Journal of Biomedical and Pharmaceutical Research
Available Online at www.jbpr.in
CODEN: - JBPRAU (Source: - American Chemical Society)
NLM (National Library of Medicine): ID: (101671502)
Index Copernicus Value 2022: 83.05
Volume 13, Issue 6: 2024, 12-19
Research Article
ISSN (Online): 2279-0594
ISSN (Print): 2589-8752

Pharmacological and Phytochemical investigation of plant Zingiber Zerumbet havinganti-ulcer activity

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Article Info: Received: 05-11-2024 / Revised: 18-11-2024 / Accepted: 30-11-2024
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DOI: https://doi.org/10.32553/jbpr.v13i6.1192
Conflict of interest statement: No conflict of interest

Abstract

This study investigates the anti-ulcerogenic properties of Zingiber zerumbet using a rat model subjected to ulcerogenic agents. The hydroalcoholic extract of Zingiber zerumbet was evaluated for its efficacy in mitigating ulcer formation, measured through the number of ulcers, ulcer index, and gastric pH levels. Results demonstrated that the extract significantly reduced both the number of ulcers (from 9.80 ± 0.75 in the control group to 0.25 in the treated groups) and the ulcer index (from 6.25 ± 0.30 in the control to 0.52 ± 0.15 in the extract-treated group). Additionally, the gastric pH improved markedly, with treated groups showing pH levels of 6.85 ± 0.75 and 6.75 ± 0.35, compared to 3.45 ± 0.32 in the control group. The qualitative phytochemical analysis revealed the presence of flavonoids, saponins, and alkaloids, which are known for their therapeutic effects. These findings underscore the potential of Zingiber zerumbet as a natural remedy for gastric ulcers, providing a basis for further research into its active constituents and mechanisms of action

Keywords: Zingiber zerumbet, anti-ulcerogenic, gastric ulcers, rat model, ulcer index, gastric pH, phytotherapy, herbal medicine, flavonoids

Introduction

Ulcers are an open sore of the skin or mucus membrane characterized by sloughing of inflamed dead tissue. Ulcers are lesions on the surface of the skin or a mucous membrane characterized by a superficial loss of tissue. Ulcers are most common on the skin of the lower extremities and in the gastrointestinal tract, although they may be encounteredat almost any site. There are many types of ulcer such as mouth ulcer, esophagus ulcer, peptic ulcer, and genital ulcer. Of this peptic ulcer is seen among many people. The peptic ulcers are erosion of lining of stomach or the duodenum. Ulcer disease has become a disease predominantly affecting the older population, with the peak incidence occurring between 55 and65 years of age. In men, duodenal ulcers were more common than gastric ulcers; in women, the converse was found to be true. Thirty-five percent of patients diagnosed with gastric ulcers will suffer serious complications. Although mortality rates from peptic ulcer disease are low, thehigh prevalence and the resulting pain, suffering, and expense are very costly. Peptic ulcer disease (PUD) is characterized by discontinuation in the inner lining of the gastrointestinal (GI) tract because of gastric acid secretion or pepsin. It extends

into the muscularis propria layer ofthe gastric epithelium.

Types of Ulcers

There are many types of ulcer such as

- ✓ Mouth ulcer
- ✓ Esophagus ulcer
- ✓ Peptic ulcer
- ✓ Genital ulcer

The two most common types of peptic ulcer are called

- ✓ Gastric ulcer
- ✓ Duodenal ulcer

The name refers to the site of ulceration. A person may have both gastric and duodenal ulcers atthe same time.

