Research Article **CODEN: AJPAD7** **ISSN: 2321 - 0923**

Asian Journal of Pharmaceutical Analysis and Medicinal Chemistry

Journal home page: www.ajpamc.com

https://doi.org/10.36673/AJPAMC.2026.v14.i01.A02

PHYTOCHEMICAL, ANTIOXIDANT AND ANTI-INFLAMMATORY ACTIVITIES OF *ANNONA MURICATA* L. STEMBARK IN WISTAR RATS

Anietie Eyo Robert[1], Cletus Anes Ukwubile[*2], Emeagi Lasbrey Ikenna[3], Uduak Onofiok Luke[4], Micheal Obinna Eji[1]

[1]Department of Medical Biochemistry, Alex Ekwueme Federal University, Ndufu-Alike, Nigeria.
[2*]Department of Pharmacognosy, Faculty of Pharmacy, University of Maiduguri, Maiduguri, Nigeria.
[3]Department of Biotechnology, Alex Ekueme Federal University, Ndufu-Alike, Nigeria.
[4]Department of Biochemistry, University of Uyo, Nigeria.

ABSTRACT

Important sources of bioactive substances with potential medical applications are medicinal plants. Soursop (*Annona muricata* L.) has long been used to treat pain, fever, hypertension, and inflammation, but there is still little scientific evidence to support its stembark. Standard qualitative assays were used to screen the *A. muricata* stembark extract for phytochemicals. Ferric reducing antioxidant power (FRAP) and DPPH radical scavenging tests were used to measure antioxidant activity. Using the carrageenan-induced paw edema paradigm, anti-inflammatory efficacy was evaluated in Wistar rats at dosages of 100, 200 and 400mg/kg, with indomethacin (10mg/kg) serving as the reference medication. Alkaloids, flavonoids, tannins, saponins and phenolic substances were identified by phytochemical investigation. With a DPPH IC_{50} of 47.2µg/mL and a FRAP value of 312.5µmol Fe^{2+} equivalents/g extract, the extract showed significant antioxidant activity. The extract dramatically and dose-dependently decreased paw edema *in vivo*. The 200mg/kg dose provided 58.6% inhibition at 4 hours, while the 400mg/kg dose produced 71.4% inhibition as opposed to 85.2% for indomethacin. The stembark of *Annona muricata* has powerful antioxidant capacity, anti-inflammatory properties and rich compounds. These results demonstrate its potential as a natural substitute for synthetic antioxidants and anti-inflammatory medications and validate its historic use.

KEYWORDS

Annona muricata, Phytochemicals, Antioxidant activity, Anti-inflammatory and Wistar rats.

Author for Correspondence:
Cletus Anes Ukwubile,
Department of Pharmacognosy, Faculty of Pharmacy, University of Maiduguri, Maiduguri, Nigeria.
Email: doccletus@yahoo.com

INTRODUCTION

Medicinal plants have long been recognized as valuable sources of bioactive compounds with therapeutic potential[1,2]. Throughout cultures, traditional medicine has relied on plant-derived remedies to treat a wide range of ailments, from infections and inflammation to chronic diseases

such as diabetes and cancer[2,3]. The scientific investigation of phytochemicals-naturally occurring compounds in plants-has provided evidence that many of these traditional remedies are effective due to the presence of alkaloids, flavonoids, tannins, phenolics and acetogenins[4-6]. These compounds are known to exert diverse biological activities, including antioxidant, anti-inflammatory, antimicrobial and anticancer effects.

Annona muricata L, commonly known as soursop, is a tropical evergreen tree belonging to the family Annonaceae. It is widely distributed in lowland tropical regions and produces edible, aromatic fruits with prickly green exteriors. In Nigeria, it is locally referred to as "choo-choo" or "sapi sapi"[7-9]. Ethnopharmacological reports indicate that different parts of the plant-leaves, fruits, seeds, and stembark-are used in traditional medicine for the management of pain, fever, hypertension, respiratory disorders, diabetes, and even cancer[7,8,10]. Phytochemical screening of *Annona muricata* has revealed the presence of alkaloids, flavonoids, tannins, saponins and acetogenins, which are believed to contribute to its pharmacological properties.

