Investigation of Aqueous Extract of *Zingiberofficinale* Root Potential in the Prevention of Peptic Ulcer in Albino Rats

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Abstract: **This study is aimed at investigating the anti-ulcerogenic and prophylactic efficacy of aqueous extract of *Zingiberofficinale* on indomethacin-induced ulcer. To achieve this, thirty adult male rats of body weight between 150 and 200g were used and were divided into six groups of five rats each. Group I was treated with 0.8mg/ml of Omeprazole for seven days. Group II was treated with a solution of 0.8 g/ml *Zingiberofficinale* for seven days, while group III received distilled water for seven days. This group served as the control group. Groups IV, V and VI were treated similarly as groups I, II and III respectively but were treated for fourteen days. Gastric ulceration was induced in the rats by the administration of 50 mg/kg indomethacin after pre-treatment with distilled water, omeprazole and *Zingiberofficinale* for 7 and 14 days respectively. Significant ulcer inhibition was produced in the groups treated with *Zingiberofficinale* and Omeprazole when compared with control groups at $p<0.05$, but omeprazole-treated groups showed greater ulcer inhibition (72.60 % and 74.29 %)when compared with that of *Zingiberofficinale*-treated groups (57.51% and 59.90%)after 7 and 14 days respectively. *Zingiberofficinale* was observed to possess anti-ulcerogenic properties and can be used as herbal remedy for the prevention of peptic ulcers.**

***Keywords*: *Zingiberofficinale*, peptic ulcer, Ulcer inhibition, anti-ulcerogenic properties, omperazole**

I. INTRODUCTION

Peptic ulcer diseases comprise of heterogeneous disorders, which manifest as a break in the lining of the gastrointestinal mucosa bathed by acid and pepsin. It is the most predominant of the gastrointestinal diseases [1][2] with a worldwide prevalence of about 40% in the developed countries and 80% in the developing countries. It is generally recognized that peptic ulcer is caused by a lack of equilibrium between the gastric aggressive factors and the mucosal defensive factors [3]. Although several orthodox pharmaceutical drugs have been employed in the management of peptic ulcers e.g. antacids, anti-cholinergic drugs, histamine H_2-receptor antagonists, antihistaminics and more recently, proton-pump inhibitors. Most of these drugs, however, produce several adverse reactions, like arrhythmias, impotence, gynecomastia and hematopoeitic changes [4]. In recent years, there has been growing interest in alternative therapies especially from plant sources due to their perceived lower side effects, ease of accessibility and affordability [5].

Herbal medicines are now used by a large population all over the world in a number of instances (~10%) for the treatment or prevention of digestive disorders [6]. Considering the morbidity caused by peptic ulcer disease and dyspepsia over the world, cheap and easily available treatments will always be in demand especially for the people of non-industrialized countries [7]. Today, pharmacopoeias of a number of different countries list ginger extract for various digestive diseases [8]. Aromatic, spasmolytic, carminative and absorbent properties of ginger are probably responsible for the therapeutic applications in digestive tract ailments [9]. Several studies have shown that ginger extract, essential oils and glycolipids possess a number of pharmacological actions, which at least in part for some of them anti-ulcerogenic efficacy may be suggested [10]. Some of ginger actions are: anti-helicobacter pylori [11], anti- oxidant [12], anxiolytic [13], anti-emetic [14], anti-inflammatory [15], anti-angiogenesis [16], anti- tumor [17], antithrombotic [18] and cardiovascular effects [19]. The major compounds found in ginger are the gingerols (i.e. 6-gingerol, 8-gingerol, zingerone, and 6-shogaol) [20]. It has been reported to heal peptic ulcer [10] [11]. This present study is aimed at investigating the efficacy of ginger in the prevention of peptic ulcer.

II. METHODOLOGY

A. Plant Preparation

Ginger root extract in the form of a powder, was purchased from Foodco, Bodija, Ibadan. It was weighed accordingly and administered in aqueous solution.

