

ANTI-OXIDATIVE AND ANTI-INFLAMMATORY EFFECTS OF GINGER

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Abstract

Spices like ginger (*Zingiber Officinale* Roscoe) are constantly used and common. It's abundant in numerous chemical factors, including organic acids, polysaccharides, terpenes, and phenolic composites. Significant attention is being paid to the clinical operation of ginger with the stopgap of remedial goods. The rich phytochemistry of ginger is allowed to be responsible for its health- promoting parcels. We outlined the most recent exploration on ginger's anti-inflammatory and antioxidant benefits in this review.

Keyword: Anti-inflammatory, anti-oxidative, ginger, reactive oxygen species.

Introduction:

Ginger is a well-known herbaceous factory that has been used for periods as a flavouring component and herbal remedy. ginger (*Zingiber Officinale* Roscoe) is a popular remedy for pain, nausea, and other common health issues (1). Australia, Asia, and numerous other nations used the *Zingiber Officinale* plant the most (2). Because it's consumed as food, it's regarded as safe for use as a supplement. For at least 2500 times, the Chinese have utilised ginger to treat rheumatism, blood diseases, and nausea (3).

Two broad orders are used to group together fresh ginger (4).

GINGER:

1. VOLATILES

- Includes the sesquiterpene and monoterpenoid hydrocarbons
- give off a characteristic ginger flavour and scent.

2. NON-VOLATILES

- Include gingerols, shogaols. Paradols and zingerone

Description:

Ginger is a herbaceous, perennial rhizome with a height of 9 cm. Rhizomes have an aromatic, light yellow colour. long and 2–3 cm wide, the leaves. Flowers a run common, with a superior calyx (5).

Varieties of ginger:

Hybrid varieties of ginger shown in South Asia region.

• Different varieties of ginger (6).

Sr.no.	Country	Varieties
1)	India	Himanchal, Maran, Nadia, Karakkal, Ellakallan, Pink ginger, Rejhata.
2)	Nepal	Bakthapur, Naval parasi
3)	Nigeria	Juggigan
4)	Brazil	Brazil
5)	Oman	Oman
6)	Pakistan	Pakistan
7)	China	China ginger

Diagram:



Taxonomical Classification:

1) **Domain:** Eukaryota

2) **Kingdom:** Plantae

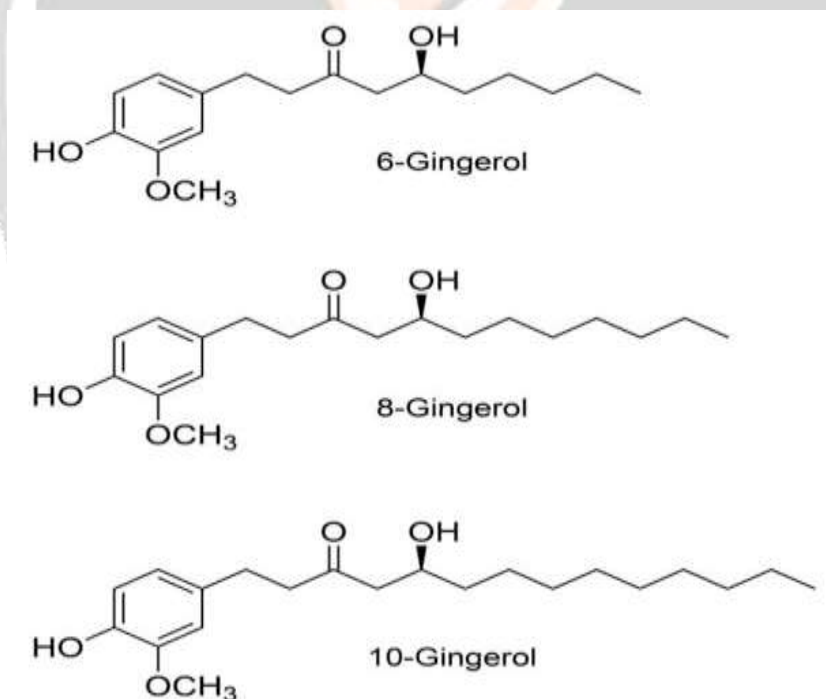
- 3) **Phylum:** Spermatophyta
- 4) **Subphylu:** Angiosperms
- 5) **Class:** Monocotyledon
- 6) **Orde:** Zingiberales
- 7) **Family:** Zingiberacea
- 8) **Genus:** Ginger
- 9) **Species:** Zingiber officinale

