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Comparative Effect of *Curcuma longa* and *Piper nigrum* Extract and their Mixture on some Gastric Secretory Parameters of Indomethacin-induced Gastric Ulceration in Albino Rats

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ABSTRACT

Peptic ulcer disease (PUD) which includes gastric and duodenal ulcer is one of the unresolved medical problems facing numerous patients in a wide range of age of both sexes worldwide. Many medicinal plants are known to exhibit antiulcer activity and some have been confirmed scientifically to possess gastro protective and antiulcer property and also found to be useful in its treatment. Among these medicinal plants turmeric (*Curcuma longa*) and black pepper (*Piper nigrum*) have been reported to possess gastroprotective potentials. However, the effect of the combination of turmeric and black pepper on some gastric secretory parameters of ulcerated rats hasn't been considered. As a result, this study was designed to evaluate the effect of ethanol extract of *Curcuma longa* and *Piper nigrum* on some gastric secretory parameters of indomethacin induced gastric ulceration in albino rats. Total of sixty (60) albino rats was used for this study. After acclimatization for 14 days, the animals were randomly allocated into six groups (n=10).Group A (normal control): rats was fed on pellet and allowed free access to water, rats in Group B (Ulcerated control) were given only indomethacin at a dose of 50mg/Kg body weight. Animals in group C (Standard control) was given indomethacin after pre treatment with esomperazole (20mg/kg) body weight. Group D, E, and F comprised ulcerated rats pre treated with turmeric (200mg/kg body weight), black pepper (100mg/kg body weight), turmeric and black pepper (200mg/Kg + 100mg/kg respectively) body weight. Treatments with the reference drug and extracts lasted for 21 days prior to ulcer induction on the twenty-third day.4 h post ulcer induction, the animals were humanely sacrificed under chloroform anaesthesia and gastric content drained into a centrifuge tube for further studies on some gastric secretory parameters. The study showed that TA levels were significantly ($p < 0.05$) higher in group B compared to the control group and all other groups. Conversely, TA levels were significantly ($p < 0.05$) lower in groups C, D, E, and F compared to the control, with group F showing the lowest levels among these, particularly lower than groups C and E. GpH levels were significantly ($p < 0.05$) lower in group B when compared to groups C, D, E, and F. However, GpH levels were significantly ($p < 0.05$) higher in groups D and E compared to the control, with group E having higher GpH levels than group C. Additionally, pepsin levels were significantly ($p < 0.05$) elevated in group B relative to the control and other groups. Pepsin levels were also significantly ($p < 0.05$) higher in groups C, D, E, and F compared to the control, with group C having lower levels than groups D and E. It can therefore concluded based on the findings of this study that the combination of turmeric and black pepper extract had more gastroprotective effect than the individual extracts alone suggestive of the synergistic effect of these plants in the management of peptic ulcer disease.

Keywords: ***Curcuma longa*, *Piper nigrum,* Indomethacin and Gastric Ulceration**