B. Chemicals

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

C. Experimental Design

Thirty (30) healthy male albino rats with body weights between 150 and 200 g were used for this study. They were bought from 'Imrat animal house' of the University College Hospital, Ibadan and were housed in Educational Advancement Centre animal house. They were allowed 14 days to acclimatize before the commencement of treatment. The animals were maintained on a standard pellet diet throughout the acclimatization and treatment period. They were divided into six groups of five rats each. Group I was exposed to omeprazole for seven days, group II was exposed to *Zingiberofficinale* solution for seven days and group III was exposed to distilled water for seven days. This group served as the control group. Groups IV, V and VI were treated similarly as groups I, II and III respectively but were treated for fourteen days.

A 0.8g/ml solution of *Zingiberofficinale* was prepared daily and the animals in groups II and V were allowed to drink *ad libitum*. This was done because people feed on ginger without attention to dosage. A 0.8mg/ml solution of omeprazole was prepared daily and the animals in groups I and IV were allowed to drink *ad libitum* while groups III and VI drank distilled water throughout the period of administration. All the animal treatments were carried out in accordance with the principles of laboratory animal care of the National Institute of Nutrition (NIN) guide for Laboratory Animal Welfare.

At the end of the administration, the animals were deprived of food for 18 hours and 50 mg/kg of indomethacin was administered orally (p.o) to the rats. After 8 hours of indomethacin administration, the animals were sacrificed by chloroform anesthesia and the stomach removed and opened along the greater curvature, rinsed with copious volume of normal saline and pinned on a board.

D. Parameters Measured

i) Ulcer Index: Ulcer index was measured. The ulcers scores were given based on their intensity as follows

Normal stomach……. 0.0

Red coloration…… 0.5

Spot ulcer…… 1.0

Hemorrhagic streak……..... 1.5

Ulcers…….. 2.0

Perforation…….. 3.0

Measurement of gastric ulcerations was done by first dissecting the stomachs along their greater curvature and fixing on a board [21]. Examination was carried out macroscopically with a hand lens (x 2). The ulcer indices (UI) of the control and treated groups were calculated using the method of [22].

$$\text{Ulcer index (mm)} = \frac{\textbf{Number of ulcers (A) x Size of ulcers (B)}}{\textbf{Magnification power of the lens used (x 2)}}$$

ii) Percentage Ulcer Inhibition: Percentage ulcer inhibition was calculated relative to control as follows:

$$\% \text{ Ulcer Inhibition (\% U.I)} = \left(1 - \frac{U_t}{U_c}\right) \text{ x } 100$$

Where U_t and $U_c$represent the ulcer index of the treated and control groups respectively.

E. Statistical Analysis

Data were subjected to analysis using the Statistical Package for Social Sciences (SPSS), version 21.0. Results were presented as Mean $\pm$ Standard deviations. Student's t-test was used for comparison of the mean. Difference between means were considered to be significant at $p<0.05$.

III. RESULT

Indomethacin induced gastric ulcer in 24 out of 30 (80 %) rats used in this study.

TABLE I: EFFECT OF DIFFERENT TREATMENTS ON ULCER INDEX IN INDOMETHACIN-INDUCED ULCER IN 7 DAYS

Treatments	Ulcer Index (mm)	% Ulcer Inhibition (%UI)
Control	69.83 ± 4.23^{a}	0.00^{a}
Omeprazole	15.59 ± 2.89^{b}	77.67^{b}
Zingiberofficinale	29.67 ± 3.61^{c}	57.51^{c}

Results are presented as mean ± standard deviation where n=5. Values with different superscript along the same column is said to be significant at $p<0.005$

Table II: Effect of Different Treatments on Gastric Ulcer Index in Indomethacin-Induced Ulcer in 14 Days

Treatments	Ulcer Index (mm)	% Ulcer Inhibition (%UI)
Control	70.53 ± 4.19^{a}	0.00^{a}
Omeprazole	13.67 ± 2.08^{b}	80.62^{b}
Zingiberofficinale	28.28 ± 5.03^{c}	59.90^{c}

Results are presented as mean ± standard deviation where n=5. Values with different superscript along the same column is said to be significant at $p<0.005$

IV. DISCUSSION

Indomethacin is a non-steroidal anti-inflammatory drug (NSAID) that was reported to induce gastric ulcer through multi-mechanisms [23]. The ulcer formation can occur either by direct mucosal injury which involves the breaking of the mucosal barrier and exposure of the underlying tissue to the corrosive action of excess acid and pepsin or by a decrease in endogenous gastric prostaglandin production and release through COX-1 and COX-2 inhibition. Indomethacin also suppresses gastroduodenal bicarbonate

secretion, reduces endogenous prostaglandin biosynthesis and disrupts the mucosal barrier as well as mucosal blood flow [24]. It is well known that inhibition of prostaglandin synthesis which is essential for mucosal integrity and regeneration will trigger the mucosal lining damage.

