**Research article**

**Antiulcerogenic Activity of Ethanolic Leaf Extract of *Croton Zambesicus* Muell. Arg**

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**ABSTRACT:** *Croton zambesicus* Muell. Arg. is often used in traditional medicine by Ibibios of Niger Delta region of Nigeria for the treatment of several diseases including gastrointestinal disorders especially ulcer. The antiulcer activity of the ethanolic extract of the crude leaf extract was investigated against indomethacin, ethanol and histamine – induced ulcer models in rats. The crude leaf extract of *Croton zambesicus* (200 – 600mg/kg) significantly (p<0.001) inhibited ulcers produced by the ulcerogens used; indomethacin, ethanol and histamine. The results of this work suggest that the leaf extract of *Croton zambesicus* possesses antiulcer activity, supporting the ethnomedical use of the plant.

**Keywords:** Do *Croton zambesicus*, antiulcer, gastroprotective

**INTRODUCTION**

*Croton zambesicus* Muell Arg. (Euphorbiaceae) (syn *C. amabilis* Muell. Arg. *C. gratissimus* Burch) is an ornamental tree grown in villages and towns in Nigeria. It is a Guineo – congolese species widely spread in tropical Africa. Ethnobotanically, the leaf decoction is used in Benin as anti-hypertensive and anti-microbial (urinary infections) (Adjanohoun et al , 1989) and in parts of Nigeria as antidiabetic and malarial remedy (Okokon et al., 2005a, 2006). The roots are used as antimalarial, febrifuge and antidiabetic by the Ibibios of Niger Delta region of Nigeria (Okokon and Nwafor, 2009a). The root is also used in Sudan for menstrual pain (El-Hamidi, 1970) and as aperients (Ngadjui et al., 1999). Boyom et al. (2002) studied the composition of essential oils from the leaves, stem and roots of *Croton zambesicus* and found the three types of oils to be similar in composition, with those from the leaves and stem rich in monoterpens, while that of the root bark contains sesquiterpenes. The root and stem bark oils were found to be rich in oxygen-containing compounds, with spathulenol and linalool as major components. Okokon and Nwafor (2009a) reported that the root extract whose LD50 is 273.86 mg/kg contains alkaloids, saponins, terpenes, tannins, phlobatannins, anthraquinones and cardiac glycosides, while flavonoids were reported to be absent. Block et al. (2002) isolated entrachyloban-3β-ol, an ent-trachylobane diterpene from dichloromethane extract of the leaves and reported that the diterpene has a cytotoxic activity on HeLa cells. Also two new trachylobane – and one isopimarane type diterpenoids; ent-18-hydroxy-trachyloban-3-one, ent-trachyloban-3-one, isopimara-7,15-dien-3β-ol, together with transphytol, β-sitosterol, α-amyrin and stigmaterol have been isolated from the leaves (Block et al., 2004). Crotonadiol, a labdane diterpenoid, clerodane, crotocorylfuran and two trachylobanes; 7β-acetoxytrachyloban – 18 – oic acid, trachyloban - 7β, 18 – diol, lupeol, β-sitosterol and its 3β-glucopyranosyl derivative were isolated from the stem
bark (Ngadjui et al., 1999). Ngadjui et al., (2002) further isolated three clerodane diterpenoids, crotozambefurans A, B and C from the stem bark. Studies have reported on the antimicrobial properties of the leaf and stem (Abo et al., 1999) as well as roots (Okokon and Nwafor, 2010). The ethanolic leaf extract has been reported to possess antiplasmodial (Okokon et al., 2005a), antidiabetic (Okokon et al., 2006), anti-inflammatory, analgesic and antipyretic activities (Okokon et al., 2005b), while the root extract has been reported to possess antimalarial (Okokon and Nwafor, 2009a) and anticonvulsant and antiulcer activities (Okokon and Nwafor, 2009b).

Information on biological activity of the leaf are scarce. We therefore investigated the gastroprotective activity of the leaf extract in rats to ascertain antiulcer potentials of this plant as it is highly patronised in traditional medicine in the treatment of ulcer.

MATERIALS AND METHODS

Plant Materials
The fresh leaves of Croton zambsicus were collected from the premises of the University of Uyo and were identified and authenticated as Croton zambsicus. Muell. Arg (Euphorbiaceae) by Dr. (Mrs.) Margaret Bassey of the Department of Botany and Ecological studies, University of Uyo and deposited at herbarium of Department of Pharmacognosy and Traditional Medicine, University of Uyo (DPNM.31c).

Extraction:
The leaves of the plant were air-dried, pulverized using a pestle and mortar and cold-macerated for 72 hours using ethanol. The liquid ethanolic extract that was obtained by filtration was concentrated in vacuo at 40°C and all the ethanol was completely removed. The ethanolic extract was stored at -4°C until used.

Animals:
Albino rats (105 – 165g) of either sex were obtained from the University of Uyo animal house. They were maintained on standard animal pellets and water ad libitum. Permission and approval for animal studies were obtained from the College of Health Sciences Animal Ethics committee, University of Uyo.