INTRODUCTION

Peptic Ulcer Disease (PUD) is clinically described as a disruption of the continuity of the gastrointestinal mucosal lining which appears as sores of at least 0.5cm in diameter in endoscopic studies [1]. It is one of the commonest ailments of the alimentary system [2] and affects about 4 million of the world's population annually, with incidence of complications in approximately 10–20% [3]; [4]. It is largely classified as gastric ulcers (GU) or duodenal ulcers (DU) based on the affected section of the gastrointestinal tract (GIT) [5].Typically, patient with acid peptic diseases presents with mucosal disruption which is considered to be as a result of hyper secretive acidic environment, which leads to epigastric pain which may subside when food or alkali is consumed [1]. PUD is predominantly caused by the activities of Helicobacter Pylori (H. Pylori) and/or Non-Steroidal Anti-inflammatory Drugs (NSAIDs). While the activities of H. Pylori creates imbalance in acid production and regulation through inflammation-induced increased gastric secretion and decreased somatostatin secretion, NSAIDs, which offer many benefits such as reduction of pain, fever, and inflammation, are being taken regularly by some people which makes them to be five (5) times more likely to develop PUD than people who do not take them [5]. Cyclooxygenase-1 (COX-1) and cyclooxygenase-2 (COX-2) are enzymes that produce prostaglandins, which promote pain, inflammation, and fever. NSAIDs work by inhibiting these two enzymes [6]. These medications often cause Peptic Ulcer Disease because COX-1 produces an additional type of prostaglandin that protects the stomach lining from stomach acid [7] By inhibiting COX-1, NSAIDs increase the risk of ulcers and GI bleeding by making the mucosal cells more vulnerable to hydrochloric acid and pepsin damage [6]. Apart from the activities of H. pylori and NSAIDs, studies have identified risk factors of PUD which are mostly modifiable. The modifiable risk factors include the use of corticosteroids, anticoagulants, coffee, alcohol, smoking, stress, spicy foods, use of unclean water sources and fasting; while non-modifiable risk factors include genetics, age, gender and past history of PUD. [4]; [8]; [9]; [10]. Since PUD impacts negatively on the health-related quality of life of the affected individuals hence, there have a rapid change in the concept of gastric ulcer management, ranging from conventional vagotomy, prostaglandin analogs, H2 receptor anatagonists and antacids to proton pump inhibitors, [11] such as cimetidine, ranitidine, misoprostol, omeprazole and esomeprazole but then gastrointestinal toxicity remains an impediment to their application in clinical practice [12]; [13]. However, there have been needs to search for non toxic, easily assessable and affordable antiulcer medication. Phytotherapy of some therapeutic plant extracts that are highly valued and widely used in traditional system of medicine such as *curcuma longa* and *piper nigrum* are being investigated to ascertain if they could provide efficient formulation for better management, as such discovering effective and safe drugs that also have gastro-protective activity. *Curcumin*, the natural phenolic active ingredient of turmeric (*Curcuma longa*) rhizome has been used in Asia as an herbal remedy for a variety of diseases [14]. Phytochemicals such as Terpenes [15], phytosterols [10]. Several bioactive essential oils [16], was also revealed, other bioactive compounds was isolated from methanol extract of *curcuma longa* rhizome. The phytochemicals analysis carried out by [5], revealed the percentages of total phenolic, alkaloid and saponin (4.91± 1.0, 6.64± 1.0 and 2.30±0.0) respectively and flavonoids 6.15+ 0.03 [17], the presence of these also confirmed the medicinal properties of turmeric rhizomes. Similar to chili, turmeric is commonly used in Asian cuisine to add a yellow color, both as a flavor and as a preservative [18]. In addition to the use of curcumin as an anti-inflammatory in ancient times, it has also been used to treat gastrointestinal (GI) diseases such as indigestion, flatulence, diarrhea, and even gastric and duodenal ulcers [19]. Great attention has been paid to the medical applications of *Curcumin* in the treatment of human diseases associated with oxidative stress and inflammation, including different cancers [19]. *Curcumin* treatment has also led to the improvement of metabolic parameters involving aging-associated diseases such as atherosclerosis, diabetes, cardiovascular disease, and chronic kidney diseases [20]; [21]. Interestingly, some promising effects of curcumin have been observed in the alleviation by this turmeric derivative of the chronic inflammatory conditions such as arthritis, uveitis, and inflammatory bowel disease [22]. In some instances, *Curcumin* has been found to aid in the prevention and treatment of various cancers [23]. Recently, the anticarcinogenic activity of *Curcumin* has been documented in the GI tract because this compound has proven to exert a therapeutic effect on different human GI cancers such as esophageal, gastric, and small and large intestinal cancer [24], [25].

Piper nigrum (Black pepper) is one of the most commonly used spices and considered as "The King of Spices"due to its trade in the international market [26]; [27]. Black pepper is used as medicinal agent, a preservative, and in perfumery [28]. The genus Piper has more than 1000 species but the most well known species are *Piper nigrum*, *Piper longum* and *Piper betli* [29]. Black pepper can be used for many different purposes such as human dietaries, as medicine, as biocontrol agents [27]; [3] [30]. Black Pepper is used worldwide in different types of sauces and dishes like meat dishes, as rubs, salad dressings. It contains major pungent alkaloid piperine (1-peperoyl piperidine) which is known to possess many interesting pharmacological actions [31], as well as other beneficial compounds such as tannins, saponins, terpenes, steroids, flavones, flavonoids [32]. A study conducted by [33]