Drug profile:

• Synonyms	African Ginger, Ardraka, Black Ginger, Imber, Indian Ginger, Shoga, Sunth, Sunthi, Zinziber officinale, Zinzeberis
• Biological source	Zingiber Officinale Roscoe
• Family	Zingiberaceae (7)
• Chemical constituents	<p>1) Essential oils of ginger or volatile oils Sesquiterpene, Bisapolene, Gingeriberene, and Zingiberol are the main active components of ginger oils. (3)</p> <p>2) Gingerol</p>
	<p>3) Diarylheptanoids</p> <p>4) Other substances, including proteins, amino acids, sugars, organic acids, and inorganic materials. (8)</p>

<p>• Uses</p>	<ol style="list-style-type: none"> 1) Antioxidant activity 2) Antimicrobial activity 3) Antidiabetic activity 4) Anticancer activity 5) Anti-inflammatory activity 6) Analgesic activity 7) Antipyretic activity 8) Immunomodulatory activity 9) Anti-obesity activity
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Structure: (9)



Antioxidant Activity:

The antioxidant is a chemical that prevents other molecules from oxidising. A chemical reaction known as oxidation involves the transfer of an electron or hydrogen from a material to an oxidising agent. Free radicals are produced during the oxidation reaction (58). Since antioxidants neutralise or eliminate "reactive oxygen

species" (ROS) or free radicals before they cause cell damage, they have become an essential component of our daily life. The chemical substances known as antioxidants bond to free oxygen radicals to stop them from harming healthy cells.

• Classification Of Antioxidants:

The classification of antioxidants can be done using many criteria. The initial characteristics are based on the function (Primary and Secondary antioxidants).

The second characteristic is based on antioxidants, both enzymatic and non-enzymatic.

1) The first function-based property.

a) Primary Antioxidants

b) Secondary Antioxidants

a) Primary Antioxidants:-

These are the antioxidants that break the chain when they come into contact with lipid radicals, transforming them into more stable byproducts. This group of antioxidants, which primarily have phenolic structures, includes the following: antioxidant vitamins, minerals, and phytochemicals such as carotenoids, flavonoids, and beta-carotene (59).

b) Secondary Antioxidants:-

These phenolic compounds serve as free radical traps and counteract chain reactions. These substances include propyl gallate and butylated (BHT) (PG).

2) Antioxidants can be divided into two classes namely (60).

