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Effect of *Bryophyllumpinnatum*on Indomethacin Induced Gastric Ulcer in Wistar Rats

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ABSTRACT
Bryophyllumpinnatum commonly known as Miracle Leaf belongs to the family of Crassulaceae. It has been widely used as a traditional medicine for the treatment of various ailments, including gastrointestinal disorder.This study evaluated the effects of *Bryophyllumpinnatum* (Miracle Leaf) on indomethacin-induced gastric ulcers in Wistar rats, focusing on ulcer counts, immunoglobulin levels, and histopathologicalchanges. A total of fifty-two rats were used for the study and were divided into pre-treatment and post-treatment groups, both having six subgroups. Each group received aqueous *Bryophyllumpinnatum* extract as follows; low dose (250 mg/kg), medium dose (500 mg/kg), high dose (1000 mg/kg), Rabeprazole for the positive control and distilled water for the negative control.Results showed that *Bryophyllumpinnatum* significantly reduced ulcer counts in both pre-treated and post-treated groups in a dose-dependent manner, with the high dose (1000mg/kg) achieving the lowest ulcer count for pre-treatment and post-treatment surpassing Rabeprazole. Immunoglobulin analysis revealed significant modulation, with reductions in iimmunoglobulin E (IgE) levels and normalization of IgG, IgA, IgM, and IgD levels, particularly at the highest dose.These findings suggest that *Bryophyllumpinnatum* possess ulcer healing properties.

Key Words: *Bryophyllumpinnatum*, indomethacin, gastric ulcers, immunoglobulin analysis

I. INTRODUCTION

Gastric ulcer represents a significant gastrointestinal condition characterized by the development of open sores on the inner lining of the stomach. Gastric ulcers are often the result of a breakdown in the mucosal barrier that normally protects the stomach from its own acidic environment [1]. This breakdown leads to ulcer formation when aggressive factors, such as stomach acid and pepsin, outweigh the protective factors, such as mucus and bicarbonate secretion leading to bleeding, perforation, and an increased risk of gastric cancer.According to a study by [2], the lifetime prevalence of peptic ulcer disease is estimated to be around 5-10%, with gastric ulcers accounting for a significant proportion of these cases. Type I ulcers are the most common, often associated with low or normal levels of gastric acid secretion [1]. Unlike other types of gastric ulcers, Type I ulcers are not usually related to hypersecretory conditions (conditions that cause excessive acid production) [3]. The primary cause of Type I ulcers is thought to be chronic gastritis, particularly atrophic gastritis, which leads to a breakdown of the mucosal barrier [4]. This barrier normally protects the stomach lining from the erosive effects of gastric acid and pepsin. Infection with Helicobacter Pylori (H. pylori), a gram-negative bacterium, is also a significant contributing factor for Type I ulcers [5]. Helicobacter pylori colonize the stomach lining and causes chronic inflammation, leading to mucosal damage and ulcer formation [6]. Additionally, these ulcers are often associated with long-term use of NSAIDs, which can inhibit the production of protective prostaglandins in the stomach mucosa [7].Type II ulcers typically coexist with duodenal ulcers [8]. They are generally associated with hypersecretion of gastric acid and are more likely to occur in patients with conditions that lead to increased gastric acid production, such as Zollinger-Ellison syndrome, a rare disorder characterized by gastrin-secreting tumors (gastrinomas) that cause excessive gastric acid secretion [1]. Type III ulcers are located in the prepyloric region, near the pylorus, which is the opening from the stomach into the duodenum [2]. Like Type II ulcers, Type III ulcers are also associated with increased gastric acid secretion. [2].These ulcers are often induced by NSAIDs use, which inhibit cyclo-oxygenase (COX) enzymes and reduces the production of protective prostaglandins that help maintain the integrity of the gastric mucosal barrier [1]. Unlike Type II and Type III ulcers, Type IV ulcers are not typically associated with increased acid secretion [1]. Instead, they are more likely to occur in the presence of low acid output and are often linked to chronic gastritis or conditions that cause ischemia (reduced blood flow) to the gastric mucosa [1].Type V ulcers are drug-induced ulcers, commonly associated with the use of NSAIDs or corticosteroids [9]. Type V ulcers can occur anywhere in the stomach and are characterized by their association with medication use rather than a specific location or level of acid secretion[2]. One of the major causes of gastric ulcers is the use of NSAIDs such as indomethacin [10]. Indomethacin is frequently prescribed for its anti-inflammatory and analgesic effects, but its use is often associated with adverse gastrointestinal effects, including the development of gastric ulcers [11]. This occurs primarily due to the drug's inhibition of COX enzymes, leading to decreased production of protective prostaglandins in the gastric mucosa [12]. These protective prostaglandins play a crucial role in maintaining mucosal integrity and stimulating mucus and bicarbonate secretion [11].The induction of gastric ulcers by indomethacin poses a significant problem in clinical settings, as these ulcers can lead to serious complications. The traditional management of NSAID-induced gastric ulcers includes the use of proton pump inhibitors (PPIs) and H2-receptor antagonists [13]. However, these treatments may not always be fully effective or may have side effects of their own [14]. Consequently, there is an ongoing need to explore alternative therapeutic options that are both effective and have fewer side effects. *Bryophyllumpinnatum,* commonly known as miracle leaf, is a plant reputed in traditional medicine for its potential therapeutic properties, including its ability to treat gastrointestinal disorders [15]. The plant is believed to possess anti-inflammatory, antioxidant, and mucosal protective properties, which might counteract the adverse effects of NSAIDs on the gastric mucosa [16]. Previous studies suggest that Miracle Leaf possesses compounds such as flavonoids, tannins, quercertin,terpenoids, steriods, organic acids and glycosides, which may contribute to its gastro-protective properties by enhancing the mucosal defense system or reducing oxidative stress in gastric tissues [17]. This study aims to fill the gap in knowledge regarding the potential of Miracle Leaf as a gastro-protective agent, especially against indomethacin-induced gastric ulcers. Additionally, understanding the gastro-protective mechanisms of Miracle Leaf could lead to the development of novel therapeutic agents derived from natural sources. The use of plant-based therapies is gaining traction due to their potential benefits, including fewer side effects, reduced costs, and the availability of natural resources.Despite these claims, there is a significant gap in scientific research evaluating the efficacy of Miracle leaf in managing indomethacin-induced gastric ulcers and if found to be effective, it could be developed into a new, safer treatment option for patients who are at high risk of developing gastric ulcers due to long-term NSAID use. This would not only broaden the range of available treatments but also support the integration of traditional medicine into modern healthcare practices [18] and pave the way for further research into the synergistic effects of combining natural and synthetic agents to enhance therapeutic efficacy and safety [19]. Also, the findings from this study could be the basis for future clinical trials in humans, thereby accelerating the transition from bench to bedside [20].

II. MATERIALS AND METHODS

All experiments were carried out following a carefully crafted protocol adhering to good laboratory practices. The recommended quality standards for biomedical research were acknowledged and implemented.

Procurement of Experimental Animals

The animals were gotten from the University of Port-Harcourt laboratory animal house, known for adhering to 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 between 40-60%, and a 12-hour light/dark cycle. The housing consisted of a polypropylene cage with sawdust bedding, which was changed regularly to maintain hygiene. A standard rodent diet and water was provided daily. The animals underwent an acclimatization period of at least one week before the start of the experiment to allow them to adjust to their new surroundings, thereby minimizing stress and ensuring reliable experimental outcomes.

