


African Journal of Tropical Medicine and Biomedical Research (AJTMBR)



The Journal is the Official Publication of the College of Health Sciences,
Delta State University, Abraka, Nigeria.

African Journal of Tropical Medicine and Biomedical Research (AJTMBR)
by College of Health Sciences, Delta State University is licensed
under Creative Commons Attribution-Share
Alike 4.0 International 

Editorial Board

Editor-in-Chief

Prof. Igbigbi, P. S.

Editor

Prof. Omo-Aghoja, L. O.

Associate Editors

Prof Akhator, A.

Prof Odokuma, E. I.

Desk/Managing Editor

Dr. Umukoro, E. K.

Dr. Moke, E. G.

Editorial Advisory Board

Prof Aloamaka, C. P.

Prof Asagba, S. O.

Prof. Dosumu, E. A.

Prof. Ebeigbe, P. N.

Prof Ekele, B. A.

Prof Fasuba, O. B.

Prof Feyi-Waboso, P.

Prof Ikomi, R. B.

Prof Obuekwe, O. N.

Prof Obaju-Obodo, J.

Prof Okobia, M. N.

Prof. Okonofua, F. E.

ISSN: 2141-6397

Vol. 8, No. 2, December 2025



Focus and Scope

The African Journal of Tropical Medicine and Biomedical Research is a multidisciplinary and international journal published by the College of Health Sciences, Delta State University of Abraka, Nigeria. It provides a forum for Authors working in Africa to share their research findings on all aspects of Tropical Medicine and Biomedical Sciences and to disseminate innovative, relevant and useful information on tropical medicine and biomedical sciences throughout the continent. The journal will publish original research articles, reviews, editorials, commentaries, short reports, case reports and letters to the editor. Articles are welcome in all branches of medicine and dentistry including basic sciences (Anatomy, Biochemistry, Physiology, Pharmacology, Psychology, Nursing etc) and clinical sciences (Internal Medicine, Surgery, Obstetrics and Gynaecology, Dental surgery, Child Health, Laboratory Sciences, Radiology, Community Medicine, etc). Articles are also welcome from social science researchers that document the intermediating and background social factors influencing health in countries of Africa. Priority will be given to publication of articles that describe the application of the principles of primary health care in the prevention and treatment of diseases.

Editorial Notices

The journal will be published biannually in the months of March and September. Annual subscription fee in Nigeria is two thousand naira (N2,000) per volume (2issues); One-thousand-naira single copy (N1000). The annual subscription rate for other parts of the world is as follows: United Kingdom £60 (post free). West Africa \$60 (post free). The rest of the World and the United States of America \$120 (post free). A charge of \$60 is made for reprints inclusive of postage. Cheques should made payable to the African Journal of Tropical Medicine and

Biomedical Research and addressed to the Editor-in-Chief.

Journal Contact

All correspondence, including manuscripts for publication (in triplicate) should be addressed to:

Professor P.S. Igbigbi

The Editor-in-Chief,
Department of Anatomy,
Faculty of Basic Medical Sciences,
College of Health Sciences,
Delta State University, Abraka,
Delta State, Nigeria.

Or:

Professor Lawrence Omo-Aghoja

Editor
Department of Obstetrics and
Gynecology,
Faculty of Clinical Medicine,
Delta State University, Abraka, Nigeria.
Email: journalajtmbr@yahoo.com
Cc: all email to
eguono_2000@yahoo.com
Tel: 08039377043

All authors are advised to submit an electronic copy in CD-ROM along with a hard copy of their manuscript, as this will spare remarkable time in the reviewing and typesetting processes.

In the alternative, authors can submit their articles and covering letter by email attachments. A covering letter (signed by all authors) accompanying the manuscript should certify that the article has not been previously published and is not being considered for publication elsewhere.

Information for Authors

All manuscript are peer-reviewed and accepted with the understanding that the work has not been published or being considered for publication elsewhere. Indeed, the authors would be requested

to sign a copyright form transferring the ownership of the paper to the African Journal of Tropical Medicine and Biomedical Research. All articles must include the correct names and addresses of author(s) including e-mail addresses and telephone numbers. Articles will be subjected to a thorough peer review process before any decision is made to publish or not. Authors should note that the African Journal of Tropical Medicine and Biomedical Research is not under any obligation to publish articles submitted, as decision to publish will be based on recommendations of reviewers and the editorial advisory board.

Manuscripts

Articles submitted for publication should be typed double-spaced with 2.5cm margins with accompanying CD-ROM in Microsoft Word format for easy and quick peer review and typesetting. Each of the following sections should begin in a new page: title page, abstract, introduction, materials and methods, results, discussion, acknowledgment (s), references, tables, legends to figures and illustrations. The manuscript should include:

Title Page

The title page should include the following information: 1. the title and sub-title; 2. the name(s) of the author(s); 3. the affiliation(s) of the author(s); 4. name and address of the corresponding author and 5. three to six key words for indexing and retrieval purposes.

Abstract

The abstract should be structured and not more than 250 words. It should carry the following headings: Introduction, Materials and Methods, Results and Conclusion.

