Antinociceptive and Anti-Inflammatory Activities of *Telfairia occidentalis* Hydroethanolic Leaf Extract (Cucurbitaceae)

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ABSTRACT *Telfairia occidentalis* (Cucurbitaceae) is a tropical vine grown in West Africa as a leaf vegetable and for its edible seeds. The plant is noted to have healing properties. It is used as a blood tonic to revive weak/ill individuals and its use by sickle cell patients has been documented. In this study, the antinociceptive activity of the hydroethanolic leaf extract of *Telfairia occidentalis* (TO) was evaluated using the acetic acid-induced writhing, formalin, tail clip, and hot plate tests in mice. The carrageenan- and egg albumin-induced rat paw edema tests were used to evaluate the anti-inflammatory action. The extract (50–400 mg/kg, p.o.) produced significant ($P < .05$) dose-dependent inhibition of pain response elicited by acetic acid and formalin while also increasing the nociceptive reaction latency in the tail clip and hot plate tests. In respect of anti-inflammatory activity, the extract elicited significant ($P < .05$) time and dose-dependent inhibition of edema development in the carrageenan and egg albumin tests. Peak effects of TO in the models were generally comparable with the effects of the standard drugs (acetylsalicylic acid, morphine, indomethacin, and chlorpheniramine) used. Phytochemical screening of the extract revealed the presence of tannins, saponins, phlobatannins, and anthraquinones. The extract did not produce any mortality and visible signs of delayed toxicity when administered orally up to 2000 mg/kg. The LD₅₀ (i.p.) was estimated to be 4073.80 mg/kg. The results obtained in this study suggest that TO possesses antinociceptive and anti-inflammatory activities possibly mediated through peripheral and central mechanisms involving inhibition of release and/or actions of vasoactive substances and prostaglandins.

KEY WORDS: • anti-inflammatory • anti-nociceptive • Cucurbitaceae • medicinal food • *Telfairia occidentalis*

INTRODUCTION

THE USE OF medicinal plants dates back a long time.¹ The classical plants of present day pharmacology are characterized by the fact that they all contain a high proportion of effective compounds, which are easily extracted. Owing to these effective medicinal compounds, which plants contain, these groups of plants have attracted attention in recent times. Africa is a continent endowed with an enormous wealth of plant resources and most of these have been used for several centuries in traditional medicine for the prevention and treatment of diseases.² During the past 10 years, there has been a substantial resurgence of interests and pursuits of natural product drug discovery and development both in the public and private sectors. Explanation for this might include the increasingly sophisticated development process; the very real threat of the disappearance of the

biodiversity essential for such research; and the persistence of old diseases and the emergence of new diseases that remain intractable to any known medicine or treatment.³

The treatment of pain is one area in which Nigerian traditional medicine practitioners enjoy patronage and success.⁴ A good number of plant species are available for this purpose, and the method of usage differs from one area to another. The common practice involves taking the extracts orally. *Telfairia occidentalis*, commonly called fluted pumpkin, is a vegetable, which belongs to the family Cucurbitaceae. It is a crop of commercial importance grown in West Africa; Nigeria, Ghana, and Sierra Leone being the major producers.⁵ Fluted pumpkin is majorly cultivated for its leaves and eaten as a potherb.⁶ In Nigeria, it is called Ugu in Igbo land, Iroko in Yoruba land, and Umeke in Edo. It is cultivated by seed in the southern part of Nigeria where it is majorly produced. The leaves of the plant contain a high amount of antioxidants and have been reported to have hepatoprotective, antimicrobial, and antischistosomal properties.^{7,8}

The aim of this study was to evaluate the antinociceptive and anti-inflammatory activities of the hydroethanolic leaf extract of *T. occidentalis* (TO) in rodents.

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MATERIALS AND METHODS

Plant authentication and preparation of extract

Fresh leaves of *T. occidentalis* were obtained from Oshodi Market in Lagos State, Nigeria. The plant material was identified and authenticated by Mr. T.K. Odewo of the Department of Botany and Microbiology, Faculty of Science, University of Lagos, Akoka, Lagos, Nigeria. A voucher specimen (No. LUH 5580) was deposited in the institutional herbarium for reference purposes.

