



Therapeutic Properties of *Zingiber officinale* Roscoe: A Review

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Authors' contributions

This work was carried out in author collaboration. Authors HAP, RN and MRH designed the study, wrote the protocol, wrote the first draft of the manuscript and managed the literature searches. Authors SO, HY, and SG managed the literature searches. All authors read and approved the final manuscript.

Review Article

Received 28th April 2014
Accepted 18th July 2014
Published 3rd August 2014

ABSTRACT

Aims: Ginger, a rhizome of *Zingiber officinale* Roscoe (Fam. *Zingiberaceae*), has been widely used as a spice to enhance the flavor of food and beverages and for medical purposes in various diseases.

Methodology: The review covers the databases and articles published between 2002-2013 via Medline and published papers on the Internet from Scientific Information Database, MagIran and Irandoc. Literature searches were performed to identify all the researches on ginger for treatment properties.

Results: The researchers conducted on ginger in medical field were about nausea and vomiting in pregnancy, contraceptive pills nausea, dysmenorrhea, motion sickness, cough, ventilator associated pneumonia, rheumatic diseases, antibacterial and antiviral effects, nausea and vomiting due to chemotherapy, spermatogenesis, anti-hyperlipidemia,

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anti-inflammatory, diabetes nephropathy and postoperative nausea and vomiting. Clinical trials about ginger were mostly to prevent and treat nausea and vomiting during pregnancy.

Conclusion: According to the published articles, ginger is an extraordinary herb and more detailed clinical trials using ginger are recommended for further studies in future.

Keywords: *Ginger; Zingiber officinale roscoe; dysmenorrhea; motion sickness; ventilator associated pneumonia.*

1. INTRODUCTION

Herbal and natural products of folk medicine have been used for centuries in every culture throughout the world. Scientists and medical professionals have shown increased interest in this field as they recognize the true health benefits of these remedies [1]. Ginger, a rhizome of *Zingiber officinale* Roscoe (Fam. *Zingiberaceae*), has been widely used as a spice to enhance the flavor of food and beverage and for medical purposes in various diseases, particularly to treat ailments such as stomachache, diarrhea and nausea [2]. Ginger is among the 20 top selling herbal supplements in the United States, and its retail sale is in the mainstream in the USA. As early as in the 12th century BCE, Shang dynasty rulers in China took care to locate the areas in the Sichuan region where the finest ginger grew so that their kitchens and their spice trade might profit from the very best ginger [3]. It is mentioned in the writings of Confucius, his Analects, as a staple in prepared medicines and in his diet. Ginger is also mentioned in the Talmud and the Bible. Via Arab traders, ginger was introduced to India and southern Europe centuries prior to the Roman Empire.

Studies have shown that ginger has various active compounds and different effects and used in the treatment of colic, bloating and indigestion, hypercholesterolemia, burns, ulcers, depression, impotence and liver toxicity [4]. It has anti-inflammatory properties in arthritis. It is an anti-spasmodic and has anti-tumor effects in cancerous patients. Ginger has antioxidant benefits and helps to neutralize free radicals. Ginger has antiemetic effect and due to non-toxic effect, it can be prescribed for long-term treatments in various diseases such as seasickness [46]. Ginger has been tested on the diseases caused by air or car travel and even in the military in the parachute and aerial maneuvers.

Ginger is a famous traditional herb in Iran [4]. Apart from the known properties of this herb among Iranian people, despite of plenty of planting and relatively its low price, its use is still limited to special conditions such as flavoring in foods or Poultrice for musculoskeletal pain [5]. Despite the high frequency of herbal plants in Iran, physician and nurses generally do not recommend it for their patients. This may be due to deficit knowledge about these products or fear of their possible side effects. Despite the high frequency of herbal plants in Iran, physician and nurses generally do not recommend it for their patients. This is may be due to deficit knowledge about these products or fear of their possible side effects. Therefore, we decided to review all investigations which were conducted about ginger in Iran and determine research limits in this field. This review covers the databases, articles published between 2002-2013 via Medline, and published papers on the Internet from Scientific Information Database, MagIran and Irandoc. Literature searches were performed to identify all the researches on ginger for treatment properties (Table 1).

