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Ameliorative Effects of Stem bark Extract of *Pterocarpus erinaceus* on Indomethacin-induced Ulcer

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Abstract

Pterocarpus erinaceus serve as a medicinal plant to many populations of Nigeria and West Africa. The stem bark, leaves, and root bark have been studied for their antioxidant, antimalaria, antiulcerogenic, and antibacterial properties. The study examined the anti-ulcerogenic properties of *Pterocarpus erinaceus* stem bark extracts in albino rats with indomethacin-induced ulcers and hepatic biochemical changes. The anti-ulcer effect was determined by histopathological examination of ulcerated rats treated with the stem bark extracts in a period of 14-days. The three extracts did not cause elevation of key liver biomarkers such as AST, ALT, and ALP. Hence are considered not non-toxic at the dose and duration given. The leaf extract exhibited anti-ulcer effect at 100, 200, and 300 mg/kg.

Keywords: Ameliorative, Stem Bark, Extract, Pterocarpus Erinaceus, Indomethacin, Induced, Ulcer

INTRODUCTION

Peptic ulcer is a long-term health issue marked by a break in the digestive tract's lining (mucosa). This break is a result of the mucosa being digested by pepsin and acid, primarily due to an imbalance stemming from either heightened aggression or diminished mucosal resistance. Typically, the stomach and the duodenum are the peptic regions of the human body, and peptic ulcer disease (PUD) is the most common medical condition impacting these areas (Umaru et al. 2018). Peptic ulcer disease is estimated to affect 5–10% of the overall population (Kuna et al. 2019). Nevertheless, recent epidemiological research has indicated a decline in the disease's incidence, hospitalization rates, and mortality (Kuna et al. 2019).

Records show that the use of plants as medicine dates back to 4000-5000 BC and the Chinese were the first to use natural herbal preparations as medicine. About 64% of the world's population still relies on traditional medicines and medicinal plants to meet their health needs (Hossain et al. 2022). According to a WHO survey, about 80% of patients in India, 85% in Burma, and 90% in Bangladesh are prescribed traditional medicines (Hossain et al. 2022). Due to limited access to quality medicines, people in many emerging countries use plants to treat common ailments (Tittikpina et al. 2018).

Medicinal plants remain a rich source of bioactive phytochemicals that have proved to be richest resource of drugs used in traditional and modern medicine as pharmaceutical intermediate and chemical entities for synthetic drugs (Patrick et al. 2018). These plants contain a wide variety of chemical compounds of therapeutic value which can be sorted out by their chemical classes and functional groups. Some of them have been documented for their antioxidant potentials (Patrick et al. 2018).

Herbal and traditional medicines are widely used in Nigeria. There is the need to promote research in drug development, especially herbal medicine. *Pterocarpus erinaceus* (*P. erinaceus*), which belongs to the family Fabaceae, is a tree usually up to 8 and 15 m in height This plant grows in savannah and is endemic from West Africa to Central Africa. In savannah, *P. erinaceus* is a medicinal plant used to heal various diseases. In the central region of Burkina Faso, its stem bark is used to treat inflammatory affections such as ulcers, rheumatism, dermatitis and infections (Okoli et al. 2022).

Pterocarpus erinaceus leaves and stem barks have been studied for their anti-inflammatory, analgesic and anti-plasmodial properties, ant-idiarrheal, antiulcerogenic, antimalarial,

antioxidant, antimycotic (Okoli et al. 2022). Previous studies by (Aliyu et al. 2005) showed that the ethanolic stem bark extracts of *P. erinaceus* possess significant and dose-dependent analgesic and anti-inflammatory activities in laboratory rats and mice. Okoli et al. (2022), reported that the phytochemical constituents of *P. erinaceus* include steroids, flavonoids, and tannins. The aim of this research study was to determine the antiulcer effects and hepato-protective activities of ethanolic stem bark extracts of *P. erinaceus*.

