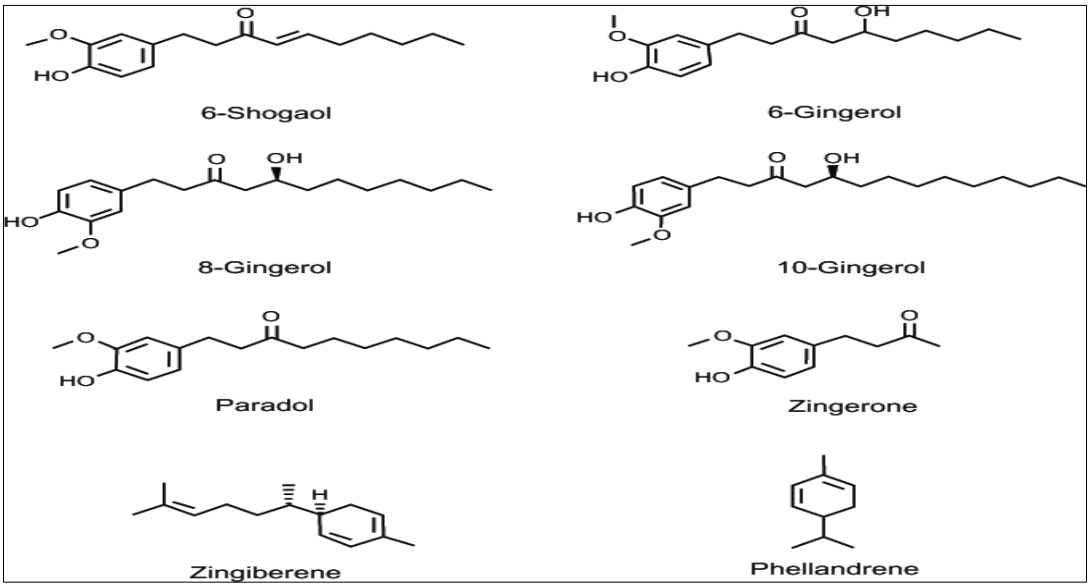

Figure 2 Major bioactive constituents of ginger

3.3. Role as Antimicrobial

The antibacterial properties of ginger rhizome have been known for a long time. *Zingiber officinale* (ginger) extracts' antimicrobial effectiveness against several pathogenic bacteria, as well as the phytochemical screening of the extracts to identify the active components that give them their antimicrobial properties [21]. Numerous studies have demonstrated that the ethanolic and methanolic extract of ginger rhizome (dry powder) inhibits the growth of a variety of Gram-positive and Gram-negative bacteria, including species of Escherichia coli, Salmonella, *Staphylococcus aureus, Streptococcus, Klebsiella, Proteus mirabilis, Bacillus species, Vibrio cholerae, Listeria Mon cytogenesis, Pseudomonas aeruginosa* and *Clostridium*. Even bacteria that are resistant to acid, like *Mycobacterium* TB, are susceptible to ginger [22]. Different kinds of ginger extract are used to stop various bacterial strains from growing. The results also demonstrated that ginger extracts exhibit antibacterial activities and could be used for the treatment of bacterial diseases. It is effective against food presenting bacteria

3.4. Role as Antifungal

Ginger is a fascinating herb with a variety of purported benefits, including the ability to fend off vampires and, more recently, the ability to treat fungal infections. The treatment of fungi infections has grown in significance in contemporary infectious disease practice. Numerous research has demonstrated the antibacterial properties of ginger [23]. In vitro and in vivo tests have revealed that extracts of ginger, at high dilutions, have fungistatic and fungicidal properties. Commercial ginger extracts are frequently used to treat patients with systemic fungal infections in the People's Republic of China [24] determined the antifungal activities of EO and oleoresin of ginger against *Aspergillus terrus*, *Aspergillus flavus*, *Trichothecium roseum*, *Fusarium graminearum* While the oleoresin completely inhibited *A.*

niger, the EO completely inhibited *F. oxysporum*. To put it simply, gingerols were shown to be the primary active ingredient in fresh ginger rhizomes, indicating that it has the potential to operate as an antifungal agent [3].