The fresh leaves of *T. occidentalis* were air-dried in the laboratory until constant weight was obtained. The dried leaves (183 g) were pulverized and macerated in 1500 mL of hydroethanol (1:1) for 48 h. The extract was thereafter decanted and filtered, and the residue was remacerated in 1000 mL hydroethanol ($\times 2$) for 48 h to ensure exhaustive extraction. At the end of the extraction process, the combined filtrate was evaporated to dryness under reduced pressure at 40°C. A dark brownish solid extract with a yield of 15.4% was obtained. The solid extract was reconstituted in distilled water to give appropriate concentrations before administration to experimental animals.

Experimental animals

Albino mice (20–25 g) and rats (150–200 g) of either sex used in this study were obtained from the Laboratory Animal Centre of the College of Medicine, University of Lagos, Lagos, Nigeria. The animals were maintained under standard environmental conditions (23–25°C, 12-h light/12-h dark cycle) with access to standard rodent diet (Livestock Feed PLC, Lagos, Nigeria) and water *ad libitum*. The experimental procedures adopted in this study were in accordance with the U.S. National Institute of Health Guidelines for Care and Use of Laboratory Animals in Biomedical Research.⁹ Equal numbers of male and female animals were used in all the groups in this study, and animals were acclimatized for 2 weeks before the commencement of the experimental procedures.

Preliminary phytochemical screening

The hydroethanolic leaf extract of *T. occidentalis* was qualitatively screened for the presence of various phytochemicals using established methods.^{10,11}

Acute toxicity test

Groups of mice fasted for 12 h before the test were administered the extract orally at the dose of 2000 mg/kg and intraperitoneally at doses of 1000, 2000, 4000, and 5000 mg/kg. Mortality observed in each group within 24 h was recorded. Surviving animals were observed for further 7 days for any signs of delayed toxicity. The LD₅₀ was estimated by the log dose–probit analysis method.¹²

Antinociceptive activity

Acetic acid-induced writhing test. Mice fasted overnight were divided into six groups of five animals each. The animals were then treated with distilled water (10 mL/kg,

p.o.), *T. occidentalis* (50, 100, 200, 400 mg/kg, p.o.), acetylsalicylic acid (ASA; 100 mg/kg, p.o.), and morphine (10 mg/kg, s.c.). Sixty minutes after oral treatment and 30 min post-subcutaneous administration, mice were administered acetic acid (0.6% v/v, 10 mL/kg, i.p.). The number of writhes (characterized by contraction of the abdominal musculature and extension of the limbs) was then counted for 30 min at 5-min intervals. Inhibition (%) was calculated from data obtained.¹³

Formalin test. Mice fasted overnight were divided into six groups of five animals each. The different groups of animals were treated with distilled water (10 mL/kg, p.o.), *T. occidentalis* (50, 100, 200, and 400 mg/kg, p.o.), ASA (100 mg/kg, p.o.), and morphine (10 mg/kg, s.c.). Sixty minutes post-oral treatment and 30 min after subcutaneous administration, formalin (20 μ L of 1% solution) was injected s.c. into the right hind paw of the mouse. The time (in sec) spent in licking and biting responses of the injected paw, indicative of pain, was recorded for each animal. The responses of the mice were observed for 0–5 min (first phase) and 15–30 min (second phase) post-formalin injection.¹⁴

Tail clip test. Mice were initially screened by applying a metal artery clip to the root of the tail to induce pain, and animals which failed to attempt to dislodge the clip in 10 sec were discarded. Eligible mice were divided into six groups of five mice each. Thereafter, treatment was done as follows: distilled water (10 mL/kg, p.o.), *T. occidentalis* (50, 100, 200, and 400 mg/kg, p.o.), and morphine (10 mg/kg, s.c.). The reaction time of each mouse was then determined 60 min post-oral administration and 30 min post-treatment for subcutaneous administration. A post-treatment cut-off time of 30 sec was used.¹⁵

Hot plate test. Mice used in this experiment were initially screened by placing the animals in turn on a hot plate set at 55 $\pm$ 1°C, and animals which failed to lick the hind paw or jump (nociceptive responses) within 15 sec were discarded. Eligible animals were divided into six groups of five mice each, and the pretreatment reaction time for each mouse was determined. Mice in different groups were then treated with distilled water (10 mL/kg, p.o.), *T. occidentalis* (50, 100, 200, and 400 mg/kg, p.o.), and morphine (10 mg/kg, s.c.). The reaction time of each mouse was then determined 60 min post-oral administration and 30 min post-treatment for subcutaneous administration. A post-treatment cut-off time of 30 sec was used.^{16,17}