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Source and Identification of Plant Material

The *Bryophyllumpinnatum* leaves used in this study were sourced from Rumuji Town in Rivers state, Nigeria, which is characterized by a mix of lowland and swampy terrains, with rich, fertile soil conducive to the growth of a variety of tropical plants. The natural vegetation in the area is lush, supporting diverse plant species, including medicinal plants like *Bryophyllumpinnatum*. The leaves were collected during rainy season, ensuring optimal medical potency and freshness.Upon collection, the leaves were carefully transported to the Plant Science and Biotechnology laboratory for authentication. A qualified botanist conducted the authentication process, which involved examining the morphological characteristics of the leaves, such as leaf shape, size, color, and texture. Additionally, a sample was compared to a herbarium specimen to ensure correct identification. The authenticated leaves were then processed and stored appropriately for further use.

Method of Extraction of Plant Parts

The freshly collected *Bryophyllumpinnatum* leaves were initially washed thoroughly with distilled water to remove any dirt, dust, or contaminants. After washing, the leaves were left to air dry at room temperature on a clean surface, ensuring they were free from excess water but still retained their natural moisture.Oncedried, the leaves were manually squeezed and sieved to extract the liquid directly from the leaf chaff. This method helps in obtaining the plant's juice, without using excessive heat or mechanical processes that might degrade sensitive compounds.The extracted liquid was immediately filtered through a fine mesh to remove any solid particles. To preserve the phytochemical integrity of the plant material, the extracted liquid was stored in clean, airtight container. The containers were labeled and then kept in a refrigerator at a temperature of approximately 4°C. This storage condition helps in maintaining the stability of the bioactive compounds, preventing microbial growth and enzymatic degradation that could compromise the quality and potency of the extract.

Figure 1: Photograph of *Bryophyllumpinnatum*Leaf

Method of Determination of Plant Extract Concentration

In this process, a crucible (an evaporating dish) kept at room temperature was weighed using a G&G electronic weighing scale and its weight noted to be 52.96g. One ml of the aqueous *Bryophyllumpinnatum* leaf extract was placed into the crucible and was placed over a warm beaker of water on a hot plate set at 40^{o}C.The content of the dish was allowed to evaporate to dryness and was allowed to cool back to room temperature. Its content and the crucible were weighed again and their weight noted to be 53.10g. The weight of the extract in the crucible was determined by subtracting the weight of the crucible from the weight of the crucible plus weight of extract as shown below:

Table 1: Shows the determination of the extract concentration

Weight Determination	*Bryophyllumpinnatum* leaf extract
Weight of Dish+ Dry extract	53.10g
Weight of Dish	52.96g
Weight Difference	0.04g
Weight in mg	**0.04x1000 = 40mg**

Since the volume of the extract used was 1 ml, it implies that the concentration of the extract is 40mg/ml.

Oral Toxicity Testing (LD_{50} Determination)

In this study, Bruce, method of 1985 was employed in determining the LD_{50}, with all the animals used weighing 200g [21]. With this method, a nulliparous and non-pregnant female Wistar rat, fasted overnight (food but not water was withheld) prior to dosing, was orally given a single dose by gavage using a suitable stomach intubation cannula, starting with a dose of 120.5mg/kg of the aqueous *Bryophyllumpinnatum* leaf extract (i.e. 24.1mg/200g or 0.6025ml/200g of the extract). The female specie was chosen in order to reduce variability and as a means of minimizing the number of animals used. After the aqueous *Bryophyllumpinnatum* leaf extract was administered, food was still withheld for a further 3-4 hours. The animal was observed for death for a period of 48 hours. This dose was chosen since there was no knowledge of the probable toxicity of the extract. At this dose, no death was observed. Since no death was observed, the dose for the next animal was increased by a factor of one half log times the original 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 77.12mg/200g of the extract. The animal was again observed carefully for up to 48 hours before making a decision on whether and how much to dose the next animal, and still there was no death. The process of progressive increment was continued with the following doses of 1233.92mg/kg or 246.784mg/200g extract. Again, another animal was treated with 3948.48mg/kg or 789.7088mg/200g of the aqueous extract**,** and was again observed for 48 hours still there was no death observed. The dose was increased to 5000mg/kg, since it is scientifically accepted that a substance is said to be non-toxic at a dose of 5000mg/kg. Thus 5000mg/kg or 1000mg/200g, was administered and there was still no death observed. This lack of toxicity was confirmed by administering this last dose to three other animals, and still no death was observed in any of them. It therefore implies that the aqueous *Bryophyllumpinnatum* leaf extract is safe at 5000mg/kg, using this method of LD_{50} determination. Where death occurs, the LD_{50} 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 LD_{50} is determined from the formula
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.

Study Design

The study was structured into several experimental groups to access the therapeutic potential of the plant extract against indomethacin induced gastric ulcer in Wister rats. A total of 44 animals were involved in the study.8 of them was used for the LD50 test, leaving 36 animals for the main study. These 36 were then split into two main categories: pre-treatment and post-treatment, with each category further divided into 6 subgroups, consisting of 3 animals per group.For the pre and post-treatment groups, group 1 received low dose of extract; group 2 received medium dose of extract; group 3received high dose of extract; group 4 received standard drug (Rabeprazole); group 5 received no drug treatment (negative control), while group 6 received distilled water (normal control).

Method of Carrying out theStudy

In the post-treatment group, the animals were fasted and subjected to gastric ulcer induction for 24 hours with indomethacin at a dose of 600mg/70kgbefore treatment began. The treatments were administered as follows: the low dose group received 250mg/kg; the medium dose group received 500mg/kg; the high dose group received 1000mg/kg; the positive control group received 400 mg/70kg of rabeprazole; the negative control group was induced with ulcers and received no treatment, while animals in normal control group received no induction but were given distilled water. The treatment period lasted for one week, after which the animals were euthanized. Ulcers were counted; blood samples were collected for immunoglobulins level evaluation, and stomach tissues were taken for histopathological studies. For the pre-treatment group, the same dosage schedule as described above was administered for a period of one week before the animals were exposed to indomethacin according to the scheduled groups for a period of 24 hours and thereafter, the animals were anaesthetized and blood samples collected as above as well as stomach tissue. The blood samples were collected into EDTA tubes, and stomach tissues were preserved in universal containers containing 10% formalin for pathohistogical evaluation.

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RESULTS

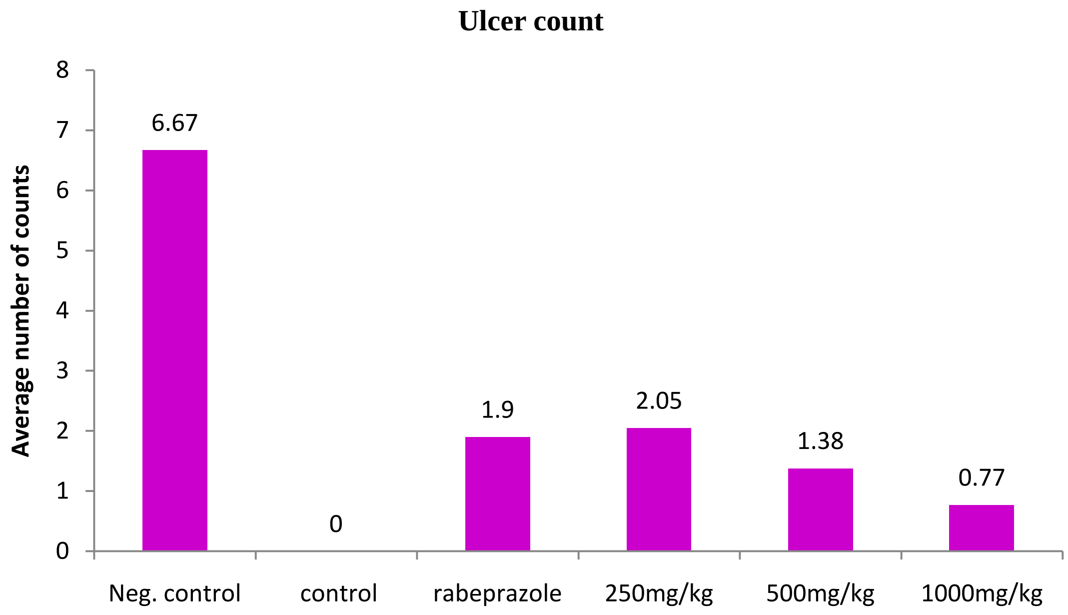

Figure 2: Effect of Bryophyllum pinnatum leaf extract on ulcer counts in post treated Wistar rats