a) Enzymatic Antioxidants

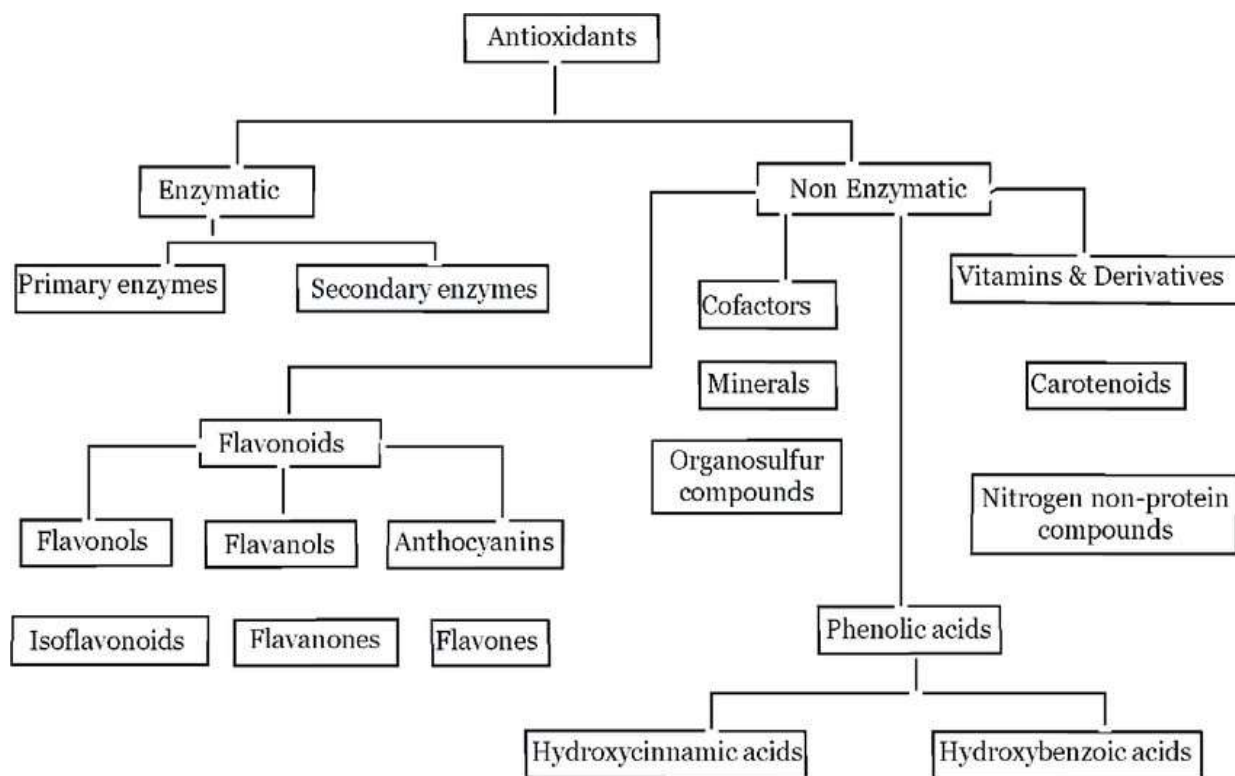
b) Non-enzymatic Antioxidants

a) Enzymatic Antioxidants:-

The way enzyme-based antioxidants work is by dissolving and eliminating free radicals. Generally speaking, these antioxidant enzymes remove harmful oxidative products by first converting them into hydrogen peroxide and subsequently into water in a multi-step process that needs a number of trace metal cofactors (copper, zinc, manganese, and iron). Enzymatic antioxidants must be created by our bodies instead than being taken orally as supplements (61).

b) Non-enzymatic Antioxidants:-

These substances halt the chain reaction of free radicals. For instance, vitamin E breaks up a free radical activity chain after just five reactions. Vitamin C, plant polyphenols, carotenoids, se, and GSH are more examples.



Ginger extracts exhibit antioxidant activity that is on par with artificial antioxidant preservatives (10). Antioxidants are substances that interact safely with free radicals and stop chain reactions before damaging essential molecules (11). The phenolic compounds in red ginger have antioxidant properties due to their ability to donate electrons or hydrogens to free radicals (12).

Ginger is often referred to as an antioxidant storehouse. Reactive oxygen species (ROS), free radicals, and peroxides may all be scavenged by ginger, which is a remarkable characteristic. The active components, gingerols, zingerone, and shogaols, have antioxidant properties. This prevents the xanthine oxidase, which is primarily responsible for producing reactive oxygen species, from working (13). Geraniol is a chemopreventive agent, while gingerone is a strong antioxidant. By scavenging oxygen-free radicals and raising the amount of total glutathione content (GSH) in the murine skin, it exerts a strong antioxidant effect (14). due to its high phenolic content, dried ginger has the strongest antioxidant action.

The various gingers' antioxidant activity tended to be in the following areas:

Fresh ginger is superior to carbonised ginger, stir-fried ginger, and dried ginger.

Fresh ginger has a high moisture content. Fresh ginger was cooked to produce dried ginger that had increased antioxidant activity. Carbonized ginger and stir-fried ginger are produced when dry ginger is heated, however they have low antioxidant activity because processing can turn gingerols into shogaols (15). The polyphenols are more abundant in dried ginger powder because they have high antioxidant activity (16). Human chondrocyte cells treated with ginger extract demonstrated antioxidant properties, with oxidative stress mediated by interleukin-1beta (17).

Anti-inflammatory Activity:-

An uncontrolled inflammatory response, however, is the primary cause of a wide range of disorders, including allergies, cardiovascular dysfunction, metabolic syndrome, cancer, and autoimmune diseases, placing a heavy financial burden on individuals and, as a result, on society. Inflammation is our body's protective response to potentially dangerous stimuli, such as allergens and/or damage to the tissues (62). A medication or chemical that lessens inflammation in the body, including pain, swelling, and redness. Anti-inflammatory medications stop some bodily chemicals from causing inflammation. They are used to treat a variety of ailments. A typical reaction to infection is inflammation involving the innate and adaptive immune systems. Herbal

remedies for boosting the body's immune systems were the focus of ancient medical practitioners. The immune system is boosted by ginger in several cultures.