1.1 Chemistry of Ginger

The sensory perception of ginger in the mouth and nose arises from two distinct groups of chemicals:

Table 1. Researches about ginger between 2002-2013

Investigators, published year	Research objective	Methodology
Taeb, 2001	Motion sickness	Review article (seasickness)
Abolghasemi, [14]	Pregnancy nausea and vomiting	Randomized clinical trial, 44 pregnant women with nausea and vomiting
Dehghan, 2002	Effect on <i>Helicobacter pylori</i>	Experimental study, water extract of turmeric, cardamom, clove and ginger is assessed on <i>Helicobacter pylori</i> species with diffusion agar method
Haghighi, [3]	Osteoarthritis	Randomized clinical trial, 80 patients with osteoarthritis
Basirat, [13]	Pregnancy nausea and vomiting	Randomized clinical trial, 65 pregnant women with gestational age (<17 weeks)
Fatehi, [40]	Chronic inflammation	Experimental study in rat
Tarshizi, [20]	Primary dysmenorrhea	Randomized clinical trial, Birjand nursing school students with primary dysmenorrhea
Ozgoli, [12]	Primary dysmenorrhea	Randomized clinical trial, 150 students with primary dysmenorrhea
Firoozbakhat, [15]	Pregnancy nausea and vomiting	Randomized clinical trial, 20 pregnant women with gestational age (<20 weeks)
Hemmatzadeh, [9]	Pregnancy nausea and vomiting	Randomized clinical trial, 30 pregnant woman with gestational age (<20 weeks)
Minaiyan, [41]	Duodenal ulcer	Experimental study, duodenal ulcer induced by cysteamine in 6 rats, Hydroalcoholic extract of ginger, ranitidine, sucralfate administered orally
Moradi, [16]	Pregnancy nausea and vomiting	Meta analysis systematic review of articles published in Medline, Embase, Central, Cinahl, SID
Rohibroojeni, [22]	Coughing and chest pain due to tracheitis	Randomized Clinical trial, 60 patients with acute tracheitis
Hosseinkhani, [10]	Pregnancy nausea and vomiting	Randomized Clinical trial, 121 pregnant women in first trimester

Table 1 continued.....

Jahromi, [4]		Review article (Ginger a soothing spices)
Johari, [34]	Spermatogenesis	Experimental study, Ginger prescription to 56 rats under cyclophosphamide therapy for 21 days.
Nasiri, [24]	Spermatogenesis	Experimental study, Wistar male rat (n=30) were allocated into three groups, control and test groups, that subdivided into groups of 2 that received ginger rhizome powder daily for 20 consequence day. In twentieth day the testes tissue of Rats in whole groups were removed and sperm was collected from epididymis and prepared for analysis.
Ozgoli, [12]	Pregnancy nausea and vomiting	Randomized clinical trial, 67 pregnant women with mild to moderate vomiting
Safavinaeeni, [17]	Contraceptive pills nausea	Randomized clinical trial, 44 women using compound contraceptive pills
Shariatpanahi, [23]	Mechanical ventilator pneumonia	Randomized clinical trial, 16 patients with ARDS
Atashak, [42]	Cardiovascular risk factor	Double-blinded clinical trial, 32 men (BMI>30)
Ghanbari, [27]	Chemotherapy nausea and vomiting	Randomized, double blinded, cross over, clinical trial, 44 patients from oncology (hematology) unit
Khaki, [33]	Spermatogenesis	Experimental study, Wistar male rat (n=40), ginger group that received 100mg/kg-per day (oral), and diabetic group that received (IP) streptozotocin. Treatment group received (IP) STZ plus ginger 10, daily for 4 weeks, respectively; the control group just received an equal volume of distilled water daily (IP).

Table 1 continued.....

