Effects of Aqueous-Methanol Bulb Extract of *Allium sativum* on Gastric Ulcer and Gastrointestinal Motility

Anthony H,* Nwinyi F.C. and Mohammed A

Department of Pharmacology and Toxicology, Faculty of Veterinary Medicine, University of Abuja, P.M.B 117, Abuja, Nigeria

Accepted May, 2022 and Published June, 2022

ABSTRACT

This research work evaluated the ulcer protective effects of aqueous-methanol bulb extract of *Allium sativum* in rats using acetylsalicylic acid and cold-stress induced ulceration model. Adult Wistar rats were grouped into 5 (consisting of 5 rats each). Rats in group A were administered normal saline (30 ml/kg P.O) to serve as negative control. Rats in groups. B, C and D were pretreated with graded doses of the extract (50, 100, and 200 mg/kg P.O). Rats in group E were treated with Cimetidine (50 mg/kg P.O) to serve as the positive control. Ulceration was induced in all groups afterwards and gross examination of the excised stomach revealed a dose-dependent decrease in ulcer indices in groups treated with the extract. The highest reduction in ulceration was observed in the group treated with 200 mg/kg of the extract, although statistically insignificant but comparable to the cimetidine treated group. This suggests that *Allium sativum* extract possesses antiulcer properties. Another aspect of this research work evaluated the effect of the same extract (50, 100 and 200 mg/kg P.O) on gastrointestinal motility in mice using activated charcoal meal model. Normal saline (20 ml/kg P.O) was used as the negative control. The results obtained from the study revealed a dose-dependent increase in intestinal motility which is suggestive of stimulant laxative mechanism of action. This validates its traditional use as a treatment for constipation and aid in digestion.

**Keywords**: *Allium sativum*, Gastric Ulcer, Antiulcer, Constipation, Intestinal Motility, Laxative, Gastrointestinal Disorder.

*Corresponding author:*
email: henryanthony575@gmail.com
Tel: +234 (0)706 458 7966
INTRODUCTION

*Allium sativum* (Liliaceae) is a perennial flowering plant that grows from a bulb. Its flowering stem is tall, erect and grows up to 1 m (3 ft). It has a flat blade, linear, solid, and approximately 1.25-2.5 cm. The stem has an acute apex, with an odoriferous bulb and contains outer layers of thin sheathing leaves surrounding an inner sheath which encloses the clove. The bulb usually contains 10 to 20 cloves, that are asymmetric in shape, except for those closest to the center. *Allium sativum* produces hermaphrodite flowers and is pollinated by butterflies, moths, bees and other insects. The flowers are carried in a dense, spherical aggregation on a spike (flower stalk) up to 25 cm in length. The young flower head is surrounded by a pair of long-beaked enclosing bracts that become papery and split to reveal the flowers. Individual flower stalks sprout from a central point. Flowers are greenish-white or pinkish in color, with six perianth segments (sepals and petals) measuring about 3 mm in length. Bulbils (asexual propagules) that look like tiny cloves are frequently found among the flowers [1].

Aside from its culinary use, *Allium sativum* (garlic) extract has reportedly been used in treatment of a wide range of ailments such as hypertension and as an antibacterial, antiviral and antifungal agent. Garlic is one of the most researched medicinal plants worldwide [2]. Garlic was recommended by ancient Chinese and Indian medicine to aid respiration and digestion, as well as to treat leprosy and parasitic infestation [3; 4]. Avicenna [5] recommended garlic as a useful compound in the treatment of arthritis, toothache, chronic cough, constipation, parasitic infestation, snake envenomation, insect bites, gynecologic diseases, and infectious diseases in his well-known book, Al Qanoon Fil Tib (The Canon of Medicines; as antibiotic). However, some patients have reported that the consumption of garlic (*Allium sativum*) produces churning sensation in their abdomen (Personal communications). Therefore, the objectives of this study were to evaluate the aqueous-methanolic bulb extract of *Allium sativum* for possible antiulcer and laxative properties using standard experimental models and to establish the scientific justification for the ethnomedicinal use of *Allium sativum* in aiding digestion and treatment of constipation.

MATERIALS AND METHODS

Plant Collection and Extraction

*Allium sativum* (Garlic) bulbs were collected from Gwagwalada Central Market, in Gwagwalada Area Council of Abuja, which is situated 8˚ 57' 2.9988” N, 7˚ 4' 36.2532” E, Nigeria. The samples were collected in the month of July, 2021. Identification and authentication were done by Mr. Lateef Akeem, a Plant Taxonomist in the Department of Medicinal Plants Research and Traditional Medicine (MPR & TM), National Institute for Pharmaceutical Research and Development (NIPRD), Idu, Abuja. Specimen voucher number issued was NIPRD/H/7246.