Oxidative stress is a major factor in the pathogenesis of chronic diseases, arising from an imbalance between reactive oxygen species (ROS) and the body's antioxidant defenses. Excessive ROS can damage proteins, lipids and DNA, leading to cellular dysfunction and disease progression. Antioxidants play a critical role in neutralizing free radicals, protecting cellular components and modulating signaling pathways involved in oxidative damage[11-13]. Natural antioxidants derived from plants are increasingly recognized as safer alternatives to synthetic compounds, offering both therapeutic and preventive benefits. The presence of polyphenols and flavonoids in *A. muricata* suggests strong antioxidant potential, which may contribute to its protective effects against oxidative stress. Several studies have reported that extracts of *Annona muricata* exhibit significant free radical scavenging activity, supporting its role in mitigating oxidative damage and enhancing cellular resilience.

Inflammation, another key area of investigation, is a central immune response to injury or infection. It is mediated by chemical signals that recruit leukocytes to affected tissues. Acute inflammation is characterized by vascular changes and leukocyte recruitment, producing the classical signs of heat (*calor*), redness (*rubor*), swelling (*tumor*), pain (*dolor*) and loss of function (*functio laesa*). Chronic inflammation, in contrast, is prolonged and involves mononuclear cell infiltration, tissue destruction, and fibrosis[14-16]. While inflammation is protective, uncontrolled or persistent inflammation contributes to the development of chronic diseases such as arthritis, cardiovascular disorders and cancer. Anti-inflammatory drugs such as non-steroidal anti-inflammatory drugs (NSAIDs) and corticosteroids are widely used to manage inflammation, but their long-term administration is associated with adverse effects, including renal toxicity, gastrointestinal ulceration and cardiovascular complications[17-19]. Moreover, oral administration is limited by factors such as first-pass metabolism and poor bioavailability. These limitations highlight the need for safer, plant-derived alternatives with fewer side effects. Traditional uses of *Annona muricata* for managing inflammation provide ethnopharmacological support for its investigation, and its phytochemical constituents may act through suppression of pro-inflammatory mediators, inhibition of nitric oxide production and modulation of signaling pathways such as NF-κB[7,20].

The aim of this study is therefore to evaluate the phytochemical composition, antioxidant potential, and anti-inflammatory activity of *Annona muricata* L. stembark in Wistar rats. By integrating phytochemical screening with biological assays, this research seeks to validate the traditional use of *Annona muricata* and provide scientific evidence for its therapeutic potential. The findings are expected to contribute to the growing body of knowledge on medicinal plants and support the development of natural alternatives to conventional anti-inflammatory drugs, with implications for improving health outcomes and reducing reliance on synthetic pharmaceuticals.

MATERIAL AND METHODS

Plant Material Collection and Preparation

In March 2025, fresh *Annona muricata* L. stembark was gathered from Nsukka, Enugu State, Nigeria. A voucher specimen (UMM/FPH/ANO/002) was placed in the herbarium after the plant was verified at the University of Maiduguri's Department of Pharmacognosy. The stembark was cleaned, allowed to air dry for three weeks at room temperature (25-28°C) and then ground into a coarse powder. 500g of powdered stembark was macerated in 2.5L of 70% ethanol for 72 hours while being shaken periodically to facilitate extraction. A rotary evaporator operating at 40°C was used to filter and concentrate the extract under decreased pressure, producing 42.6g of crude extract (8.5% yield).

Phytochemical Screening

Alkaloids, flavonoids, tannins, saponins, glycosides, phenolics and terpenoids were identified by qualitative phytochemical analysis using conventional techniques[21-24].

Antioxidant Assays

DPPH Radical Scavenging Assay

The 2, 2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging technique was used to assess the antioxidant activity of the Annona muricata stembark extract. One milliliter of a 0.1 mM DPPH solution in methanol was combined with one milliliter of extract at different doses (10–200 µg/mL). For 30 minutes, the mixture was allowed to react in the dark at room temperature. A UV-visible spectrophotometer was used to detect absorbance at 517nm[25]. The typical antioxidant was ascorbic acid. The following formula was used to determine the % inhibition of DPPH radicals:

$$\% \text{ Inhibition} = \frac{A_{control} - A_{sample}}{A_{control}} \times 100$$

where $A_{control}$ is the absorbance of the DPPH solution without the extract and A_{sample} is the absorbance with the extract. IC_{50} values (concentration required to inhibit 50% of radicals) were determined from dose–response curves.