Anti-inflammatory activity

Carrageenan-induced rat paw edema test. Rats used in this experiment were divided into six groups of five animals each and the respective groups were treated with distilled water (10 mL/kg, p.o.), *T. occidentalis* (50, 100, 200, and 400 mg/kg, p.o.), and indomethacin (10 mg/kg, p.o.). One hour after administration of the various agents, edema was induced by injection of carrageenan (0.1 mL, 0.01 g/mL

saline) into the subplantar tissue of the right hind paw. The linear paw circumference was then measured using the cotton thread method of Bambgose and Noamesi.¹⁸ Measurements of paw circumference were done immediately before injection of the phlogistic agent and at 1-h intervals for 6 h.¹⁹

Egg albumin-induced rat paw edema test. Treatment with distilled water (10 mL/kg, p.o.), *T. occidentalis* (50, 100, 200, and 400 mg/kg, p.o.), and chlorpheniramine (60 mg/kg, p.o.) was carried out in six groups of five rats each. One hour post-treatment, edema was induced by injection of egg albumin (0.1 mL, 0.01 g/mL saline) into the subplantar tissue of the right hind paw. The linear paw circumference was then measured using the cotton thread method of Bambgose and Noamesi.¹⁸ Linear paw circumferences of rats were determined just before injection of the phlogistic agent and at 30-min intervals for 3 h.¹⁴

Statistical analysis

Data are presented as mean $\pm$ standard error of the mean (SEM). Statistical analysis was done using Student's *t*-test and one-way ANOVA, followed by Tukey's *post hoc* test, as applicable, using GraphPad Prism 5 software (GraphPad Software, Inc., La Jolla, CA, USA). Results were considered significant at $P < .05$.

RESULTS

Preliminary phytochemical screening

The results revealed the presence of saponins, tannins, anthraquinones, and phlobatannins.

Acute toxicity test

T. occidentalis did not produce any mortality when administered orally up to 2000 mg/kg. When administered intraperitoneally at doses of 1000, 2000, 4000, and 5000 mg/kg, the mortality produced was 0%, 20%, 40%, and 60%, respectively. The LD₅₀ value for the intraperitoneal route was obtained to be 4073.80 mg/kg.

Acetic acid-induced writhing test

Intraperitoneal injection of acetic acid elicited the writhing syndrome in control mice with 113.4 ± 7.39 writhes counted in 30 min. *T. occidentalis* produced significant dose-dependent ($P < .05$, .001) reduction in the number of writhes with peak effect (80.78% inhibition) produced at the highest dose of 400 mg/kg. This effect was comparable with that produced by 100 mg/kg acetylsalicylic acid (72.31% inhibition) and 10 mg/kg morphine (96.47% inhibition) (Fig. 1).

Formalin test

In the first phase, injection of formalin into the subplantar tissue of the right hind paw of control mice produced nociceptive responses of biting and licking of the injected paw with a total duration of 113.4 ± 14.05 sec. *T. occidentalis*

FIG. 1. Effect of *Telfairia occidentalis* (TO) in the acetic acid-induced mouse writhing test. Bars represent mean $\pm$ SEM ($n=5$). ^a $P < .05$, ^c $P < .001$ versus control; ^γ $P < .05$, ^{**} $P < .001$ versus morphine; ^{**} $P < .01$ versus ASA (one-way ANOVA, followed by Tukey's *post hoc* test). ASA, acetylsalicylic acid.

produced significant ($P < .05$ –.001) dose-dependent inhibition of nociceptive reaction with peak effect (61.12% inhibition) produced at the dose of 400 mg/kg. This effect was higher than that produced by 100 mg/kg acetylsalicylic acid (29.81% inhibition), but was comparable with the effect produced by 10 mg/kg morphine (91.81% inhibition). In the second phase, the total duration of nociceptive reaction in the control group was 135.20 ± 15.14 sec. The effect of the extract in inhibiting the biting and licking responses was significant ($P < .05$ –.001) and dose-dependent. The greatest effect (86.98% inhibition) was produced at the highest dose of 400 mg/kg. The effect of ASA (63.61% inhibition) was comparable and not significantly different from that of the most effective dose of the extract. In addition, the peak effect of the extract was comparable and not significantly different ($P > .05$) relative to the effect of 10 mg/kg morphine (98.22% inhibition) (Fig. 2).

