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Mapping herbal medicine cancer research in Africa: A bibliometric analysis

Samuel ANKAMAH [1], Benjamin NK ADDO [1], Emelia OPPONG-BEKOE [2*]

[1] Emmanuel Quaye Archampong Library, College of Health Sciences, University of Ghana, Accra, Ghana
[2] Department of Pharmacognosy and Herbal Medicine, School of Pharmacy, College of Health Sciences, University of Ghana, Accra, Ghana

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Abstract

Herbal medicines have long been a part of the traditional healthcare systems across Africa, and their integration into modern medical practices has been significantly impactful in recent years. In Africa, the potential of herbal medicine as an alternative therapy is increasingly being explored. This is even more relevant to cancer, which remains a significant public health challenge worldwide. Cancer leads to high morbidity and mortality rates globally. This study offers a bibliometric analysis of research on herbal medicines for use in cancer therapy care in Africa. This is relevant for knowledge mapping to inform research policy regarding herbal medicines in cancer treatment. Using 1,134 datasets from Scopus (Elsevier) up to 2023, the study employed MS Excel, Harzing's Publish or Perish, and VOSviewer for analysis and visualisation. The results reveal a growing trend in publications on this topic, with the Journal of Ethnopharmacology (JEP) being the most active source, contributing 116 articles (10.23%). South Africa emerged at the forefront in this research area, accounting for 166 publications (9.05%). The most prolific author was Efferth, T., with 31 documents, while the University of Dschang, Cameroon, was the most influential institution, with 36 publications (2.75%). The National Research Foundation was the top funder, supporting 42 publications (3.26%). The most cited article was Chang and Adami (2006), which received 1,097 citations. Keyword analysis revealed that "article", "human", and "medicinal plant" were the most frequently used terms. The co-occurrence analysis identified five thematic clusters centred on "article", "human", "human cell", "in vitro study" and "drug effect". This study provides valuable insights for policymakers, researchers, and medical professionals by identifying key research areas, emerging trends, and influential contributors to herbal medicine in cancer management in Africa. These results are expected to inform future research and funding strategies to support the advancement of cancer care across the continent.

Keywords: Herbal medicine, cancer, Africa, bibliometric analysis, citation analysis, research impact

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INTRODUCTION

Cancer remains one of the leading causes of death globally, with developing nations bearing a particularly heavy burden [1,2]. The global cancer burden increased to an estimated 20 million new cancer cases, including 9.7 million deaths in 2022 [2]. In Africa, the incidence of cancer is expected to rise steadily in less than a decade, with millions of new cases predicted [3,4]. For instance, the projections for 2030 indicate a significant rise to an estimated 1.27 million cases and 0.97 million deaths, largely driven by population growth and ageing in Africa [4]. Limited access to conventional cancer treatment across much of the continent due to economic constraints, inadequate healthcare infrastructure, and a shortage of medical professionals accounts for the patronage of poorly-researched traditional and alternative therapies, particularly herbal remedies, which are deeply rooted in African cultural practices [5,6].

Herbal medicine has long been an integral part of Africa's traditional healthcare systems, treating various ailments, including cancer [7-9]. Recently, the integration of these herbal remedies into modern medical practices has significantly increased as researchers and healthcare providers explore complementary and alternative

* *Corresponding author*
Email: eoppongbekoe@ug.edu.gh

treatments for cancer [10]. In resource-limited settings where access to chemotherapy and radiotherapy is often scarce, herbal medicines offer a cost-effective option for managing cancer. Despite the growing interest, research on herbal medicines in Africa faces numerous challenges, including insufficient funding, weak research infrastructure (facilities, equipment, resources, and services that support herbal medical cancer research), and disparities in research output [11,12]. While countries such as South Africa and Nigeria have established research capabilities in this field, many other nations lag [13,14], thus hindering progress in validating the efficacy of herbal medicines for cancer treatment [15].

The rising burden of cancer in Africa, coupled with limited access to conventional treatments, underscores the urgency of exploring alternative therapies in this respect [3]. The research landscape remains fragmented across the continent. While some African countries have made notable contributions, overall research output in cancer studies is limited when compared to other global regions [16-18]. A clearer understanding of the research productivity and impact of African scholars and institutions is needed to harness herbal medicine research effectively in addressing the continent's healthcare challenges. Without this understanding, it will be difficult to successfully develop policies or allocate resources that will support the rapid integration of herbal medicine into cancer care. Bibliometrics, the quantitative analysis of academic literature, provides a powerful tool for assessing research productivity, impact, and collaboration within a specific field [19]. By examining publication trends, citation metrics, and keyword co-occurrence, bibliometric studies can reveal influential researchers, institutions, and topics shaping the discourse in herbal medicine for cancer management in Africa. This approach can help identify which countries, institutions, and researchers are leading the field and where research gaps exist.

Other analyses could highlight the role of international collaborations and funding bodies in supporting African research. By using bibliometric tools such as VOSviewer and Harzing's Publish or Perish, researchers can thus visualise the structure of research networks and access the impact of individual studies through citation analysis [20,21]. Such methodical findings provide crucial information for policymakers, funding agencies, researchers, and research institutions to enhance the visibility and effectiveness of herbal medicine research across Africa. Understanding the current research landscape enables stakeholders to make informed decisions about where to allocate resources and how to foster greater collaboration and innovation in this vital area of healthcare.

