

SPICE AND MEDICINE: *ZINGIBER OFFICINALE*Shariq Shamsi^{*1}, Tajuddin², S.H. Afaq²

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ABSTRACT : Dietary agents including spices, vegetables and fruits have drawn a great deal of attention from both the science peoples and the general public due to their various health promoting effects, these agents consist of a wide variety of biologically active compounds, many of them have been used as traditional medicines from thousands of years. *Zingiber officinale* commonly known as ginger is one of the most widely used species of the ginger family, commonly used as a condiment for various foods and beverages. It has a long history of medicinal use dating back 2500 years. Ginger is well known all over the world especially for its use in disorders of the gastrointestinal tract such as constipation, dyspepsia, diarrhoea, nausea and vomiting. Ginger is described by Dioscorides as hot, digestive, gently laxative and stomachic. This article aims at reviewing the *Zingiber officinale* on the basis of Traditional system of Medicine and to discuss its recent Phytochemical and Pharmacological studies.

Key Words: Ginger, Medicine, *Zingiber officinale*.

INTRODUCTION

Ginger (*Zingiber officinale* Rosc) (Figure.1), belonging to a tropical and subtropical family-Zingiberaceae, originating in south east Asia and introduced to many parts of the globe, has been cultivated for thousands of years as a spice and for medicinal purposes. The underground stem or rhizome of this plant has been used as a medicine in Asian, Indian and Arabic herbal traditions since ancient times [Shukla and Singh, 2007]. It has been used in Unani, Ayurvedic and Chinese herbal medicines all over the world, since antiquity, for a wide array of unrelated ailments that include arthritis, rheumatism, sprains, pains, muscular aches, sore throats, indigestion, vomiting, fever, hypertension, cramps, constipation, dementia, helminthiasis and infectious diseases [Ali et al, 2008]. Ginger was known in China as early as 400BC. It was used as a spice by the Greeks and Romans who considered it an Arabian product because it was received from India by way of the Red Sea [Anonymous, 1976 and Chopra et al, 1958]. Ginger was also known to Europeans as it was an important item in European Commerce with the east during the middle age [Evans, 2003].

Figure 1*Zingiber officinale* Rosc*Zingiber officinale* Rosc. (Rhizome)

Extracts of the ginger are rich in shagaols and gingerols which exhibit antiinflammatory, anti-oxidant, anti-fungal, anti-mycobacterial and anticarcinogenic proprieties under “in vitro” and “in vivo” systems [Surh et al., 1998; Surh, 2002]. Some constituents of ginger have potent anti-oxidant and anti-inflammatory effects. [Dias, 2006].

Many reviewers have been devoted to specific aspects of ginger’s action. For example, one review dealt with the cancer preventive properties of the crude drug [Shukla and Singh, 2007] whereas another one dealt with an anti-inflammatory property of the ginger [Grzanna et al 2005].

In Traditional system of Medicine, ginger has been used in the treatment of Nausea [Attar, 1888], Asthma [Dymock, 1893], Cough [Khan, 1353 H], Colic [Said, 1997], Palpitation [Khan, 1353H], Inflammation [Dandya and Vohora 1989], Dyspepsia [Khan, 1313H], Loss of Appetite [Nadkarni, 2000], Rheumatism [Bhattacharjee and De, 2005], Vomiting [Khan, 1280H], Gout [Dymock, 1893], Atonic dyspepsia [Razi, 1967], Flatulent colic/ Flatulence [Dash and Kashyap, 1979], Relaxed condition of the throat [Dymock, 1893], Constipation [Ibn-Sina, 1316H], Indigestion [UPI, 2007], Anorexia [Anonymous, 2004], Weakness of stomach [Kabiruddin, 2007], Debility [Ghani, 1921], Arthritis [Lubhaya, 1977] and Catarrh [Khan, 1313H].

BOTANICAL DISTRIBUTION OF PLANT

A perennial herb reaching up to 90 cm in height [Anonymous 1976] with a large, solid, tough rhizome which is stout, tuberous, horizontal consisting of series of many persistent roundish joints [Kirtikar and Basu, 1993; Bentley and trimen, 1983]. The roots are numerous, large, cylindrical, fleshy, thick and brittle [Bentley and trimen, 1983]. The leaves are alternate, distichous, narrow, subsessile 1-2 cm wide, sheaths long, standing away from the stem [Bentley and trimen, 1983; Kirtikar and Basu, 1993; Anonymous, 1976]. Flowers are greenish with a small dark purple or purplish black lip, in radical spikes 3.8-7.5 cm long and 2.5 diameter on peduncles 15-30cm long [Kirtikar and Basu, 1993; Anonymous, 1976]. Stem is erect, leafy, 0.6-1.2 meter in height entirely covered with leafy stem [Bentley and trimen, 1983; Kirtikar and Basu, 1993; Anonymous, 1976; Hooker, 1894] and the fruits are not seen [Bentley and trimen, 1983].