For millennia, people have known that ginger has anti-inflammatory qualities. There are several lines of evidence showing the usefulness of ginger or chemicals derived from it against inflammation and its mediators, mostly in various animal models of inflammation and to a much lesser amount in humans or human cells (63). It was first discovered in the early 1980s that ginger possesses anti-inflammatory properties, which are supported by its inhibitory effects on the production of prostaglandins (64).

Ginger's anti-inflammatory properties. The focus of ancient medical practitioners was on using herbs to strengthen the body's immune system. Many nations employ ginger and its compounds to strengthen the body's immune system (18). Many diseases, including atherosclerosis, diabetes, obesity, and allergies, are brought on by chronic inflammation (19,20). By suppressing the expression of the cyclooxygenase COX-1, COX-2, and 5-lipoxygenase (5-Lo) enzymes, ginger prevents the synthesis of inflammatory mediators such as cytokines, prostaglandins, leukotrienes, and chemokines (21).

Ginger rhizome has strong chemicals that prevent allergic responses (22). Gingerols prevent LPS-induced COX-2 expression, but shogaol extracts have no impact on COX-2 expression, indicating that the key components of gingers prevent the generation of PGE (2,23). 6- Shogaol has more anti-inflammatory properties than 6- Gingerol. The dried ginger methanolic extract's hexane fraction, which inhibits the expression of proinflammatory genes in LPS-activated BV2 microglial cells, has anti-neuroinflammatory activity (24,25). The anti-inflammatory effects of whole ginger extracts on NO/ iNOS, PGE₂/ COX-2, TNF- α , IL-1 β , and macrophage chemoattractant protein-1 (MCP-1) production in murine macrophages, such as RAW264.7 cells and J774.1 cells, as well as human monocytes, U937 cells (26,27,28).

Fresh ginger eating for humans reduces arthritis-related pain (29). The ginger essential oil reduces the development of chronic adjuvant arthritis in rats (30). Ginger supplementation both alone and in combination with antitubercular therapy dramatically reduces levels of malondialdehyde (MDA), ferritin, and tumour necrosis factor (TNF) α (31). In order to treat patients for hypoalgesic effects, 2 gm of ginger supplementation was given daily for 11 days. Ginger that has been heated and consumed daily is used to relieve muscle discomfort

(32). Results on ginger's efficacy in osteoarthritis sufferers are controversial. The effects of ginger extracts on knee osteoarthritis symptoms are strong (66). As a rheumatic illness of the joints, gout. [6]- Shogaol can be employed as a restorative agent and has a potent anti-inflammatory effect (67).

Pharmacological Significance:-

Ginger have beneficial medicinal properties. The pre-clinical studies shows the gingers are used in the treatment of obesity, diabetes, diarrhoea, pain, fever, rheumatoid arthritis, cancer, allergies. The biological activities of several volatile and non-volatile constituents of ginger through selected in vitro and in vivo models, are discussed in the following sections.

- 1) Cardiovascular activity
- 2) Antimicrobial activity
- 3) Anti-ulcer activity
- 4) Anti-diabetic activity
- 5) Immunomodulatory activity
- 6) Anti-platelet aggregation activity
- 7) Hepato protective activity
- 8) Anti-cancer activity
- 9) Anti-atherosclerotic activity

10) Anti-obesity activity

1) Cardiovascular Activity:-

The left atria of the dispersed guinea pigs demonstrated a strong positive inotropic response to ginger (33). According to Ayurveda, ginger is a potent heart tonic that prevents several heart diseases and decreases blood clotting. In addition to boosting heart health, ginger helps lower high cholesterol levels (34).

2) Anti-microbial Activity:-

To increase food quality and shelf life, antimicrobials can prevent bacterial and fungal growth. Ginger has potent antibacterial and, to a certain extent, antifungal effects (35). Ginger's menthol extract has antibacterial properties that are effective against *Staphylococcus aureus*, *Escherichia coli*, and *salmonella enteritis* (36). *Aspergillus niger*, *Mycoderma* sp., *Lactobacillus acidophilus*, and *Bacillus cereus* are all susceptible to *Aspergillus niger* essential oil's antibacterial effects (37).