Benefits of bibliometric studies on herbal medicines used in the treatment of cancer

This study is aligned with key global and continental development frameworks, particularly the United Nations Sustainable Development Goals (SDGs) and the African Union's Agenda 2063. The SDGs highlight the importance of promoting good health and well-being for all ages (Goal 3) [22]. By focusing on herbal medicines used in cancer management, this research contributes directly to SDG Target 3.4, which aims to reduce premature mortality from non-communicable diseases, including cancer, through prevention, treatment, and the promotion of mental health and well-being. Moreover, this study supports SDG 9, which advocates for building resilient infrastructure, promoting inclusive and sustainable industrialisation, and fostering innovation. By identifying gaps and opportunities for African research on herbal medicine, this study encourages healthcare innovation and the development of locally appropriate solutions to pressing health challenges. The African Union Agenda 2063's Aspiration 1 emphasises the importance of a healthy and well-nourished population [23]. In alignment, this study supports the aspiration for a prosperous Africa that is rooted in inclusive growth and sustainable development. This study also contributes to the integration of traditional knowledge with modern healthcare systems, thereby improving the well-being of African populations. Additionally, the study encourages collaboration across African research institutions, promoting pan-African cooperation in line with Agenda 2063's vision of a people-driven development that harnesses the potential of Africa's youth and scientific community.

As researchers affiliated with the University of Ghana, this study also contributes directly to the achievement of the institution's strategic goals for 2024-2029 [23] by addressing one of Africa's most critical health issues, "cancers" [24] and exploring the potential of indigenous knowledge in providing cost-effective treatment alternatives. The focus on cancer aligns with the University's commitment to producing research that has a lasting impact on society, particularly within the context of African healthcare. The focus on cancer aligns with the University's commitment to producing research that has a lasting impact on society, particularly within the context of African healthcare. The primary purpose of this study is to conduct a comprehensive bibliometric analysis of the research on herbal medicines in cancer management in Africa. The aim is to map out the research landscape, identify leading contributors, and highlight emerging trends and gaps in the literature. By analysing research productivity, collaboration networks, and citation impact in the field of herbal medicine, the study generates insights that can inform policy, guide future research and investments, and ultimately improve cancer care across the continent.

The findings are also expected to inform researchers, funders and healthcare professionals about the current state of research in this field. Additionally, the study aims to guide future initiatives to promote collaboration, knowledge sharing, and innovation in the use of herbal medicines for cancer treatment, ultimately improving healthcare outcomes across the continent.

Current bibliometric studies on herbal medicines used in the treatment of cancer

A study conducted by Biglu in 2014, utilising the MEDLINE database (2000-2014), revealed that most Iranian breast cancer articles were published in journals from Thailand, followed by the USA and the UK [25]. Similarly, a study by Perez Santos and Anaya-Ruiz on Mexico's breast cancer research output (2003-2012) highlighted that the National Autonomous University of Mexico (22.3%), the National Institute of Cancerology (21.9%), and the Mexican Social Security Institute (20.3%) were the leading contributors based on 256 articles [25]. Cross-national assessments using Scopus and Web of Science databases consistently show that the US leads in cancer research output and impact [25]. Despite advancements in conventional cancer care, the use of herbal medicine remains widespread, particularly as it is the most common form of alternative and complementary medicine available [26]. Herbal treatments, rooted in indigenous knowledge (IK), are prevalent across African communities (8, 9). There is a growing need to foster dialogue between scholars and traditional health practitioners to promote best practices [26].

Globally, research on traditional herbal medicine has grown steadily since 1990, with China, Japan, and India being major contributors, and China leading in both publications and funding [27]. In Africa, health informatics research has also seen a notable increase in publication output. A study covering the period from 1987 to 2018 identified 2,332 publications, with South Africa emerging as the leading contributor [26]. The University of Cape Town was the top institution for health informatics research, and the PLoS One journal was identified as a primary publication platform. Funding from bodies like the Bill and Melinda Gates Foundation and the National Institutes of Health has been instrumental in supporting health informatics research in Africa [26]. Additionally, a bibliometric analysis of health-related research in Africa has revealed increasing productivity and collaboration. Stem cell research performance analysis shows the US, UK, and the Netherlands as top contributors, with English-language publications accounting for 88.52%, followed by Chinese (2.86%) and Japanese (0.94%) [28].

Another study examined the publishing patterns related to herbal medicine in cancer management in Africa from 1968 to 2023 using bibliometric methods and a dataset from Scopus. Previous studies by Koobotse et al. (2023) and Moodley et al. (2015) have explored herbal medicine and cancer research, focusing on individual countries. Therefore, this study assesses the visibility of African scholarly works and the disparity in research output, focusing on areas where their contributions are significant. Musa et al. (2023) revealed that the most cited article on herbal medicine for cancer treatment, TCMSP: A Database of Systems Pharmacology for Drug Discovery from Herbal Medicines, amassed 1,346 citations, averaging 149.56 citations annually. The second most cited article, Some Traditional Herbal Medicines, Some Mycotoxins, Naphthalene and Styrene, received 774 citations, with an average of 36.86 citations per year.