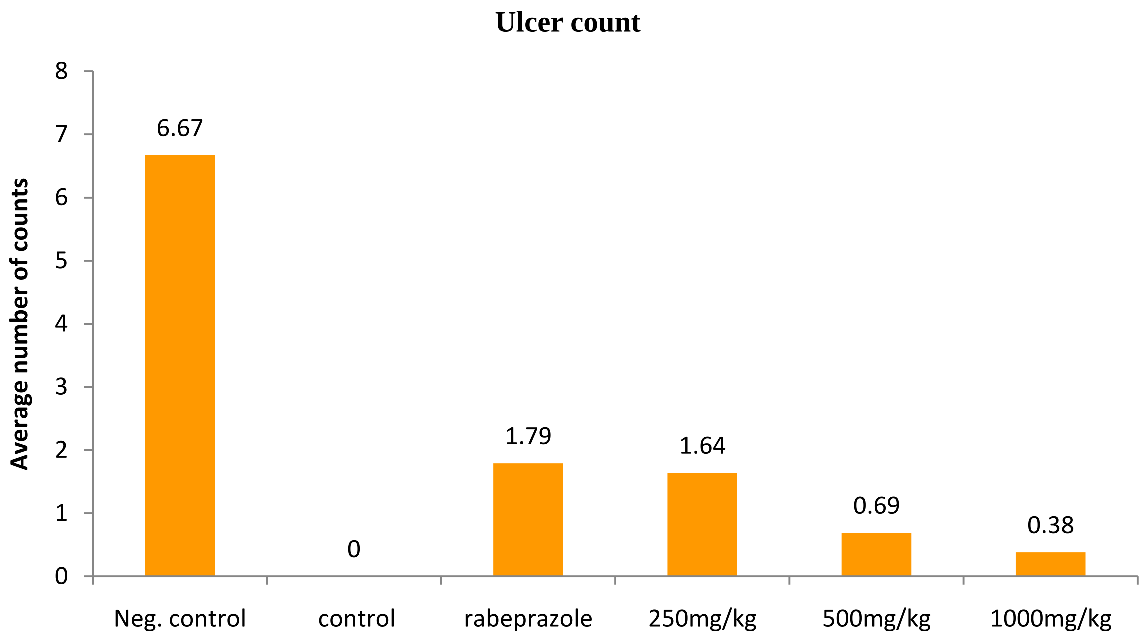

Figure 3: Effect of Bryophyllum pinnatum leaf extract on ulcer counts in pre-treated Wistar rats

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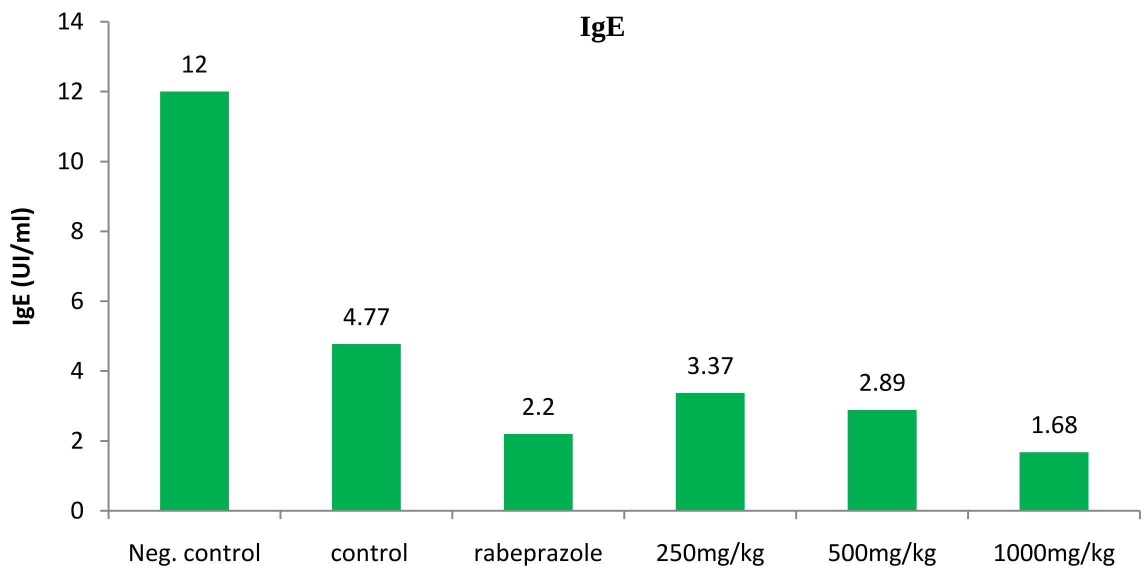

Figure 4: Effect of Bryophyllum pinnatum extract on immunoglobulin E level in post treated Wistar rats

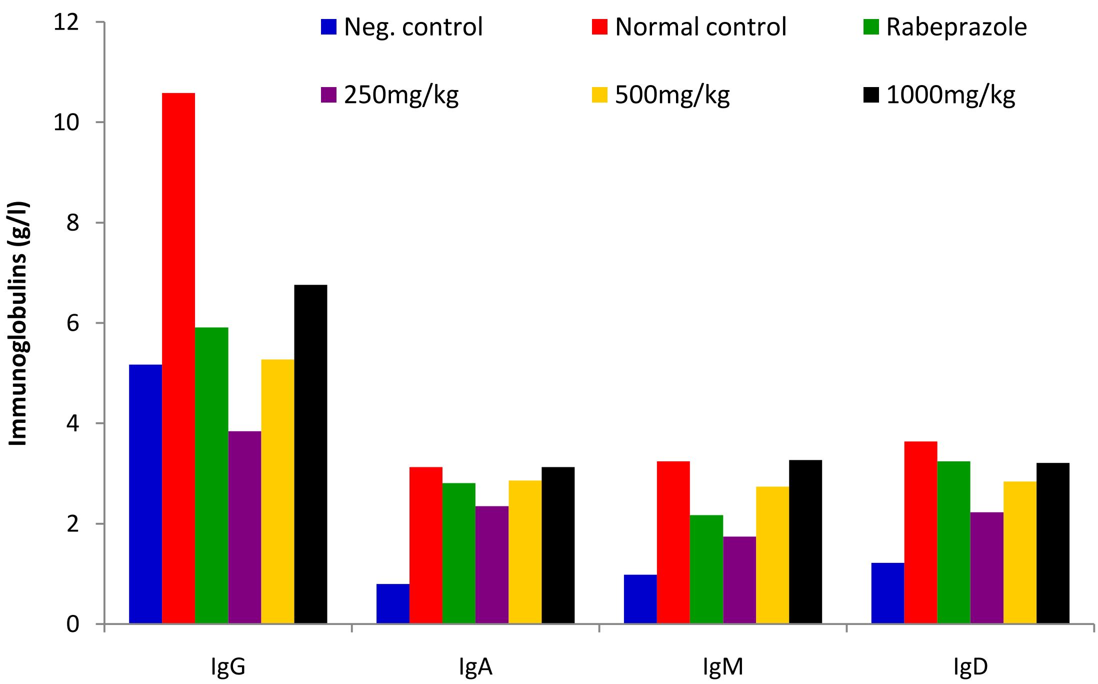

Figure 5: Effect of Bryophyllum pinnatum extract on immunoglobulin levels in post treated Wistar rats