MATERIALS AND METHODS

Study Area

This study was carried out at Federal University, Wukari, Taraba State, Nigeria, between February 2022 to July 2022. Wukari town is the headquarters of Wukari Local Government Area in Taraba State, Nigeria. It lies between latitude 7.9303°N and longitude 9.8125°E of the equator.

Plant Material

The stem bark samples of *P. erinaceus* were collected from uncultivated farmland of Federal University Wukari, Wukari Local Government Area of Taraba State, Nigeria. The plant was taxonomically identified and authenticated in the Department of Plant Science of Modibbo Adama University of Technology, Yola, Nigeria.

Stem bark Extraction

The stem bark samples were rinsed before being air-dried over 30 days. It was then reduced to powdered form by grinding in a mortar and pestle. One hundred and fifty grams of the powdered stem bark were cold macerated in 500 mL of ethanol inside an Erlenmeyer flask shaken at the interval of an hour and then allowed at room temperature to stand for 48 hrs and filtered using Whatman's filter paper No. 1. The extract was then concentrated to dryness using a rotary evaporator. It was then stored under a frozen condition until required.

Animals

Thirty (30) male Wistar albino rats weighing 80 ± 20 g are used for this experiment. The rats are purchased from the National Veterinary Research Institute, Vom, Plateau State. The rats are maintained under standard laboratory conditions and are allowed free access to standard diet and water *ad libitum*. They are allowed to acclimatize for 14 days.

Experimental Design

Thirty (30) male albino rats weighing 80 ± 20 g used in the study were randomized into six (6) groups of five (5) rats each. Ulceration was induced in the animals with a single oral dose of indomethacin (30 mg/kg/body weight) on the first day of the experiment. The animals were deprived of food but had access to water 24 hours prior to ulcer induction. The groupings of the animals were as follows: Group A. (normal control) animals received only broiler finisher feed with water. Animals in Group B were given indomethacin 30 mg/kg/b.w single oral doses as a negative control (ulcer control). Group C comprised ulcerated rats treated with 20 mg/kg b.w omeprazole (standard drug). Groups D, E, and F comprised ulcerated rats treated with stem bark extracts of *P. erinaceus* (100, 200, and 300 mg/kg/ b.w) respectively. Treatments with the omeprazole and plant extract lasted for fourteen (14) days on indomethacin- ulcer induced animals. Omeprazole and plant extract administered orally once daily using oral intubator. Food and water were given *ad libitum* throughout the experimental period. Determinations were done at the end fourteen (14) days by sacrificing all the animals.

Microscopic Examination of Stomach Tissues

The histopathology study was carried out according to the method reported by Umaru et al. (2018). The stomach was harvested and opened along the greater curvature and the tissues was fixed in 10% formalin, dehydrated in gradual ethanol (50-100%), cleared in xylene, and embedded in paraffin wax. Stomach tissue sections of 5-6 mm thickness was prepared using rotary microtome and stain with hematoxylin and eosin dye and then observed under microscope (10x) for histopathological changes in the stomach.

Liver Function Test

The blood samples were taken from the heart of the rats and centrifuged for five minutes at 3000 rpm to prepare the serum for biochemical analysis. The ALT (alanine transaminase), AST (aspartate aminotransferase), ALP (alkaline phosphatase), TB (total bilirubin), DB (direct bilirubin), TP (total protein) and ALB (albumin) levels were determined by the method adopted by Yakubu *et al*. (2021).