3.5. Role as Antioxidant

Ginger's high antioxidant value has shown extremely active with its ability to scavenge a number of free radicals and protect cell membrane lipids from oxidation in a dose-dependent manner [25]. Numerous studies have found that ginger possesses potent in vivo and in vitro antioxidant effects. Ginger extract in both aqueous and ethanol form is a substantial source of natural antioxidants [26]. Studies on rats revealed that ginger has an antioxidant effect that is comparable to ascorbic acid in that it dramatically reduced induced lipid peroxidation and increased levels of antioxidant enzymes and serum glutathione. Another review supported 6-gingerol's ability to reduce NO generation [27].

3.6. Role as Anticancer

One of the vital organs in the body is the gastrointestinal (GI) tract. This tract begins in the mouth and continues via the esophagus, stomach, small and large intestine, rectum, and anus [28]. Different defects, including cancer, result from disorder in any section of the GI system. Numerous cancer types, including skin, ovarian, colon, breast, cervical, oral, renal, prostate, gastric, pancreatic, liver, and brain cancer, are thought to be affected by ginger and its active ingredients, according to evidence from in vitro, animal, and epidemiological research. A study on human participants shown that ginger reduces nausea brought on by chemotherapy. In this research trial, chemotherapy patients were given a regular meal, a protein drink with ginger, and additional high-protein ginger supplements twice daily [29]. Numerous experimental investigations have demonstrated the anticancer effects of ginger and its active ingredients, notably 6-gingerol and 6-shogaol, on GI cancer [30].

3.7. Role as Antidiabetic

An endocrine malfunction known as diabetes mellitus is characterized by deficiencies in insulin secretion or activity, which impairs the metabolism of glucose, lipids, and proteins [31]. Poor blood glucose controlled is thought to have a major role in the emergence of diabetic complications in both type 1 and type 2 diabetes [32]. Numerous research has demonstrated the anti-diabetic properties of ginger. According to Akhani et al. [33] ginger pretreatment prevented the generated Hyperinsulinemia and Hyperglycemia found that after 1 hour of therapy, STZ-diabetic rats' fasting blood sugar levels were considerably lowered by oral administration of an alcoholic extract of ginger (800 mg/Kg). With dosages of 100-800 mg/Kg, the impact peaked after 4 hours and blood glucose was reduced by 24-53%. In comparison to baseline, the levels of fasting blood sugar (FBS), hemoglobin A1c (HbA1c), and malondialdehyde (MDA) in the ginger group as well as the control group significantly decreased after receiving 2 g of ginger powder orally daily for 12 weeks [34]

3.8. Role in Hepatoprotective

Alcohol intake is a prevalent component of contemporary life, and alcoholism is currently considered to be a serious health concern. In both people and laboratory animals, ethanol-induced liver damage has been linked to free radicals and oxidative stress. In essence, alcohol dehydrogenase in the liver converts ethanol into cytotoxic acetaldehyde, which is then oxidized to acetate by aldehyde oxidase or xanthine oxidase, producing reactive oxygen species (ROS) via Cytp450. Accordingly, excessive alcohol use led to the creation of oxygen radicals, which lowers the body's natural defense system and alters enzyme function, reduces DNA repair, and impairs oxygen utilization, lipid peroxidation, and protein oxidation.

On the hepatoprotective properties of ginger rhizome, there is now just a small amount of preliminary data [35,36]. Ginger and silymarin ethanol extracts given orally to rats reduced the elevation in blood AST, ALT, ALP, and g-GTP levels brought on by CML. As a result, garlic has a potential antioxidant role and is an effective medicine for treating alcoholic diseases. Marker enzymes for liver function and integrity include liver enzymes like ALT, AST, and ALP. These enzymes are typically elevated in cases of acute hepatotoxicity or mild hepatocellular injury, but they tend to decline with continued alcohol consumption because of liver damage [37].

3.9. Role as Anti-inflammatory

A limited protective response of cells and tissues to irritant chemicals, allergic reactions, or infections called inflammation. Fundamentally, there are two types of inflammation: acute inflammation and chronic inflammation [38] Today's situation has a significant demand for herbal therapy. Ginger is said to be effective in Ayurvedic medicine for alleviating rheumatism and inflammation. These herbal medications, which contain anti-inflammatory characteristics, are used to treat a variety of painful illnesses, such as arthritis and aches in the muscles and ligaments [39]. Ginger is

said to be effective in the Ayurvedic treatment of rheumatism and inflammation. Ginger has a calming effect and functions as a dual inhibitor of eicosanoid biosynthesis, which is connected to the suppression of leukotriene and prostaglandin formation. Studies on animal models have demonstrated that ginger has a dual inhibitory effect on lipoxygenase and cyclooxygenase (COX), and they also showed that it reduced the swelling of rat paws caused by carrageenan [40]. Numerous research has demonstrated the powerful anti-inflammatory properties of Z. officinale [3].