Tail clip test

Application of the metal artery clip onto the tails of mice in the control group elicited reactions toward clip removal with the post-treatment latency being 1.29 ± 0.12 sec compared with pretreatment latency of 0.70 ± 0.14 sec. *T. occidentalis* caused a significant ($P < .001$) dose-dependent increase in reaction latency with peak effect produced at the dose of 400 mg/kg. The effect at this dose of the extract was less than that elicited by morphine (10 mg/kg) (Fig. 3).

Hot plate test

Application of thermal stimuli to the animals in the control group elicited reactions with the post-treatment latency being 2.86 ± 0.31 sec compared with pretreatment latency of 3.36 ± 0.56 sec (Fig. 4). *T. occidentalis* caused a significant ($P < .05$) dose-dependent increase in reaction latency with peak effect (47.74% inhibition) produced at the dose of 400 mg/kg. This effect was less than that elicited by morphine (10 mg/kg; 100%).

FIG. 2. Effect of *T. occidentalis* (TO) in the formalin test in mice. Bars represent mean $\pm$ SEM ($n=5$). ^a $P < .05$, ^b $P < .01$, ^c $P < .001$ versus control; ^γ $P < .05$, ^β $P < .01$, ^α $P < .001$ versus morphine (one-way ANOVA, followed by Tukey's *post hoc* test).

Carrageenan-induced rat paw edema test

Injection of carrageenan into the subplantar tissue of the right hind paw of rats in the control group caused edema development, which peaked at 3 h post-phlogistic agent injection (0.50 ± 0.06 cm increase in paw circumference). *T. occidentalis* produced significant ($P < .05-.001$) time and dose-dependent inhibition of edema development with peak effect (88.24% inhibition) produced at the dose of 400 mg/kg at the sixth hour. This effect was equal to that elicited by 10 mg/kg of indomethacin (Table 1).

Egg albumin-induced rat paw edema test

Subplantar injection of egg albumin into the right hind paw of rats in the control group produced edema, which peaked at 30 min post-phlogistic agent injection (0.84 ± 0.07 cm

FIG. 3. Effect of *T. occidentalis* (TO) in the tail clip test in mice. Bars represent mean $\pm$ SEM ($n=5$). ^a $P < .05$, ^b $P < .01$, ^c $P < .001$ versus pretreatment latency (Student's *t*-test; paired, two-tailed).

FIG. 4. Effect of *T. occidentalis* (TO) in the hot plate test in mice. Bars represent mean $\pm$ SEM ($n=5$). ^a $P < .05$, ^b $P < .01$ versus pre-treatment latency (Student's *t*-test; paired, two-tailed).

increase in paw circumference). *T. occidentalis* produced significant ($P < .05-.001$) time-dependent but dose-independent inhibition of edema development. Peak significant effect (85.71% inhibition) was produced at the dose of 200 mg/kg at the 2.5-h interval. This effect was comparable and not significantly different ($P > .05$) from that produced by 60 mg/kg chlorpheniramine (64.29% inhibition) at the same time interval (Table 2).

DISCUSSION

The aim of this study was to evaluate the antinociceptive and anti-inflammatory activities of the hydroethanolic leaf extract of *T. occidentalis* in rodents. In the mouse writhing test, the intraperitoneal injection of acetic acid elicited writhing (a syndrome characterized by a wave of abdominal musculature contraction, followed by extension of the hind limbs). The writhing test is simple, reliable, and affords rapid evaluation of antinociceptive activity.²⁰ The induction of writhing by chemical substances injected intraperitoneally results from the sensitization of nociceptors by prostaglandins,²¹ and the test is useful for evaluation of mild, antinociceptive, nonsteroidal anti-inflammatory drugs.²² The dose-dependent inhibition of writhing induced by acetic acid in this study by *T. occidentalis* suggests significant peripherally mediated antinociceptive activity. This is based on the association of the model with stimulation of peripheral receptors, especially the local peritoneal receptors at the surface of cells lining the peritoneal cavity.²³ Morphine and ASA were significantly effective in this model, although morphine was more potent.