METHODOLOGY

The bibliometric analysis for this study involved data collection, analysis, and visualisation to systematically capture and examine relevant bibliographic data. For data collection, Scopus (Elsevier) was selected as the primary database due to its comprehensive coverage of peer-reviewed literature across multiple disciplines, including medicine, pharmacology, and the life sciences and its extensive citation data and indexes a wide range of African-based research outputs (31). A team of information specialists developed a tailored search strategy using keywords related to herbal medicine, cancer management, and geographical terms specific to Africa. The search covered publications from the inception of Scopus up to 2023 to ensure a comprehensive longitudinal analysis. This study included all document types (peer-reviewed journal articles, conference proceedings, etc.) indexed in Scopus without any language restriction. Only documents explicitly focusing on the use of herbal medicine in cancer treatment within the African context were included.

This resulted in the extraction of 1,134 datasets from Scopus, capturing information such as author names, article titles, source journals, publication years, institutional affiliations, and citation metrics. A combination of software tools was employed for the data analysis. MS Excel was used for initial data cleaning, sorting, and conducting basic statistical analysis. Harzing's Publish or Perish software was applied to gather citation metrics (the h-index, g-index and so on) and analyse the impact of authors and institutions. VOSviewer was utilised to visualise bibliometric networks (keyword co-occurrence networks). Descriptive statistics summarised the distribution of publications across different categories such as document and source types, language of documents, subject area and so on, while temporal trends in publication output were analysed to identify growth patterns. The study also identified the most prolific authors and their institutional affiliations, thus shedding light on key contributors to herbal medicine research used in cancer care in Africa.

Additionally, citation metrics were used to identify highly cited articles and influential authors. Keyword analysis revealed prominent themes and research focus areas through co-occurrence analysis, highlighting the specific areas of interest within the field of study. The visualisation of the data employed various tools and techniques to ensure a clear representation of the findings. Line charts were used to visualise temporal trends in the number of publications over the years, while geographical maps and charts illustrated the distribution of research outputs across the African countries, thus showcasing which nations are leading in this area of study. VOSviewer was crucial in generating network maps that depicted relationships

between keywords. Keyword co-occurrence networks revealed thematic clusters within the research.

RESULTS

Document type and source type

Details of the distribution of the various document types in the dataset are displayed in Table 1. The distribution of the document types underlines the active participation of African scholars in a range of scholarly works, with a particular focus on articles and reviews. This pattern suggests a strong culture of research activities. Of the 1134 publications, articles accounted for 916 (80.78%) and were followed by reviews (15.34%) and book chapters (15.32%). Conference papers and letters accounted for 8 (0.71) of all publications. Less than 1% of the total publication types were also recorded by the following document types: books, notes, editorials and short surveys. Conference review was the document type with the lowest publishing rate (0.09%). The types of sources of the publications are shown in Table 2. Most of the articles were in journals, which accounted for 1109 (97.80%). Books came in second with 17 (1.50%), book series 6 (0.53%), trade journals 1 (0.09%), and conference proceedings 1 (0.09%).

Year of publications/ evolution of published studies

Figure 1 presents the distribution of publications over the years from 1968 to 2023 and shows a fluctuating trend in publications over this period, with the most recent years having the highest number of publications. There was a significant increase in publications within the 13 years (2011-2023), with the highest records occurring in 2021 (8.82%), 2022 (8.02%), and 2023(8.02%).

Languages of documents

Table 3 shows the various languages used for the publication of literature on herbal medicines employed in cancer therapy in Africa. The most predominant language used was English, accounting for approximately 1103 (96.92%) of the publications over the study period. There were 16 (1.41%) publications in French as the second predominant language. All the other languages recorded less than 1% of the total publications. They included German 6 (0.70%), Chinese 6 (0.53%), Russian 2 (0.18%), and 1 (0.09%) of the publications were in Portuguese, Spanish and Ukrainian.

Subject area

Figure 2 displays the distribution of herbal medicine in cancer management across various subject areas. The table illustrates the highly interdisciplinary nature of the field in question. Medicine recorded the highest number of publications: 548 (26.20%), followed by Pharmacology, Toxicology, and Pharmaceutics with 539 (25.76%). Other notable fields include Agricultural and Biological Sciences with 199 (9.51%), Chemistry with 172 (8.22%), Immunology and Microbiology with 49 (2.34%), Environmental Science with 48 (2.29%), Chemical Engineering with 36 (1.72%), Multidisciplinary with 29 (1.39%), Biochemistry, Genetics and Molecular Biology

Table 1. Document Type

Document Type	Total Publications (TP)	Percentage (%)
Article	916	80.78
Review	174	15.34
Book Chapter	15	1.32
Conference Paper	8	0.71
Letter	8	0.71
Short Survey	4	0.35
Editorial	3	0.26
Note	3	0.26
Book	2	0.18
Conference Review	1	0.09
Total	1134	100.00

Table 2. Source Type

Source Type	Total Publications (TP)	Percentage (%)
Journal	1109	97.80
Book	17	1.50
Book Series	6	0.53
Trade Journal	1	0.09
Conference Proceeding	1	0.09
Total	1134	100.00

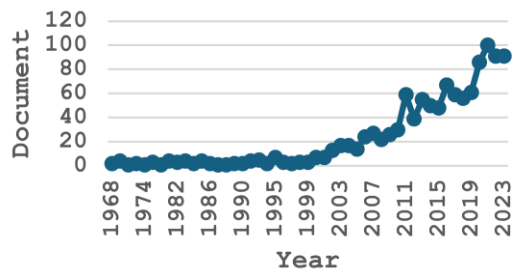

Figure 1: Document by Year

Table 3: Languages Used for Publications

Language	Total Publications	Percentage (%)
English	1103	96.92
French	16	1.41
German	8	0.70
Chinese	6	0.53
Russian	2	0.18
Portuguese	1	0.09
Spanish	1	0.09
Ukrainian	1	0.09
Total	1138	100.00