The cloves of *Allium sativum* bulbs were air-dried at the Faculty of Veterinary Medicine, University of Abuja for 5 days. The cloves were pulverized using mortar and pestle. Exactly 200 g of the powder was macerated in 80% methanol for 72 hours. The mixture was filtered using a filter paper and the filtrate was concentrated in a rotary evaporator (KNF RC 900 Neuberger, USA). The extract was refrigerated at 4˚C until when required.

Determination of the Yield of the Extract

The resultant yield was determined after the extracted concentrate was weighed. The percentage yield was calculated using the given formula:

\[
\text{Percentage yield of extract (\%) = \frac{\text{Weight of extract}}{\text{Weight of pulverized bulbs}} \times 100}
\]
Drugs and Chemicals
Aspirin (Bayer, Leverkusen), Cimetidine (Tagacure, County Cork), Normal saline (Unisal, Charlotte, NC), Tragacanth (Katira Gond, Delhi) and Activated charcoal (Kunimed, Lagos) were used for the studies.

Animals
Forty (40) Wistar rats of both sexes were purchased from Luluchi Farms, Quadri close, off Chukwuemeka Street, Mararaba, Nasarawa State, Nigeria while Twenty-nine (29) albino mice of both sexes were purchased from Otabel Farms and Multipurpose Ventures, 28B Silver Jubilee Estate, A.B.U Quarters Samaru, Zaria, Kaduna State, Nigeria. The animals were allowed to acclimatize for a period of two weeks at the Animal Holding Section of the University of Abuja Veterinary Teaching Hospital prior to experimental procedure. They were fed ad libitum with growers' mash and allowed access to clean drinking water, except when starvation was required during the study.

Acute Toxicity Study
The acute toxicity study was done according to the modified method of Lorke [6]. The method estimates the median lethal dose (LD$_{50}$) which is the dose of a drug that will result in the death of 50% of the treated animal population. In summary, the method involved the starvation of the experimental animals of feed for 24 hours prior to experimental study while allowing them access to drinking water. The study was carried out in biphasic manner using Wistar rats. In the first phase, nine (9) rats were divided into three groups (of 3 rats in each group) and were used for the experimental procedure. Graded doses of the plant extract (10, 100, and 1000 mg/kg P.O) were administered to the various groups respectively. The second phase was carried out based on the outcome of no mortality of the test rats in the first phase. Graded doses of the extract (2000, 3000 and 5000 mg/kg P.O) were administered to new set of rats (n = 3) in the second phase. After the administration in both phases, the rats were observed for 72 hours for signs of toxicity such as nervousness, ataxia, excitement, writhing or death. The oral median lethal dose was calculated using the formula; Ld$_{50}$ = $\sqrt{\text{Minimum toxic dose } \times \text{maximum toxic dose}}$ Abdu et al [7].

Acetylsalicylic Acid and Cold Stress-induced Anti-Ulcer Study in Rats
Adult Wistar rats (113-306 g) of either sex were used for the study. The rats were fasted for 24 hours prior to experimental procedure but were allowed access to clean drinking water. They were marked using 10% picric acid, weighed and randomly allocated to five groups comprising 5 rats per group.

Group A- Rats were given normal saline (30 ml/kg P.O) to serve as negative control.

Group B- Rats were administered *Allium sativum* bulb extract (50 mg/kg P.O).

Group C- Rats were administered *Allium sativum* bulb extract (100 mg/kg P.O).

Group D- Rats were administered *Allium sativum* bulb extract (200 mg/kg P.O).

Group E- Rats were administered Cimetidine (50 mg/kg P.O) to serve as the positive control group.

Thirty minutes after the treatments with normal saline, plant bulb extract and cimetidine, 200 mg/kg of acetylsalicylic acid (aspirin) emulsified with tragacanth was administered orally to each rat using oropharyngeal cannula. All the rats were then subjected to cold stress in a refrigerator (4˚C) for four hours. At the end of the 4-hour period, the rats were stunned and humanely sacrificed, the stomach of each rat was excised and opened along the greater curvature.

