International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 3 Number 1 (2014) pp. 347-354**
http://www.ijcmas.com

Original Research Article

Evaluation of the anti-ulcerogenic effect of *Zingiber officinale* (Ginger) root in rats

Sameer Uz Zaman[1], Mrutyunjay M. Mirje[2] and S. Ramabhimaiah[3]

[1]Department of Pharmacology,Kamineni Academy of Medical Sciences and Research Centre, L.B. Nagar, Hyderabad – 500068, India
[2]Department of Pharmacology,Institute of Medical Science and Research, Mayni, District - Satara – 415102, India
[3]Department of Pharmacology,Navodaya Medical College,Raichur – 584103, India
Corresponding author

Keywords

Zingiber officinale; anti-ulcerogenic; gastro-protective; gastric ulcer; omeprazole.

A B S T R A C T

The purpose of this study was to evaluate and compare the anti-ulcerogenic activity of extract of *Zingiber officinale* (ginger) in indomethacin (NSAID) - induced gastric damage animal model. This study was conducted at Navodaya Medical College and Research Centre for a period of two years. The gastro-protective effect of aqueous extract of *Zingiber officinale* was studied using the model of indomethacin-induced gastric damage and compared with omeprazole. *Zingiber officinale* (200mg/kg or 400mg/kg) or omeprazole (10mg/kg) were administered alone in separate group of rats. The percentage inhibition of gastric ulcers was 40.91%, 57.58% and 65.91% by ginger 200mg/kg and ginger 400mg/kg and omeprazole respectively. This shows that ginger root extract significantly inhibited the gastric damage induced by indomethacin and its efficacy as a gastro-protective agent was comparable to that of omeprazole. s ginger root showed significant anti-ulcerogenic activity in the model studied, it can be a promising gastro-protective agent.

Introduction

Peptic ulcer is a worldwide problem and its prevalence is quite high in India. Several field studies from different parts of our country suggest its occurrence in 4 to 10 per thousand populations. Three states of India, i.e. Tamil Nadu, Andhra Pradesh, and Jammu and Kashmir are considered to be very high risk areas (Khushtar *et al*., 2009).

An *ulcer* is defined as disruption of the mucosal integrity of the stomach and/or duodenum leading to a local defect or excavation due to active inflammation. Ulcers occur within the stomach and/or duodenum and are often chronic in nature (Fauci *et al*., 2008). Burning epigastric pain exacerbated by fasting and improved with meals is a symptom complex

associated with peptic ulcer disease (PUD).

A known fact is that NSAIDs act by the inhibition of the cyclooxygenase pathway which in turn can cause an inhibition of prostaglandin synthesis. This has both many benefits and drawbacks. Prostaglandins have been shown to have housekeeping and gastro-protective functions by maintaining gastric mucosal integrity (Perez *et al*., 1997; Garcia Rodriguez and Hernandez-Diaz, 2001). Upper gastrointestinal endoscopic studies have shown a 15-30% prevalence of ulcers in the stomachs of patients taking NSAIDs regularly (Gajraj, 2003). Thus, a major side effect of NSAIDs is gastric irritation which can lead to peptic ulceration. The disease results in chronic sufferings, loss of working hours and occasional fatality. Smoking, alcoholism, and spices add to the severity of the disease.

Zingiber officinale (ginger) which belongs to the family Zingiberaceae, is a slender perennial plant that reaches the height of two feet and has greenish yellow flowers resembling orchids. The dried rhizome of ginger contains approximately 1-4% of volatile oils which are the medicinally active constituents and are also responsible for the characteristic odour and taste.
Phytochemical studies showed that the plant is rich in a large number of substances, including α-zingiberene, β-bisabolene, gingerols and shogaols (Khushtar *et al*., 2009). These compounds have been reported to display anti-ulcerogenic activity (Chioma A Anosike *et al*., 2009).