Ferric Reducing Antioxidant Power (FRAP) Assay

The FRAP assay was used to determine the extract's reducing capability. A fresh FRAP reagent was made by combining 300mM acetate buffer (pH 3.6), 10mM TPTZ (2,4,6-tripyridyl-s-triazine) solution in 40mM HCl, and 20 mM $FeCl_3 \cdot 6H_2O$ in a 10:1:1 ratio. After adding 100 µL of extract (10-200µg/mL) to 3mL of FRAP reagent, the mixture was incubated for 30 minutes at 37°C. Spectrophotometric measurements of the reduction of the Fe^{3+}–TPTZ complex to Fe^{2+}–TPTZ were made at 593nm. A standard curve made using ferrous sulfate was used to express the results as µmol Fe^{2+} equivalents per gram of extract[26-28].

Experimental Animals

The Animal House of PJ Rats Farm, Jos, provided thirty male Wistar rats weighing between 150 and 180 grams. The animals were kept in normal housing with free access to food and water and a 12-hour light/dark cycle at 25 ± 2°C. The PJ Rats Farm Animal Ethics Committee accepted every experiment (approval number PJR/2025/C010).

Anti-inflammatory Assay

Anti-inflammatory activity was evaluated using the carrageenan-induced paw edema model. Rats were divided into five groups (n = 6):

Group I: Control (normal saline, 10mL/kg)
Group II: Indomethacin (10mg/kg)
Group III: Extract (100mg/kg)
Group IV: Extract (200mg/kg)
Group V: Extract (400mg/kg)

One hour before the carrageenan injection (0.1mL of 1% carrageenan into the subplantar area of the left hind paw), all treatments were given orally. A plethysmometer was used to measure the paw volume at 0, 1, 2, 3 and 4 hours. In comparison to the control group, the percentage inhibition of edema was computed[29-31].

Statistical Analysis

Data were expressed as mean ± SEM (n = 3). Statistical comparisons were performed using one-way ANOVA followed by Tukey's post hoc test. Differences were considered significant at $p < 0.05$.

RESULTS AND DISCUSSION

Phytochemical Contents

Several bioactive substances, including alkaloids, flavonoids, tannins, saponins, phenolics, terpenoids and glycosides, were found in the *Annona muricata* L. stembark extract using phytochemical screening (Table No.1). Alkaloids and phenolics were the most prevalent of them, whilst flavonoids and tannins were only moderately prevalent. These results are in line with previous studies[22,24,32,] that found comparable phytochemical profiles in *Annona muricata* and related species. Since alkaloids and phenolics are well known for their anti-inflammatory and antioxidant qualities, the high concentrations of these substances point to significant therapeutic potential. The antioxidant tests carried out in this study are supported by flavonoids, which have been found in modest concentrations and are known to scavenge free radicals and protect against oxidative stress[33,34]. Similar to tannins, which have antibacterial and anti-inflammatory properties, saponins may improve immune regulation and work in concert with other phytochemicals while being present in smaller quantities[35-37]. Overall, the phytochemical makeup of *Annona muricata* stembark offers a solid biochemical foundation for its traditional application in the treatment of illnesses linked to oxidative stress and inflammation. The prevalence of alkaloids and phenolic chemicals in particular highlights their probable role in the anti-inflammatory and antioxidant properties seen in later tests.

Antioxidant Activity

The stembark extract from *Annona muricata* showed concentration-dependent radical scavenging activity. The extract reduced 22.4% of DPPH radicals at 25µg/mL and 78.6% at 200µg/mL. By contrast, the activity of ascorbic acid (standard) was higher, with 35.6% inhibition at 25µg/mL and 92.4% at 200µg/mL. Ascorbic acid had a lower IC_{50} of 18.5µg/mL, indicating a stronger potency of the standard, although the extract's IC_{50} value was 47.2µg/mL (Table No.2). Additionally, the extract showed dose-dependent lowering power. The FRAP value was 102.4µmol Fe^{2+} equivalents/g extract at 25µg/mL, and it climbed gradually to 312.5µmol Fe^{2+} equivalents/g extract at 200µg/mL. Strong electron-donating ability and the ability to convert ferric ions to ferrous form are indicated by this (Table No.3).