3.10. Role in cardiovascular system

Ginger is used in traditional Chinese medicine to enhance the flow of bodily fluids. It has a strong stimulatory impact on the heart muscle and dilutes blood, which both help to accelerate blood circulation throughout the body [41]. It is thought that the increased cellular metabolic activity brought on by the better circulation helps to relieve cramps and tension. According to a Japanese study, ginger's active ingredients lower blood pressure and lower the workload on the heart. Ginger decreased the production of thromboxane and prostaglandins, which decreased the blood's tendency to clot [13]. Ginger inhibits platelet aggregation more effectively than the equivalent effects of garlic and onion [42]. After consuming cholesterol-rich foods, ginger can stop cholesterol levels from rising.

4. Ginger role in Fertility

Fertility is actually another word for reproduction. The ability to conceive a child naturally is known as fertility. The fresh or dried root of ginger (*Zingiber officinale*), which has been extensively studied for its potential medical benefits, is supposed to increase fertility [43]. By inhibiting the creation of free radicals, breaking down oxidative chain reactions, lowering oxidative stress, and changing the levels of gonadotropin hormones (LH, FSH) and sex hormones (such as testosterone), ginger enhances semen quality and boosts sperm fertility [44]. Ginger is also believed to be beneficial for women who have uterine fibroids because it improves blood flow, which supports a balanced inflammatory response and regular normal detoxification. Another study on animals exposed that ginger could increase the maturity of ovarian follicles, or, Folliculogenesis a process that is necessary for female reproduction. Additionally, a study on rats with polycystic ovarian syndrome (PCOS), a disorder that can harm a woman's ability to conceive, revealed that large dosages of ginger extract were given to the animals to balance their hormone levels. 100mg to 200mg of ginger extract used is ideally [45].

4.1. Role in blood clotting

It was determined that taking ginger orally affected the serum PGE2 levels considerably. When given orally or IP, high doses of ginger (500 mg/kg) were considerably beneficial in reducing serum PGE2[45]. However, rats given 500 mg/kg of ginger orally but not intravenously had considerably lower TXB2 levels. After giving rats a raw aqueous extract of ginger daily for four weeks, either orally or intraperitoneally, the impact of the ginger's aqueous extract on platelet thromboxane-B2 (TBX2) and prostaglandin-E2 (PGE2) synthesis was investigated (IP). A small amount of ginger (50 mg/kg), given orally or IP, had no discernible impact on the blood TBX2 levels. But at this dosage, ginger taken orally changed the serum PGE2 significantly. When given orally or IP, high doses of ginger (500 mg/kg) were considerably beneficial in reducing serum PGE2. However, rats given 500 mg/kg ginger orally but not via IP had significantly reduced TXB2 levels [46].

4.2. Role in blood pressure

Normal blood pressure is categorized as having a systolic pressure of less than 120 and a diastolic pressure of less than 80. Ginger. High-dose ginger supplements may help lower high blood pressure, according to research. Numerous pieces of evidence, mostly from rat experiments, have demonstrated that ginger affects blood pressure and heart rate in a variety of direct and indirect ways. The arterial blood pressure of rats under anesthesia was observed to decrease in a dose-dependent manner (0.3–3 mg/kg) in response to the crude ginger extract [47].

4.3. Role in gastrointestinal tract

By boosting muscle activity in the digestive tract, some of ginger's active ingredients are said to improve digestion, absorption, and reduce constipation and gas. Additionally, it increases muscle activity in the digestive tract while considerably reducing nausea and vomiting [48,49]. Ginger (940 mg) proved useful in treating motion sickness. Ginger's effects were comparable to those of 100 mg of metoclopramide.

5. Conclusion

It has been demonstrated throughout the preparation of this research that ginger contains a number of bioactive components that can be obtained as powder and extract. Due to their wide antibacterial and antifungal inhibitory range, some of these substances have the ability to inhibit the most significant microorganisms related to foodborne illnesses. Numerous clinical investigations have demonstrated the effectiveness of ginger and many of its chemical components in treating postoperative vomiting and obstetric vomiting. Ginger is regarded as a secure herbal remedy with negligible and infrequent negative effects.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare no conflict of interest.

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