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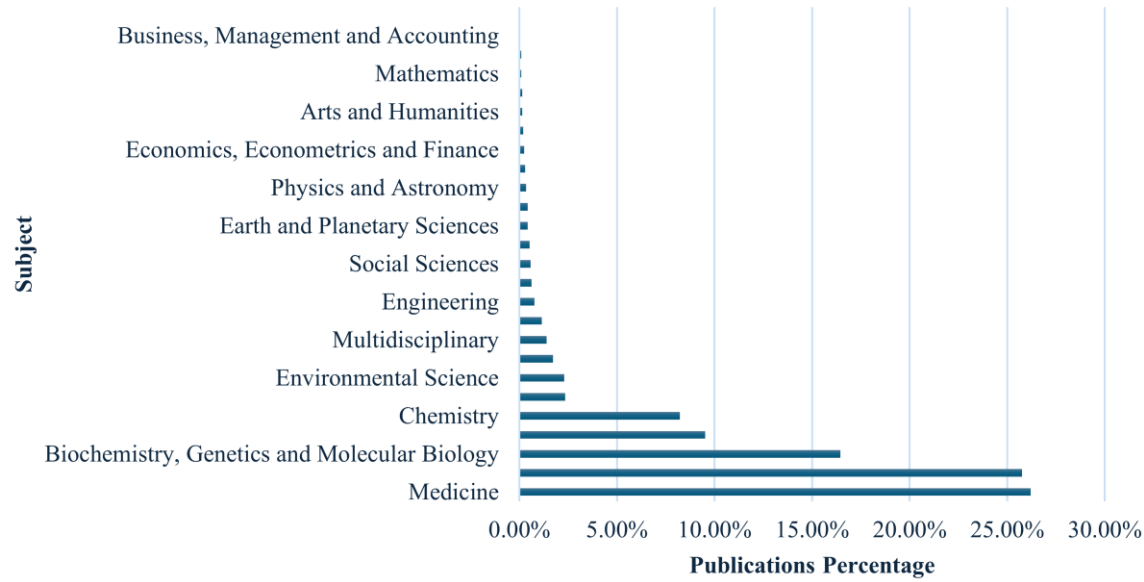

Figure 2: Subject Area

Table 4. Top 19 Most Active Source Title

Source Title	Total Publications (n=1134)	Percentage (%)
Journal of Ethnopharmacology	116	10.23
Journal of Natural Products	54	4.76
South African Journal of Botany	32	2.82
Evidence-based Complementary and Alternative Medicine	30	2.65
BMC Complementary and Alternative Medicine	25	2.20
Fitoterapia	17	1.50
Molecules	17	1.50
Pharmaceutical Biology	16	1.41
Planta Medica	16	1.41
Natural Product Communications	14	1.23
African Journal of Traditional, Complementary and Alternative Medicines	13	1.15
Phytomedicine	13	1.15
Frontiers in Pharmacology	12	1.06
Natural Product Research	12	1.06
Tropical Journal of Natural Product Research	12	1.06
PLoS ONE	11	0.97
Tropical Journal of Pharmaceutical Research	11	0.97
Journal of Herbal Medicine	10	0.88
Phytochemistry	10	0.88

Table 5. Top Keywords

Keywords	Total Publications (n = 18824)	Percentage (%)
Article	729	3.87
Human	703	3.73
Medicinal Plant	685	3.64
Plant Extract	559	2.97
Unclassified Drug	555	2.95
Nonhuman	501	2.66
Controlled Study	453	2.41
Humans	440	2.34
Plant Extracts	341	1.81
Human Cell	314	1.67
Plants, Medicinal	296	1.57
Chemistry	263	1.40
Female	262	1.39
Cytotoxicity	261	1.39
Antineoplastic Agent	254	1.35
Antineoplastic Activity	252	1.34
Male	238	1.26
Plant Leaf	216	1.15
Phytotherapy	211	1.12
Traditional Medicine	211	1.12

with 344 (16.44%), and Nursing with 24 (1.15%). Less prominent areas, each with fewer than 1% of the publications, included Engineering with 16 (0.76%); Materials Science with 13 (0.62%), Social Sciences with 12 (0.57%), Computer Science with 11 (0.53%), Earth and Planetary Sciences with 9 (0.43%), Health Professions with 9 (0.43), Physics and Astronomy with 7 (0.33%); Neuroscience with 6 (0.29%), Economics, Econometrics, and Finance with 5 (0.24), Energy with 4 (0.9%), Arts and Humanities with 3 (0.14%), Veterinary with 3 (0.14%), Mathematics with 2 (0.10%); Psychology with 2 (0.10%), Business, Management and Accounting with 1 (0.05%), and Dentistry with 1 (0.05%).

Most active source titles

Table 4 details journals with their respective publications on herbal medicine in cancer management in Africa. The Journal of Ethnopharmacology published the most articles, with a record of 116 (10.23%). Other journals with notable publications in this area were the Journal of Natural Products (4.76%, n = 54), the South African Journal of Botany (2.82%, n = 32), and Evidence-Based Complementary and Alternative Medicine (2.65%, n = 30). Journal of Herbal Medicine and Phytochemistry are among the journals that recorded the least publications, with 10 (0.88%) publications each.