Original Research- The journal welcomes

articles reporting on original research, including both quantitative and qualitative studies. Full-length articles should generally not exceed 3000 words, excluding abstract, tables, figures, and references. The subject matter should be organised under appropriate headings and sub-headings as itemized above.

Review Articles- Comprehensive review articles on all aspects of tropical medicine and biomedical sciences will also be considered for publication in the journal. Reviews should provide a thorough overview of the topic and should incorporate the most current research. The length of review articles must not exceed 3,000 words and the organisational headings and sub-headings used are at the author's discretion.

Short Reports - Brief descriptions of preliminary research findings or interesting case studies will be considered for publication as short reports. The length of the abstract and article should be restricted to 150 and 2,000 words respectively and organisation of short reports are left to the author's discretion.

Commentaries or Editorials- Commentaries or editorials on any aspect of tropical medicine and biomedical sciences in Africa will be considered for publication in the journal. Opinion pieces need not reference previous research, but rather reflect the opinions of the author(s). The length should not exceed 2,000 words.

Tables and Figures

All tables and figures should be submitted on separate sheets of paper and should be clearly labelled. Coloured tables and figures may be reprinted in black and white. Authors should especially take care that all tables are clear and understandable by themselves, independent of

the text. A reader should be able to read only the tables and easily grasp all information without the text.

Acknowledgments

Acknowledgments should be included on a separate sheet of paper and should not exceed 100 words. Funding sources should be noted here.

References

References should be in the Vancouver style and numbered consecutively in the order in which they are mentioned in the text. Titles of journals should be abbreviated according to the Index Medicus style. Authors must cross-check and make sure that all information provided in the reference list is complete and correctly written. Reference numbers should be inserted above the line on each occasion a reference is cited in the text, e.g., ... as 1-3 reported in other studies. Numbered references should appear at the end of the article and should include the names and initials of all authors. The format of references should be as published by the International Committee of Medical Journal Editors in the British Medical Journal 1988, volume 296, pages 401-405. The following are sample references

for an article published in a journal and for a book: Ahmed Y, Mwaba P, Chintu C, Grange JM, Ustianowski A, Zumla A. A study of maternal mortality at the University Teaching Hospital, Lusaka, Zambia: the emergence of tuberculosis as a major non-obstetric cause of maternal death. *Int J Tuberc Lung Dis* 1999; 3: 675-680. Whitby LG, Smith AF, Beckett GJ. *Enzyme Tests in Diagnosis*. In: *Lecture Notes on Clinical Chemistry*. Whitby LG, Smith AF & Beckett GJth (eds). 4 editions. Blackwell Scientific Publications. 1988. 103-127.

Units of Measurement

All measurements should be expressed in SI (Systeme International) Units.

Galley proofs

Corrections of galley proofs should be strictly restricted to Printer's error only. Orders for offprints should be made when the corrected proofs are being returned by the authors. Articles accepted for publication remain the property of the journal and can only be reproduced elsewhere in line with section 5 of the copyright agreement.

“For those journals with their own websites, and a very high degree of in-house technical competency, it is possible to get code snippets from the Creative Commons website for the license type chosen, which can be embedded in your online content, but please note that that is definitely not a requirement, just a “nice to have”.

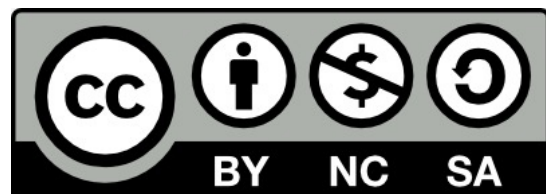


Table of Contents

Editorial

- The Role of Forensic Medicine in Criminal Justice Delivery in Nigeria 7-11
Umeaku, U

Original articles

- Differential Alterations In Behavioural Phenotypes, Brain Biochemical Profiles And Histomorphology In Mice After Administration Of Sildenafil-dapoxetine Formulation 12-26
Omogbiya A, Orowigbo O, Moke EG, Obob M, Emudainobwo JOT, Awbin PE, Saviour GU
- Pre-Examination Stress Among Pre-Clinical Medical Students: A Nigerian Survey 27-39
Ominde, BS, Enaobwo, MT, Jeremiah, O, Omoro, OF, Igbigbi, PS.
- Evaluation Of Computational And Insecticidal Activities Of Oils From *Ocimum Gratissimum* And *Cymbopogon Citratus* Against *Anopheles Gambiae* Mosquito 40-55
Elelegu, EJ, Dunkwu, CC, Enyi, KC, Onuelu, JE, Onyesom, I.
- Induced Abortion As A Method Of Contraception By Married Women With Unintended Pregnancy In Delta State, Nigeria: Prevalence, Predictors, And Reproductive Health Burden. 56-66
Williams, OO, Ayo, N, Omonigbo, E.
- Duration-Dependent Post-Trauma Sleep Deprivation Differentially Modulates PTSD-Like Anxiety and Oxidative Markers in Mice 67-76
Ben-Azu B, Omogbiya AI, Ayereoghene SM, Usin SG, Oyovvi MO
- Assessment of cytotoxicity and growth inhibitory effects of methanol extract of *Ageratum conyzoides* Linn 77-85
Ikoya, S, Apitikori-Owumi, JE, Nwoguezè, BC, Agboola, OE, Ekakitie, LI, Odegbe, OJ, Ofoke, IH, Oviri, MO.
- Evaluating The Impact Of Computer Assisted Cognitive Remediation On Recovery Outcomes In Schizophrenia: A Quasi Experimental Study From Northwest Nigeria. 86-93
Yakubu AA, Bashir SM, Aveka AI, Murinyi MM, Khalid S, Yakasai BA
- Biochemical Impact Of Occupational Cement Dust Exposure On Block Industry Workers In Rivers State, Nigeria. 94-98
John, GC, Anosike, IK