Peptic ulcer is a common illness in internal medicine which affects a considerable number of people worldwide [25]. Although, many products are available for the treatment of gastric ulcers (e.g., antacids and antihistaminics), most of these drugs produce several adverse effects, such as arrhythmias, impotence, gynecomastia, and hematopoeitic changes [4]. The extracts of many herbal plants have been shown to produce promising results for the treatment of gastric ulcers with fewer or negligible side effects [26].

Ginger has extensive medicinal history. It is used as spice in food and beverages and in traditional medicine as carminative, antipyretic and in the treatment of pain, rheumatism and bronchitis [10]. Its extracts have been extensively studied for a broad range of biological activities including antibacterial [27][28], analgesic and anti-inflammatory[29], antiangiogenesis and antitumor [16]. It has also been used for the treatment of gastrointestinal disorders including gastric ulcerogenesis [30]. On the basis of these common uses of *Z. officinale* in ethnomedicine, this study was therefore aimed at assessing the efficacy of the aqueous extract of ginger in the prevention of peptic ulcer.

The result of this study indicates that *Z. officinale* is a potent preventive measure against peptic ulcer. This is reflective in the significant increase observed when the percentage ulcer inhibition of *Z. officinale*-treated animals were compared with that of the control animals at $p<0.05$ after 7 and 14 days pre-treatment respectively (Tables 1 and 2). Phytochemical studies showed that *Z. officinale* is rich in a large number of substances, including α-zingiberene, β-bisabolene, gingerols and shogaols. These compounds have been reported to display anti-ulcerogenic activity [31]. The efficacy of *Z. officinale* against indomethacin-induced ulceration might be due to the presence of these substances.

The gastroprotective effect exhibited by *Z. officinale* may also be attributed to the presence of flavonoids [6]. This result is in agreement with the study of [32] who reported that *Curcuma longa*was able to prevent peptic ulcer due to the presence of flavonoid.

Many studies have examined the anti-ulcerogenic activities of plants containing flavonoids [32][33][34]. Plants containing flavonoids were found to be effective in preventing this kind of lesion mainly because of their anti-inflammatory activity and anti-oxidant properties. They protect the gastric mucosa against a variety of ulcerogenic agents and oxidation processes which are involved in the mechanisms of several gastric disorders, including ulcerogenes is in different mammalian species [32].

The result of this study reveal a significant decrease in the percentage ulcer inhibition of animals treated with aqueous extract of *Z. officinale* (57.51% and 59.90%)when compared with those of omeprazole-treated animals (77.67% and 80.62%) after 7 and 14 days respectively. This might be due to the fact that high percentage of ginger's active components did not dissolve in water used in the preparation.

When seven and fourteen days' *Z. officinale*-treatedanimals were compared at $p<0.05$, there was no significant difference in protection against gastric ulceration caused by indomethacin induction. Similarly, when seven and fourteen days' omeprazole-treated animals were compared at $p< 0.05$, no significant difference in protection against gastric ulceration caused by indomethacin induction was observed. Therefore, further treatment with*Z. officinale* and omeprazole does not guarantee greater protection as far as the treatment is ongoing before ulcer induction.

V. CONCLUSION

The results of this study indicate that *Z. officinale* is potent in the prevention of indomethacin-induced ulcer. Ulcer patients are advised to consume ginger as much as possible due to its high flavonoid and antioxidant content. Using methanoic or ethanoic extract of *Z. officinale* in the prevention and treatment of indomethacin-induced ulcer and other types of ulcer induction can be further confirmed.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in this paper.

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