Other pharmacological actions of ginger and compounds isolated from it include anti-inflammatory (Zahra Fatehi-Hassanabad *et al*., 2005; antioxidant (Ahmed *et al*., 2000; hypoglycemic (Ojewole, 2006) analgesic(Ojewole, 2006), antiplatelet (Nurtijahja – Tjendraputra *et al*., 2003), antiemetic(Sharma *et al*., 1997), antithrombotic (Thomson *et al*., 2002), anti-tumorigenic (Shukla and Singh), radio protective (Jagetia *et al*.,), antimicrobial, antifungal actions (Ficker *et al*., 2003b). There is an increasing awareness, both in the medical community and among the public, for the use of unconventional or alternative treatment modalities by patients. Patients with chronic and painful diseases often seek alternative therapy, and currently ginger is one of the most popular herbal medications for inflammatory diseases.

Keeping all the above in mind, this study has been designed and carried out to evaluate the anti-ulcerogenic potential of *Zingiber officinale* powder in albino rats.

Materials and Methods

Materials

Preparation of extract

Ginger root extract in the form of a powder, was obtained from Vidya Herbs, Bangalore. It was weighed accordingly and administered in aqueous solution.

Chemicals

Omeprazole (Cipla) and indomethacin (Sun) were of analytical grade.

Animals

Albino rats weighing 150 – 250 grams of either sex were used for the study. The animals were housed in an air conditioned environment with natural light and dark cycles for a week following selection to enable acclimatization. They were provided a diet consisting of normal rat

pellet food and water *ad libitum*. The experimental protocol was approved by the Institutional Animal Ethics Committee, Navodaya Medical College, Raichur.

Methods

Animals were randomly divided into 4 groups of 6 rats each. They were starved for 24 hours but given access to water *ad libitum* prior to drug administration. The test drugs were administered by oral gavage in the following doses as either aqueous solution or suspension:

a) Group I – distilled water – 2ml/kg body weight.
b) Group II - omeprazole – 10 mg / kg body weight.
c) Group III - test rats – receive *Z. officinale* 200 mg/kg body weight.
d) Group IV - test rats – receive *Z. officinale* 400 mg/kg body weight.

Half an hour later, all the animals of all groups were treated with indomethacin in a dose of 25 mg/kg body weight to induce gastric damage. Following model was used to screen the anti-ulcerogenic activity of ginger.

Indomethacin (NSAID)-induced gastric damage in rats

The animals were then sacrificed after 6 hours using ether anaesthesia. Stomachs were removed and placed on saline soaked filter paper until inspection. A longitudinal incision along the greater curvature was made with fine scissors. The stomach was inverted over the index finger and the presence or absence of gastric irritation is determined by a magnifier.

The presence of single or multiple lesions were noted. Erosions, ulcers, perforations and hyperaemia were considered to be positive indicators of gastric damage. The number and depth of the ulcers and the occurrence of hyperaemia and prominence of stomach rugae were noted (Gupta, 2009; Gerhard Vogel H *et al*., 2002; Ghosh, 2008).

Grades of ulcer severity
0 = No ulcer.
1 = Superficial ulcer.
2 = Deep ulcer.
3 = Perforation.

Ulcer index [UI] = UN + US + UP X 10^{-1}

Where, UN – Average number of ulcers per animal; US – Average severity scores; and UP – Percentage of animals with ulcers. Ulcer index was compared between the treatment and control groups.

Statistical analysis

Data were subjected to one-way analysis of variance (ANOVA) using SPSS 11.0 software. The results of anti-inflammatory activity were expressed as "mean increase in paw volume ± SD" and gastro protective effect were expressed as “mean total severity score ± SD". ANOVA was done to find out whether the readings were significant or not. P values < 0.05 were considered as significant and $P < 0.001$ as highly significant.

If found significant, one way ANOVA was followed by Dunnett’s t-test (post-hoc analysis).