Rare causes

- ✓ Zollinger-Ellison syndrome
- ✓ Malignancy (gastric/lung cancer, lymphomas)
- ✓ Stress (Acute illness, burns, head injury)
- ✓ Viral infection
- ✓ Vascular insufficiency
- ✓ Radiation therapy
- ✓ Crohn disease
- ✓ Chemotherapy

MATERIALS AND METHODS

Extraction of plant material: Defatting: Qualitative estimation of phytoconstituents Quantitative study of phytoconstituents

Perform quantitative analyses for specific phytoconstituents:

Evaluation of anti-ulcer effect:

Collection of plant material

Plants can be collected from either wild woods or herbariums. However, there is a risk of erroneously recognized plants in the case of wild plants. They have the advantage of notcontaining any pesticides or herbicides. They are treated as quickly as possible after collection to avoid secondary metabolites from deteriorating. The rhizomes of selected plant *Zingiber zerumbet* were identified and collected from nursery of Bhopal in month of January, 2024.

Extraction of plant materials

Extraction is defined as the separation of medicinally active portions of plant tissues from the inactive components through the use solvents. Marc is the damp solid material or the plant being used and menstruum is the liquid material or solvent. During extraction, the solvent diffuses into the marc and solubilizes compounds with similar polarity. The shade dried rhizomes of *Zingiber zerumbet* (50 gm) was coarsely powdered and subjected to extraction. Plant material extracted by hydroalcoholic solvent (80: 20; ethanol: water) was used. In this method, the finely pulverized marc is placed in a thimble which is placed in a chamber of the Soxhlet apparatus.

Phytochemical Screening

Phytochemicals encompass a wide range of chemical classes, including alkaloids, flavonoids, terpenoids, phenolic compounds, glycosides, and many others. Each class of phytochemicals may have specific physiological effects and potential health benefits. For example, flavonoids are known for their antioxidant properties, alkaloids often possess antimicrobial or analgesic properties, while terpenoids can have antitumor or anti- inflammatory effects. Phytochemical examinations were carried out extracts as per the following standard method

In vivo* antiulcer activity of hydroalcoholic extract of *Zingiber zerumbet

Animals

Wistar rats (180±20g) were group housed (n= 6) under a standard 12 h light/dark cycle and controlled conditions of temperature and humidity (25±2 °C, 55–65%). Rats received standard rodent chow and water *ad libitum*. Rats were acclimatized to laboratory conditions for 7 days before carrying out the experiments. All the experiments were carried out in a noise-free room between 08.00 to 15.00 h. A separate group (n=6) of rats was used for each set of experiments. The animal studies were approved by the Institutional Animal Ethics Committee (IAEC), constituted for the purpose of control and supervision of experimental animals by the Ministry of Environment and Forests, Government of India, New Delhi, India.

Experimental designs - Aspirin-induced gastric ulcer

The rats were randomly divided into 5 groups (n=6), and 6 animals were placed in each group.

Group I: The normal group used 1% carboxymethylcellulose (CMC)

Group II: 150 mg/kg/day of aspirin suspended in 3 mL of 1% carboxy-methylcellulose (CMC) in water for 3 days, during which the rats were fasted for induction of ulcer.

Group III: Cimetidine 100 mg/kg suspended in 3 mL of 1% CMC and was orally administered to the animals.

Group IV: Ulcerated rats pretreated with *Zingiber zerumbet* 100 mg/kg, **Group V:** Ulcerated rats pretreated with *Zingiber zerumbet* 200 mg/kg,**Statistical analysis**

The data were presented as the mean ± standard deviation (SD) for each experimental group. Statistical comparisons between groups were performed using a one-way analysis of variance (ANOVA), followed by Tukey's post hoc test for multiple comparisons. Results were statistically significant at $P<0.05$.

RESULTS AND DISCUSSION

Determination of percentage yield

Extract	Colour	Consistency	Yield (% w/w)
Zingiber zerumbet			
Hydroalcoholic	Dark brown	Solid	7.5%