Khalili, [5]	Chronic pain	Experimental study. Effects of alcoholic <i>Zingiber officinale</i> Roscoe rhizome extract on two different models of acute and chronic inflammation and pain. Formalin, xylen and acetic acid were used to induce acute inflammation in paw, ear and peritoneum, respectively.
Momeni, [25]	Genitourinary infection	Experimental study, organisms were investigated using agar diffusion method. Raw, cold-water, heat-water and ethanolic extracts of onion and ginger were provided and injected to the culture
Rahnama, [19]	Primary dysmenorrhea	Randomized clinical trial, 78 student with primary dysmenorrhea
Sanavi, [18]	Complication	Case report of a rare complication of ginger consumption (subacute thyroiditis), A 34-year-old female was referred to Mostafa khomeini Hospital, Tehran, Iran
Tavakol, Afshari, [31]	Breast cancer	Experimental study, Breast cancer cell line (MCF7) and normal connective tissue cell line (L929) was cultured in DMEM medium. Ethanolic extract of <i>Zingiber officinale</i> Roscoe was prepared and cell lines were treated with different concentration of extract
Tavakol ,Afshari, [31]	Liver cancer	Experimental study, the effect of ginger extract on HepG and normal liver cell (L929)
Fahimi, [28]	Chemotherapy nausea and vomiting	Randomized double-blind placebo-controlled cross-over study, patients receiving cis-platin
Panahi, [30]	Chemotherapy nausea and vomiting	A pilot, randomized, open-label clinical trial, 100 women with advanced breast cancer

Table 1 continued.....

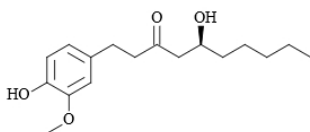
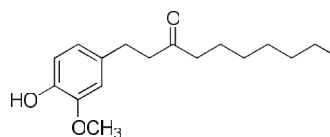
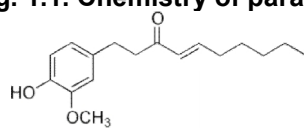
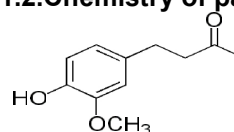
Yerkta, [29]	Chemotherapy induced vomiting	randomized double-blind placebo-controlled clinical trial, 80 women with breast cancer
Zahedi, [36]	Spermatogenesis and infections	A randomized- control study, 40 adult wistar male rats
Montazeri, [53]	Postoperative nausea and vomiting	Randomized, double-blinded study, 160 eligible patients.

1.1.1 Volatile oils

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 monoterpenoid hydrocarbons are present with 1,8-cineole, linalool, borneol, neral, and geraniol being the most abundant [6,7]. Many of these volatile oil constituents contribute to the distinct aroma and taste of ginger.

1.1.2 Non-volatile pungent compounds

The 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 [6,7]. In addition, the shogaols, another homologous series and the dehydrated form of the gingerols, are the predominant pungent constituents in dried ginger [8]. Paradol is similar to gingerol and is formed on hydrogenation of shogol. The major constituents of ginger are shown in (Fig. 1).

**Fig. 1.1. Chemistry of paradol****Fig. 1.2. Chemistry of paradol****Fig. 1.3. Chemistry of shagol****Fig. 1.4. Zingerone of shagol****Fig. 1. The major constituents of ginger**

1.1.3 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 [8].

2. THE REVIEW OF LITERATURE

2.1 Nausea or Vomiting in Pregnancy

Nausea and vomiting [commonly referred as morning sickness] are very common symptoms in pregnancy, affecting 70–85% and 40–50% of pregnant women; respectively [9,10]. It has been estimated that the financial burden of morning sickness on the American health system is more than 130 million dollars per year. Many medications are currently available for the treatment of morning sickness. However, concerns about the potential teratogen effects of drugs administered during the critical embryonic period of pregnancy drastically limit their use [11]. A recent literature survey reports that the most commonly used natural drugs for the treatment of morning sickness are ginger, chamomile, peppermint, and raspberry leaf. Among these, only ginger has been evaluated in controlled trials for the treatment of morning sickness [9].