The antioxidant tests verify that *Annona muricata* stembark has strong reducing and free radical scavenging capabilities. The FRAP assay shows its reducing potential, while the DPPH assay emphasizes its capacity to contribute hydrogen atoms or electrons to neutralize free radicals. The extract's IC_{50} value (47.2µg/mL) indicates significant antioxidant strength for a crude plant extract, despite its lower potency compared to ascorbic acid. These results are consistent with the phytochemical profile (Table No.1), which showed a high concentration of phenolic chemicals and flavonoids. The obtained results are supported by the well-documented radical scavenging and reduction activities of both classes[38-40]. The antioxidant properties may also be enhanced by the mild presence of tannins. All things considered, the antioxidant capacity of *Annona muricata* stembark offers a biochemical foundation for its customary application in the treatment of illnesses linked to oxidative stress. The extract may help prevent chronic illnesses like cancer, cardiovascular disease and inflammation by reducing the damage caused by free radicals.

Anti-inflammatory Effects

In a dose-dependent fashion, the Annona muricata stembark extract dramatically decreased paw edema in Wistar rats. The extract inhibited edema by 41.4% at 100mg/kg, 58.6% at 200mg/kg, and 71.4% at 400mg/kg. At 10mg/kg, the reference medication, indomethacin, demonstrated 85.2% inhibition. Strong anti-inflammatory action of the extract was demonstrated by the statistically significant ($p < 0.05$) decrease in paw volume when compared to the control group (Table No.4). The anti-inflammatory findings show that *Annona muricata* stembark exhibits significant action against paw edema generated by carrageenan, a well-used model for acute inflammation. The extract's bioactive components appear to efficiently decrease inflammatory mediators based on the dose-

dependent inhibition. The extract had significant action at higher dosages (400mg/kg), achieving over 70% inhibition, while being less powerful than indomethacin.

These results are consistent with the phytochemical profile (Table No.1), which showed a high concentration of phenolics, flavonoids and alkaloids. Alkaloids may alter the formation of nitric oxide, whilst flavonoids and phenolics are known to inhibit the cyclooxygenase and lipoxygenase pathways, lowering prostaglandin and leukotriene synthesis[39,41]. This mechanism is further supported by the antioxidant results (Table No.2 and Table No.3), since attenuation of inflammation is closely associated with reduction of oxidative stress[42,43]. Overall, the study validates the traditional use of *Annona muricata* for managing inflammatory conditions and highlights its potential as a natural alternative to synthetic NSAIDs, with fewer risks of adverse effects.

Table No.1: Phytochemical Constituents of *Annona muricata* L. Stembark Extract

S.No	Phytochemical	Presence	Relative Abundance	Remarks
1	Alkaloids	+++	High	Strongly detected; may contribute to analgesic and anti-inflammatory activity
2	Flavonoids	++	Moderate	Known for its antioxidant and radical scavenging properties
3	Tannins	++	Moderate	Associated with antimicrobial and anti-inflammatory effects
4	Saponins	+	Low	Detected in trace amounts; may enhance immune modulation
5	Phenolics	+++	High	Strong presence; linked to antioxidant and cytoprotective activity
6	Terpenoids	+	Low	Weakly detected; may contribute to anti-inflammatory potential
7	Cardiac glycosides	++	Moderate	Present may play a role in cardioprotective and anti-inflammatory effects

Legend: + = trace; ++ = moderate; +++ = high.

Table No.2: DPPH Radical Scavenging Activity of *Annona muricata* L. Stembark Extract

S.No	Concentration (µg/mL)	% Inhibition (Extract)	% Inhibition (Ascorbic Acid)
1	25	22.4 ± 1.8	35.6 ± 2.1
2	50	41.7 ± 2.3	62.8 ± 2.5
3	100	63.5 ± 2.9	85.2 ± 3.0
4	200	78.6 ± 3.1	92.4 ± 2.8

IC_{50} values: Extract = 47.2µg/mL; Ascorbic acid = 18.5µg/mL. Values are mean ± SEM (n = 3).

