

The Anti-Ulcerative and Immunomodulatory Effect of *Sida Acuta* (Stubborn Grass) on Ulcer Induced Wister Rats

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ABSTRACT: *Sida Acuta* also known as stubborn grass is a flowering plant and it belongs to the mallow family, Malvaceae. It contains numerous phytochemicals with potential therapeutic effect and has been widely used as a traditional medicine for the treatment of various ailments. This study evaluated the anti-ulcerative and the immunomodulatory effect of *Sida Acuta* extract on indomethacin-induced Wistar rats. Our study suggests that *Sida Actua* has potential therapeutic effects that are beneficial for the treatment of gastric ulcer. For the purpose of this study, 36 animals were categorised into pre- and post-treatment groups, with both further subdivided into 6 groups of 3 animals each. With the pre-treatment group, the normal, negative and standard group received 0.25mL/kg of the standard drug, Cimetidine and the other 3 groups received *Sida Acuta* extract at doses 0.9mL/kg, 1.8mL/kg and 3.6mL/kg respectively. For 7 days, the pre-treatment group was given the extract and then, gastric ulcer was induced using indomethacin on the 8th day. After 24hours, the rats were sedated using chloroform soaked in cotton, their stomachs all harvested, and then, blood samples were collected. The results were analysed using Dunnett t-tests. This study demonstrated that *Sida Acuta* significantly reduced ulcer counts in a dose-dependent manner. When compared with the standard drug, Cimetidine, it was observed that with the group (1000mg/kg) that received the highest dose (3.6mL/kg) had the lowest ulcer counts in both pre- and post- treatment groups. A further analysis on the Immunoglobulin level showed that, at high doses, significant modulation on immunological responses was observed.

KEYWORDS: *Sida Acuta*, cimetidine, gastric ulcer, indomethacin, phytochemicals, non-steroidal anti-inflammatory drugs (NSAIDs), immunoglobulin

I. INTRODUCTION

The stomach is a vital organ responsible for digesting the food we consume. It is a part of the gastrointestinal system and it is composed of many layers and cells, all of which work together to facilitate digestion, protect the stomach lining, and regulate stomach function (Hsu et al., 2023). The protective and adaptive mechanisms of the stomach, established by various factors including mucus, bicarbonate, microcirculation, and a phospholipid barrier, allow it to tolerate extreme conditions, such as low pH, the presence of digestive enzymes, and in certain cases, severe injuries. Furthermore, the stomach defence is supported by mechanisms involving both the central nervous system and hormonal factors. These processes could often be overwhelmed and may result in the development of gastric mucosal lesions referred to as gastric ulcers (Ajeigbe et al., 2017; Matteo et al., 2011).

Gastric Ulcer is a mucosal break in the stomach or duodenum of about 3mm in its largest diameter, having a visible depth and a distinct border (Yahya, 2023; Sverdén et al., 2019). Gastric ulcer, according to Grassi et al. (2011), is a condition caused by an upper gastrointestinal tract disorder induced by the gastric mucosa secreting excessive acid and pepsin. It is an opening in the lining of the duodenum, stomach or oesophagus. (Ravisankar et al., 2016), and it can occur in any area of the digestive system that is normally impacted by gastric juice (Kelechi Ndidi, 2020). Gastric ulcer results in minute to deep invasive sores of the gastric mucosal lining, which may produce harmful symptoms in our body (Kumar et al., 2023). According to Hamid et al. (2023) and Çağari (2023), gastric ulcer occurs when the biological balance between defensive (such as prostaglandins, mucus, and growth factors) and aggressive factors in the gastrointestinal tract is disrupted. It is a prevalent disorder that affects millions of individuals globally, with an estimated global prevalence of about 8.09% (Xie et al., 2022). Although asymptomatic, gastric

ulcers are a chronic illness that can cause nonspecific symptoms, including epigastric pain (which worsens after or between meals), bloating, belching, nausea, vomiting, and sensitivity to fatty foods (Yahya, 2023). The primary cause of gastric ulcers is the increased secretion of gastric acid above the normal limit by the parietal cells, the reduced secretion of mucus and bicarbonate and reduced blood flow. Long-term use of non-steroidal anti-inflammatory drugs (NSAIDs), *Helicobacter pylori* infection, smoking, and excessive alcohol intake are some of the risk factors; however, peptic ulcer caused by *H. pylori* is the most common cause (Ajeigbe et al., 2017; Gaurav et al., 2025; Kumar et al., 2023).

Nonsteroidal anti-inflammatory drugs (NSAIDs), including indomethacin, naproxen, ibuprofen, and aspirin, are primarily used for their analgesic, antipyretic, and anti-inflammatory properties. They are used for the treatment of rheumatoid arthritis, osteoarthritis and ischemic cardiovascular disease. Despite the therapeutic properties of these medications, some studies have connected persistent use to the development of gastrointestinal risk. This is mostly related to their ability to inhibit cyclooxygenase enzymes, particularly cyclooxygenase-1 (COX-1) (Hamid et al., 2023; Hamza et al., 2024). COX-1 is found in the majority of cells, including the endothelial cell, the gastrointestinal epithelium and platelets (Musa 2017). The inhibition of this enzyme causes prostaglandin deficiency in the gastric mucosa, inhibiting the secretion of bicarbonate and mucus (both of which have cytoprotective properties), reducing blood flow to the mucosa and also making the mucosa more susceptible to injury.

Helicobacter Pylori are curved, gram-negative bacteria present in the gastric mucosal epithelium, and it is the most common cause of gastric ulcers (Ahmed et al., 2019). It is commonly acquired in childhood and lasts until treated. Low socioeconomic level, unsanitary conditions and crowding are also risk factors for this infection

(Mechu et al., 2018). *H. pylori* disrupt the gastric mucosa, stimulating gastric acid secretion and contributing to ulcer formation. Despite the bacterium being asymptomatic in infected individuals, it is also known to induce gastritis and gastric ulcer. This bacterium is typically treated with a combination of an acid inhibitory drugs and antibiotics to aid in the complete eradication of the bacteria from the gastric mucosa (Ekwealor et al., 2020). Bismuth, clarithromycin, amoxicillin, tinidazole and metronidazole are some of the drugs that have proven effective in the treatment and eradication of this bacteria.

Several lifestyle factors have been linked to an increased incidence of gastric ulcers. Smoking, for example, has been recognised as a significant risk factor for peptic ulcer development and complications via various pathways including; increased gastric secretion and decreased mucosal defense. It inhibits ulcer healing and raises the risks of complications (Hao et al., 2024; Roshini et al., 2023). Another risk factor is excessive alcohol consumption, which can erode the stomach lining and lead to ulcers or, worsen the symptoms of an existing ulcer (Roshini et al., 2023; Shilpa Amin 2023). Dietary habits, such as excessive consumption of spicy foods, fried foods or meals with high protein content have been linked to the worsening of ulcer symptoms (Kabir et al., 2021). Furthermore, stress tends to exacerbate ulcers since the body's natural response to stress increases the secretion of stomach acid, which is a source of ulcers (Health essentials, 2022). Overall, the epidemiology of gastric ulcers is influenced by a complex interplay of factors, including the widespread use of NSAIDs, *Helicobacter pylori* infection, and various lifestyle choices. Therefore, understanding these risk factors is crucial for the prevention and management of gastric ulcers.

Medicinal herbs have been used for millennia in traditional medicine to treat a wide range of diseases, including gastrointestinal issues and among these is ***Sida acuta***.



Fig 1: An image of the Sida Acuta plant.

Sida Acuta is a flowering plant that belongs to the mallow family, Malvaceae. It is a tiny, erect, perennial shrub that grows around 1.5m height and has several branches. It is abundantly distributed in the subtropical regions and has various traditional uses across each region. In English, it is also known as stubborn grass or broomweed or wireweed, while the Yoruba's name it Ìsékètu, the Igbo and Hausa name are Udo and Wada respectively. Though all parts of the leaf are considered therapeutically important, its leaves are the most frequently used by traditional medical practitioners especially in Asia and Nigeria (Ekwealor et al., 2020; Hassan et al., 2023; Ogunmoyole et al., 2022 & Shankar et al., 2021).

Sida Acuta has been discovered to be rich in bioactive compounds such as alkaloids (which is said to be the main active component), saponins, tannins, alkaloids, steroids, flavonoids, anthraquinones, terpenoids and cardiac glycosides. It has been used for numerous purposes including, neurological disease, headaches, leucorrhoea, tuberculosis, diabetes, malarial and other fevers, uterine disorders, rheumatic problems, renal inflammation, asthma, childbirth and worms (Chinelo et al., 2018, Hassan et al., 2023 & Malik et al., 2022). In Nigeria, the plant is used for the treatment of malaria, gonorrhoea, ulcer, abortion, breast cancer and poisoning (Ekwealor et al., 2020). Following its rich source of natural fibers, it is also used in food, beverages in horticulture.