In another research, the efficacy and safety of ginger in reducing nausea and vomiting during early pregnancy has been evaluated. According to the findings, ginger reduces nausea and vomiting of pregnancy. Based on this evidence we can safely use ginger in early pregnancy with therapeutic doses [approximately 1 gr/day] for a limited period of time [12]. Likewise it has been shown that oral use of ginger during the first trimester period is effective to reduce the severity of nausea [10]. A study showed that ginger biscuits are effective in reducing the severity of nausea during pregnancy [13]. It has been reported that taking 750 mg of ginger every day is a good way to improve nausea and vomiting during pregnancy [14]. In a double-blind clinical trial, the effect of ginger capsules to treat pregnancy nausea and vomiting in comparison with vitamin B₆ is studied. Ginger was more effective than vitamin B₆ in reducing nausea severity but it had same effect in reducing early pregnancy vomiting. The results indicate that ginger is effective in treating nausea and vomiting of pregnancy. However further studies have been recommended to determine the appropriate dose of drug and its probable maternal and fetal complications [15]. Another study has shown that ginger may reduce nausea and vomiting of pregnancy and can be used at a therapeutic dosage [1gr/day] for a limited period of time [16]. Likewise, in a research, 1gr/day of ginger powder in capsule QID was prescribed to 30 pregnant women lower than 20 week pregnancy with nausea and vomiting. The results showed that there was a significant decrease in nausea and vomiting and no side effects have been reported [9]. Considering the main positive results of random control trials and the absence of adverse effects on pregnancy outcomes, ginger may be an effective alternative treatment in managing nausea and vomiting symptoms during pregnancy. After extensive pharmacological studies, it has been concluded that ginger has significant anti-inflammatory, antiemetic and chemoprotective effects. It is now recognized as a drug choice for nausea and vomiting. It has also been found useful in pregnancy related morning sickness [11].

2.2 Contraceptive Pills Nausea

The findings of a recent study have shown that due to strong antioxidant and anti-inflammatory effect of ginger, it can be used in the treatment of nausea resulting from combined contraceptive pills. There was a significant difference in terms of nausea periods at different months [17,18].

2.3 Dysmenorrhea

Given the high prevalence of primary dysmenorrhea and its adverse consequences on quality of life, known drugs in dysmenorrhea [mefenamic acid and ibuprofen] and ginger have been studied in the medical students living at dormitories of universities. The results revealed that ginger capsule is effective in improving primary dysmenorrhea. However, determining the effects of ginger on the other symptoms associated with primary dysmenorrhea was recommended [12]. A recent research has shown the effect of powdered extract of ginger rhizome on primary dysmenorrhea experienced by nursing students at dormitories. The results showed that 500mg ginger three times in a day is appropriate to reduce pain of primary dysmenorrhea [19]. Another study found similar findings and suggested further studies to determine probable side effects and more accurate dosage in primary dysmenorrhea [20].

2.4 Motion Sickness

Motion sickness is a dysfunction of the vestibular system, vision and proprioceptive imbalance. Nausea in this disease is due to involvement in the hypothalamus and part of cerebral cortex. In a study it has been found that instead of 100mg dimenhydrinate, 940mg of ginger before travel has better effect on nausea and vomiting due to seasickness [21].

2.5 Cough

Coughing is a natural mechanism of the respiratory system but sometimes due to the severity of the discomfort interferes in social activities. A recent study has shown that a solution containing the herb marshmallow and ginger has anti-inflammatory effect and can reduce coughing and chest pain in patients with tracheitis, and also reduce the adverse gastrointestinal symptoms induced by bronchodilator and synthetic anti-inflammatory drugs [22].

2.6 Anti-bacterial and Anti-viral Effect

Pneumonia aspiration is one of the serious complications in patients at intensive care unit. Gastric emptying difficulties may have an important role in gastrointestinal aspiration. On the other hand, ventilator associated pneumonia [VAP] is a problem. In a research, the effect of enteral feeding with ginger extract was studied. Results showed that this intervention can delay gastric emptying and therefore decrease VAP. *Helicobacter pylori* is known as an important factor in the development of chronic gastritis, duodenal ulcer and also likely in distal gastric adenocarcinoma [23]. In a recent study about the effect of ginger essence on 25 *Candida albicans* species resistant to fluconazole, and the results showed that ginger has inhibitory effect on all examined species. Thus, it can be suggested as an antifungal in clinical trials [24]. In another research, the antibacterial properties of raw, aquatic and ethanolic extracts of *Allium cepa* [onion] and *Zingiber officinale* Roscoe were investigated against *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Escherichia coli* and *Candida albicans* isolated from vaginal specimens. These four organisms cause reproductive and urinary tract infections. The results indicate that ginger has more inhibitory effect and antibacterial activities compared to the onion. Thus, it can be used widely in folk medicine in this regard [25].