Results and Discussion

Indomethacin (NSAID)-induced gastric damage in rats

The results obtained are shown in table 1 and figures 1 and 2. The administration of indomethacin caused gastric damage with

a mean total severity score of 22.33 ± 2.25. The administrations of omeprazole 10mg/kg, ginger 200mg/kg, and ginger 400mg/kg, along with indomethacin limited the mean total severity score to 4 ± 2.28, 10.6 ± 3.26 and 6.2 ± 3.55 respectively.

The percentage inhibition of gastric ulcers was 40.91%, 57.58% and 65.91% by ginger 200mg/kg and ginger 400mg/kg and omeprazole respectively. Calculation of ulcer indices returned values of 52.8 for indomethacin, and 31.2, 22.4 and 18 for the groups in which indomethacin was administered with ginger 200mg/kg, ginger 400mg/kg and omeprazole respectively.

These results show that ginger root extract significantly inhibited the gastric damage induced by indomethacin and its efficacy as a gastro-protective agent was comparable to that of the proton pump inhibitor omeprazole (with the dose of 400 mg/kg being better than 200 mg/kg).

The primary objective of the present study was to examine the anti-ulcerogenic activity of ginger and ascertain if it is comparable to the standard drug, omeprazole, in models of NSAID-induced gastric damage in rats.

A result of the present study clearly indicates that the extract of ginger root and omeprazole used in this study showed significant gastro protective effect when compared with control. The administration of indomethacin caused gastric damage, as was indicated by the total severity score and ulcer index in gastric tissue, while administrations of ginger extract or omeprazole along with indomethacin limited the gastric damage. The mean number of ulcers in the indomethacin group was reduced when indomethacin was administered with ginger extract and omeprazole respectively. The percentage inhibition of gastric ulcers by ginger root extract was comparable to omeprazole. The results thus indicate that ginger root extract has the potential to prevent the gastric damage resulting from indomethacin (NSAID) administration.

NSAIDs like indomethacin are known to induce gastric ulceration; the reason being attributed principally to inhibition of "cytoprotective prostaglandins" e.g. PGE's and PGI_2 (by inhibition of cyclooxygenase pathway of arachidonic acid metabolism) resulting in overproduction of leukotrienes and other products of 5-lipoxygenase pathway.

Several anti-ulcer compounds have been isolated from ginger, including 6-gingesulphonic acid (Yoshikawa *et al*., 1992), 6-shogaol and ar-curcumene (Ghayur *et al*., 2005). Most notable is 6-gingesulphonic acid, which showed weaker pungency and more potent anti-ulcer activity than 6-gingerol and 6-shogaol (Yamahara *et al*., 1988; al-Yahya *et al*., 1989; Yoshikawa *et al*., 1994). The protective action of ginger root extract against indomethacin-induced gastric lesions could possibly be due to its 5-lipoxygenase inhibitory effect**.**

Another study also states the possibility that the various active constituents in ginger root could have an antisecretory activity and also offer cytoprotection by increasing mucus wall thickness (barrier mucus) (Khushtar *et al*., 2009). Despite the above possibilities, the main mechanism of gastro protection is by inhibition of both the proton pump and *Helicobacter pylori* growth and also increased mucin secretion (Siddaraju *et al*., 2010).

Table.1 Gastro-protective effect of *Zingiber officinale* (ginger) and omeprazole on indomethacin-induced gastric damage in rats

Treatment group (Dose ml/kg or mg/kg bw)	Total severity score (mean ± SD)	Percentage Inhibition (%)	Ulcer Index
Group I (Indomethacin 25mg/kg)	22.33 ± 2.25**	-	52.8
Group II (Omeprazole 10mg/kg)	4 ± 2.28**	65.91	18
Group III (Ginger 200mg/kg)	10.6 ± 3.26**	40.91	31.2
Group IV (Ginger 400mg/kg)	6.2 ± 3.55**	57.58	22.4
ANOVA			
F - value	46.75		
P - value	< 0.001		

Each value represents the mean ± SD (n = 6). Statistical analysis by one-way ANOVA followed by Dunnett's multiple comparison. P value < 0.001 (**) is highly significant. Abbreviations: bw = body weight; SD = standard deviation.