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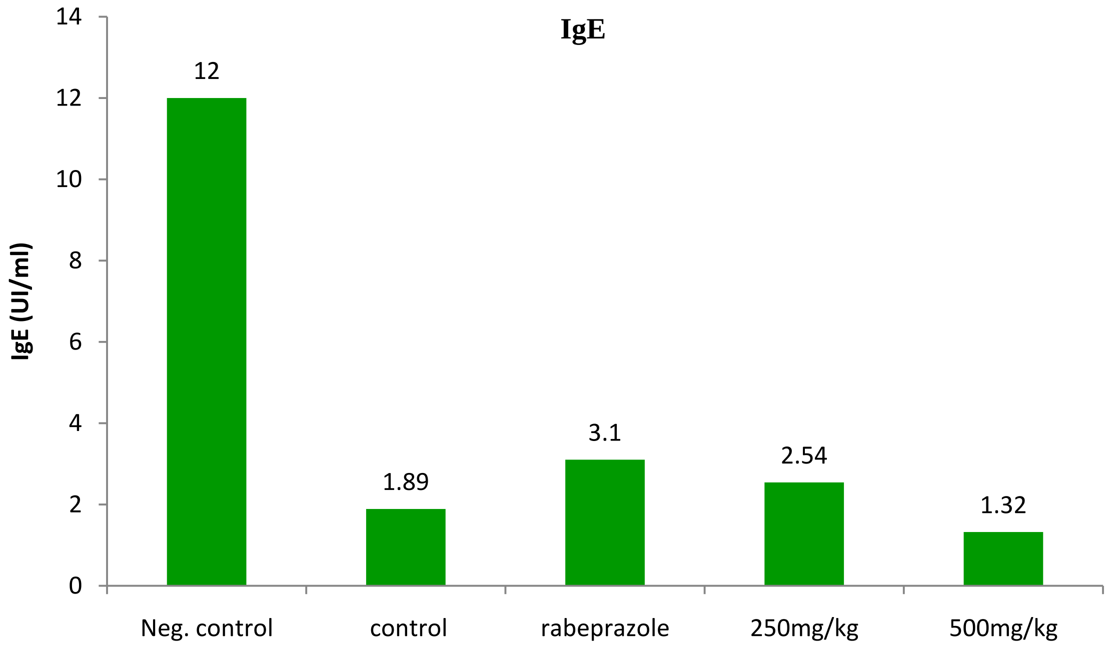

Figure 6: Effect of Bryophyllum pinnatum leaf extract on immunoglobulin E level in pre-treated Wistar rats

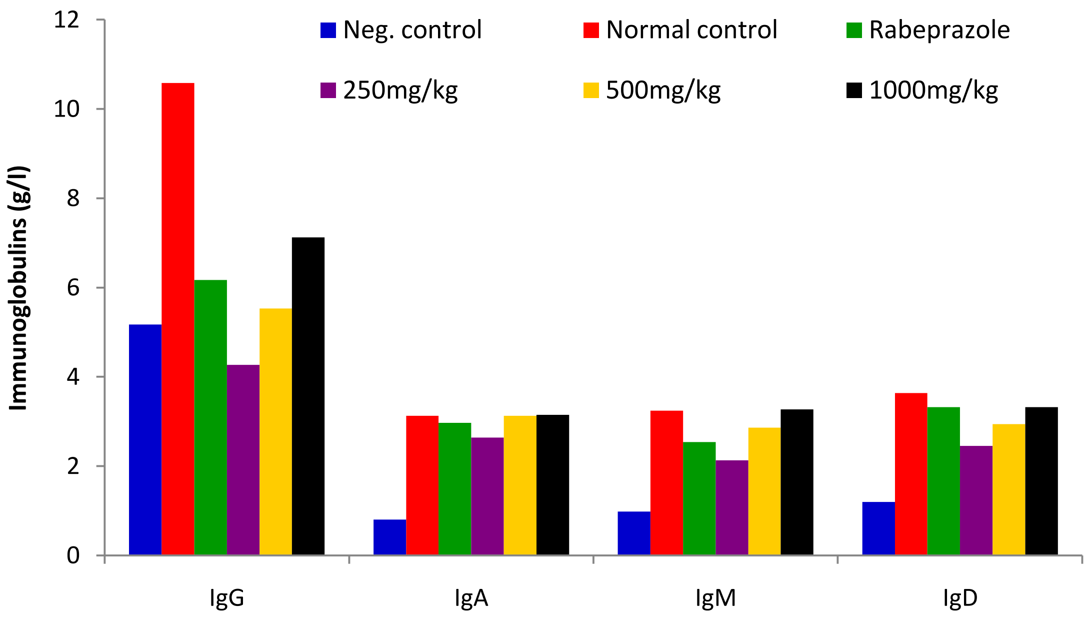

Figure 7: Effect of Bryophyllum pinnatum leaf extract on immunoglobulin levels in pre-treated Wistar rats

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Histological Results

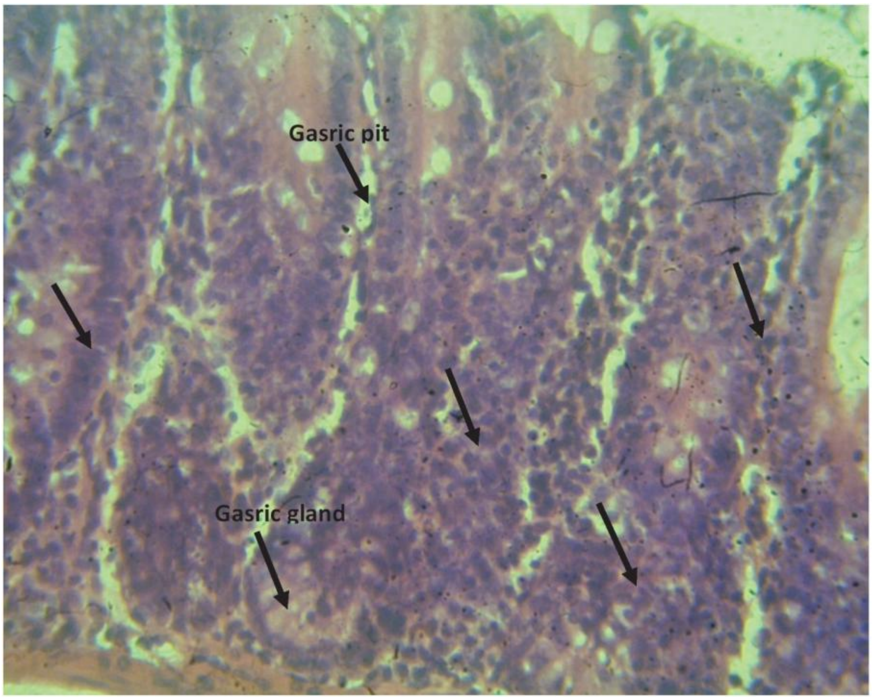

Plate 1: Showsphotomicrograph (H&E X400) of the basal layer of the stomach of Low Dose of post treatment group. It revealed reduced multifocal inflammatory activities with necrotic features of the parietal cells within the propria (arrows),depicting inflammatory distortion of the Mucosa wall