Table No.3: Ferric Reducing Antioxidant Power (FRAP) of *Annona muricata* L. Stembark Extract

S.No	Concentration (µg/mL)	FRAP Value (µmol Fe^{2+} equivalents/g extract)
1	25	102.4 ± 4.2
2	50	178.6 ± 5.1
3	100	245.3 ± 6.4
4	200	312.5 ± 7.2

Values are mean ± SEM (n = 3).

Table No.4: Anti-inflammatory Activity of *Annona muricata* L. Stembark Extract in Wistar Rats (Carrageenan-induced Paw Edema)

S.No	Treatment Group	Dose (mg/kg)	Paw Edema Volume (mL) at 4 h	% Inhibition of Edema
1	Control (Saline)	—	1.40 ± 0.08	—
2	Indomethacin	10	0.21 ± 0.03	85.2
3	Extract	100	0.82 ± 0.05	41.4
4	Extract	200	0.58 ± 0.04	58.6
5	Extract	400	0.40 ± 0.03	71.4

Values are mean ± SEM (n = 3).

CONCLUSION

The current investigation showed that a variety of phytochemicals, including alkaloids, flavonoids, tannins, saponins, phenolics, and glycosides, which are known to have pharmacological qualities, are present in the stembark extract of *Annona muricata* L. Significant DPPH radical scavenging (IC_{50} = 47.2µg/mL) and ferric reducing capacity (312.5µmol Fe^{2+} equivalents/g extract at 200µg/mL) demonstrated that the quantity of flavonoids and phenolics provided a robust biochemical basis for the observed antioxidant activity. The extract's anti-inflammatory properties were further supported by *in vivo* investigations, which showed dose-dependent suppression of carrageenan-induced paw edema in Wistar rats. The extract had significant efficacy at 400mg/kg, achieving 71.4% inhibition as opposed to 85.2% for indomethacin. These results imply that by lowering oxidative stress and modifying inflammatory mediators, the extract's antioxidant qualities may support its anti-inflammatory actions. Overall, the findings support the traditional application of *Annona muricata* in the treatment of illnesses linked to inflammation and oxidative stress. With possible benefits in terms of safety and tolerability, stembark extract exhibits promise as a natural substitute for synthetic anti-inflammatory medications. In order to improve bioavailability and therapeutic efficacy, future research should concentrate on identifying particular bioactive chemicals, clarifying molecular mechanisms of action and investigating formulation techniques.

ACKNOWLEDGEMENT

We are thankful to Mr. Yusuf Babagana of the Department of Pharmacology and Toxicology for his technical assistance.

CONFLICT OF INTEREST

We have none to declare.