RESULTS

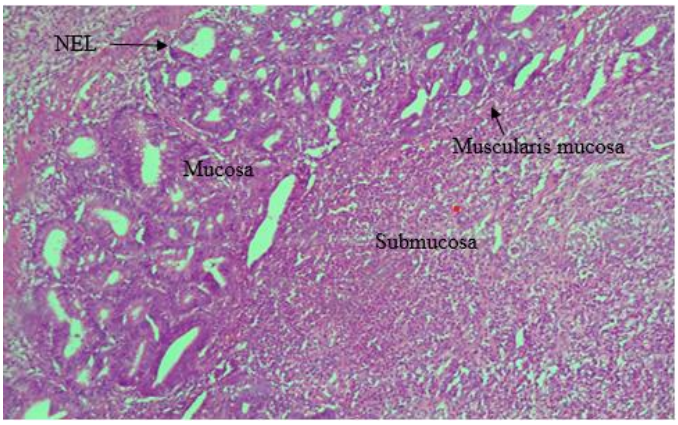

Plate 1: **Photomicrograph of section of gastric tissue of normal control rat** (group A)

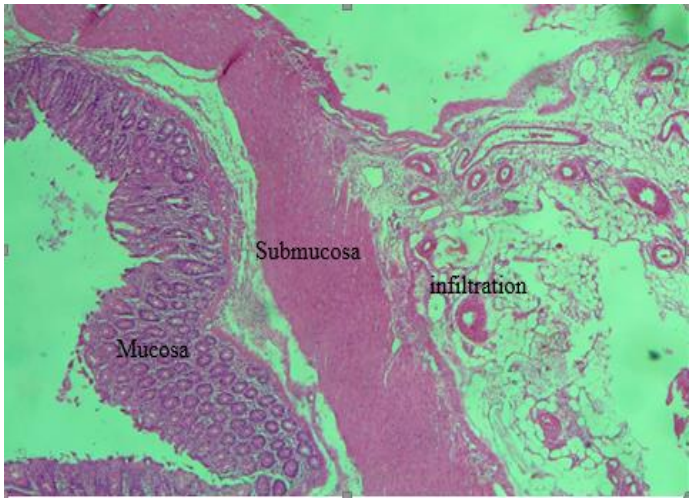

Plate 2: Photomicrograph of section of gastric tissue of rat administered indomethacin (25 mg/kg) only (group B)

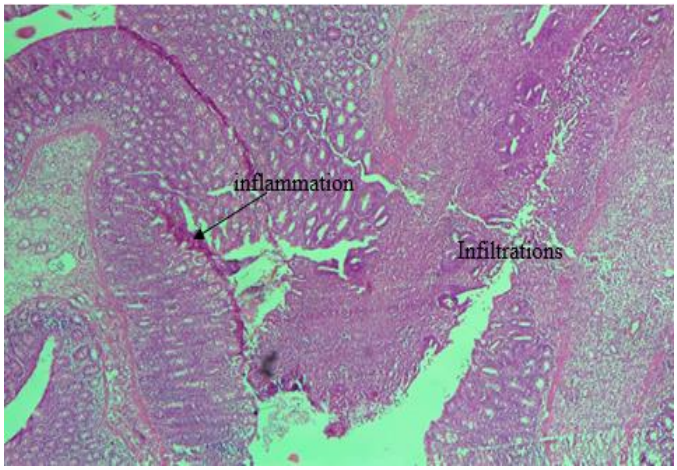

Plate 3: Photomicrograph of section of gastric tissue of rat administered indomethacin (25 mg/kg) and omeprazole (20 mg/kg) (group C)

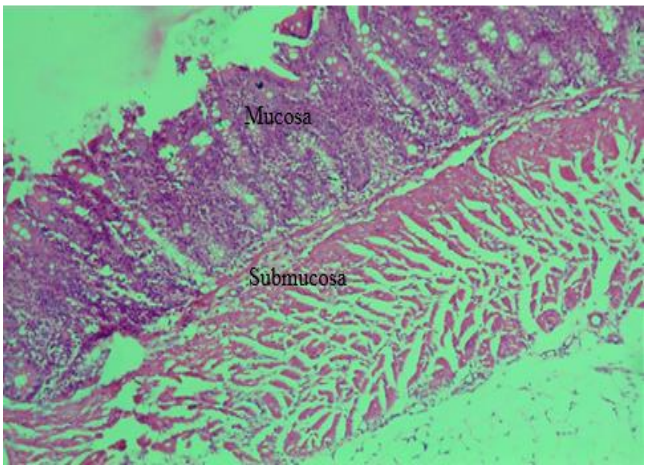

Plate 4: Photomicrograph of section of gastric tissue of rat administered indomethacin (25 mg/kg) and stem-bark extract of *Pterocarpus erinaceus* (100 mg/kg) (group D)