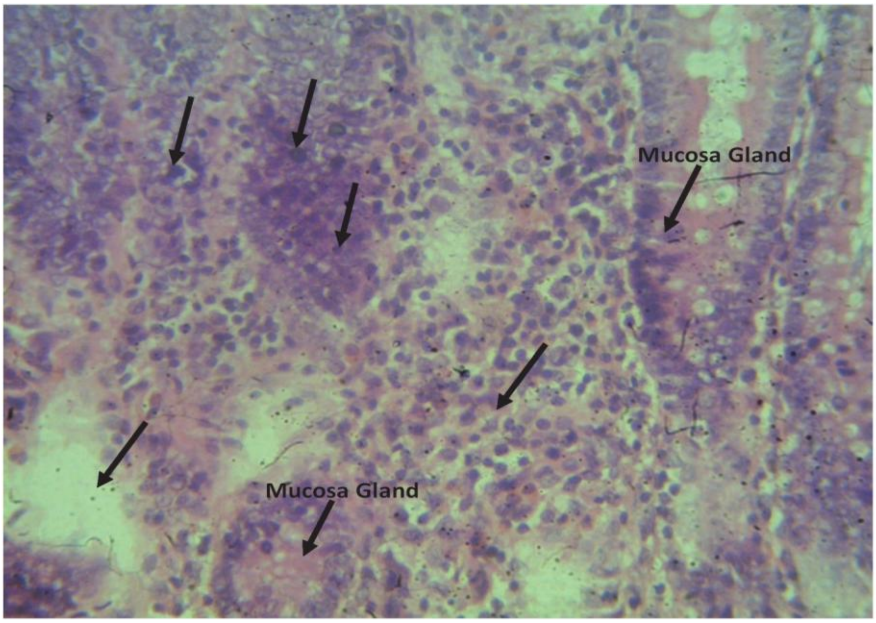

Plate 2: Shows**p**hotomicrograph (H&E X400) of the basal layer of the stomach of mediumdose of post treatment group. It also revealed reduced multifocal inflammatory activities with necrotic features of the parietal cells within the propria (arrows), depicting inflammatory distortion of the Mucosa wall

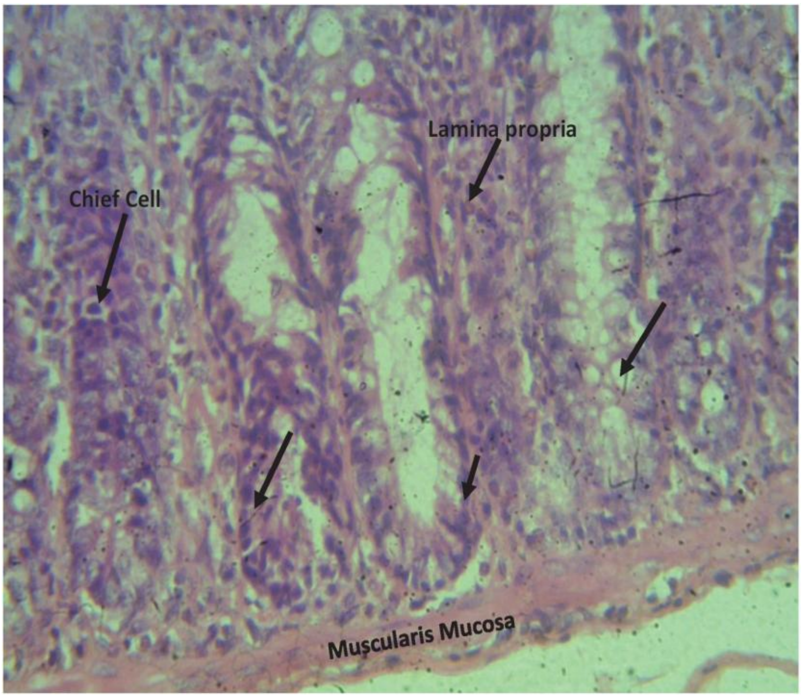

Plate 3: Shows **p**hotomicrograph (H&E X400) of the basal layer of the stomach of high dose of post treatment group. It shows mild disruption of mucosal wall of the stomach with no observable necrotic features (arrows), implying a mild distortion of the stomach tissues.

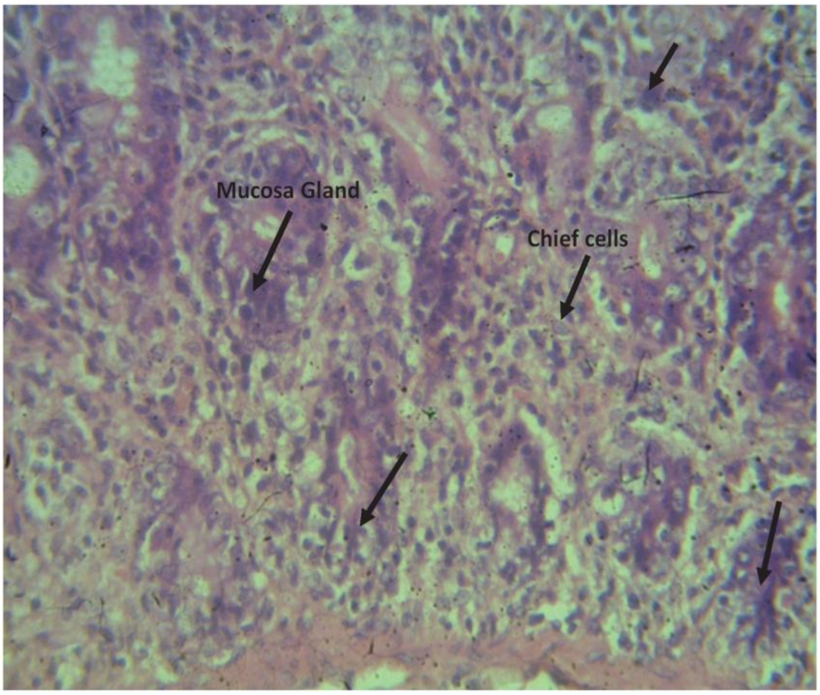

Plate 4: Shows **p**hotomicrograph (H&E X400) of the basal layer of the stomach of animals treated with rabeprazole. It shows mild disruption of mucosal wall of the stomach with reduced inflammatory cell activities (arrows)also, implying a mild distortion of the stomach tissues

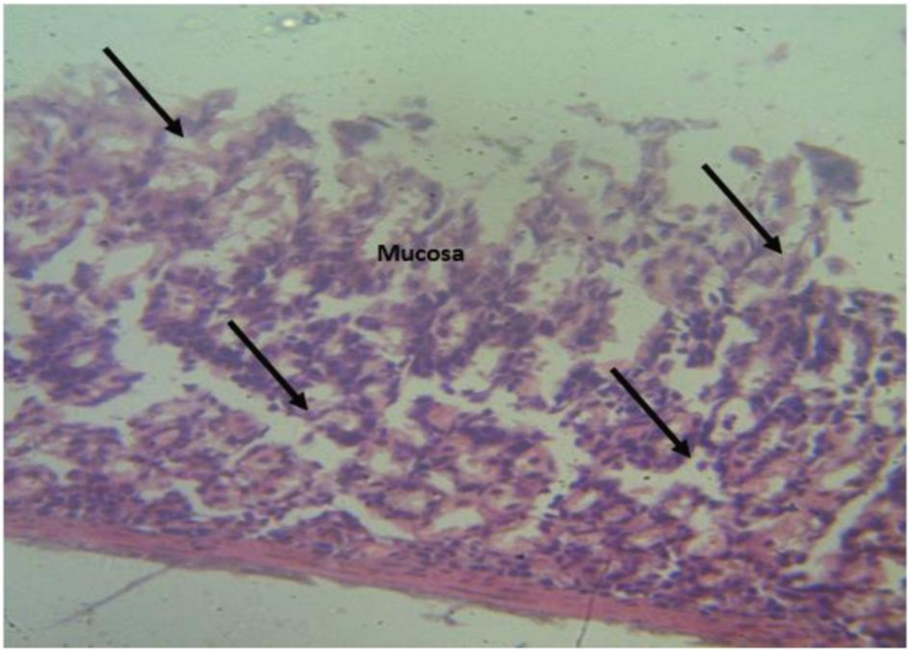

Plate 5: Shows **p**hotomicrograph (H&E X400) of the basal layer of the stomach of animals in the negative control group. It revealed severe multifocal disruption of the mucosal glands and cells (arrows), which impliessevere distortion of the mucosa wall.