Keywords analysis

Several important themes emerged from the keyword analysis of the field of herbal medicines in cancer management research conducted in Africa (Table 5). The term "Article" is widely used, indicating the reliance and engagement with existing literature in 729 (3.87%) of the publications. Specific mentions such as Medicinal Plant 685 (3.64%), Plant Extract 559 (2.97%), Plants, Medicinal 296 (1.57%), Plant Leaf 216 (1.15%) and Traditional Medicine 211 (1.12%) demonstrate that the focus was on herbal medicine. The societal influence is highlighted by the human-centred keywords like Human 703 (3.73%), Non-human 501(2.66%), Humans 440 (2.34%), Human Cell 314 (1.67%), Female 262 (1.39%) and Male 238 (1.26%).

Geographical distribution of publications - most influential countries

Figure 3 presents the top 20 countries that have also made significant contributions to this research field in Africa, with South Africa, the United States, Nigeria, and Germany leading the chat with contributions of 166 (9.05%), 141 (7.69%), 131 (7.14%) and 104 (5.67) respectively. India 99 (5.40%) and Egypt 95 (5.18%) were also countries that contributed notably. Also, Tunisia, Madagascar, and Ghana

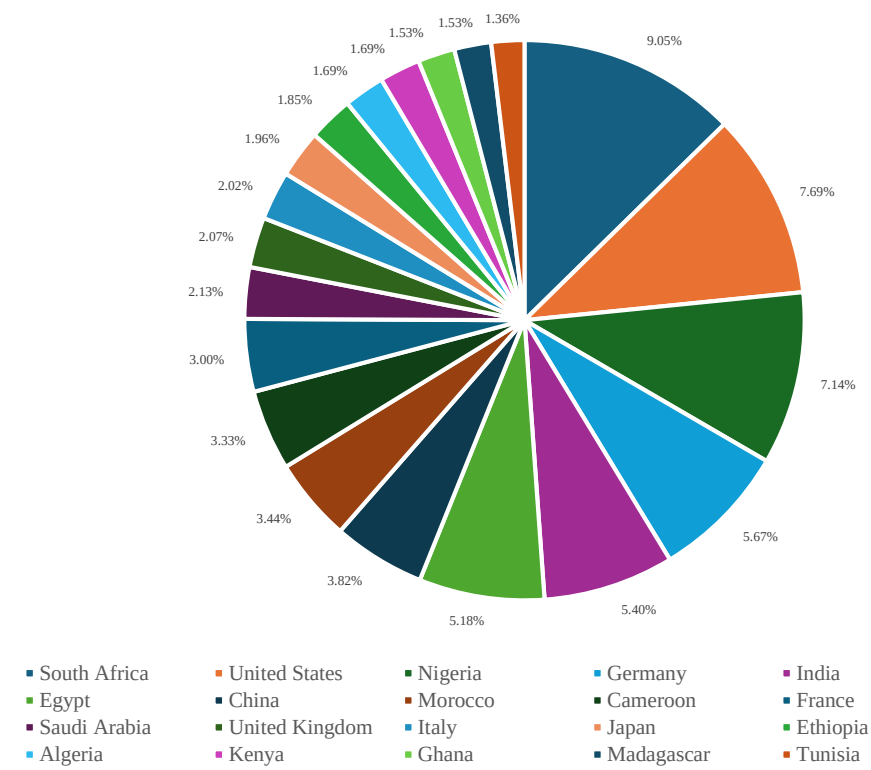

Figure 3. Top 20 Countries contributing to publications

made the least, with Ghana and Madagascar contributing 28 (1.53%) each and Tunisia 25 (1.36%).

Authorship

Table 6 lists the number of authors per document. Most publications, according to the findings, had few authors. The most published articles were those with four authors, 155 (13.67%), followed by articles with three authors, 153 (13.49%), and five authors, 147 (12.96%), respectively.

A total of 118 (10.41%) were co-authored and 73 (6.44%) were solely authored. Generally, articles with more than 13 authors accounted for 0.62% of the total publications. Table 7 presents the productivity of the authors as measured by their respective number of documents published on herbal medicines used in cancer management in Africa. Most of the authors published fewer than ten papers. Authors like Efferth, T., Kingston, D.G.I., Kuete, V., Rasamison, V.E. published 31 (4.06%), 27 (3.53%), 22 (2.88%), and 21 (2.75%) respectively, thus being the top four (4) most productive authors.

Text analysis

Figure 4 shows the network visualisation map, which comprehensively analyses the relationships between texts in the research areas of Herbal Medicines in Cancer Management research in Africa. This map aids in understanding the prevailing research trends by illustrating how frequently various texts co-occur in literature. The map encompasses 1000 texts, grouped into five (5) distinct clusters represented by different colours. These texts are interconnected by 184215 links, reflecting a total link strength of 608639 thematically organised around "article," "human," "human cell," "in vitro study," "drug effect," "female," "male", and "animals". This dense network indicates a robust interrelationship among the research topics in this field.

Most influential institutions

Figure 5 below shows institutions that have contributed substantially to publications within this field of study. With a total of 160 institutions, only institutions with a minimum of 13 publications were included. The University of Dschang emerged as the most productive institution, with 36 (2.75%) publications. The University of KwaZulu-Natal was the second highest with 34 (2.60%), followed by the National Research Centre and Johannes Gutenberg-Universität Mainz, which both had 32 (2.44%) publications.