Rhinoviruses are among those viruses which cause to common cold. Dried rhizomes of ginger have been investigated for anti-rhino-viral activity in the plaque reduction test. Fractionation by solvent extraction, solvent partition and repeated chromatography guided by bioassay, allowed the isolation of several sesquiterpenes with anti-rhino-viral activity. The most effective of these was β -sesquiphellandrene [2].

2.7 Rheumatic Diseases

In the study of the effects of alcoholic ginger extract, formulated in 500mg capsules containing ginger and 500mg capsules containing a placebo, on 80 patients with osteoarthritis in two groups of 40 patients, the results showed no any report of side effects while taking this medication. Ginger extract and ibuprofen were significantly more effective than the placebo in the symptomatic treatment of osteoarthritis, while there was no significant difference between the ginger extract and ibuprofen groups. This study showed that treatment with ginger was more effective than the placebo in mechanical pain due to osteoarthritis and can be a good alternative to non-steroidal anti-inflammatory drugs [3].

2.8 Nausea and Vomiting Due to Chemotherapy

Nausea and vomiting due to chemotherapy is a major concern in cancerous patients. The prevalence of these side effects is reported as 54-95% [26]. A recent double blind randomized clinical trial research has shown the effect of ginger on nausea or vomiting among 44 patients undergone chemotherapy. The results showed that there was no significant difference at the frequency of nausea or vomiting in the intervention group [treated with ginger], but there was a significant decrease in the intensity of nausea and score [after 3 and 24 hours of chemotherapy] compared with the placebo group [27]. In another research, the effect of (Fam. *Zingiberaceae*) on nausea and vomiting in patients receiving cisplatin based regimens was studied. In this study, addition of ginger to the standard antiemetic regimen has shown no advantage in reducing acute [day 1] and delayed [day 2-3] nausea and vomiting in patients receiving cisplatin [28].

The results of a randomized double-blind placebo-controlled clinical trial to evaluate the effect of ginger plant on chemotherapy-induced vomiting, on 80 women with breast cancer undergoing chemotherapy shown that taking ginger capsules (for 6 days, starting 3 days before chemotherapy) accompanied by the routine antiemetic treatment could relieve chemotherapy-induced vomiting in all phases [29].

The results of a pilot, randomized, open-label clinical trial study on 100 women with advanced breast cancer who were initially assigned to standard chemotherapy protocol with docetaxel, epirubicin, and cyclophosphamide were randomized to receive ginger plus standard antiemetic regimen and standard antiemetic regimen alone showed a significantly lower prevalence of nausea in the ginger group during 6 to 24 hours post chemotherapy time period. Thus, combining ginger (1.5g/d) to standard antiemetic therapy in patients with advanced breast cancer can reduce the prevalence of nausea during post chemotherapy time period [30].

2.9 Anti-tumor

A recent study has shown that ginger has toxic effect on cancerous liver cells, therefore it can be used for liver cancer. In the same study the effect of *Zingiber officinale* Roscoe in

breast cancer was studied. The results showed that ginger doses in 2500 µg concentration inhibited 50% of cell growth after 48 hours [31].

2.10 Spermatogenesis

In a research conducted to determine the effect of ginger [fresh rhizome powder and fresh onion water] on spermatogenesis in rats. There was significant difference between the intervention group and control group in terms of sperm count, motility percentage and vitality. This suggested that ginger may be promising in enhancing sperm health parameters [32,33]. In a recent study, the toxicity of gentamicin on sperm in rats was assessed. Ginger administration caused a marked increase in the testosterone concentrations of the rats even in spite of receiving 5mg/kg/day gentamicin compared with the control and gentamicin treated groups. Ginger rhizome is able to overcome reproductive toxicity of gentamicin and induces spermatogenesis probably mainly through the elevation of testosterone levels [33]. In a study, the effect of ginger extract on body weight, testes and spermatogenesis in male rats under chemotherapy with cyclophosphamide was searched. The results showed that cyclophosphamide led to a decrease in body weight, and spermatogenesis. When it was prescribed with ginger, these variables increased significantly [34]. Likewise in another research, sperm parameters significantly decreased in the streptozocin induced diabetic rat group. However, in the treatment group that received 100mg/kg [oral] ginger, there was an increase in the sperm parameters in comparison to the experimental groups. Due to this preventive effect on the sperm parameters it seemed that it could be effective for treatment of diabetic rats [35].