Gross Examination of the Stomach
The stomach was rinsed under running tap
water and pinned flat on a white cork board for evaluation from the fundus to the pylorus. The examinations for ulcerative lesions were done with the aid of a hand lens (x 10 magnification). The severity of ulceration was observed and recorded accordingly.

The scoring of the severity was done as described by Asuzu and Onu [8]:
- $< 1$ mm (pinpoint) = 1
- $1-2$ mm = 2
- $> 2$ mm = 3
- $> 3$ mm = 4

**Determination of the Mean Ulcer Index**
The mean ulcer index was determined by dividing the total ulcer indices in a group by the total number of rats in that group [8].

Mean ulcer index = \[ \frac{\text{Total ulcer indices in a group}}{\text{Total number of animals in the group}} \]

**Determination of Percentage Severity of Ulceration**
The percentage severity of ulceration was determined by dividing the mean scores of ulcers in each group by the mean ulcer scores in the control group and the result multiplied by 100 [9].

Percentage severity (%) \[= \frac{\text{Mean ulcer score of a group}}{\text{Mean ulcer score of the negative control group}} \times 100\]

**Determination of Percentage Ulcer Protection**
The percentage ulcer protection was determined by calculating the difference between 100 % and the percent severity of ulceration.

Percentage protection (%) \[= 100 - \% \text{ severity of ulceration} \]

**Study on Gastrointestinal Motility in Mice**
Albino mice (17.1 – 28.9 g) of either sex were used for the study. The mice were fasted for 24 hours prior to experimental procedure but were allowed access to clean drinking water. The mice were marked with picric acid, weighed and grouped into 4 groups (5 mice in each group).

Group A - Mice in this group were given normal saline (20 ml/kg P.0) and served as the negative control.

Group B - Mice were administered *Allium sativum* bulb extract (50 mg/kg P.O).

Group C - Mice were administered *Allium sativum* bulb extract (100 mg/kg P.O).

Group D - Mice were administered *Allium sativum* bulb extract (200 mg/kg P.O).

One-hour (1 h) post treatment, 0.5 ml of 10% activated charcoal solution mixed with 5 g of tragacanth powder was administered orally to each mouse in every group. After 30 minutes, the mice were stunned and humanely sacrificed. The intestines were dissected out and placed on a clean surface. The distance travelled by the activated charcoal meal, from the pylorus to the ileocecal junction was measured. The entire length of the intestine was also measured. The percentage distance travelled by the activated charcoal along the small intestine (from pylorus to the caecum) was then calculated for both the extract and the normal saline treatment groups, as described by Akah et al [9].

**Determination of Mean Distance Travelled by Activated Charcoal**
The mean distance travelled by activated charcoal was determined by dividing the total distance travelled by activated charcoal in all the mice in a group by the total number of mice in that group.

Mean distance travelled by activated charcoal per group \[= \frac{\text{Total distance traveled by activated charcoal in all the mice in a group}}{\text{Total number of mice in that group}} \]
Determining of Percentage Distance Traveled by Activated Charcoal

\[
\% \text{ distance traveled by activated charcoal} = \frac{\text{Mean distance traveled by activated charcoal of a group}}{\text{Mean length of intestine for the group}} \times 100
\]

Statistical Analysis
Statistical analysis was done using the IBM SPSS Statistical package, version 23. All data were expressed as the Mean ± Standard Error of Mean (SEM) and the differences among the treatment groups were analyzed using one-way analysis of variance (ANOVA). Tukey Post Hoc Test was used to determine the differences between the treatment groups. P values ≤ 0.05 were considered statistically significant. The results were presented as tables, figures and plates.

RESULTS

Plant Extract
The extract yield was 58.606 g while the percentage yield was calculated to be 29.303 %. The extract obtained was slightly oily with a sticky texture and brown in colour.

Acute Toxicity Study
There was no mortality recorded in all the experimental groups after 72 hours of observation. However, at the dosage of 5000 mg/kg P.O, two rats had erect fur and were quiet but quickly returned to normal after 5 minutes. The oral median lethal dose (LD\text{50}) of aqueous-methanol bulb extract of \textit{Allium sativum} in rats was therefore estimated to be greater than 5000 mg/kg (Table 1).