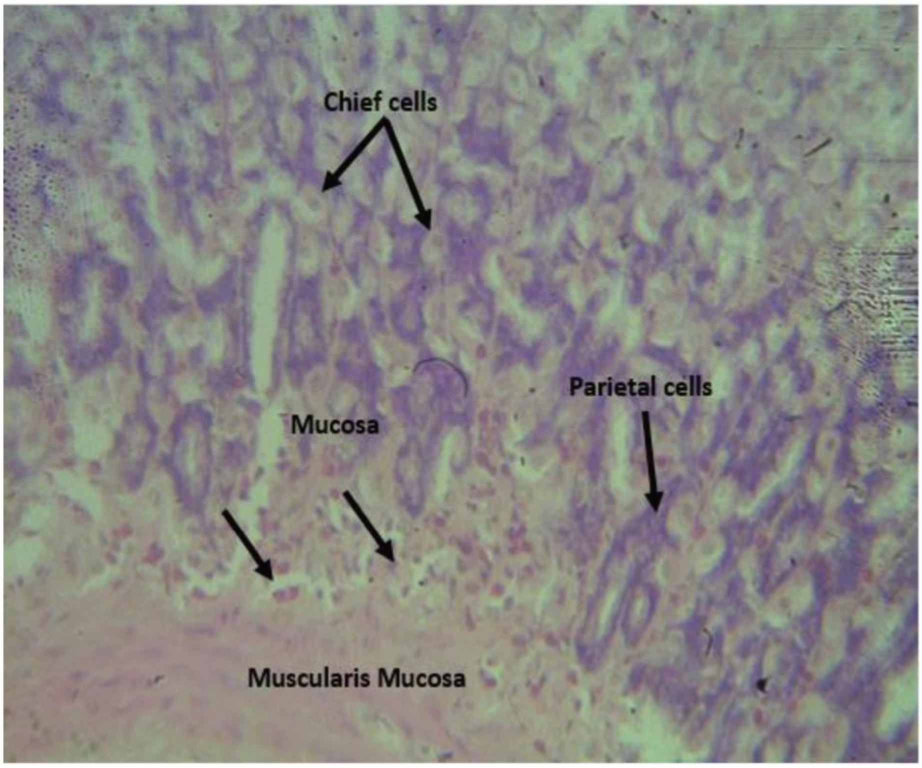

Plate 6: Shows **p**hotomicrograph (H&E X400) of the basal layer of the stomach of animals in the normal control group. It shows mucosal gland cells with minimal hemorrhagic deposit (arrows), but with normal appearance of the stomach.

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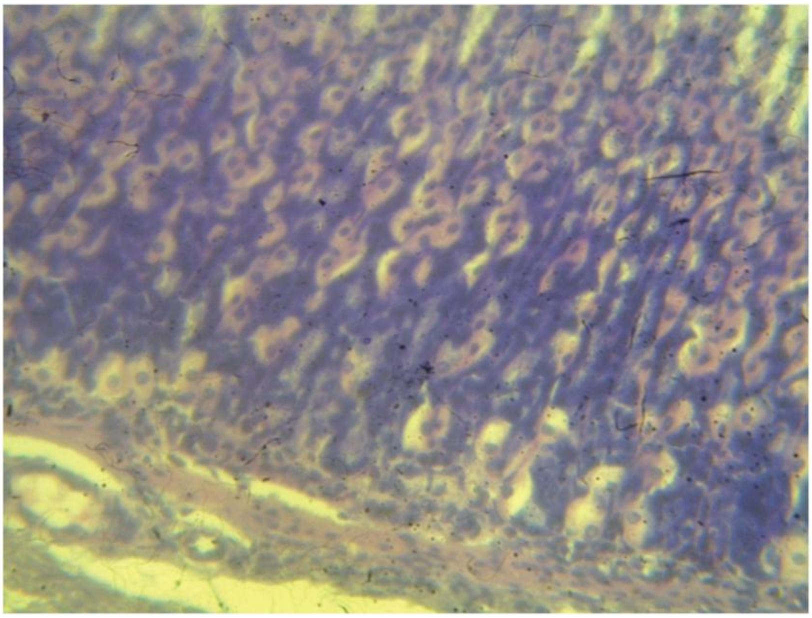

Plate 7: Shows **p**hotomicrograph (H&E X400) of the basal region of the stomach of low dose of pre-treatment group, revealing inflammatory activities within the mucosal wall (arrows), **i**nflammation and degeneration of the stomach tissue.

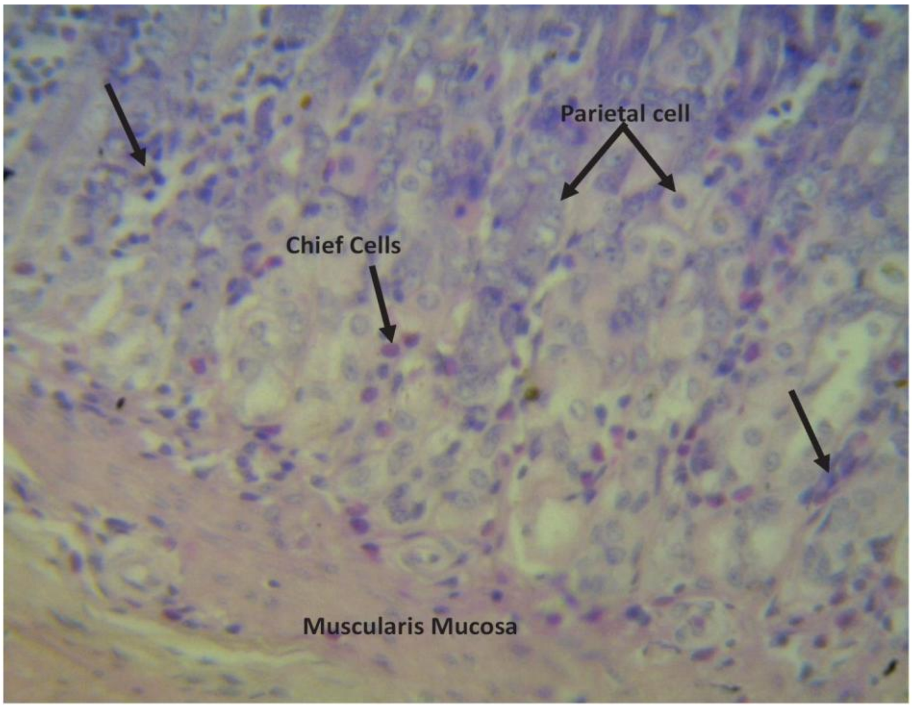

Plate 8: Shows **p**hotomicrograph (H&E X400) of the glandular stomach of mediumdose of pre-treatment group. It shows moderate epithelial cell Inflammation with no observable mucosal wall disruption (arrows), implying, moderate inflammation of the stomach tissue.

