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Short Communication

A Decade of Research on Plant-Based Anticancer Compounds: A Scientometric Analysis

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ABSTRACT

Cancer continues to be one of the leading global health challenges, driving increasing scientific interest in natural and plant-derived therapeutic alternatives. This study presents a scientometric analysis of global research on plant-based anticancer compounds published between 1997 and 2025, with a particular focus on the past decade (2014–2023). A total of 279 publications were retrieved from the Web of Science database and analyzed using bibliometric techniques to map publication growth, research hotspots, collaborations, and citation impact. Findings indicate a consistent rise in scholarly output, with a sharp surge after 2017, reflecting the growing integration of phytochemistry, nanotechnology, and oncology. India, China, and the USA emerged as the leading contributors, supported by European and Middle Eastern collaborations. Prominent institutions include Comenius University (Slovakia) and NIPER (India), while key journals such as Journal of Ethnopharmacology and Phytomedicine have served as major publication venues. Keyword analysis revealed evolving themes from classical phytochemical mechanisms (apoptosis, angiogenesis inhibition) to emerging areas such as green nanotechnology, polyherbal synergism, and immunomodulation. Highly cited works emphasize the potential of synergistic phytochemical formulations and nanoparticle mediated delivery systems. Despite encouraging laboratory results, challenges such as assay variability, poor standardization of phytochemicals, and limited clinical translation remain major barriers. Future directions point toward integrating artificial intelligence, omics-based approaches, and sustainable green nanotechnology for advancing phytomedicine. This scientometric overview highlights the growing global emphasis on plant-based anticancer compounds, offering valuable insights for researchers, funding bodies, and policymakers to strengthen translational research in natural product oncology.

Keywords: Plant-based compounds, Anticancer, Medicinal Plants, Phytochemicals, Scientometric analysis, Cancer therapy, Natural products.

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INTRODUCTION

Cancer remains one of the most formidable global health challenges of the 21st century, contributing to high mortality and morbidity rates despite significant advances in diagnostics and therapeutics. The limitations associated with conventional cancer treatments, such as toxicity, resistance, high costs, and lack of selectivity, have prompted a renewed scientific interest in alternative and complementary therapies.[1] Among these, plant-based anticancer compounds have garnered considerable attention due to their bioavailability, chemical diversity, therapeutic efficacy, and minimal side effects. Medicinal plants have been integral to traditional healing systems for centuries. In modern pharmacognosy and oncology, numerous plant-derived molecules such as paclitaxel (from *Taxus brevifolia*), vincristine (from *Catharanthus roseus*), camptothecin (from *Camptotheca acuminata*), and curcumin (from *Curcuma longa*) have demonstrated potent anticancer properties.[2] These bioactive phytochemicals exert their effects through various mechanisms, including the induction of apoptosis, inhibition of angiogenesis, cell cycle arrest, modulation of oxidative stress, and immune regulation. The past decade (2014-2023) has witnessed a significant surge in research publications focused on plant-derived anticancer agents, reflecting both growing scientific curiosity and global health priorities.[1,3] This research expansion has been facilitated by technological advances in drug discovery, high-throughput screening, molecular docking, and systems biology, which have accelerated the identification and validation of novel phytochemicals.[4] To objectively assess the progress and emerging trends in this dynamic field, scientometric analysis offers a powerful and data-driven approach. By analyzing patterns in scholarly output, collaboration networks, citation metrics, and keyword co-occurrence, scientometric studies provide insights into the evolution, impact, and intellectual

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structure of research domains. While several reviews exist on specific plant-derived compounds and their anticancer activity, a comprehensive scientometric overview of this multidisciplinary field remains limited.[5,6] This short communication aims to fill that gap by presenting a decade-long scientometric analysis of global research on plant-based anticancer compounds. Using bibliometric data extracted from the Web of Science database, the study evaluates the trends in publication output, identifies leading countries and institutions, highlights the most influential journals and authors, and maps research hotspots.[2] The findings not only reveal the trajectory and collaborations in this field but also suggest future directions for research, funding, and policy development in phytomedicine and oncology.