Figure.1 Effect of *Zingiber officinale* (ginger) and omeprazole on total severity score in model of indomethacin-induced gastric damage in rats.

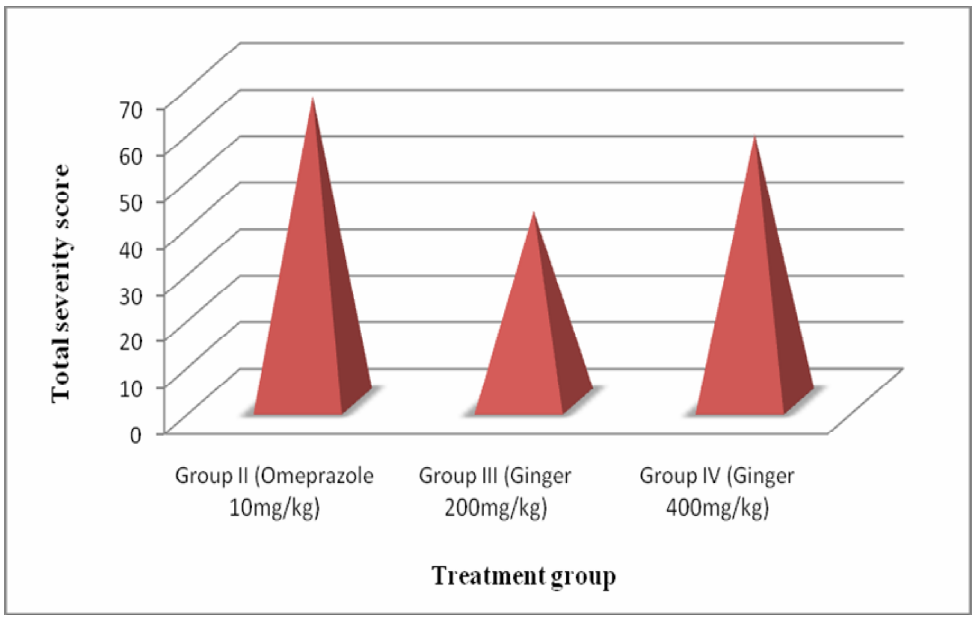
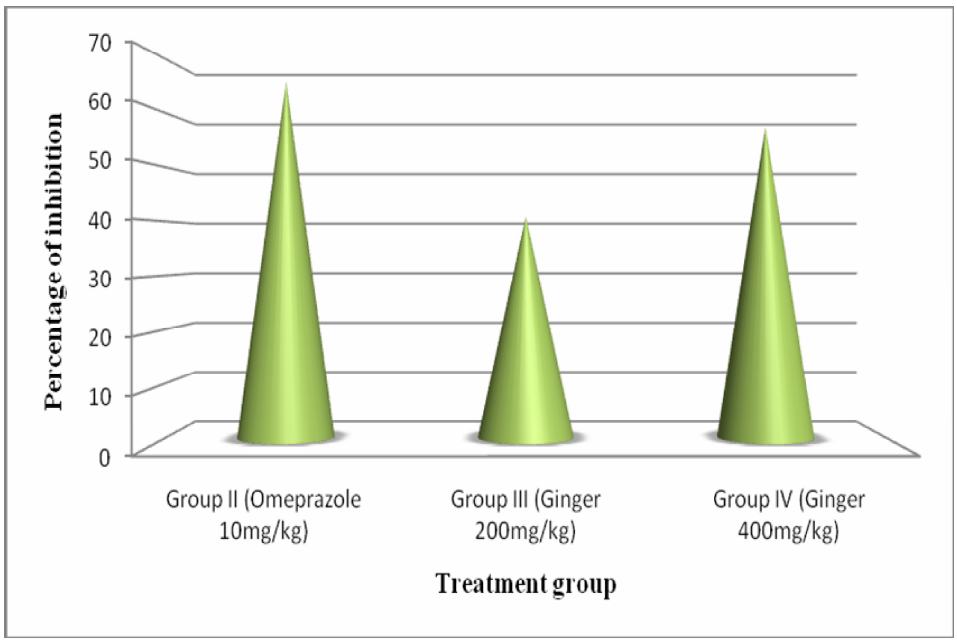


Figure.2 Percentage of inhibition produced by *Zingiber officinale* (ginger) and omeprazole in indomethacin-induced gastric damage in rats.