Evaluation of antiulcer activity

Indomethacin-induced ulcer: Male adult albino rats (150 – 170g) were randomly divided into five groups of six rats each. The animals were starved from food 24 hours and water 2h before the commencement of experiment (Alphin and Ward, 1967). They were treated as follows; Group 1 (control) received only indomethacin (Sigma, 60 mg/kg p.o. dissolved in 5% Na2CO3); Groups 2 - 4 were pretreated with Croton zambsicus extract (200, 400 and 600 mg/kg p.o. respectively); Group 5 received cimetidine (100mg/kg p.o. dissolved in 50% Tween 80). One hour later, groups 2-5 were administered with indomethacin. Animals were killed by cervical dislocation, four hours after indomethacin administration. The stomachs were removed and opened along the greater curvature. The tissues were fixed with 10% formaldehyde in saline. Macroscopic examination was carried out with a hand lens and the presence of ulcer lesion was scored (Nwafor et al., 1996). Ulcer index (UI) and preventive ratio (PR) of each of the groups pretreated with extract were calculated using standard methods (Zaidi and Mukerji, 1985; Nwafor et al., 2000).

Ethanol-induced gastric ulceration: The procedures were similar to that used in indomethacin-induced ulceration except that the negative control group (group 1) received only ethanol (2.5 ml/kg p.o), Groups 2-4 were pretreated with Croton zambsicus extract (200, 400 and 600 mg/kg p.o. respectively);and positive control group (Group 5) received propranolol (40 mg/kg p.o. dissolved in distilled water). Time of administration of ulcerogen and sacrificed, stomach processing and examination as well as ulcer scoring were as in indomethacin-induced ulceration.

Histamine-induced gastric ulceration in rats: The procedures were similar to that used in indomethacin-induced ulceration except that the negative control group (group 1) received only received only histamine acid phosphate (Sigma, 100mg/kg i.p.dissolved in distilled water)(Maity et al.,1995); and positive control group (Group 5) received cimetidine (100mg/kg p.o. dissolved in 50% Tween 80). Groups 2 - 4 were pretreated with Croton zambsicus extract (200, 400 and 600 mg/kg p.o. respectively); Group 5 received cimetidine (100 mg/kg p.o. dissolved in 50% Tween 80). Time of administration of ulcerogen (histamine acid phosphate, 100mg/kg i.p), stomach processing and examination as well as ulcer scoring were similar to that used in indomethacin-induced ulceration except that the animals were killed by cervical dislocation 18 hours after histamine administration.

Statistical Analysis
Data are reported as mean ± standard error of the mean(SEM) and were analyzed statistically using One way ANOVA followed by Tukey-kramer multiple comparison test and values of p<0.01 were considered significant.
RESULTS

Indomethacin-induced gastric ulceration: The extract (p.o.) pretreatment on indomethacin-induced gastric ulceration showed a dose-dependent reduction in ulcer indices in pretreated groups relative to control. The reduction was statistically significant (P<0.001) compared to control. (Table 1). The effect of the extract was more than that exhibited by the standard drug, cimetidine.

Ethanol-induced gastric ulceration: The extract significantly protected rats from ethanol–induced ulcer (Table 2). There was a significant (P<0.001) dose-dependent reduction in the ulcer indices relative to control. The effect of the extract was more than that exhibited by the standard drug, propranolol.

Histamine–induced ulceration: Administration of the extract significantly (P<0.001) reduced histamine-induced gastric ulceration in a dose-dependent fashion compared to control (Table 3). The effect of the extract was more than that exhibited by the standard drug, cimetidine.

Table 1: Effect of C. zambesicus extract on indomethacin-induced ulcer

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Dose (mg/kg)</th>
<th>Ulcer Indices</th>
<th>Preventive Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (indomethacin)</td>
<td>60</td>
<td>15.16±1.24</td>
<td>-</td>
</tr>
<tr>
<td>C. zambesicus extract p.o.</td>
<td>200</td>
<td>6.66±1.32*</td>
<td>56.06</td>
</tr>
<tr>
<td></td>
<td>400</td>
<td>1.66±0.76*</td>
<td>89.05</td>
</tr>
<tr>
<td></td>
<td>600</td>
<td>1.50±0.50*</td>
<td>90.10</td>
</tr>
<tr>
<td>Cimetidine</td>
<td>100</td>
<td>2.50±0.27*</td>
<td>83.50</td>
</tr>
</tbody>
</table>

Data were expressed as mean ±SEM. significant at *p< 0.001 when compared to control n = 6.

Table 2: Effect of C. zambesicus extract on ethanol-induced ulcer

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Dose (mg/kg)</th>
<th>Ulcer indices</th>
<th>Preventive ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (ethanol)</td>
<td>-</td>
<td>± 0.57</td>
<td>-</td>
</tr>
<tr>
<td>C. zambesicus extract p.o.</td>
<td>200</td>
<td>1.66±0.47*</td>
<td>54.64</td>
</tr>
<tr>
<td></td>
<td>400</td>
<td>0.33±0.37*</td>
<td>90.98</td>
</tr>
<tr>
<td></td>
<td>600</td>
<td>0.00±0.00*</td>
<td>100</td>
</tr>
<tr>
<td>Propranolol</td>
<td>40</td>
<td>1.33±0.47*</td>
<td>63.66</td>
</tr>
</tbody>
</table>

Data were expressed as mean ±SEM. significant at *p< 0.001 when compared to control n = 6.