revealed that black pepper fruits are endowed with essential oils (1.0–2.5%) and alkaloids (5–9%) also a study showed that it contains Tannins (0.81–2.25) Saponins (1.73,) and Flavonoids 1.28. [34]; [35].
[36], reported that this plant and its active components piperine can stimulate the digestive enzymes of pancreas and intestine and also increases billiary bile acid secretion when orally administered. Black pepper is important for its medicinal values [37]. Medicinally black pepper can be used digestive disorder like large intestine toxins, different gastric problems, diarrohea and indigestion and also can be used against respiratory disorder including cold fever, asthma [38]; [39]; [41]. Piperine exhibits diverse pharmacological activities like antihypertensive and anti-platelets [41] antioxidant, antitumor [42], antipyretic, analgesic, anti-inflammatory, anti-diarrheal, anti-spamodic, hepato-protective, antibacterial, antifungal, anti-thyroids, anti-apoptotic, anti-spermatogenic, insecticidal and larvicidal activities. Piperine has been found to enhance the therapeutic efficacy of many drugs, vaccines and nutrients by increasing oral bioavailability [43],Research supports that combining the piperine in black pepper with the curcumin in turmeric enhances curcumin absorption by up to 2,000% [44]; [45] hence in one study Shoba and colleagues reported that adding 20 mg of piperine to 2 grams of curcumin increased its absorption significantly by slowing down the breakdown of curcumin by the liver, thereby increasing its blood levels [45].

The combined effect of *Curcuma longa* and *Piper nigrum* may provide a synergistic approach to gastric ulcer protection, enhancing mucosal defense while reducing the production of harmful gastric secretions. However, there is a dearth of literature exploring the comparative effects of these plants individually and in combination on gastric secretory parameters in indomethacin-induced ulceration.
This study aims to investigate the comparative effect of *Curcuma longa*, *Piper nigrum*, and their mixture on gastric secretory parameters in albino rats with indomethacin-induced gastric ulcers. The findings could offer insights into the potential of plant-based treatments for managing NSAID-induced gastric ulcers and provide a basis for future therapeutic applications.

MATERIALS AND METHODS

Materials

Equipment and Instruments

The equipment and instruments used was of good analytical grade.

Chemicals and Reagents

Indomethacin and esomeprazole was respectively procured from Kapit Pharmaceutical Limited, Nigeria and Ranbaxy Laboratories, India. Trichloroacetic acid (TCA), dimethylaminobenzaldehyde, epinephrine, acetyl acetone, bovine serum albumin (BSA), gallic acid, aluminum chloride, quercetin and thiobarbituric acid (TBA) were products of Sigma Chemical Co. (St. Louis, MO, USA). Assay kits from Randox Laboratories limited, United Kingdom was used. Other chemicals used was of analytical grade from reputable companies in the world.

Plant collection and authetication

Curcuma longa rhizomes and piper nigrum peppercorns were collected locally and were botanically identified by a Botanist in the department of Botany, Ebonyi state university, Nigeria.

Preparation of extracts

Curcuma longa rhizomes and black pepper was air-dried at room temperature for 10 days to constant weight. The dried samples were then be pulverized with an electric blender (model: Bajaj Stormix: 410501), weighed and kept airtight prior to extraction. Powdered samples of turmeric (180g) and black pepper (250g) was separately extracted in 1.8 litres and 2.5 litres of 70% alcohol respectively for 120 hours using a rotary evaporator kept at a temperature of 40℃. The solutions obtained was filtered with Whatman No. 1 filter paper and yielded 25.56% and 17.60% for turmeric and black pepper respectively.

METHODS

Experimental animals

Wister albino rats was purchased from Animal Unit of Faculty of Veterinary Medicine, University of Nigeria, Nsukka, Enugu, Nigeria. All animals received humane care in accordance with the National Institute of Health guidelines for the care and use of laboratory animals. The animals were left to acclimatize for one week before the start of the experiment and housed in standard clean cages under a controlled room temperature of 21–25 °C and a 12 h light/dark cycle. The animals were given free access to clean water and standard chow diet *ad libitum*.