Sida acuta has anti-inflammatory, antioxidant, and cytoprotective properties that help

preserve the stomach mucosa and improve overall gastrointestinal health. Despite its widespread usage, there is limited scientific data to support its usefulness in the treatment of stomach ulcers, particularly those caused by NSAIDs such as Indomethacin, which prompted this investigation.

II. EXPERIMENTATION

Procurement of Experimental Animals

The animals were gotten from the animal house at the University of Port-Harcourt, which is well-known for its ethical breeding and care standards. They were housed in a controlled environment, maintaining specific conditions such as a temperature range of 22-24°C, humidity levels ranging between 40-60%, and a 12-hour light and dark cycle. The housing was made of polypropylene cage and had a sawdust bedding that was changed on a regular basis to keep it clean. A standard rat diet and water was provided every day. The animals were acclimated for at least one week before the experiment commenced to allow them adjust to their new environment, reducing stress and assuring consistent experimental results.

Collection of Samples

The plant, *Sida Acuta*, was sourced from the farm at the University of Port Harcourt and then it was sent to the Plant Science and Biotechnology department at the university. At the laboratory, the leaves were identified, its morphological characteristics examined and assigned an herbarium number by a qualified and well-trained

botanist. Afterwards, the authenticated leaves were thoroughly cleansed to remove dust and other contaminants, processed and then, stored appropriately for further use.

Extraction of Plant Parts

For the process of extracting the plant parts, the aqueous technique was used. 10g of *Sida Acutawas* thoroughly washed and then placed in a clean pot. Using 3L of distilled water, the leaves were allowed to boil and concentrated to 1L. The concentrate was decanted and the extract stored in a clean, dry and accurately labelled container at 4°C until it was ready for use.

Determination of the concentration of *Sida Acuta*

Using a &g electronic weighting scale, a crucible (an evaporating dish) kept at room temperature was weighed and determined to be 52.97g. 1mL of the aqueous **stubborn grass extract** was put in to the crucible, and the total weight of the liquid extract was 53.16g and then, placed over a warm beaker of water on a hot plate set at 40°C. The contents of the dish were thoroughly dried before being removed from the beaker and allowed to cool to room temperature. Its contents and the crucible were further weighed, and the total weight was found to be 53.02g. The weight of the extract in the crucible was determined by subtracting the weight of the crucible from the total weight of the crucible and extract (i.e. weight of the crucible plus weight of the extract), as shown in the table below:

Table 1: The determination of the concentration of the extract

Weight determination	Stubborn grass leaf
Weight of dish + liquid extract	53.16g
Weight of dish + dry extract	53.02g
Weight of dish	52.97g
Weight difference	0.05g
Weight (mg)	50mg

**Since the volume of the extract used was 1 mL, it implies that the concentration of the extract is 50mg/mL.

Oral Toxicity Testing for LD₅₀ Determination

In this study, the Bruce method of 1985 was utilised to determine the LD₅₀, with all the animals used weighing 180g. Using this method, a nulliparous and non-pregnant female Wistar rat, fasted overnight (food but not water was withheld) before dosing, was orally given a single dose by gavage using a suitable stomach intubation cannula, starting with a dose of 120.5mg/kg of aqueous **stubborn grass extract** (i.e. 21.69mg/180g or 0.43mL/180g animal). The female species was chosen in order to reduce variability and to limit the number of animals handled. After administering the aqueous extract, food was withheld for an additional 3-4 hours and then, the animal was monitored for death for 48 hours. This dosage was chosen because there was no understanding of the extract's potential toxicity. At this dose, no deaths were reported. Since no deaths were observed, the dose for the next animal was increased by a factor of one-half log times the initial dose; (Note: 3.2 is the default factor corresponding to a dose progression of one-half log unit). This was calculated to be 385.6mg/kg or 69.41mg/180g, corresponding to 1.39mL of extract per 180g animal. The animal was carefully monitored for up to 48 hours before deciding

whether and how much to dose the next animal, and still, there was no death. The process of progressive increment was maintained with the following doses: 1233.92mg/kg or 222.106mg/180g, i.e. (4.4ml/180g of animal extract). Again, another animal was treated with 3948.48mg/kg or 710.73mg/180g or (14.2ml/180g) of the aqueous extract, and was monitored for 48 hours. There was no death reported. Since there was no observed death, a factor that when employed will give 5000mg/kg was required, as it is scientifically acknowledged that a substance is non-toxic at a level of 5000mg/kg. Thus, 5000mg/kg or 900mg/180kg (18ml/180g animal) was administered and still, no death was observed in any of the animals, even when this final dose was given to three Wistar rats. Using this LD₅₀ measurement method, it therefore implies that the aqueous extract is considered safe. Where death occurs, the LD₅₀ is usually determined using the geometric mean of the last two doses, the highest dose that did not cause death and the lowest dose that caused death as follows;

The LD₅₀ is determined from the formula

$$LD_{50} = \sqrt{D_1 \times D_2}$$

Where:

D_1 is the highest dose that did not cause death and

D_2 is the lowest dose that caused death in the test animals.

Acquisition of Animals

The animals, 52 female Wistar rats weighing 180g each, were obtained from the animal house at the University of Port Harcourt. The rats were raised in cages at the animal house of the Department of Pharmacology at the University of Port Harcourt in Rivers State, Nigeria. These animals were given two (2) weeks to acclimatise and were fed grower mash continuously. During the breeding phase, the animals were housed in wooden cages at room temperature, with proper ventilation and 12/12 hours light/dark cycles. Every animal had complete access to clean water. All animal housing and handling employed in this study follow the National Institute of Health Guidelines for Care and Use of Laboratory Animals in Biomedical Research.

Study Design

This study included 52 animals. 16 animals were assigned to the LD_{50} test, leaving 36 animals for the main study. These remaining 36 animals were divided into two primary groups: pre- and post-treatment, with each group further subdivided into 6 groups of 3 animals each.

For the pre- and post-treatment, group 1 received a low dose of the extract, group 2 got a medium dose of the extract, and a high dose of the extract was administered to group 3. Group 4 was the positive control, and so, the animals were given the standard drug (cimetidine), while group 5 was the negative control and group 6 being the normal control received only distilled water and no treatment respectively. All the animals in treatment groups 1-3 were administered the extract at varying doses as specified.

Research Method

Post-Treatment Group

Animals were subjected to fasting and induced with gastric ulcers for 24 hours before treatment commenced. The treatment followed the administration as specified: the low dose group received 0.9mL/kg, the medium dose group received 1.8mL/kg, the high dose group received 3.6mL/kg, and the standard (positive) control group received 0.25mL/kg of the standard drug. The negative control group was induced with ulcers, given distilled water and no treatment, whereas the normal

control group received no treatment and no inducement. The treatment lasted 1 week, after which the animals were sacrificed. Ulcer counts were performed, blood samples were taken for immunoglobulin analysis, and the stomach tissue was harvested for histological analysis. Chloroform soaked in cotton was used to sedate the animals, dissect, and their stomachs were harvested and fixed in 10% formalin before further analysis.

Method of Carrying out the Study

For the pre-treatment group, gastric ulcer was not induced. The same dosage regimen as the post-treatment group was repeated; however, the negative group received no treatment, but was induced, while the normal control was not induced with ulcers and received no treatment. The negative control group received distilled water. After a week of treatment, the ulcer count was done, the animal sacrificed, and the harvesting of stomach tissue.

The parameters checked in both pre- and post-treatment groups were: ulcer count, histological analysis of the stomach tissue, and immunoglobulin levels using blood samples. Blood samples were collected in EDTA bottles, and stomach tissues were stored in universal bottles for analysis.

III. RESULT

Effect of Sida Acuta on ulcer counts in post-treated animals

In post-treated animals (table 2), the highest average number of ulcer counts was observed among the negative control group (6.67 ± 0.88) while, the normal control group had no ulcer count (0.00 ± 0.00). The experimental group that received Cimetidine had a reduced ulcer count of about 3.00 ± 0.58 , further demonstrating its efficacy in the treatment of ulcer. The group that was administered 1000 mg/kg of sida acuta extract had the lowest average number of ulcer count of 0.67 ± 0.33 , and in comparison with the standard ulcer drug, Cimetidine, this was significantly lower.