Assessment of Cytotoxicity and Growth Inhibitory Effects of Methanol Extract of *Ageratum conyzoides* Linn.

¹Ikoya, S, ²Apitikori-Owumi, JE, ³Nwoguzze, BC, ⁴Agboola, OE, ¹Ekakitie, LI, ⁵Odeghe, OJ, ⁶Ofoke, IH, ⁷Oviri, MO

ABSTRACT

Introduction: Evaluating cellular cytotoxicity is a crucial step in the development of specific anticancer therapies. As a medicinal plant, *Ageratum conyzoides* is well-known for its abundance of bioactive constituents, anti-inflammatory and anti-bacterial properties. In this study, its effect was evaluated to confirm if its methanol extract exhibits cytotoxic and growth-inhibitory properties, with potential relevance to oncology.

Materials and Methods: Extraction of 1000 g of dried leaf material with methanol yielded 100 g of crude extract (10 %), indicating a high content of methanol-soluble bioactive compounds. The cytotoxic potential of the extract was assessed using *Ranicep ranninus* tadpoles as a preliminary model.

Results: The study's findings demonstrated a clear concentration-dependent increase in mortality, with significant effects observed at 160 and 320 µg/mL and a moderate LC₅₀ value of 100.76 µg/mL, confirming the extract's capacity to impair cell viability. Additionally, the extract exhibited significant inhibitory effects on the radicle growth of *Sorghum bicolor*, with both dose- and time-dependent responses. Higher concentrations (8 -16 µg/mL) and prolonged exposure periods resulted in marked suppression of radicle elongation, as reflected by percentage inhibition and IC₅₀ values.

Conclusion: These findings suggest that the extract can interfere with cell division and proliferation, processes analogous to those driving uncontrolled growth in cancer cells. Collectively, this is an indication that *A. conyzoides* methanol extract possesses compounds with both cytotoxic and antiproliferative activity. These effects in non-cancerous models suggest preliminary potential as natural anticancer sources agents.

Keywords: Cell viability, Chemical compounds, Cytotoxicity, Environmental contaminants, Pharmaceutical agents

¹.Department of Medical Biochemistry, Faculty of Basic Medical Sciences, Delta State University, P.M.B. 1, Abraka, Nigeria. ufuomasuccess247@gmail.com; ORCID: <https://orcid.org/0009-0002-9710-4027>

².Department of Pharmacognosy and Traditional Medicine, Faculty of Pharmacy, Delta State University, P.M.B. 1, Abraka, Nigeria.

³.Department of Physiology, Faculty of Basic Medical Sciences, Delta state University, P.M.B. 1, Abraka, Nigeria

⁴.Institute for Drug Research and Development, Bogoro Research Centre, Afe Babalola University, Ado-Ekiti, Nigeria

⁵.Department of Educational Management, Delta State University, P.M.B. 1, Abraka, Nigeria.

⁶.Department of Biochemistry, Faculty of Science, Madonna University, Nigeria

⁷.Department of Biochemistry, Faculty of Science, Michael and Cecilia Ibru University, Delta State, Nigeria.

Corresponding author: Success Ikoya; Email: ufuomasuccess247@gmail.com; Phone Number: +2347018671743

INTRODUCTION

In biological sciences, cytotoxicity refers to the capacity of a substance to damage cells or induce cell death and is a fundamental concept in toxicology, pharmacology, and biomedical research.¹ Cytotoxicity assessment is routinely performed to evaluate the effects of chemical substances, pharmaceutical agents, or environmental pollutants on cell survival and

viability.² Such agents may induce cell death through mechanisms such as necrosis or apoptosis, underscoring the need to ensure that potential therapeutic compounds are effective while remaining safe for patients. Because substances vary greatly in their cytotoxic potential, systematic evaluation is essential before clinical or environmental application.³ Indeed, many chemotherapeutic drugs currently used in

cancer treatment exert their effects through well-established cytotoxic mechanisms.⁴⁻⁶ Growth inhibition, by contrast, describes the suppression or reduction of cell, tissue, or organismal growth following exposure to a given substance.⁷ Growth inhibition assays are widely applied in biological and pharmacological research to assess the activity of chemical compounds, plant extracts, or drugs against targets such as cancer cells, microorganisms, or developing plant tissues.^{8,9}