Ulcer Induction

After a 24 hour fasting period, gastric ulceration was induced in the animals according to the procedure described by [46]. Briefly the rats was administered orally at a dose of (50mg/kg body weight) of indomethacin; this dosage used was based on previous findings that rats administered 50mg/kg body weight of indomethacin presented a very high degree of weakness, behavioral changes, reduced physical activity and very high ulcer index. [47].

Experimental designs

Total of sixty (60) albino rats was randomly allocated into six groups (n=10). Doses of (200mg/kg body weight) turmeric was administered, selecting this dose of curcumin, was informed by previous findings that at dose of 200mg/kg an effective protection against hyperacidity was observed [48]. Doses of (100mg/kg body weight) black pepper was administered; a study showed that *Piper nigrum* offered a prophylactic treatment at a dose of 100 and 200/kg body weight [6]. Group A (normal control): rats was fed on pellet and allowed free access to water, rats Group B (Ulcerated control) were given only indomethacin at a dose of 50mg/Kg body weight.Animals in group C (Standard control) will be given indomethacin after pre treatment with omperazole (20mg/kg) body weight; it was selected as a standard treatment and dose based on a present study carried out by [43]. Group D, E, and F comprised ulcerated rats pre treated with turmeric (200mg/kg body weight), black pepper (100mg/kg body weight), turmeric and black pepper (200mg/Kg + 100mg/kg respectively) body weight. Treatments with the reference drug and extracts lasted for 21 days prior to indomethacin administration. These were orally administered once daily using oral intubator with *ad libitum* provision of food and water throughout the experimental period. On the twenty-second day prior to ulcer imduction, the animals were fasted for 24 hours and animals in groups 2 – 6 were thereafter indomethacin at a dose of 50mg/Kg body weight.

Isolation of the stomach and the gastric juice

On the twenty-third day (4 h post ulcer induction), the animals were humanely sacrificed under chloroform anaesthesia. The abdomen was opened and the stomach excised keeping oesophagus and the pylorus closed. The stomach was thereafter opened along greater curvature and gastric content drained into a centrifuge tube. Five ml of distilled water was added and the resultant solution centrifuged at 3000 rpm for 10 min. The supernatant obtained was afterwards used for biochemical analyses. The cleaned stomachs was preserved by fixing in 10% formaldehyde solution and tissues stored for further histological analysis.

Determination of gastric acid secretory parameters

Determination of Gastric acid output (volume).

Free and total acidity was determined by titrating 1.0 ml gastric juice with 0.01 N sodium hydroxide (NaOH) using the Topfer's reagent and phenolphthalein respectively as indicator.One mL of gastric juice was pipetted out followed by the addition of few drops of Topfer's reagent and titrated with NaOH until all traces of the red colour disappears and turns into yellowish orange. The volume of alkali, corresponds to free acidity added was noted. Few drops of phenolphthalein solution were added and titrated until definite red tinge reappears. Total volume of alkali which corresponds to total acidity was recorded as mEq/l/100 g [49].

Determination of pH

The pH of gastric juice was determined using a pH meter [50].

Determination of pepsin activity:

Pepsin was assayed according to the method of [52], using haemoglobin as substrate. The reaction mixture consisting of 5 mL of substrate (1% BSA in HCl at pH 2.1) and 1 mL of gastric juice sample (equal volume of gastric juice with HCl at pH 2.1, warmed to 37 °C) was incubated for 15 min. The reaction was arrested by the addition of 10 mL TCA. The blank contained a mixer of 10 mL TCA and 1 mL gastric juice sample was incubated for 15 min before the addition of 5 mL of the substrate. After 30 min, the reaction mixture and the blank were filtered separately. The filtrate was added with 10 mL of 0.5 M NaOH and 1 mL of Folin-phenol reagent and absorbance was read at 680 nm. A graph was prepared with different concentrations of tyrosine. The activity of pepsin was expressed as micrograms of tyrosine equivalents released per mL of gastric juice per minute.

