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Review

Exploring the Pharmacological and Nutritional Benefits of Ginger

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Ginger has been known for its several scientific properties and valued for the last 2500 years in different parts of the globe. 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 diarrhea, stomach upset, indigestion and nausea. It also has anti-inflammatory and antioxidant properties. Ginger constituents are 80% moisture, 2% protein, 2% fiber, 1% mineral, 0.9% fat, and 12% carbohydrate. The chemistry of ginger is well documented with the respect to the oleoresin and volatile oil. It is concluded that, ginger has potential 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. 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.

Key words: Ginger, *Zingiber officinalis*, anti-inflammatory, anti-oxidant.

INTRODUCTION

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 (Duke and Ayensu, 1985; 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).

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). 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).

PROPERTIES OF GINGER

1. Potency: spicy
2. Taste: bitter
3. Properties: light, adhesive and thick

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In 13th century, ginger culinary properties were discovered and soon it was widespread across the globe including Europe and was indicated for several diseases including travel sickness and flatulence. It is cultivated from Asia to Africa and used everywhere as a cooking spice. It is also useful in case of chills. In India, it is widely consumed in dose of 8-10 g as a flavouring agent (Kelly et al., 2009; al-Yahya et al., 1989; Gong et al., 1989; Stewart et al., 1991; Yamahara et al., 1985; Yamahara et al., 1990).

BIOCHEMISTRY OF GINGER

Ginger standards have been well documented in USP (United State Pharmacopoeia) and National formulary. The chemistry of ginger is well documented with the respect to the oleoresin and volatile oil. There is stringent criteria for the usage of medical grade (should contain 1.5% or more volatile oil).

The studies have identified more than 400 different compounds in ginger and major constituents are as follows:

1. Carbohydrates- about 70%
2. Lipid- about 8% which includes free fatty acids.
3. Volatile oils- about 3% consist mainly of the sesquiterpenes, beta-bisabolene
4. In addition, raw fibres, vitamins and minerals are also present in ginger.

Ginger also contains amadaldehyde, paradole, gingerdiols, gingerdiacetates, gingerenones, 6-gingersulfonic acid, diterpense, gingerglycolipids A, B and C (Qian and Liu 1992; Huang et al., 1991; Pecoraro et al., 1998; Anonymous 1997; Frisch et al., 1995).

MATERIALS AND METHODS

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.

THERAPEUTIC PROPERTIES OF GINGER

Cardiovascular effects

Large number of studies showed that the important constituents of ginger namely gingerol and shogaol classes of compounds might have many therapeutic effects including anti-inflammatory, antioxidant, and hypo-cholesterolemic effects.

Ginger enhances blood circulation throughout the body by stimulation of the heart muscle and by diluting circulating blood. This enhances 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).

Hypotensive effect

There are many studies which prove 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).

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; Al-Awwadi, 2010; 2013).

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).

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).

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).

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).

Hematologic (platelets) effects of ginger

Scientific evidence is still pending; however it was found that ginger is having anti-thrombotic and strong anti-inflammatory 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). 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).

Rheumatologic effect of ginger

Ginger exerts its anti-inflammatory effects by the mechanisms which explain the role of inhibition of pre-inflammatory 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).

Headache

Ginger is used for the treatment of headache and having 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).

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).

Antimicrobial

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).

Antiviral

Ginger has shown antiviral effect; however, more published literature is needed to prove efficacy (Gong et al., 1989; Ernst and Pittler, 2004; Anonymous, 1997; Ha et al., 2012; Lantz et al., 2007).

Antibacterial

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).

Antifungal

Gingerols and Gingerdiol are the main anti-fungal principles and extract of ginger powder is effective against several antifungal diseases (Ernst and Pittler, 2004; Ramkissoon et al., 2012; Mallikarjuna et al., 2008; Nasri et al., 2013).

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).

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).

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; Al-Awwadi,2010; 2013).

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).

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).

Insulin

Studies have suggested that ginger may improve insulin sensitivity in body. The mineral element of ginger is effective for the same (El-Sharaky et al., 2009; El-Abhar et al., 2008; Jagetia et al., 2004; Choi et al., 2013 ; Pushpanathan, 2008).

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).

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).

Therapeutic effects of Zingiber officinale in HCV (hepatitis C virus*)*

Ginger has powerful antiviral effect. It is effective in hepatitis C virus (HCV) infection where viral clearance is affected (Newall et al. 1996; Chaiyakunapruk et al., 2006; Verma et al., 1993; Kubra et al., 2013).

Menstrual cramps (dysmennorhea)

The powerful anti-inflammatory action on prostaglandin synthesis help in menstrual cramps (Halvorsen et al., 2002; Mallikarjuna et al., 2008; Mahmoud et al., 2012; Kubra et al., 2013).

CONCLUSION

This review article is based on current and past research done on the therapeutic effect of ginger for the various indications. It was found that ginger is useful in many acute and chronic conditions such as nausea, vomiting, menstrual cramp, reducing gas, joint pain, asthma, congestive conditions, and as an aphrodisiac.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest.

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