Funding sponsor

Table 8 presents the top 20 sponsors of publications on herbal medicines in cancer care in Africa. The National Research Foundation led with 42 publications (3.26%), followed by the National Cancer Institute with 30 (2.33%), the Fogarty International Centre with 27 (2.10%), and the National Institutes of Health with 17 (1.32%). Styrelsen för Internationellt Utvecklingssamarbete and the Tertiary Education Trust Fund each supported the fewest publications, contributing 6 (0.47%) each.

Table 6. Number of author(s) per document

Author Count	Total Publications	Percentage (%)
0	3	0.26
1	73	6.44
2	118	10.41
3	153	13.49
4	155	13.67
5	147	12.96
6	130	11.46
7	95	8.38
8	92	8.11
9	56	4.94
10	40	3.53
11	20	1.76
12	22	1.94
13	11	0.97
14	7	0.62
15	4	0.35
16	2	0.18
17	2	0.18
19	2	0.18
21	1	0.09
46	1	0.09
Total	1134	100.00

Table 7. Most productive authors

Author's Name	No. of Documents (n=764)	Percentage (%)
Efferth T.	31	4.06%
Kingston D.G..I	27	3.53%
Kuete V.	22	2.88%
Rasamison V.E.	21	2.75%
Brodie P.J.	15	1.96%
Miller J.S.	12	1.57%
Rakotobe E.	11	1.44%
Andriantsiferana R.	10	1.31%
Afolayan A.J.	9	1.18%
Callmander M.W.	9	1.18%
Cao S.	9	1.18%
Bouyahya A.	8	1.05%
Harinantenaina L.	8	1.05%
Proksch P.	8	1.05%
Randrianaivo R.	8	1.05%
Shen Y.	7	0.92%
Van Staden J.	7	0.92%
Anywar G.	6	0.79%
Awale S.	6	0.79%
Birkinshaw C.	6	0.79%
Dibwe D.F.	6	0.79%
Grierson D.S.	6	0.79%
Mbaveng A.T.	6	0.79%
Rakotonandrasana S.	6	0.79%
Spiteller M.	6	0.79%
Suh E.M.	6	0.79%
Wiench B.	6	0.79%
Zengin G.	6	0.79%

Table 8. Funding Sponsor

Funding Sponsor	Total Publications (n = 1288)	Percentage (%)
National Research Foundation	42	3.26
National Cancer Institute	30	2.33
Fogarty International Center	27	2.10
National Institutes of Health	17	1.32
Deutscher Akademischer Austauschdienst	16	1.24
National Natural Science Foundation of China	14	1.09
Alexander von Humboldt-Stiftung	12	0.93
National Research Foundation of Korea	11	0.85
Council of Scientific and Industrial Research, India	10	0.78
Fundação para a Ciência e a Tecnologia	9	0.70
Inyuvesi Yakwazulu-Natali	9	0.70
Ministry of Education, Culture, Sports, Science and Technology	9	0.70
Bundesministerium für Bildung und Forschung	8	0.62
Fonds National de la Recherche Luxembourg	8	0.62
University of Johannesburg	8	0.62
Addis Ababa University	7	0.54
Department of Science and Technology, Ministry of Science and Technology, India	7	0.54
Japan Society for the Promotion of Science	7	0.54
Styrelsen för Internationellt Utvecklingssamarbete	6	0.47
Tertiary Education Trust Fund	6	0.47

Citation analysis

Table 9 shows an overview of research conducted on HMs in cancer management in Africa between 1968 and 2023. The citation metrics provide valuable insights into the impact and dissemination of research findings during this time frame. The dataset includes 1134 papers with 33,912 citations over a 56 years time period (1968 – 2024). This equals to an average of 605.57 citations annually. Additionally, the h-index and g-index values of 86 and 130, respectively, show the impact of the most influential papers within the dataset.

Highly cited articles

Table 10 displays the leading publications on HMs in cancer management in Africa, thus showing how different studies have impacted this field. The most cited work on the list is "The enigmatic epidemiology of nasopharyngeal carcinoma" by Chang and Adami (2006), with 1097 citations and an average of 60.94 citations per year. Batiha et al. (2019) came in second with 483 citations and an average of 120.75 per year on "Chemical constituents and pharmacological activities of garlic (Allium sativum L.): A

Table 9. Citations Metrics

Metrics	Data
Publication years	1968-2023
Citation years	56 (1968-2024)
Papers	1134
Citations	33912
Citations/year	605.57
h-index	86
g-index	130