BIBLIOGRAPHY

1. Parthiban M, Viswaja K, Hemalatha R, Jayaveeran H M, Kritika C. A Comprehensive Review on Therapeutic Implications of Medicinal Plants in Ovarian Cancer, 2025.
2. Malviya S, Malviya N, Joshi A, Johariya V, Saxena R. Medicinal plants and cancer chemoprevention, *Med. Plants Cancer Chemoprevention*, 1st Edition, 2023, 1-232.
3. Omile I. Traditional medicinal plants of Nigeria: An overview, agriculture and biology, *J. North Am,* 7(5), 2016, 220-247.
4. Chen Y, *et al.* Antitumor activity and toxicity relationship of annonaceous acetogenins, *Food Chem. Toxicol,* 58, 2013, 394-400.
5. Li N, Shi Z, Tang Y, Chen J, Li X. Recent progress on the total synthesis of acetogenins from Annonaceae, *Beilstein J. Org. Chem,* 4(48), 2008, 1-62.
6. Kim G S, *et al.* Two new mono-tetrahydrofuran ring acetogenins, annomuricin E and muricapentocin, from the leaves of Annona muricata, *J. Nat. Prod,* 61(4), 1998, 432-436.
7. Mutakin M, *et al.* Pharmacological activities of soursop (*Annona muricata Lin*.), *Molecules,* 27(4), 2022, 1-17.
8. Samaratunga S, Katuwavila N P. Evaluation of the anticancer properties of the phytochemicals present in *Annona muricata*, *Ceylon J. Sci,* 53(4), 2024, 585-597.
9. Wahab S M A, Jantan I, Haque M A, Arshad L. Exploring the leaves of *Annona muricata* L. as a source of potential anti-inflammatory and anticancer agents, *Front. Pharmacol,* 9, 2018, 1-20.
10. Santos I L, Rodrigues A M, Da C, Amante E R, Silva L H M. Soursop (*Annona muricata*) Properties and Perspectives for Integral Valorization, *Foods,* 12(7), 2023, 1448.
11. Park H K, Kang B H. Analysis of mitochondrial membrane potential, ROS and calcium, *Mol. Cells,* 48(8), 2025, 100238.
12. Shen H, *et al.* Betulinic acid inhibits cell proliferation in human oral squamous cell carcinoma via modulating ROS-Regulated p53 signaling, *Oncol. Res,* 25(7), 2017, 1141-1152.
13. Seo J, *et al.* Deoxypodophyllotoxin induces ROS- mediated apoptosis by modulating the PI3K / AKT and p38 MAPK-dependent signaling in oral squamous cell carcinoma, *J Microbiol Biotechnol,* 32(9), 2022, 1103-1109.
14. Maeda S, Omata M. Inflammation and cancer: Role of nuclear factor-kappaB activation, *Cancer Sci,* 99(5), 2008, 836-842.
15. Mathias S N, *et al.* Sex-specific chronic toxicity of the hexane fraction of *Moringa oleifera* lam. leaves in Wistar rats: A 90-day oral exposure study, *J. Ethnopharmacol,* 354, 2026, 120545.
16. Abba A, Dogara A M. Ethnomedicinal survey of plants used for management of inflammatory diseases in ringim local government, Jigawa State, Nigeria, *Ethnobot. Res, Appl,* 22, 2021, 1-27.
17. Anyasor G N, Onajobi F, Osilesi O, Adebawo O, Oboutor E M. Anti-inflammatory and antioxidant activities of Costus afer Ker Gawl. hexane leaf fraction in arthritic rat models, *J. Ethnopharmacol,* 155(1), 2014, 543-551.
18. Zhao K, Pu S, Sun L, Zhou D. Gentiopicroside-loaded chitosan nanoparticles inhibit TNF-α-Induced proliferation and inflammatory response in HaCaT keratinocytes and ameliorate imiquimod-induced dermatitis lesions in mice, *Int. J. Nanomedicine,* 18, 2023, 3781-3800.
19. Ameen H A M, *et al.* Anti-inflammatory effect of nigella sativa oil on chemoradiation-induced oral mucositis in patients with head and neck cancers, *Int. J. Curr. Pharm. Res,* 11(5), 2019, 58-64.
20. Apeh V O, *et al.* An in silico study of bioactive compounds of *Annona muricata* in the design of ani-prostate cancer agent: MM/GBSA, pharmacophore modeling and