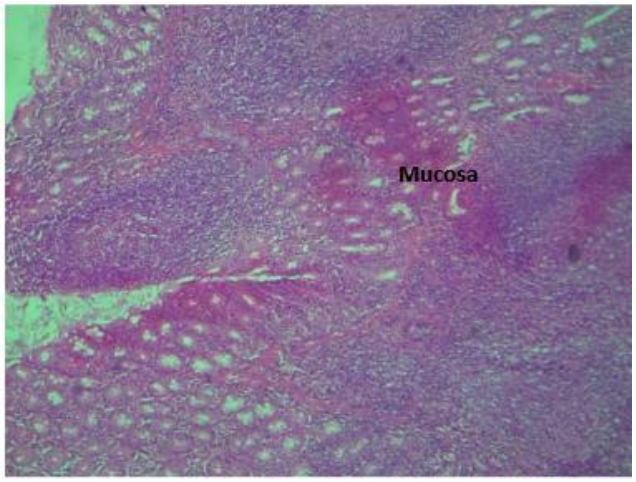

Plate 5: Photomicrograph of section of gastric tissue of rat administered indomethacin (25 mg/kg) and stem-bark extract of *Pterocarpus erinaceus* (200 mg/kg) (group E)

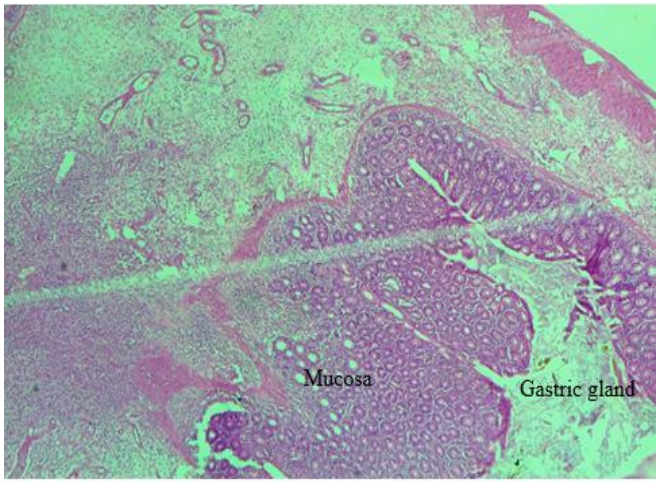

Plate 6: Photomicrograph of section of gastric tissue of rat administered indomethacin (25 mg/kg) and stem-bark extract of *Pterocarpus erinaceus* (300 mg/kg) (group F)

Table 1: Concentration of Selected Liver Function Parameters in Stomach Ulcerated Rats Administered Ethanolic Stem Bark Extract of *Pterocarpus erinaceus* (At the end of 14 Days Treatment)