Medicinal plants remain a major source of novel therapeutic agents,¹⁰⁻¹¹ with ongoing research focused on identifying bioactive lead compounds and evaluating the efficacy of whole-plant preparations.¹² Numerous studies demonstrate that medicinal plants contain compounds with antibacterial, anti-inflammatory, antioxidant, and anticancer activities,¹³⁻¹⁵ and several naturally derived molecules have played key roles in modern anticancer drug development.¹⁶ Consequently, scientific evaluation of plants used in traditional medicine is critical to establish safety standards and minimise risks associated with toxic herbal products.¹⁷ Historically, plants have served as reservoirs of unique secondary metabolites capable of treating a wide range of diseases,^{18,19} and many contemporary pharmaceuticals are plant-derived.²⁰ Rigorous assessment of traditionally used plants is therefore necessary to identify compounds that are both safe and effective, while reducing potential toxicity.¹³

Ageratum conyzoides is a medicinal plant widely used in traditional healthcare systems worldwide, with applications varying by region. In Nigeria, it is known as *Imi esu* among the Yoruba people.²¹⁻²³ In India, it is used as a bactericidal, anti-dysenteric, and anti-lithic agent, while in parts of Asia, South America, and Africa, aqueous extracts are commonly

employed for antibacterial purposes.²⁴ In Central Africa, the plant is used to treat pneumonia and to promote wound and burn healing,²⁵ as well as for managing fever, rheumatism, headaches, and colic. Phytochemical studies reveal that *A. conyzoides* contains diverse secondary metabolites, including terpenoids, flavonoids, chromenes, alkaloids, coumarins, and lignans.²⁶ Its essential oil is rich in biologically active compounds such as quercetin derivatives, chromenes, phytosterols, and saponins,²⁷ highlighting its pharmacological potential. This study therefore evaluated the cytotoxic and growth-inhibitory effects of the methanol extract of *Ageratum conyzoides*.

MATERIALS AND METHODS

Collection and authentication of plant materials

Fresh leaves of *A. conyzoides* were obtained from the surroundings of campuses II (5.79093 ° N, 6.09847 ° E) and III (5.78072 ° N, 6.10169 ° E) of Delta State University, Abraka, Nigeria (Figure 1).



Figure 1: Fresh leaves of *A. conyzoides* Linn (Billygoat weed).

Preliminary identification and authentication of the plant were carried out by Akinnibosun Henry

Adewale at the Department of Plant Biology and Biotechnology, Herbarium Unit, Faculty of Life Sciences, University of Benin, Benin City, Edo State, Nigeria. A voucher specimen was deposited in the herbarium with the reference number UBH-A344 (*Ageratum conyzoides* Linn). The freshly collected leaves were thoroughly rinsed under running tap water to eliminate dirt and debris, after which they were air-dried at ambient laboratory temperature (23–29 °C) in the Department of Medical Biochemistry laboratory, Delta State University, Abraka. Drying was continued for 21 days until a constant weight was achieved, following the methods described by Usin and Ugwu²⁸ and Odeghe *et al.*²⁹ The dried leaves were then ground into a fine powder and stored in airtight containers at 4 °C prior to extraction.

Preparation and extraction of plant materials

The harvested plant material was washed and allowed to air-dry at ambient temperature for 14 days. Thereafter, the dried sample was milled into a fine powder using an electric grinding blender. A measured quantity of the powdered leaves (1000 g) was subjected to methanol extraction using a Soxhlet apparatus, following the method previously described by Usin and Ugwu.²⁸ The resulting extract was concentrated on an electrothermal constant water bath to obtain a greenish semi-solid residue, which was subsequently preserved in a refrigerator at 4 °C for subsequent analyses.

Sources of tadpoles (*Raniceps ranninus*)

Tadpoles were collected from toad breeding sites in small water bodies within Campus II (5.79093 ° N, 6.09847 ° E) of Delta State University, Abraka, Nigeria. Species identification was carried out by the Department of Animal and Environmental Biology, Faculty of Sciences, Delta State University, Abraka. Following identification, tadpoles aged 5 - 6 days were excluded from the study.

Evaluation of cytotoxic activity of *A. conyzoides* fractions on tadpole (*Raniceps ranninus*)

The cytotoxic activity of *A. conyzoides* fractions was assessed using a procedure adapted from Ayinde *et al.*³⁰ with minor modifications. Ten tadpoles were introduced into 250 mL beakers containing 15 mL of water obtained from the original tadpole habitat, which was then diluted with distilled water to a volume of 49 mL. The final volume was adjusted to 50 mL by adding 0.5, 1, 2, 4, or 8 µL of the fractions prepared in 5 % dimethyl sulfoxide (DMSO) in water, corresponding to final concentrations of 20, 40, 80, 160, and 320 µg/mL, respectively. Control groups were treated accordingly, and tadpole mortality was monitored over a period of at least 24 hours.

- Group 1:** Tadpoles + 5 % DMSO in distilled water.
- Group 2:** Tadpoles + 20 µg/mL of methanol extract
- Group 3:** Tadpoles + 40 µg/mL of methanol extract
- Group 4:** Tadpoles + 80 µg/mL of methanol extract
- Group 5:** Tadpoles +160 µg/mL of methanol extract
- Group 6:** Tadpoles + 320 µg/mL of methanol extract

The experiment was carried out in triplicate.