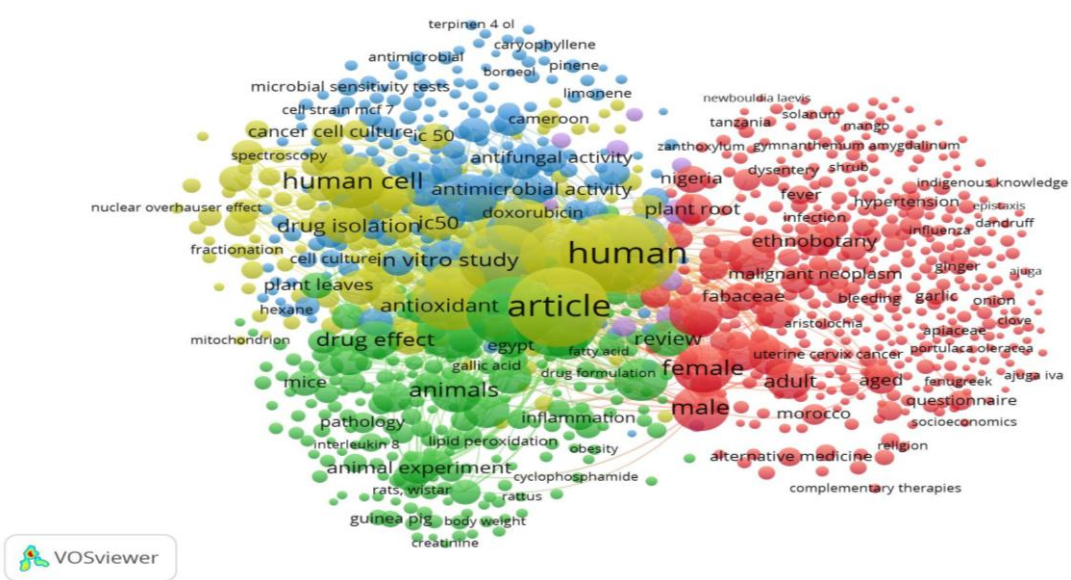

Figure 4: VOSviewer visualization of texts co-occurrence network based on title and abstract fields (Full Counting)

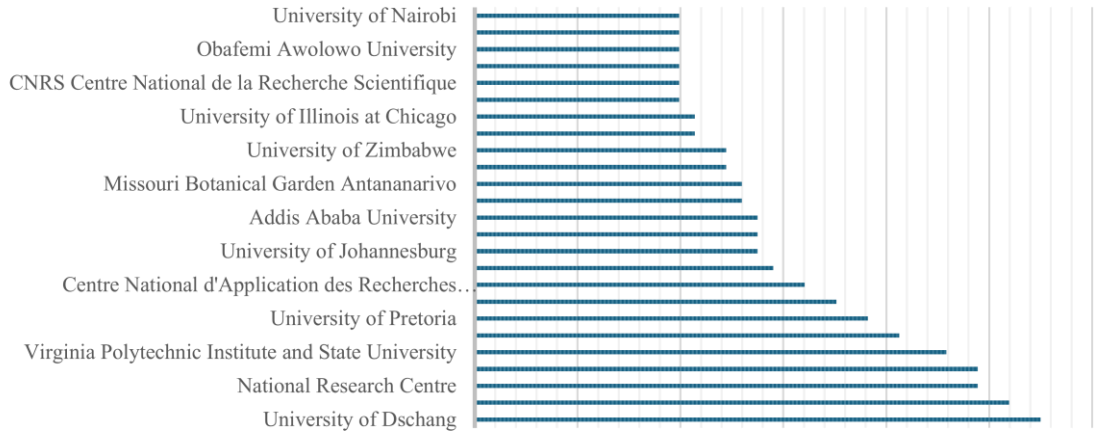

Figure 5. Most influential institutions

Table 10: Highly cited articles

Authors	Title	Year	Cites	Cites Per Year
Chang E.T., Adami H-O	The enigmatic epidemiology of nasopharyngeal carcinoma	2006	1097	60.94
Batiha G.E.-S. *e.t al.*	Chemical constituents and pharmacological activities of garlic (*Allium sativum L.*): A review	2020	483	120.75
Kingston D.G.I.	Modern natural products drug discovery and its relevance to biodiversity conservation	2011	407	31.31
Russo E.B.	History of cannabis and its preparations in saga, science, and sobriquet	2007	402	23.65
Joseph B., Jini D.	Antidiabetic effects of *Momordica charantia* (bitter melon) and its medicinal potency	2013	325	29.55
Kupchan S.M. *et. al.*	Bruceantin, a New Potent Antileukemic Simaroubolide from Brucea antidysenterica	1973	325	6.37
Kamatou G.P.P. *et. al.*	South African Salvia species: A review of biological activities and phytochemistry	2008	250	15.63
Facchini P.J., De Luca V.	Opium poppy and Madagascar periwinkle: Model non-model systems to investigate alkaloid biosynthesis in plants	2008	225	14.06
Van Wyk B.-E.	The potential of South African plants in the development of new medicinal products	2011	213	16.38
Hsouna A.B. *et. al.*	Chemical composition, cytotoxicity effect and antimicrobial activity of Ceratonia siliqua essential oil with preservative effects against Listeria inoculated in minced beef meat	2011	206	15.85
Fouche G. *et. al.*	In vitro anticancer screening of South African plants	2008	206	12.88
Kuete V., Efferth T.	Cameroonian medicinal plants: Pharmacology and derived natural products	2010	203	14.5
Boukhatem MN *et. al.*	Lemon grass (*cymbopogon citratus*) essential oil as a potent anti-inflammatory and antifungal drugs	2014	202	20.2
Hostettmann K *et. al.*	The potential of African plants as a source of drugs	2000	193	8.04
Ochwang'i D.O.	Medicinal plants used in treatment and management of cancer in Kakamega County, Kenya	2014	188	18.8
Sargin S.A. *et. al.*	An ethnobotanical study of medicinal plants used by the local people of Alaşehir (Manisa) in Turkey	2013	184	16.73
Shen T. *et. al.*	The genus Commiphora: A review of its traditional uses, phytochemistry and pharmacology	2012	183	15.25
Atawodi S.E. *et. al.*	Evaluation of the polyphenol content and antioxidant properties of methanol extracts of the leaves, stem, and root barks of Moringa oleifera Lam.	2010	183	13.07
Mills E. *et. al.*	African herbal medicines in the treatment of HIV: Hypoxis and Sutherlandia. An overview of evidence and pharmacology	2005	183	9.63
Teklehaymanot T.	Ethnobotanical study of knowledge and medicinal plants use by the people in Dek Island in Ethiopia	2009	174	11.6

review". Kingston (2011) and Russo (2007) added a significant amount with 407 and 402 citations, respectively.