With the pre-treated animals (as shown on table 4 and fig. 5), it was also observed that, the experimental group that received 1000mg/kg of the extract had the lowest ulcer count of 0.33 ± 0.33 while the group that received the standard drug, Cimetidine had an ulcer count of 6.67 ± 0.88 . Overall, a dose-dependent reduction in ulcer counts was observed among the groups that received the Sida Acuta extract.

Table 2: A table showing the effects of Sida Acuta on the ulcer count of the experimental rats

Groups	Ulcer count
Neg. control	6.67±0.88
Normal Control	0.00±0.00
Cimetidine	3.00±0.58
250mg/kg	4.33±0.33
500mg/kg	2.33±0.33
1000mg/kg	0.67±0.33

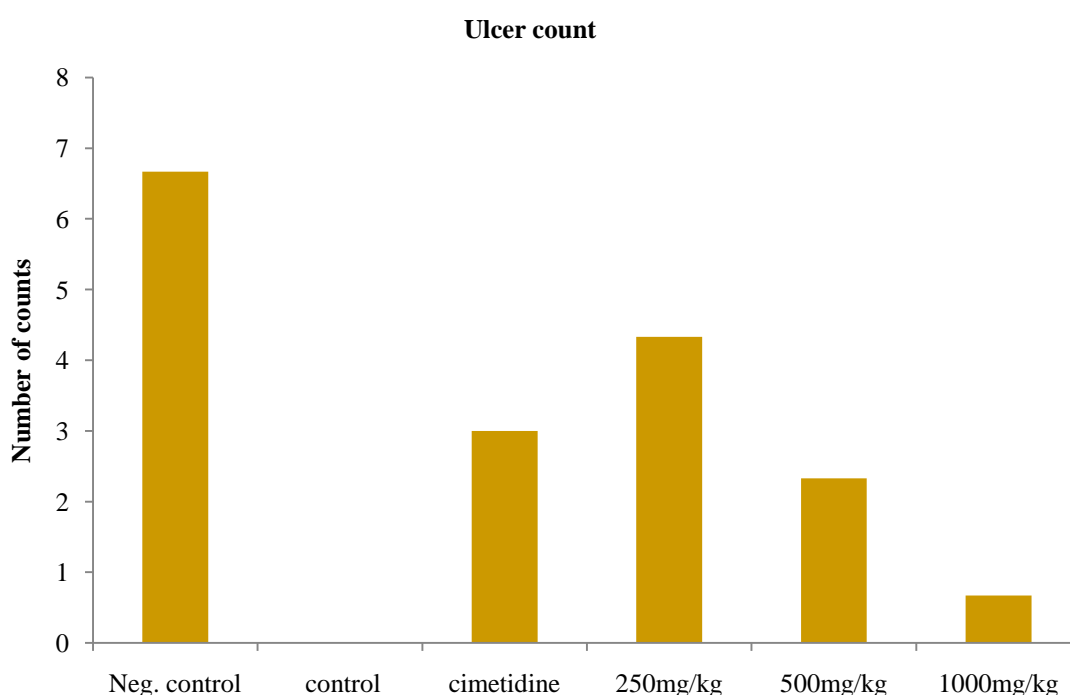


Figure 2: Effect of Sida acuta on ulcer counts in post treated Wistar rats

Effect of Sida Acuta. on Immunoglobulins Levels in post-treated animals

For the post-treated Wistar rats, the results for immunoglobulin E (IgE) are presented in figures 3 and table 3, while those for IgG, IgA, IgM, and IgD are presented in table 4 and table 7 for the post- and pre-treatment, respectively. At the dose of 1000 mg/kg when compared to the negative control (12.00±0.58) and all other groups except cimetidine (1.67±0.28), it was observed that the extract exhibited a significantly reduced IgE (1.73±0.15).

For immunoglobulin G (IgG), the normal control showed the highest level (10.58±0.05) and this was significantly higher than all the other groups. For IgA, IgM and IgD, a similar pattern was also observed. The animals that were treated with a dose of 1000mg/kg of Sida acuta also had high levels of immunoglobulins. This demonstrated that both Cimetidine and Sida acuta dosed at 1000 mg/kg normalised the immunoglobulin levels, particularly Ig E further highlighting the significant immunomodulatory effects of Sida acuta.

Table 3: Effect of Sida Acuta. on Immunoglobulins Levels in post-treated animals

Groups	IgG (g/l)	IgE (UI/ml)	IgA (g/l)	IgM (g/l)	IgD (mg/l)
Neg. control	5.17±0.04	12.00±0.58	0.80±0.12	0.98±0.05	1.22±0.01
Normal Cont.	10.58±0.05	4.77±0.04	3.13±0.02	3.42±0.04	3.64±0.02
Cimetidine	4.60±0.31	1.67±0.28	2.80±0.20	1.64±0.08	3.47±0.18
250mg/kg	3.30±0.15	2.80±0.20	2.43±0.30	2.13±0.13	2.35±0.17
500mg/kg	4.40±0.23	2.40±0.25	2.93±0.29	2.40±0.21	2.77±0.27
1000mg/kg	5.73±0.33	1.73±0.15	3.50±0.35	2.80±0.20	3.30±0.15

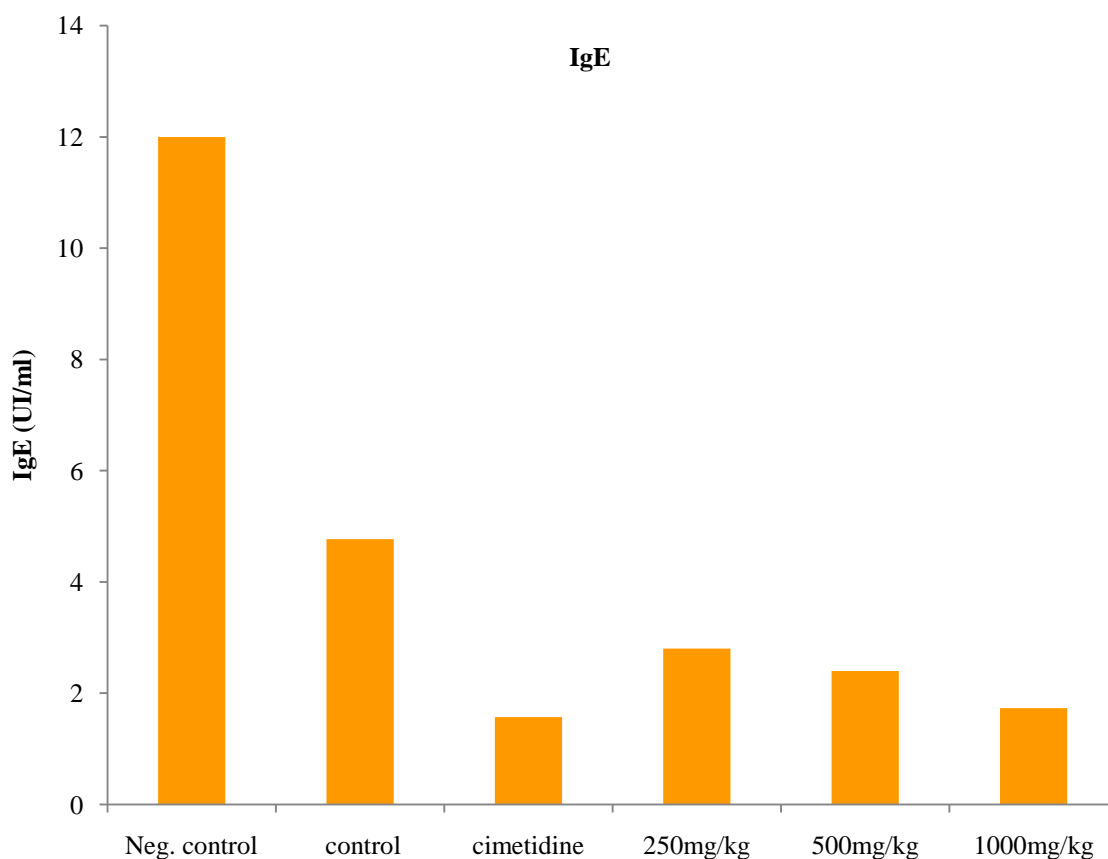


Figure 3: Effect of Sida acuta on immunoglobulin E (IgE) level in post treated Wistar rats