Statistical Analysis

The data was analysed using the statistical package for social science (SPSS Inc., Chicago, IL, USA) version 21.0. One-way analysis of variance (One-way ANOVA) was used to determine significant difference among groupd. Results were expressed as mean±standard error of mean (SEM). The results were considered statistically significant different at p values less than 0.05

RESULTS

Comparative effect of Turmeric, Black Pepper and their Mixture on some Gastric Secretory Parameters of Indomethacin-Induced ulceration in Rats

The study's results, as detailed in table 1, indicate that TA levels were significantly ($p < 0.05$) higher in group B compared to the control group and all other groups. Conversely, TA levels were significantly ($p < 0.05$) lower in groups C, D, E, and F compared to the control, with group F showing the lowest levels among these, particularly lower than groups C and E. GpH levels were significantly ($p < 0.05$) lower in group B when compared to groups C, D, E, and F. However, GpH levels were significantly ($p < 0.05$) higher in groups D and E compared to the control, with group E having higher GpH levels than group C. Additionally, pepsin levels were significantly ($p < 0.05$) elevated in group B relative to the control and other groups. Pepsin levels were also significantly ($p < 0.05$) higher in groups C, D, E, and F compared to the control, with group C having lower levels than groups D and E.

Table 1: comparative effect of turmeric, black pepper or their mixture on some gastric secretory parameters of indomethacine-induced ulceration in rats.

Parameters	Experimental Groups					
	A	B	C	D	E	F
TA (mg/dl)	0.11 ± 0.01^{a,b,c,d,e}	0.18 ± 0.00*^{,b,c,d,e}	0.07 ± 0.01*^{,a,c,e}	0.05 ± 0.00*^{,a,b}	0.06 ± 0.00*^{,a,e}	0.04 ± 0.01*^{,a,b,d}
GpH	4.55 ± 0.03^{c,d}	3.97 ± 0.04^{b,c,d,e}	4.86 ± 0.09^{a,d}	5.57 ± 0.16*^{,a}	5.67 ± 0.39*^{,a,b}	5.17 ± 0.07^{a}
Pepsin (U/ml)	2.00 ± 0.03^{a,b,c,d,e}	6.00 ± 0.07*^{,b,c,d,e}	3.42 ± 0.21*^{,a,c,d}	4.40 ± 0.15*^{,a,b}	4.15 ± 0.25*^{,a,b}	3.85 ± 0.08*^{,a}

Values are expressed as mean±SEM (n=10). TA: Titratable acidity; GpH: Gastric pH. Values with different superscripts are statistically significant (p<0.05).

* = significantly different from group A at p<0.05; a = significantly different from group B at p<0.05; b = significantly different from group C at p<0.05; c = significantly different from group D at p<0.05; d = significantly different from group E at p<0.05; e = significantly different from group F at p<0.05.