Table 1: Oral acute toxicity effect of aqueous-methanol bulb extract of \textit{Allium sativum} in rats

<table>
<thead>
<tr>
<th>Treatment with \textit{Allium sativum}</th>
<th>Number of deaths</th>
<th>% Lethality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 mg/kg p.o</td>
<td>0/3</td>
<td>0 %</td>
</tr>
<tr>
<td>100 mg/kg p.o</td>
<td>0/3</td>
<td>0 %</td>
</tr>
<tr>
<td>1000 mg/kg p.o</td>
<td>0/3</td>
<td>0 %</td>
</tr>
<tr>
<td>Phase 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000 mg/kg p.o</td>
<td>0/3</td>
<td>0 %</td>
</tr>
<tr>
<td>3000 mg/kg p.o</td>
<td>0/3</td>
<td>0 %</td>
</tr>
<tr>
<td>5000 mg/kg p.o</td>
<td>0/3</td>
<td>0 %</td>
</tr>
</tbody>
</table>

Acetylsalicylic Acid and Cold Stress-induced Ulceration Study in Rats

Gross Observations on the Stomach
Acetylsalicylic acid and cold stress induced gastric lesions such as multifocal petechial (pinpoint) to purpura haemorrhages were observed on the gastric mucosa of rats treated with normal saline (30 ml/kg P.O; Plate I). In the group treated with \textit{Allium sativum} bulb extract (50 mg/kg P.O), there were multifocal pinpoint haemorrhages on the gastric mucosa of the rats (Plate II). In the group treated with \textit{Allium sativum} bulb extract (100 mg/kg P.O), a few pinpoint haemorrhages were observed on the gastric mucosa of the rats (Plate III) while slight petechial haemorrhages were observed on the gastric mucosa of rats in the group treated with \textit{Allium sativum} bulb extract (200 mg/kg P.O; Plate IV). Also, only slight pinpoint haemorrhages were observed on the gastric mucosa of the rats treated with cimetidine (50 mg/kg P.O; Plate V). This was comparable to the group treated with \textit{Allium sativum} bulb extract (200 mg/kg P.O).
Plate I: Multifocal petechial haemorrhage (i) and Purpura haemorrhage (ii) on the stomach (fundus to pylorus) of rats pre-treated with normal saline (30 ml/kg P.O).

Plate II: Multifocal petechial haemorrhages (i) on the stomach (fundus to pylorus) of rats pre-treated with aqueous-methanol bulb extract of *Allium sativum* (50 mg/kg P.O).
Plate III: Few petechial haemorrhages on the stomach (fundus to pylorus) of rats pre-treated with aqueous-methanol bulb extract of *Allium sativum* (100 mg/kg P.O).

Plate IV: Slight petechial haemorrhage (i) on the stomach (fundus to pylorus) of rats pre-treated with aqueous-methanol bulb extract of *Allium sativum* (200 mg/kg P.O).

Plate V: Slight petechial haemorrhages (i) on the stomach (fundus to pylorus) of rats pre-treated with cimetidine (50 mg/kg P.O).
Mean Ulcer Score
The study showed that the normal saline (30 ml/kg P.O)-treated rats had a mean ulcer score of 2.0 while the aqueous-methanol *Allium sativum* bulb extract (50, 100 and 200 mg/kg P.O) produced a dose-dependent decrease in ulcer indices with mean ulcer score of 1.6, 1.4 and 1.0 respectively. However, the decreases were not statistically significant (P > 0.05). The effect of the extract at 200 mg/kg P.O was comparable to that of cimetidine (50 mg/kg P.O) with a mean ulcer score of 0.8 (Table 2).

Table 2: Mean ulcer score of rats subjected to acetylsalicylic acid and cold stress-induced ulceration post treatment with aqueous-methanol bulb extract of *Allium sativum* (50, 100 and 200 mg/kg P.O)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mean Ulcer Score ± SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative control (Normal saline, 30 ml/kg P.O)</td>
<td>2.0 ± 0.3</td>
</tr>
<tr>
<td><em>Allium sativum</em> 50 mg/kg P.O</td>
<td>1.6 ± 0.4</td>
</tr>
<tr>
<td>100 mg/kg P.O</td>
<td>1.4 ± 0.2</td>
</tr>
<tr>
<td>200 mg/kg P.O</td>
<td>1.0 ± 0.3</td>
</tr>
<tr>
<td>Cimetidine 50 mg/kg P.O</td>
<td>0.8 ± 0.4</td>
</tr>
</tbody>
</table>

Values are expressed as mean ± SEM (n = 5) One-way ANOVA; Tukey Post Hoc.
*P ≤ 0.05: significantly different from control.