GEOGRAPHICAL DISTRIBUTION

Ginger is cultivated in many parts of India; on a large scale in the warm, moist regions, chiefly in Madras, Cochin and Travancore, and to a somewhat less extent in Bengal and the Punjab [Nadkarni, 2000; Dey, 1973].

The herb is widely cultivated in tropical Asia [Bentley and trimen, 1983].

At present it is cultivated in all the warmer regions of whole world notably in the West Indies, India and Nigeria [Ghani, 1921; Kirtikar and Basu, 1993]

PHYTO-CHEMICAL STUDIES

Ginger contains volatile oil 1.350; resin, 1.205; neutral resin, .950; Gingerol, 600; substance precipitated by acids, 5.350; mucilage, 1.450; extractive soluble in alcohol not in ether or water, .280 alkaloid a trace; metarabin, 8.120; starch, 15.790; pararabin, 14.400; oxalic acid, .427; cellulose, 3.750; albuminoids, 5.570; moisture, 13.530; ash, 4.800. The essential oil is pale yellow, laevogire and not acrid. Gingerol, the active principle is a straw coloured, viscid, odourless fluid of extremely pungent taste [Dymock, 1893]. Chemically ginger contains several classes of compounds. The chemical composition of dried ginger is as follows: starch 40-60%, proteins 10%, fats 10%, fibres 5%, inorganic material 6%, residual moisture 10% and essential oil (oleoresin) 1-4 per cent. The essential oil of ginger contains various terpins and sesquiterpenes. The predominant sesquiterpene hydrocarbon is zingiberene.

The characteristic pungent odour is due to its oleoresin content which is an oily liquid containing oxymethyl phenols like shogaol, zingerone and gingerol etc. In all more than 200 different volatile substances have been characterised in the essential oil fraction [Verma and Bordia, 2001].

Shukla and Singh reported as follows: The volatile oil components in ginger consist mainly of sesquiterpene hydrocarbons, predominantly zingiberene (35%), curcumene (18%) and farnesene (10%), with lesser amounts of bisabolene and b-sesquiphellandrene. A smaller percentage of at least 40 different monoterpene hydrocarbons are present with 1, 8-cineole, linalool, borneol, neral, and geraniol being the most abundant. Many of these volatile oil constituents contribute to the distinct aroma and taste of ginger. Non-volatile pungent compounds: This species contains biologically active constituents including the non-volatile pungent principles, such as the gingerols, shogaols, paradols and zingerone that produce a ‘hot’ sensation in the mouth. The gingerols, a series of chemical homologs differentiated by the length of their unbranched alkyl chains, were identified as the major active components in the fresh rhizome. In addition, the shogaols, another homologous series and the dehydrated form of the gingerols, are the predominant pungent constituents in dried ginger. Paradol is similar to gingerol and is formed on hydrogenation of shogaol. Other constituents: In addition to the extractable oleoresins, ginger contains many fats, waxes, carbohydrates, vitamins and minerals. Ginger rhizomes also contain a potent proteolytic enzyme called zingibain [Shukla and Singh, 2007].

PHARMACOLOGICAL STUDIES

Anticancer effect

Rhode et al, (2007) reported that [6]-gingerol, a ginger component possess substantial anticarcinogenic property. The results of the study indicated that ginger exhibited anti-neoplastic effects through the inhibition of NF- κ B.

Antiinflammatory effect

Levy et al, (2006) reported that 6-Shogaol, one of the major compounds in the ginger rhizome reduced complete Freund's Adjuvant (CFA) induced chronic inflammatory response in the knee joint of rats and protected the femoral cartilage from damage. These findings suggested that 6-shogaol has useful anti-inflammatory properties that can be exploited. Jana et al, (1999) reported that *Zingiber officinale* produced significant anti-inflammatory effect in both acute and subacute models of inflammation. In sub acute inflammation, the results of the drug was less than phenylbutazone. Tripathi et al, (2008) observed that Ginger extract inhibited IL-12, TNF- α , IL-1 β (pro inflammatory cytokines) and RANTES, MCP-1 (pro inflammatory chemokines) production in LPS stimulated macrophages. In addition ginger extract negatively affected the antigen presenting function of macrophages and showed a significant reduction in T cell proliferation in response to allostimulation, when ginger extract treated macrophages were used as APCs. A significant decrease in IFN- γ and IL-2 production by T cells in response to allostimulation was also showed.

