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Review Article

A Pharmacological Investigation of *Zingiber Officinale*

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ABSTRACT

Ginger, a rhizome of *Zingiber officinale* belongs to the family Zingiberaceae, is a slender, perennial herb. It has a long history of use in Chinese and Ayurvedic medicine as an antioxidant, antipyretic, gastroprotective, antiemetic, antitussive, hepatoprotective agent. The medicinal property of ginger is mainly due to the presence of gingerol, shogaols, paradol, etc. In traditional medicine, this plant has been employed for treating several diseases like asthma, arthritis, stroke, toothaches, paralysis, and diabetes. Currently, there is a renewed interest in ginger and many clinical experiments are carried out extensively for the isolation, identification of active constituents and scientific verification of its pharmacological for the treatment of several disease and conditions. With further more research the plant can be established as a standard drug because of its broad range of medicinal activity. This article aims at reviewing the most recent studies carried out on the pharmacological property of Z. *officinale* and the potential mechanism.

Keywords: *Zingiber officinale*, pharmacology, Zingerone

INTRODUCTION

Ginger (*Zingiber officinale*), a genus of rhizomatous herbs belonging to the family Zingiberaceae, is a spice commonly used as a condiment and preservative for a variety of foods. [1] It is a slender, perennial erect herb with thick underground stem (rhizome) from which the aerial stems grow up to about 1m high which is entirely covered by the leaf-sheaths. Chinese and Ayurvedic system of medicine uses ginger as an antiemetic, antipyretic, and anti-inflammatory agent. In traditional medicine, this plant has been employed for treating several diseases like asthma, arthritis, stroke, toothache, paralysis, diabetes and gastrointestinal problems. [2] The dried rhizome of ginger contains approximately 1-4% of volatile oils which are medicinally active constituents and are also responsible for the characteristic odor and taste. The aim of this review is to and summarize the more recent and common pharmacological property of ginger and to elucidate the potential mechanism.

Phytochemical studies showed that the plant is rich in a large number of substances, including α-Zingiberene, β-bisabolene, gingerols and shagaols. The major pungent constituents of ginger, 6-gingerol and 6-shogaol have been shown to have many interesting pharmacological effects such as antioxidant, antitumor promoting and anti-inflammatory effects. Also, the phytochemical screening of ginger oil showed that alkaloids, carbohydrate, glycosides, proteins, saponins, steroids, flavonoids and terpenoids were present. The constituent of ginger may also vary depending on the place of origin and

whether the rhizomes are fresh or dry. Ginger owes its characteristic organoleptic properties to two classes of constituents: the odor and much of the flavor of ginger is determined by the constituents of its steam-volatile oil, while the pungency is produced by nonsteam- volatile components. The aroma and flavor of ginger are determined by the composition of its steam volatile oil, which is comprised mainly of sesquiterpene, hydrocarbons, monoterpene hydrocarbons and oxygenated monoterpenes.

METHODS

Internet browsing from Google scholar database was used to identify and to download abstract and research paper related to the pharmacological activity of *Zingiber officinale* using the suitable keywords (ginger + pharmacology). We used literature from English language and studied both human and animal models, and then we had about 55 articles. We could achieve only 28 articles from these articles and reviewed and summarized for the pharmacological property of ginger. Moreover, we mostly preferred articles published in recent time. The review articles were only included in the study if they provided us some new ideas.

Pharmacology:

Gastroprotective activity:

Some active components of ginger are reported to stimulate digestion, absorption, relieve constipation and flatulence by increasing muscular activity in the digestive tract. In the present study by SU Zaman et al-2014 the gastroprotective activity and the underlying mechanism of the 95% ethanolic extract of Z.*officinale* was investigated. The extract was evaluated against gastric ulceration induced by hydrochloric acid (HCL) or water immersion restraint stress (WIR) or aspirin (ASP). Ginger extract reduced gastric lesions in three different models of gastric ulcers, by 81%(HCL), 44.1%(WIR) and 68.2% (ASP). The study concluded that ginger extract exerts moderate gastric ulcer protection by increasing mucus secretion. [3]

Another important study by Chantharangsikul G et al-2016 showed that ginger root extract significantly inhibited the gastric damage induced by indomethacin and its efficacy as a gastroprotective agent was comparable to that of proton pump inhibitor omeprazole (with the dose of 400mg/kg being better than 200mg/kg). [4]

Anti-inflammatory activity:

Ginger has a long history of use as an anti-inflammatory and many of its constituents have been identified as having anti-inflammatory properties. A study was conducted for the anti-inflammatory activity of ginger alone and in combination with Indomethacin using carrageenan-induced rat paw edema. Aqueous extract of *Zingiber officinale* (200mg/kg or 400mg/kg) was administered alone and in combination with Indomethacin (25mg/kg) to separate group of rats. Indomethacin, ginger 200mg/kg and ginger 400mg/kg displayed the value of 95%, 89.5%, and 92.6%inhibition of paw edema respectively thus showing a similarity in the anti-inflammatory profile of ginger and Indomethacin. [5]

Another study documented the ability of a hexane fraction of dried ginger methanolic extract to suppress proinflammatory gene expression in LPS-activated BV2 microglial cells, thus displaying anti-neuroinflammatory activity. [6]

Hepatoprotective and Antioxidant activity:

The current study was designed by Hasan et al-2016 to evaluate the potential hepatoprotective and antioxidant activity of Z.*officinale* against liver injury and fibrosis induced by CCl4 in rats. To induce liver fibrosis, Wistar albino rats received CCl4 (2ml/kg diluted in corn oil) twice weekly for 8 weeks also rats were concurrently treated with ginger extract at two different dose (300 and 600mg/kg/day), the CCL4 induction produced a significant increase in serum aminotransferases, lipids, liver lipid peroxidation, and nitric oxide. The hepatoprotective effect was evidenced by

the significant decrease in serum aminotransferases and liver lipid peroxidation. Through its potent antioxidant activity, ginger maintained the integrity of plasma membrane and increased the regenerative and reparative capacity of the liver. [7]

Another report has shown that administration of single dose of aqueous extract of ginger (200, 400 mg/kg prior to acetaminophen) was effective in preventing the acetaminophen-induced hepatotoxicity and also decreased ALT, AST, and ALP levels and increased the activities of antioxidant enzymes levels in the liver. [8]

Antimicrobial activity:

The aim of the study was to identify the antimicrobial property of ginger Riaz et al.-2015 conducted a study against various human pathogens by agar diffusion method using the culture of E.coli, Bacillus subtilis, Staphylococcus aureus, and Streptococcus faecalis to identify the antimicrobial strength. Soybean-Casein Digest Agar was used as culture media. Ginger possesses a noticeable antimicrobial activity which was confirmed by checking the susceptibility of different strains of bacteria and fungus by measuring the zone of inhibition. The study concluded that different bacterial species exhibited different sensitivities towards the extract of ginger. [9]

Antiemetic effect:

The components in ginger that are responsible for antiemetic effect are thought to be gingerols, shogaols, and galanolactone, a diterpenoid of ginger. Studies based on animal model revealed that ginger extract possesses anti-serotoninergic and 5-HT3 receptor antagonism effects which play an important role in the etiology of postoperative nausea and vomiting. [10, 11]

In a research study by Ullah et al.-2015 Z.*officinalis* acetone fraction (ZO-ActFr) was investigated for attenuation of emesis induced by cisplatin in healthy pigeons.ZO-ActFr at the dose of 50mg/kg provided maximum protection against the retching and vomiting which was ~ 58.13% (18 ± 4.2 episodes) ($P < 0.05$) as compared to cisplatin control. The attenuation with the 25 & 100 mg doses observed was 44.18% (24 ± 4.1 episodes) and 27.9% (31 ± 5.6 episodes) respectively, but the suppression was found to be statistically non-significant. The study verifies the antiemetic activity of ginger by the serotonergic and dopaminergic component in the mediation of its antiemetic effect. [12]

Anticancer activity:

An ethanolic ginger extract applied topically to mouse skin provided a highly significant protective effect against the development of skin tumors, and this was associated with the inhibition of 12-O-tetradecanoylphorbol-13-acetate (TPA)-caused induction of epidermal ornithine decarboxylase, cyclooxygenase and lipoxygenase activities. [13] Another important study has shown that 6-shogaol show anticancer activities against breast cancer via inhibition of cell invasion reduction of matrix metalloproteinase-9 expression. [14] Another important finding suggests that 6-gingerol stimulates apoptosis through up regulation of NAG-1 and G1 cell cycle arrest through down regulation of cyclin D1. [15]

Antiplatelet aggression:

Ginger has been shown to inhibit platelet aggregation and to decrease platelet thromboxane production in vitro. Significant anti-platelet aggregation activity was displayed by 6-GN and 6-SG, while 10-GN inhibited Ca^{2+} dependent contractions in media high in K^{+}. [16] The aggregation and release reaction of an arachidonic acid and collagen-induced rabbit platelets were inhibited by 6-GN at 0.5-20 lM. It also inhibited thromboxane B_2 and PG D_2 formation, caused by arachidonic acid, at 0.5–10 lM 6-GN. [17]

Cardiovascular activity:

An early study found a dose-dependent positive inotropic action of [6]-, [8]- and [10] gingerol on isolated guinea pig left atria, and ‘gingerol' stimulated the Ca^{2+} pumping ATPase activity of fragmented sarcoplasmic reticulum prepared from mammalian skeletal and cardiac muscle.

The study was conducted 22 male and 38 female for the effect of ginger extract on heart rate and blood pressure and result showed significant ($p<0.05$) in all measured parameter two hours after ginger extract administration and the significant increase ($p<0.05$) only in systolic BP, 4 hours after ginger administration.

Neuroprotective activity:

Ginger and their constituents play a vital role as a neuroprotector. The exact mechanism of action of ginger in this vista is not known fully. But it is thought ginger shows neuroprotector effect due to the phenolic and flavonoids compounds. An important study has shown that 6-shogaol has neuroprotective effects in transient global ischemia via the inhibition of microglia. [6] Another finding in the support of ginger as neuroprotector suggests that it exhibit neuroprotective effect by accelerating brain anti-oxidant defense mechanisms and down regulating the MDA levels to the normal levels in the diabetic rats. [18]

Analgesic activity:

Shogaol has also been shown to inhibit acetic acid-induced writhing in mice and to elevate the nociceptive threshold of the yeast-inflamed paw. In an experiment by Chyad AH et al-2016 ginger was shown to have peripheral and central analgesic effect in mice which may be attributed to the to the various phytochemicals present in rhizomes of Z.*officinale*.

CONCLUSION

Zingiber officinale has been subjected to many extensive clinical investigations. Experimental studies have demonstrated its anti-inflammatory, analgesic, antiemetic properties. So further many kinds of research can be done for finding out the more medicinal use of ginger and it can be an alternative to modern medicine for the treatment of any underlying disease. We hope this review will facilitate all about the past scientific research and the necessary information about the enormous pharmacological activities of ginger and more detailed clinical research appears
worthwhile to establish it as a standard drug.

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