DISCUSSION

Peptic ulcer disease (PUD) which includes gastric and duodenal ulcer is one of the unresolved medical problems facing numerous patients in a wide range of age of both sexes worldwide [51], with a global prevalence of 5-10% [52], Nigeria ranked #31 in the world with PUD total deaths of 0.39% according to the World Health Organisation and an unexpected rise in gastric ulcer has also been reported in the South-East [53]; [54]. Many medicinal plants are known to exhibit antiulcer activity [55] and some have been confirmed scientifically to possess gastro protective and antiulcer property and also found to be useful in its treatment [56]; [57]. Some studies have been conducted on the use of turmeric and black pepper respectively and also its combination to achieve therapeutic effects on various diseases including gastro intestinal diseases. [58]; [59]; [60]. However, the effect of the combination of turmeric and black pepper on the biochemical indices of ulcerated rats hasn't been considered. As a result, this study was designed to evaluate the effect of ethanolic extract of *Curcuma longa* and *Piper nigrum* on some biochemical makers and the histopathology of indomethacin induced gastric ulceration in albino rats. Gastric secretory paramaters such as gastric pepsin activity, pH and total acidity have proven to be useful tools serving as markers for peptic ulcer disease particularly gastric ulcer. Pepsin have been reported to play a role in the development of both acute gastric lesions and ulcer disease with an increased homogenate level suggesting a case of gastritis [61]. The result obtained from this study showed that total acidity (TA) levels were significantly ($p < 0.05$) higher in group B compared to the control group and all other groups. Conversely, TA levels were significantly ($p < 0.05$) lower in groups C, D, E, and F compared to the control, with group F showing the lowest levels among these, particularly lower than groups C and E. This shows that esomeprazole, extracts of *Curcuma longa*, *Piper nigrum* and their combination significantly reduced the synthesis of HCl by the parietal cell of the stomach of ulcerated rats. The combination of extracts of *Curcuma longa* and *Piper nigrum* was shown to be more effective in neutralizing the acid content of the gastric juice when compared to esomeprazole and the indiviaual extracts alone suggesting the synergistic effect of *Curcuma longa* and *Piper nigrum*. The mechanism in which total acidity of the gastric juice was reduced is not well understood, but it is likely that these extracts alone and in combination has the potential to affect the acid secreting mechanism or act as a proton-pump inhibitor (PPI) by inhibiting the action of the enzyme H^+-K^+ ATPase. Also, the effectiveness of the combination of extracts of Curcuma longa and Piper nigrum as against the individual extracts maybe due to their synergistic effects, as it has been reported that the co-supplementaion of piperine obtained from Piper nigrum with curcumin obtained from Curcuma longa increased the bioavailability and absorption (up to 2000%) of curcumin thereby increasing the time of action of curcumin [62]; [44]. The mechanism by which this is achieved has been reported to be by the inhibition of the activities of curcumin metabolizing enzymes throught the inhibition of glucuronidase in both the intestine and liver and reduction in the conjugation of curcumin with glucuronic acid and its elimination via urine [62]. There is a dearth of knowledge on the effect of the combination of turmeric and black pepper in the management of peptic ulce disease. However, [61], reported that indomethacin-induced gastric ulcerated rats had a significantly higher level in total acidity when compared with other experimental groups, and treatment with curcumin (50 mg/kg, p.o.) significantly reduced the total acid output in ulcerated rats, which was consistent with the result obtained from the present study. Similarly, an older study done by [63], reported that administration of ethanolic extract of turmeric (*Curcuma longa*) protected against several known necrotizing agents by significantly reducing the volume of gastric secretion, titratable acidity, total acid output and ulcer index. They opined that this

gastroprotective effect maybe be attributed to the antioxidant properties of the ethanolic extract of *Curcuma longa*. Also, [64] reported that administration of methanolic extract of *Piper sarmentosum* to stress-induced ulcerated rats reduced the elevated gastric acidity and malondialdehyde induced by stress. This finding was consistent with the result obtained from the present study. In this study it was observed that gastric pH (GpH) levels were significantly ($p < 0.05$) lower in group B (ulcerated group) when compared to groups C, D, E, and F. However, GpH levels were significantly ($p < 0.05$) higher in groups D and E compared to the control, with group E having higher GpH levels than group C. A similar study done by [65] on the assessment of gastric acid anti-secretory effects of fraction extracts of *Piper guineense* leaf on histamine-induced gastric ulcer in wistar rats reported that pre-treatment with *Piper guineense* leaf extract significantly elevated gastric pH levels with simultaneous decrease in gastric secretory volume which were consistent with the result obtained in the present study.