3) Anti-ulcer Activity:-

The ginger inhibits the gastric ulcer in rats (38). The fresh ginger in the water which improved the 10 patients which suffering from peptic ulcers (39).

4) Anti-diabetic Activity:-

Diabetes is a significant global health issue. Low levels of blood insulin contribute to improper glucose metabolism, which is the root cause of diabetes (40). When 6-gingerol was given to diabetic mice, the animals' insulin signalling was improved and their hypoglycemic properties were demonstrated. It inhibits enzymes that hydrolyze saccharides (41,42) and is used to manage hyperglycemia in type 2 diabetic patients (43). In diabetic rats, oral administration of *zingiber officinale* ethanolic extract for 20 days significantly reduced hyperglycemia (44).

5) Immunomodulatory Activity:-

The fact that ginger is used to cure coughs, colds, and flu is likely due to the plants' immune-stimulating characteristics (48). Ginger reduced the synthesis of IL-2 and IL-10, which in turn reduced lymphocyte proliferation (49).

6) Anti-platelet Aggregation Activity:-

The 6-GN and 6-SG shown notable anti-platelet aggregation activity, while the 10-GN inhibits Ca^{2+} dependent contractions in media rich in K^{+} (50). The 6-GN at 0.5–20 IM reduced the aggregation and release response of collagen and arachidonic acid-induced rabbit platelets. Additionally, it prevents the synthesis of thromboxane beta-2 and PG D2, which are brought on by arachidonic acid, at 0.5-10 IM 6GN (51).

7) Hepatoprotective Activity:-

The hepato-protective properties of ginger and its components are mostly protective against the hepatotoxicity caused by CCL4 (52). A single dose of ginger aqueous extract reduced ALT, AST, and ALP levels while being helpful in preventing acetaminophen-induced hepatotoxicity (53).

8) Anti-cancer Activity:-

The active ingredients in ginger, including [6]-gingerol, [6]paradosol, and [6]-shogaol, have antitumorigenic and antiinflammatory properties (54). The protective properties of ginger against numerous carcinomas and cell lines of the lung, skin, liver, pancreas, and kidney.

Topically putting ethanol-infused ginger extracts on a mouse's skin has been shown to have anti-tumor properties (55). Ginger's effectiveness and the biomolecules it contains help to reduce ovarian cancer. Ginger prevents NF- κ B activation and reduces VEGF and IL-8 release, both of which are beneficial in treating ovarian cancer. Inhibiting cell adhesion invasion motility is another way that ginger treats breast cancer (56,57).

9) Anti-atherosclerotic Activity:-

In a more recent investigation, rabbits with artificially generated atherosclerosis were administered air-dried ginger powder (100 mg/kg orally daily) for 75 days, and this prevented atherosclerotic alterations by roughly 50% in the coronary arteries and aorta (68). In this trial, the ginger treatment did not significantly lower serum lipid levels, but it did reduce lipid peroxidation and boost fibrinolytic activity.

10) Anti-obesity Activity:-

The 6-GN prevents mice from gaining weight and accumulating fat (69). 6-GN inhibits rosiglitazone-induced adipogenesis in 3T3-L1 cells by preventing the generation of oil droplets and reducing the size of the droplets (70). Oil droplets in adipocytes were also able to be found using histochemical staining at quantities between 5 and 15 μ g/mL. Fatty acid synthase and adipocyte-specific fatty acid binding protein levels were also found to be lower.

Conclusion:-

Ginger's potential benefits for health are well established. Through anti-inflammatory and immune-nutritional reactions, it can treat a variety of disorders. Due to ginger's anti-inflammatory properties, it can lessen muscle discomfort after strenuous exercise. The anticancer potential of ginger is also widely known, and functional components including gingerols, shogaol, and paradols are useful components that can block cell cycle progression, induce apoptosis, and prevent the spread of various malignancies. In addition to these, it helps gastrointestinal health, diabetes mellitus, and cardiovascular problems. Although the conclusion of this review favours ginger, numerous ambiguities call for additional research before asserting its efficacy.

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