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# Ginger and its health benefits: A review

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**Abstract**
For the last 2500 years, ginger has been known for its several scientific properties and valued in different parts of the globe. Ginger is a spice that has traditionally been treated as medicine in both Traditional Chinese Medicine and Ayurveda. Ginger has rich phytochemistry and several health promoting perspectives. In ginger family, *Zingiber officinalis* is one of most widely used species and it is found in several foods and beverages. Ginger has been used commonly to treat diarrhoea, stomach upset, indigestion and nausea. It also has anti-inflammatory and antioxidant properties. Ginger constituents include 17.77g carbohydrates, 1. 7g sugars, 2g dietary fibre, 0.75g fat and 1.82g proteins per 100g. The chemistry of ginger is well documented with respect to its phytochemicals, oleoresins and volatile oils. This review presents the potential properties of ginger to treat numerous disorders including cancer due to its anti-inflammatory and anti-oxidant properties. It is also useful in controlling the process of aging. Ginger, one of the most commonly used spices and medicinal plants, has been demonstrated to improve dietinduced metabolic abnormalities. This scientific review favors ginger due to its rich phytochemistry; however, due to some ambiguities, it is recommended to conduct clinical trials of ginger with sound protocol design before claiming its efficacy.

**Keywords:** Ginger, health benefits

## Introduction
Ginger (*Zingiber officinale*) is a flowering plant whose rhizome, ginger root or ginger, is widely used as a spice and a folk medicine. It is a herbaceous perennial which grows annual pseudostems (false stems made of the rolled bases of leaves) about a meter tall bearing narrow leaf blades. The inflorescences bear pale yellow with purple flowers and arise directly from the rhizome on separate shoots. In 2017, global production of ginger was 3.3 million tonnes, led by India with 34% of the world total. Nigeria, China, and Indonesia also had substantial production.

## Ginger and Its Constituents
Ginger (*Zingiber officinale*), a member of the *Zingiberaceae* family, is a popular spice used globally especially in most of the Asian countries. Chemical analysis of ginger shows that it contains over 400 different compounds. The major constituents in ginger rhizomes are carbohydrates (50–70%), lipids (3–8%), terpenes, and phenolic compounds (Grzanna *et al* 2005) [31]. Terpene components of ginger include zingiberene, $\beta$-bisabolene, $\alpha$-farnesene, $\beta$-sesquiphellandrene, and $\alpha$- curcumene, while phenolic compounds include gingerol, paradols, and shogaol. These gingerols (23–25%) and shogaol (18–25%) are found in higher quantity than others. Besides these, amino acids, raw fiber, ash, protein, phytosterols, vitamins (e.g., nicotinic acid and vitamin A), and minerals are also present (Langner *et al* 1998, Shukla *et al* 2007) [21, 48]. The aromatic constituents include zingiberene and bisabolene, while the pungent constituents are known as gingerols and shogaols [58]. Other gingerol- or shogaol-related compounds (1–10%), which have been reported in ginger rhizome, include 6-paradol, 1-dehydrogingerdione, 6- ginger Dione and 10-gingerdione, 4-gingerdiol, 6-gingerdiol, 8- gingerdiol, and 10-gingerdiol, and diarylheptanoids (Govindrajan *et al.* 1982, Ali *et al* 2008). The characteristic odor and flavour of ginger are due to a mixture of volatile oils like shogaols and gingerols.
The rhizome of ginger plant has been used as a spice since several years across the globe. It was found that, ginger was one of wildly used herbs in traditional Chinese, Ayurveda, Europe and America (Langner *et al.*, 1998; Avato *et al.*, 2000; Duke and Ayensu, 1985; Kapil *et al.*, 1990; Qureshi *et al.*, 1989; Blumenthal *et al.*, 1997; Kamtchouing *et al.*, 2000; Afzal *et al.*, 2011; Grzanna *et al.*, 2005) [31, 21, 48, 38, 1, 20, 63, 62]. The mode of administration of ginger is oral, intra muscular (IM) and topically (Barnes *et al.*, 2002; Yang and Chang, 1988;

Chrubasik *et al.*, 2005; Shukla and Singh, 2007) [11, 17, 68]. Historically, it has been used to treat nausea, vomiting, rheumatism, baldness, respiratory diseases and bleeding disorders (Young *et al.*, 2006; Suekawa *et al*., 1984; Newall *et al.* 1996; Srivastava, 1984; Kim *et al*. 2005; Kelly *et al*., 2009) [85, 71, 41, 40, 69].