The formalin test, a method commonly used to study the anti-inflammatory antinociceptive properties of drugs,²⁴ has been reported to produce a distinct biphasic nociceptive response.²³ The first phase (0–5 min) has been associated

TABLE 1. EFFECT OF *TELFAIRIA OCCIDENTALIS* ON CARRAGEENAN-INDUCED RAT PAW EDEMA

Treatment	Dose (mg/kg)	Increase in paw circumference (cm)					
		T1h	T2h	T3h	T4h	T5h	T6h
Distilled water	10 (mL/kg)	0.22±0.04 (—)	0.36±0.06 (—)	0.50±0.06 (—)	0.34±0.07 (—)	0.34±0.07 (—)	0.34±0.07 (—)
Indomethacin	10	0.14±0.02 ^c (36.36)	0.14±0.06 ^b (61.11)	0.16±0.07 ^c (68.00)	0.08±0.02 ^c (76.47)	0.06±0.02 ^c (82.35)	0.04±0.02 ^c (88.24)
<i>T. occidentalis</i>	50	0.14±0.04 ^c (36.36)	0.22±0.05 (38.88)	0.28±0.06 ^b (44.00)	0.18±0.08 (47.06)	0.16±0.06 ^a (52.94)	0.14±0.04 ^a (58.82)
<i>T. occidentalis</i>	100	0.12±0.02 ^c (45.45)	0.18±0.04 ^a (50.00)	0.24±0.02 ^c (52.00)	0.14±0.02 ^a (58.82)	0.12±0.02 ^b (64.71)	0.08±0.02 ^c (76.47)
<i>T. occidentalis</i>	200	0.10±0.00 ^c (54.55)	0.14±0.02 ^b (61.11)	0.18±0.02 ^c (64.00)	0.10±0.03 ^b (70.59)	0.08±0.02 ^c (76.47)	0.06±0.02 ^c (82.35)
<i>T. occidentalis</i>	400	0.08±0.04 ^c (63.64)	0.12±0.04 ^b (66.67)	0.16±0.02 ^c (68.00)	0.08±0.02 ^c (76.47)	0.06±0.02 ^c (82.35)	0.04±0.02 ^c (88.24)

Values represent mean±SEM (n=5). Figures in parentheses indicate inhibition (%) of edema development.

^aP<.05, ^bP<.01, ^cP<.001 versus control (one-way ANOVA, followed by Tukey's *post hoc* test).

SEM, standard error of the mean.

with direct effect of formalin on nociceptors, while the late phase (15–30 min) is said to involve inflammatory processes.²⁵ Centrally acting drugs (e.g., morphine) inhibit both phases of the formalin test, while peripherally acting drugs (e.g., ASA) inhibit the late phase only.²⁶ From the results obtained in the formalin test, the extract significantly inhibited nociceptive reactions in both phases, thus confirming a peripheral mechanism of action while also suggesting the involvement of a central mechanism of the antinociceptive effect. The antinociceptive effect produced by *T. occidentalis* in the second phase was greater than that elicited in the first phase.

To confirm the involvement of central mechanism(s) in the antinociceptive activity of *T. occidentalis*, the tail clip and hot plate tests were used based on the fact that centrally acting antinociceptive drugs elevate the pain threshold of rodents toward pressure and heat.²³ The tail clip test involves application of a metal artery clip onto the tail of the experimental animals. The hot plate test involves the spinal reflex and measures the complex response to a noninflammatory, acute nociceptive input.^{23,27} In both tests, the extract produced a significant dose-dependent increase in reaction latency with peak effect at the dose of 400 mg/kg. Morphine elicited 100% pain inhibition in both tests. Based on the effectiveness of *T. occidentalis* in the tail clip and hot plate tests, a central mechanism of action is confirmed for its observed antinociceptive effect.

The anti-inflammatory activity of *T. occidentalis* was evaluated in this study using the carrageenan and egg albumin rat paw edema tests. Carrageenan-induced inflammation consists of three distinct phases, including an initial

release of histamine and serotonin, a second phase mediated by kinins, and a third phase involving prostaglandins. On the other hand, egg albumin-induced edema results from the release of histamine and serotonin.¹⁵ In this study, *T. occidentalis* showed a significant inhibitory effect on rat paw edema development in the three phases of the carrageenan test, with the observed anti-inflammatory activity being most pronounced in the third phase. These findings suggest that the extract inhibits the release and/or actions of vasoactive substances (histamine, serotonin, and kinins) and most especially prostaglandins. A strong involvement of the effect on prostaglandins release and/or actions is suggested based on the fact that the late phase of carrageenan-induced edema is associated with the release of prostaglandin-like substances²⁴ and is sensitive to clinically useful steroidal and nonsteroidal anti-inflammatory agents.²⁸ *T. occidentalis* also elicited a significant inhibitory effect on egg albumin-induced rat paw edema development. This confirms inhibition of the release and/or actions of histamine and serotonin as one of the mechanisms through which the extract produced its observed anti-inflammatory action.