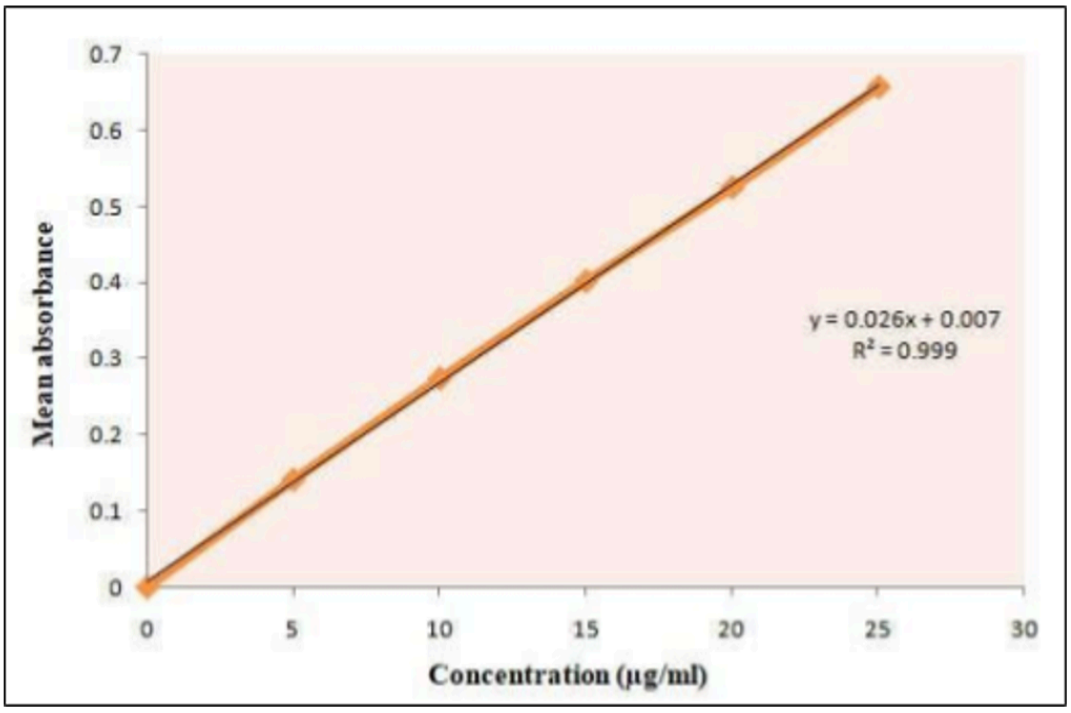
In the discussion of Table, the yield of the hydroalcoholic extract of *Zingiber zerumbet* is 7.5% (w/w). This yield indicates the efficiency of the extraction process, and the quantity of bioactive compounds present in the plant material.

Preliminary qualitative phytochemical tests for *Zingiber zerumbet* extract

Table presents the preliminary qualitative phytochemical screening of the hydroalcoholic extract of *Zingiber zerumbet*. The presence and absence of various primary and secondary metabolites.

Phytoconstituents	Hydroalcoholic extract of *Zingiber zerumbet*
Primary Metabolites	
Carbohydrates	(+)
Amino acids	(+)
Proteins	(+)

Secondary metabolites	
Steroids	(-)
Triterpenoids	(-)
Volatile oils	(-)
Diterpenes	(+)
Glycosides	(-)
Saponins	(+)
Flavonoids	(+)
Tannins & Phenol	(-)
Alkaloids	(+)
'+' = Present; '-' = Absent	



Total flavonoidcontent

estimation (TFC)

The total flavonoid content (TFC) was expressed as mg/100mg of quercetin equivalent of dry 2extract sample using the equation obtained from the calibration curve: **y = 0.026x + 0.007, R = 0.999,** where X is the quercetin equivalent (QE) and Y is the absorbance.