Sources of guinea corn (*Sorghum bicolor*)

Guinea corn was obtained from the Abraka Main Market and was cleansed with absolute ethanol. The viability of the seeds was determined by their ability to remain submerged in water.³¹ The seeds that remained submerged in water were selected and dried for use in this study.

Evaluation of growth inhibitory activity of *A. conyzoides* fractions on guinea corn radicle length

Precisely 10 mL of the fractions at concentrations of 1, 2, 4, 8, and 16 µg/mL, prepared in 5 % DMSO in water, were dispensed into 9 cm Petri dishes lined with cotton wool and Whatman No. 1 filter paper. Seed viability was assessed by pre-soaking twenty seeds in 50 mL of distilled water, after which they were evenly distributed on each Petri dish and incubated in a dark cabinet. The lengths (cm) of the emerging radicles were measured at 24,

48, 72, and 96 hours. Control seeds received 10 mL of 5 % dimethyl sulfoxide in distilled water without any extract, in accordance with the method described by Ayinde *et al.*³⁰

Group 1: Guinea corn seeds + 5 % DMSO in distilled water.

Group 2: Guinea corn seeds + 1 µg/mL of methanol extract

Group 3: Guinea corn seeds + 2 µg/mL of methanol extract

Group 4: Guinea corn seeds + 4 µg/mL of

methanol extract

Group 5: Guinea corn seeds +8 µg/mL of methanol extract

Group 6: Guinea corn seeds +16 µg/mL of methanol extract

RESULTS

Percentage yield methanol extract of *A. conyzoides* leaf

The percentage yield of the methanol extract of *Ageratum conyzoides* leaf is presented in Table 1.

Table 1: Percentage yield of methanol extract of *A. conyzoides* leaf.

Solvent	Weight of plant material used (g)	Extract yield (g)	Percentage yield (%)
Methanol	1000.00	100.00	10.00

It shows that the extraction of 1000 g of plant material with methanol produced 100 g of crude extract, giving a percentage yield of 10 %. This indicates that methanol was an effective solvent for extracting soluble bioactive constituents

from the plant material, suggesting a relatively high abundance of methanol-soluble compounds in the sample.

Cytotoxic effect of the methanol extract of *A. conyzoides* on *Ranicep ranninus* (tadpole)

Table 2: Cytotoxicity effect of methanol extract of *A. conyzoides* leaf of *Ranicep ranninus* (tadpole)

Test agent/ concentration	0	40 µg/mL	80 µg/mL	160 µg/mL	320 µg/mL
Methanol extract	1.67 ± 0.67	2.33 ± 0.33	5.00 ± 0.00	9.33 ± 0.67 [#]	10.00 ± 0.00 [#]
D.H ₂ O	0	0	0	0	0

The values above are mean of three replicates n=3. Mean ± SEM. Values with [#]superscript indicate significant difference $p < 0.05$ in comparison with the control.

Table 3: Cytotoxicity effect of methanol extract of *A. conyzoides* leaf of *Ranicep ranninus* (tadpole)

Test agent/ concentration	% mortality					
	20 µg/mL	40 µg/mL	80 µg/mL	160 µg/mL	320 µg/mL	LC ₅₀
Methanol extract	16.67	23.33	50.00	93.33 [#]	100 [#]	100.76
D.H ₂ O	0	0	0	0	0	0

Values are % mortality of three replicates (n = 3). Mean ± SEM. Values with [#]superscript indicate a significant difference ($p < 0.05$) in comparison with the control.

The results from Tables 2 and 3 showed that the methanol extract exerted a clear, concentration-dependent cytotoxic effect on *Ranicep ranninus* tadpoles. Both cytotoxic response and percentage mortality increased steadily with rising extract

concentration, with statistically significant effects observed at 160 and 320 µg/mL when compared with the control. The absence of mortality in the D.H₂O control confirms that the observed effects were due to the extract. The LC₅₀ value of 100.76 µg/mL indicates moderate

cytotoxic potency of the methanol extract.

Growth inhibitory effect of the methanol extract of *A. conyzoides* of *S. bicolor* (guinea corn) radicle.

Table 4: Growth inhibitory effect of methanol extract of *A. conyzoides* of *Sorghum bicolor* (guinea corn) radicle

Conc (µg/mL)	Time (hours)			
	24	48	72	96
D.H ₂ O	0.64 ± 0.07	1.76 ± 0.17	2.45 ± 0.24	3.13 ± 0.29
1	0.74 ± 0.09	1.86 ± 0.19	2.13 ± 0.23 [#]	2.25 ± 0.24 [#]
2	0.88 ± 0.08 [#]	2.49 ± 0.15 [#]	3.02 ± 0.15 [#]	3.17 ± 0.17
4	0.69 ± 0.06	1.87 ± 0.18	2.38 ± 0.24 [#]	2.70 ± 0.28 [#]
8	0.63 ± 0.08	1.24 ± 0.16 [#]	1.28 ± 0.20 [#]	1.34 ± 0.22 [#]
16	0.55 ± 0.06	1.37 ± 0.12 [#]	2.03 ± 0.17	2.40 ± 0.19 [#]

The values above are mean of three replicates, n=20. Mean ± SEM. Values with [#] superscript indicate significant difference p<0.05 in comparison with the control (D.H₂O).