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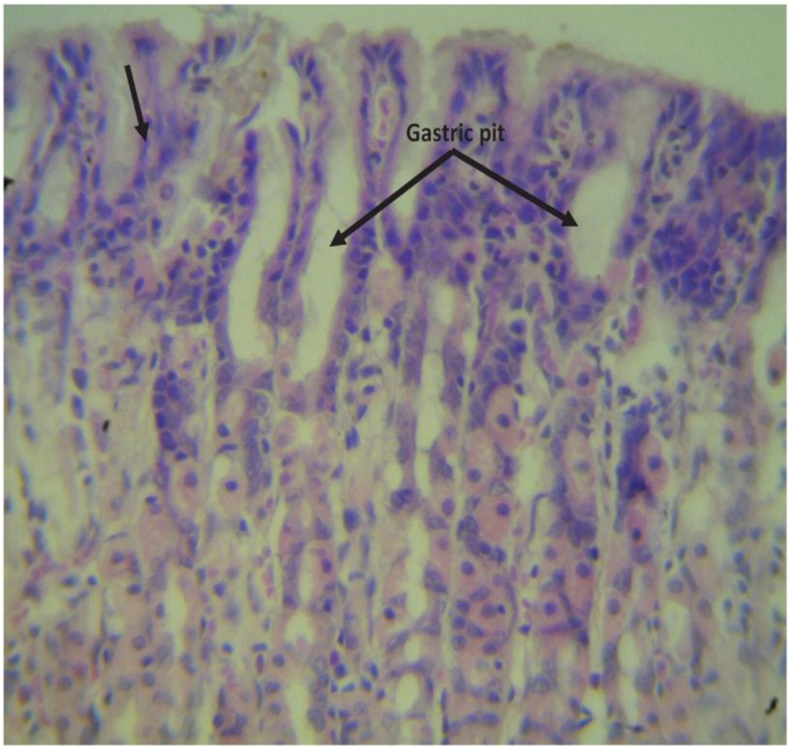

Plate 9: Shows **p**hotomicrograph (H&E X400) of the glandular stomach of high dose of pre-treatment group, revealing columnar epithelia cell, gastric pit and parietal cells with no observable epithelial cell Inflammation (arrows), implying and revealing normal appearance of the stomach tissues

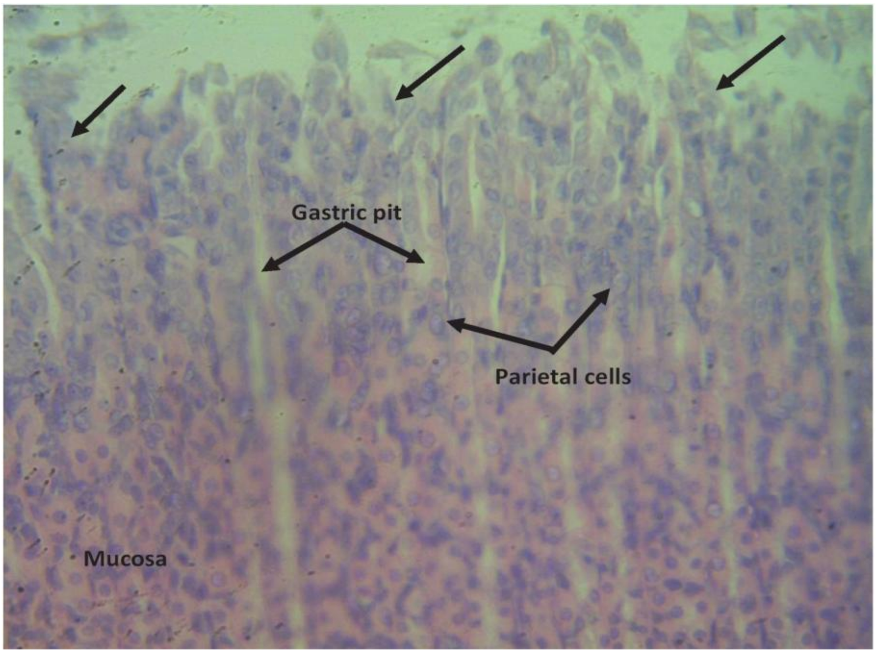

Plate 10: Shows **p**hotomicrograph (H&E X400) of the basal layer of the stomach of animals treated with rabeprazole. It shows mild distortion of the surface epithelium (arrows) and degeneration of the parietal cells of the mucosa, implying mild distortion of the stomach mucosa.

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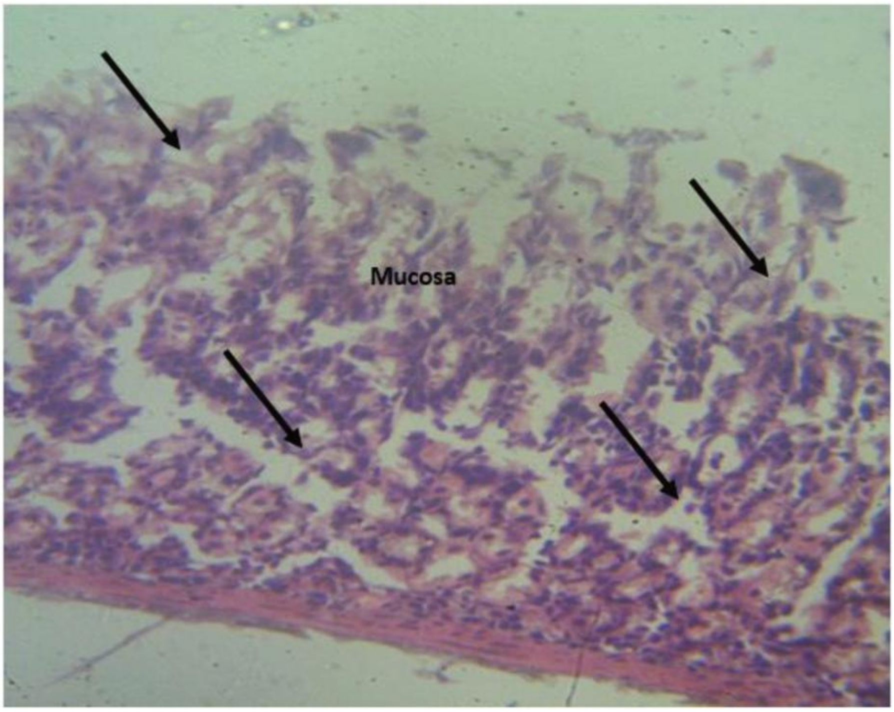

Plate 11: Shows **p**hotomicrograph (H&E X400) of the superficial region of stomach of animals in the negative control group, revealing severe multifocal disruption of the mucosal glands and cells (arrows), and implying severe distortion of the mucosa wall.

III. RESULTS

In post-treated animals, the negative control group showed the highest average number of ulcer count (6.67±0.88) which was significantly different from all other groups, while the normal control group had no ulcers (0.00±0.00). Rabeprazole reduced ulcers counts to an average of 1.90±0.58, demonstrating its efficacy. *Bryophyllum pinnatum* extract exhibited a dose-dependent reduction in ulcer counts, with 1000 mg/kg achieving the lowest average number of ulcer count of 0.77±0.33, which is significantly lower than Rabeprazole. While In pre-treated animals, similar trends were observed. The negative control group maintained significantly higher ulcer counts, while pre-treatment with 1000 mg/kg of *Bryophyllum pinnatum* extract reduced the average number count to 0.38±0.33, significantly surpassing Rabeprazole (1.79±0.58). This suggests that both post and pre-treatment with the extract at 1000 mg/kg was more effective than all other group. Regarding immunoglobulin levels a similar result was observed for IgE. The extract exhibited a significantly greater ability to reduce IgE at the dose of 1000 mg/kg when compared to the other groups including rabeprazole. On the contrary, the negative control group exhibited the highest levels of IgG, IgE, IgA, IgM, and IgD, indicative of immune dysregulation. Rabeprazole normalized the immunoglobulin levels, particularly IgE (2.20±0.58) and IgM (2.17±0.07). *Bryophyllum pinnatum* extract showed significant immunomodulatory effects, with 1000 mg/kg reducing IgE to 1.68±0.19 and modulating other immunoglobulins effectively. In pre-treated animals, the negative control group displayed similarly elevated immunoglobulins. Rabeprazole and the 1000 mg/kg dose of the extract both significantly restored normal levels of the immunoglobulins. For instance, IgE was reduced to 1.32±0.15 with the extract, outperforming Rabeprazole (1.89±0.33). Levels of IgA and IgM were also well-regulated, highlighting the extract's effectiveness. Overall, *Bryophyllum pinnatum* extract exhibited strong anti-ulcer and immunomodulatory properties, particularly at higher doses of 1000 mg/kg. Pre-treatment generally outperformed post-treatment, suggesting a protective effect of the extract as a natural intervention for managing ulcers, though further studies are essential to validate these findings.