GROUPS	AST (IU/L)	ALT (IU/L)	ALP (IU/L)	ALB (g/L)	TP (g/L)	DB (mmol/L)	TB (mmol/L)
A	40.67 ± 2.08[a]	41.67 ± 1.15[a]	171.00 ± 2.00[a]	31.67 ± 1.53[a]	57.67 ± 2.08[a]	0.80 ± 0.23[a]	10.834 ± 0.58[a]
B	86.67 ± 4.16[b]	59.67 ± 3.51[b]	141.67 ± 2.08[b]	30.00 ± 4.00[a]	41.00 ± 3.60[b]	1.00 ± 0.00[b]	12.77 ± 2.53[a]
C	12.00 ± 1.00[c]	10.00 ± 1.73[c]	122.00 ± 1.73[c]	30.00 ± 0.00[a]	70.00 ± 5.00[c]	0.44 ± 0.06[b]	8.00 ± 0.87[b]
D	22.00 ± 4.35[d]	32.67 ± 2.52[d]	77.00 ± 1.73[d]	31.00 ± 3.60[a]	73.00 ± 8.71[c]	0.40 ± 0.02[a]	5.00 ± 0.43[c]
E	15.33 ± 1.52[c]	40.33 ± 2.52[a]	117.33 ± 6.35[c]	32.67 ± 2.31[a]	68.67 ± 5.51[c]	0.94 ± 0.08[a]	12.00 ± 1.50[a]
F	33.33 ± 2.08[e]	44.00 ± 3.00[a]	130.00 ± 1.00[e]	30.00 ± 0.00[a]	66.00 ± 1.73[ac]	0.93 ± 0.12[a]	10.50 ± 0.50[a]

Note: Results are expressed in Mean ± SD. value with same superscript within column are statistically not significant while values with different superscripts within a column are statistically significant ($P<0.05$).

Legend: **Group A** = Normal, **Group B** = Indomethacin 25mg/kg. bw, **Group C** = Indomethacin 25mg/kg. bw + omeprazole 20mg/kg. bw. **Group D** = indomethacin 25mg/kg.bw + *P. erinaceus* 100mg/kg. bw, **Group E** = indomethacin 25mg/kg.bw + *P. erinaceus* 200mg/kg. bw, and **Group F** = indomethacin 25mg/kg.bw + *P. erinaceus* 300mg/kg. bw

AST = aspartate aminotransferase, **ALT** = alanine transaminase, **ALP** = alkaline phosphatase, **ALB** = albumin, **TP** = total protein, **DB** = direct bilirubin, and **TB** = total bilirubin.

DISCUSSION

The histopathology of the stomach of control rats over a 14-day period revealed a normal cellular structure with a normal epithelial lining (NEL) consisting of mucosa, muscularis mucosa, and submucosa layers (fig. 1). Group 2, which was administered only

indomethacin at 25 mg/kg body weight, exhibited infiltration of the epithelial lining with normal mucosa and submucosa (fig. 2). This supports the ulcer-inducing effect of high-dose indomethacin administration. The infiltration could be attributed to the erosion of surface epithelial cells, a reduction in mucosal thickness, and a loss of gastric mucosa integrity, as reported by Yomna et al. (2018). NSAIDs function by inhibiting the metabolism of arachidonic acid via both cyclooxygenase and lipoxygenase enzyme pathways. Group 3, which was administered 20 mg/kg body weight of omeprazole, showed infiltrated and inflamed epithelial lining (fig. 3). This suggests that the administration of omeprazole, a standard ulcer treatment drug, did not result in complete ulcer healing within a 14-day treatment period.

The administration of *P. erinaceus* stem bark extract at concentrations of 100, 200, and 300mg/kg body weight resulted in normal mucosa and submucosa without any infiltration and inflammation after 14 days of treatment. This suggests that the stem bark extract could potentially heal the indomethacin-induced ulcer at concentrations of 100, 200, and 300mg/kg body weight. This is also in agreement with a study by Patrick et al. (2018) which revealed that the aqueous extract of *P. erinaceus* stem bark reduced the ulcer index in an indomethacin-induced ulcer.

The study's results indicate that *P. erinaceus* stem bark extracts significantly decrease AST and ALP levels in treated groups compared to the control group, suggesting their safety for hepatocytes. Notably, ALT levels show no significant increase, and albumin and total protein concentrations rise, further supporting the extract's non-harmful effects. These findings align with Atchou et al.'s (2021) observations, where a 28-day treatment with a hydroethanolic extract of *P. erinaceus* stem bark at 500 mg/kg reduced AST and ALT levels in male albino rats. However, caution is warranted due to variations in bilirubin levels, especially for prolonged use. However, the variations in bilirubin levels indicate that while the extract is not harmful at the tested concentrations, caution is advised for prolonged use.