Table 5: Percentage inhibition of methanol extract of *A. conyzoides* of *S. bicolor* (guinea corn).

Conc (µg/mL)	Time (hours)							
	24 (% inhibition)	IC ₅₀	48 (% inhibition)	IC ₅₀	72 (% inhibition)	IC ₅₀	96 (% inhibition)	IC ₅₀
D/H ₂ O	-		-		-		-	
1	-15.63	28.36	-5.68	21.93	13.06	26.84	28.11	30.11
2	-37.50		-41.48		-23.27		-1.28	
4	-7.81		-6.25		2.86		13.74	
8	1.56		29.55		47.76		57.19	
16	14.06		21.16		17.14		23.32	

The data presented above represent the percentage of growth inhibition for guinea corn radicle length (n = 20).

The results in Tables 4 and 5 indicate that the methanol extract of *Ageratum conyzoides* affected the radicle growth of *Sorghum bicolor* in a concentration- and time-dependent manner. While the control showed normal progressive radicle elongation, exposure to the extract led to significant growth inhibition at several

concentrations, particularly at higher doses (8 - 16 µg/mL) and longer exposure periods. The percentage inhibition data further confirm this trend, with positive inhibition values increasing over time and corresponding IC₅₀ values demonstrating measurable phytotoxic activity.

DISCUSSION

Cancer is fundamentally characterised by uncontrolled cell proliferation, resistance to cell death, and sustained growth signalling.³² Therefore, substances capable of inducing

cytotoxicity and inhibiting growth in biological models are of considerable interest as potential anticancer agents.³³ The extraction yield of 10% obtained using methanol suggests that the plant leaf is rich in methanol-soluble secondary metabolites. Methanol is known to extract compounds such as flavonoids, alkaloids, terpenoids, and phenolic compounds, many of which have been widely reported to possess anticancer properties.^{34,35} The appreciable yield observed in this study indicates a high likelihood that the extract contains sufficient quantities of these bioactive compounds capable of exerting biological effects, including cytotoxicity against rapidly dividing cells. The cytotoxicity assay using *Ranicep ranninus* tadpoles revealed a clear concentration-dependent toxic effect of the methanol extract, with significant mortality at higher concentrations and an LC₅₀ value of 100.76 µg/mL. Although tadpoles are not cancer cells, this model serves as a preliminary biological system to evaluate general cytotoxic potential.³⁶

Furthermore, the growth inhibitory effect of the methanol extract on *Sorghum bicolor* radicle elongation reinforces its relevance to cancer growth suppression. Guinea corn radicle growth depends on active cell division, elongation, and differentiation, processes that are also exaggerated in cancer cells.^{37,38} The significant reduction in radicle length at higher extract concentrations and longer exposure times indicates that the extract interferes with cellular proliferation.³⁹ In cancer treatment, inhibiting cell cycle progression and suppressing proliferative capacity are key therapeutic goals. The observed concentration- and time-dependent growth inhibition, therefore, suggests that the extract may contain anti-proliferative agents capable of limiting abnormal cell growth. The percentage inhibition and IC₅₀ values further support this

interpretation, as increasing inhibition over time reflects sustained suppression of growth-related processes. In cancer models, such sustained inhibitory effects are desirable, as they imply the ability of a compound to restrain tumour expansion rather than producing only transient effects continuously. The presence of both growth-stimulatory effects at very low concentrations and inhibitory effects at higher concentrations is also consistent with the behaviour of many anticancer agents, which may exhibit hormetic responses depending on dose.

CONCLUSION

The present study suggests that the methanol extract of *Ageratum conyzoides* leaf could exhibit cytotoxic and growth-inhibitory properties, which are relevant in the field of oncology. Even though these findings are based on non-cancer biological models, they provide preliminary evidence that the extract might contain bioactive compounds capable of inducing cell death and suppressing proliferation, which are the two critical targets in cancer treatment. However, further studies using established cancer cell lines, apoptosis assays, and molecular mechanism analyses are necessary to validate the anticancer potential of this extract and to identify the specific compounds responsible for these effects.

REFERENCES

1. Singhal M, Shaha S, Katsikogianni M. Comparative analysis of cytotoxicity assays, from traditional to modern approaches. *IntechOpen*. 2024;1006842.
2. Rajpoot K, Katare P, Tekade M, Sharma MC, Polaka S, Sengupta P, Tekade RK. Toxicokinetic and toxicodynamic considerations in drug research. In: Tekade RK, editor. *Pharmacokinetics and Toxicokinetic Considerations*. Elsevier; 2022. p. 751–776.
3. Jhamb SK, Goyal A, Pandey A, Bhowmik A. A review of cytotoxicity testing methods and