Antibiotics such as gentamicin, streptomycin and ofloxacin are routinely used by urologists to treat infections prior to in vitro fertilization treatment. Gentamicin and Ofloxacin affect the spermatozoa by affecting their number, motility and morphology. Gentamicin induced structural changes such as sloughing of somniferous epithelium, vacuoles and gaps in the epithelium, nuclear pyknosis and atrophic changes in a few tubules. A study by Zahedi et al. [36] to evaluate protective effect of ginger on gentamicin-induced apoptosis in testis of rats were done. In order to study the recovery effects of ginger on testis apoptosis after treatment with gentamicin, 40 adult Wistar male rats were selected and randomly divided into four groups of normal saline control (group I), gentamicin control (group II), ginger control (group III) and gentamicin+ginger (group IV) each having 10 rats. The results revealed that there was a significant increase in apoptosis in the group III when compared with the other groups. However, ginger could decrease apoptosis in the group IV that received 100mg/kg/rat of ginger. Regarding these results, it recommended that administration of ginger with gentamicin might be beneficial in men who receive gentamicin to treat infections.

2.11 Diabetes

In a research, the effect of ginger on diabetes nephropathy, plasma antioxidant and lipids peroxidation were assessed. The results have shown that ginger powder caused to a decrease in the level of lipid peroxidation, an increase in plasma antioxidant potential and a decrease in renal nephropathy [37]. The results of another study showed that ginger caused to a decrease in the level of serum glucose, TG and LDL as glibenclamide in diabetic rats. The decrease of serum glucose was statistically more than glibenclamide. Also, VLDL and TG decreased statistically more compared to glibenclamide. Considering these results, these researchers suggested that ginger has a potential effect to decrease glucose and blood fats, but it needs further investigations [38]. In a recent research, the effect of ginger on the

occurrence of oxidative stress in the small intestine of diabetic rats was studied. Oxidative stress is produced under diabetic conditions and possibly causes various forms of tissue damage in patients with diabetes. Their findings indicate that ginger as antioxidant improves diabetes induced oxidative stress and its complications through prevention of lipid peroxidation and protein oxidation [39]. Furthermore, the effect of aqueous extract of ginger root in diabetic mice was studied. The anti-inflammatory effect of extract was almost the same as L-NAM [a nitric oxide synthase inhibitor], but less than indomethacin. The results suggest that the anti-inflammatory effect of aqueous extract of *Zingiber officinale* Roscoe is comparable to L-NAME [40].

2.12 Anti-inflammatory and Inflammatory Bowel Diseases

The effect of ginger extract on an acute colitis in rats was evaluated. It has been shown that hydro alcoholic extract of ginger was effective to protect against experimental colitis and the efficacy was greater when higher doses of extract [350 and 700mg/kg] were administered orally for prolonged period. In rheumatoid arthritis and osteoarthritis it is used as a natural pain reliever and an anti-inflammatory agent [41].

2.13 Cardiovascular Disorders and Hypolipidemic

The use of exercise along with herbal supplements is one of the recommended methods for controlling obesity and its complications, but its effects have been controversial due to the diversity of training programs and also herbal supplements. In a recent study, the effects of ginger supplement for 10 weeks and progressive resistance training on C-reactive protein [CRP] and other cardiovascular risk factors have been investigated in obese men. Resistance training was a preventive approach to reduce the cardiovascular risk in obese men. Moreover, ginger supplementation at dose of 1g/day did not have any influence on the lipid profile and insulin resistance; however, it exerted favorable effects on CRP in the obese men. It is also useful in curing ulcer and preventing heart attack and stroke. Several numbers of studies have been published about the cholesterol lowering effects of ginger [42]. The effects of ethanolic extracts of ginger were studied in cholesterol fed rabbits. The marked rises in the serum and tissue cholesterol, serum triglyceride, serum lipo-proteins and phospholipids following 10 weeks of cholesterol feeding were significantly reduced by the ethanolic ginger extract. The results indicate that ginger acts as an anti-hyperlipidemia agent [39].