CONCLUSION

The study revealed that the treatment of indomethacin-induced ulcer in Wistar albino rats with *P. erinaceus* stem bark extract at concentrations of 100, 200, and 300mg/kg body weight over a 14-day period resulted in some repairs in ulcerated rats showing normal mucosa and submucosa without any infiltration and inflammation, suggesting its potential

in ulcer healing. Liver function analysis on ulcerated rats resulted to a significant decrease in AST and ALP levels, and a non-significant increase in ALT level, indicating that the extract does not cause hepatocyte damage. The study also observed changes in albumin levels, total protein concentrations, and levels of direct and total bilirubin, suggesting that the extract is not harmful to the liver at the tested concentrations. Therefore, *P. erinaceus* stem bark extract shows promise as a potential treatment for ulcers and for maintaining liver health.

REFERENCES

Atchou, K., Lawson-Evi, P. & Eklu-Gadegbeku, K. (2021). In vitro study of protective effect of Pterocarpus erinaceus Poir. stem bark and Amaranthus spinosus L. root bark extracts on cataractogenesis and glomerulopathy. Bulletin of the National Research Centre, 45(1), 1-9.

Hossain, M. M., Uddin, M. S., Baral, P. K., Ferdus, M. & Bhowmik, S. (2022). Phytochemical screening and antioxidant activity of Ipomoea hederifolia stems: A potential medicinal plant. Asian Journal of Natural Product Biochemistry, 20(2).

Kuna, L., Jakab, J., Smolic, R., Raguz-Lucic, N., Vcev, A. & Smolic, M. (2019). Peptic ulcer disease: a brief review of conventional therapy and herbal treatment options. Journal of clinical medicine, 8(2), 179.

Okoli, E. C., umaru, I. J., & Olawale, O. (2022). Assessment of phytochemical compositions, antibacterial effects and DPPH scavenging activities of ethanolic root extracts of Pterocarpus erinaceus. Asian Journal of Natural Product Biochemistry, 20(2).

Patrick, A. T., Samson, F. P., & Madusolumuo, M. A. (2018). Antiulcerogenic Effects of Aqueous Stem-Bark Extracts of Pterocarpus erinaceus on Indomethacin-Induced Ulcer in Albino Rats. J Biochem Cell Biol, 1(107), 2.

Tittikpina, N. K., Nana, F., Fontanay, S., Philippot, S., Batawila, K., Akpagana, K. & Duval, R. E. (2018). Antibacterial activity and cytotoxicity of Pterocarpus erinaceus Poir extracts, fractions and isolated compounds. Journal of Ethnopharmacology, 212, 200-207.

Umaru, I. J., Badruddin, F. A. & Umaru, H. A. (2018). Gastroprotective Effect of Leptadenia Hastata (Pers.) Decne and Histopathological Changes on Indomethacin-Induced Gastric Ulcer in Rats. Int. J. Pure App. Biosci, 6(5), 20-27.

Yakubu, O. E., Ojogbane, E. B., Atanu, F. O., Udeh, C. S., Ale, M. E., & Bello, B. H. (2021). Hepatoprotective effects of partially purified fractions of Senna occidentalis ethanolic extract on diethyl nitrosamine-induced toxicity in wistar rats. Intl J Sci Rep, 7(8), 374-81.

Yomna, I. M., Eman, A. and Abd, E. (2018). Spirulina Ameliorates Aspirin-induced Gastric Ulcer in Albino Mice by Alleviating Oxidative Stress and Inflammation. Biomedicine and Pharmacotherapy, 109: 314-321.