Percentage Severity of Ulceration
The study showed that the rats treated with aqueous-methanol bulb extract of *Allium sativum* (50, 100, and 200 mg/kg P.O) had percent ulcer severities of 80%, 70% and 50% respectively while the rats treated with the standard drug, cimetidine (50 mg/kg P.O) had a percent ulcer severity of 40%. (Figure 1).

![Figure 1: Percentage severity of acetylsalicylic acid and cold stress-induced ulceration in rats treated with aqueous-methanol bulb extract of *Allium sativum* (50, 100, and 200 mg/kg P.O) and Cimetidine (50 mg/kg P.O).](image-url)
**Percentage Ulcer Protection**
The aqueous-methanol bulb extract of *Allium sativum* (50, 100 and 200 mg/kg P.O) showed ulcer protective percentages of 20%, 30% and 50% respectively. The percent protection was dose-dependent. The result for *Allium sativum* bulb extract (200 mg/kg P.O) was comparable with cimetidine (50 mg/kg P.O) -treated group with percentage ulcer protection of 60% (Figure 2).

![Figure 2: Percentage ulcer protection of rats treated with aqueous-methanol bulb extract of *Allium sativum* (50, 100 and 200 mg/kg P.O) and cimetidine (50 mg/kg P.O).](image)

**Gastrointestinal Motility in Mice**
The study showed that the normal saline (20 ml/kg P.O) -treated mice had a mean activated charcoal travelled distance of 29.2 cm while the aqueous-methanol bulb extract of *Allium sativum* (50, 100 and 200 mg/kg P.O) had a dose-dependent increase in mean activated charcoal travelled distance of 32.0, 33.6 and 40.6 cm respectively. The result was significant (P < 0.05) only at the dose of 200 mg/kg P.O (Table 3).

**Table 3: Effect of the aqueous methanol bulb extract of *Allium sativum* (50, 100, and 200 mg/kg P.O) on intestinal motility in mice.**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mean Intestinal Distance Traveled by Activated Charcoal (cm) ± SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative control</td>
<td>29.2 ± 3.1</td>
</tr>
<tr>
<td>(Normal saline, 20 ml/kg P.O)</td>
<td></td>
</tr>
<tr>
<td><em>Allium sativum</em></td>
<td></td>
</tr>
<tr>
<td>50 mg/kg P.O</td>
<td>32.0 ± 2.8</td>
</tr>
<tr>
<td>100 mg/kg P.O</td>
<td>33.6 ± 3.2</td>
</tr>
<tr>
<td>200 mg/kg P.O</td>
<td>40.6 ± 1.6*</td>
</tr>
</tbody>
</table>

Values are expressed as mean± SEM (n = 5); *P* ≤ 0.05, significantly different from control; One way Anova; Tukey Post Hoc.
Percentage of Intestinal Propulsion of Charcoal

The aqueous-methanol bulb extract of *Allium sativum* (50, 100 and 200 mg/kg P.O) showed increase in intestinal propulsion of charcoal with percentages of 66.1%, 72.1% and 82.8% respectively. The percentage increase observed was dose-dependent. (Figure 3).

**Figure 3:** Percentage intestinal distance travelled by activated charcoal in mice treated with aqueous-methanol bulb extract of *Allium sativum* (50, 100 and 200 mg/kg P.O) and normal saline (20 ml/kg P.O).

**DISCUSSION**

The absence of mortality in the acute toxicity study at graded doses (10, 100, 1000, 2000, 3000 and 5000 mg/kg P.O) indicated that the oral lethal dose of *Allium sativum* bulb extract could be any value greater than 5000 mg/kg. According to Lorke [6], LD₉₀ values greater than 1 g (1000 mg/kg) for a test substance or chemical is only slightly toxic (relatively safe). Therefore, the result of this study suggests that the extract is relatively safe for consumption. However, it was observed that at the dosage of 5000 mg/kg P.O, 2 rats had erect fur and were quiet but quickly returned to normal after 5 minutes. This could possibly be the onset of manifestation of toxicity signs.

The use of orthodox medication for the treatment of gastric ulceration is not without side effects, which include headache, giddiness, dizziness, fatigue, constipation and diarrhoea [10]. This was one of the objectives for carrying out this study; to discover a potent antiulcer agent of plant origin, with minimal or no side effects.