S. No.	**Concentration (µg/ml)**	**Mean Absorbance**
1	5	0.141
2	10	0.274
3	15	0.402
4	20	0.525
5	25	0.657

Preparation of calibration curve of Quercetin

S. No.	Extract	Total flavonoid content mg/ 100mg
1.	Hydroalcoholic extract	0.84

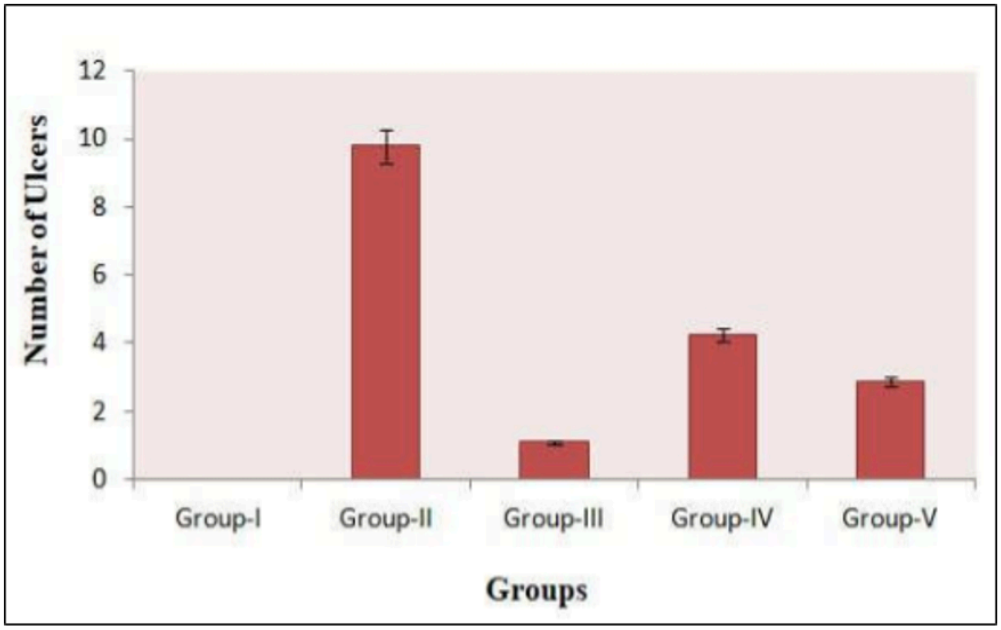
Total bioactive constituents content of *Zingiber zerumbet*

The total flavonoid content of 0.84 mg/100 mg indicates a moderate concentration of flavonoids in the *Zingiber zerumbet* extract. Flavonoids are known for their wide range of biological activities, including antioxidant, anti-inflammatory, and antiulcer properties. Despite the relatively low concentration, this amount can still contribute significantly to the overall pharmacological potential of the extract, considering the potency of flavonoids even in small quantities.

Results of antiulcer activity of *Zingiber zerumbet*

The observed results may be attributed to the antioxidant properties of *Zingiber zerumbet*, which can scavenge free radicals and reduce oxidative stress, a key contributor to gastric mucosal injury. Additionally, the anti-inflammatory effects of the extract might further support its role in protecting the gastric lining from ulcerogenic damage.

Anti-ulcerogenic effect of *Zingiber zerumbet* against ulcerogenic agents in rats (Number of Ulcers)



Group	Number of Ulcers
Group-I	-
Group-II	9.80 ± 0.75#
Group-III	1.10 ± 0.25***
Group-IV	4.25 ± 0.20*
Group-V	2.85 ± 0.30**