The histological results also suggest protective and curative potentials of the high dose of the extract as presented below;**Plate 1:** Shows

photomicrograph (H&E X400) of the basal layer of the stomach of Low Dose of post treatment group. It revealed reduced multifocal inflammatory activities with necrotic features of the parietal cells within the propria (arrows), depicting inflammatory distortion of the Mucosa wall. **Plate 2:** Shows **p**hotomicrograph (H&E X400) of the basal layer of the stomach of mediumdose of post treatment group. It also revealed reduced multifocal inflammatory activities with necrotic features of the parietal cells within the propria (arrows), depicting inflammatory distortion of the Mucosa wall. **Plate 3:** Shows **p**hotomicrograph (H&E X400) of the basal layer of the stomach of high dose of post treatment group. It shows mild disruption of mucosal wall of the stomach with no observable necrotic features (arrows), implying a mild distortion of the stomach tissues. **Plate 4:** Shows **p**hotomicrograph (H&E X400) of the basal layer of the stomach of animals treated with rabeprazole. It shows mild disruption of mucosal wall of the stomach with reduced inflammatory cell activities (arrows)also, implying a mild distortion of the stomach tissues. **Plate 5:** Shows **p**hotomicrograph (H&E X400) of the basal layer of the stomach of animals in the negative control group. It revealed severe multifocal disruption of the mucosal glands and cells (arrows), which implies **s**evere distortion of the mucosa wall. **Plate 6:** Shows **p**hotomicrograph (H&E X400) of the basal layer of the stomach of animals in the normal control group. It shows mucosal gland cells with minimal hemorrhagic deposit (arrows), but with normal appearance of mucosal disruptions. **Plate 7:** Shows **p**hotomicrograph (H&E X400) of the basal region of the stomach of low dose of pre-treatment group, revealing inflammatory activities within the mucosal wall (arrows), **i**nflammation and degeneration of the stomach tissue. **Plate 8:** Shows **p**hotomicrograph (H&E X400) of the glandular stomach of medium dose of pre-treatment group. It shows moderate epithelial cell Inflammation with no observable mucosal wall disruption (arrows), implying, moderate inflammation of the stomach tissue. **Plate 9:** Shows **p**hotomicrograph (H&E X400) of the glandular stomach of high dose of pre-treatment group, revealing columnar epithelia cell, gastric pit and parietal cells with no observable epithelial cell Inflammation (arrows), implying and revealing normal appearance of the stomach tissues. **Plate 10:** Shows **p**hotomicrograph (H&E X400) of the basal layer of the stomach of animals treated with rabeprazole. It shows mild distortion of the surface epithelium (arrows) and degeneration of the parietal cells of the mucosa, implying mild distortion of the stomach mucosa. **Plate 11:** Shows **p**hotomicrograph (H&E X400) of the superficial region of stomach of animals in the negative control group, revealing severe multifocal disruption of the mucosal glands and cells (arrows), and implying severe distortion of the mucosa wall.

IV. DISCUSSION

Gastric ulcer is a gastrointestinal condition that occurs as a result of development of open sores on the inner lining of the stomach due to the breakdown in the mucosal barrier that normally protects the stomach from its own acidic environment [1]. When stomach acids such as pepsin, hydrochloric acids and gastric amylase outweighs the protective factors, such as mucus and bicarbonate secretion leading to bleeding and perforation, gastric ulcer occurs [1].*Bryophyllumpinnatum*, also called the Miracle Leaf, is a plant commonly used in traditional medicine for its potential therapeutic properties, including its ability to treat gastrointestinal disorders [15]. Research has it that the plant possesses anti-inflammatory, antioxidant, and mucosal protective properties, which might counteract the adverse effects of NSAIDs on the gastric mucosa [16]. Studies also revealed that the Miracle Leaf contains compounds such as flavonoids, tannins, quercertin, terpenoids, steriods, organic acids and glycosides, which may contribute to its gastro-protective properties by enhancing the mucosal defense system against the stomach acid or reducing oxidative stress in gastric tissues [17]. This study thus corroborates these reports.

The results from the study demonstrated that the extract had a strong anti-ulcer property, particularly at a dose of 1000 mg/kg, which was greater than that of rabeprazole in both post-treatment and pre-treatment settings. The extract significantly reduced ulcer counts in a dose-dependent manner, with the highest dose (1000 mg/kg) showing the more effect as compared to the rest of the groups in both pre- and post-treatment groups. These anti-ulcer effects of *Bryophyllum pinnatum* extract are consistent with previous studies that have been carried out. For example, in a study carried out to ascertain the gastric ulcer healing property of *Bryophyllum pinnatum* leaf extract in chronic model In Vivo and gastroprotective activity of its major flavonoid, it was observed that the leaf extracts of this species showed gastroprotective effects in acute gastric lesions induced by ethanol and indomethacin in rats

[22]. The literature describes the presence of phenolic compounds in the leaves of this species and the presence of flavonoids and glycosides derived from quercetin, patuletin, eupafolin, and kaempferol in the leaf extract [22].The quercetin was reported to prevent gut microbiota dysbiosis, in addition to presenting antioxidant and anti-inflammatory activities [23] thereby preventing oxidative stress in the gastric mucosa, that provoked the development of gastric lesions caused by ethanol and indomethacin [24]. In another study on the antiulcer activity of methanolic extract of *Bryophyllum pinnatum* in rats, the result showed that extract of *Bryophyllum pinnatum* exhibited a dose dependent gastroprotective effect on indomethacine induced ulceration in rats.The cytoprotection offered by 40mg/kg of *B. pinnatum* was greater than that produced by 40mg/kg propranolol indicating than the extract could be more potent than propranolol in measured variables [25].

The extract also demonstrated significant immunomodulatory effects, particularly in its reduction in IgE levels. At a dose of 1000 mg/kg, the extract significantly reduced IgE levels as compare to the negative control, in both pre- and post-treatment, and thus showing a better immunomodulatory effect than rabeprazole in both settings. The extract's immunomodulatory effects, particularly in reducing IgE levels is of great significance as elevated IgE level is often associated with allergic reactions and immune dysregulation. The extract's ability to modulate IgE levels and other immunoglobulins suggests potential applications in managing immune-related disorders.and this finding agrees with another study carried out to explore *Bryophyllum pinnatum* compounds as potential inhibitors for Vespula vulgaris allergen proteins and the study unveiled *Bryophyllum pinnatum* compounds, particularly Bryophyllin B and Bryotoxin A as promising inhibitors for V. vulgaris allergen proteins and these findings contribute valuable insights to the field, offering potential solutions to address the increasing prevalence of allergic reactions induced by V. vulgaris venom which could likely occur when there is an increase in the levels of IgE which plays a crucial role in allergic reactions and in defending the body against parasites [26].

The photomicrographs presented in this study demonstrate the effects of *Bryophyllum pinnatum* extract on the histopathology of stomach tissues in animals with gastric ulcers. The results show that the high dose (1000mg/kg) of the extract (post-treatment) and (pre-treatment) exhibited significant curative and protective effects respectively against gastric ulceration and this is of similar findings to that on the gastric ulcer healing property of *Bryophyllum pinnatum* leaf extract in chronic model in vivo where the histological analysis also indicated that the B. pinnatum leaves, due to the presence of flavonoid were capable of modulating the inflammatory process. Also, the quercetin present in it showed a cytoprotective effect in the gastric mucosa thereby promoting the wound healing process of *Bryophyllum pinnatum* leaf extract in this tissue [27].

V. CONCLUSION

This study revealed that *Bryophyllum pinnatum* significantly reduced ulcer counts and immunoglobulin E (IgE) levels in both pre- and post-treatment groups. It was also observed that the extract reversed as well as prevented mucosal damage in both post-treatment and pre-treatment groups respectively.

Ethical Approval
Animal Ethic committee approval has been collected and preserved by the author(s)

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