The study evaluated the ulcer-protective activity of the aqueous-methanol bulb extract of *Allium sativum* in Wistar albino rats using acetylsalicylic-acid and cold stress as an ulcer induction model. Nonsteroidal anti-inflammatory drugs (NSAIDs) are among the most commonly prescribed over-the-counter medications, but they frequently cause severe gastrointestinal ulceration and bleeding [11]. One of such NSAIDs is acetylsalicylic acid (aspirin) and it is based on its ulcer causing property that it is used as a model to induce gastrointestinal ulceration in animals, alongside its combination with cold stress.

Acetylsalicylic acid induces gastric ulceration via different mechanisms including; inhibition of the activity of cyclooxygenase (COX). This enzyme's activity leads to the formation of prostaglandins (PGs) that cause inflammation,
swelling, pain and fever. However, by inhibiting this key enzyme in PG synthesis, aspirin also prevents the production of physiologically important PGs which protect the stomach mucosa from damage by hydrochloric acid, also by reduction of blood flow and increasing acid synthesis [12].

The result of the antiulcer study revealed a dose-dependent decrease in number of gastric lesions, with the highest decrease produced at a dosage of 200 mg/kg P.O. Although the decrease was statistically insignificant, the group treated with 200 mg/kg P.O of *Allium sativum* extract showed a similar percentage ulcer protection (50%) when compared with the group treated with the standard drug, cimetidine 50 mg/kg P.O (60%).

The antiulcer protective effect of *Allium sativum* on gastric mucosa and the reduction in the ulcer index observed maybe due to its antagonistic effect on any of the mechanisms of action involved in the development of gastric ulcer.

Studies have revealed the presence of phytochemical constituents in *Allium sativum* such as; alkaloids, flavonoids, steroids, glycosides, tannins, terpenoids, phenols, saponins and other compounds [13]. Flavonoids' anti-ulcer effects include anti-acid secretion, inhibition of pepsin level and activity, and increased gastric mucus and bicarbonate secretion. Flavonoids also improve mucosal cytoprotective, antioxidative, anti-inflammatory, and antibacterial defenses against peptic ulcer. Typically, one type of flavonoid can have anti-ulcer effects via multiple mechanisms [14].

In gastric ulcers, tannin-protein complex layer protects the stomach by increasing resistance to chemical and mechanical injury or irritation. Furthermore, tannins have been shown in several experimental models of gastric ulcer to have antioxidant activity, promote tissue repair, have anti *Helicobacter pylori* effects, and are involved in gastrointestinal tract anti-inflammatory processes. The presence of tannins explains why many natural products have anti-ulcer properties [15].

Since these antiulcer phytochemical components are evidently present in *Allium sativum*, it therefore indicates that they may have contributed to the antiulcer dose-dependent activity of the bulb extract which favours its use as a potential antiulcer agent.

The gastrointestinal study evaluated the effect of aqueous-methanol bulb extract of *Allium sativum* on gastrointestinal motility using activated charcoal meal in mice. The result of the study revealed a dose-dependent increase in the distance travelled by activated charcoal along the intestinal tract. This suggests increase in gastrointestinal motility.

Avicenna [5] recommended garlic as a useful compound in the treatment of constipation, which is difficulty in passing stool. This resonates with the outcome of this study, because increased gastrointestinal motility will in turn ease bowel movement and alleviate constipation. One of the many treatments of constipation includes the use of stimulant laxatives, which work by increasing intestinal secretions and motility [16]. Therefore, the use of *Allium sativum* as treatment for constipation could be due to the similarities in mechanism of action with stimulant laxatives and that makes it a potential source for the development of a laxative agent. Also, the increase in gastrointestinal motility possibly explains the abdominal churning experienced by some individuals.

**Conclusion**

Based on the results of this work, the aqueous-methanol bulb extract of *Allium sativum* showed a dose- dependent ulcer-protective effect in rats ulcer-induced with acetylsalicylic acid and cold stress, with the highest ulcer protection at 200 mg/kg P.O. Although the ulcer-protective effect was statistically insignificant (P > 0.05), the protective effect was comparable to the effects of the standard
drug cimetidine (50 mg/kg P.O). Thus, *Allium sativum* has a potential in the treatment of gastric ulcer.

For the motility study, the aqueous-methanol bulb extract of *Allium sativum* produced a dose-dependent increase in intestinal motility, with highest propulsion of activated charcoal at 200 mg/kg P.O. Thus, *Allium sativum* can be a potential source of agents for the development of a laxative that will be useful in the treatment and management of constipation and other gastrointestinal disorders. It also justified its traditional use for digestion.

**REFERENCES**