Antioxidant activity

An Ayurvedic combination of spices (*Piper nigrum*, *Piper longum* and *Zingiber officinale*) and herbs (*Cyperus rotundus* and *Plumbago zeylanica*) with salts make up *Amrita Bindu* was evaluated for the antioxidant property of individual ingredients against the free radical 2,2'-azinobis-(3-ethylbenzothiazoline-6-sulphonic acid) (ABTS). The analysis revealed the antioxidant potential of the ingredients in the following order: *Piper nigrum* > *Piper longum* > *Cyperus rotundus* > *Plumbago zeylanica* > *Zingiber officinale*. [Natarajan et al, 2006].

Anthelmintic activity:

Crude powder (CP) and crude aqueous extract (CAE) of dried ginger were exhibited a dose- and a time-dependent anthelmintic effect in sheep naturally infected with mixed species of gastrointestinal nematodes. It was concluded that ginger possesses *in vivo* anthelmintic activity in sheep thus justifying the age-old traditional use of this plant in worm infestation [Iqbal et al, 2006].

Effect on Obesity:

Methanol and ethyl acetate extracts of *Zingiber officinale* has showed potential beneficial effects in conditions of obesity. In addition to decrease serum glucose, insulin and lipid levels it can also significantly retard gain in body weight. Based on these beneficial effects, *Z. officinale* can be considered as supplementary herbal therapy in obese patients [Goyal and Kadnur, 2006].

Anti-emetic property:

A study performed by Abdel-Aziz et al, (2006) to determine the mode of action of gingerols and shogaols on 5-HT₃ receptors: Binding studies, cation uptake by the receptor channel and contraction of isolated guinea-pig ileum. Three different *in vitro* models were used to investigate their effects on 5-HT₃ receptors (serotonin receptor subtype) in more detail: [¹⁴C] guanidinium influx into N1E-115 cells which express 5-HT₃ receptors, isotonic contractions of the isolated guinea-pig ileum and equilibrium competition binding studies using a radioactively labeled 5-HT₃ receptor antagonist ([³H]GR65630) (3-(5-methyl-1H-imidazol-4-yl)-1-(1-methyl-1H-indol-3-yl)-1-propanone). All four compounds inhibited the [¹⁴C] guanidinium influx through 5-HT₃ receptor channels as well as contractions of the guinea-pig ileum induced by SR57227A ((4-amino)-(6-chloro-2-pyridyl) L-piperidine hydrochloride), a highly selective 5-HT₃ receptor agonist. All compounds showed also weak anticholinergic and antineurokininergic activities in the guinea-pig ileum (acetylcholine and substance P are mediators of the 5-HT₃ receptor effect). It was concluded that [6]-, [8]-, [10]-gingerol and [6]-shogaol exert their anti-emetic effect at least partly by acting on the 5-HT₃ receptor ion-channel complex, probably by binding to a modulatory site distinct from the serotonin binding site.

Immunomodulatory effect

In a study performed by Zhou et al, (2006) to evaluate the immunomodulatory effects of the volatile oil of ginger (*Zingiber officinale* Roscoe), *In vitro*, the volatile oil of ginger significantly inhibited T lymphocyte proliferation, decreased the number of the total T lymphocytes and T helper cells, but increased the percentage of T suppressor cells to the total T lymphocytes in the mice. In addition, the volatile oil of ginger inhibited IL-1 α secretion by the mice peritoneal macrophages. *In vivo*, oral administration of the volatile oil of ginger dependently weakened the delayed type of hypersensitivity response to 2, 4-dinitro-1-fluorobenzene in the sensitized mice. These results showed that the volatile oil of ginger influences both cell-mediated immune response and nonspecific proliferation of T lymphocyte, and may exert beneficial effects in a number of clinical conditions, such as chronic inflammation and autoimmune diseases

Nephroprotective effects

It has been reported that Ethanolic extract of *Zingiber officinale* alone and in combination with vitamin E (a-tocopherol) partially ameliorated cisplatin-induced nephrotoxicity. This protection is mediated either by preventing the cisplatin-induced decline of renal antioxidant defense system or by their direct free radical scavenging activity [Ajith et al, 2007].

CONCLUSION

A significant number of laboratory animal studies provide substantial evidences that ginger and its constituents are effective in various ailments. This review clearly validated some of Traditional Medicine claims as they describes that ginger is useful in Inflammation, Arthritis and Vomiting etc and use of this ancient medicine for various problems has been given scientific approval. In Traditional system of medicine it used mainly in the gastrointestinal problems. Further studies on determining the activities of ginger and its active components should ideally include human trials to investigate its effectiveness against various diseases.

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