DISCUSSION

The findings of this bibliometric analysis have provided a deeper understanding of the research landscape of herbal medicines in cancer management in Africa by building on trends outlined in the literature review. The global burden of cancer, particularly in low- and middle-income countries with limited access to conventional therapies, has driven interest in alternative treatment approaches such as herbal medicines. This analysis reinforces the growing role of herbal medicines as a complementary option and aligns with previous studies that highlight the persistent use of herbal treatments in cancer care across Africa [26]. A key insight from the results is the geographical concentration of research output. South Africa's prominence in herbal medicines research, as noted in this study, contrasts with the literature, which identifies China, India, and the USA as global leaders in this area [27]. While South Africa leads within Africa, there remains a significant disparity in research outputs between other African nations and top-performing countries worldwide. Nigeria, Egypt, and Cameroon contributed notably, but many other African countries remain underrepresented.

To the best of our knowledge, no similar bibliometric study has been conducted on this same topic, thus limiting direct comparisons with the current study. However, a study examining research trends globally and advancements in medicinal plant-synthesised nanoparticles for cancer treatment reported that India, China, Iran, Saudi Arabia, and the USA are the top contributors in this speciality, with India accounting for 27.7% of all the research outputs. The leading journals in this field included the International Journal of Nanomedicine, Molecules, and the Journal of Drug Delivery Science and Technology, which are very different from the leading African journals identified in this study, such as the Journal of Ethnopharmacology. This suggests that Africa's research focus and dissemination channels differ from those of global leaders, possibly due to funding limitations, institutional priorities, and regional research interests.

The role of funding and international collaboration in African research on herbal medicines is critical. This review noted that institutions like the Bill and Melinda Gates Foundation and the National Institutes of Health have supported health informatics research in Africa [26]. This analysis further identified key funding sponsors, such as the National Research Foundation and the National Cancer Institute, which play crucial roles in supporting African research on herbal medicines for cancer. However, funding disparities and institutional challenges remain significant barriers to research productivity in Africa. Many African countries allocated less than 0.5% of their GDP to research and development, with Kenya and South Africa being among the highest spenders, of 0.98% and 0.82%, respectively, albeit far below global averages [33]. This limited investment hinders the development of research infrastructure, access to cutting-edge technologies, and opportunities for collaboration. Consequently, African researchers face significant challenges in conducting long-term studies, accessing modern laboratory equipment, and engaging in international partnerships that could enhance research quality and impact. The inadequate funding also results in a scarcity of locally generated and shared knowledge, which impedes the development of context-specific healthcare solutions tailored towards African needs. Several other obstacles hinder research progress in Africa, including inadequate mentorship, language barriers, and brain drain [34]. To accelerate the translation of herbal medicine research into clinical practice, it is essential to address these challenges through increased funding, supportive policies, and strengthened regional collaborations, ultimately enhancing Africa's research impact in herbal medicine and cancer management.

Conclusion

This study provides a comprehensive bibliometric analysis of research on herbal medicines in cancer management across Africa by analysing 1,134 publications from the Scopus database. The results reveal significant contributions from South Africa, Nigeria, and Egypt, with the Journal of Ethnopharmacology being the most active publication outlet. Through co-authorship, co-citation, and keyword co-occurrence analyses, this study has identified key research themes, influential authors, and institutions driving this field while also pointing to emerging trends and gaps in the research landscape. The findings of this study thus contribute to the growing body of literature on the use of herbal medicines in cancer treatment by mapping out the research landscape across Africa. This bibliometric analysis not only identified the most prolific researchers and institutions but also provided valuable insights into thematic clusters and trends, helping to guide future research directions. By highlighting the role of funding agencies and international collaborations, this study offers a framework for policymakers, researchers, and funding bodies to support and expand research efforts in this critical area of healthcare. Furthermore, this study underscores the need to strengthen research infrastructure and collaboration across African countries to enhance the integration of traditional medicine into modern cancer care.

While this study offers valuable insights, several limitations must be acknowledged. First, the analysis was restricted to data from the Scopus database, which may not capture all relevant publications, particularly those indexed in other databases like PubMed or Web of Science. Secondly, the focus on English-language publications, which constitute most of the dataset, may overlook significant research conducted in other languages, limiting the inclusivity of the analysis. Finally, the study primarily relied on citation metrics, which may not fully reflect the quality or real-world impact of the respective research.

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Future studies should aim to expand the scope of bibliometric analyses by incorporating data from multiple databases to ensure a more comprehensive understanding of the research landscape. There is also a need for more patient-centred studies to validate the efficacy of herbal medicines in cancer management. Additionally, efforts should be made to increase the visibility of research conducted in non-English languages to ensure that all relevant contributions are recognised. Finally, further exploration of funding trends and their impact on research output would help guide resource allocation to herbal medicine research across Africa.

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Not Applicable

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Author contribution
All authors contributed equally to the study's conceptualisation, design, data collection, analysis, drafting and finalisation of the manuscript.

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Availability of data
Data is available upon request to the corresponding author

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