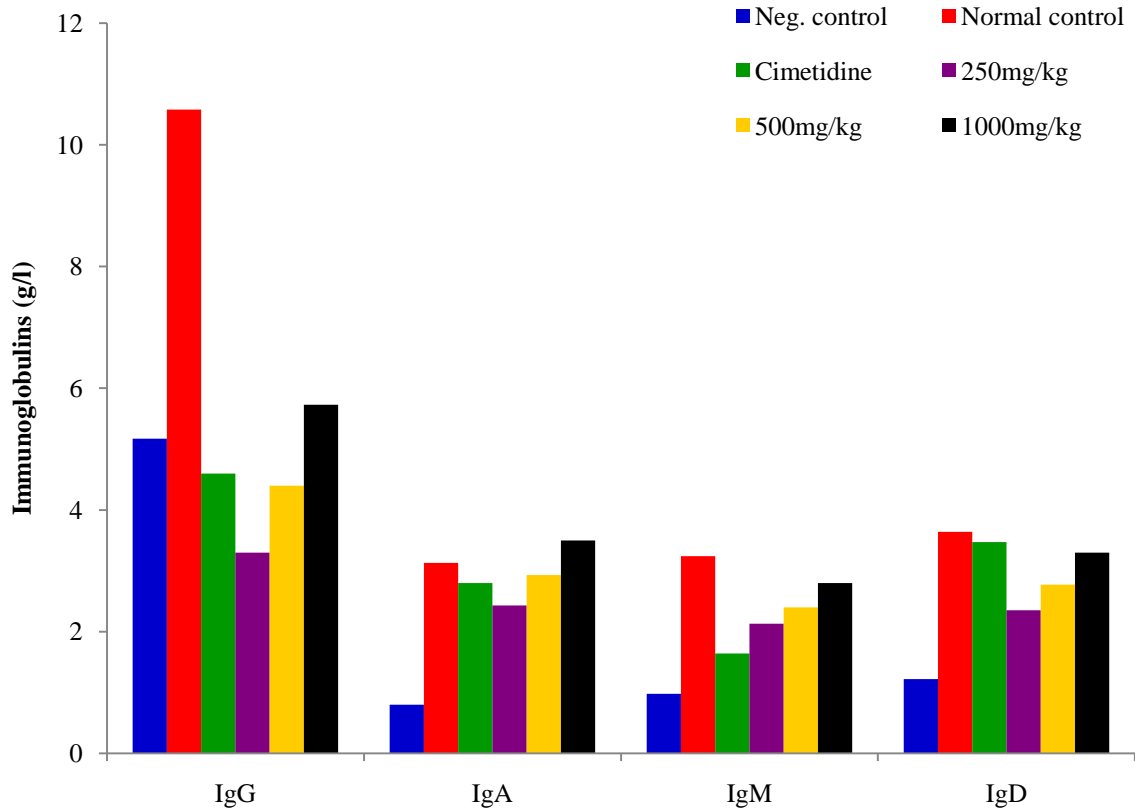


Figure 4: Effect of *Sida acuta* on immunoglobulin levels in post treated Wistar rats

Effect of *Sida Acuta*. on ulcer counts in pre-treated animals

Table 4: Effect of *Sida Acuta*. on ulcer counts in pre-treated animals

Groups	Ulcer count
Neg. control	6.67±0.88
Normal Control	0.00±0.00
Cimetidine	2.67±0.67
250mg/kg	4.00±0.58
500mg/kg	2.00±0.58
1000mg/kg	0.33±0.33

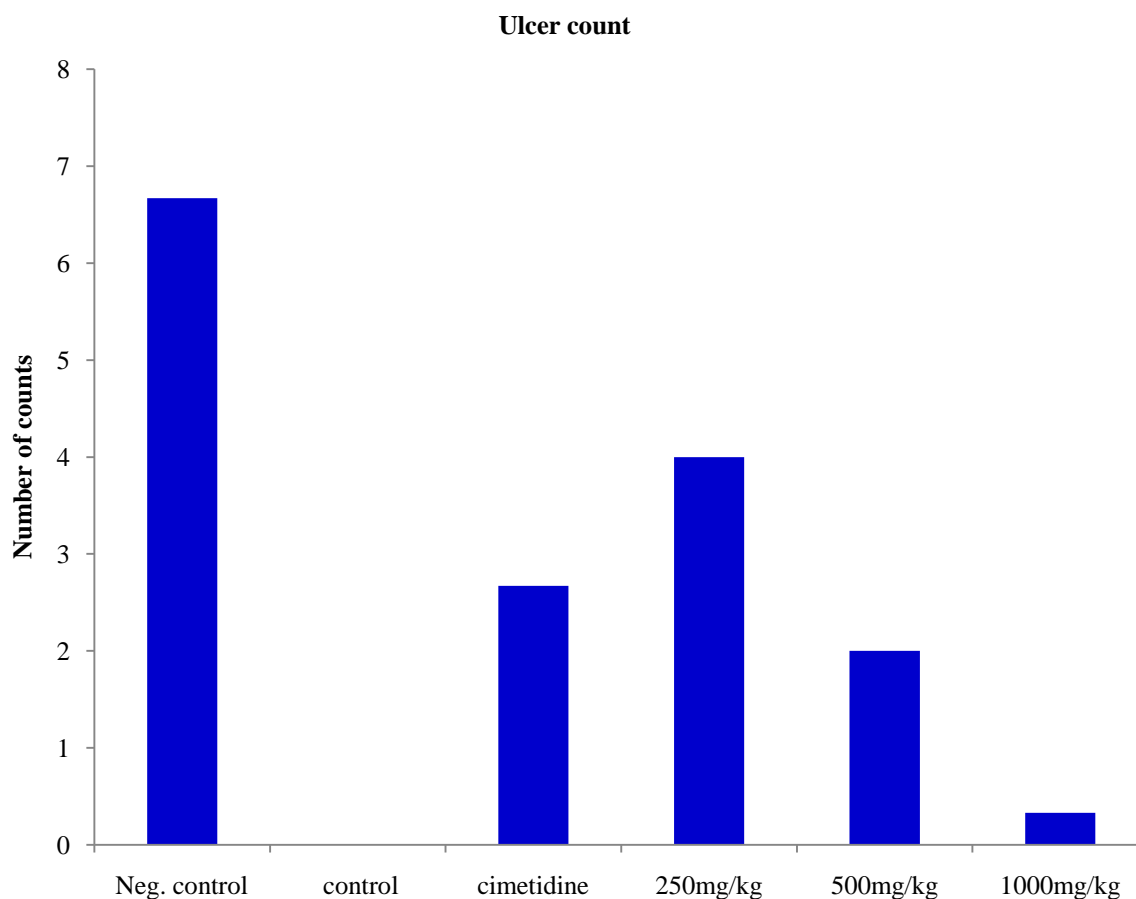


Figure 5: Effect of *Sida acuta* on ulcer counts in pre-treated Wistar rats

Table 5: Effect of *Sida Acuta*. on Immunoglobulins levels in pre-treated animals

Groups	IgG (g/l)	IgE (UI/ml)	IgA (g/l)	IgM (g/l)	IgD (mg/l)
Neg. control	5.17±0.04	12.00±0.58	0.80±0.12	0.98±0.05	1.22±0.01
Normal Cont.	10.58±0.05	4.77±0.04	3.13±0.02	3.42±0.04	3.64±0.02
Cimetidine	4.67±0.33	1.97±0.03	2.93±0.07	1.71±0.15	3.13±0.18
250mg/kg	3.50±0.29	3.13±0.47	2.60±0.31	2.33±0.33	2.45±0.24
500mg/kg	4.73±0.18	2.27±0.12	2.73±0.18	2.57±0.30	2.97±0.20
1000mg/kg	6.03±0.09	1.57±0.07	3.37±0.22	3.07±0.41	3.50±0.15