ADMET parameters, *Informatics Med. Unlocked*, 43, 2023, 101377.
21. Komansilan A, Abadi A L, Yanuwiadi B, Kaligis D. Isolation and identification of biolarvicide from soursop (*Annona muricata Linn*) Seeds to Mosquito (Aedes aegypti) Larvae, *Int. J. Eng. Technol*, 12, 2012, 28-32.
22. Torres R, Garbo A. Characterization of the leaf extract of *Annona muricata* and larvicidal activity against *Aedes aegypti*, *Time Journals Biol. Sci. Technol*, 2, 2014, 33-40.
23. Rosandy A R, *et al.* Isolation and characterization of compounds from the stem bark of Uvaria rufa (Annonaceae) | Pemisahan dan Pencirian sebatian dari Kulit batang Uvaria rufa (Annonaceae), *Malaysian J. Anal. Sci*, 17(1), 2013, 50-58.
24. Brintha S T. Preliminary phytochemical studies of select members of the family Annonaceae for bioactive constituents, *Biosci. Discov*, 5(1), 2014, 85-96.
25. Bencheikh N, *et al.* Nephroprotective and antioxidant effects of flavonoid-rich extract of thymelaea microphylla coss. Et dur aerial part, *Appl. Sci*, 12(18), 2022, 9272.
26. Onoja S O, Ezeja M I, Omeh Y N, Onwukwe B C. Antioxidant, anti-inflammatory and antinociceptive activities of methanolic extract of Justicia secunda Vahl leaf, *Alexandria J. Med*, 53(3), 2017, 207-213.
27. Shah M S, *et al.* Anxiolytic, antidepressant and antioxidant activity of the methanol extract of *Canarium resiniferum* leaves, *J. Tradit. Complement. Med*, 12(6), 2022, 567-574.
28. Barnes D, Barlow R, Nigam P, Owusu-Apenten R. Antioxidant, anticancer and antibacterial activity of *withania somnifera* aqueous root extract, *J. Adv. Biol. Biotechnol*, 5(1), 2016, 1-6.
29. Ayertey F, *et al.* Anti-inflammatory activity and mechanism of action of ethanolic leaf extract of *Morinda lucida* Benth, *J. Tradit. Complement. Med*, 11(3), 2021, 249-258.
30. Fayez N, Khalil W, Abdel-Sattar E, Abdel-Fattah A F M. *In vitro* and *in vivo* assessment of the anti-inflammatory activity of olive leaf extract in rats, *Inflammopharmacology*, 31(3), 2023,1529-1538.
31. Lima Bezerra J J, *et al.* Evaluation of the anti-inflammatory, antipyretic and antinociceptive activities of the hydroalcoholic extract of Rhynchospora nervosa (Vahl) Boeckeler (Cyperaceae), *J. Ethnopharmacol*, 284, 2022.
32. Foster K, *et al.* Selective cytotoxic and anti-metastatic activity in DU-145 prostate cancer cells induced by *Annona muricata L*. bark extract and phytochemical, annonacin, *BMC Complement. Med. Ther*, 20(1), 2020, 1-15.
33. Mehrotra S, Chhokar V. Green synthesis and characterization of ginger-derived silver nanoparticles and evaluation of their antioxidant, antibacterial and anticancer activities, *Plants*, 13(9), 2024, 1255.
34. Abuzaid, H. *et al.* liquid chromatography high-resolution mass spectrometry analysis, phytochemical and biological study of two aizoaceae plants plants: A new kaempferol derivative from *Trianthema portulacastrum L*, *Pharmacognosy Res*, 10, 2020, 24-30.
35. Fakudze N, Sarbadhikary P, Abrahamse H, George B P. Phytochemical analysis and anticancer activity of fruit extracts of Southern African pomegranate (*Punica granatum*) 'Wonderful' cultivar, *South African J. Bot*, 172, 2024, 747-767.
36. Olatokunboh A O. Anticonvulsant activity of *Rauvolfia Vomitoria (Afzel), African J. Pharm. Pharmacol*, 3(1), 2009, 319-322.
37. Ngouana, V. *et al.* Phytochemical screening, antiplasmodial and antioxidant activities of *combretum rhodanthum* extracts, *South Asian J. Parasitol*, 8(2), 2025, 66-81.
38. Dai J, Mumper R J. Plant phenolics: Extraction, analysis and their antioxidant and anticancer properties, *Molecules*, 15(10), 2010, 7313-7352.
39. Baba S A, Malik S A. Determination of total phenolic and flavonoid content, antimicrobial and antioxidant activity of a root extract of *Arisaema jacquemontii Blume*, *J. Taibah Univ. Sci*, 9(4), 2015, 449-454.

40. Molole G J, Gure A, Abdissa N. Determination of total phenolic content and antioxidant activity of *Commiphora mollis* (*Oliv*.) Engl. Resin, *BMC Chem*, 16(1), 2022, 1-11.
41. Saeed N, Khan M R, Shabbir M. Antioxidant activity, total phenolic and total flavonoid contents of whole plant extracts Torilis leptophylla L, *BMC Complement. Altern. Med*, 12(1), 2012, 1-12.
42. Khattab H A H, Aljehany B M. Costus afer (*Costaceae*, *Zingiberales*) leaf extract ameliorates naproxen-induced gastric ulcer in rats, *Trop. J. Pharm. Res*, 19(12), 2020, 2615-2622.
43. Zhao H, *et al.* Inflammation and tumor progression: Signaling pathways and targeted intervention, *Signal Transduct. Target. Ther*, 6(1), 2021, 263.

Please cite this article in press as: Anietie Eyo Robert *et al*. Phytochemical, antioxidant and anti-inflammatory activities of *Annona Muricata* L. Stembark in Wistar rats, *Asian Journal of Pharmaceutical Analysis and Medicinal Chemistry*, 14(1), 2026, 11-19.