Additionally, it was observed that pepsin levels were significantly ($p < 0.05$) elevated in group B relative to the control and other groups. Pepsin levels were also significantly ($p < 0.05$) higher in groups C, D, E, and F compared to the control, with group C having lower levels than groups D and E. Pepsin have been reported to play a role in the development of both acute gastric lesions and ulcer disease with an increased homogenate level suggesting a case of gastritis [61]. [66] examined the influences of different concentrations of turmeric rhizome powder supplemented diet (TRPSD) on the gene expressions of both anti-ulcer and ulcer biomarkers in indomethacin-induced ulcerated rats, they reported that prophylactic treatment of test groups with TRPSD at 1% - 5% significantly suppressed the gene expression of pepsin in comparison with the ulcerated control. However, at 10% pepsin gene expression was not suppressed when compared with the ulcerated control. This suggests that at 1% - 5% turmeric had the potential to reduce pepsin synthesis which is consistent with the result obtained from this study by down-regulating the gene responsible for pepsin expression. Similarly, [61] reported that a single dose of indomethacin (30mg/Kg) significantly decreased mucin concentration with a significant increase in total acid output and pepsin activity compared to the control group and pre-treatment with curcumin significantly increased gastric juice mucin concentration with a concomitant decrease in total acid output as well as pepsin activity compared with the indomethacin-induced ulcer group. Conversely, in contrast with the result obtained from this study, [67] assessed the effects of black pepper on the gastric mucosa using double-blind intragastric administration of the spice (1.5 g) to healthy human volunteers, with aspirin (655 mg) as positive control, they reported that black pepper caused significant increases in parietal secretion, pepsin secretion, and potassium loss. In contrast to the previous work done by [67] and consistent with the result obtained from this study, [68], have evidenced protective action of piperine against experimental gastric ulcer in rats and mice. They reported that piperine inhibited the volume of gastric juice, gastric acidity, and pepsin activity which is consistent with the result obtained from this study. Omeprazole administered intraduodenally have been reported to have a dose-dependent inhibitory effect on gastric secretions which comprises of gastric volume, acid content and pepsin output [69]. As at the time of writing this report, there is little or nothing known of the effect of the co-administration of turmeric and black pepper extracts on gastric secretory paramaters particularly pepsin secretion. However, the result obtained from this study shows that the co-administration of turmeric and black pepper extracts exhibited similar inhibitory effect on pepsin secretion as the standard drug esomeprasole. This suggests that co-supplemetation of turmeric and black pepper could be used as an alternative to proton pump inhibitors such as esomeprasole while avoiding their adverse effects.

CONCLUSION

This study compared the effects of Piper nigrum, Curcuma longa, and their combination on different gastric secretory parameters in albino rats that had stomach ulcers caused by indomethacin. Different treatment groups exhibited varied patterns in total acidity (TA), gastric pH (GpH), and pepsin levels. Also various findings provide important information on the regulatory and gastroprotective functions of various plant extracts. The substantial ulcerogenic effects of indomethacin were highlighted by the results, which showed that TA levels were much greater in group B (the group treated with indomethacin) than in the control and all other treatment groups. One important component in the development of ulcers is strong stomach acid secretion, which is correlated with the higher TA levels in group B. Conversely, the TA levels of the groups treated with Curcuma longa (C), Piper nigrum (D), and their combination (E and F) were significantly lower, indicating the possibility that these extracts could inhibit overabundance of acid secretion. The group F, which consisted of a combination of higher concentrations of Curcuma longa and Piper nigrum, demonstrated the greatest decrease in TA levels, suggesting that the combined extracts had a synergistic effect that was more successful than either extract alone in reducing acid secretion. The GpH levels between the groups also differed considerably. The GpH of Group B was the lowest, indicating extremely acidic circumstances that are favourable for the development of ulcers. However, groups D and E had considerably higher GpH levels than the control group, indicating that Piper nigrum and Curcuma longa together may help elevate GpH levels and provide a less acidic stomach environment that promotes mucosal healing. Group E exhibited the greatest GpH of all the groups, which supports the idea that the

plant extracts work together to modulate pH levels to promote stomach protection. Pepsin activity was shown to be significantly higher in group B when compared to the control and other treatment groups. Pepsin activity is important in the pathophysiology of ulcers because it breaks down the stomach mucosal barrier. Groups C, D, E, and F also had higher pepsin levels, but they were noticeably lower than in group B, suggesting that the extracts had a protective impact. Curcuma longa treatment group C had the lowest levels of pepsin among the treatment groups, indicating that curcumin may have a more potent inhibitory impact on pepsin production than piperine. In summary, this investigation shows that by modifying stomach secretory characteristics, Curcuma longa and Piper nigrum extracts, both separately and together, provide a protective effect against indomethacin-induced gastric ulceration. It was discovered that the combination of these extracts, especially at higher concentrations, was more efficient than using each one separately in lowering pepsin activity, raising stomach pH, and reducing overall acidity. These results imply that the combined benefits of Piper nigrum and Curcuma longa may be a viable natural option for the treatment and prevention of NSAID-induced stomach ulcers. To better understand the underlying mechanisms and possible clinical uses of these plant extracts in the treatment of stomach ulcers, more research is advised.

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