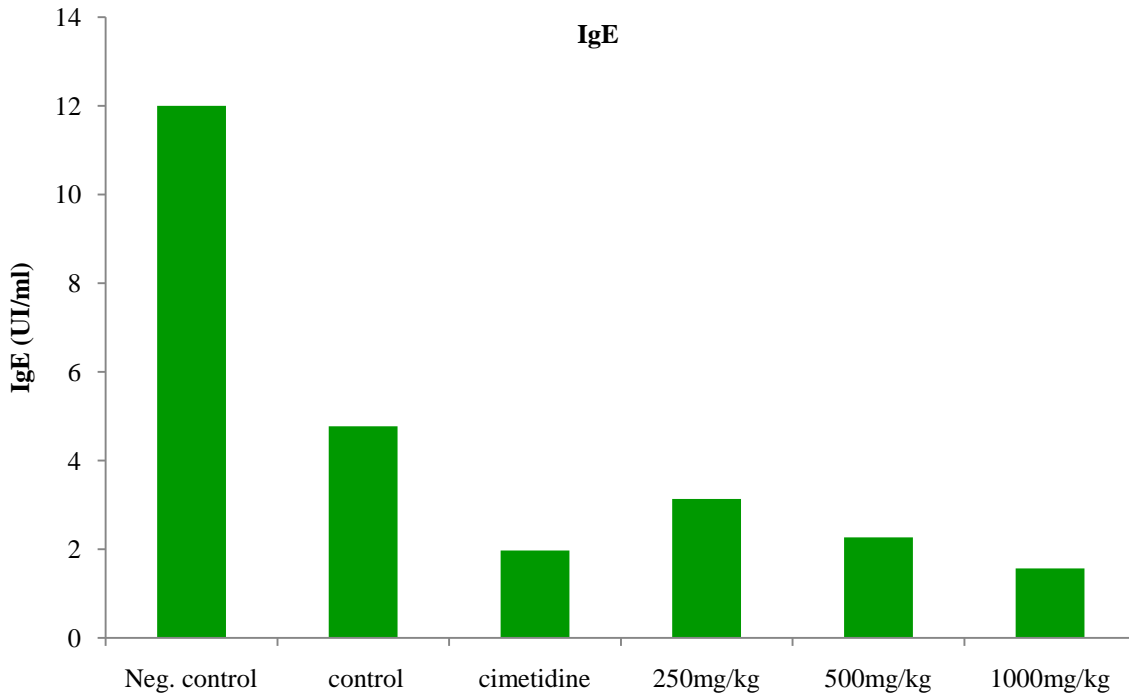


Figure 6: Effect of *Sida acuta* on immunoglobulin E level in pre-treated Wistar rats

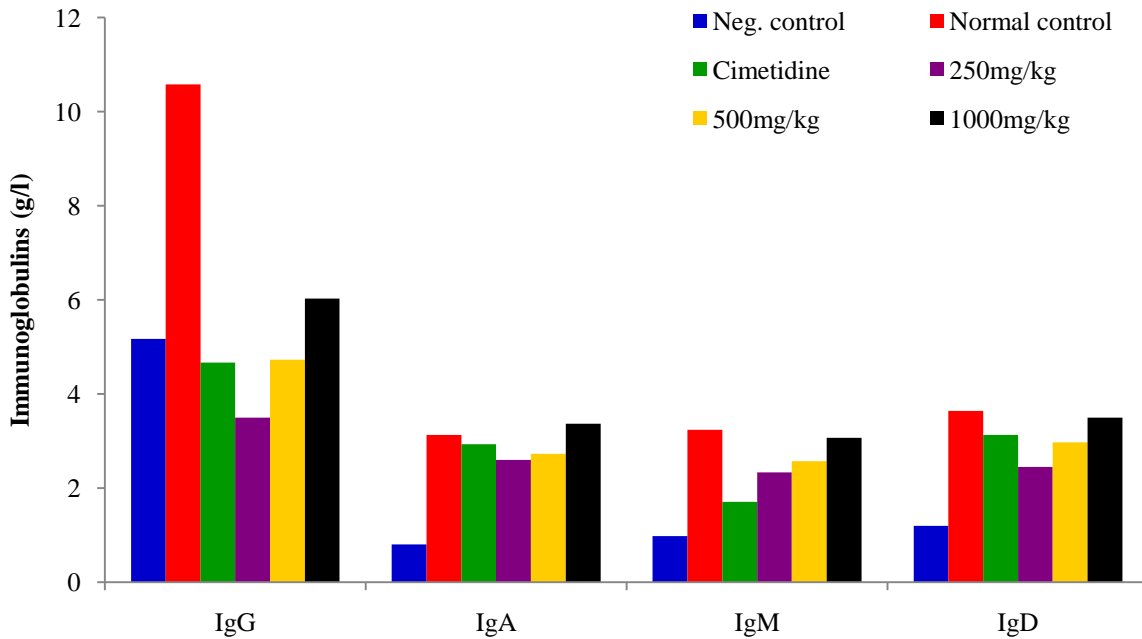


Figure 7: Effect of *Sida acuta* on immunoglobulin levels in pre-treated Wistar rats

Histological Analysis Post Treatment

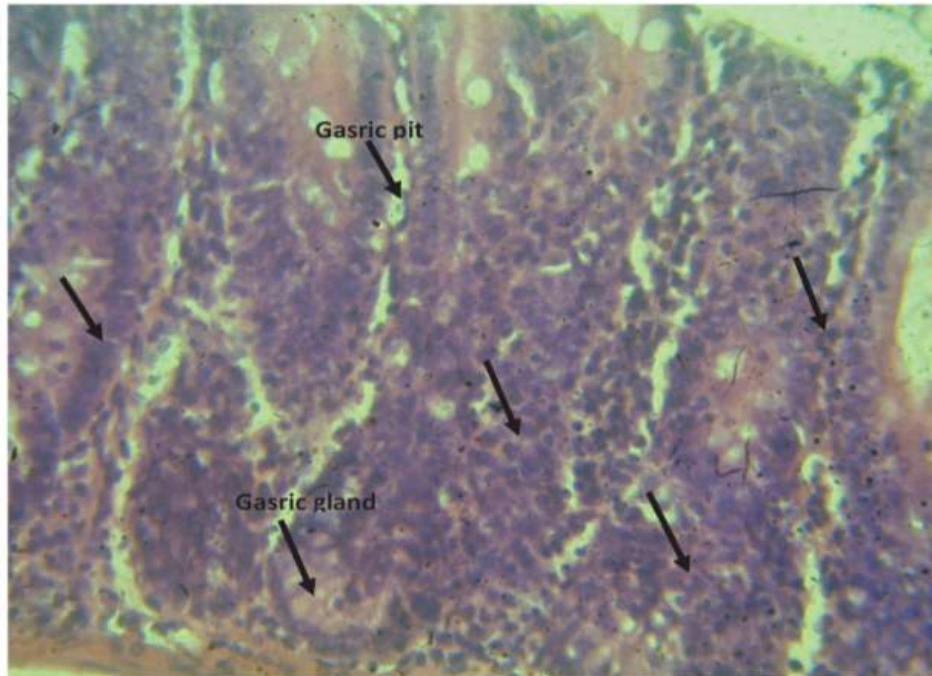


Plate 1: the histological representation of the low dose group (0.9mL/kg of sida acuta extract)

Photomicrograph (H&E X400) of the basal layer of the stomach showing reduced multifocal inflammatory activities with necrotic

features of the parietal cells within the propria (arrows)

Diagnosis: Inflammation of the Mucosa wall distortion

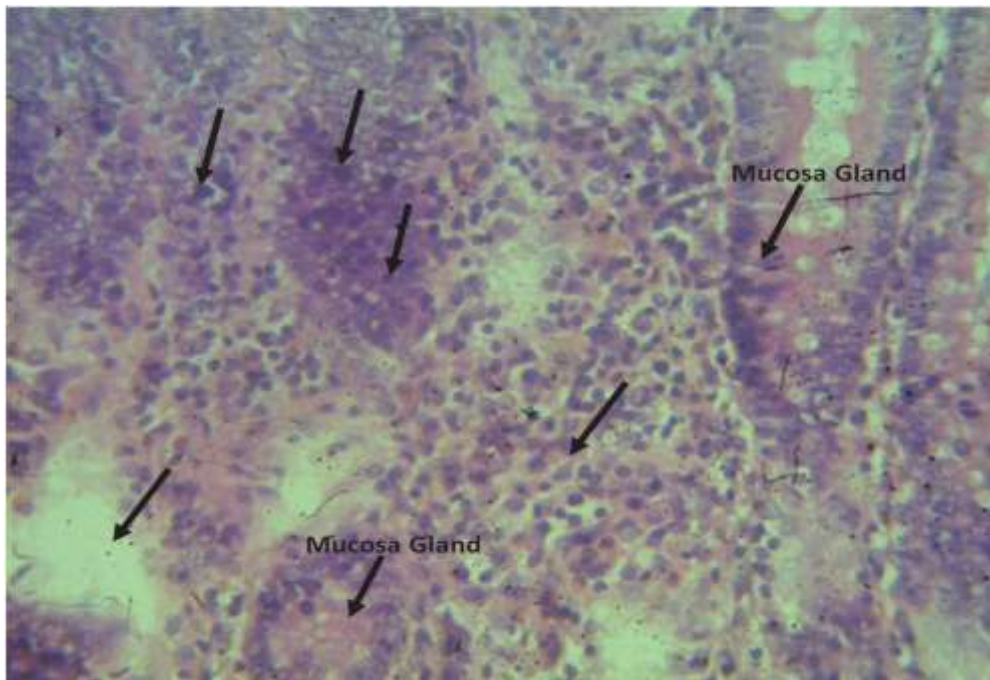


Plate 2: the histological representation of the medium dose group (1.8mL/kg of sida acuta extract)