Sickle cell disease is the most common of the hereditary blood disorders. It occurs almost exclusively among African Americans and black Africans.²⁹ A severe attack, known as sickle cell crisis, can cause pain because blood vessels can become blocked or the defective red blood cells can damage organs in the body.²⁹ The role of algnesia and inflammation in the pathophysiology of sickle cell anemia is of critical importance as the search for new therapeutic approaches to its management continues.^{30,31} Challenges emanating from the search for drugs and/or nutrients to cure or manage the

TABLE 2. EFFECT OF *T. OCCIDENTALIS* ON EGG ALBUMIN-INDUCED RAT PAW EDEMA

Treatment	Dose (mg/kg)	Increase in paw circumference (cm)					
		T0.5h	T1h	T1.5h	T2h	T2.5h	T3h
Distilled water	10 (mL/kg)	0.84±0.07 (—)	0.70±0.04 (—)	0.44±0.04 (—)	0.34±0.05 (—)	0.28±0.06 (—)	0.20±0.06 (—)
Chlorpheniramine	60	0.44±0.02 ^c (47.62)	0.34±0.05 ^c (51.43)	0.20±0.05 ^b (54.55)	0.14±0.05 ^a (58.82)	0.10±0.03 (64.29)	0.06±0.02 (70.00)
<i>T. occidentalis</i>	50	0.40±0.08 ^c (52.38)	0.32±0.07 ^c (54.29)	0.18±0.02 ^b (59.09)	0.12±0.02 ^a (64.71)	0.08±0.02 ^a (71.43)	0.04±0.02 (80.00)
<i>T. occidentalis</i>	100	0.38±0.08 ^c (54.76)	0.30±0.08 ^c (57.14)	0.18±0.03 ^b (59.09)	0.10±0.06 ^b (70.59)	0.06±0.04 ^a (78.57)	0.06±0.04 (80.00)
<i>T. occidentalis</i>	200	0.34±0.04 ^c (59.52)	0.28±0.02 ^c (60.00)	0.14±0.02 ^c (68.18)	0.08±0.02 ^b (76.47)	0.04±0.02 ^b (85.71)	0.02±0.02 (90.00)
<i>T. occidentalis</i>	400	0.32±0.04 ^c (61.90)	0.26±0.04 ^c (62.86)	0.16±0.02 ^c (63.64)	0.10±0.03 ^b (70.59)	0.08±0.02 ^a (71.43)	0.04±0.02 (80.00)

Values represent mean±SEM (n=5). Figures in parentheses indicate inhibition (%) of edema development.

^aP<.05, ^bP<.01, ^cP<.001 versus control (one-way ANOVA, followed by Tukey's *post hoc* test).

syndrome necessitated the trial and application of many substances, especially in developing countries where incomes are low and adequate medical care is grossly lacking.²⁹ Herbal medicines or alternate and complementary medicines become the most available option. In Nigeria and most developing countries, *T. occidentalis* has been used in the treatment of sickle cell crises.⁸ The results obtained in this study, thus provide a basis for the use of *T. occidentalis* extract as an adjunct in the management of this condition.

In respect of the preliminary phytochemical screening, *T. occidentalis* was found in this study to contain tannins, saponins, phlobatannins, and anthraquinones. One or a combination of these phytoconstituents may be responsible for the observed antinociceptive and anti-inflammatory activities observed in this study. Saponins and related phytosterols, tannins, and some glycosides have been reported to have antinociceptive and/or anti-inflammatory activities.^{32,33}

Based on the results obtained in the acute toxicity test, the hydroethanolic leaf extract of *T. occidentalis* can be said to be safe when administered through the oral route as the extract did not produce any mortality and visible signs of delayed toxicity when administered up to 2000 mg/kg. However, the LD₅₀ when administered intraperitoneally was estimated to be 4073.80 mg/kg.

CONCLUSION

The experimental findings in this study suggest that the hydroethanolic leaf extract of *T. occidentalis* possesses antinociceptive and anti-inflammatory activities possibly mediated through peripheral and central mechanisms involving inhibition of release and/or actions of vasoactive substances (histamine, serotonin, and kinins) and prostaglandins.

To isolate, identify, and characterize the specific phytochemical principles responsible for the established antinociceptive and anti-inflammatory properties of *T. occidentalis* and to determine the exact mechanism(s) of action, further research work is ongoing.

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AUTHOR DISCLOSURE STATEMENT

No competing financial interests exist.

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