**Therapeutic Properties of Ginger**

The review article was written with help from secondary data analysis. Information on searching databases, various journals, books, articles and key words were used during writing of therapeutic properties of ginger.

**Cardiovascular effects**

Gingerol and shogaol classes of compounds might have many therapeutic effects including anti-inflammatory, antioxidant, and hypocholesterolemic effects, as suggested by many studies. Ginger enhances blood circulation throughout the body by diluting circulating blood and by enhanced stimulation of the heart muscle. This improves cellular metabolism and helps to relief cramp and tension (Gong *et al.*, 1989; Pecoraro *et al*., 1998; Frisch *et al.*, 1995; Yamahara *et al*., 1989; Ernst and Pittler, 2000; Chaiyakunapruk *et al*., 2006) [14, 30, 24, 58, 58]. *In vitro* research indicates that gingerols and the related shogaols exhibit cardio depressant activity at low doses and cardiotonic properties at higher doses (Wang CC *et al* 2003) [79]. Both (6)-shogaol and (6)-gingerol, and the gingerdiones, are reportedly potent enzymatic inhibitors of prostaglandin, thromboxane, and leukotriene biosynthesis (Rajesh Kumar Mishra *et al* 2012).

**Hypotensive effect**

Many studies have proven the hypotensive effect of ginger when it was given at 0.3-3 mg/kg. It helps to reduce atrial blood pressure by blocking calcium channel or by acting on muscarinic receptor (Ernst and Pittler, 2004; Portoni *et al.*, 2003; Ozgoli and Goli, 2009; Vutyavanich *et al*., 2001) [24, 59, 57, 77].

**Antinociceptive Effects**

(6)-shogaol has produced anti-nociception and inhibited the release of substance P in rats, seemingly via the same receptor to which capsaicin binds. However, it was observed to be 100 times less potent and to elicit half the maximal effect of capsaicin (MaJ *et al* 2004).

**Gastrointestinal Effects**

There is evidence that ginger rhizome (root) increases stomach acid production. If so, it may interfere with antacids, sucralfate (Carafate), H2 antagonists, or proton pump inhibitors. In contrast, other *in vitro* and animal studies have revealed gastro protective properties (Thomson M *et al* 2002, Al Yahya *et al* 1989) [5, 7] in addition, (6) shogaol, generally more potent than (6)- gingerol, has inhibited intestinal motility in intravenous preparations and facilitated gastrointestinal motility in oral preparations. Ginger extract has also been reported to inhibit the growth of Helicobacter pylori *in vitro* (Srivastava KC *et al* 1984) [69]

**Anti-hypercholesteraemic effect**

Ginger extracts interfers with cholesterol biosynthesis leading to decreasing cholesterol levels. Ginger extracts have antilipidemic effects, by reducing thermogenesis and high lipids levels. It also helps to increase serum HDL-cholesterol (Ernst and Pittler, 2004; Portoni *et al.*, 2003; Ozgoli and Goli, 2009; Vutyavanich *et al*., 2001; AlAwwadi, 2010; 2013) [24, 59, 57, 77]. Gastrointestinal effect of ginger Ginger is very useful in the treatment of several gastrointestinal diseases including peptic and duodenal ulcer. Ulcer is generally caused due to imbalance between defensive and offensive factors like acid, pepsin and Helicobacter pylori; and in this case, ginger is useful due to its anti-inflammatory properties. Ginger acts and protects gastric mucosa against several ulcerogenic agents. Ginger is also very useful in cases of ulcerogenesis due to its antioxidant activities (Lumb, 1994; Gull *et al.*, 2012; Dugasani *et al.*, 2010; Halvorsen *et al.*, 2002) [51, 32, 19, 34].