Photomicrograph (H&E X400) of the basal layer of the stomach with reduced focal inflammatory activities with necrotic features of the parietal cells within the propria (arrows)

Diagnosis: Reduced Inflammation and distortion of the mucosa wall

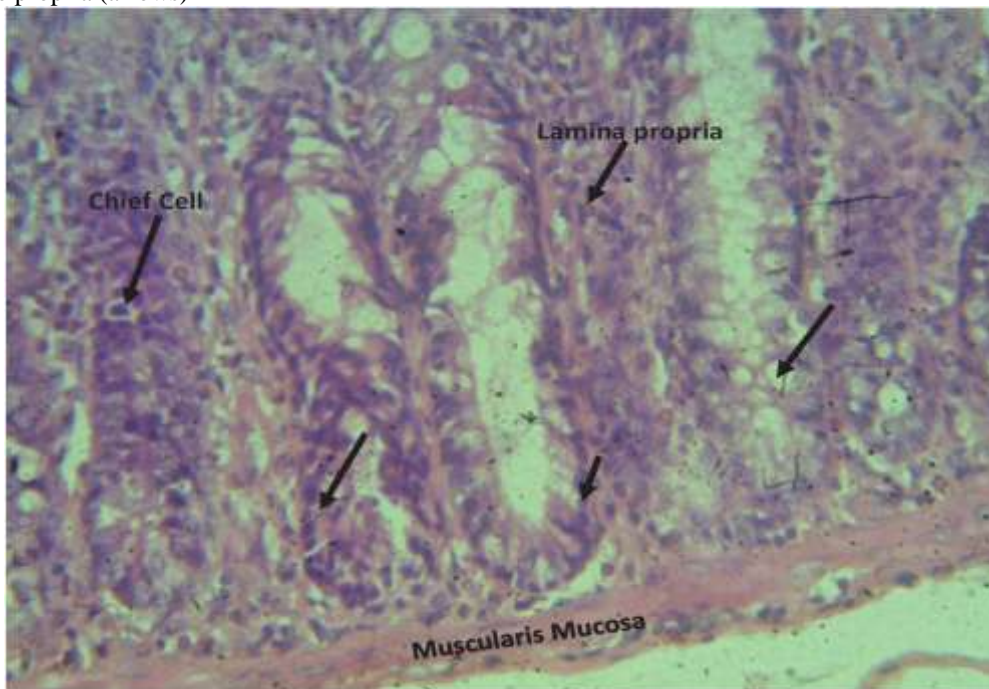


Plate 3: the histological representation of the high dose group (3.6mL/kg of sida acuta extract)

Photomicrograph (H&E X400) of the stomach showing mild distortion of mucosal wall of the stomach with no observable necrotic features.

Diagnosis: Mild distortion of the stomach tissue

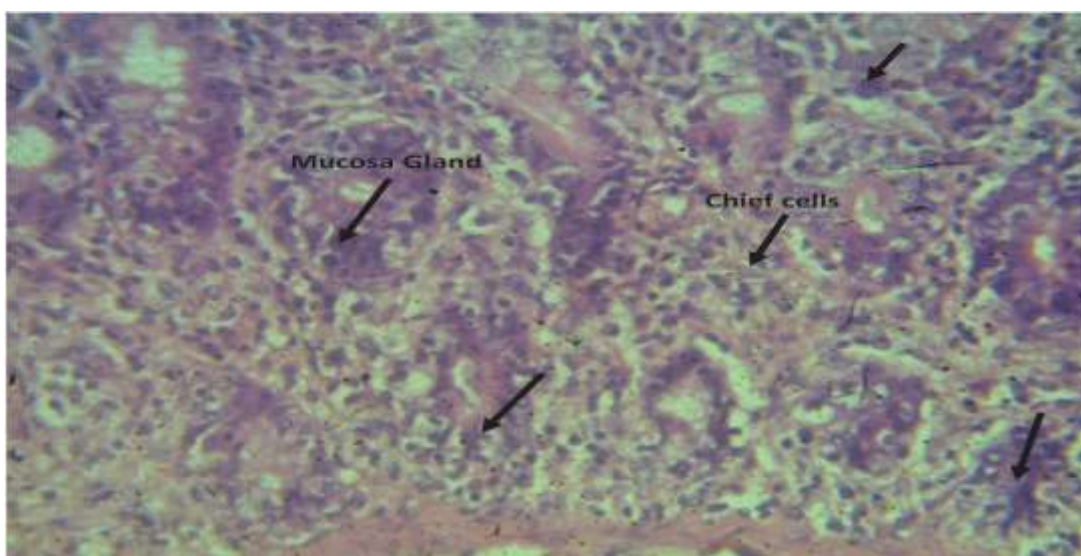


Plate 4: the histological representation of the positive control group (0.25mL/kg of the standard drug, Cimetidine)

Photomicrograph (H&E X400) of the stomach showing mild disruption of mucosal wall of the

stomach with reduced inflammatory cell activities (arrows).

Diagnosis: Mild distortion of the stomach tissue

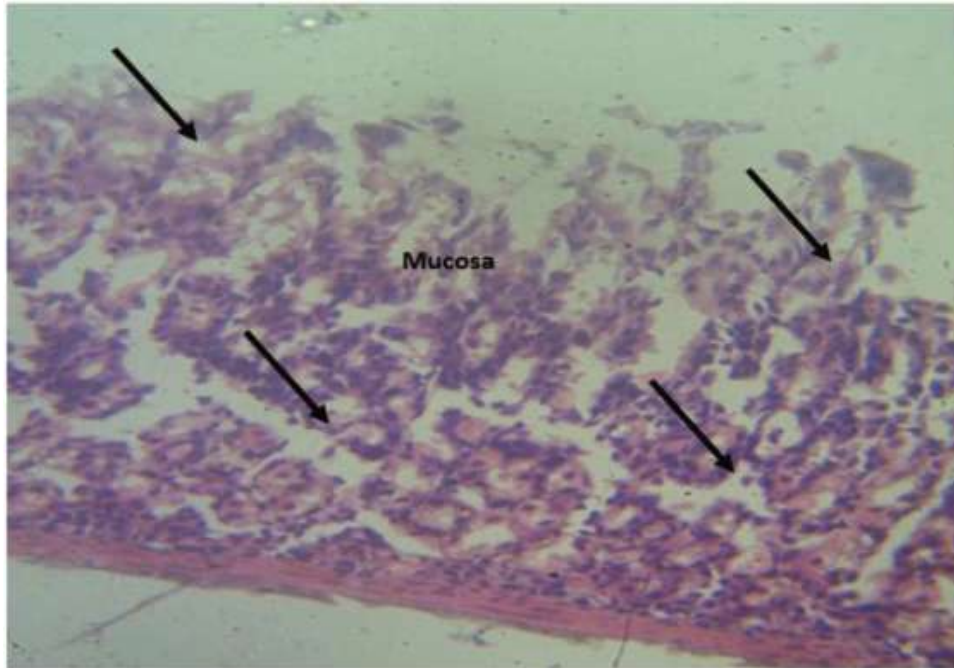


Plate 5: the histological representation of the negative control group

Photomicrograph (H&E X400) of the superficial region of the stomach showing severe multifocal disruption of the mucosal glands and cells (arrows).

Diagnosis: Severe distortion of the mucosa wall.

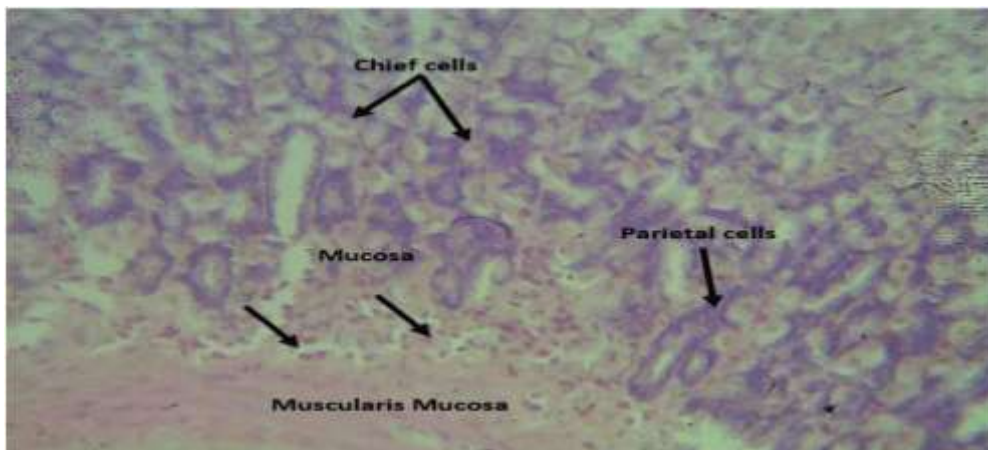


Plate 6: the histological representation of the normal control group

Photomicrograph (H&E X400) of the basal region of the stomach showing mucosal gland cells with minimal hemorrhagic deposit (arrows).