- in vitro study of biodegradable Mg–Sn–HA composite by elution method. *J Mater Sci Mater Med.* 2025;36:92.
4. Naeem A, Hu P, Yang M, Zhang J, Liu Y, Zhu W, Zheng Q. Natural products as anticancer agents: current status and future perspectives. *Molecules.* 2022;27:8367.
 5. Anand U, Dey A, Chandel AKS, Sanyal R, Mishra A, Pandey DK, De Falco V, Upadhyay A, Kandimalla R, Chaudhary A, Dhanjal JK, Dewanjee S, Vallamkondu J, Pérez de la Lastra JM. Cancer chemotherapy and beyond: current status, drug candidates, associated risks and progress in targeted therapeutics. *Genes Dis.* 2023;10:1367–1401.
 6. Singh R, Malhotra A, Bansal R. Synthetic cytotoxic drugs as cancer chemotherapeutic agents. In: *Medicinal Chemistry of Chemotherapeutic Agents: A Comprehensive Resource of Anti-infective and Anti-cancer Drugs.* 2023. p. 499–537.
 7. Capes-Davis A, Freshney RI, Geraghty RJ, Nims RW. *Freshney's culture of animal cells: a manual of basic technique and specialized applications.* Wiley-Blackwell; 2021.
 8. Ovuakporaye SI, Enaohwo TM, Mordi JC, Naiho AO. Serum electrolytes and renal histology of Wistar rats treated with seed extract of *Citrullus lanatus*. *J Pharm Bioresour.* 2020;17:66–74.
 9. Mazumder K, Biswas B, Raja IM, Fukase K. A review of cytotoxic plants of the Indian subcontinent and a broad-spectrum analysis of their bioactive compounds. *Molecules.* 2020;25:1904.
 10. Singh S, Sedha S. Medicinal plants and their pharmacological aspects. *Food Pharma Int.* 2016;1:156–170.
 11. Usin SG, Okon UE, Daramola EA, Dyap PE. Evaluation of phytochemical constituents and elemental profiling of selected medicinal plants in South-West Nigeria. *Asian J Biol Sci.* 2024;17:145–155.
 12. Agboola OE, Agboola SS, Fadugba AE, Adegbuyi AT, Odeghe OB. Computational analysis of *Curcuma longa* L. compounds: unraveling molecular interactions and drug-like properties for novel therapeutic applications. *Next Res.* 2025;2:100283.
 13. Odeghe OB, Onobrudu DA, Orororo OC, Ikoya S, Apitikori-Owumi JE, Egbune EO, Nwogueze BC, Ojugbeli ET, Agboola OE, Awhin EP, Ekakitie LI, Oviru MO, Ofoke IH, Dunkwu CC, Enyi KC, Derhie VA, Isaac PO, Mordi JC, Adegoke AO. Phytochemical profiling, GC-MS analysis, and antioxidant activity of polar solvent extracts of *Conoclinium coelestinum* leaves. *Trop J Nat Prod Res.* 2025;9(6): 2784–2794.
 14. Parham S, Kharazi AZ, Bakhsheshi-Rad HR, Nur H, Ismail AF, Sharif S, RamaKrishna S, Berto F. Antioxidant, antimicrobial and antiviral properties of herbal materials. *Antioxidants.* 2020;9(12):1309.
 15. Chandra S, Gahlot M, Choudhary AN, Palai S, de Almeida RS, de Vasconcelos JEL, dos Santos FAV, de Farias PAM, Coutinho HDM. Scientific evidences of anticancer potential of medicinal plants. *Food Chem Adv.* 2023;2:100239.
 16. Jenča A, Mills DK, Ghasemi H, Saberian E, Jenča A, Karimi Forood AM, Petrášová A, Jenčová J, Jabbari Velisdeh Z, Zare-Zardini H, Ebrahimifar M. Herbal therapies for cancer treatment: a review of phytotherapeutic efficacy. *Biologics.* 2024;18:229–255.
 17. Bourhia M, Abdelaziz Shahat A, Mohammed Almarfadi O, Ali Naser F, Mostafa Abdelmageed W, Ait Haj Said A, El Gueddari F, Naamane A, Benbacer L, Khilil N. Ethnopharmacological survey of herbal remedies used for the treatment of cancer in the Greater Casablanca-Morocco. *Evid Based Complement Alternat Med.* 2019;2019:1613457.