2.14 A Rare Complication of Ginger Consumption

A rare case report of ginger complication was related to a 34 years old women who was referred to Mostafa Khomeini Hospital in Tehran, because of sudden onset of a severe pain at the back of the mouth and neck radiating to jaw, difficulty in swallowing, hoarse voice, mild fever and palpitation. An interesting finding in her history was ginger powder consumption with honey for 10 nights. The thyroid function tests revealed thyrotoxicosis. Radioactive iodine uptake of thyroid gland was compatible with the diagnosis of subacute thyroiditis. One year later, following ginger candy consumption, she experienced the same previous symptoms [18].

2.15 Antioxidant Properties of Ginger

Zingiber officinale Roscoe contains a number of antioxidants such as beta-carotene, ascorbic acid, terpenoids, alkaloids, and polyphenols such as flavonoids and flavones glycosides [43]. Easily cultivable, *Zingiber officinale* Roscoe with its wide range of antioxidants can be a major source of natural or phytochemical antioxidants [44,45]. Previous studies on the antioxidant properties of various ginger species had been confined only to the rhizomes which have been reported to have tyrosinase inhibiting properties [28], [46,1,47]. Recently, skin-lightening cosmeceutical products have been developed from the rhizomes of gingers. Although the leaves of ginger species have been used for food flavouring and in traditional medicine, insufficient research has been done on their antioxidant and tyrosinase inhibiting properties [48].

2.16 Postoperative Nausea and Vomiting

Ginger is listed as a food on the U.S. Food and drug administration's (FDA) generally regarded as safe list. Ginger compounds, including 6-gingerol, 6-shogaols, and galanolactone, have shown anti HT5-receptor activities in guinea pig ileum and also galanolactone acts as a competitive HT5 antagonist in ileum [49].

Postoperative nausea and vomiting is one of the most common complications of surgery, and may occur in the 20-30% of patients up to 24 hours after the surgery. Patients with a history of nausea and vomiting following surgery believe that this side effect is the most stressful complication after the surgery. Uncontrolled nausea and vomiting leads to a delay in patient's discharge, increased treatment costs, and decreased patient satisfaction [50,51]. Traditional and complementary medicine has lots of positive points including variety, flexibility, easy access, availability in many parts of the world, high acceptance among the majority of people in developing countries, relative inexpensiveness, less dependence to technology and economy. Among several traditional and complementary medicines, herbal medicine and acupuncture are from prevalent methods [52].

In a randomized, double-blinded study which performed by Montazeri et al. [53] for evaluation of oral ginger efficacy against postoperative nausea and vomiting, 160 eligible patients were randomly assigned in experimental or placebo groups. The experimental group received 4 capsules containing 250mg ginger and the placebo group received 4 placebo capsules 1 hour before the surgery. The mean scores of nausea at 2, 4 and 6 hours post operation was significantly lower in the experimental group. According to the results of study, using ginger was effective in decreasing postoperative nausea and ginger could be used as a safe antiemetic drug at post operation.

2.17 Cancer Preventive Properties of Ginger

Some pungent constituents present in ginger and other zingiberaceae plants have potent antioxidant and anti-inflammatory activities, and some of them exhibit cancer preventive activities in experimental carcinogenesis. The anticancer properties of ginger are attributed to the presence of certain pungent vallinoids, viz. [6]-gingerol and [6]-paradol, as well as some other constituents like shogaols, zingerone etc. A number of mechanisms that may be involved in the chemopreventive effects of ginger and its components have been reported from the laboratory studies in a wide range of experimental models [7].

3. CONCLUSION

Data collected in this review from Iranian databases showed that ginger is under investigation in recent years especially, but the published papers had focused on some aspects of ginger use mainly in the animal models as experimental studies. Therefore it is necessary to conduct more clinical trials. Apart from worldwide application of this herb data show that researches are mostly limited to the women problems. Also, there were limited researches about cancer and cardiovascular and gastrointestinal benefits. Today herbal drugs are an important intervention for various disorders with no or low side effects in proper use. Therefore, health care providers must learn necessary knowledge about complementary medicine such as herbal medicine which is used in other countries comprehensively.

CONSENT

No patient was involved in this study.

ETHICAL APPROVAL

No human or animal subjects were involved in this study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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