Diagnosis: stomach appears normal with minimal.

Pre-Treatment Phase

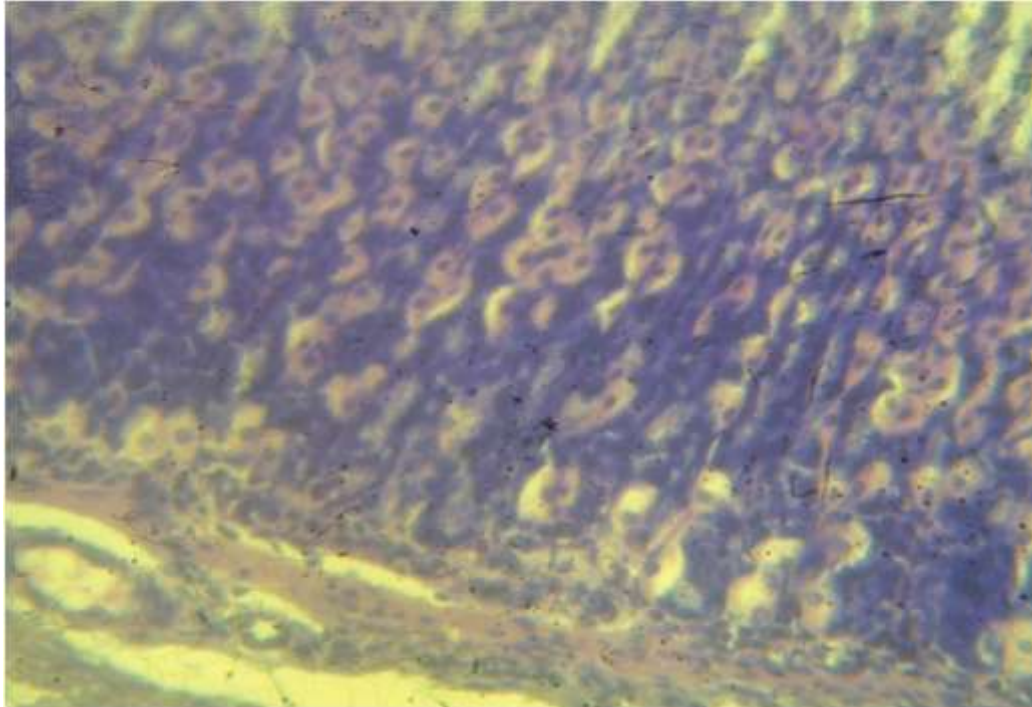


Plate 7: low dose

Photomicrograph (H&E X400) of the stomach showing basal region with inflammatory activities within the mucosal wall (arrows).

Diagnosis: Inflammation and degeneration of the stomach tissue.

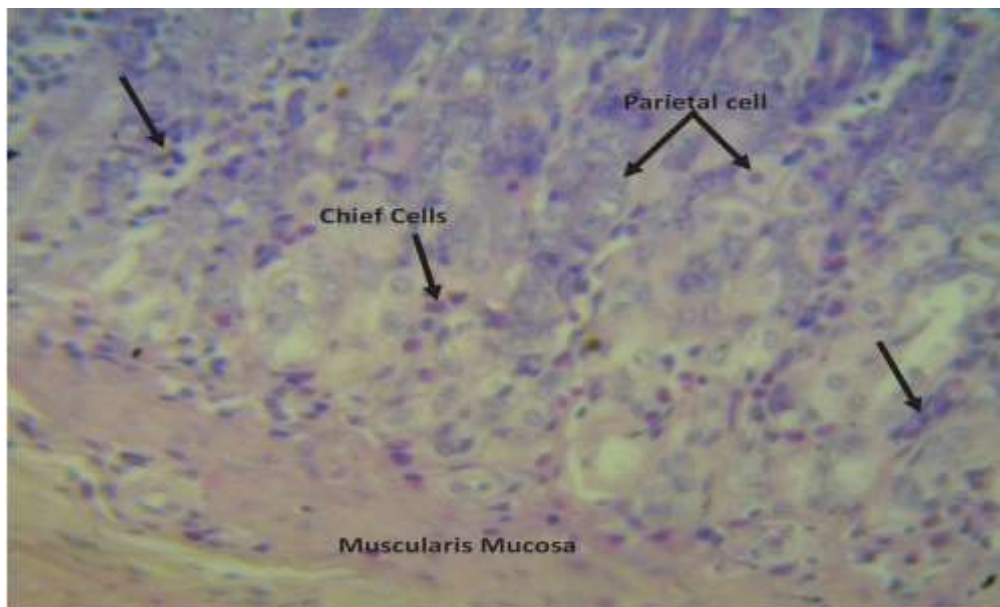


Plate 8: medium dose

Photomicrograph (H&E x400) of the glandular stomach showing moderate epithelial cell

Inflammation with no observable mucosal wall disruption (arrows).

Diagnosis: Moderate inflammation of the stomach tissue

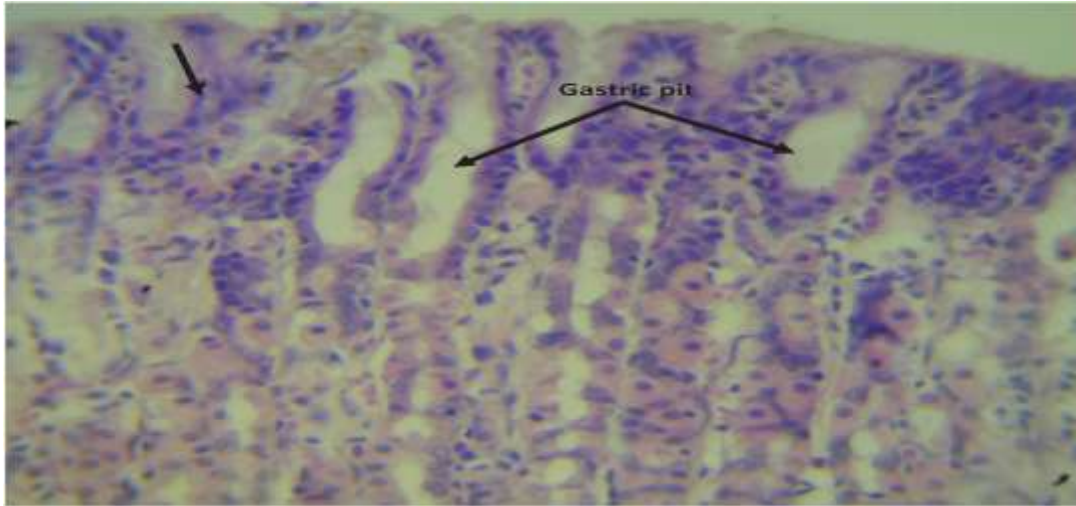


Plate 9: high dose

Photomicrograph (H&E x400) of the glandular stomach showing columnar epithelial cell, gastric pit and parietal cells with no observable epithelial cell Inflammation (arrows)

Diagnosis: Normal Appearance of the stomach tissue

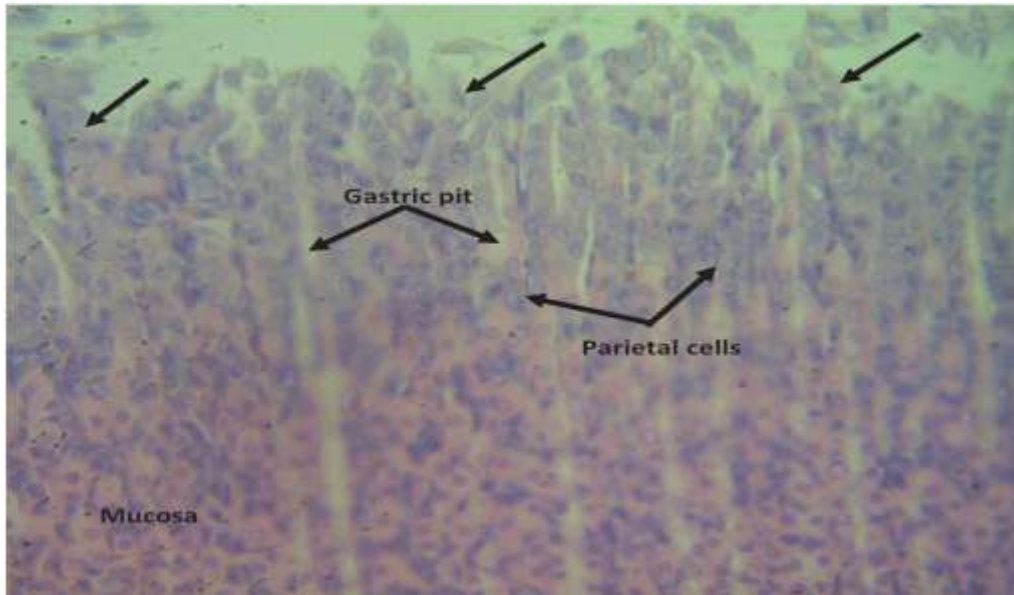


Plate 10: Positive Control [Standard drug]

Photomicrograph (H&E X400) of the stomach with mild distortion of the surface epithelium (arrows) and degeneration of the parietal cells of the mucosa

Diagnosis: mild distortion of the stomach mucosa.