Table 3: Effect of C. zambesicus extract on histamine-induced ulceration in rats

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Dose (mg/kg)</th>
<th>Ulcer index</th>
<th>Preventive ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (Histamine)</td>
<td>100</td>
<td>11.33±0.68</td>
<td>-</td>
</tr>
<tr>
<td>C. zambesicus extract</td>
<td>200</td>
<td>6.33±2.11*</td>
<td>44.13</td>
</tr>
<tr>
<td></td>
<td>400</td>
<td>2.00±0.73*</td>
<td>82.39</td>
</tr>
<tr>
<td></td>
<td>600</td>
<td>1.00±0.36*</td>
<td>91.17</td>
</tr>
<tr>
<td>Cimetidine</td>
<td>100</td>
<td>2.00±0.77*</td>
<td>82.34</td>
</tr>
</tbody>
</table>

Data were expressed as mean ±SEM. Significant at *p< 0.001 when compared to control n = 6.
DISCUSSION

*Croton zambesicus* leaves though used in the treatment of various diseases have been reported to be used traditionally in the treatment of gastrointestinal disorders. For this reason, the antiulcer activity of the leaf extract was evaluated using indomethacin, ethanol and histamine–induced ulcer models. Indomethacin, is known to cause ulcer especially in an empty stomach and histamine–induced ulcer models. Indomethacin, ethanol, and hexoxygenase pathway (Rainsford, 1987). Prostaglandins function to protect the stomach from injury by stimulating the secretion of bicarbonate and mucus, maintaining mucosal blood flow and regulating mucosal turnover (Hayllar and Bjarnason, 1995; Hiruma-Lima et al., 2006). Suppression of prostaglandins synthesis by indomethacin result in increased susceptibility of the stomach to mucosal injury and gastroduodenal ulceration.

The extract was observed to significantly reduce mucosal damage in the indomethacin–induced ulcer model, suggesting the possible extract mobilization and involvement of prostaglandin in the anti- ulcer effect of the extract. Administration of ethanol has been reported to cause disturbances in gastric secretion, damage to the mucosa, alterations in the permeability, gastric mucus depletion and free radical production (Salim, 1990). This is attributed to the release of superoxide anion and hydroperoxy free radicals during metabolism of ethanol as oxygen derived free radicals has been found to be involved in the mechanism of acute and chronic ulceration in the gastric mucosa (Pihan et al., 1987). It was observed in this study that the extract significantly reduced ethanol-induced ulcer. This may be due to cytoprotective effect of the extract via antioxidant effects. Ethanol is also reported to cause gastric mucosal damage by stimulating the formation of leukotriene C₄ (LTC₄) (Whittle et al., 1985). The gastroprotective effect of the extract may in part be due to the suppression, by the extract of lipoxygenase activity (Nwafor et al., 1996). Histamine-induced ulceration is known to be mediated by enhanced gastric acid secretion as well as by vasospastic action of histamine (Cho and Pfeiffer, 1981). The inhibition of ulcer due to histamine by the extract may be due to its suppression of histamine-induced vasospastic effect and gastric secretion. The leaf extract has been found to contain flavonoids, terpenes, saponins, alkaloids and cardiac glycosides among others. Flavonoids such as quercetin have been reported to prevent gastric mucosal lesions in various experimental models (Di carlo et al., 1999; Zayachkivska, 2005) by increasing the amount of neutral glycoproteins (Di carlo et al., 1999). Flavonoids have been reported to protect the gastric mucosa from damage by increasing the mucosal prostaglandin content and by inhibiting histamine secretion from mast cells by inhibition of histidine decarboxylase. Free radical scavenging ability of flavonoids has been reported to protect the gastrointestinal tract from ulcerative and erosion lesion (Borrelli and Izzo, 2000). Saponins, especially triterpenes type have been implicated in antiulcer activity mediated by formation of protective mucus on the gastric mucosa and also protect the mucosa from acid effects by selectively inhibiting PGF₂α (Agwu and Okunji, 1986; Lewis and Hanson, 1991). The antiulcer activity of the root extract of *C. zambesicus* has been reported by Okokon and Nwafor (2009a). Also, essential oil from the bark of *Croton cajucara* has been reported to produced gastroprotective effect in rodent (Hiruma-Lima et al., 2000).

In conclusion, the results of the present study show that *Croton zambesicus* leaf extract displays gastroprotective activity as demonstrated by significant inhibition of the formation of ulcers induced through the three different ulcer models studied. The antiulcer activity of the extract may be due to the action of the chemical compounds present in the extract. The observation justifies the ethnomedical uses of the plants as antiulcer agent and as antacid in addition to its nutritional values.

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**REFERENCES**