The antiulcer activity of ginger may also be due to the potent thromboxane synthetase inhibition (Srivastava, 1984). Ginger was shown to significantly scavenge superoxide and hydroxyl radicals and inhibit lipid peroxidation (Cao *et al*., 1993).

Acknowledgement

I would like to thank Dr. S. Ramabhimaiah, Professor and H.O.D., for all the inspiration and guidance. Sincere thanks to my colleague Dr. Mrutyunjay Mirje for his assistance and support. Thanks to all the staff of Dept. of Pharmacology, Navodaya Medical College, for all their help.

References

Khushtar, M., V Kumar, K Javed, and Uma Bhandari. Protective Effect of Ginger oil on Aspirin and Pylorus Ligation-Induced Gastric Ulcer model in Rats. Indian J Pharm Sci. 2009 Sep-Oct; 71(5): 554-558.

Fauci, Braunwald, Kasper, Hauser, Longo, Jameson & Loscalzo. Harrison's Principles of Internal Medicine, 17th Edition. McGraw-Hill Medical Publishing Division; 2008. P. 1855-1872.

Perez GS, Rodriguez LA, Roiford DS. Individual NSAIDs and other risk factors for upper gastrointestinal bleeding and perforation. Epidemiology 1997; 8: 18-24.

Garcia Rodriguez LA, Hernandez-Diaz S. The risk of upper gastrointestinal complications associated with NSAIDs, glucocorticoids, acetaminophen and combination of these agents. Arthritis Res.2001; 3: 98-101.

Gajraj NM. Cyclooxygenase - 2 inhibitors. Anesth Analg 2003; 96: 1720-38.

Khushtar,M., V Kumar, K Javed, and Uma Bhandari. Protective Effect of Ginger oil on Aspirin and Pylorus

Ligation-Induced Gastric Ulcer model in Rats. Indian J Pharm Sci. 2009 Sep-Oct; 71(5): 554-558.

Chioma A Anosike, Onyechi Obidoa, Lawrence US, Ezeanyika and Meshach M Nwuba. Anti-inflammatory and anti-ulcerogenic activity of the ethanol extract of ginger (*Zingiber officinale*). African Journal of Biochemistry Research Vol. 3 (12), pp 379-384, December, 2009.

Zahra Fatehi-Hassanabad, Zahra Gholamnezhad, Mostafa Jafarzadeh, Mohammad Fatehi. The Anti-inflammatory Effects of Aqueous extract of Ginger root in Diabetic Mice. DARU Volume 13, No.2, 2005.

Ahmed RS, Seth V, Banergee BD. Influence of dietary ginger (Zingiber officinale Roscoe.) on antioxidant defense system in rat: comparison with ascorbic acid. Indian J Exp Biol 2000; 38 (6): 604-6.

Ojewole JA 2006. Analgesic, anti-inflammatory and hypoglycemic effects of ethanolic extract of Zingiber Officinale (Roscoe.) rhizomes (Zingiberaceae) in mice and rats. Phyother. Res. 20, 764-772.

Nurtijahja – Tjendraputra E: Ammit AJ, Roufoglis BD, Tran VH, Duke CC; 2003. Effective antiplatlet and COX-1 enzyme inhibitors from pungent constitutents of ginger. Thromb. Res. 111, 259-265.