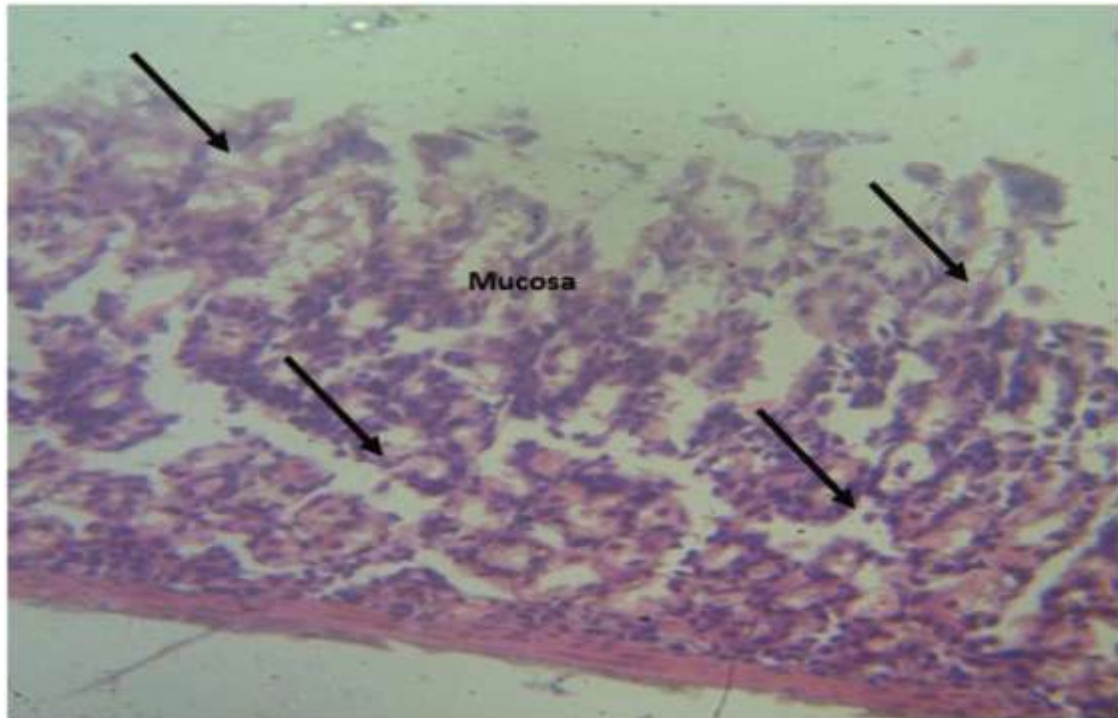


Plate 11: Negative Control

Photomicrograph (H&E X400) of the superficial region of the stomach showing severe multifocal disruption of the mucosal glands and cells (arrows).

Diagnosis: Severe distortion of the mucosa wall.

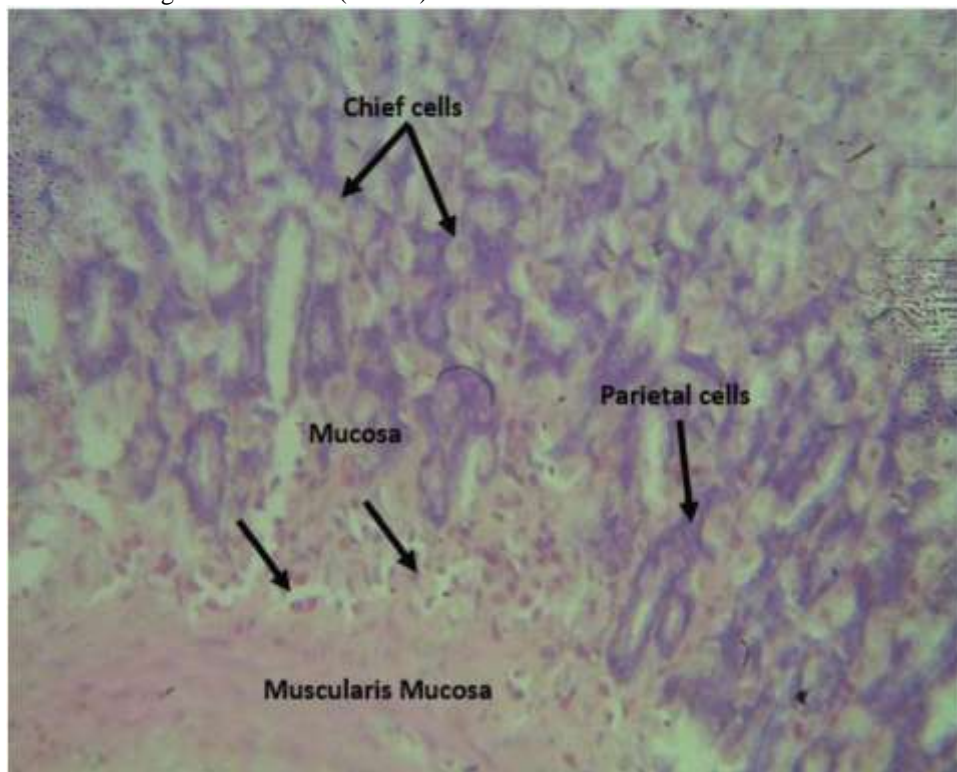


Plate 12: Normal Control

Photomicrograph (H&E X400) of the basal region of the stomach showing mucosal gland cells with minimal hemorrhagic deposit (arrows).

Diagnosis: Stomach appears normal with minimal.

IV. DISCUSSION

The study evaluated the effects of *Sida Acuta* on indomethacin-induced gastric ulcers in Wistar rats, focusing on ulcer counts, immunoglobulin levels, and histological changes. High doses of *Sida acuta* (1000mg/kg) demonstrated significant efficacy in reducing ulcer counts in both pre-treatment and post-treatment phases, exceeding the standard ulcer drug, Cimetidine. In the post-treatment phase, the ulcer count decreased to 0.67 ± 0.33 with *Sida acuta*, compared to 3.00 ± 0.58 for cimetidine. Similarly, in the pre-treatment phase, the high dose reduced ulcers to 0.33 ± 0.33 , emphasising its preventive and curative potential. Immunoglobulin study demonstrated that *Sida acuta* modulated immunological responses, especially at high doses. Post-treatment levels of IgG, IgA, and IgM improved significantly, approaching normal control levels, while pre-treatment results showed enhanced mucosal immunity, suggesting the extract's role in fortifying the gastric mucosa before injury. Histological analysis validated these findings, showing reduced inflammation, preserved gastric tissue integrity, and the absence of necrosis in high-dose groups. In contrast, negative controls exhibited severe mucosal disruption.

The findings indicate that *Sida Acuta* extract was effective in lowering the ulcer count in all study groups, demonstrating both preventive and therapeutic effects. The effects on immunoglobulin modulation varied by dose across the sample, with higher doses resulting in improved recovery and activation of immunological markers. Overall, ulcer treatment with *Sida Acuta* extract had an immunomodulatory effect, improving immune function but not completely normalising it.

V. CONCLUSION

Sida acuta demonstrates strong anti-ulcer properties, with high doses effectively preventing and treating NSAID-induced gastric ulcers by reducing ulcer severity, enhancing mucosal immunity, and preserving gastric tissue. It holds promise as a natural alternative to conventional treatments, warranting further research to explore its clinical potential.

VI. RECOMMENDATION

Further studies, including clinical trials in human subjects, are recommended to validate the efficacy and safety of *Sida acuta* extract. Research should focus on isolating the bioactive compounds responsible for its therapeutic effects, exploring the specific mechanisms of action, and determining the optimal dosing strategy for maximising benefits while minimising risks.

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