METHODOLOGY

This study employed a scientometric approach to analyze the global research trends on plant-based anticancer compounds. The bibliographic data were retrieved from the Web of Science Core Collection (Science Citation Index Expanded SCI-EXPANDED), a widely recognized multidisciplinary database.[7] The literature search was conducted using the topic search query TS=("Plant-Based Anticancer Compounds"), which scans titles, abstracts, author keywords, and Keywords Plus. The search was restricted to the period from 1997 to 2025 to encompass nearly three decades of scientific output and to identify long-term trends and emerging research themes. A total of 279 publications were retrieved globally, including original research articles and review papers, ensuring a comprehensive coverage of scholarly work in this field. The raw bibliographic records were exported in plain text format with full records and cited references. Data preprocessing involved cleaning, parsing, and extracting fields such as publication year, authorship, countries of affiliation, organizations, journal sources, funding agencies, and citation counts. To visualize and analyze the data, several bibliometric tools and programming libraries were used. Python scripts utilizing libraries like matplotlib, networkx, and pandas were developed to extract co-authorship patterns, keyword frequencies, funding sources, and country-level collaboration. Co-authorship networks were generated to illustrate collaboration intensity among prolific researchers, while keyword frequency distributions and bar charts were used to identify thematic concentrations over time. The analysis also included top contributing countries, institutions, authors, and most cited papers, providing a multi-dimensional view of the field's structure and dynamics. This methodological framework provides a robust and reproducible means of evaluating the scholarly landscape of plant-based anticancer research and supports evidence-based insights into the evolution and future directions of this interdisciplinary domain.

RESULTS AND DISCUSSION

The scientometric analysis of the Web of Science dataset covering plant-based anticancer compounds over the past decade reveals a dynamic and evolving research landscape. The records reviewed predominantly consist of review articles and original research papers, reflecting the dual focus on both consolidating knowledge and exploring novel phytochemical entities. A notable trend is the consistent annual increase in publication volume, particularly after 2017, suggesting a growing global interest in plant-derived therapies for cancer. Among the most frequently addressed topics were breast cancer, clinical trials of phytochemicals, and nanoparticle-based delivery of plant compounds, indicating the multidisciplinary nature of this field spanning oncology, pharmacognosy, biotechnology, and nanomedicine. Key phytochemicals repeatedly mentioned across the dataset include curcumin, resveratrol, taxol (paclitaxel), vincristine, and camptothecin, all of which are derived from well-known medicinal plants and have shown promising anticancer mechanisms such as induction of apoptosis, inhibition of angiogenesis, and suppression of metastasis.

The analysis also highlighted several research challenges, such as variability in colorimetric assays (e.g., MTT, XTT, MTS), which may lead to false-positive results, affecting the reproducibility and clinical translatability of findings. This was explicitly discussed in studies critiquing assay reliability in plant-based drug development workflows.

Geographically, contributions were prominent from India, China, and European nations, with institutions such as the Comenius University in Slovakia, NIPER (India), and Qatar-based collaborations playing influential roles. These centers have produced highly cited works focusing on functional foods, synergistic phytochemical effects, and clinical potential of polyherbal formulations.

Another emerging theme involves the green synthesis of nanoparticles using plant extracts, showing promise for targeted anticancer delivery systems and reduced cytotoxicity. The integration of green chemistry and nanotechnology represents a future-forward approach increasingly explored within the dataset.

Citation metrics show high impact for reviews addressing synergism between multiple phytochemicals versus isolated compounds, supporting the growing belief in whole-plant or polyherbal advantages in cancer chemoprevention. Despite promising laboratory results, the dataset also underscores the lack of clinical translation, with few compounds progressing beyond *in vitro* or *in vivo* models.

CONCLUSION

The scientometric exploration of global research on plant-based anticancer compounds between 1997 and 2025 reveals a steadily growing interest in this interdisciplinary field. With 279 publications indexed in the Web of Science database, the data underscores the increasing scientific emphasis on identifying, evaluating, and optimizing phytochemicals for cancer prevention and therapy. The analysis highlights key contributors, including India, China, and the USA, along with prominent institutions such as Comenius University and NIPER, which play pivotal roles in advancing this domain. Collaborative research networks and funding agencies have been instrumental in accelerating innovation, especially in areas like green synthesis of nanoparticles, synergistic phytochemical combinations, and novel bioassays. Despite significant progress, the field still faces challenges such as variability in assay reproducibility, limited clinical translation of *in vitro* findings, and the need for stronger interdisciplinary integration. However, the rise in publication volume, growing international collaborations, and the diversification of research themes point toward a promising future for plant-derived compounds in oncological applications. This scientometric communication provides valuable insights for researchers, policymakers, and funding bodies to identify knowledge gaps, strengthen research ecosystems, and support evidence-based drug discovery rooted in nature.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

AI: Artificial Intelligence; **CAGR:** Compound Annual Growth Rate; **DST:** Department of Science and Technology (India); **MTT/XTT/MTS:** Common colorimetric cell viability assays; **NIPER:** National Institute of Pharmaceutical Education and Research (India); **NIH:** National Institutes of Health (USA); **QSAR:** Quantitative Structure–Activity Relationship; **SCI-EXPANDED:** Science Citation Index Expanded; **WoS:** Web of Science.

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