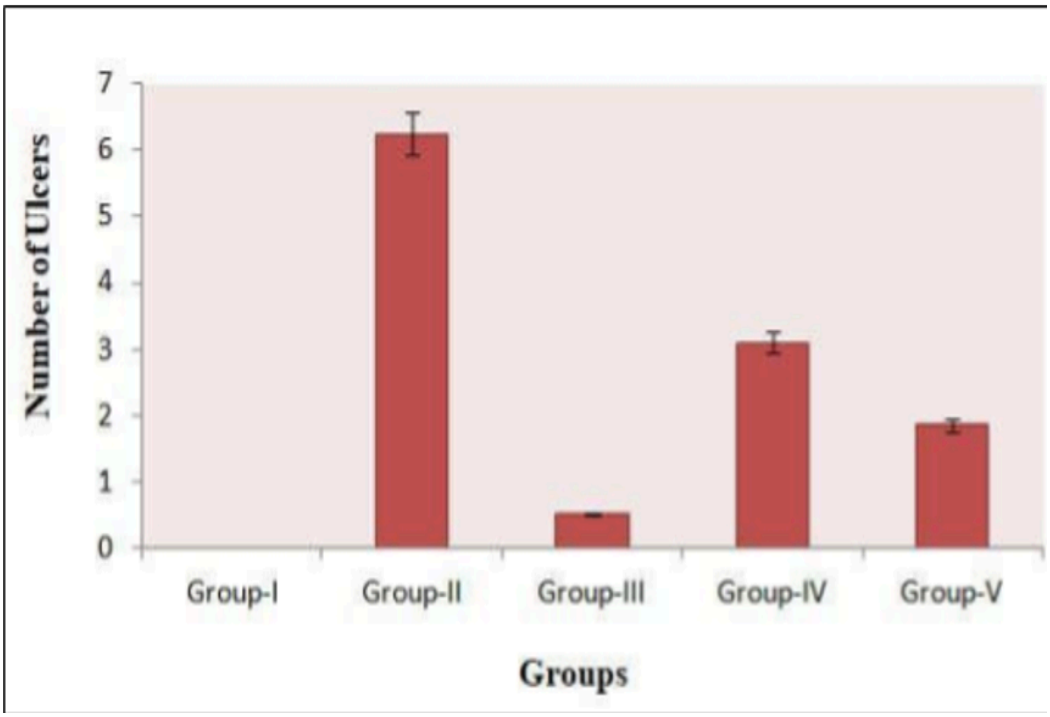
Values are expressed as mean±S.E.M. (n = 6). #P<0.001 vs Group I; ***$P < 0.001$, ** $P < 0.01$, * $P < 0.05$ vs Group II (One-way ANOVA followed by Tukey's post hoc test).

Anti-ulcerogenic effects of Zingiber zerumbet against ulcerogenic agents in rats (Ulcer index) The evaluation of the anti-ulcerogenic effects of Zingiber zerumbet was further substantiated by analyzing the ulcer index among different groups of rats. The ulcer index provides a quantitative measure of gastric mucosal damage and serves as a reliable indicator of the protective efficacy of the treatment. In Group II, which received only the ulcerogenic agents, the ulcer index was significantly high at 6.25 ± 0.30, confirming the detrimental impact of these agents on gastric mucosa. This establishes a baseline for assessing the protective effects of Zingiber zerumbet. In contrast, Group III, which received the highest dose of Zingiber zerumbet, showed a remarkably low ulcer index of 0.52 ± 0.15. The significant reduction compared to Group II ($P < 0.001$) underscores the potent protective effect of the extract. This reduction indicates that Zingiber zerumbet effectively mitigates gastric damage, likely due to its anti- inflammatory and antioxidant properties.

Group	Ulcer Index
Group-I	-
Group-II	6.25 ± 0.30#
Group-III	0.52 ± 0.15***
Group-IV	3.10 ± 0.20**
Group-V	1.85 ± 0.35***

Values are expressed as mean ± S.E.M. (n = 6). #P<0.001 vs Group I; ***$P < 0.001$, ** $P < 0.01$, * $P < 0.05$ vs Group II (One-way ANOVA followed by Tukey's post hoc test).

Anti-ulcerogenic effects of *Zingiber zerumbet* against ulcerogenic agents in rats (Ulcerindex)



CONCLUSION

The study assessed the anti-ulcerogenic effects of *Zingiber zerumbet* in a rat model subjected to ulcerogenic agents, focusing on the ulcer index as a key measure of gastric protection. In Group I, the control group, the ulcer index was absent, indicating no ulceration. Conversely, Group II, which received the ulcerogenic agent alone, exhibited a significantly high ulcer index, demonstrating severe gastric damage. However, treatment with *Zingiber zerumbet* led to a remarkable reduction in the ulcer index in Group III, which recorded an index, signifying substantial protective effects. Group IV also benefited from treatment, showing a reduced ulcer index, while Group V further confirmed the extract's efficacy with an ulcer index. These results indicate that *Zingiber zerumbet* effectively mitigates ulcer formation, suggesting its potential as atherapeutic agent for preventing gastric ulcers.

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