**Antiemetic effect of ginger**

Ginger shows strong antiemetic property by enhancing intestinal motility and inhibiting serotonin receptors. It stimulates peripheral anti-cholinergic and ant-histaminic receptors and antagonises 5- hydroxytreptamine receptors in the GIT (Lumb, 1994; Gull *et al.*, 2012; Dugasani *et al.*, 2010; Halvorsen *et al.*, 2002) [51, 34 19, 32]. Ginger anti-nausea effect due to chemotherapy Chemotherapy is known to cause severe nausea and vomiting. It has been proved that ginger is effective in preventing nausea and vomiting caused by chemotherapy. Gingerols the key ingredients responsible for the activity have shown pharmacological effect. It is also used to treat nausea after surgery and same has been proved in several randomised clinical trials. This effect is seen due to its action on the 5-HT3 receptor (Ajith *et al.*, 2007; Krim *et al.*, 2013; Waggas, 2009; Sabina *et al.*, 2011; Ahmed *et al.*, 2008) [3, 43, 78, 66, 4]. Morning sickness FDA classifies ginger as safe for the treatment of morning sickness and it is widely used during early pregnancy. It reduces symptoms of morning sickness if same is taken in the recommended amount. The German Commission and Europe does not consider it as safe due to lack of published data (El-Sharaky *et al.*, 2009; Nasri *et al.*, 2013; Ajith *et al.*, 2008; El-Abhar *et al.*, 2008; Kyung *et al.*, 2006) [23, 55, 4, 22, 46]. Hematologic (platelets) effects of ginger Scientific evidence is still pending; however it was found that ginger is having anti-thrombotic and strong antiinflammatory effect due to increased fibrinolytic activity when same has been taken at about 5 g. It was found that Gingerols and Paradol have good anti-platelet and COX-I inhibitor properties (Mehdizadeh *et al.*, 2012; Jagetia *et al.*, 2004; Jagetia *et al.*, 2003) [13, 35, 54, 6]. The effect of the ginger is different if it is consumed dry or fresh. Regulation of blood glucose and lipid levels Ginger is very effective in lowering blood glucose level when same has been taken in dried form. It also decreases cholesterol and triglyceride level. Long term usage helps to increase high-density lipoprotein cholesterol concentrations (Duke and Ayensu, 1985; Afzal *et al.*, 2011; Kim *et al.*, 2007; Li *et al*., 2012) [20].

**Rheumatologic effect of ginger**

Ginger exerts its anti-inflammatory effects by the mechanisms which explain the role of inhibition of preinflammatory factor like prostaglandin and leukotriene biosynthesis which can decline pain associated with rheumatoid and osteoarthritis. It is having proven history of treatment of rheumatic conditions (Duke and Ayensu, 1985; Avato *et al*., 2000; Afzal *et al.*, 2011; Ha *et al.*, 2012) [20, 13, 15]. Headache Ginger is used for the treatment of headache

and having Al-Awwadi 113 good effect on reducing symptoms of pain. This effect is due to reduction in prostaglandin synthesis. It also has been reported that ginger suppresses leukotriene biosynthesis by inhibiting 5-lipoxyganse (Ernst and Pittler, 2004; Nasri *et al.*, 2013; Tjendraputra *et al.*, 2001) [24, 25, 55, 72]. Anti- Inflammatory effect Ginger is showing anti-inflammatory effect by suppression of PG synthesis and also interference in cytokine signalling (Duke and Ayensu, 1985; Uz *et al.*, 2009; Mahmoud *et al.*, 2012) [20, 73, 52].

**Antigen toxic Activity**

Norethandrolone and oxandrolone were investigated for their genotoxic effect on human lymphocyte chromosomes using chromosomal aberrations and sister chromatid exchanges as parameters and subsequently Genistein and [6]-gingerol were used as antigenotoxic agents to ameliorate the genotoxicity induced by the steroids. Norethandrolone and oxandrolone were studied at 5, 10, 20, 30 and 40 µM, respectively and were found to be significantly genotoxic at 30 and 40 µM. Genistein and [6] gingerol proved to be equally effective in reducing genotoxic damage at appropriate doses (Beg T *et al* 2008) [12].