18. Wang W, Xu J, Fang H, Li Z, Li M. Advances and challenges in medicinal plant breeding. *Plant Sci.* 2020;298:110573.
19. Odeghe OB, Orororo OC, Agboola OE, Onyeso G, Dennis-Eboh U, Ekakitie LI, Awhin EP, Ojugbeli ET. Phytochemical profiling and in vitro antioxidant activity of methanolic extracts from *Fadogia cienkowskii* leaves. *Asian Plant Res J.* 2024;12(5):110–120.
20. Narayanan M, Kiran A, Natarajan D, Natarajan D, Kandasamy S, Shanmugam S, Alshiekheid M, Almoallim HS, Pugazhendhi A. The pharmaceutical potential of crude ethanol leaf extract of *Pedaliium murex* (L.). *Process Biochem.* 2022;112:234–240.
21. Chahal R, Nanda A, Akkol EK, Sobarzo-Sánchez E, Arya A, Kaushik D, Dutt R, Bhardwaj R, Rahman MH, Mittal V. *Ageratum conyzoides* L. and its secondary metabolites in the management of different fungal pathogens. *Molecules.* 2021;26(10):2933.
22. Obafemi J. A review of some medicinal plants used by indigenous Yoruba in Nigeria. *J Nat Prod Plant Resour.* 2021;11:1-8.
23. Asiru MA. *Ageratum conyzoides*, Imi-isu, for ulcer treatment in Yoruba land, Nigeria: implications for health information professionals. *Trop J Biol Sci.* 2025;1:9-18.
24. Zouine N, El Ghachtouli N, El Abed S, Koraichi SI. A comprehensive review on medicinal plant extracts as antibacterial agents: factors, mechanism insights and future prospects. *Sci Afr.* 2024;26: e02395.
25. Shekhar TC, Goyal A. A comprehensive review on *Ageratum conyzoides* Linn. (Goat weed). *Int J Pharm Phytopharmacol Res.* 2019;9:391-395.
26. Kaur R, Dogra NK. A review on traditional uses, chemical constituents and pharmacology of *Ageratum conyzoides* L. (Asteraceae). *Int J Pharm Biol Arch.* 2014;5:33-45.
27. Yadav N, Ganie SA, Singh B, Chhillar AK, Yadav SS. Phytochemical constituents and ethnopharmacological properties of *Ageratum conyzoides* L. *Phytother Res.* 2019;33:2163-2178.
28. Usin SG, Ugwu MN. Hepatoprotective effect of petroleum ether extract of unripe *Carica papaya* seed on streptozotocin-induced diabetic rats. *Int J Biochem Physiol.* 2022;7:00213.
29. Odeghe OB, Monanu MO, Anacletus FC. In vitro antioxidant abilities and inhibition of rabbit muscle lactate dehydrogenase by aqueous extract of *Hannoa klaineana* stem bark. *Int J Adv Res (Indore).* 2016;4:509–515.
30. Ayinde B, Agbakwuru U. Cytotoxic and growth inhibitory effects of the methanol extract of *Struchium sparganophora* Ktze (Asteraceae) leaves. *Pharmacogn Mag.* 2010;6:293.
31. Kaproth MA, McGraw JB. Seed viability and dispersal of the wind-dispersed invasive *Ailanthus altissima* in aqueous environments. *For Sci.* 2008;54:490–496.
32. Brown JS, Amend SR, Austin RH, Gatenby RA, Hammarlund EU, Pienta KJ. Updating the definition of cancer. *Mol Cancer Res.* 2023;21:1142–1147.
33. Anoor PK, Yadav AN, Rajkumar K, Kande R, Tripura C, Naik KS, Burgula S. Methanol extraction revealed anticancer compounds quinic acid, 2(5H)-furanone and phytol in *Andrographis paniculata*. *Mol Clin Oncol.* 2022;17(5):151.
34. Elizondo-Luévano JH, Gomez-Flores R, Verde-Star MJ, Tamez-Guerra P, Romo-Sáenz CI, Chávez-Montes A, Rodríguez-Garza NE, Quintanilla-Licea R. In vitro cytotoxic activity of methanol extracts of selected medicinal plants traditionally used in Mexico against human hepatocellular

- carcinoma. *Plants*. 2022;11(21):2862.
35. Ukwubile CA, Ahmed A, Katsayal UA, Yau J. Evaluation of preliminary cytotoxic and growth inhibitory effects of *Melastomastrum capitatum* leaf methanol extract by bench-top bioassay. *Int J Med Plants Nat Prod*. 2018;4:42–47.
36. Purnama MTE, Rahmaningtyas IH, Pratama AR, Prastika Z, Kartikasari AM, Cahyo NPD. Tadpole serum activity (*Rana catesbeiana*) in caspase-3 as a marker of the role of apoptosis and total cytotoxic T lymphocytes in albino rats' epithelial cells induced by neoplasia. *Vet World*. 2019;63-67.
37. Burz C, Berindan-Neagoe I, Balacescu O, Irimie A. Apoptosis in cancer: key molecular signalling pathways and therapy targets. *Acta Oncol*. 2009;48:811–821.
38. Bundy MGR, Thompson OA, Sieger MT, Shpak ED. Patterns of cell division, cell differentiation and cell elongation in epidermis and cortex of *Arabidopsis* pedicels in the wild type and in *erecta*. *PLoS One*. 2012;7:e46262.
39. Althubayani MA, Alrefaei AF, Qari SH, Alharbi RS, Alqathama A. Biological analysis of *Sonchus oleraceus* (Linn) extract and its effect on mitigating sodium benzoate-induced cytotoxicity and genotoxicity. *Front Toxicol*. 2025;7:1674822.

Ikoya S, Apitikori-Owumi JE, Nwoguzue BC, Agboola OE, Ekakitie LI, Odeghe OJ, Ofoke IH, Oviri MO Assessment of Cytotoxicity and Growth Inhibitory Effects of Methanol Extract of *Ageratum conyzoides* Linn. *Afr. J. Trop. Med. & Biomed. Res*. 2025; 8(2) 77-85
<https://dx.doi.org/10.4314/ajtmbr.v8i2.11>