Sharma SS, Kochupillai V, Gupta SK, Seth SD, Gupta YK: Antiemetic efficacy of ginger (Zingiber officinale) against Cisplatin induced emesis in dogs. J. Ethnopharmacol. 1997; 57: 93-96.

Thomson M, Al-Qattan KK, Al-Sawan SM, Alnaqeeb MA, Khan I, Ali M. The use of ginger (Zingiber officinale Rosc.) as a potential anti-inflammatory and antithrombotic agent. Prostaglandins Leukot. Essent. Fatty Acid 2002; 67; 475-478.

Shukla Y, Singh M. Cancer preventive properties of ginger: A brief review. Food Chem. Toxicol. 45: 683-90.

Jagetia G, Baliga M, Venkattesh P. Ginger (Zingiber Officinale Rosc.), a dietary supplement, protects mice against radiation induced lethality; mechanism of action. Cancer Biother. Radiopharm. 19: 422-435.

Ficker CE, Arnason JT, Vindas PS, Alvarez LP, Akpagana K, Gbeassor M, DeSouza C, Smith ML. Inhibition of human pathogenic fungi by ethnobotanically selected plant extracts. Mycoses. 2003b; 46: 29-37.

Gupta, S.K., Drug Screening Methods (Preclinical Evaluation of New Drugs), 2nd Edition. New Delhi: Jaypee brothers Medical Publishers Pvt. Ltd., 2009. 511-19.

Gerhard Vogel H *et al*. Drug Discovery and Evaluation. 2nd edition Germany: Springer - Verlag Berlin Heidelberg. 2002. 825-946.

Ghosh MN. Fundamentals of experimental pharmacology. 4th edition Kolkata: Ghosh SK and others; 2008. 162-169.

Yoshikawa M, Hatakeyama S, Taniguchi K, Matsuda H, Yamahara J. 6-Gingesulfonic acid, a new antiulcer principle and Gingerglycolipids A, B and C, Three new monoacyldigalactosyl glycerols, from Zingiberis Rhizoma originating in Taiwan. Chem Pharmaceu Bull 1992;40:2239-40.

Ghayur MN. Gilani AH, Afridi MB, Houghton PJ. Cardiovascular effects of ginger aqueous extract and its phenolic constituents are mediated through multiple pathways. Vascul. Pharmacol 2005; 43: 234-241.

Yamahara J, Mochizuki M, Rong HQ, Matsuda H, Fujimura H. The antiulcer

effect in rats of ginger constitutents. J Ethnopharmacol 1988;23:299-304.

al-Yahya M A, Rafatullah S, Mossa J S, Ageel A M, Parmar N S, Tariq M. Gastroprotective activity of ginger (*Zingiber officinale* Rosc.) in albino rats. Am J Chin med 1989;17:51-6.

Yoshikawa M, Yamaguchi S, Kunimi K, Matsuda H, Okuno Y, Tamahara J, Murakami N. Stomachic principles in ginger III. An antiulcer principle, 6-gingesulfonic acid and three monoacyldigalactosylglycerols, ginger glycolipids A, B and C, from Zingiberis Rhizoma originating in Taiwan. Chem Pharmaceu Bull 1994;6:1226-30.

Siddaraju M Nanjundaiah, Harish Nayaka Mysore Annaiah and Shylaja M Dharmesh. Gastroprotective effect of Ginger Rhizome (Zingiber officinale) extract: Role of Gallic acid and Cinnamic acid in H, K-ATPase/*H. pylori* inhibition and anti-oxidative mechanism. eCAM, Oxford Journals: 2010, 8:24.

Srivastava KC. Aqueous extracts of onion, garlic and ginger inhibit platelet aggregation and alter arachidonic acid metabolism. Biomed Biochem Acta 1984;43:335-46.

Cao ZF, Chen ZG, Guo P, Zhang SM, Lian LX, Luo L, Hu WM. Scavenging effects of ginger on superoxide anion and hydroxyl radical. Chungkuo chung yao tsa chih (China Journal of Chinese Materia Medica) 1993;18:750-1.

.