**Antimicrobial Effect**

Due to phenolic compounds, ginger has shown excellent antimicrobial properties and effective in controlling virus, bacteria, fungal disease. In many countries, ginger is used to preserve food (Ernst and Pittler, 2004; Liao *et al.*, 2012; Chen *et al.*, 2009) [25, 50].

**Antibacterial Effect**

Ginger has shown good antimicrobial effect against both Gram positive and negative bacteria; however, severally, this effect is reduced due to heating (Jagetia *et al.*, 2004; Ha *et al.*, 2012; Tjendraputra *et al.*, 2001; Kubra *et al.*, 2013) [4, 16, 32, 6].

**Antiparasitic Action**

Ginger acts as anti-parasitic; study shows the *in vivo* potential of methanolic extract of *Zingiber officinale* in the treatment of trypanosomiasis (Halvorsen *et al.*, 2002; Jagetia *et al.*, 2003; Kubra *et al.*, 2013; Duarte, 2016; Kumar *et al.*, 2015; Choi *et al.*, 2013; Saraswat, 2010; Pushpanathan, 2008) [12, 14, 73, 37, 35, 18]. 114 J Pharmacognosy Phytother.

**Antineoplastic**

Ginger is a powerful antineoplastic agent. In several studies, extracts of ginger suppress cell proliferation and act against resistance of cancerous cells (Barnes *et al.*, 2002; Newall *et al.* 1996; Ernst and Pittler, 2000; Nasri *et al.*, 2013; Kumar *et al.*, 2015; Saraswat, 2010) [24, 55]. Antioxidant Ginger is having powerful antioxidant activity due to its oil which has protective effect on DNA damage. They have demonstrated this effect in many cell culture (Chaiyakunapruk *et al.*, 2006; Ramkissoon *et al.*, 2012; Kabuto *et al.*, 2005; Mahmoud *et al.*, 2012; AlAwwadi, 2010; 2013) [14, 37, 42]. Ginger is a scavenger of free radicals Ginger oil has scavenging effects due to volatile oils and same has been proved in many studies (Duke and Ayensu, 1985; Avato *et al.*, 2000; Kamtchouing *et al.*, 2000; Kumar *et al.*, 2015; Pushpanathan, 2008) [20 32, 16, 64, 34]. Lipid peroxidation Ginger has preventive effect on lipid peroxidation and it inhibits or breaks its chain (Duke and Ayensu, 1985; Afzal *et al.*, 2011; Verma *et al.*, 1993) [20].

**Anti-ulcerogenic effect of ginger**

This has both many benefits and drawbacks. Prostaglandin has been shown to have housekeeping and gastro-protective function by maintaining gastric mucosal integrity (Duke and Ayensu, 1985; Qureshi *et al.*, 1989; El-Sharaky *et al.*, 2009; Ajith *et al.*, 2008; Duarte, 2016) [23, 20, 4, 18]. Modulation of biological activities by ginger Ginger modulates genetic pathway, acts on tumour suppression of genes and modulates biological Activities (Duke and Ayensu, 1985; Jagetia *et al.*, 2004; Ha *et al.*, 2012; Duarte, 2016) [20, 6, 18].

**Conclusion**

Although the medicinal properties of ginger have been known for thousands of years, a significant number of *in vitro*, *in vivo*, and epidemiological studies further provide substantial evidence that ginger and its active compounds are effective against wide variety of human diseases. This marvellous spice and medicinal plant, ginger, is constrained severely by the absence of seed set, and the breeder is left with the alternative of clonal selection or induced mutations with all its uncertainty and limitations. Biotechnology opened up many potential avenues such as tissue culture, somaclonal variation, *in vitro* mutagenesis and selection, molecular fingerprinting, recombinant DNA technology, and genetic modification through transgenic for creating disease-resistant lines. Concerted efforts are needed to solve the serious problems besetting this "great medicine" and "universal cure" as described in the Indian systems of medicine, which is a great spice unparalleled in the range of applications and uses. Moreover, most of the known activities of ginger components are based only on *in vitro* and *in vivo* studies, except for a few clinical studies in human subjects. Therefore, more extensive and well-controlled human studies are required to demonstrate its efficacy as a safe and cost-effective alternative.

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